13th ANNUAL RAILROAD ENGINEERING CONFERENCE

FRA OR&D 76-280 282030

SPECIAL BIBLIOGRAPHY

Railroad Safety Research

October 1976

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL RAILROAD ADMINISTRATION
Office of Rail Safety Research
Washington, D.C. 20590

prepared by
RAILROAD RESEARCH INFORMATION SERVICE, TRANSPORTATION RESEARCH BOARD

Railroading Challenges in America's Third Century: Improved Reliability and Safety

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15. Supplementary Notes

16. Abstract

This Special Bibliography prepared from the magnetic-tape files of the Railroad Research Information Service, contains selections which were accessioned between 1973 and 1976. Although the literature which is referenced does in a few cases date back three decades, all listings are considered pertinent to contemporary railroad safety problems. The volume is divided into three main categories (with sections listed after each): Improved Track Structures Research (Track Accident Reduction, Improved Track Performance); Rail Vehicle Safety Research (Rolling Stock/Safety, Rolling Stock/Track-Train Dynamics, Locomotives/Safety, Locomotives/Track-Train Dynamics, Hazardous Materials Cars, Grade Crossings, Human Factors, Control Systems); Improved Inspection, Detection and Testing Research (Track Inspection and Testing, Automated Track Inspection, Vehicle Inspection, Life Cycle Testing). All of the citations in this Bibliography appear also in one of the regular RRIS semiannual publications. Because it cites only safety-related topics, this Bibliography should not be considered a comprehensive collection of RRIS citations; it incorporates about one-fourth of all RRIS holdings. There are 4,368 listings, involving 3,131 abstracts of research reports and journal articles, and descriptions of computer programs with some individual citations appearing in more than one of the 14 sections. The categories in this Bibliography are based on the functional responsibilities of the groups comprising the staff of the FRA Office of Rail Safety Research; these categories differ from the regular RRIS classification scheme. While categories differ, the accession numbers are common under either type of classification and may be used for identification.

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Railroad Safety Research

October 1976

RRIS PUBLICATION 76S1

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Commission on Sociotechnical Systems, National Research Council
National Academy of Sciences

1(a)

Railroad Research Information Service

Office Address: 2100 Pennsylvania Avenue, N.W., Washington, D.C.
Telephone: 202-389-6611 or, toll-free in U.S. only, 800-424-9473

Mail Address: Transportation Research Board, 2101 Constitution Avenue, N.W.
Washington, D.C. 20418

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PREFACE

This bibliography, prepared for initial distribution at the Thirteenth Annual Railroad Engineering Conference at Pueblo, Colorado, in October 1976, contains references pertinent to the conference theme, "Railroading Challenges in America's Third Century: Improved Reliability and Safety." The references can, however, be of long-term interest to those involved in the design, maintenance, operation, and regulation of railroads.

The material in this volume is compiled from the magnetic tape files of the Railroad Research Information Service. RRIS was developed within the National Research Council under contract to the Federal Railroad Administration of the U.S. Department of Transportation. The RRIS computerized data system incorporates information on the planning, building, managing, operation, and regulation of rail transportation systems. The scope of RRIS includes rail rapid transit, and some references to this technology do appear in the following pages.

The selections in this volume are categorized by areas corresponding to the functional responsibilities of the FRA Office of Rail Safety Research, which has sponsored this publication. The subjects include the design, maintenance, and safe operation of railroad track and rolling equipment. The categories under which entries appear in this volume are *not* those used in the regular RRIS classification system and in the semiannual Railroad Research Bulletins that are published by RRIS. All the entries here do appear, however, in one of the regular RRIS publications. Although RRIS has been operational since 1973, the abstracts of technical reports and journal articles and descriptions of computer programs cited do cover some of the significant investigations made during the past 3 decades. Comprehensive coverage is given to the published material of the past decade.

In addition to the acquisition and selection of material, RRIS work includes the classification, indexing, storage, retrieval, and dissemination of abstracts, descriptions, and ongoing project summaries. Concepts and procedures are similar to those of the other transportation research information services within the National Research Council: the Highway Research Information Service and the Maritime Research Information Service. The Railroad Research Bulletin, published semiannually, contains the material added to the RRIS file during the preceding 6 months. Each bulletin includes summaries of ongoing research projects in the railroad field, none of which is included in this bibliography. The Railroad Research Bulletin is available on a subscription basis from RRIS.

The material appearing in this bibliography gives thorough coverage to only a portion of the RRIS holdings at the time of publication. Information may be obtained from RRIS about holdings in other subject areas, about subsequent accessions in the areas covered by this volume, and about ongoing research in all its areas of coverage.

USING THIS BIBLIOGRAPHY

This volume is a collection of abstracts of technical reports and journal articles and descriptions of computer programs, which are divided into three major sections: improved track structures; rail vehicle safety; and improved inspection, detection, and testing. Each of these general categories is again divided into more specific subject areas, which are indicated in the Contents. The categories and sections correspond to the functional responsibilities of the FRA Office of Rail Safety Research, which sponsored the preparation of this bibliography. There are also indexes by source, author, and subject.

If you are interested in reviewing reports of completed research and other published documents, find the subject area and code in the Contents and turn to the appropriate section. The subject area and code also appear at the top of each page on which abstracts are printed.

If you can identify your interest by subject, turn to the Subject Term Index. Each term in this index is followed by a document record number, which consists of a 2-digit subject area code and a 6-digit TRIS accession number that identifies that individual document under the category. Although many of the citations in this bibliography appear in more than one section because they may be applicable in each, the indexes indicate only the first such listing in this volume.

If you are looking for publications by a specific author, turn to the Author Index and find the author's last name in the alphabetized listing. Again the document record designation indicates only the first such listing, even though it may appear again in subsequent sections.

If you are interested in abstracts of articles or reports that appeared in a particular publication or were the works of a specific organization, turn to the Source Index. Again the document record number may be used to find the first (and often only) listing in this publication.

Although this Subject Term Index gives a general idea of the scope of RRIS classification, it includes those terms applicable only to this bibliography. There are many others that do not appear in this publication.

ABBREVIATIONS

AAR*	Association of American Railroads
AIAA*	American Institute of Aeronautics and Astronautics
AREA*	American Railway Engineering Association
ASCE*	American Society of Civil Engineers
ASME*	American Society of Mechanical Engineers
CIGGT*	Canadian Institute of Guided Ground Transport
CNR	Canadian National Railways HQ Library
DOT*	U.S. Department of Transportation
DOTL	U.S. Department of Transportation Library, Washington, D.C.
ECMT*	European Conference of Ministers of Transport
EI	Engineering Index
ESL*	Engineering Societies Library
Fig	Figures
FRA*	Federal Railroad Administration
FY	Fiscal year
GPO*	U.S. Government Printing Office
IEEE*	Institute of Electrical and Electronics Engineers
IPC*	IPC Transport Press Ltd.
IRCA	International Railway Congress Association
IRF	International Road Federation
IRRD	International Road Research Documentation
JC	Journal Collection (DOTL)
NAE*	National Academy of Engineering
NAS*	National Academy of Sciences
NRC*	National Research Council
NTIS*	National Technical Information Service
OECD*	Organization for Economic Cooperation and Development
ORE*	Office for Research and Experiments, UIC
OST*	Office of the Secretary of Transportation
PB	Prefix identifying an NTIS accession number
Phot	Photographs
Ref	References
Repr PC	Paper copy of original document
RP	RRIS Repository (DOTL)
RPI*	Railway Progress Institute
Rpt	Report
RTAC*	Roads and Transportation Association of Canada
SAE*	Society of Automotive Engineers
Shaw	Shaw Publishing Company Ltd.
SNAME*	Society of Naval Architects and Marine Engineers
Tab	Tables
TRB*	Transportation Research Board
TRRL*	Transport and Road Research Laboratory
TSC	Transportation Systems Center
UIC*	International Union of Railways
UITP*	International Union of Public Transport
UMTA*	Urban Mass Transportation Administration
XUM*	Xerox University Microfilms

*See page vi for availability of papers and research reports.

AVAILABILITY OF RESEARCH REPORTS AND JOURNAL ARTICLES

An availability statement is included with most abstracts. Addresses for ordering documents are given with the abstracts or with the publisher listing in the Source Index. Copies of reports and articles listed in this publication are not available from the Railroad Research Information Service. When ordering from any source, give full information on the item wanted. When ordering from the National Technical Information Service, be sure to give the NTIS accession number as well as the title and other information. When no availability is specified with an abstract, consult an established transportation library. Because a large number of documents are available from a few sources, space and printing costs have been reduced by abbreviating sources as follows:

AAR
Association of American Railroads
1920 L Street, N.W.
Washington, D.C. 20036

AIAA
American Institute of Aeronautics and Astronautics
Technical Information Service
750 Third Avenue
New York, New York 10017

AREA
American Railway Engineering Association
59 East Van Buren Street
Chicago, Illinois 60605

ASCE
American Society of Civil Engineers
345 East Forty-seventh Street
New York, New York 10017

ASME
American Society of Mechanical Engineers
345 East Forty-seventh Street
New York, New York 10017

CIGGT
Canadian Institute of Guided Ground Transport
Queen's University
Kingston, Ontario K7L 3N6
Canada

DOT
U.S. Department of Transportation
Nassif Building
400 Seventh Street, S.W.
Washington, D.C. 20590

ECMT
All documents available through OECD (see below)

ESL
Engineering Societies Library
345 East Forty-seventh Street
New York, New York 10017

FRA
Federal Railroad Administration
Transpoint Building
2100 Second Street, S.W.
Washington, D.C. 20590

GPO
Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402

IEEE
Institute of Electrical and Electronics Engineers
345 East Forty-seventh Street
New York, New York 10017

IPC
IPC (America), Inc.
205 East Forty-second Street
New York, New York 10017

NAE/NAS/NRC
National Academy of Sciences
Publication Sales
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

NTIS
National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22161

OECD
OECD Publications Center
Room 1207
1750 Pennsylvania Avenue, N.W.
Washington, D.C. 20006

ORE
See UIC/ORE below.

OST
Office of the Secretary
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

RPI
Railway Progress Institute
801 North Fairfax Street
Alexandria, Virginia 22314

RTAC
Roads and Transportation Association of Canada
875 Carling Avenue
Ottawa, Ontario K1S 5A4
Canada

SAE
Society of Automotive Engineers
400 Commonwealth Drive
Warrendale, Pennsylvania 15096

SNAME
Society of Naval Architects and Marine Engineers
74 Trinity Place
New York, New York 10006

TRB
Transportation Research Board
Publications Office
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

TRRL
Transport and Road Research Laboratory
Crowthorne, Berkshire RG11 6AU
England

UIC
International Union of Railways, BD
14-16 Rue Jean-Rey
75015 Paris
France

UIC/ORE
For technical reports identified by a report number such as B125/RP3/E (note restrictions below):
International Union of Railways
Office for Research and Experiments
Oudenoord 60
Utrecht, Netherlands

UITP
International Union of Public Transport
Avenue de l'Uruguay 19
B-1050, Brussels
Belgium

UMTA
Urban Mass Transportation Administration
400 Seventh Street, S.W.
Washington, D.C. 20590

XUM
Xerox University Microfilms
300 North Zeeb Road
Ann Arbor, Michigan 48106

RESTRICTED AVAILABILITY OF UIC/ORE DOCUMENTS

Certain publications of the International Union of Railways (UIC) that are cited in the holdings of the Railroad Research Information Service are subject to restrictions on use. These apply particularly to the reports of the UIC Office for Research and Experiments (ORE).

The president of ORE indicates those reports that can be made available to third parties (industrial firms, individuals, universities, and technical colleges). For each report a price per copy and a separate fee for the right-of-use are established.

Members of ORE—certain railroad administrations that are members of UIC and, in the United States, the Federal Railroad Administration of the U.S. Department of Transportation—receive the ORE reports and possess, by virtue of their membership, the right to use these reports. Possession by virtue of ORE membership or the acquisition of a right-of-use covering a specific report only authorizes the holder of the information in the report to use such data for his or her own needs. This right-of-use is nontransferable. Possession of right-of-use does not authorize the holder to communicate, even in part, the contents of such a report to third parties who have not also acquired a right-of-use. An exception may be made, with special ORE authorization, for use by contractors of those organizations that have the right-of-use. Patent rights and design rights associated with solutions developed by ORE research and disclosed in reports are not acquired automatically when right-of-use is acquired. Such rights must be arranged separately between the report user and the owners of the patent or design.

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Those wishing to acquire the information in ORE reports that are referenced in the RRIS system should contact the Director, International Union of Railways, Office for Research and Experiments, Oudenoord 60, Utrecht, Netherlands. The report should be carefully identified, and the use to which the information is to be put should be completely explained. ORE will then indicate whether the report is available to third parties and specify the charges involved. The collections of ORE reports held in the United States by the Federal Railroad Administration are not available to third parties, except when they serve as contractors to that agency or other U.S. Department of Transportation elements. In such cases, the request for use must be directed to ORE through the Technical Planning Officer, RRD-1, Federal Railroad Administration, Washington, D.C. 20590.

LOAN AND PHOTOCOPY SERVICE FOR PUBLICATIONS IN THIS VOLUME

The Northwestern University Transportation Center Library and the University of California Institute of Transportation Studies Library are functioning as TRISNET Centers in the operation of a prototype document delivery system under contract to the U.S. Department of Transportation. The publications in this volume may be requested from either of these Document Delivery Centers.

The objective of the TRISNET Centers is to provide the documents identified through search of the Transportation Research Information Service (TRIS) abstracting and indexing services (RRIS and the Highway, Maritime, and Air Transportation Research Information Services).

In referring your requests for publications to either of these libraries, please cite the following:

Accession number
Author
Article Title
Publisher or journal title
Date of publication

The request may be for either loan of the publication for a period of 2 weeks plus estimated mailing time (Northwestern accepts a user's request directly, but University of California requires submission of an interlibrary loan request) or for photocopies of articles or conference papers. If the document is unavailable at the library, referral to the best available source will be made.

Loan services are free when publications are mailed at the book rate. If the user requires priority mailing, the library will charge for mailing costs. Photocopies of articles or individual conference papers are made at the rate of 10 cents per page plus a handling charge of 50 cents per item. In all cases, invoices are mailed with the loan or photocopy.

The TRISNET Center at either library may be contacted as follows:

Transportation Center Library
Northwestern University
Evanston, IL 60201
312-492-5273
TWX 910-231-0872

Institute of Transportation Studies Library
University of California
412 McLaughlin Hall
Berkeley, CA. 94720
415-642-3604

RRIS FILE SEARCHES

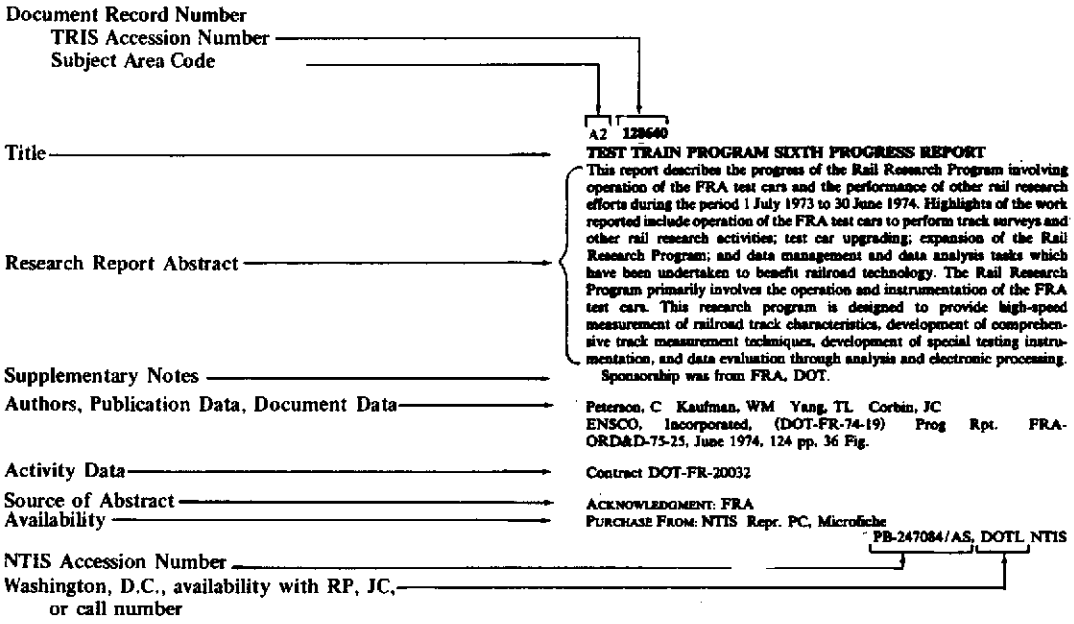
The RRIS file is maintained on magnetic computer tape and is available for searches for information related to specific inquiries. The key to searching is RRIS categories and appropriate subject terms. The search is normally done by computer. Output may include abstracts of articles and reports, descriptions of computer programs, and summaries of ongoing research. The output is a computer-printed listing similar in format to listings that appear in this publication.

The fee schedule for RRIS file searches reflects the primary support for the service from the Federal Railroad Administration and the nonprofit nature of all National Research Council information services. The charge for computer retrieval from the RRIS file is $50 per request plus $0.25 per printout page, which is screened by RRIS. A written authorization or purchase order is required before the retrieval is made.

SAMPLE ABSTRACTS

Abstracts are classified according to an 8-digit document record number: The first 2 digits indicate the subject area code, and the last 6 digits indicate the TRIS accession number, which is a unique number assigned to each document. The subject area code and the subject area appear at the tops of the pages in the abstract and summary sections. The document record number appears at the top of each abstract. Abstracts within each subject area are listed in ascending order of the accession numbers, although these usually will not be consecutive. Examples of a report abstract and of a journal article abstract appear below.

ABSTRACT OF A REPORT



ABSTRACT OF A JOURNAL ARTICLE

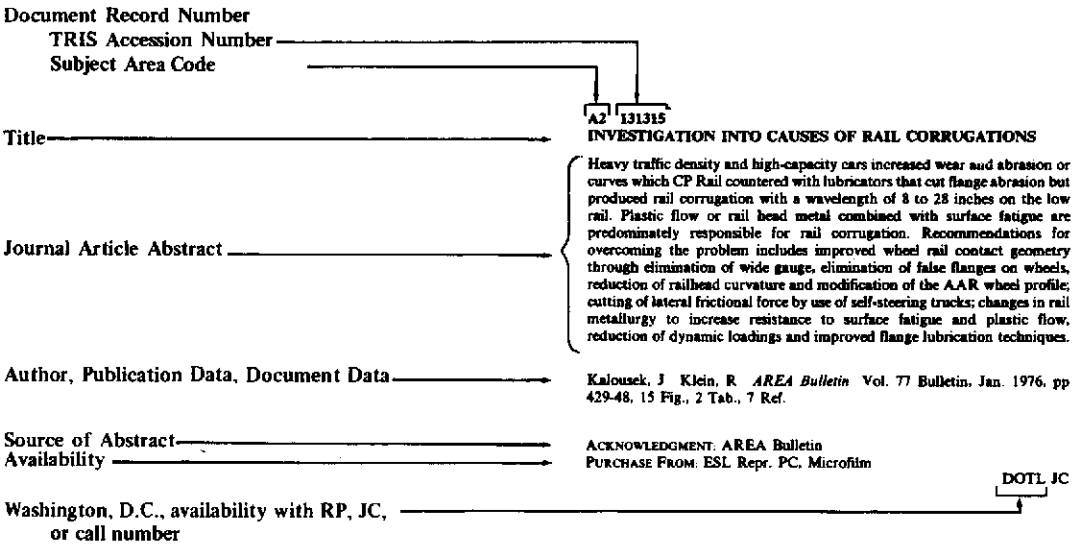


Figure 1. Organization of the Federal Railroad Administration.

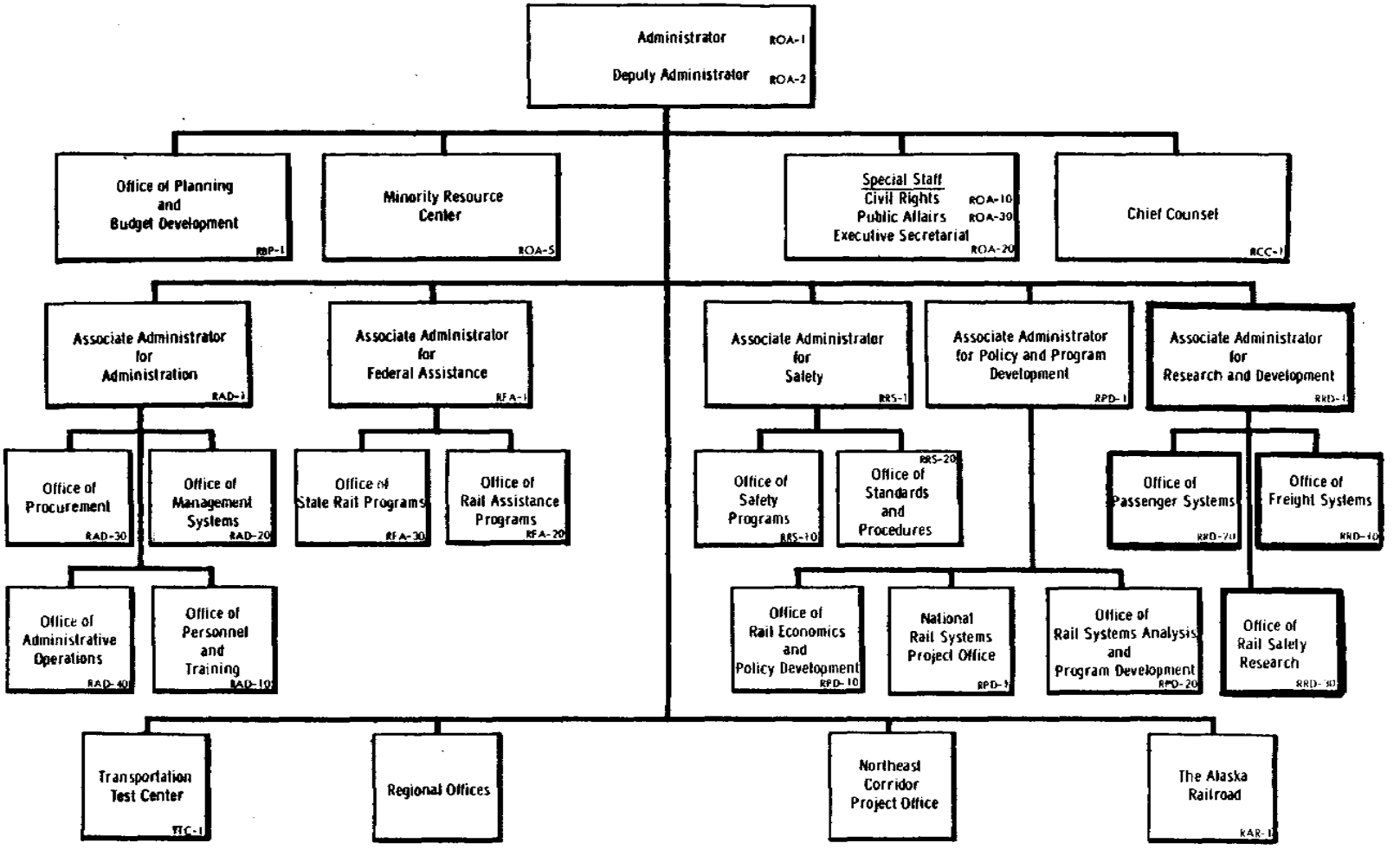
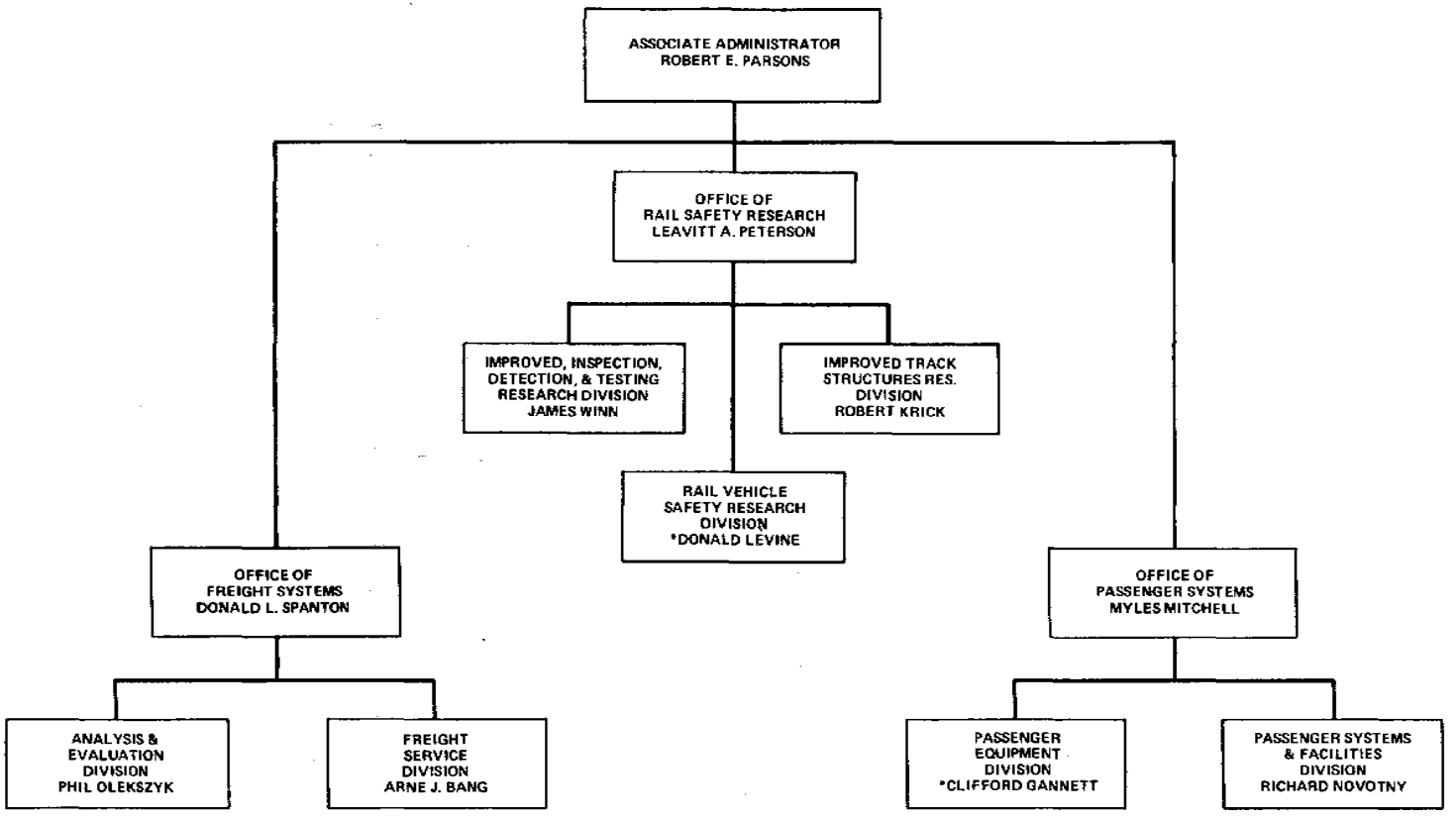
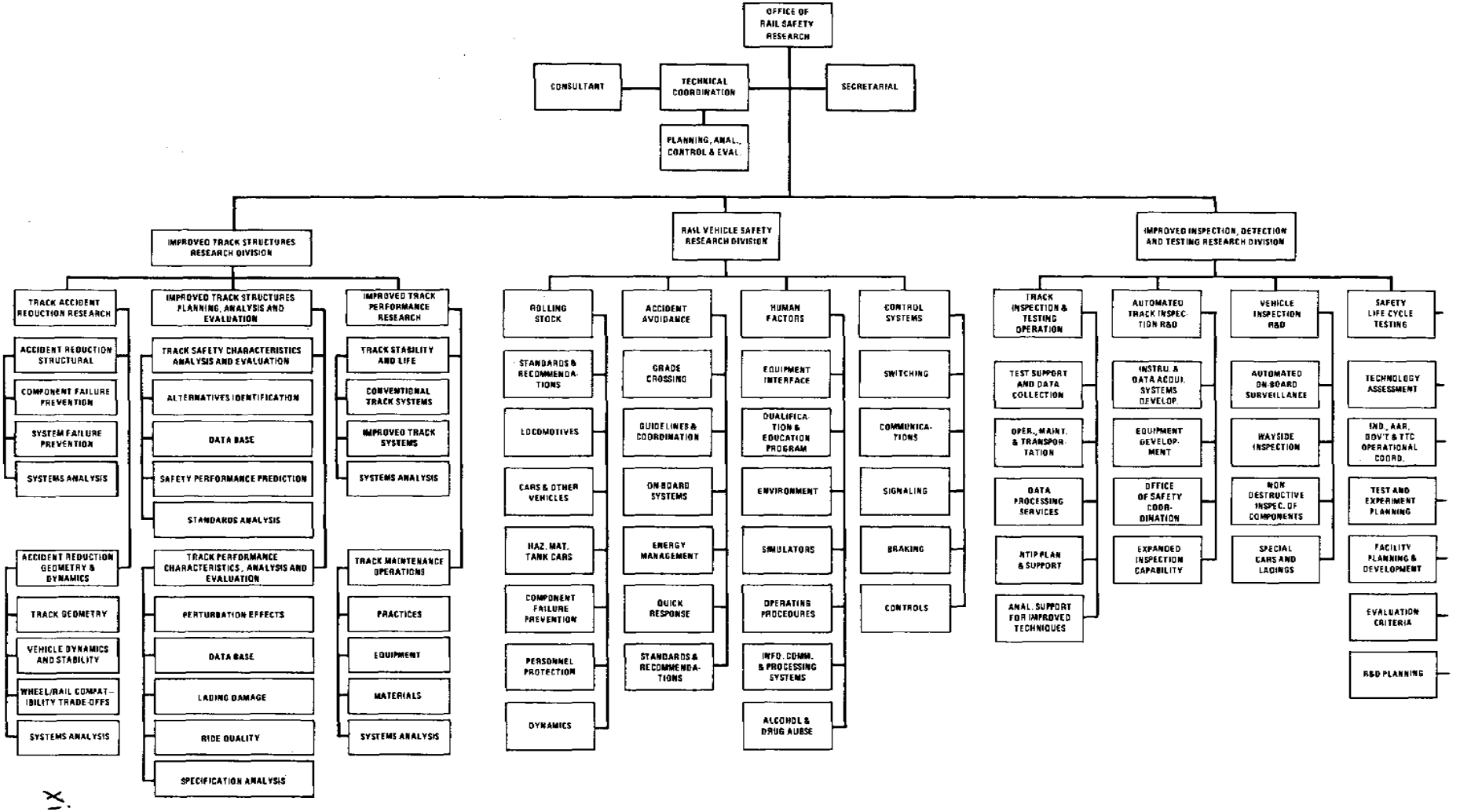


Figure 2. Organization of the Office of Research and Development.



*ACTING

Figure 3. Organization of the Office of Rail Safety Research.



INTRODUCTION

The Federal Railroad Administration was created pursuant to section 3e1 of the Department of Transportation Act of 1966 and is composed of the Office of the Administrator, the headquarters offices, the Transportation Test Center, the Office of Northeast Corridor Project, and the Alaska Railroad. Included in the act was the transfer of railroad safety activities from the Bureau of Railroad Safety and Service of the Interstate Commerce Commission.

Under the Railroad Safety Act of 1970, FRA was given the responsibility to conduct and administer a program to ensure safe operating and mechanical practices within the railroad industry. The Office of Research and Development was organized and given the mission to "plan, conduct, promote, and coordinate research, development, and demonstration of all aspects of intercity ground transportation and railroad safety." As a result of continuing problems in existing rail systems, FRA's research and development activities were redirected in 1975 to near- and intermediate-term problems. Consistent with this redirection was the structuring of the research and development program into three offices to address specific customer needs.

The Office of Passenger Systems concentrates on developing practical improvements to existing technology that can be implemented by AMTRAK and other rail passenger operations. These developments will achieve lower operating and maintenance costs. The main areas under investigation include traction and propulsion, suspension braking, equipment, controls, train evaluations, and systems developments.

The Office of Freight Systems was established (a) to provide component and system performance specifications to the railroad industry (operators and suppliers) that will lead to reduced life-cycle costs and more profitable operations and (b) to establish a technical basis, including analytical tools and facilities, for the development of more productive freight systems in both the near and long term. Current research programs include dynamic analysis and evaluation, systems analysis and technology assessment, classification yard technology, equipment performance analysis, energy and environment, and intermodal freight systems technology.

The Office of Rail Safety Research was also created under the reorganization to plan, sponsor, and implement research and development programs designed to improve rail safety. In broad terms, the goals of the office are to reduce the rate of fatalities and injuries and the rate and severity of railroad accidents through the application of research results. To achieve these goals, the office is divided into three divisions, each of which conducts research in one of three main areas: improved track structures, rail vehicle safety, and safety inspection and defect detection of track, rail vehicle components, and systems.

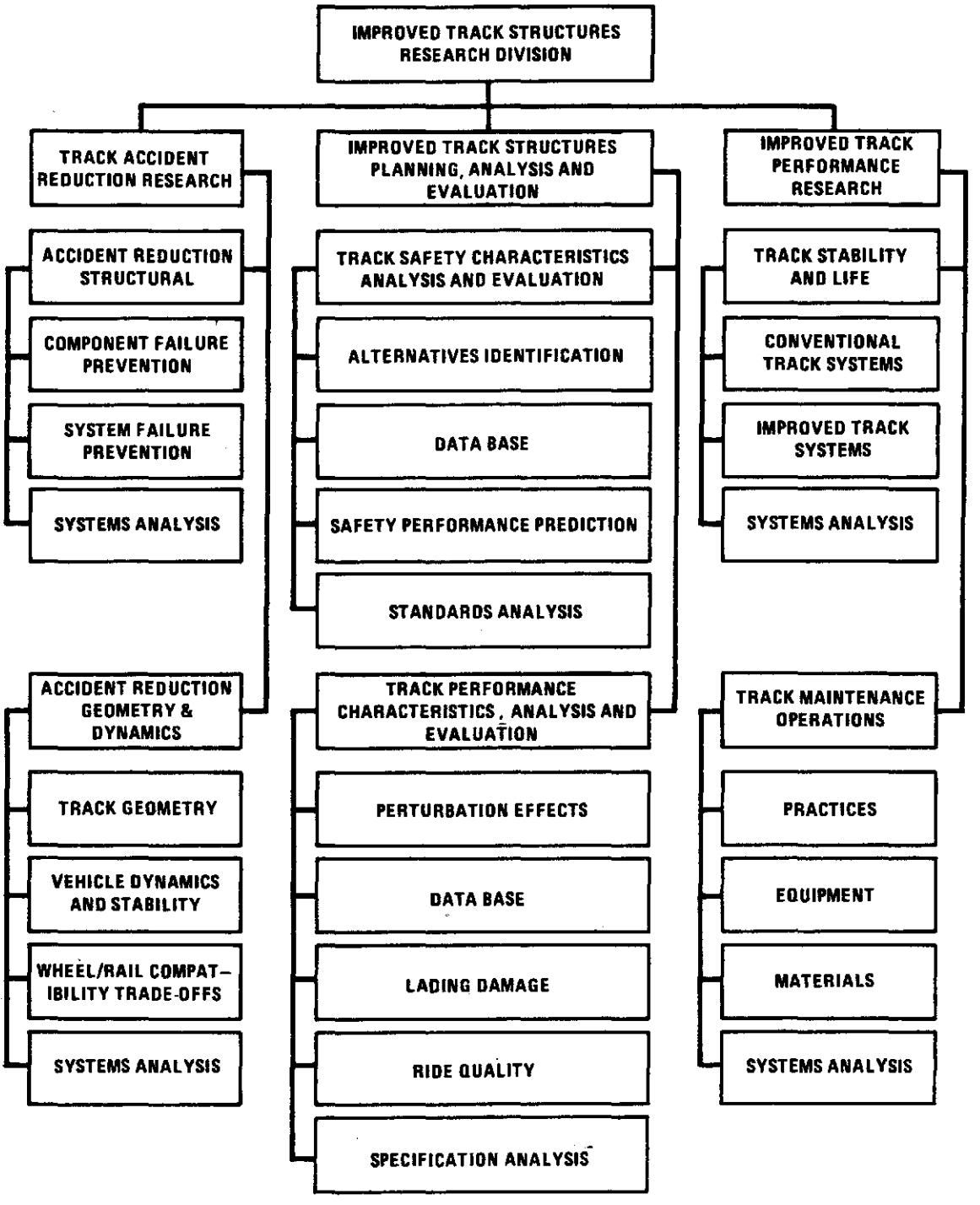
Research efforts are both planned and coordinated with potential users of the research results, e.g., FRA Office of Safety and Northeast Corridor Project Office, AMTRAK, and the railroad industry, including various government-industry-union research groups such as the Railroad Safety Research Board, the Locomotive Control Compartment Committee, and the Track-Train Dynamics Program jointly sponsored by the Association of American Railroads, the Railway Progress Institute, the Transportation Development Agency of Canada, and the Federal Railroad Administration.

IMPROVED TRACK STRUCTURES RESEARCH

Improved track structures research is directed toward (a) reduction in the number of track-caused train accidents and (b) more cost-effective track construction and maintenance procedures. The first case includes identification of safe minimum behavioral limits of track systems and components. The second addresses the domain of service-oriented, cost-effective track construction and maintenance methods.

Attainment of these two goals is being pursued through two distinct strategies. In the case of track safety, the objective is to identify the limits to which the track system and its components can be safely exercised. This includes specification of maximum track deflection under load, track geometry characteristics that adversely affect rolling stock, stress and fatigue limits of system components, and other conditions that cannot be exceeded without jeopardizing safe train operation. The research approach employed to reduce track construction and maintenance costs is to determine how the system breaks down and then work with typical materials to discover how to repair or reconfigure the system to achieve greatest durability at the least cost and to determine the most efficient method for maintaining the track structure.

Figure 4. Organization of the Improved Track Structures Research Division.



Abstracts of Reports and Journal Articles

A1 033083
WHEEL-RAIL ADHESION
The subject of adhesion between locomotive wheels and rails has been an area of vital interest to locomotive manufactures and to the railroads. Horsepower of internally powered locomotives has continued to increase significantly, thereby providing more power for traction. The trend of increasing horsepower has been the product of progress in technology and engineering development. Wheel-to-rail adhesion within the lower speed range has been a limiting factor in tonnage ratings for locomotives in drag service on U.S. railroads. Factors Affecting Adhesion are: (1) Vehicle Factors, (2) Track Factors, and (3) Contact-Area Common Factors. Additional discussion of the conclusions follows.

Marta, HA Mels, KD (General Motors Corporation) *ASME Journal of Engineering for Industry* 68-WA/RR-1, Aug. 1969, pp839-854, 69 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-019)
DOTL RP

A1 033084
FRICTION CREEP PHENOMENON OF ADHESION BETWEEN STEEL WHEELS AND RAILS
The purpose of this article is to present a summary of the laboratory and field tests which have been conducted by EMD to evaluate the friction and creep phenomenon of adhesion between steel wheels and rails. The available adhesion coefficient between the driven wheels and rail is a primary factor in determining the amount of power that can be converted to tractive force by the locomotive. For this reason, experimental investigations into rolling contact friction-creep phenomenon were conducted on model equipment in 1968 along with full scale field tests on an SD-45 model locomotive.

Conference sponsored by the American Society of Mechanical Engineers and the Institute of Electrical and Electronics Engineers.

Marta, HA Mels, KD Itami, GS (General Motors Corporation) *ASME/IEEE Railroad Conference* 1971, 35pp, 31 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-020)
DOTL RP

A1 033091
STRESSES AT RAIL JOINTS AS INFLUENCED BY BOLT HOLES
The failures of rails caused by bolt holes of joints (end breaks) have recently come to occupy the majority of rail breaks. In order to prevent such breaks it was customary to reduce the diameter of the bolt holes or to keep the holes away from the rail ends. The present writers conducted experiments upon joints of the structure actually used for 50 kg/m rails, bolts of different diameters, rails with bolt holes of different intervals and fishplates with bolt holes of different diameters and different intervals with an aim of ascertaining what type of a fish joint is the most durable.

Koyama, K Sasaki, N (Japanese National Railways) *Railway Technical Research Institute* Vol. 1 No. 3, Sept. 1960, pp45-49

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-028)
DOTL RP

A1 033120
RAIL WEAR LIMITS
The Southern Railway, after reviewing rail wear conditions which were thought to have been a principal contributing factor to derailments, found that approximately 40 percent of loss of rail head wear for 130-132 lb. rail was the amount beyond which such derailments had occurred. Limits to show the top wear limit and side wear limit to be allowed for the different rail sections for various classes of track. The corresponding limits for the smaller sections of rail were pretty much a matter of judgment, using the limits for the 130-132 lb. sections as a guide.

Private Communication

Magee, GM (Southern Railway) June 1971, 4pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-059)
DOTL RP

A1 033121
COLLECTION OF PRIVATE MEMORANDA ON DERAILMENT
A series of derailment reports discusses the contributing factors which caused derailment. These factors include unique qualities of hopper cars and their tendency to rock at certain speeds, track irregularities, uneven loading of a flat car in conjunction with rail which has excessive wear.

Private Communication

22pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-060)
DOTL RP

A1 033126
EXPERIMENTS ON LOCAL STRESSES OF RAILS IN PRINCIPAL USE IN SEVERAL COUNTRIES
There is room for improvement in the current JNR standards for rail section with respect to their effectiveness as beam members and also to their pattern of distributed local stress. The project of the new Tokaido trunk line construction now being pushed forward has prompted JNR to the renewed design of its rail section from various angles since 1958. Laboratory and field tests were conducted for contributing to a better design to the two tentatively designed rail sections of 67 kg/m for the new trunk line and to the current 50 kg/m one, as well as to the five sections of imported rails.

Sasaki, N Kakisawa, M *Railway Technical Research Institute* Quart Rpt Vol. 2 No. 3, Sept. 1961, pp34-39

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-066)
DOTL RP

A1 033132
TECHNICAL PROCEEDINGS OF THE ENGINEERING EXCHANGE FORUM
Papers from a railroad forum which discuss car design trends, high speed track design, roll and wheel lift tests, coupling requirements. Also included with the papers are comments and questions concerning the papers presented at the forum.

Engineering Exchange Forum Sept. 1966, 53pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-072)
DOTL RP

A1 033175
FIELD TEST OF CORROSION PREVENTED RAILS ON THEIR ENDURANCE LIMIT TO RAIL END FRACTURE
In order to prevent rail end fracture by corrosion fatigue cracking, various measures for prevention of corrosion were examined by field tests. In the

preliminary test, 25 measures for prevention of corrosion were examined in tunnels under steam traction. Considering the test results, 4 measures were selected for life test. The most remarkable result of life test was as follows: In the tunnel, in which the mean life of non-treated rail was only 3 years, that of shot-peened rail covered with zinc metalicon was elongated up to 5 or 6 years.

Takihara, M Tomita, K Takeuchi, Y Tsuyuki, S Hirose, S Kose, Y Sato, Y (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 9 No. 1, Mar. 1968, pp17-20, 1 Ref
SPONSORING AGENCY: Maritime Administration, /Department of Commerce

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-129)
DOTL RP

A1 033192
TEST ON REPAIR OF RAIL SLIP DAMAGE THROUGH HEATING CORRECTION (REPORT 1)
Tests were made to establish the possibility of heating the top and web of a slip-damaged rail and correcting it as laid in the track without replacing it with a new one. The results proved the feasibility of this rail correction method.

Takahashi, T Aoyama, S Kodama, J Hiruma, M (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 9 No. 3, Sept. 1968, pp182-183

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-148)
DOTL RP

A1 033198
FATIGUE STRENGTH TESTS ON RAILS
Fatigue strength data on rails have seldom been published. Japanese National Railways, in connection with the adoption of long rails (0.5, 1.0, 1.5 or 2.0 km) and speed-up of train operation, is vigorously pushing fatigue strength investigations as well as qualitative study of rails. Soundness of the welded rail is hard to evaluate through a mere external inspection; therefore, nondestructive testing methods such as ultrasonic, magnetic detection and mechanical methods such as static bending, repeated drop weight should be coupled with it. Present demand is to secure a sound welded rail in the field through fatigue strength comparison between the base metal of rail and the welded joint.

Yamanaka, Y (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 5 No. 2, June 1964, pp44-50

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-155)
DOTL RP

A1 033207
BEHAVIOUR OF THE METAL OF RAILS UNDER THE REPEATED ACTION OF WHEELS. STUDY OF THE FIELD OF STRESSES IN THE ELASTO-PLASTIC ZONE
This report contains the results of the various calculations effected so far. These can be considered as preliminary calculations carried out before proceeding to the complete calculation of the stresses in a railhead. The report likewise contains several analytical studies, both for the purpose of gaining a better insight of the stresses (the methods and the formulae are, as a rule, well known, though, generally speaking, the numerical results are not published) and for rendering possible a comparison of the results obtained by means of the numerical method with those obtained by means of exact calculations.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Interm Rpt Mar. 1964, 102pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-165)
DOTL RP

A1 033208
MUTUALLY PERMISSIBLE WEAR PROFILES OF WHEEL TYRES AND OF POINTS AND CROSSINGS. ASSESSMENT CRITERIA FOR THE PERMISSIBLE WEAR PROFILES OF WHEEL FLANGES AND SWITCH COMPONENTS.
Studies include the investigation of the wear forms of a great number of worn wheel flanges used on various types of vehicles (passenger coaches, wagons, railcars, electric and diesel bogie locomotives) and of worn rails in areas containing points and crossings so as to obtain an adequate basis, adapted to practical demands, for arriving at a judgment. Starting from a characteristic wear profile of a flange a track guage was developed, permitting the verification of the compatibility of the wear profiles of the ironwork of switches with such a flange.

Measurements conducted using the gauge enable development of wear forms of rails endangering the traffic to be detected (particularly in sections containing switches and stock rails) and they indicate, at the same time, how this risk can be eliminated and how their use can be prolonged by reprofiling operations. The results of the studies are that it will be possible to deduce, from an analysis of the geometry of the contact between flange wear shapes and track, the compatibility criteria adapted to practical conditions and only requiring simple measures to be taken on the wheel and the switch work items (checking by means of the gauge). This procedure will lead to a decisive improvement of the riding safety of vehicles.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Rpt C70/RP 1/E, Apr. 1969, 30 pp, 22 Figs., Tabs, 5 App.

ACKNOWLEDGEMENT: Battelle Memorial Institute (BCL-166)
PURCHASE FROM: UIC Repr. PC

A1 033211
LATERAL STABILITY OF RAILS, ESPECIALLY OF LONG WELDED RAILS. ENQUIRY RELATING TO LAYING IN CURVES
This report discusses the results of a questionnaire to determine the state-of-the-art of welded rail. Includes discussion of the history of the uses of long welded rail, and of tests to determine the characteristics of such rail under varying climatic conditions. Report also covers track buckling tests at Karlsrule and London in the late 1950's and includes a chapter on the characteristics of track incorporating long-welded rail. Various theories on the stability of long welded rails are covered briefly, and an extensive bibliography is included.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Intrm Rpt. D14/RP 2/E, Apr. 1965, 9 pp, 2 App.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-169)
PURCHASE FROM: UIC Repr. PC
DOTL RP

A1 033212
THE PRINCIPAL RAIL DEFECTS, INTERIM REPORT NO. 3 (CHAPTERS I-IV)
A listing of principal rail defects which includes the description, causes, consequences and remedies for each. Those included are: vertical longitudinal splitting, laps, shelling of heattreated rails, gauge corner shelling, star cracking of fish bolt holes, progressive transverse cracking in rail heads, horizontal cracking of rail head and transverse fractures at longitudinal fissures. Included at the end of each unit are a number of photographs of each flaw.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Intrm Rpt Rpt 3, Mar. 1962, 57pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-170)
DOTL RP

A1 033250
AN ANALYSIS OF THE RAIL CLIMBING TENDENCY OF A WHEEL AXLE SET AT VARIOUS ANGLES OF ATTACK
This analysis examines the rail climbing tendency of a wheel at various angles of attack. Static conditions (incipient motion or constant speed motion with no lateral acceleration or track irregularities) are assumed. The analysis shows no tendency for the wheel to climb the rail at any normal angle of attack.

Johnson, MR Oct. 1956, 4pp
ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-198)
DOTL RP

A1 033258
RELATION BETWEEN SUPERELEVATION AND CAR ROLLING
Springs and links between car body and axles can be thought as a mechanical filter to isolate the car body from axle motion (except axle revolution). Then the problem to know the relation between track irregularity and car vibration is the problem to know the characteristics of this filter. there are three methods to study the characteristics. The first method is to calculate the characteristics theoretically from the parts constants. The second method is to know the characteristics by measuring the output of filter for special input. The third method is to determine the characteristics by analyzing the input-output relations for normal operation. No special equipment except measuring instruments is needed. Second, the effect of random noise can be cancelled out by statistical treatment of data. An application of this method is described.

Nakamura, I (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 3 No. 1, Mar. 1962, pp17-20

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-207)
DOTL RP

A1 033267
SPECIAL ACCOUNTS SUMMING UP THE REPORTS ON THE QUESTIONS FOR DISCUSSION AT THE EIGHTEENTH SESSION OF THE INTERNATIONAL RAILWAY CONGRESS ASSOCIATION (MUNICH, 1962)
The data and opinions are set out in the following five chapters: (1) Effect of locomotives and rolling stock on the track; (2) Track alignment points and crossings; (3) Gauges; distances between running lines, obstructions; (4) Equipment and ballasting of present day high-speed tracks; track renewal conditions. (5) Safety of trains and staff on high speed lines; control of these lines; measures taken concerning the quality of track; increase in maintenance costs due to increased maximum speeds.

Thille, A (French National Railways) *Rail International* Vol. 39 No. 6, June 1962, pp888-924

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-217)
DOTL RP

A1 033268
THE STABILITY OF LONG WELDED RAILS
A report of British Railways testing of long welded railroad track. Testing program to determine the stability of welded rails by tests for buckling, torsional resistance, lateral moment of resistance and lateral ballast resistance. Conclusions that track can buckle but factors controling stability are torsional resistance of fastenings, sleeper spacing, ballast resistance.

Bartlett, DL (British Railways) *Rail International* Vol. 38 No. 10, Oct. 1961, pp679-708

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-218)
DOTL RP

A1 033284
SHOCK AND VIBRATION THEORY
It defines terms used in a mathematical representation of shock and vibration which are part of railroad phenomenon and discusses mass, inertia, momentum, force as related to "railroad impact shock". In addition the relationship of railroad car spring, and effect of flat wheels or rail joints upon the suspension of the car are represented and discussed.

The Railroad Environment: A Guide for Shippers and Railroad Personnel.

Railroad Environment pp27-32

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-235)
DOTL RP

A1 033285
TESTS OF PENNSYLVANIA RAILROAD ELECTRIC LOCOMOTIVES AT CLAYMONT, DELAWARE
In 1934 studies were made by the Pennsylvania of larger size electric motive power in anticipation of the heavier trains to come. A class R-1 locomotive was designed and built in 1934 with a 4-8-4 wheel arrangement. It was considerably heavier on the axles than the consulting firm which electrified the Pennsylvania deemed desirable, and they persuaded the Pennsylvania Railroad to borrow one of the new New Haven locomotives, which had a wheel arrangement of 4-6-6-4 and had a comparable axle load to the earlier class of Pennsylvania locomotives. The R-1 could not match the tracking flexibility of the GG-1, wheel arrangement of which was articulated. The GG-1 was safer and smoother riding at high speed with less destructive forces being exerted on the rail than the R-1.

From the book "The Locomotives that Baldwin Built".

Westing, F
Superior Publishing Company Book 1966

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-236)
DOTL RP

A1 033292
ACCOUSTIC EMISSION TECHNIQUE FOR THE DETECTION OF FLAWS IN RAIL WELDS
An acoustic emission technique of testing for flaws in welded rail was conducted in June and July of 1969 at the Bellevue, Ohio, rail welding plant and at the Roanoke, Va., gas welding plant. Several welds by thermite, gas and electric welding processes were prepared for these tests under controlled conditions, with several samples of each process having artificially induced or included defects. This technique is entirely non-destructive and is accomplished immediately after welding so authoritative corrective action can be taken. Correlation was found between poor welds and high AE activity and good welds and lower AE activity. It appears that innovations and refinements will be required to obtain a practical "black box" of this type suitable for use on the railroads.

Company report.

Norfolk and Western Railway SCE 1188, SCE 155, July 1969, 4pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-245)
DOTL RP

A1 033297
TRACK-TRAIN DYNAMICS STUDY PROJECT TR-14 RAIL-VEHICLE INTERACTION STUDY REPORT NO. 1 (PRELIMINARY ANALYSIS OF SAMPLE DATA)
As a result of various derailments, a task force was formed to investigate the

dynamic forces exerted by locomotive and freight car wheels against the rail. Critical study was directed at the 3 and 2 axle trucks of high horsepower locomotives, 85 feet TFC cars, and 50 feet box cars. The objective of this investigation was to determine if dynamic forces of sufficient magnitude to cause derailment were being generated by equipment, track structure and operating practice, and to recommend whatever corrective action might be indicated. Extensive field tests of wheel-rail interaction were conducted in various territories between Los Angeles and Pine Bluff, Arkansas. An analysis of these test results led to the following general conclusions: 1. Dynamic forces of sufficient magnitude to cause derailments are being generated in every day operation of revenue trains. 2. The forces are also sufficient to cause greatly accelerated wheel and rail wear. 3. Forces of sufficient magnitude to exceed the ability of the track structure to resist permanent deformation in alignment are also being generated.

Lynch, JP TenBroeck, HR Wagner, TB (Southern Pacific Company) Southern Pacific Company Report No.1, June 1970, 126pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-250)
DOTL RP

A1 033298
THIRTEENTH PROGRESS REPORT OF THE COOPERATIVE INVESTIGATION OF FAILURES OF RAILROAD RAILS IN SERVICE AND THEIR PREVENTION

Since control cooling of railroad rails came into general use at all rail mills in 1936, a procedure has been established to study and properly classify all failures reported as transverse fissures in control cooled rails. It has been found that several of the reported transverse fissures are wrongly classified; however in a few cases such failures have been found to develop from defects other than shatter cracks, the usual cause of transverse fissures. Investigations have also been made of end-hardened rails in service. New methods of end-hardening rails are now being developed at several rail mills. Some laboratory tests have been made of these end-hardened rails and other tests are planned. A few control cooled rails developed transverse fissures or compound fissures from porosity, but no rails failed during this period from improper control cooling or shatter cracks. The detail fractures from shelly spots and head checks had mostly been incorrectly classified as transverse fissures while the web and base failures were sent to the laboratory for special investigation of each failure. Porosity is a newly recognized cause of transverse fissures which have been found in control cooled rails. No fissures from porosity have been found in rails from the three mills which do not reheat their blooms. This is rather strong evidence that the overheating of the blooms is the cause of the porosity. Rail fissures and porosity are illustrated in several photographs.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 48 pp809-818

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-252)
DOTL RP

A1 033299
FATIGUE TESTS OF RAIL WEBS

The study of the fatigue strength of rail webs has been continued. Tests were made on T-shaped specimens cut from the web of a 112-lb RE rail, under a range of stress which simulated as nearly as possible stress conditions encountered in service, namely, a bending stress ranging from a maximum compressive stress at the surface to a tensile stress 20 percent as great. Since the fatigue failures were in compression, the cracks progressed very slowly, and the criterion of failure was taken to be the number of cycles when the crack could be first detected. Eight T-shaped specimens were cut from the same piece of 112-lb rail and were shot peened. Tests indicated that shot peening raised the endurance limit approximately 32 percent over that for the unstamped specimens with the surface as rolled. To get some measure of the reduction in fatigue strength resulting from corrosion, it was suggested that fatigue specimens be cut from a corroded or rusty rail and tested in the same manner to determine the amount of weakening due to a rusty, pitted surface. A short piece of very rusty rail was obtained from which specimens were cut for these tests. The curve for these date indicates an endurance limit of 57,000 psi at 10 million cycles, or a reduction of slightly less than 3-1/2 percent below that for the non-corroded specimens. To observe the effect of water corrosion on fatigue strength, several specimens were tested with tap water dripping continually on them. The fatigue curve shows an endurance limit of 56,000 psi at 40 million cycles, which is approximately the same as for the rusty rail specimens.

Jensen, RS (Illinois University) *AREA Bulletin* Vol. 48 pp804-808

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-253)
DOTL RP

A1 033301
FIFTH PROGRESS REPORT OF THE SHELLY RAIL STUDIES AT THE UNVERSITY OF ILLINOIS

Several specimens of alloy steel were received for rolling-load tests to study their resistance to shelling. The chemical analyses, Brinell hardness and some physical tests of these steels, are given in Table 1. The heat-treated specimens were short lengths of rails and very little materials is available for physical tests until the rolling-load tests have been completed. Photographs of the shelling cracks for some specimens are shown. Heat-treated low alloy rails were much superior to any other specimens and compare very favorably with the 3-percent chromium rails and heat-treated carbon steel rails. The 3-percent chromium rail stood up to 5,000,000 cycles and the laboratory heat-treated carbon steel rolled 4,560,000 cycles before complete failure. The two tests made on the silico-manganese spring steel rails were discouraging as these specimens developed a brittle type of fracture after only 983,000 cycles and 657,000 cycles, respectively. Photographs of both of these failures are shown. The rolling-load tests of the as-rolled alloy steels were also discouraging as the best of these ran approximately one million cycles in the cradle-type rolling machine. These alloy steels could, or course, be heat-treated to produce physical properties which would give much better rolling-load tests.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 48 pp756-766

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-255)
DOTL RP

A1 033302
DEVELOPMENT AND CHARACTERISTICS OF FRACTURES UNDER ENGINE BURNS IN RAIL TOGETHER WITH INVESTIGATIONS AS TO THE EFFECTIVENESS OF WELDING UP ENGINE BURNS BY OXYACETYLENE OR ELECTRIC METHODS

This is a progress report covering rolling-load tests and metallurgical investigations on engine-burned rails. In summary: a driver burn of a rail causes extreme hardness because of the development of a martensitic structure. This constituent develops from the process causing the burn, namely, (a) friction heating and (b) rapid quenching. The martensite transformation apparently creates quench cracks because of the volume change. The quench cracks greatly reduce the fatigue resistance and the rail may fail in a shorter time. Attention should be given in the repair of driver burns by welding, to removing parent metal containing quenching cracks beyond each end of the burned area in addition to the burned metal, before weld metal is applied. Study should also be given to means of making the weld to obtain a minimum of oxide inclusions. Numerous photographs document engine burns and quench cracks in rail.

Akers, JB Armstrong, JE Barnes, WC *AREA Bulletin* Vol. 48 pp734-750

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-256)
DOTL RP

A1 033306
THE EFFECT OF THE RATIO OF WHEEL DIAMETER TO WHEEL LOAD ON EXTENT OF RAIL DAMAGE

This is a report of progress on studies of pressure as affected by the area of contact between wheel and rail. One phase of this investigation involves the conduct of rolling load tests of rails subjected to wheels of various diameters and loads. To summarize, a depth hardness survey on a 112-lb rail removed from service after approximately 12,000,000 tons of traffic shows the maximum hardness to be at a depth of approximately 0.04 in. at a distance

of 1-3/6 in. from the center of the head toward the gage side, the maximum hardness being Rockwell C 34.6. Tests on a full section 131-lb rail under a 75,000-lb load after 1,333,000 cycles (100,000,000 tons) of testing are as follows: For the 33 in. wheel--a hardness of Rc 15 on the tread and a maximum of Rc 32 at a depth of 0.15 in.; for the 50 in. wheel--a hardness on the tread of Rc 23 and a maximum hardness of Rc 27.4 at a depth of 0.10 in. Using "mutilated" head specimens and a 50-in. wheel it was found that a 58,000-lb load could be carried for 100,000,000 tons, but that a 63,000-lb load would break down the rail tread after 15-45 million tons.

Alleman, NJ (Illinois University) *AREA Bulletin* Vol. 47 No. 453, June 1945, pp725-741

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-260)
DOTL RP

A1 033308
TENTH PROGRESS REPORT OF THE JOINT INVESTIGATION OF FISSURES IN RAILROAD RAILS
Report discusses the field testing of end hardened rails for batter and resulting weeping cracks which developed and were repaired by welding. A series of rails from Carey Ohio (C&O) were examined for weeping cracks and the rails in which they developed were compared as to air and water quenched end hardened rail. The last section discusses control cooled rails which failed in service. Eleven illustrations show the types of failure.

Moore, HF Jensen, RS Cramer, RE (Illinois University) *AREA Bulletin* Vol. 45 pp481-502

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-262)
DOTL RP

A1 033309
SECOND PROGRESS REPORT OF THE SHELLY RAIL STUDIES AT THE UNIVERSITY OF ILLINOIS
The laboratory studies of the cause and prevention of shelling of rail surfaces are carried on in cooperation with the AREA Committee on Rail, Assignment 11-Investigate causes of shelly spots and head checks in rail surfaces for the purpose of developing measures for their prevention. Low strength of the steel, as indicated by low Brinell hardness, seems to be a significant factor in the development of shelly spots on rails. No defects were found in the metal of these rails which might have contributed to the development of shelling. It was also found that the shelling on these rails developed differently from that described as starting internally in last year's report on shelly rails. Several photographs are presented to illustrate the shelling that occurred. The rolling-load tests to compare the flow of various kinds of rail steels under laboratory controlled conditions, described in the 1942 report, have been continued, and the results are now complete on 21 specimens. Eight rails have changed less than one hundredth of an inch and a ninth rail was only slightly over this value. In contrast to these rails are 12 rails which changed in profile over two hundredths of an inch. It will be noted that all the rails except two which changed in profile over two hundredths of an inch were below 300 in Brinell hardness.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 45 pp462-469

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-263)
DOTL RP

A1 033311
INVESTIGATE CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL SURFACES FOR THE PURPOSE OF DEVELOPING MEASURES FOR THEIR PREVENTION
As the subcommittee investigates this subject more fully, it has been found that shelling is a much more serious and wide spread condition than was first realized, and while the shelly condition may be visible in some cases, in many others fractures of the rail may occur without the defect becoming noticeably visible on the surface of the head; therefore, it is doubly important that a solution be found. In addition to a study of rail-steel compositions, heat treatments, wheel and rail contacts and pressure, the subcommittee may turn to a study of mill practices as a possible cause of shelly steel, or it may finally resort to a consideration of larger diameter wheels or lighter loads on the wheels. If the answer lies in some special composition of rail steel or in heat treatment, the investigation must enbrace a study of the possibility that the new chemistry or heat treatment may give rise to some other types of defects or that they may lead to excessive difficulties or expense in production. While this assignment covers both shelling and head checking, very little mention has so far been made of the latter. At one time the subcommittee was of the opinion that one solution would cover both defects, but recent developments indicate that this may not be true. This report covers shelling only.

Hewes, FS (American Railway Engineering Association) *AREA Bulletin* Vol. 45 pp446-462

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-265)
DOTL RP

A1 033312
SECOND PROGRESS REPORT OF THE ROLLING-LOAD TESTS OF JOINT BARS
Discusses the results of rolling load tests on joint bars. Details of test equipment, specimens, are discussed as well as table illustrating the test program of cantilever bending moment. Brinell hardness readings, wheel load position, design, bolt tension, bar reflectors and spring actions. Finally, a short report in the development and characteristics of the fractures which are formed beneath wheel bars in rail.

Alleman, NJ (Illinois University) *AREA Bulletin* Vol. 45 1944, pp434-445

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-266)
DOTL RP

A1 033313
INVESTIGATION OF THE IMPACT EFFECT OF FLAT WHEELS PRELIMINARY REPORT
The test reported the effect of wheel flat upon rail, tie plates, ties. Test situation included a test track over which a loaded coal car with a 4 inch long flat spot, was run. Stress was measured by special M.I.T. testing gear and a high speed camera. The tests were run at speeds of 5 to 40 mph to determine effect of speed upon stresses created by out-of-round wheels.

Magee, GM Cress, EE (Association of American Railroads) *AREA Bulletin* Vol. 45 1944, pp9-23, 6 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-267)
DOTL RP

A1 033314
STUDIES OF THE PRESSURE AS AFFECTED BY THE AREA OF CONTACT BETWEEN WHEEL AND RAIL. EFFECT OF WHEEL SIZE
The following is a progress report on one phase of this investigation, namely, rolling-load tests in which wheels of various diameters are rolled to and fro on a short length of rail for the purpose of determining the number of cycles of load application required to produce failure. The results of the rolling-load tests to fracture show considerable "scatter" and no very marked difference between the results of tests under a 50-in. wheel and those from tests under a 33-inch wheel. The vertical wear on rail 757C (33-in. wheel) was 0.046 in. at failure, whereas the wear on rail 757C1 (50-in. wheel) at 580,900 cycles was 0.041 in. At failure, 750,100 cycles, the wear on rail 757C1 was 0.0425 in. A second type of test being tried to ascertain the effect of wheel size on the rail is to measure the depth of work hardening in the rail head. The rail head appeared to have been work hardened down to a depth of about 0.45 in. by the 33-in. wheel with a maximum hardness of 296 at a depth of 0.15 in. A test on a section from the same rail rolled with the 50-in. wheel appears to have been work hardened down to a depth of 0.20 in. with a maximum hardness of 269 at a depth of 0.10 in.

Alleman, NJ (Illinois University) *AREA Bulletin* Vol. 45 1944, pp3-8

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-268)
DOTL RP

A1 033315
STRESS MEASUREMENTS IN THE WEB OF RAIL ON THE DENVER AND RIO GRANDE WESTERN
Progress on stress measurement in rail located in curved and tangent situations was measured, and reported. The vertical web stresses under different locomotives is included, and the varying speeds are listed. A comparison of stresses between 112 lb and 115 lb rail as well as 112 lb and 131 lb rail is included in the discussion.

Magee, GM Cress, EE (Association of American Railroads) *AREA Bulletin* Vol. 44 1943

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-269)
DOTL RP

A1 033316
FIELD TESTS FOR BATTER OF END-HARDENED RAILS IN SERVICE ON THE CHESAPEAKE AND OHIO RAILWAY
A series of reports are presented for various aspects of rail, including field tests for batter of end-hardened rail, examination of rail for weeping cracks, control cooled rail with in-service failure and comparison of drop and bend tests.

Jensen, RS (Illinois University) *AREA Bulletin* Vol. 44 II, 1943, pp611-621

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-270)
DOTL RP

A1 033318
FIELD TESTS FOR BATTER OF END-HARDENED RAILS IN SERVICE ON THE CHESAPEAKE AND OHIO RAILROAD
Progress report which discusses the measurement of batter and hardness, testing of cracked and hardened rails with "weeping cracks", and a summary of these rails. Photos illustrate the weeping and shatter cracks found. Recommended practice for the controlled cooling of rails as a means to avoid or to minimize the formation of shatter cracks. A comparative study of control cooled and Brunorized rails--with the results of controlled cooled rails having reduced fissures and more improvements with improved insulation at the mills. Finally, a study and comparison of the drop and bend tests to determine rail quality and acceptability.

Jensen, R Alleman, NJ *AREA Bulletin* Vol. 43 I, 1942, pp607-640, 5 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-272)
DOTL RP

A1 033320
SPECIAL COMMITTEE ON STRESSES IN RAILROAD TRACK. SEVENTH PROGRESS REPORT
Since 1914 this committee has conducted analytical and experimental investigations on the action of railroad track under the loads of locomotives and cars running at various speeds and for a variety of conditions. The tests herein reported were made to obtain information on the action of various types of rail joints in track when subjected to the loads of locomotives and cars at speeds up to 90 miles per hour. Testing equipment enabled tests to be made accurately and expeditiously in a way that had not been accomplished before. Tests were undertaken particularly to obtain information on the action of different forms of rail joints in track under the traffic of locomotives and cars running at various speeds and to learn the magnitude of the bending moments developed in the joint bars as compared with those developed in the full rail away from a joint. It was also desired to learn if possible how speed of train affects these various matters. To serve as a basis of comparison, the stresses and moments and depressions of the full rail in the same track under the action of the same locomotive and cars were needed. Tests were conducted at Elkton, Md. The test site was on a 14-min. curve to the right with superelevation of 1-1/2 in. Ahead of and behind this curve the compound curve became 33 min. The total curve extended over a distance of about a mile.

Talbot, AN Bronson, CB Burton, WJ *AREA Bulletin*

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-274)
DOTL RP

A1 033322
ON THE LIFE OF RAIL
Annual trend of rail failures of the Japanese National Railways in recent years amounted to 5264 in 1963. There are included in rail failures the numbers of broken rails, cracked rails and defective rails all together, they do not always cause interference to train operation. It is known from the figures that end break ranks the first and amounts to more than 60 percent. The number of end breaks is divided into two parts, namely in tunnels and out of tunnels. End breaks in tunnels are more frequent for their track length and the rails in tunnel have shorter life than the ones out of tunnels, due to unfavorable conditions of corrosion in tunnels of our country. End breaks almost occur as results of rail fatigue by train loads. Stress induced on rail varies in magnitude according to train speed, wheel load, lateral force and position of wheel contact on rail, and the stress distribution was found in many measurements to be a normal distribution or its combination in most cases.

Sato, Y (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 7 No. 1, Mar. 1966, pp28-31

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-004)
DOTL RP

A1 033323
A THEORY OF THE DERAILMENT OF WHEELSET
In this study, in order to find out an allowable limit of derailment, the author made four assumptions and analyzed the simplest case where a wheelset derails. In order to prove the theory, the author made experiments by 1/10 and 1/5 scale model wheelset. The results of either case of 1/10 or 1/5 models coincide with theoretical values, and no difference was observed on the limit value of derailment by stationary side thrust having various kinds of radii of wheels.

Yokose, K (Japanese National Railways) *Railway Technical Research Institute* Vol. 7 No. 3, Sept. 1966, pp30-34, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-002)
DOTL RP

A1 033324
SEVENTH PROGRESS REPORT OF THE JOINT INVESTIGATION OF FISSURES IN RAILROAD RAILS
The development of detector cars made possible the detection of many fissures before rail fracture had occurred, but it did not touch the problem of prevention of fissures. A "rolling-load" testing machine was designed and built which subjected a specimen of rail to repeated cycles of wheel load and bending moment. Before testing in this machine an etch test to detect the presence of shatter cracks was made on the rail from which the specimen was cut. Rolling-load tests showed the following results: Only shatter-cracked rails developed fissures, but not all shatter-cracked rails developed fissures. It is the complex stresses directly under a wheel load which cause cracks to develop into fissures. Bending moment tends to cause fissures to take a transverse direction, and accelerates their spread. No greater wheel load was required to start a fissure in a heavy rail than in a lighter rail. The minimum wheel load which started a fissure in the rolling-load tests was 40,000 lb. The wheel load necessary to start a fissure, the theoretical shearing stress in the zone where shatter cracks are located, the fatigue strength of rail steel, and the weakening effect of minute cracks (shown by fatigue tests of specimens) form a coherent picture of the mechanism of fissure formation and spread. The solution of the problem of preventing shatter cracks in rails was attacked by making tests of specimens from rails cooled in air and also controlled cooled. A large amount of study has been given to the problem of finding a nondestructive test which could be used to detect shatter cracks in new rails. Shatter cracks are so minute that changes, due to these shatter cracks, in properties or structure of metal around them, are masked by other variations in the metal. Unfinished work of the investigation relating to fissures includes formulation of proposed standards for control cooling of rails and for bend tests for acceptance of rails. Numerous photographs detail rail defects of the type described.

Moore, HF (Illinois University) *AREA Bulletin* Vol. 42 1941, pp681-751, 15 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-275)
DOTL RP

A1 033325
INVESTIGATE JOINT BAR FAILURES AND GIVE CONSIDERATION TO THE REVISION OF DESIGN AND SPECIFICATIONS
This assignment to investigate joint bar failures, included the study of cracks which may or may not lead to ultimate breakage. The two most common types of cracking are illustrated in Figures 1 and 2, namely, (1) fatigue cracks originating in the spike slot, and (2) fatigue cracks originating at the upper contact surface of the bar. To study possible means of eliminating the cracking of joint bars, tests in track and tests in the laboratory are being conducted along the following lines. 1. Resistance to cracking by improving the physical properties. 2. Photoelastic studies as to effect of design and bolt tension. 3. Fatigue tests, using full size bars of various design in assembled joints. 4. Observations as to the effect of saw swelling of the rail end.

McBrian, R Akers, JB Armstrong, JE *AREA Bulletin* Vol. 42 1941, pp666-679

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-276)
DOTL RP

A1 033326
SECOND PROGRESS REPORT--JOINT INVESTIGATION OF CONTINUOUS WELDED RAIL
Report of committee on welded rail includes a brief resume of past research and then continues into the present research area. The first covered is the testing of welded rail joints under repeated wheel load. The procedure, the endurance limit and fractures developed are included. A comparison between welds and joint bars was included. Metallographic tests of the welds are included and such tests as hardness, etching and metallographic examination of the welds are also included. Mechanical tests of the welded joints were also part of the test sequence. A complete comparison of the test are indicative of metal qualities rather than joints, and that the quality of metal is important to the joint strength as weld outline, cracks and other stress raisers in the joint.

Moore, HF Thomas, HR Cramer, RE (Illinois University) *AREA Bulletin* Vol. 40 1940, pp737-755

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-277)
DOTL RP

A1 033331
ELECTRONIC EQUIPMENT TO ESTIMATE THE STANDARD DEVIATION OF TRACK IRREGULARITES
Discusses the data processing equipment used in a track inspection car of the JNR New Tokaido Line. This car uses the less expensive less complex system than that used in the MAYA 341. The car under discussion uses mechanical type equipment to inspect track for irregularities, changes because of slack, cant, etc.

Nakamura, I Wada, K (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 6 No. 3, Sept. 1965, pp27-28, 3 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-282)
DOTL RP

A1 033348
MAXIMUM VALUE OF TRACK IRREGULARITY
To know maximum values of track irregularities in a certain length of track is necessary for those who maintain track for the safety of traffic and for those who are in charge of maintenance of way. States of track irregularities are represented by the following indexes: P: Index of track irregularity (probability exceeding plus or minus 3 mm) m: Mean value of track irregularities sampled at random sigma: Standard deviation of track irregularities sampled at random. If the mutal relation between the maximum value of irregularity and the irregularity index is ascertained, it will be very useful.

Hiroi, I (Japanese National Railways) *Permanent Way* Vol. 5 No. 3, No. 16, Sept. 1962, pp16-24

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-301)
DOTL RP

A1 033349
DYNAMIC EFFECT OF A FLAT WHEEL ON TRACK DEFORMATION
A series of riding tests was made to clarify dynamic effects of wheels (whose treads were set with flat spots) on the rolling stock as well as on the track at various speeds up to 200 km/h on the test run section of the New Tokaido Truck Line on December 7-11, 1963. In the present report, major test results concerning track deformation are outlined. Shock values resulting from rail bending stress and pressure between rail and sleeper grow rapidly with train speed, showing the peak at 20 to approximately 30 km/h, and thereafter up to 100 km/h, they gradually decrease.

Satoh, Y (Japanese National Railways) *Permanent Way* Vol. 7 No. 1, No. 22, Mar. 1964, pp14-22

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-303)
DOTL RP

A1 033350
PROTECTION OF RAIL JOINTS FROM CORROSION TO PREVENT RAIL END BREAKS
Many parts of the railway track including the rails are made of carbon steel. Carbon steel excels in strength but is prone to be corroded. Rail end breaks are considered as fatigue destruction caused by corrosion. Since stress and corrosion act at the same time, cracking is developed easily. It is because the fatigue strength of a rail decreases sharply in acid environments, that end breaks are more liable to occur in non-electrified sections than in electrified sections. Since corrosion has much to do with end breaks of rails in tunnels, the application of a proper protective method prevents end breaks of rails.

Kose, Y (Japanese National Railways) *Permanent Way* Vol. 6 No. 3, No. 22, Sept. 1963, pp1-13

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-304)
DOTL RP

A1 033357
HOW TO PREVENT RAIL FAILURES WHICH CAUSE TRAFFIC DISTURBANCE
Discusses the types of rail failure and the causes. Includes tables which illustrate various types of failure, the frequency and month by month break down of failure. Conclusions include recommendations for rail inspection and means to control the quality of rail steel to minimize break down.

Ito, A Kurihara, R (Japanese National Railways) *Permanent Way* Vol. 8 No. 2, No. 27, pp1-16, 2 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-311)
DOTL RP

A1 033358
SHELLING OF RAILS EXPERIENCED IN JAPANESE RAILWAYS
In some local lines of the Japanese National Railways and in major privately owned railways and subways in the Kanto and Kansai districts, rail failures caused by shelling of rails are showing signs of increasing. AREA Committee for Rail Shelling says that in curved tracks, if the rail heads and wheel flanges are lubricated, the incidence of shelling increases, but if lubrication is stopped, head checks, flaking and shelling conspicuously decreased. Rate of progress of the fatigue caused by contact should be made to balance with the rate of the progress of the wear. Allowing some wear to arise and also preventing for large plastic flow to occur, such failure may be prevented.

Ito, A Kurihara, R (Japanese National Railways) *Permanent Way* Vol. 8 No. 2, No. 27, pp17-32

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-312)
DOTL RP

A1 033360
TRACK FOR JAPAN'S 210 KM/H TRAINS
Detailed report of high speed operation. Details of maintenance of the right of way are discussed. The main features of the system are outlined, track cross sections and construction are further examined. The planning, organization and personnel of the maintenance operation are further discussed. The use of high speed inspection vehicles and their operation is

included. Finally, protective devices against earthquake, rain and snow damage are mentioned and studied in detail.

Matsubara, K (Japan Transportation Consultants, Incorporated) *Permanent Way* Vol. 11 No. 3-4, Nos. 40-41, 67pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-314)
DOTL RP

A1 033378
THE STABILITY OF TRACKS LAID WITH LONG WELDED RAILS
A study of the behavior of track under traffic situation. Factors considered are axle loading, pliability of the formation, mechanical characteristic of the rail, temperature, type of sleepers and fastenings. Included is a study of the deformation of the track in its plane which initiates a differential equation of variable and non-linear coefficients. Recommendations for the requirements of 250 km/h plus 300 km/h systems are included at the end.

Prud'Homme, MA Janin, MG (French National Railways) *Rail International* Oct. 1969, pp601-620, 34 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-335)
DOTL RP

A1 033379
THE STABILITY OF TRACKS LAID WITH LONG WELDED RAILS
Primarily devoted to the stability of non-loaded track under thermic stresses. Tracks as compared include wooden sleeper construction opposed to pot sleepers. (2 concrete blocks joined by a steel tiebar). The qualities of stabilized and nonstabilized track are further considered under the headings of wooden and pot sleeper.

Prud'Homme, MA Janin, MG (French National Railways) *Rail International* Aug. 1969, pp459-487, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-337)
DOTL RP

A1 033388
WORK-HARDENING BOLT HOLES IN RAIL ENDS
Causes of rail failure occurring at holes near the rail head are discussed. These are radial or star cracking caused by high shear stress in the web aggravated by presence of fish bolt holes. Stresses are caused by locomotives with small driving wheels. Improvement in rail resistance is the result of work hardening the surface of the holes. Accomplished by drilling undersize holes, and broaching or drifting with a spherical tool.

Wise, S (British Railways) *Rail International* Oct. 1960, pp863-865

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-348)
DOTL RP

A1 033390
THE EFFECT OF SUSPENSION DESIGN ON RAIL STRESSES. THE MATCHING OF SPRING STIFFNESS AND DAMPER CHARACTERISTICS AS AN AID TO IMPROVING RIDING AND REDUCING RAIL STRESSES
Article considers the relationship between spring stiffness, damper characteristics of rolling stock as a way to improve comfort and to reduce stress at the rail and also considers factors of vehicle mass, spring stiffness, damping factors of vehicles and track irregularity, sprang-unspramg weight mass, stiffness of track, and the softness of the ballast.

Koffman, JL (British Railways) *Rail International* Sept. 1960, pp756-766, 15 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-351)
DOTL RP

A1 033415
DERAILMENT TEST WITH EXPERIMENT TRACK
Outline of the derailment test on the experiment track was conducted there. We expect to make, from next year on, experiments with practicable and likely irregularities attached to rolling stock and track, and experiments with a train of rolling stock instead of single car. It is hoped that the causes of derailment will be fairly clarified, and more effective preventive measures will be worked out through the future tests, thereby paving the way for a derailment theory.

Oki, H (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 8 No. 4, Dec. 1967, pp14-17

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-378)
DOTL RP

A1 033420
JNR IMPROVING METHODS OF SUPPRESSING TRAIN OPERATION ACCIDENTS
Discusses the increase of railroad accidents, the contributory factors and steps which are being taken to eliminate them. Includes the prevention of grade crossing accidents by reducing the numbers, erection of warning devices, automatic train stop system, automatic signal and relay interlock plus devices to cut off power to catenary lines when an obstruction is present.

Akashi, T (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 6 No. 2, June 1965, pp10-12

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-384)
DOTL RP

A1 033430
THE STRENGTH OF FISH-BOLTS
A report on performance of hardened and non-hardened fish bolts, also bending-free bolts are included. Tests included the use of Vibrogir to determine the effect of vibration in the loosening of a rail-fish plate and bolt unit. Under the equivalent of a passage of 85 million tons, no looseness because of nut turning was found.

Umekubo, S (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 6 No. 2, June 1965, pp23-26

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-394)
DOTL RP

A1 033434
MEASUREMENT OF RAIL SURFACE CONDITIONS
The coefficient of adhesion is a major factor affecting the performance characteristics of railcars and locomotives. Adhesion characteristics of the locomotives themselves have been improved by modification of the truck structure, main circuit in electric locomotives, etc. Various methods were developed and examined in laboratory to determine the most dominating factors in rail surface conditions, wetness and contamination, and these methods were applied to the measurement of rail conditions in the field test of an electric locomotive.

Ueda, T Shiba, S Kobayashi, T (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 6 No. 3, pp45-46, 2 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-398)
DOTL RP

A1 033435
EFFECT OF WHEEL FLAT ON THE CAR VIBRATION
A series of running tests was performed with the prototype "B" train for the new Tokaido line. The object is to investigate the effect of the wheel flat on the car body and truck vibration. The data were expected to give a reference for design and maintenance of car, and to give a base for determining the allowable limit of the flat length in practical operation. The running speed was 200 km/h for the flat up to 90 mm, and 50 km/h for 110 mm. So far as the truck and car body vibration is concerned, flat caused more vibration at a low speed than at a high speed. So car vibration is not considered the most decisive factor limiting the allowable length of flat.

Matsui, N Miyoshi, K (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 6 No. 3, Sept. 1965, pp51

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-399)
DOTL RP

A1 033440
THE RESISTANCE OF THE PERMANENT WAY TO THE TRANSVERSAL STRESSES EXERTED BY THE ROLLING STOCK
The improvement of the stability of running of the rolling stock is certainly important. Is desired to increase the speeds of both the passenger and the freight trains. In the case of the latter, in which the general public is interested, the problems raised by increasing the maximum speeds from 120 to 140 km/h and even 160 km/h have been solved satisfactorily, and it is now question of going a stage further by reaching speeds of 200 km/h in current service.

Prud'Homme, A (French National Railways) *Rail International* Nov. 1967, pp731-766, 2 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-406)
DOTL RP

A1 033442
AXLE LOAD AND WHEEL DIAMETER CONSIDERED FROM THE ASPECT OF THE STRESSES ACTING ON THE MATERIAL OF WHEEL AND RAIL
This discussion is on the mechanical stresses of each wheel and each rail as part of the normal and tangential forces acting at the contact surface. Wheels wear and form "worn profiles" resulting in flatter curvature and lower stresses than in new profiles. As wheel diameters decrease, the load cycle or incidence of contact increases.

Kilb, E (German Federal Railways) *Rail International* Oct. 1967, pp663-668, 5 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-408)
DOTL RP

A1 033443
CALCULATION OF THE LONGITUDINAL STRESSES, ACCORDING TO VARIATIONS IN THE TEMPERATURE, IN A SECTION OF LINE LAID WITH LONG WELDED RAILS
A comparison of these various hypotheses and their simplified diagrams, shows that the elastic behaviour of the ballast has a great influence upon the distribution of the reactions which start in the sleepers as a result of a variation in the temperature. Seeing that all the sleepers have elastic displacements, we can no longer speak about the fixed part or "respiration length". If concerned with large plastic deformations, the length will be found to be smaller than that taken for the rigid behaviour of the ballast. The exponential distribution, corresponding to the elastoplastic behaviour of the ballast is the closest to reality.

Teodoresco, CC (Polytechnical Institute of Bucarest) *Rail International* Vol. 44 No. 10, Sept. 1967

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-409)
DOTL RP

A1 033445
STRESSES ACTING ON THE RAIL--RECENT FINDINGS
Increased axle pressures and reduced wheel radii give rise to higher stresses in the rail head. If the permissible shearing stress is exceeded, fatigue fractures will occur in the rail head. This can be counteracted by using a steel of greater strength and purity. Also of importance are the additional flexural tensile stresses at the lower edge of the rail head. This permits an indirect measurement of the guiding efforts.

Eisenmann, J (German Federal Railways) *Rail International* July 1967, pp537-550, 3 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-411)
DOTL RP

A1 033448
WHY METALS BREAK
To list some of the principal modes of failure at present known: 1 Collapse due to buckling or general yielding, 2. fatigue, 3. brittle fracture, 4. creep, 5. stress corrosion, 6. corrosion fatigue, 7. tearing or shear failure. This paper has endeavoured to list some of the failure mechanisms which can lead to fracture in metals, and to show that the tensile strength of the metal has virtually no significance in any of the important failure modes, although it may be useful as a simple basis for comparison between different steels or non-ferrous alloys. Photographs show failures of rail, axles, wheels and bogies.

Wise, S *Railway Division Journal* Vol. 2 No. 2, Mar. 1971, pp162-188, 7 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-418)
DOTL RP

A1 033723
DEFORMATION OF RAILWAY TRACK UNDER HIGH-SPEED TRAIN--MEASUREMENTS ON THE TEST-RUN SECTION OF THE NEW TOKAIDO LINE
In designing the new Tokaido line, many tests through actual operations of trains at high speed were conducted in parallel with model experiments, laboratory tests and theoretical analyses. Major items of measurement on the ground were rail deflections, rail stress, stress on fastening device, track vibration acceleration and sleeper stress. Major measured items on the car were wheel side thrust, wheel load, bogie stress, car body vibration, axle box vibration and similar forces.

Satoh, Y Toyoda, M (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 7 No. 2, June 1966, pp20-23

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-003)
DOTL RP

A1 033734
VERTICAL FORCED VIBRATION OF VEHICLE BODY AND VERTICAL WHEEL LOAD DIMINUATION DUE TO TRACK IRREGULARITY
A high speed passenger railway vehicle is designed to offer an agreeable riding comfort as well as to assure the safety running. Possibility of a high speed of 500 km/h, from these viewpoints, is examined by calculating the vertical acceleration and the change of wheel load. The results suggest promising possibilities of realization.

Matsui, N Arai, S (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 9 No. 3, Sept. 1968, pp169-170

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-178)
DOTL RP

A1 033735
MEMORANDUM DESCRIPTION OF DERAILMENT
A memorandum discussing a derailment includes the vehicles involved (4 diesel locomotives, 112 loaded and unloaded freight cars) and the probable causes of the derailment. The scene of the accident is described, list of possible causes, with each discussed in detail. Causes are not clearcut, but probably the rolling of an empty car, the wheel of one track on that car hitting a rail joint on the outer rail of a curve, the upward force from car roll, the bad joint caused the wheel to run over the rail causing the derailment. It is suggested that differences in rail height at joints be limited to 1/16 in. and rail wear be limited so that wheel flanges will not be raised by joint bars when hit by wheels with worn treads.
Unpublished data.

Magee, GM
Association of American Railroads May 1968, 8pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-190)
DOTL RP

A1 033736
FIRST PROGRESS REPORT LATERAL ACTION OF COMMON DESIGNS OF FREIGHT CAR TRUCKS HAVING AXLES WITH AND WITHOUT END COLLARS
The objective of certain instrumentation in the tests was to obtain fundamental information on the lateral action of different common designs of freight car trucks having standard and modified parts in the journal box assemblies, and having axles with and without end collars. It was desired to determine the motions of truck parts, and relation between these motions and lateral car body accelerations, and the origins of lateral disturbances to the car body, relative importance of these origins, and manner of transmission of these disturbances from the rail through the truck to the car body. A mechanical recorder was attached to one truck to obtain records

of the relative lateral movements of truck parts (axle, bearing, wedge, frame) at both ends of one axle, and records of the vertical and lateral displacements of both side frames relative to the bolster. The conclusions are as follows: The most important origin of lateral disturbance to the car body is the nosing of the wheel-axle assemblies and truck, due to coning of the wheel treads. The effects of axle end collars on truck action are to increase the activity of truck parts but to limit the forces transmitted through the truck. Increase of lateral clearance, which does not reduce the beneficial effects of axle end collars, should improve the lateral riding quality of conventional trucks with snubbers. Curved track produces a quieting influence on truck action and improves lateral riding quality. Definite improvement in lateral riding quality should result from the use of a device which would cause the car body to seek a centered position between lateral clearances.

Progress Report.

Association of American Railroads F4000, Dec. 1950, 51pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-197)

DOTL RP

A1 033741

THE ANALYSIS OF TRUCK FORCES ON CURVED TRACK

This report contains an analysis of the static, steady state forces on a four-wheel truck moving on curved track. The truck is used in the general sense to describe any four-wheel rigid wheel base of conventional truck size or as large as experimental four-wheel cars. This work should represent one phase of a program to attempt a rationalization of various truck phenomena. Appended to this report is an 8-part series of published articles: "The Mechanics of a Locomotive on Curved Track". These articles appeared in The Railway Engineer, 1934-1935.

Unpublished Data.

Johnson, MR Apr. 1957, 40pp, 8 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-240)

DOTL RP

A1 033742

TRACK-TRAIN DYNAMICS STUDY PROJECT TR-14 RAIL-VEHICLE INTERACTION STUDY--REPORT NO. 2 (COMPLETE ANALYSIS OF DATA USING COMPUTER TECHNOLOGY)

Following a description of the problem involved in preparing a hybrid computer program for the analysis and reduction of transient data taken in the actual field tests of the TRACK-TRAIN DYNAMICS STUDY PROJECT and an explanation of the computational approach, there is a description of the method of interfacing the digitized data with the digital computers used to obtain an in-depth engineering analysis of the results of the tests. The evaluation of the numerical data indicated that under controlled operating conditions, the L/V ratios were significantly repetitive, which fact can be helpful in future studies. However, the inability to measure the track lateral deflections simultaneously to obtain the combined effect of vertical and lateral displacements in the rail was a severe limitation, and it was not possible to derive any information concerning track stresses and probable damage due to high dynamic loads. Graphs and bar charts were developed from the computational results to show the relationship between speed, drawbar load and L/V ratios for locomotives and cars, and graphs were used to illustrate the accumulative distribution of dynamic rail deflections on various segments of the railroad where the tests were run. Parameters that were not included in the field measurements which could have possibly contributed to the establishment of a more definite pattern include: the relative velocity between instrumented cars, track curvature and truck hunting action and the cross-level of track.

Company Report.

Lind, EF Nuttrell, NW (Southern Pacific Company)
Southern Pacific Company Report 2, Apr. 1971, 104pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-251)

DOTL RP

A1 033743

JACKKNIFING OF DIESEL ELECTRIC LOCOMOTIVES REPORT OF THE JOINT COMMITTEE ON RELATION BETWEEN TRACK AND EQUIPMENT

A number of railroad companies had been reporting difficulties with diesel electric locomotives under buffing or pusher operation. This action was evidenced by lateral instability between the several units, especially those under the largest buffing forces and resulted in lateral displacements and lateral forces of such magnitude that the rails were turned over and derailments caused in some cases. To obtain as complete an understanding of the jackknifing action as possible it was decided to make measurements on both the locomotive and the track. A test location was picked on a right curve of 8 deg. 6'. The grade was 1.72 percent at the curve but within a mile became 2.20 and 2.40 percent so that part of the train on the steeper grade when the recordings were made. The rail was 131 lb. RE Section laid in 1946 and rather badly curve worn. The test locomotives were GP-7 Electro Motive general purpose road switchers. The following conclusions were drawn: Jackknifing is the result of lateral instability of the several units and its severity is dependent on the magnitude of the buffing force and the eccentricity of the force. It is evident the eccentricity of the force will depend on the amount of overhang and the clearance available for lateral movement. Reduction of the bolster clearance to a small amount improves the conditions sufficiently that operation is not excessively difficult. Lateral forces are reduced about 50 percent. Operation of the general purpose units with full bolster clearance and standard couplers under buffing forces is not practicable with four units and probably undesirable with three units. Forces of almost 25,000 lb were measured at 10 mph and 140,000 to 175,000 lb tractive force and higher forces can be developed at lower speeds or under impact conditions. These laterals applied continuously will be very detrimental to rail and wheels, cause journals to run hot, and may cause derailment. The use of the alinement control coupler attachments reduced the forces to a normal amount for the curvature of the test location. The lateral forces under full regenerative braking with alinement control couplers for an undetermined reason were a little higher in the few tests made than in the pusher operation which had twice the tractive force. However, they are still quite moderate. The jacknife position, once assumed, remains until the train is stretched out.

Magee, GM Keller, WM Ferguson, R (Association of American Railroads)
Association of American Railroads Rept. 10838, Jan. 1955, 21 pp, 2 Ref.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-290)

DOTL RP

A1 033850

RAILWAY TRACK STABILITY IN RELATION TO TRANSVERSE STRESSES EXERTED BY ROLLING STOCK. A THEORETICAL STUDY OF TRACK BEHAVIOUR. A PRACTICAL METHOD FOR DETERMINING THE RESISTANCE OF THE TRACK TO TRANSVERSE STRESSES EXERTED BY ROLLING STOCK

Part one studies the behaviour of railway track subjected to the stress of rolling stock and the experimental results on a test track with formulae for the pressures on the track through ballast or by rails through sleepers. Part two contains a computer solution to a fourth degree equation representing equilibrium equation of a track segment. Last, the interrelationship between rails, ballast, temperature and stress upon track behaviour are discussed.

Amans, F Sauvage, R (French National Railways) *Rail International* Nov. 1969, pp685-716, 2 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-334)

DOTL RP

A1 037204

STRESSES IN RAIL HEADS--COMPARISON BETWEEN THEORY AND EXPERIENCE [SCHIENENKIPFBEANSPRUCHUNG-VERGLEICH ZWISCHEN THEORIE UND PRAXIS]

This article describes the latest investigations into the problems of rail loading and stresses. Laboratory experiments with a plastic model of a rail are described, with the results charted. These are related to the tests and experience of the German Railways in their investigations of rail failures and damage. Charts are included which show the relations of the shearing stresses in the rail head to the wheel diameter and axle loading, the stresses increasing as the wheel diameter decreases or as the axle load increases. [German]

Eisenmann, J *Eisenbahntechnische Rundschau* No. 10, Oct. 1967, pp 355-361, 17 Fig, 4 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-465)

DOTL RP

A1 037208
LATERAL FORCES ACTING TO WHEEL, WHEEL LOAD, COEFFICIENT OF DERAILMENT AND BENDING STRESS OF WHEEL-AXLE OF THE CAR ON THE NEW TOKAIDO TRUCK LINE
The lateral force acting to wheel, wheel load, coefficient of derailment lateral acceleration of carbody and bending stress of wheel-axle were measured for the purpose of track maintenance and for the running safety. Data are shown graphically.

Nakamura, H Tanaka, S *Railway Technical Research Institute* Vol. 8 No. 2, June 1967, pp 103-106, 10 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-628)
DOTL RP

A1 037209
HUNTING PROBLEM OF HIGH-SPEED RAILWAY VEHICLES WITH SPECIAL REFERENCE TO BOGIE DESIGN FOR THE NEW TOKAIDO LINE
This paper describes the preliminary experiment on hunting by means of a model vehicle; the hunting tests of an experimental bogie and the prototype bogie at the rolling stock testing plant; a considerable amount of various hunting calculations carried out in the design stage; running test, with casual hunting observed, of the prototype bogies on the test track section of the new Tokaido line; and the construction of a bogie finally designed--and gives a number of major results with some discussion on the points to be considered. Elaborate running tests of six prototype cars were carried out on the test track section of the new Tokaido line. In designing this bogie, special attention was paid to the following two points to prevent hunting: (1) Mode of axle-box support and its stiffness: (2) Combination of frictional and elastic restoring force against bogie rotation. According to the running test at 246 km/h this bogie exhibited a very high running stability.

Matsudaira, T (Japanese National Railways) *Institution of Mechanical Engineers, Proceedings* Vol. 180 No. t 3F, 1965, pp 58-66, 6 Fig, 1 Tab, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-629)
DOTL RP

A1 037211
SOME ASPECTS OF THE HUNTING OF A RAILWAY AXLE
Equations of motion are derived to describe the hunting mode of a railway axle running at constant velocity along straight track. It is assumed that the wheel and rail-head profiles take some arbitrary shape. This shape gives rise to non-linearities in the equations. The equations are first linearized, and approximate expressions derived for the frequency of the oscillation and conditions of stability. Asymptotic stability for all initial conditions of the non-linear system is then considered in the manner of Aiserman, and the equations are examined for stable limit-cycle by applying the first approximations of Kryloff and Bogoliuboff. It is shown that, when running at low velocities, the axle will execute limit-cycle oscillations even though the wheel's flanges do not contact the rails. Small increases in velocity, however, quickly result in flange contact.

Brann, RP (London University College) *Journal of Sound and Vibration* Vol. 4 No. 1, 1966, pp 18-32, 6 Fig, 8 Ref, 2 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-631)
DOTL RP

A1 037213
LATERAL DYNAMICS OF RAILWAY VEHICLES
The fundamentals of lateral dynamics theory of railway vehicles is reviewed. Numerous topics are presented, including: stable running theory, longitudinal creep, forward speeds, sinusoidal path, forces acting, hunting, conditons for stability, critical speeds, profiled wheels, suspension, coned and profiled wheels, wear of trends, vehicle design, and track geometry.

Wickens, AH (British Railways Research Department) *Railway Gazette* Vol. 121 Dec. 1965, pp 987-990, 4 Fig, 2 Phos, 14 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-633)
DOTL RP

A1 037219
TRACK LOADING FUNDAMENTALS--4 CURVED TRACK AND LATERAL STRENGTH
Various factors affecting the design of curves are examined. These include ballast depth, flange forces exerted on curves, lateral strength of curved track, and track slewing. It is pointed out that the lateral strength of track depend chiefly on sleeper spacing, quality and depth of ballast and quality of roadbed. Track slewing can be retarded by using heavier rail to maintain alignment, laying stone ballast, reducing sleeper spacing, or by using metal sleepers selectively on curves.

Clarke, CW *Railway Gazette* Vol. 106 Feb. 1957, pp 220-221, 1 Fig, 4 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-639)
DOTL RP

A1 037221
TRACK LOADING FUNDAMENTALS--6 TRACK DESIGN RELATED TO BRIDGE LOADING
Track design is discussed in terms of its relationship to bridge loading. Wheel loads are computed for various British-Unit bridge loadings. It is shown how track can be designed in accordance with B.U. loading, whereby rail section and ballast depth for given sleeper sizes and spacings can be determined to carry vehicles at the speed for which the bridges were designed.

Clarke, CW *Railway Gazette* Vol. 106 Mar. 1957, pp 335-336, 1 Fig, 5 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-641)
DOTL RP

A1 037229
WELDED RAIL JOINT FRACTURES AND THEIR EFFECT ON 200 KM/H OPERATION
JNR conducted a series of tests to determine the effect of broken welded rail joints on trains running at high speed. A rail gap of 20 to approximately 30 mm was employed since this was considered the likely amount just after a rail fracture in winter on the New Tokaido Line. The train used for this test consisted of six 2-axle bogie type electric rail-cars with an axle-load of 15 tons. Items measured included: rail deflection, rail stress, stess on the fastening device, track vibration acceleration and sleeper stress and the like; most of these were measured using wire strain gauges. On-the-rolling-stock measurements included: wheel side thrust, whee load, bogie stress, car body vibration, axle box vibration and similar forces. The results of the test indicate that train operation on the New Tokaido Line is judged as completely safe from the point of view of possible broken welded rail joints, in that even the lateral discrepancy of ends of the broken rails and wheel side thrust at the train passing the broken point were found to be less than 1/2 of respective maximum limits for safe train operation, and values for car body vibration and other items were also found to be sufficiently small.

Matsubara, K (Japanese National Railways) *Railway Technical Research Institute* Vol. 15 No. 3, Sept. 1964, pp 21-24, 8 Fig, 4 Phos

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-650)
DOTL RP

A1 037235
DERAILMENT OF ELECTRIC PASSENGER TRAIN
The derailment of the last coach of an electric multiple-unit down passenger train on December 13, 1963, which subsequently came into glancing contact with the side of another passenger train, was caused by axle fatigue. This fatigue would have been detected if the prescribed frequency for ultrasonic inspection had been observed. It was suggested that no axle be tested less frequently than every 18 months. One passenger was killed and 31 injured.

Robertson, JRH (Ministry of Railroads, England) *Railway Gazette* Vol. 120 Nov. 1964, pp 953

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-931)
DOTL RP

A1 037246
INQUIRY INTO DERAILMENTS ON THE VICTORIAN RAILWAYS
This summary of a committee of Public Accounts inquiring into derailments during the years 1954-1964 examines the incidence of hot boxes, fracture of axle-box guides, track defects, mileage and ballast with total derailments.

The conclusions were that the recent increase in freight trains derailments was due to the use of four-wheel wagons and poor track conditions on low traffic country lines. Also, cross ties were in poor condition on some lines, and ballast was inadequate.

Railway Gazette Vol. 121 Sept. 1965, pp 688-690, 5 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-942)
DOTL RP

A1 037247
RAIL FAILURE DETECTION IN THE UNITED STATES
The major components of inductance, residual magnetic, and ultrasonic instruments for detection of flaws in rails are described. The Association of American Railroads report for 1964 correlated the drastic reduction in service failures due to transverse defects with the success in controlled cooling of the rails during manufacture, although the number of failures detected using the above NDT methods remained fairly constant. It was concluded that the $400,000 cost of the flaw detection services was well worth while in the USA, but could not be justified in the United Kingdom due to the use of different steel for the rails.

Railway Gazette Vol. 121 Aug. 1965, pp 665-666, 1 Fig, 4 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-943)
DOTL RP

A1 037249
TRACK STRESS RESEARCH
The purpose of this work was (1) to verify the speed allowance formula, (2) to investigate the increment of stress over and above the static effect under normal conditions from track defects, (3) to investigate the conditions of support at rail joints, (4) to investigate the stability of ballast, and (5) to investigate the effects on rails and sleepers of the lateral forces set up by the hunting movement of locomotives. In regard to (1) and (2) it was found that experimental static deflections and stresses are in reasonably close agreement with calculated values. In regard to (3), it was concluded that stronger fishplates are needed to facilitate maintenance and rail joints of inadequate strength are the cause of much of the impact effect. Increasing the number of sleepers will reduce this impact effect. In regard to (4), the shape of the sleeper was found experimentally to have no noticeable influence on its deflection under a given load, but stress distribution between the sleepers and subsoil requires investigation. In regard to (5), further investigation on curved track was recommended to confirm the consideration that design to rolling stock to reduce nosing on the sharper main-line curves would reduce the secondary stresses and thus offset the increased stress due to centrifugal effects.

Gelson, WE Blackwood, FA (Railway Department, India) *Railway Gazette* Vol. 73 Feb. 1940, pp 254-255, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-945)
DOTL RP

A1 037254
DERAILMENT AT KENTISH TOWN
The accident report describes the incident of derailment of an empty freight train and the consequent collision with a passenger train. Cause of the derailment was due to part of the brake rigging on the leading bogie of the fourth coach striking and operating an economic facing point lock with the result that the trailing bogie and following coaches took the wrong route. Evidence showed that the trailing end of the brake pull rod of the coach had been dragging along the track during an overnight journey. The pin which should have secured the pull rod to the fulcrum lever was missing, and both safety loops were broken. An on duty coach examiner improvised safety loops of wire. Conclusions reached were: (1) the improvised safety loops were ineffective, (2) the examiner made error in judgment in not removing the brake pull rod completely from the bogie, or at least releasing the brakes on the coach before securing the pull rod, (3) failure of R.R. staff to detect broken safety loops indicates examination of the train was not adequate.

Railway Gazette Vol. 123 Dec. 1967, p 959

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-952)
DOTL RP

A1 037262
TOKAIDO LINE STANDARDS, TEST LENGTH AND TRIALS
Various characteristics of the New Tokaido Line are presented, including track, tunnel and bridge construction, bogie design, and passenger and track inspection vehicles. Testing of rolling stock at 124 mph prior to the opening of the Line revealed wheel side thrust to be only 3-4 tonnes and lateral and vertical vibration accelerations of 0.2 g and 0.3 g respectively.

Railway Gazette Vol. 118 No. 11, Mar. 1963, pp 209-301, 5 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-969)
DOTL RP

A1 037274
ACCIDENTS ON BRITISH RAILWAYS IN 1960
A comparison of accidents, deaths, and equipment failures for the years 1959 and 1960 show that there were a total of 1213 train accidents in 1959 (1175 in 1960). Out of these, passenger and freight trains were involved in 416 in 1959 (415 in 1960). The total accidents at level crossings were 231 (1959) and 242 (1960). Deaths at level crossings totaled 37 (1959) and 35 (1960). Railway personnel deaths were 160 (1959) and 143 (1960). Failures, including engines, couplings, and rails amounted to 1271 in 1959 and 1395 in 1960.

Railway Gazette Vol. 115 Nov. 1961, pp 562-563

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-981)
DOTL RP

A1 037296
FLAT-BOTTOM RAIL DEFECTS
In 1944, 38,708 transverse fissure failures were reported, of which 31,781 were discovered in advance of actual failures by patrolling detector cars, and 6,927 were in rails that broke in the track, in certain cases with disastrous results. The use of flat-bottom rails in Great Britain will increase the need to control the cooling process during formation of the rails. The British medium manganese rail is less susceptible to fissure failure due to its lesser carbon content, 0.6 percent carbon in British rails compared to 0.7 to 0.8 percent in U.S. Rails. In the U.S. a troublesome defect is the shelling or flaking of rails on the gauge corner of the head. This problem is prevalent on the high rail of curves where traffic conditions are severe. No direct connection has been found between the chemical composition of rails and their susceptibility to shelling, except in so far as the hardness of the steel is affected; heat-treated rails and rails containing 3 percent of chromium have given better results than rails of standard composition. Water quenching can produce weeping cracks in steel. Steel with Brinell hardness after end quenching in the range 360 to 375 were not susceptible to weeping cracks. There is a continuing need for a fishplate steel of reduced notch sensitivity. High manganese alloy fishplates have given good results, but are costly.

Railway Gazette Vol. 85 Sept. 1946, p 345

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1159)
DOTL RP

A1 037300
LATERAL TRACK STABILITY TESTS
On January 15, 1966, an Illinois Central train south bound near Barkley Dam, Kentucky displaced the track without derailment under the loaded train. The train consisted of five locomotives, one of them isolated with 140 cars loaded mainly with coal and 53 empty totaling 14,999 gross tons. The train displacement was 10 inches off line. The train was braking due to a shallow decline at the displacement. This series of memos describes the displacement and the design and results of tests to determine the displacement face necessary to move the track 1/4 and 1 inch. A conclusion is not reached as to the cause of the displacement. Two opinions are given as to possible causes.
Unpublished Memos.

Leroy, HD (Illinois Central Gulf Railroad); Hinueber, GL Smith, R (Association of American Railroads)
Association of American Railroads 41 pp, 22 Fig, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1163)

A1 037306
RAIL FAILURES
A train, travelling at slow speed on the down line between Tweedmouth and Kelso in 1941, was derailed by a rail broken in 12 pieces. The rail, laid in 1890, was a 90-lb one, with an average yard weight at the time of the accident of 83 lb. It was situated inside a 19-ch. curve, provided with check rails and 3 in. of super-elevation. Slipping with a heavy load when accelerating from rest was the cause of the rail failure. The heat generated by the slipping was estimated to reach about 700 C. Slipping had occurred over a several week period, but was most pronounced within two days of the derailment. Sections of the rail were subjected to falling weight tests. One piece dropped with the head up broke at 7 feet. The other piece dropped head down, broke at 1 foot.

Railway Gazette Vol. 80 Feb. 1944, p 110

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1292)
DOTL RP

A1 037308
HOW RAILS BREAK
The manufacturing defects described are in ingots; in rolling methods; a transverse fissures, the fractures caused by stresses set up in cooling. The failures described arising from service conditions may be caused by excessive wear; fatigue or impact; rail-end batter; corrosion in tunnels, at water troughs, or at wet ashpits; slipping by wheels; faulty heat treatment, welding or cutting; corrugation; or war damage. Rail failures in India in 1929 due to rolling defects resulted in the use of impact testing on the side of the rail-head being added to test specification. The temperature equalization scheme adopted by British mills in 1928 to avoid transverse fissures is given.

Dinsdale, C (London North Eastern Railroad) *Railway Gazette* Vol. 80 Mar. 1944, p 213

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1294)
DOTL RP

A1 037420
PURPOSES AND REQUIREMENTS OF TRACK INSPECTION AND MEASUREMENT
This is the first part of a two-part study prompted by recent interest in automated inspection devices and systems. This first portion, deals with the general questions about inspection such as why is track inspected, what is being looked for, when and how often inspection should be done rather than how it should be done. The first is as a fundamental guide to procedures and purposes of inspection, and for an examination of what may or may not be wrong about the way inspection is now being performed. The track materials inspection should include: the load bearing function of the track; the effects of loading on deformation and rupture and wear and abrasion, and on fatigue; and the environmental effects. The present inspection methods are given for rail, cross ties, switches, turnouts, crossings, and ballast.

Way, GH
Chesapeake and Ohio Railway Tech Rpt 71-103, Feb. 1971, 74 pp, 3 Fig, 3 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-485)
DOTL RP

A1 037444
ONE-MAN PORTABLE MITSUBISHI TRANSISTORIZED CRACKMETER
Mitsubishi's Type CM-2 all-transistorized crackmeter is designed to be handled easily by one operator. Providing both visual and aural confirmation of defects at rail joints, it can pinpoint flaws without removal of the fishplates. Ammeter registration of approaching trains is an added safety feature. It can be used on rails of different widths by a simple screw adjustment.

Railway Gazette Vol. 125 May 1969, p 24, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-851)
DOTL RP

A1 037445
DETECTION OF RAIL FAULTS ON SNCF
French National Railways methods of magnetic examination of rails in service are so successful that 95 percent of all rails lifted in 1967 for transverse cracks were as a result of inspections made on only one-sixth of the main lines. The development of transverse cracks in the rail head generally follow an exponential law related to the traffic carried. A transverse crack increases by 10 percent of the section of the rail head and with an initial detection at 55 percent by the electromagnetic process, the risk of breakage is reached when about 15,000 tons have passed over the track.

Deutsch, R (French National Railways) *Railway Gazette* Vol. 125 Sept. 1969, pp 459-464, 3 Fig, 10 Phot, 3 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-852)
DOTL RP

A1 037455
RAIL DEFECT TESTING IN THE UNITED STATES
Over 130,000 miles of track are tested annually in USA by the Sperry fleet of 25 self-propelled test cars. A new and highly efficient ultrasonic detection system was developed which is capable of finding most cracks and flaws in the joint area. Details are reported. As part of its service Sperry Rail Service has compiled and published a comprehensive manual of rail defects, covering subjects from history and methods of rail manufacture to causes of rail defects and classifications of every known rail defect. This Rail Defect Manual is furnished free to any railway.

Railway Gazette Vol. 125 Mar. 1969, pp 180-184, 4 Fig, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-865)
DOTL RP

A1 037458
SURVEY OF RAIL FAILURES ON JNR
JNR examined 675 faulty rails as part of a comprehensive study of rail failures in Japan. This article examines some of the findings in relation to type of failure and cause. Sections are devoted to transverse cracks, vertically-split webs, impurity distribution, shatter cracks, tensile tests, heat treatment methods, chemical composition, and cold shortness. Photographs show some of the problems encountered.

Railway Gazette Vol. 124 July 1968, pp 505-508, 1 Fig, 1 Tab, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-874)
DOTL RP

A1 037461
SETBACK IN BR SAFETY RECORD FOR 1967
The marked increase in the number of freight train derailments, from 1963 to 1967, is attributed to the rapid changeover from steam to diesel locomotives hauling unbraked or partially-braked trains consisting largely of old short-wheelbase four-wheel cars. The British Railway is retiring the short-wheelbase, four-wheel cars and replacing jointed track with continuously welded track to reduce accidents.

Railway Gazette Vol. 124 Dec. 1968, p 897

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-912)
DOTL RP

A1 037471
DERAILMENT NEAR HITHER GREEN
An express passenger train, consisting of two six-coach diesel-electric sets, derailed near Hither Green at about 70 mph, when the leading pair of wheels of the third coach struck a wedge-shaped piece of steel that had broken away from the end of a running rail, and became derailed. The initial derailment was caused by the fracture of a rail as the train was passing over it. The fracture was caused by excessive working of the joint resulting from unsatisfactory support conditions including: inadequate clean ballast under the two original concrete joint sleepers; the absence of a rubber pad under the rail seat; and substitution of a wood sleeper for the running-off concrete sleeper which cracked because the pad was missing. Due to unsatisfactory track maintenance, a speed restriction of 60 mph was placed on the track.

Railway Gazette Vol. 124 Oct. 1968, p 753

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-880)
DOTL RP

A1 037477
DERAILMENT NEAR AMBLE JUNCTION
The train, travelling at 75 mile/h, became derailed at a broken rail. A piece had broken away from the head of the six-foot rail at the running-on end. The rail had also broken completely about 8 in. from the end. All eight keys for four sleepers on the approach side of the joint, and the cess rail keys for the first four sleepers beyond the joint, were out and lying beside their chairs. Examination of the broken rail stated that the 95 lb/yd bullhead rail had broken to detach a piece of the head and a section of the web and foot. Both fishing surfaces were highly polished, indicating that the four-hole fishplate had been working for some considerable time. The small flaw at the upper fillet radius of the rail end would be impossible to detect with the Audigage instrument because of its small area. Similarly a crack less than 1/4-in. in extent is unlikely to be found at the bolt hole.

Railway Gazette Vol. 124 May 1968, p 353

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-824)
DOTL RP

A1 037478
COLLISION AT ST. ANNE'S PARK
A collision between two passenger trains in the Western Region of British Railways was the direct result of irregular block working on the part of the signalman at Bristol East Depot Main Line. This accident would not have occurred if full block controls including one acceptance control had been installed on the down line. This control requires the berth train circuit at the outermost stop signal to have been occupied and cleared before a second line clear can be given.

Railway Gazette Vol. 124 May 1968, p 353

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-825)
DOTL RP

A1 037481
BROACHING HOLES IN RAILS
Anything that can be done to reduce bolt hole stresses will increase the fatigue life of rails. The perfect result is achieved by completely eliminating fishbolt holes. Four methods of improving fishbolt holes are: 1. careful drilling to produce holes of smooth fish; 2. radiusing the edges of the holes; 3. reducing the diameter of the holes; 4. work hardening the internal surface of the holes. Work hardening the hole is achieved by forcibly increasing its diameter after the initial drilling. The fatigue strength of the drilled rails is improved by at least 25 percent by work hardening.

Railway Gazette Vol. 124 Nov. 1968, p 892, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-907)
DOTL RP

A1 037593
TRACK STRESSES AND VEHICLE MOTION AT HIGH SPEEDS
The high speed test runs made with the locomotives E 10 299 and E 10 300 and 8 wheeled track recording cars and passenger cars are described. Extensive measurements were made of the stresses to which the track is subjected at train speeds of 140 to 200 km/h, and of the dynamic wheel loads and lateral pressures against the rail, as well as the effect of these forces on the roadbed. The results of these tests on curved and straight track are given and illustrated by charts. The present usual track structure will suffice for the high speed operation. The minimum radius of curvature should not be under 1890 meters. Continuous welded rail improves the riding qualities in high speed operation. A desirable riding comfort level is attained in the passenger cars at 200 km/h speeds.

Birmann, F *Eisenbahntechnische Rundschau* Vol. 14 No. 8, Aug. 1965, pp 335-351, 49 Fig, 2 Tab, 9 Phot, 15 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-478)
DOTL RP

A1 037597
THE NATURE, MAGNITUDE, AND FREQUENCY OF LOADS AND FORCES APPLIED TO RAILROAD ROADBED
The magnitude, nature and frequency of loads imposed on railway roadbed by track structures and by traffic on the track structure is summarized for use by engineers in designing alternate types of roadbed construction. An SD-40 locomotive was studied to test severe loads Magnitude of reactions in the roadbed depends not only on the loads themselves but also in the spacing of the loads and the type and composition of support. In conventional track, the contact pressure on the bottom of a tie is not uniformly distributed either laterally or longitudinally. The total load on an individual tie depends on track conditions, size and distribution of load, and size, spacing and condition of the ties. There are traditionally two ways of handling impact loads, i.e. "equivalent static load" and "energy load." Of the two, "equivalent static load" is usually given for railroad situations and will be used here. Longitudinal loads come from inherent stress (from manufacture and laying of rails), reaction to locomotive traction, wheel flange friction and braking, thermal rail stress, and longitudinal component of train weight on grades. The longitudinal component of train weight can be calculated statistically knowing gross weight, grade, length of train, etc. Fortunately, this load is not concentrated but is spread out over a considerable distance. With conventional track construction the perpendicular component of train weight increases the frictional restraint of ties in ballast so that this is of little consequence. Longitudinal loads applied to the track by traffic have been the subject of considerable study in both this country and Europe. They are difficult to analyze because they are affected by so many variables, and uncontrolled variables at that. Transverse, or lateral, forces are particularly important since if they exceed roadway resistance they cause unstable alignment or buckled track and likelihood of derailment. Mathematical calculations show the rail reaction for the SD-40 on 122 lbs rail.

Way, GH
Chesapeake and Ohio Railway, Baltimore and Ohio Railroad Tech Rpt May 1967, 22 pp, 7 Fig, 2 Tab, 9 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-483)
DOTL RP

A1 037598
LATERAL RAIL FORCES DUE TO VARIOUS LOCOMOTIVE AND TRAIN CONSISTS
A series of tests was performed to determine the lateral forces developed by various types of locomotives and train consists. Analysis of the data indicates that no excessive lateral forces were developed by any of the test consists. The maximum average force, 7,400 pounds was developed by the T.P.F.C. freight. The effect of roadway irregularities on lateral forces generated by normal consists remains largely unknown. Based on the results of this test series, it is concluded that light locomotive, passenger and freght consists generate relatively low lateral force on good roadway. There is a slight reduction in maximum lateral forces as training tonnage is increased. A study of the available research literature on the forces required to overturn rail shows that the maximum pressures measured were about 30% of the forces theoretically needed.

Luebke, RW
Chesapeake and Ohio Railway, Baltimore and Ohio Railroad Test Rpt Apr. 1967, 14 pp, 8 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-484)
DOTL RP

A1 037608
MAUL BLOWS ON WEBS CRACK RAILS AT LOW TEMPERATURES
The fact that the webs of rails can be fractured readily in cold temperatures by heavy spike maul blows has been demonstrated by laboratory tests. These tests in which rails were chilled to a temperature of 20 deg below zero and then struck on the web with a spike maul while at temperatures ranging from 13 deg below zero to 25 deg above zero, point to the danger of heavy blows on the web of a rail, particularly under low temperatures, at any time during its life. The second series of tests were made for the purpose of determining to what extent if any rail design might influence the development of cracks from spike maul blows. Summarizing this second series of tests, it was observed that cracks were produced in one or more specimens of all rail sections included in the tests. Concerning all of the tests, it is of interest to note that cracks were produced irrespective of the branding, stamping, rail position in the ingot or rail section. "It may be concluded from these tests that it is entirely possible to produce cracks in the rail web by striking the web a heavy blow when at a low temperature."

Railway Engineering and Maintenance Dec. 1944, 2 pp, 1 Tab, 7 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-508)
DOTL RP

A1 037616
THEORETICAL OBSERVATIONS OF RAIL HEAD STRESSES AT POINT OF LOADING
The author presents a theoretical treatment of the stresses in rail heads resulting from both vertical and lateral pressures, as well as the oblique loading from imposed wheel loads, including the torsional as well as the vertical and horizontal stresses. Specific attention is directed to the "S 49" and "S 54" rail sections.

Eisenmann, J *Eisenbahntechnische Rundschau* Vol. 14 No. 1-2, Jan. 1965, pp 25-34, 16 Fig, 16 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-517)
DOTL RP

A1 037617
TRACK WARPING OVER A FINITE LENGTH
The author presents a theoretical study of the distortion of an infinite length of track subject to critical rail temperatures in wave lengths of various patterns, as applied to track of finite length as continuous welded rail, under the influence of high ambient temperatures.

Schweda, F *Eisenbahntechnische Rundschau* Vol. 14 No. 1-2, Jan. 1965, pp 44-48, 4 Fig, 2 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-518)
DOTL RP

A1 037618
ULTRASONIC TESTING OF RAIL--EXPERIENCE AND IMPROVEMENTS
The author discusses improvements in the methods of ultrasonic testing of rail for defects and flaws on the German Federated Railways, giving details of the present state of the art in the new test equipment, and reviewing the knowledge accumulated. Possible improvements in the testing techniques are discussed, including the need for doubling, at least, the speed presently required for this testing of rails.

Egelkraut, K. *Eisenbahntechnische Rundschau* Vol. 14 No. 1-2, Jan. 1965, pp 49-59, 15 Fig, 11 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-519)
DOTL RP

A1 037629
LONG WELDED RAIL INVESTIGATIONS
The Western Region of British Railways has been carrying out valuable investigations into the behavior, control, and economic factors relating to long continuous lengths of welded rail. The test lengths of long welded rail in South Wales were subjected to apparatus for measuring and recording movements of the rail. Nine pairs of instrument stations 100 yd. apart were initially established with recording instruments grouped at a central point. The behavior of the track recorded was mainly longitudinal movement due to changes in temperature but transverse movement was also registered. Laboratory static tests were for resistance to longitudinal movement of a rail through its fastenings, and a dynamic testing machine was also evolved for equating track loading and deflection under the equivalent of the passage of a locomotive at 60 mph. Long continuous rail lengths carrying fast traffic must be provided with ample ballast and a firm foundation. Maintenance must be to a first-class alignment and special attention must be paid to the maintenance of the fastenings. More accurate means of costing maintenance will also have to be devised for ascertaining the economics of long welded rails.

Railway Gazette Vol. 106 Apr. 1957, pp 472-473

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-531)
DOTL RP

A1 037636
WELDED RAIL IN THE U.S.A.
The elimination of rail-joint maintenance is claimed to be more than covering the additional cost of welding, transporting the welded strings to site, and handling them. In general, few troubles have been experienced. Expansion and contraction at the ends of welded strings has been little more than normal, and has been restrained by increasing the number of rail anchors applied over the last six lengths of rail (234 ft) at the end of each string. Given proper anchorage, no trouble is experienced with buckling, but that considerable care has to be exercised as to the temperatures at which continuously-welded rail is surfaced.

Railway Gazette Vol. 107 July 1957, pp 65-66

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-538)
DOTL RP

A1 037647
SYSTEMATIC DETECTION OF RAIL DEFECTS IN U.S.A.
The Missouri Pacific Lines have increased the daily mileage of a Sperry detector car from 21.1 to 30.0, and its annual mileage from 6,188 to 9,074. Annual examinations are made of 55 percent, or 4211 track miles, of the total rail system. Rail inspection statistics are given for the years 1931 to 1939, including: transverse fissures detected; longitudinal fissures detected; other defects; total defective rails; and average defects per track mile.

Railway Gazette Vol. 76 Jan. 1942, pp 159,166, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-550)
DOTL RP

A1 037652
LONG-WELDED RAILS ON EAST COAST MAIN LINE
The first long-welded rails on the East Coast main line were laid on a section of line where a continuous stretch of almost a mile now exists. Normal 60-ft. rails were first flash butt welded into 300-ft. sections. On the site, the ends of the rails to be joined together were held in a mold and heated. A mixture of powered metal and magnesium was ignited and the powered metal melted into the gap between the rail-ends. The mold was knocked off as soon as possible and spare metal trimmed by cold chisel and grinder. Each weld took about 45 min. to complete.

Railway Gazette Vol. 107 Nov. 1957, p 594, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-556)
DOTL RP

A1 037657
LONG WELDED RAILS
A survey was taken to determine the uses and value of long welded rails, their manufacturing and laying techniques, and maintenance. The results were reported to the Seventeenth International Railway Congress. The maintenance costs are at least 15 percent less for the welded rail than for conventional track. The most suitable length for welded rail and anti-creep devices are discussed. Isolated cases of breakage due to welded defects, buckling due to disregard of temperature regulations of poor ballasting, and creep due to thermal stress are cited.

Railway Gazette Vol. 109 Aug. 1958, pp 242-243

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-564)
DOTL RP

A1 037669
"FROZEN" RAIL JOINTS
The Delaware and Hudson, on its main line stretching from Albany, New York, to Montreal, has experimented with frozen joints for continuous-welded rails. For frozen joints, the rails are laid tight, allowing for no expansion at the joints. The elimination of joint maintenance is a main argument in favour of welding into long lengths. The weld itself is expensive, not to speak of the extra cost of handling the long lengths of "ribbon rail." Furthermore, if a rail is damaged, it can easily be replaced, whereas with ribbon rail the section damaged has to be cut out. There may be extensive potential maintenance economics to be effected by laying rail tight with frozen joints.

Railway Gazette Vol. 108 Feb. 1958, p 180

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-582)
DOTL RP

A1 037674
LONG-WELDED RAILS
A comparative study of methods for welding very long rails was made for Great Britain, South Africa, New Zealand, Australia, Sweden, Japan and the U.S.A. The use of long rails is largely experimental and no definite policy has been reached as to the length of section to be laid with them. Wood, steel, and concrete sleepers are being used and their numbers vary from 1,240 to 1,920 per km. Methods of fastening the rails to the sleepers include dog spikes, elastic spikes, clips and bolts, and cast iron chairs with keys. The most favored method of manufacturing long-welded rails is by flash-butt welding in the depot into transportable lengths and then by thermit welding into long sections on site.

Jackson, F (South African Railways & Harbours) *Railway Gazette* Vol. 108 May 1958, p 622

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-587)
DOTL RP

A1 037677
SPECIAL COMMITTEE ON CONTINUOUS WELDED RAIL
Rolling-load tests were made of specimens of continuous welded rail in the 12-in stroke machine on four acetylene welds, 4 electric welds, and 4 thermit welds. All of the thermit welds failed in this test. One acetylene weld also failed just below 2 million cycles. Other rolling-load tests were made in a 33-in. stroke rolling machine primarily to test the welds in the rail bases. All the acetylene and electric welds ran to over 2 million cycles without failure. Two thermit welds developed failures in the rail heads. A few other observations on possible causes of weld failures are listed, including grinding burns electrode burns, and cases where the flame goes out in oxyacetylene welding. The fastenings subcommittee reports five methods used to anchor welded rail across open-deck steel viaducts or long deck steel spans.

Cramer, RE (Illinois University); Wise, E, Jr *AREA Bulletin* Vol. 59 Feb. 1958, pp 895-904, 3 Tab, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-590)
DOTL RP

A1 037683
FURTHER THREE-DIMENSIONAL PHOTOELASTIC STUDIES OF STRESSES IN RAIL HEAD DUE TO WHEEL CONTACT PRESSURE
A transparent model of a rail head about two-thirds scale was constructed and tested. The model testing showed that the three principal stresses are compressive immediately under the wheel, but as we go away from the wheel both to the right and to the left, all these compressive stresses become tensile. The main difficulty in this study was not studying the stresses in the model of the rail head or the rail, but rather from the difficulties of interpreting the meaning of the stresses in relation to shelly rail failures, or failures in general.

Frocht, MM (Illinois Institute of Technology) *AREA Bulletin* Vol. 60 1959, pp 1167-70

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-597)
DOTL RP

A1 037686
MEASUREMENT OF RAIL HEAD WEAR
A novel method of rail wear measurement is being used on the London Midland and Scottish Railway in order to compare rails of special composition or rails which have been specially treated to increase resistance to wear. The apparatus is simple, and consists of a jig formed to the contour of the part of the rail to be measured, and a dial gauge reading to 0.5 in. by 0.001 in. graduations. The actual gauging can be done at the rate of about one minute per section.

Railway Gazette Vol. 73 Aug. 1940, p 228, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-600)
DOTL RP

A1 037691
VEHICLE DESIGN RELATED TO TRACK CONDITIONS
Recommendations which may influence improvements in the safety and comfort of passenger-train rolling stock are made in a paper, Vehicle Suspension and Bogie Design in Relation to Track Conditions, by Mr. R.M. Hancock of British Railways. The paper deals with the necessity of relating vehicle suspension and bogie design to the track conditions likely to be encountered in practice, particularly where lateral and crosslevel wave shape are concerned, as these are most likely to produce discomfort. The vehicle-response basis of systematic testing main routes as carried out with the Western Region track-testing car has provided much of the experience from which the illustrations in the paper are drawn. The effects of coning and track shape, in relation to the riding of four-wheel vehicles, are considered with reference to an investigation of their derailment in fast trains.

Hancock, RM (British Railways) *Railway Gazette* Vol. 110 Apr. 1959, pp 445-446

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-605)
DOTL RP

A1 037692
LATERAL FORCES BETWEEN WHEELS AND RAILS, AN EXPERIMENTAL INVESTIGATION
The paper deals with a new method of measuring continuously the lateral forces between the wheels and the rails over long distances. Fundamental knowledge concerning these forces has been obtained both from studies of the results from short test runs and from statistical assessments of the results from long sections of the Swedish railway network. Since the tests are concerned only with a single locomotive, the results should not be generalized. It is clear, however by means of the individual diagrams of curve forces as well as the statistical evaluation of about 40 curve runs, that the lateral forces between the rails and the wheels of the leading axle are on the whole substantially greater than the resulting force on the permanent way. This factor should be all the more noticed, since the utilized friction coefficient can assume such unexpectedly high values, as is shown from the measurements.

Presented at ASME-AIEE Railroad Conference Pittsburgh, Pa., April 20-21, 1960.

Olson, PE Johnsson, S (Swedish State Railways)
American Society of Mechanical Engineers Paper 60-RR-6, Apr. 1960, 8 pp, 19 Fig, 1 Tab, 2 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-606)
DOTL RP

A1 037694
THOUGHTS OF A CURVE DERAILMENT
The derailment of the New York Central New York to Chicago express on April 19, 1940, at Little Falls curve is described. The train was about half-way around the curve travelling 14 mph in excess of the stipulated limit when derailment occurred. Speed alone was not responsible for the accident. A locomotive inspector had instructed the driver to brake. It is believed that the driver either became confused and closed the throttle or applied the brakes which slowed the locomotive much slower than the remaining train and caused the jack-knife action between the engine and tender.

Railway Gazette Vol. 74 Apr. 1941, 3 pp, 1 Fig, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-608)
DOTL RP

A1 037709
CONTROL OF TRACK IRREGULARITIES IN JNR
The existing rules in Japan regulating track irregularities are given. Inspection cars and techniques used for examining track are described. Recommendations are made for revisions of track irregularities limits considering their effect on safe operation, riding quality, and economic aspects.

Ban, Y (Japanese National Railways) *Japanese National Railways* Vol. 4 No. 4, Dec. 1963, pp 30-32, 2 Tab, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-627)
DOTL RP

A1 037710
THE EFFECT OF LONGITUDINAL FORCES ON CONTINUOUSLY WELDED TRACK AND ON TRACK BALLAST
The properties of the ballast under the influence of longitudinal forces or longitudinal stresses in continuously welded track are discussed. The first

part of the paper deals with the different causes of longitudinal stresses. The second part is concerned with research on the mechanical properties of the ballast. From theoretical considerations and on the strength of test results, characteristic data for the resistance to longitudinal displacement are obtained. The third part deals with measurements of rail stresses encountered in tracks under traffic. A description is given of investigations based on train braking tests on continuously welded track.

Sickmeier, EW (Hanover Technical University) *Rail International* July 1965, pp 446-489, 20 Fig, 8 Tab, 3 Phot, 53 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-671)
DOTL RP

A1 037712
LANDSLIDES
Replies to 12 questionnaires on landslides returned from U.S. and Canadian railroads are summarized. The responding roads represent 24 percent of the line mileage in the two countries. Direct annual maintenance costs due to landslides are reported for each railroad. An estimation is made both of average direct maintenance costs for all U.S. and Canadian railroads due to landslides and an estimate of the indirect costs. Preventative maintenance methods in use by the lines are outlined.

AREA Bulletin Vol. 58 1957, pp 735-737

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-703)
DOTL RP

A1 037713
TRACK MAINTENANCE AND HIGH CAPACITY TRUCKS
The high capacity truck from the maintenance of way standpoint is the means by which the increased gross weight of the large modern freight car is transmitted to the track, roadbed, bridges, trestles, viaducts and culverts, over which it must pass. As such, its design, dimensions and position are of vital concern to those responsible for the satisfactory operating condition of the railroad. Stress in rails and joint bars, track deflection, maximum load on ties and effect on undergrade bridges require specific consideration in determining whether or not a car can be accepted for movement; and if so whether it will be free-running or whether it will be restricted as to speed and routing. An immediate concern in relation to high capacity car trucks is the anticipated increase in shelling rail failures due to increased bearing pressure. Shelling rail failures are the result of the plastic flow of metal from the middle portion of the head toward the guage corner under high shearing stresses produced by intense wheel loads eventually starting a horizontal crack. The Joint Committee on Relation between Track and Equipment has recommended maximum axle loads of 52,800 pounds on 33 inch wheels, 58,400 pounds on 36 inch wheels, and 62,400 pounds on 38 inch diameter wheels.

Hammond, WT (Pennsylvania Railroad) *Engineering Interchange for Railroad Advancement* Tech Proc Sept. 1965, pp 1-3

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-714)
DOTL RP

A1 037718
CAR ROLL AND WHEEL LIFT, PROBLEM CHARACTERISTICS
The problem of car roll becomes more acute as the height of the center of gravity of the car body and lading is increased by greater car heights; and as car lengths are increased to the extent that the distance between truck centers approximates a standard rail length. While severe car roll is objectionable the most serious immediate consequences are wheel lift and resultant derailments. Commulative roll can develop very quickly to cause wheel lift. With rail joints 3/4-inch low, wheel lift can develop in four rail lengths at critical speed. Wheel lift can also be obtained on track with joints only 3/8-inch to 1/2-inch low if the joint stagger is midway and uniform, all joints are equally low, and the critical speed is maintained for about ten rail lengths. Fortunately, only a small percentage of wheel lifts result in derailments. When car roll is severe enough to cause wheel lift, there is a sizeable lateral force in the direction of the wheels staying on the rail, so that on tangent track, the wheels that are lifted simply come back down on the rail. In addition to the derailment hazard possibility there will be an increase in fatigue failures of journals, wheels and rail near joints as the result of the repeated high wheel loads being sustained due to severe rolling of heavier cars on track with less-than-perfect rail joint conditions.

Scott, HL (Norfolk and Western Railway) *Engineering Interchange for Railroad Advancement* Tech Proc Sept. 1965, pp 30-32

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-719)
DOTL RP

A1 037719
CAR ROLL AND WHEEL LIFT, PROBLEM SOLVING APPROACHES
The author discusses the problem of derailment and larger hopper cars as a two step process, (1) problem definition and (2) the selection of possible solutions or alternatives. It is pointed out that not all 100-ton cars derail. Only a relative few derail and, those which do, derail at more or less predictable locations. In the rail-versus-car controversy, it is obviously not very reasonable to spend the money to overhaul every mile of railroad track, nor is it any more reasonable to condemn the 100-ton car since it is one of the major factors contributing to increased railroad business. One possible solution might be to correct the very bad areas of track where the rail joint conditions produce severe dip, and the track arrangement is such that roll is reinforced; then do enough to the car itself to make it tolerate the remaining track. A few solutions on which there has been some work during the last year or two include improvement of the track and roadbed, and control of operation of the train so that susceptible cars don't move over troublesome curves at the critical speed or under certain conditions of draft or buff. Most derailments occur with newer cars, and when substantial milage is accumulated so all contact surfaces are worked in and maximum freedom of movement is attained there is a distinctly lessened tendency toward derailment. However, work on hopper car derailments has not produced a generalized solution which is widely adopted.

Reed, G (ACF Industries, Incorporated) *Engineering Interchange for Railroad Advancement* Tech Proc Sept. 1965, pp 32-38

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-720)
DOTL RP

A1 037732
CAR ROLL AND WHEEL LIFT TESTS ON SIMULATED SERVICE TRACK: TEST CONDITIONS AND RESULTS AT PRR ALTOONA TEST SITE
The class H-43, 100-ton hopper car began derailing at increasing rates beginning in the Spring of 1964 as more and more of these cars were placed in service. It was decided to set up a test track to simulate the rock-off phenomena and determine what modifications could be made to the car to reduce wheel lift and car roll. All cars were tested first on a tangent track with rails shimmed 3/4" to produce an 1-1/2" total change in cross level at each 39-ft. joint over a distance of ten rail lengths at speeds in the range of ten miles per hour to 22 miles per hour at approximately one mile per hour increments or until the critical speed was exceeded. The cars were then tested on a 3 degree curve having a 4-1/2" super-elevation with an 1-1/2" change in cross level superimposed at each joint over a distance of six rail lengths. Speeds on the 3 degree curve did not exceed 15 miles per hour. After testing, it was decided to adopt the following truck modifications:--1. Replace the 2-1/2" travel springs with 3-11/16" travel springs. 2. Add two friction snubbers to each spring group to absorb energy input into the spring group: 3. Move the side bearings in from 50" centers to 46" centers. 4. Machine the bolster gibs to permit more bolster lateral freedom. Even though a truck modification eliminate wheel lift on the test track, it was not certain just how close the wheel is to becoming unloaded.

Bertram, LW (Pennsylvania Railroad) *Engineering Exchange Forum* Tech Proc Sept. 1966, pp 23-27

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-734)
DOTL RP

A1 037743
COUPLERS--LONG CAR PROBLEMS
Concern for increased car length and the resultant need generated by such cars for a 60" coupler is discussed. Included are the results of tests and effect of longer couplers negotiating various crossovers. These couplers would also reduce lateral forces and wheel lift when cars are in a buff mode.

Byrne, R (Association of American Railroads) *Engineering and Operations Interface* Tech Proc Sept. 1967, pp 23-27, 2 Fig, 3 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-742)
DOTL RP

A1 037766
SOME RECENT FACETS OF CONTINUOUS-WELDED TRACK PRACTICE IN BRITAIN
Maximum working temperatures have been laid down for continuous welded rail above which it is not permissible for consolidation of the track or work to be undertaken on it. With slag or crushed stone ballast this temperature has been set at 32 deg C. Should slewings at any time exceed 1-1/4 in. the whole of the rail length affected must be restressed. An important aspect of continuously welded track is the strict adherence to restressing and destressing procedures. These have been developed to ensure that continuously welded track is kept in a uniform and safely stressed condition at all temperatures.

Railway Gazette Vol. 126 Sept. 1970, pp 705-707, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-776)
DOTL RP

A1 037772
WEAR OF RAILS ON CURVES
Abrasion caused by locomotives and electric motor coaches, the condition of the track, and methods of alleviation are discussed. Insufficient information is available to say what type of vehicle produces the most rapid wear in the outer rails on curves. Increase in tractive effort may result in increased transversal reaction and greater lateral wear of the rails. Rate of wear varies inversely as the radius of the curve, but no quantitative relation between degree of wear and radius has yet been established, nor have the effects of irregularities in curvature. What is certain is that excess or deficiency in cant causes unequal wear on rails.

Railway Gazette Vol. 100 Mar. 1954, pp 266-267

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-782)
DOTL RP

A1 037776
INTERIM REPORTS ON DERAILMENTS AT LICHFIELD, SOMERTON AND SANDY
This is an accident report of three derailments in England which occurred during June-July, 1969. All took place in welded rail and all were caused by distortions or buckling of the rail. No definite conclusions as to the cause of the incidents aside from an inherent track weakness were reached. Causes for track distortions, during the period 1958 to 1968, are reviewed.

Railway Gazette Vol. 126 Apr. 1970, pp 314-315

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-790)
DOTL RP

A1 037777
ASHCHURCH: DERAILMENT AND COLLISION
The derailment was due primarily to the excessive speed of the goods train. Responsibility must rest with the driver who drove his train well in excess of the permitted maximum of 35 mile/h. The derailment was initiated by one of the loaded mineral cars near the front. These cars are normally stable up to 45 mile/h. As several of the cars derailed they collided with four cars of an express passenger train. The condition of the track contributed to the accident but had the goods train been driven at its correct speed or even up to 45 mile/h derailment would most probably not have occurred. Speed was estimated at 50 mile/h.

Railway Gazette Vol. 126 Mar. 1970, p 237

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-792)
DOTL RP

A1 037780
SIMPLIFIED RIDE INDEX MEASUREMENT
This portable instrument will provide a continuous meter indication of the ride index of the vehicle in which it is placed. The meter uses a variable inductance accelerometer as an acceleration element. The meter is placed on the floor of the vehicle and the plane of measurement selected, either vertical or horizontal. The ride quality is shown directly on the meter scale as a continuous reading.

Railway Gazette International Jan. 1971, p 35, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-795)
DOTL RP

A1 037805
DERAILMENT DISEASE HITS CANADA
The results of a special inquiry into derailments in Canada, from 1967 to 1969, points to the need for government-imposed safety standards similar to the U.S. Railroad Safety Act of 1970. The predominate causes of freight train derailments are the combination of higher speeds, heavier axleloads, ageing rolling stock, inadequate track maintenance, and the uncertain area of vehicle/track interaction.

Railway Gazette International Apr. 1971, pp 121-122

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-846)
DOTL RP

A1 037813
DERAILMENT AT BERKHAMSTED
Two derailments are described, one at Berkhamsted and another at Auchencastle in June 1968. The prime cause of both accidents was attributed to track instability. At Berkhamsted the rail had not been made stress-free at 75 degrees F after the laying of continuous-welded track in freezing conditions, though the temperature at the time of buckling was not sufficiently high as to cause unacceptable expansion pressure within the rails. The bad welded joint and reverse curve alignment were also contributory causes to the disturbance of the track. At Auchencastle the speed may have been over the limit but track stability should have been sufficient to have withstood the effect of the vehicles at that speed. To increase the stability of continuous-welded sleepered track further investigation should ensure that compressive stresses are never more than the planned maximum, to reduce maximum compressive stresses and to improve and maintain lateral stability.

Reed, WP (Ministry of Transport, England) *Railway Gazette* Vol. 125 Dec. 1969, p 915

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-892)
DOTL RP

A1 037818
DERAILMENT NEAR STEVENTON
A train, consisting of 35 short-wheel-base cars and a brake van, was travelling 50 mph when the 16th car derailed. Tests were conducted under load of the main bearing springs and revealed that the permitted 5/16 in variation between the free camber of the four bearing springs was exceeded. Such imbalance might allow the car to leave the rails at a minor track irregularity. Imbalance was augmented by lateral oscillation which developed in the empty, short-wheelbased car.

Railway Gazette Vol. 123 Apr. 1967, p 273

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-899)
DOTL RP

A1 037819
DERAILMENT AT READING
A train travelling 15 mph between Reading General and Reading West stations derailed when a cess-side rail containing three wheelburns broke. A previous report by the Audigage ultrasonic flaw detector operator indicated two wheelburn cracks 1/4-and 1/2-in. long in the side of the rail head. It was concluded that a transverse brittle fracture occurred during passage of a previous train at the location of a wheelburn. Fatigue flaws at the wheelburns had been propagated by many thousands of loading cycles until the vertical flaws extended to cover about half the cross section of the rail head.

Railway Gazette Vol. 123 June 1967, p 433

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-900)
DOTL RP

A1 037821
DERAILMENT AT HATFIELD
Details of a derailment that occurred at Hatfield England in January 1966 are presented. This accident developed when the trailing bogie of the sixth

coach of a seven-coach train derailed after dislodging a fractured piece of railhead. It was concluded that the increased vertical deflection at the joint coupled with the small fatigue crack at the bolt hole caused the brittle fractures. It was noted that insufficient care was taken during relaying operations in November 1965 in matching the fishplates used at the joint with the worn fishing surfaces of the expansion switch stockrail and the adjacent closure rail. To reduce the risk of fatigue failures, work hardening of bolt holes is being introduced on switches and crossings.

Olver, PM (Ministry of Transport, England) *Railway Gazette* Vol. 123 June 1967, p 474

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-901)
DOTL RP

A1 037822
DERAILMENT NEAR SITTINGBOURNE
The train comprising 24 empty continental ferry vans and a brake van, became derailed on plain track approximately one mile west of Sittingbourne Station. The train was running at 55-60 mile/h when it derailed, a speed substantially in excess of the 45 mile/h limit. Since the intermittent side-cutting of the high rail contributed to this derailment, the possibility of reducing it by making some change in train behavior over the curve deserved consideration. Train behavior itself should be altered if the cant were reduced to three-fourths inches at which equilibrium speed would be 39 mile/h. The fast trains which appeared to cause the intermittent side-cutting would then run more firmly against the outer rail and the intermittent side cutting would be checked.

Railway Gazette Vol. 123 July 1967, p 513

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-903)
DOTL RP

A1 037832
STRESSES BENEATH A RAILWAY TRACK
By physically testing track structure the British Railways attempted to confirm the validity of theoretical stress calculations. Those stresses studied were located beneath the track, between the sleeper and ballast, and within the track formation proper. Results show blanket material does not influence stress level. They found agreement between measured and theoretical results. There is a greater degree of reversing shear in the formation than in the blanket layer.

Heath, DL Cottram, M (British Railways) *Railway Gazette* Vol. 122 Dec. 1966, pp 1001-7, 13 Fig, 1 Tab, 4 Phot, 6 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-916)
DOTL RP

A1 037838
DERAILMENT AT ROTHWELL HAIGH
Derailment of a train comprising three empty six-wheel milk tank wagons marshalled next to the 2,500 hp Type 4 diesel-electric locomotive, and eight passenger coaches two of which were sleeping cars is described. It was travelling at about 60 mile/h. The rolling of the leading tank wagon as it approached Rothwell Haigh may have synchronized with the natural slight impact of the first common crossing, and its pattern could have matched the reversals in cant through the obtuse crossings, thus accentuating the roll. The tendency under the influence of the roll would be to lift and the falling cant gradient of the crossing was 1 in 93 for about 3 feet, it did so lift coming down on its next roll on the head of the rail at the point of derailment.

Railway Gazette Vol. 122 Aug. 1966, p 627

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-922)
DOTL RP

A1 037841
SAFETY ON THE INDIAN RAILWAYS
This is primarily a review of the safety record of Indian Railways. This analysis, for 1962-63, 1963-64, and 1964-65, differentiates between significant and other accidents, such as collisions at level-crossings, fires in trains, and running into cattle and other obstructions. Accidents caused by train-wrecking are included under derailments. Partings of trains which have not resulted in collisions or derailments are excluded, as are other types of failure. In general, there was a substantial drop in accidents in recent years following a big rise in traffic over the last decade and a half. Detailed data are presented throughout the article.

Langley, CA (British Railways Board) *Railway Gazette* Vol. 122 June 1966, pp 473-475, 7 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-925)
DOTL RP

A1 037842
DERAILMENT AT HEST BANK STATION
Derailment at Hest Bank Station is described. The sleeping car express became derailed over water troughs when travelling at 70 mile/h, and broke into three portions. The cause of the accident was a broken rail, a portion of the cess rail about 13 feet long. The fracture had occurred 15 feet from the nearest weld apparently started as a transverse crack through the rail head, underneath an old wheelburn, subsequently turning horizontally in the direction of travel along the web until it had turned down to the foot and up to the head leaving a piece of rail head 4 feet 7 inches long detached. An ultrasonic flaw detector examination five months prior to the derailment failed to detect the vertical crack in the railhead. The final failure occurred because of low temperature on the night of the accident which caused a tensile stress to be set up in the long welded rail, causing an increase in the stress concentration round the edge of the fractured zone.

Railway Gazette Vol. 122 June 1966, p 459, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-926)
DOTL RP

A1 037846
LONDON TRANSPORT RAIL DE-STRESSER
A new device was designed for de-stressing long-welded rail after any disturbance to them in cold weather. The machine, a rail-heating trolley is so geared that it is easily propelled along the track by one man at the low operating speed required--about 2 mile/h. At each corner of the trolley is carried a 100-lb bottle of propane, and from these, flexible hoses run to the rail heaters. The equipment is designed for use on the open sections of line. De-stressing is not necessary in tunnels as the temperature remains almost constant throughout the year. On open lines, rails are de-stressed after they are installed, and it is only necessary then to de-stress them again when they have been disturbing for changing a block-joint or resleepering outside the mid-range temperature.

Railway Gazette Vol. 119 Nov. 1963, pp 519-20, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-957)
DOTL RP

A1 037854
WEAR AND CORROSION OF RAILS
The use of the Shaw Rail Contourograph to measure vertical wear is described and illustrated. The wide limits of specific rail wear on the British Railways and London Transport are shown as a result of corrosive influence of atmospheric pollution in tunnels and industrial areas. Annual wear is approximately proportional to the square root of the number of axles passing per annum. A comparison between the British and American rail wear values shows much lower values in America for specific wear at the same traffic intensity. This may be partly because of the higher carbon content in America where the relative humidity is above 80 percent for much fewer hours per annum, and atmospheric pollution from industry is less concentrated than in Britain. The effects of steel composition, axleload and braking on rail wear are discussed.

Dearden, J (British Railways) *Railway Gazette* Vol. 121 Jan. 1965, pp 518-521, 3 Fig, 2 Tab, 1 Phot, 13 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-989)
DOTL RP

A1 037869
LONG WELDED RAILS
The experiments conducted using welded rails in Great Britain and the U.S. are reviewed. The expansion and contraction of the long rails caused by temperature changes are discussed. Ballasting and sleeper spacing techniques are important in developing a strong support against the expansion and compressive stresses created in the rails. Photographs of welded rails at Southern Railway installations are shown.

Cantrell, AH *Railway Gazette* Vol. 71 July 1939, pp 101-103, 2 Phot
ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1050)
DOTL RP

A1 037871
SEVEN YEARS OF CONTINUOUS WELDED RAIL
The Delaware and Hudson has installed 10,984 butt-welded joints in 12 locations comprising 446,024 feet of rail. The longest continuous stretch of rail is 7018 feet. Of the welded joints, there have been only 29 failures, a failure rate of 0.26 percent; 25 failures occurred in thermit welds and four in flash welds. The causes of failure are itemized. Comparative maintenance costs between the welded rail and jointed rail for two locations are presented in tabular form. The man-hours expended per annum per mile were 19.75 and 25.71 for welded and jointed track, respectively, for the Port Henry, N.Y., installation.

Railway Gazette Vol. 76 Jan. 1942, 3 pp, 3 Tab, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1052)
DOTL RP

A1 037872
RECENT PROGRESS IN RAIL FISSURE DETECTION
The experience with Sperry detector cars during 10 years of service in the U.S. is reported. Changes in the design of the car to increase sensitivity and reliability are reported. The rails are pre-energized by a magnetic flux, followed by the magnetic flux from the search unit. The searching unit has four-coils which are staggered rather than in line. The Type 80 modification is described which contains special amplifiers and recording pens to differentiate defects of certain types. During 5 years of experience 40 percent of the defects detected were transverse or compound fissures, 40 percent were vertical split heads, 15 percent were horizontal split heads, and 5 percent were miscellaneous defects. Five hundred miles of fissure-containing rails have been removed during the last 10 years after detection with Sperry detector cars.

Railway Gazette Vol. 75 Aug. 1941, pp 216-17

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1053)
DOTL RP

A1 037879
RAILWAY ENGINEERING AND RADIOGRAPHY
When X-rays penetrate a substance opaque to visible light they are partly transmitted, partly absorbed, and partly reflected or scattered, the amount of each depends on the substance and its thickness. Substances of high density and atomic weight usually absorb X-rays to a much greater extent than those of light weight, for the latter tend to scatter the rays rather than absorb them. An outline arrangement for taking a radiograph is shown. In welds, unsoundness of the weld metal, imperfect penetration of the weld head and cracks in both bead and parent plate may be sought for. In castings, any such defects as porosity, draws and hot tears are likely to be revealed. Radiographs are shown of various welded and cast specimens.

Knights, ED *Railway Gazette* Vol. 77 Oct. 1942, pp 348-50, 1 Fig, 12 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1060)
DOTL RP

A1 037883
EXPANSION IN LONG RAILS
Experiments have been conducted on rails up to 1 mile long. These rails are fixed by means of the resistance of the fishplates, sleeper fastenings, and sleepers themselves embedded in the ballast; thus, for a 75 degrees F temperature variation above and below the temperature at which the rail was laid, a total force of about 61.3 tons (137,800 lb) is brought into play for a 96-lb rail, and the tendency to push the rail ends away from the center of the rail is resisted, and contained within the rail in the form of compressive stress (or with the tendency to contraction, tensile stress). The prevention of a rail from expanding or contracting causes an internal stress of 195 lb per sq. in. for each 1 degree F change in temperature. To minimize these high internal stresses, it is customary to lay long rails at the mean average annual temperature, and thus reduce the tendency of the rail to buckle, if the fastenings should become weakened. One of the great difficulties with long rails, apart from the practical limitations provided by transport, is that the opening up of the track can be done only at approximately the same temperature as that at which the rail was laid. The London Transport railways has used sliding expansion joints at the ends of the long sections. this expansion joint enables the keys to be knocked out, and any tendency toward expansion or contraction which may be imprisoned in the rail can exhaust itself at each end before further operations are begun.

Railway Gazette Vol. 90 Feb. 1949, p 144

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1066)
DOTL RP

A1 037889
LONG WELDED RAILS IN THE CASCADE TUNNEL, U.S.A.
The long welded rails were used in the recent renewal of four miles of track in the Cascade Tunnel. The tunnel, which is 7 miles 1,397 yd. long carries the main line of the Great Northern Railway from St. Paul to the Pacific coast through the Cascade Mountains. The railway was laid with 110-lb rails, rolled to the standard American length of 1,326 feet de-stressed by heat treatment, tested magnetically for flaws, cleaned, and given a coat of anti-corrosive paint. The new rails are secured by four cut spikes in every baseplate. The rails are anchored by 48 grip-type anchors in each 39-foot panel. To provide anchorage in both directions, these are applied in pairs for each rail against both faces of alternate sleepers. Insulated joints are inserted in the track at intervals of one mile.

Railway Gazette Vol. 91 Nov. 1949, pp 551-52

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1080)
DOTL RP

A1 037907
LONG WELDED RAILS
The item gives an historical and an evolutionary account of the development of long welded rails. Mention is made of the practice in the U.K., U.S.A., Germany and elsewhere. The use of welded rails has proven technically sound and comparative maintenance labor costs between continuously-welded rail and fishplated rail show savings in lining and surfacing ranging from 31 to 46 percent, and in gauging of from 33 to 39 percent.

Railway Gazette Vol. 86 Feb. 1947, pp 180-81

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1098)
DOTL RP

A1 037913
LONG WELDED RAILS IN THE U.S.A.
Experience to date with continuously-welded rail has revealed the following facts: (1) A sound practicable welded joint can be made. (2) Welded rail in long lengths can be transported and installed readily. (3) In the climate of that part of the U.S.A., welded rail should not be installed at a temperature under 60 degrees. (4) Welded track can be surfaced, lined, and otherwise worked without risk when done at a temperature equal to or less than that at which laid. (5) There are fewer failures in welded rail than in jointed rail. (6) Proper superelevation must be maintained on curves for the type of traffic handled to secure the maximum life of the rail on curves. (7) It is practicable to transpose welded rail on curves to increase rail life. (8) It appears that a less expensive fastening for welded rail is possible. (9) Difficulties experienced with continuously-welded rail can be eliminated by proper construction and maintenance. Considerable statistical data are included on costs and number of welds.

Railway Gazette Vol. 87 July 1947, pp 10-11, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1105)
DOTL RP

A1 037940
THE RAIL CORROSION PROBLEM
Hitherto the problem of rail corrosion has found no completely satisfactory solution. Innumerable remedies have been tried, but most of them have proved to be no more than palliatives, effective over a limited period. Welding the rails into continuous lengths reduces the number of joints, and the number of fatigue failures also, but does nothing to reduce the corrosion. The Norfolk & Western Railway has made a new approach to this problem. A preservative coating used for the rails is Texas No. 45 oil, which contains 45 per cent of asphalt, and it is applied after the rails have been flame-cleaned with oxy-acetylene jets. It is in the flame-cleaning that the novelty lies, and

the value of this treatment is that the steel surface is not merely cleaned, but is dehydrated also, and provision is thus made for a good bond between the oil coating and the rail. The flame-cleaning has been found more effective and cheaper than sand-blasting for the same purpose.

Railway Gazette Vol. 83 July 1945, pp 3-4

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1139)
DOTL RP

A1 037943
CONTINUOUS RAIL WELDING
One of the most extensive examples of continuous rail welding yet laid was completed by the Elgin, Joliet & Eastern Railroad of the United States, between Joliet and Coynes, Illinois. The total length is 5-1/2 miles, and the longest individual rail is 3,503 ft. The principle interest in this installation lies in the fact that the rails were welded at a depot, then moved in continuous strings up to 1,750 ft. long, to the sites at which they were to be laid in. The rails were of the 131 lb. per yd. flat-bottom section, in 39-ft. lengths, and 1,156 tons were required for the work. Butt-welding by the oxy-acetylene process was the method used. The total cost of the continuous rail was about $1,150 a mile greater than that of the conventional type of track with 131 lb. rails 39 ft. long and bolted joints. A minimum saving in maintenance of $100 a mile should justify the investment. The absence of joints is expected to increase the life of rails, eleminate excessive wear of joint sleepers and the constant attention needed to packing at the joints.

Railway Gazette Vol. 83 Aug. 1945, pp 142-143, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1142)
DOTL RP

A1 037945
COMPARATIVE STRESSES IN VERTICAL AND CANTED RAILS
An analysis and comparison is made of the stresses in rails laid either vertically or canted at the usual angle of 1 in 20. The method employed is the usual graphical one for any horizontal girder subjected to purely transverse loading. The two general cases of rails in straight track or tangent and curved track will be considered independently.

Inglis, RA *Railway Gazette* Vol. 83 Nov. 1945, pp 480-482, 4 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1144)
DOTL RP

A1 037949
THE PROBLEM OF THE TOP RAIL
It is a matter of common knowledge that the least reliable part of any normal steel ingot is the top. Standard rail specifications require that the rail shall be free from all top-of-the-ingot defects, and though in principle this requirement is carried out, in actual practice the average top rail from the ingot is not 100 percent free from the influence of these defects, as the broken rail records of every railway show. Theoretically the top rail should be the equal in quality of the middle rail or the bottom rail; practically it is not always so. Things that can and cannot be done to insure sound top rails are reviewed. From the manufacturing point of view, additional precautions can be taken to assure sound top rails, but they add to manufacturing costs. One is to cast the ingot large end up and provide it with a head encased in a refractory lining, which keeps the top of the metal molten until the ingot proper has solidified. Another precaution is to cast a larger ingot, so that a greater percentage of crop may be removed from the top end.

Railway Gazette Vol. 84 Mar. 1945, pp 272-273

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1148)
DOTL RP

A1 037954
MINISTRY OF TRANSPORT ACCIDENT REPORT
This accident report relates to the derailment of a passenger train at 55 mph on straight track near Kingsbury. It was concluded that the engine was hunting on the approach to the point of derailment and for some distance past it and that this distorted the track. The hunting was caused, it is considered, by the significant variations in cross level some distance back, followed by lesser ones coinciding with the period of hunting of the engine, and partly by uneven loading of its bogie and coupled wheels which, with the tender axle side play, made it less stable.

Reed, WP (Ministry of Transport, England) *Railway Gazette* Vol. 100 May 1954, pp 613-614

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1214)
DOTL RP

A1 037955
MINISTRY OF TRANSPORT ACCIDENT REPORT
This accident report describes an occurrence on September 2, 1950, near Mansfield, England, when a passenger train derailed on plain straight track. A derailment on plain track usually is due to (a) excessive speed, (b) defective locomotive, (c) defective track, (d) an obstruction, or a combination of two or more of these. There was no evidence to suggest that the train was travelling at high speed and no reason for the driver to do so. Examination of the engine showed excessive side play in the pony truck and the broken springs mentioned above, which would have affected the balance of the engine. The only track defect was the variation in cross-level, which was remarkably regular, though the actual differences at any one point were not excessive. It is likely that low joints on the curve set up minor oscillations, slightly increased perhaps by water surging in the tanks, but not becoming serious until the straight track was reached, where regular cross-level changes increased them. Then build-up must have been unusually rapid, probably due to short pitch cant variations synchronising with the periodicity of the engine. The theory of engine hunting is borne out by the track distortions, etc., all tending to show that the leading wheel became forced over the rail when it was carrying little weight.

Langley, CA (Ministry of Transport, England) *Railway Gazette* Vol. 95 Aug. 1951, pp 190-192, 4 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1234)
DOTL RP

A1 037956
MINISTRY OF TRANSPORT ACCIDENT REPORT
An accident occurred on May 12, 1950, on the Chesterfield-Lincoln line when a passenger train became totally derailed. The derailment was caused by the condition of the track and to a lesser extent by that of the engine. The principal fault in the track was the rapid and very considerable reversal of cross-level. Side cutting of rails suggested that side to side oscillation of engines was usual as they passed through the junction and it may have persisted for some time. A feature of this derailment was that the track had been inspected within the previous week. All concerned were experienced men, but their standards of maintenance were not perhaps as high as they should have been, and they allowed themselves to fall into an error of judgment. Further, the engine was allowed in traffic with three broken springs.

Walker, RJ (Ministry of Transport, England) *Railway Gazette* Vol. 95 Aug. 1951, pp 220-221, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1236)
DOTL RP

A1 037957
MINISTRY OF TRANSPORT ACCIDENT REPORT
This accident report describes a mishap which occurred on October 23, 1950 near Kirkbridge. The incident involved the derailment of a passenger train at 45 mph. There were two fatalities. The cause was attributed to faulty track, causing the engine to roll badly. In addition to poor cant, the track was found to be too flexible with short light rails poorly seated in the chairs. Details are given.

McMullen, D (Ministry of Transport, England) *Railway Gazette* Vol. 95 Aug. 1951, pp 246-247, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1237)
DOTL RP

A1 037959
DERAILMENTS IN INDIA
The results of an 18-month derailment study during 1949-1950 are summarized. Primarily a statistical analysis, the derailments are categorized according to: (1) gauge, (2) type of train or yard, (3) railway, (4) month of occurrence, (5) cause, (6) time of day or night, and (7) whether at a large station. Further, the derailments are analyzed by principal causes (1) track

defects, (2) locomotive defects, (3) carriage and wagon defects, (4) faults of traffic staff, (5) faults of power staff, (6) obstructions, and (7) miscellaneous causes. Specific findings for 12,993 derailments during the 18-month period revealed the following: 56 percent were due to traffic staff faults and 8.3 percent to track defects, 7.6 percent resulted from carriage and wagon defects, and another 7.6 percent from obstructions on the track; 6.5 percent were caused by faults of the locomotive staff, and 1.3 percent by locomotive defects. The remaining 12.7 percent are classed as "miscellaneous causes."

Latham, WG (Madras & Southern Mahratta Railway); Isaacs, EW (East Indian Railway) *Railway Gazette* Vol. 95 Nov. 1951, pp 592-593

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1244)
DOTL RP

A1 037961
MINISTRY OF TRANSPORT ACCIDENT REPORT
An accident which occurred in Glasgow on November 14, 1951 is reported. The train went out of control on a down gradient, which averages 1 in 43, and collided with eleven empty passenger cars travelling through a scissors crossover. There were several injuries and extensive damage. The runaway was due to vacuum brake failure. Details of the investigation are reported.

Langley, CA (Ministry of Transport, England) *Railway Gazette* Vol. 97 Aug. 1952, pp 191-192, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1267)
DOTL RP

A1 037971
TRACK TESTS ON THE ILLINOIS CENTRAL RR
This article describes a number of tests conducted on the Illinois Central. One test was conducted to determine whether the removal of the mill scale from the rail ends and fishing surfaces of the plates would reduce the initial rate of bolt tension loss or have beneficial effects on fishplate wear. Insulated joints were also tested. Tests were also carried out with various types of bearing plates in an attempt to eliminate the cutting of soft wooden sleepers by such plates. To prevent creep, 14 rail anchors of different types were fitted per rail length, and in addition 12 rail clips to the rail length were used. Eight different arrangements of the anchors were installed. Various kinds of sleepers and ballast were also tested.

Railway Gazette Vol. 81 July 1944, p 11, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1304)
DOTL RP

A1 037978
HOW LONG CAN A RAIL BE?
The continuous welding of rails as practiced in the United States by five railways is summarized. Summarizing the collective views at the time of this article, it was clear that expansion and contraction would not present problems. It was equally clear that there are appreciable savings in the costs of maintenance as compared with standard jointed track. There are good prospects of longer rail life, because destructive action on the part of the rails is reduced. Rolling stock rides more quickly and smoothly. Track circuits give less trouble, and can be lengthened.

Railway Gazette Vol. 81 Oct. 1944, pp 281-282

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1311)
DOTL RP

A1 037988
FACING POINT LOCKING
A paper by O.S. Nock on facing point protection presented to the Institute of Railway Signal Engineers on Feb. 4, 1959, is summarized. The question how far one should go in applying supplementary precautions against irregular movement of power points by using local track locking and/or revised circuit arrangements, designed to give greater security against the effect of faults, is discussed. It is determined that facing points must be made as safe as the latest techniques can make them.

Nock, OS *Railway Gazette* Vol. 110 Feb. 1959, p 176

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1408)
DOTL RP

A1 039011
A CALCULATION OF THE LATERAL HUNTING MOTION OF A TRACKED VEHICLE
The lateral hunting motion of a vehicle running on tracks is not only prejudicial to riding comfort, but may also cause dangerous derailment. The initial step in the design of a safe high-speed train is a theoretical and experimental investigation of this lateral hunting motion and a practical method of preventing it. The usual railroad train may be idealized as a system consisting of a number of cars connected end to end like links of a chain. The transfer-matrix technique purports to be applicable to such a system, whereby once the transfer matrices of each component (car) are derived, it is only necessary to perform successive matrix multiplications to fit the entire system. It is demonstrated that the transfer matrix method may be applied successfully in a study of lateral hunting motion. The stability problem associated with this motion, and forced vibrations caused by irregularities and lateral distortions in the rails may also be investigated by the use of the transfer-matrix technique. (Author)

Iguchi, M
Massachusetts Institute of Technology DSR-76109-5, Nov. 1966, 27 pp

Contract C-85-65t

ACKNOWLEDGMENT: NTIS (PB-173652)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-173652, DOTL NTIS

A1 039068
STRESS AND STRAIN IN ROLLING BODIES IN CONTACT
The three-dimensional solution of the stresses and strains in the contact region of a rolling wheel which carries normal, lateral and tangential loads is sought. Because of the complexity of the general problem a preliminary step has been to seek the solution for two spheres of similar material rolling on each other. The approach has been to divide the 'locked' region into a grid of n cells formed by fixed circular grid lines and variable grid lines which have a shape similar to an assumed shape for the boundary between the 'locked' and 'slipped' regions. The equations and boundary conditions were formulated and a computer program solves 2n simultaneous equations to find the stress distributions. If all boundary conditions are not satisfied by the solution the computer program shifts the grid points according to an error criterion and reiterates the solution. The results were encouraging although the final solution is not yet available. The results for the two spheres can be extended to the case of a wheel rolling on a surface of dissimilar material. This solution is of considerable importance for high speed rail travel because forward and sidewise creep (which are vital parameters in stability calculations) and rolling stresses (fatigue, etc.) can be calculated from the complete picture of stresses and strains in the region. (Author)

Paul, IL Nayak, PR
Massachusetts Institute of Technology Nov. 1966, 43 pp

Contract C-85-65t

ACKNOWLEDGMENT: NTIS (PB-173651)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-173651, DOTL NTIS

A1 039166
A RECOMMENDED RAIL SAFETY RESEARCH PLAN FOR FISCAL YEARS 1971-1975
The document is concerned with the initial picture of railroad safety, configured research projects which address specific needs as expressed by industry, labor and government, an estimation of the resources (in time and dollars) required to accomplish each project, and 3 alternative 5-year safety research program plans for the fiscal years 1971-1975. (Author)

Melpar, Incorporated FRA-RP-70-1, Oct. 1969, 115 pp

Contract DOT-FR-9-0047

ACKNOWLEDGMENT: NTIS (PB-188967)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-188967, DOTL NTIS

A1 039167
SUPPLEMENTARY REPORT TO FEASIBILITY STUDY FOR A WHEEL-RAIL DYNAMICS RESEARCH FACILITY
This supplement to PB 182 472 deals with: (1) the trade-off considerations in extending the simulation capability of the wheel-on-roller design to lower speeds and sharper curves, and to more precise simulation of general system behavior; (2) the methods of implementation of the various simulation schemes and/or the method of compensation and constraint in lieu of such simulation; (3) the relative merit of electromechanical drive versus hydraulic drive systems, and some considerations in tractive and braking performance associated with the electromechanical drive-system selected; and (4) stress and deflection considerations of the diaphragm-coupler and the roller systems, their compliances, and how they relate to total system compliance and system performance.

Supplement to report dated Dec 68, PB-182 472.

General American Transportation Corporation Oct. 1969, 146 pp

Contract DT-7-35363

ACKNOWLEDGMENT: NTIS (PB-189096)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-189096, DOTL NTIS

A1 039288
A MODEL STUDY FOR VERTICAL TRACK BUCKLING
The paper contains a study of two models which represent the mechanism of vertical buckling of a track when subjected to a mechanical or to a thermal compression force, respectively. The postbuckling equilibrium curves and their stability are discussed and a stability criterion is defined. The effect of various track model parameters upon the buckling load or buckling temperature, are shown. The nonlinear equilibrium equations were then linearized. It was found that the buckling loads, or temperatures, obtained from a linearized analysis have no relevance to the actual values obtained from a nonlinear analysis; the difference in results being substantial for buckling temperatures. (Author)

Kerr, AD
New York University, Bronx NYU-AA-71-31, Oct. 1971, 31 pp

Contract DOT-FR-10019

ACKNOWLEDGMENT: NTIS (PB-209614)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-209614, DOTL NTIS

A1 039437
INVESTIGATION OF LATERAL STRENGTH OF RAIL FASTENINGS ON TOKAIDO TRUNK LINE BETWEEN FUJIEDA AND SHIMADA BY LATERAL FORCE TESTING CAR
As a result of tests by the JNR lateral testing car, several types of rail fasteners were designed. Statistical prediction gave a stress variation of 3 to 6t. All designs were designed to withstand a lateral force of 3t and will not easily fail at stresses of 6t. The strongest fasteners utilizes polyurethane gage blocks. Weaknesses of design and materials in the order fasteners tested are also discussed and compared.

Minemura, Y Ichikawa, S (Niigata Railway Administration, Japan) *Railway Technical Research Institute* Vol. 5 No. 2, June 1964, pp 50-53, 5 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-691)
DOTL RP

A1 039440
EXPERIMENTAL RESULTS OBTAINED ON THE LATERAL PROBLEMS OF THE LONG WELDED RAIL CONTINUOUSLY LAID ON SEVERAL SPANS OF THE BRIDGE WITHOUT BALLAST
To show the lateral stability of continuous welded rail on a bridge, and the character of the lateral load to the bridge as a result of such rail, a test was conducted by the JNR on an actual bridge. The data resulting from this test shows that even though there were no problems resulting from unballasted rail on a bridge, the lateral forces between rail and sleepers varies and may reach a value which is ten times the calculated value. The phenomena is a result of continuous rail laid on a bridge resulting from the high lateral elastic coefficient of the rail supporting system.

Sato, Y Nagata, M (Japanese National Railways) *Railway Technical Research Institute* Vol. 10 No. 1, Mar. 1969, pp 8-10, 3 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-694)
DOTL RP

A1 039446
TESTS OF RAIL JOINT IMPACT EFFECTS ON THE CHICAGO AND NORTH WESTERN
Tests were conducted to evaluate the economics of 78-foot rail. Fundamental information was obtained on the impact effects on joint ties due to rail end batter, joint gap, and joint bar fit of regular rail joints compared to the impact effects with a butt weld. Conclusions suggest that to compare welded rail joints with conventional joints, the costs of maintaining a rail joint in equally good condition including the maintenance of rail end batter not to exceed 0.015 in., replacement of joint bars, tightening of track bolts plus corrosion protection must be included.

AREA Bulletin Vol. 57 1956, pp 865-883, 7 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-702)
DOTL RP

A1 039451
ELEVENTH PROGRESS REPORT OF THE ROLLING-LOAD TESTS OF JOINT BARS
This report discusses the test program of rolling load tests of joint bars using 3-33 inch stroke rolling machines. The results of the tests of joint bars, which were heat treated and tempered are given. Hardness tests of the bars are included as well as the rolling load tests. Test results of 132 RE leadfree bars (oil quenched) averaged 573,100 cycles before failure which started at a rail end. Tests of 132 RE leadfree bars (water quenched) averaged 365,300 cycles. 4 bars failed, 2 from the top, 2 from the base.

Jensen, RS (Illinois University) *AREA Bulletin* Vol. 54 1953

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-708)
DOTL RP

A1 039452
INVESTIGATION OF FAILURES IN CONTROL-COOLED RAILROAD RAILS
A summary is tabulated of the number and types of rail failure, while a detailed account of each type of failure is given. Sources, rail size, mill, date of manufacture as well as failure class are also included.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 54 1953, pp 1186-93, 6 Fig, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-709)
DOTL RP

A1 039459
TRACK LIMITATIONS ON SPEED
The article is a review of the findings of a book, "Super-Railroads for a Dynamic American Economy." The discussion is concerned primarily with the effects of curvature and gradients upon hp requirements for locomotives. The effect of speed restorations upon train speed and resulting power waste is considered. Although locomotive power increases, this does not eliminate the need for track alignment and re-grading to reduce the number of speed limitations.

Railway Gazette Vol. 105 July 1956, pp 100-101

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-754)
DOTL RP

A1 039460
TIGHT-JOINT LONG RAIL LENGTHS
The use of high torque bolts in a testing situation by U.S., railroads is discussed. These bolts were being tested as an alternative to continuous welded rail, to eliminate the problems of transport, laying, renewal which is inherent in use of welded rail. Rail used in 132 lb RE with six hole joints held by 1-1/8 in. bolts. So far, measurements have not given significant results except for the flow of metal at rail ends, plus shipping of rail joints.

Railway Gazette Vol. 105 Aug. 1956, p 32

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-755)
DOTL RP

A1 039465
STRESSES IN THE TRACK SUBSTRUCTURE RESULTING FROM TRAFFIC LOADS
Experimental research has led to findings concerning the interactions between the different structural components of the track under quasi-static loading conditions. The tests were intended to show whether the results found for the quasi-static range can also be regarded as valid under dynamic conditions. Results showed that there is a linear correlation between the measured sleeper reaction and the pressure or stress in the ballast and formation. The results showed a relatively high degree of scatter, amounting to 17.5% for a concrete sleepered track without rail joints, and to 25% for a track on wooden sleepers with rail joints. The maximum vertical stress in the formation decreased in the course of time due to changes in the stress distribution. For certain soils, there is a definite limiting stress. If this stress is exceeded, repeated load applications will lead to a rapidly increasing deformation and to plastic setting. Below this (limiting stress), repeated load applications will merely cause permanent deformations.

Rail International May 1971, pp 494-498, 3 Fig, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-760)
DOTL RP

A1 039481
THE MOVEMENTS OF RAILWAY VEHICLES ON THE TRACK AND THE FORCE ARISING THEREFROM
A critical analysis is given of the interaction of flanges and rails, together with a resume of the scientific principles involved. The friction arising between wheel and rail is fundamental for all railway transport. The frictional force R is equal to or less than the product of the frictional factor f and the wheel load Q, which are the variable quantities. As the direction of force R coincides with the resulting sliding motor between wheel and rail, its action is opposed to the direction of motion. Force R determines not only rolling resistance, but also that due to curves, guiding pressure, security against derailment, maximum tractive and braking power, axle strain, wear of rail and flange, and--last but not least--freedom from hunting. Methods to determine the precise position and value of R are discussed.

Liechty, MR *Railway Gazette* Vol. 83 Nov. 1945, pp 564-565

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-813)
DOTL RP

A1 039489
DERAILMENT NEAR WARRINGTON
This accident report details a derailment which took place at Warrington when 11 coaches were derailed as a rail joint became disconnected. The nuts were loose and finally ran off the bolts. As a result of the incident, improved inspection procedures are called for the ensure that all bolts are tightened plus specifications for bolts now call for 1/4 inch longer bolt to accept a Parlox nut, and 11 thread per inch instead of 9 as previously required.

Railway Gazette Vol. 125 Mar. 1969, pp 237

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-849)
DOTL RP

A1 039496
RAIL FAILURES ON BRITISH RAILWAYS
Every rail or portion of rail that has to be removed from a running line prematurely because of a break, crack or other defect has to be reported as a failure; failed welds that are repaired by re-welding in situ without the removal of a rail must also be reported. Information relating to the rail and its conditions of service is coded and punched on computer tape. This enables the failures in any year to be easily and quickly analyzed according to region, rail section, age, traffic carried, class of line, manufacturer or any other feature considered to have or suspected of having an influence on the failure pattern. Failures in tunnels and on water troughs are analyzed separately from failures elsewhere, as are failures at welded joints. Types and causes of failure for 1961-1963 are reported. Comparisons between regions and manufacturing process used to produce the rail are also made.

Dearden, J (British Railways) *Railway Gazette* Vol. 121 Feb. 1965, pp 148-150, 4 Tab, 4 Phot, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-992)
DOTL RP

A1 039497
DERAILMENT AT CHEADLE HULME
The train which consisted of a steam locomotive and nine coaches ran on to a temporary underline bridge immediately before Cheadle Hulme Station, at a speed in excess of the 10 mile/h restriction, burst the track, derailed, and parted between the fourth and fifth coaches. Two children and a railway representative were killed and 27 injured. Standard indicators had been provided at the beginning and end of the restriction but the warning board near Branhall Loop was non-standard. The train ran on to the bridge where the speed restriction was 10 mile/h at a speed of at least 45 mile/h. The warning board was not as conspicuous as it should have been. Such boards should be of standard design and brightly painted. The weakest point of the temporary bridge design was shown to be the fastening of the track to the waybeam by transoms and clamps to every other sleeper.

Railway Gazette Vol. 121 Apr. 1965, p 33

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-999)
DOTL RP

A1 039501
AREAS OF CONCERN FOR FREIGHT CAR ENGINEERING
The aims of containerization are to provide cheaper, safer and quicker transportation for commodities which can be placed in standard size boxes. To obtain maximum benefits, special equipment is necessary and economically justified. The size of the containers, loading and securing methods, and size and capacity of the cars are described. A series of tests were made to determine the source and methods to eliminate the poor ride qualities of 60 feet container cars used on the Canadian National Railways. The tests were run over the same track at a range of speeds. The acceleration was measured in the vertical and lateral directions. Track hunting was apparent above 45 mph. The results of the tests are shown.
Technical Proceedings from 1969 Railroad Engineering Conference.

Radford, RW (Canadian National Railways)
Dresser Transportation Equipment Division Tech Proc Sept. 1969, pp 16-25, 19 Fig, 12 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1003)
DOTL RP

A1 039502
ENGINEERING CRITERIA FOR FUTURE FREIGHT CAR TRUCK DESIGN AND PERFORMANCE
To establish the criteria for design and performance of freight car trucks, the environmental effects on the truck must be examined. These environmental effects are grouped as: external environment from track conditions, carbody and train speed; and internal environments which are induced by the truck design, the specialty components, such as roller bearings and the state of the art in developing the most desirable elements in the truck assembly. Each of these effects is described. The lack in the U.S. of a full-scale wheel-rail dynamics research facility to test trucks and tracking has hampered the efforts on truck design. A British Railways test using a U.S. truck design and their Freighliner test equipment is briefly described.
Technical Proceedings from 1969 Railroad Engineering Conference.

Garin, PV (Southern Pacific Company)
Dresser Transportation Equipment Division Tech Proc Sept. 1969, pp 26-30

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1004)
DOTL RP

A1 039503
THE PROBLEMS
Considerable fore and aft wear in the body and bolster Center plates on cars in service up to 1962, was due to action when the car is in motion. By applying manganese steel wear rings into the truck bolster, the wear disappeared. It was also found that the body center plate was cracking. When a change of construction material was unsuccessful in correcting the problem, a fillet weld was tested. After three years, no center plate cracks around the bowl have been found. Several design changes for the center plates being considered to increase strength are mentioned.
Technical Proceedings from 1969 Railroad Engineering Conference.

Seel, M (Trailer Train Company)
Dresser Transportation Equipment Division Tech Proc Sept. 1969, pp 30-32

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1005)
DOTL RP

A1 039504
CARBUILDER'S APPROACH TO THE SOLUTIONS OF THE TRUCK–CAR BODY RELATIONSHIPS
Three failure modes for center plate areas are discussed and illustrated. Wear of vertical wall inboard and outboard has been reduced by the wear ring and harder center plate. By use of these modifications, the 50 and 70 ton service experience should be approached. Cracking of center plates was prevalent prior to 1967, and was a function of the center plate center filler contact area. Failures had not occurred at conference time of the solid forced plate designed to eliminate the cracking problem. Cracking of the cushioned underframe center plate is a function of the overall bolster design and with proper design and reinforcement, this mode of failure should not occur.
Technical Proceedings from 1969 Railroad Engineering Conference.

Ruppecht, WJ (ACF Industries, Incorporated)
Dresser Transportation Equipment Division Tech Proc Sept. 1969, pp 32-39, 18 Fig, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1006)
DOTL RP

A1 039505
PULLMAN'S APPROACH TO CENTER PLATE PROBLEMS
Tests were conducted on fabricated cushioned underframe center plates using a Hy-Cube car, using a car rocking device designed to excite a fully-loaded car at its natural roll frequency. Results were correlated with field service reports. Tests were in progress on the rocking device using a 100-ton covered hopper car. The conclusion of the two-year test program on cushioned underframe cars has indicated these results: rock and roll is instrumental in center plate wear and breakdown; breakdown originates in the transition radius and propagates into the transverse and longitudinal reinforcement; the 3/8" radius is not satisfactory for today's fatigue environment; longitudinal reinforcement on the center plate should be located over the outer circumference of the bowl; a flat center plate application significantly reduces the attachment pre-stress in the transition radius; both fabricated and cast center plates can develop cracking unless fatigue design is considered; the center plate application is related to car configuration; and supplemental snubbing devices that reduce car body roll would increase the fatigue life of center plates.
Technical Proceedings from 1969 Railroad Engineering Conference.

Rousseau, GL (Pullman-Standard Car Manufacturing Company)
Dresser Transportation Equipment Division Tech Proc Sept. 1969, pp 39-41

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1007)
DOTL RP

A1 039506
CARBUILDER'S APPROACH TO THE SOLUTIONS OF THE TRUCK-CAR BODY RELATIONSHIPS
In early 1967 General American standardized on a cast steel combination center brace, center plate, and rear draft lug. This casting is attached using the two-piece rivet; that is, the Huck or Townsend bolt. Laboratory tests were conducted for all capacities through 125-tons with impact loads beyond AAR design requirements. This design has operated successfully in service. Test results on the center plates on car built from 1960 to 1967 are given. The test showed that a solid bowl is not as good as the recessed type bowl because of slight deviations in the bolster.
Technical Proceedings from 1969 Railroad Engineering Conference.

Krause, JF, JR (General American Transportation Corporation)
Dresser Transportation Equipment Division Tech Proc Sept. 1969, pp 41-42

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1008)
DOTL RP

A1 039513
RESUME OF LONG CAR TRACKING PROBLEMS
It was necessary to employ a special coupler in the design of the 86'6" Hy-Cube box car for automotive stampings. To permit those cars to negotiate curves it was necessary to use a nonstandard 60-in. "F" shank coupler with a Type "E" head. The coupler carriers have been broken on several of the cars as they were passing over vertical curves of lesser radii than the cars were designed to negotiate. Coupler carriers on other cars coupled to Hy-Cube cars have been literally torn off while negotiating vertical curves. The most prevalent difficulty with the long couplers on cars with long overhangs, is caused by missed couplings. Accidents of this kind smash angle cocks, train line nipples, uncoupling mechanisms and in many cases causes much damage to the center sills, especially to sliding center sills. The answer to longer trains and reduced draw-bar pull may be automatically controlled locomotives spaced in trains.
Technical Proceedings from 1964 Railroad Engineering Conference.

Douglass, JR (Louisville & Nashville Railroad)
Symington Wayne Corporation

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1025)
DOTL RP

A1 039548
DETAILED INVESTIGATIONS INTO SLEEPER DEFECTS
In 1950-51, 400,000 failed wooden cross ties were examined and classified as to the type of failure: (1) decay, (2) plate-cutting, (3) splitting, (4) shattering, (5) spike killing, (6) braking (7) ring separation, and (8) accident. Five types of wood were involved, but 85 percent of the sleepers examined were of pine or fir species more universally used then the other two, oak and gum. Plate-cutting, splitting and shattering accounted for about 1/3 each of the total failures.

Railway Gazette Vol. 98 June 1953, pp 725-726, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1187)
DOTL RP

A1 039549
THE ULTRASONEL FLAW DETECTOR
The Ultrasonel instrument of Trevor-Johnstone Company for detection of flaws in locomotive frames and thin plates by measuring the intensity of ultrasonic waves is described. The Ultrasonel will detect either internal or surface defects. The internal defects may be revealed by either transparency or echo methods as may be convenient, whereas the surface flaws are detected by inclining the feelers at an angle to the surface. The feelers are set at an angle to the surface so that the ultrasonic waves move along the surface without penetrating the test material.

Railway Gazette Vol. 99 July 1953, pp 17-18, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1188)
DOTL RP

A1 039551
RAIL FLAW DETECTION BY UNTRASONIC BEAM
The Audigage flaw detector, of Branson Instruments Inc. consists of a small-battery-operated ultrasonic frequency generator and receiver, carried in an 11-1/2-lb. pack on the operator's back, a crystal in a special holder on the end of a long handle, and a pair of headphones. The crystal is applied to the head of the rail and the presence of a crack indicated by a lowering of the continuous tone produced in the headphones by a perfect rail. In a cracked rail the wave is reflected by the flaw, and a change in tone--or loss of tone--is produced in the headphones. The nearer the crack to the head of the rail, the greater is the drop in frequency. The instrument has been in use by London Transport for about three weeks, during which time some 15 miles of rail have been inspected with it. Several minor defects which were not revealed by visual inspection were discovered in sections of rail covered by the fishplates.

Railway Gazette Vol. 99 July 1953, pp 45-46, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1190)
DOTL RP

A1 039564
TRACK MAINTENANCE PROBLEMS
This summary of track maintenance problems was obtained from the railway administrators of the International Railway Congress. All the railways consulted are studying possible modifications in the traditional maintenance organization, but investigations are still in the experimental stage, and there are no indications what the final pattern will be. The experiments can be grouped into two categories: (1) Concentration of smaller into large gangs, and the various methods of transport for their mobility, and (b) mechanization. The article summarizes activities and equipment used by various countries in the areas of track recording equipment, speed restrictions and signals and mechanical tools and mechanization problems. Economic and financial aspects are included as well as the use of medium-sized gangs for maintenance.

Railway Gazette Vol. 100 Feb. 1954, pp 150-151, 1 Tab, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1203)
DOTL RP

A1 039571
LONG WELDED RAILS
If very long weld rails are used to circumvent the many disadvantages of the jointed form of track, important safeguards are essential. The standard types of doubly-flexible rail-to-sleeper fastenings in use on the French railways are among the most efficient deterrents to the risk of fracture due to tension. With an 800 m. length an expansion joint of the sliding switch-blade and stock-rail type is used, allowing of a relative movement of up to 7 in. between the rail-ends. The French railways use arc-welding plant equipped with special finishing devices, in the shape of precision grinding and truing units working in both plan and profile, assisted by hydraulic jacks. It is too early to access precisely the economies resulting from welded track, but the smallest calculated saving so far is about 30 percent, and was secured on the Paris-Marseilles line near l'Etang de Berre.

Railway Gazette Vol. 100 June 1954, p 687, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1216)
DOTL RP

A1 039577
MINISTRY OF TRANSPORT ACCIDENT REPORT
This accident report covers a passenger train derailment in a tunnel at 65 mph. Minor injuries were reported. The rail breakage which caused derailment was traced to a defective rail end caused by corrosion fatigue cracks at joints of stress concentration around bold holes.

Railway Gazette Vol. 101 Aug. 1954, pp 246-248, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1222)
DOTL RP

A1 039589
CONTINUOUSLY-WELDED RAILS
To offset the increased cost of laying welded as compared with bolted rail ($1000/mi) important savings are being effected. The first is in general track surfacing work. The initial 5-1/2 miles of Elgin Joliet and Eastern Railroad welded track, laid in 1943, will not require general surfacing for another two or three years yet, though it carries 20,000,000 gross tons of traffic annually; in the normal course it would need general surfacing every seven years, and joint surfacing, now no longer needed, at much shorter intervals. Also, construction methods, maintenance benefits and costs are discussed.

Railway Gazette Vol. 95 Aug. 1951, p 207

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1235)
DOTL RP

A1 039602
GAUGING THE USEFUL LIFE OF RAILS
A device for determining the useful life of a rail is described. This particular instrument requires no attachment to the rail as do many other devices. The weight of the rail is read directly on a single scale. Also, a cross-section of the worn rail can be produced.

Railway Gazette Vol. 96 Apr. 1952, p 375, 1 Fig, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1254)
DOTL RP

A1 039605
BURSTING A CROSSING
The Doncaster derailment attracted great attention, not only because of the resultant causalties but also from the fact that the train had just started and was not traveling at any speed. The train was passing through a scissors crossover, up slow to up main, where superelevation had to be such that the run-up of the cant was very steep— in certain circumstances a disagreeable necessity. Of recent years a speed limit of 10 mph has been in force over the slow line approach from the station and through this connection, but unfortunately, as in so many places, it has been indifferently observed. The conclusion, supported by practical tests, was that the train concerned passed at from 20 to 25 mph. There was no reason for supposing that the condition of either locomotive or train contributed to the accident. It was concluded, from a review of all those cases and every relevant fact revealed by the inquiry, that the disaster was initiated by the bursting of the crossing. All crossings form inherently weak points in the track and their components are subject to constant shock.

Railway Gazette Vol. 96 Apr. 1952, p 425

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1257)
DOTL RP

A1 039614
RAIL-END DEFECTS
Of all steel rail defects, probably the most difficult to detect are those which occur at the rail-ends and are concealed by the fishplates. The major cause is the pounding and vibration to which rail-ends are subject because of the gap between the rails over which the rolling load must pass. This may encourage the development of corrosion fatigue cracks from any sharp edges, such as those of the fishbold holes or in the fishing angles of the rails, which stresses are concentrated. In the course of ordinary inspection, the only way to discover whether or not a rail is cracked at the end is to take off the fishplates but this is a costly operation from the labour point of view. In the United States certain railways are now supplementing the regular patrolling of their tracks with Sperry or other detector cars by supersonic testing of rail-ends. One of the problems arising from such inspections has been to decide at what stage of development a crack becomes sufficiently serious to demand the removal of the rail from the track. To remove all rails in which small cracks are found would appear to be an unjustifiable costly proceeding. The present practice of classifying the cracks and removing from the track only rails that have cracks of over a certain length, would appear to be reasonably safe, and far less costly than the indiscriminate removal of all rails show ing the slightest sign of cracking.

Railway Gazette Vol. 97 Aug. 1952, pp 199-200

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1268)
DOTL RP

A1 039627
A NEW FATIGUE DEFECT IN RAILS
The shelling defect has been most commonly encountered in the 131-lb standard flat-bottom section, though it has been reported in some degree in all sections from 100 lb. upwards. The first manifestation of the trouble is the appearance, on the running surface of the rail near the running edge of dark spots, which indicate the presence of horizontal planes of separation of the steel within the rail-head; these may occur at a number of different levels in the same rail. The shelling is the result of wheel action on the rail causing failure of the metal, either by direct stress exceeding the elastic limit, or by loss of ductility which is the outcome of constant reversals of stress. Factors which may influence the relative severity of the shelling are the inclination of the rail, the superelevation, the bearing pressure exerted by the wheels, the radius connecting the flanges and the treads of the wheels, and the radius of the gauge corner of the railhead.

Railway Gazette Vol. 79 July 1943, p 38

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1283)
DOTL RP

A1 039636
RAIL WEB FAILURES
Out of 30,881 failures of new rails in U.S.A. tracks in 1942-51, and removed during that period because of defects, 13,554, or 44 percent, were web failures. The great majority of the latter were failures within the area of the rail joint. Laboratory and track tests showed that many web failures could be explained by corrosion-fatigue but not by corrosion alone. Various factors increase the web stresses at rail ends. One is poor or irregular fit of fishplates; loose or worn fishplates or loose fishbolts have a bad effect, as they are liable to cause greater impacts to develop under the rolling load. Excessive gaps at the rail-joints or battered rail ends similarly tend to increased impacts.

Code, CJ (Pennsylvania Railroad) *Railway Gazette* Vol. 102 Feb. 1955, p 162

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1332)
DOTL RP

A1 039653
EXPERIENCE WITH WELDED RAILS
The railroads in the U.S. in the early 1950's began substituting 78-ft. rails for the 39 ft. standards. The 78-ft. rails decreased the number of joints by 50 percent, which justified the longer rail on the basis of a corresponding savings on maintenance. The same equipment can be used to lay both size rails. Wild grinding to reduce the bulge at the weld is discussed. The repair of continuously welded rail is described.

Railway Gazette Vol. 103 Sept. 1955, pp 343-344

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1349)
DOTL RP

A1 039659
MINISTRY OF TRANSPORT ACCIDENT REPORT
A ten-coach passenger train derailed on January 23, 1955, due to excessive speed on a curve on a substitute route while engineering work was being performed on the main-line, loss of life, passenger injuries and property damage were heavy. The accident was blamed on the driver; however, lack of speed restriction signals contributed to the accident.

Railway Gazette Vol. 103 Oct. 1955, pp 484-486, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1357)
DOTL RP

A1 039668
THE SAFE LIFE OF RAILS EXAMINED
The rail sections considered are the 109-lb. fb and rBS 95-lb. bh rail, both in common use on British Railways. Among the conclusions reached by the authors is the fact that the rail sections standardized by British Railways are of sufficient strength for long life under existing steam traffic where maintenance is good and corrosion not severe. But, they believe that rail life should be governed by the type, speed, and quantity of traffic carried rather than by loss of weight. Furthermore, they suggest that any practical way of altering rail joints to increase their life should be investigated and that the development of special joints for the ends of welded rails would appear necessary irrespective of any stress-relieving requirement.

Wise, S Lindsay, D Duncan, IGT *Railway Gazette* Vol. 112 Jan. 1960, pp 64-65

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1384)
DOTL RP

A1 039676
LONG-WELDED RAILS ON BRITISH RAILWAYS
Prior to installing long welded rail, British Railways conducted a thorough 5 year investigation of the factors and potential saving to be realized. Among other things, a formula was derived to predict the buckling load of any type of track under any conditions. Additionally, it was found that concrete sleepers were more suitable with long welded rail than wooden ones. Details on how the British accomplished their modernization--began in 1955--are provided.

Railway Gazette Vol. 112 June 1960, p 644

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1393)
DOTL RP

A1 039683
ACCIDENTS ON BRITISH RAILWAYS IN 1959
There were a total of 1154 accidents in 1959. Of these, 609 were attributed to the human element, 113 were caused by technical defects, and 432 resulted from other causes. Within the causes of the human element category there were 276 collision, 119 derailments, 174 running into obstructions, 7 fires, and 2 miscellaneous accidents. In the technical defects category there were 12 collisions, 69 derailments, 14 running into obstructions, 13 fires and 5 miscellaneous accidents. The other causes category accounted for 130 collisions, 27 derailments, 205 running into obstructions, 42 fires, and 28 miscellaneous accidents.

Langley, CA *Railway Gazette* Vol. 113 Oct. 1960, pp 418-420, 3 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1400)
DOTL RP

A1 039691
CAPABILITY OF FASTENERS TO RESIST RAIL OVERTURNING
The purpose of the investigation was to determine the overturning resistance of the rail fastened to either wood or prestressed concrete ties when subjected to various loading conditions. No effort was made to include the torsional resistance of the rail. The procedure used in testing the rail on the wood ties was accomplished by fastening a short piece of 136 lb. rail and tie plate to a new treated oak tie by four spikes in pre-bored holes. The rail on the prestressed concrete tie was fastened by two bolts and two AREA Specification clips with a 3/16 in. polyethylene plastic pad between the rail and concrete. It was found that rail on the prestressed concrete ties is capable of carrying considerably more lateral load than the rail fastened to wood ties with spikes. An analytical study conducted at the Research Center indicates a definite relation between the wheel lifting off the rail, wheel climbing the rail and the lateral and vertical loads on the rail. The results of the analytical study shown on Fig. 11 indicate that all values of P(sub v)/P(sub L) smaller than 0.78 have no significance as the wheel will climb the rail and thus relieve the lateral load component on the rail. Lateral wheel loads as large as 30,000 lb have been recorded and for this condition, the analytical study indicates the wheel will not climb the rail until the vertical component of the rail load is 23,400 lb or lower. It was concluded that the method of fastening the rail to the prestressed concrete ties, as recommended in the Preliminary Specification for Design, Materials, Construction and Inspection of Prestressed Concrete Ties, is satisfactory for the imposed lateral forces.

Association of American Railroads Technical Center Tech Rpt ER-77, Nov. 1967, 14 pp, 11 Fig, 4 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1470)
DOTL RP

A1 039693
TRACK GAUGE WIDENING ON TANGENT TRACK--ROLLER BEARING TIE PLATE TESTS--MILE POSTS 614.08 AND 626.61
A problem of gauge widening on tangent track led to these tests with instrumented ties with roller bearing tie plates and an instrumented diesel-electric locomotive. The road bed was in average condition, with the track of 133 lb. rail. Conclusions drawn from these tests were as follows: No class of locomotives or cars individually were found to exert a lateral force at the test site sufficient to result in the gauge widening being experienced. The cars created a greater number of and higher values of lateral forces than the locomotives involved. Dynamic braking of the trains produced no noticeable lateral forces in the trailing unit of the locomotive consist or the head end cars. The faster trains created higher forces than the slower trains. Apparently the gauge widening had resulted from the high utilization of the track and high train speeds.

Flebbe, PE
Union Pacific Railroad File 340

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1472)
DOTL RP

A1 039697
GP-7 LOCOMOTIVE WHEEL TO RAIL LATERAL LOADING TEST ON ILLINOIS CENTRAL RAILROAD
The report is based upon testing conducted by EMD to determine causes of derailments which involved GP-9 locomotives. The EMD Test Car was used to determine wheel loading levels for the GP-9 locomotive to determine

wheel loading at the derailment sites. The test train from which data for this report was obtained represented a typical freight train operating in normal service through the areas where previous derailments occurred. The loads measured between wheel and rail during the testing were substantially below levels which are normally considered necessary to cause derailment by wheel climbing rail, rail turn-over, or shift of entire track structure. The maximum steady state net lateral load measured on the guiding wheel was 13,200 lbs. which represents 41.2% of the nominal wheel vertical load. Accompanying this load was a 5,400 lb. axle lateral load which represented 8.5% of the nominal axle vertical load. The above loads were measured in a 6-1/2 inch curve. Threshold tendency of wheel climbing rail is generally expected when net lateral force on guiding wheel is 90 to 100% wheel vertical load. Rail turnover demands that total lateral load compared to total vertical load on an entire rail length unsupported, or practically unsupported, by adjacent lengths gives a ratio great enough to cause the load resultant to fall outside of the base of the rail. Dynamic instanteous peak loads which are of very short duration resulting from sudden rail irregularities (joints) are not believed to affect wheel climbing rail or rail turn-over. Train speed did not significantly change steady state forces in a particular curve. However, increased speed did significantly change the level of dynamic loading as much as 200%.

Klinke, WR
General Motors Corporation Tech Rpt 119, Mar. 1965, 49 pp, 33 Fig, 18 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1477)
DOTL RP

A1 039698
ANALYSIS OF WHEEL-RAIL LOADING OF FP-45 LOCOMOTIVE ON A 3 DEGREES 3' TRACK CURVE SANTA FE RAILROAD
This report is an investigation of lateral loading of an EMD FP-45 locomotive to determine the relationship to derailments. Included is a comparison between the FP-45 and other six, four and two axled locomotives. Finally, with a discussion of lateral load data and dynamic lateral forces, the report concludes that the derailments caused by rail turnover were the result of poor rail joints which were present in the section.

Marta, H
General Motors Corporation Tech Rpt 898-133, Feb. 1968, 19 pp, 1 Fig, 45 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1478)
DOTL RP

A1 039904
RAIL FAILURES ON BRITISH RAILWAYS
The article is a survey of the kind of rail failures on the British Railways which lead to rail removal. Tables include failures by type and cause, rail failures by year, and frequency of failure between plain rail and switch/crossing rails. Effects of methods of manufacture, environments and seasonal conditions are also discussed.

Dearden, J (British Railways) *Railway Gazette* Nov. 1957, pp 509-511, 3 Fig, 3 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-554)
DOTL RP

A1 039943
STEEL RAIL FAILURES
Rail failures occurring on the German State Railway from 1928 to 1937 are summarized. The German testing program for selecting rail steel is compared with that used in Great Britain. Various types of breakages are examined according to rail weight, track classification, proximity to rail joints, as well as breakages in rail head, web and flange. The data are tabulated.

Herwig, V (German State Railway) *Railway Gazette* Vol. 71 July 1939, pp 52-56, 2 Fig, 4 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1321)
DOTL RP

A1 039954
MINISTRY OF TRANSPORT ACCIDENT REPORT
A fully-braked screw-coupled freight train, consisting of 34 cars and a caboose, derailed June 21, 1955, at a running speed between 40 to 45 mph. The derailment occurred at the 21st car, which had faults in its spring attachments. A drawing shows the securing spring shoes of the type that failed on the derailed car. The springs were of the ordinary laminated type designed to bear on the axlebox centers, with their two ends bearing against steel shoes fastened to the underside of the wooden solebar. It was concluded that looseness of the spring shoes combined with uneven loading would have permitted excessive oscillation and diagonal pitching and that this motion caused the derailment.

Railway Gazette Vol. 104 Apr. 1956, pp 207-208, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1363)
DOTL RP

A1 039980
THE RAIL SHELLY CRACK IN JAPAN
Investigation into the growth mechanism of shelly cracks and a method of prevention is reported. Examinations included track condition, materials quality, loading condition and friction and wearing phenomenon of affected rails. It was found that in the ordinary contact condition, the contact stress between tyre and rail is so large that plastic flow is caused. With the progress of plastic deformation, steel becomes hard and its elastic limit rises. After these changes, rail surface becomes fit for ordinary wheel load. Though before this time the progress of plastic flow nearly stops, the crack grows through the fatigue due to rolling with slide. It was also found that the existence of ferrite in the surface layer seems to take part in the growth of the crack. As a first step in preventing shelly cracks, rail steel should be strengthened against fatigue. Water decreases the wear of rail and accelerates the development of crack. These conditions promote the growth of the crack due to the rolling fatigue. Secondly, though the decrease of stress is difficult to realize in general, the decrease of lateral force and the decrease of contact stress by decreasing the difference of both curvatures in contact part of wheel and rail are found effective. Thirdly, as it is clear that the existance of water is unfavourable, total stop or restraint of watering is very effective. Since the same effect is achieved by oiling, it is necessary to be careful not to oil excessively.

Nakamura, R Owaku, S Enomoto, N *Railway Technical Research Institute* Vol. 6 No. 3, Sept. 1965, pp 34-44, 21 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1445)
DOTL RP

A1 039982
MEASUREMENT OF LATERAL STRENGTH OF RAILWAY TRACK BY "LATERAL STRENGTH TESTING CAR" (1ST REPORT) MECHANISM OF TESTING CAR
The "Lateral Strength Testing Car" represents a two-axle bogie car additionally attached with a one-axle testing truck which carries a mechanism, which applies a vertical and a lateral load to the center axle, a mechanism which lifts the said testing truck above the rails and an oscillograph for recording the vertical and lateral loads. The car answers the questions: How much lateral load can the track withstand? and under what conditions and in what process a derailment of a car takes place? Procedures for measuring these quantities are provided.

Tanahashi, H *Railway Technical Research Institute* Vol. 4 No. 2, June 1963, pp 46-48, 4 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1447)
DOTL RP

A1 039983
SOME EXPERIMENTS ON SHELLING CRACKS IN RAILROAD RAIL (NO. 1) TWO DIMENSIONAL PHOTOELASTIC EXPERIMENTS ON A MODEL HAVING A FINE EDGE CRACK UNDER CONTACT LOAD
The shelling cracks grown in the head of rails are said to be fatigue cracks which are produced by excessive rolling pressure of wheels passing over them. The detailed mechanism of failure, however, has not yet been made clear. To find whether the growth of cracks be due to repeated shearing stress or mainly to repeated tensile stress is necesary both for clarifying the

mechanism of shelling and for selecting the rail material. Two dimensional photoelastic investigations were carried out on half planes having a fine edge crack to which a contact load was applied and the fringe patterns at the end of the cracks were observed. When a semicircular model is pressed to a model which has an edge crack inclined at an angel of 30 degree to the contact surface, there grows a tangential force along the fracture surface when the contact load comes above the crack. When the contact load has an inclination toward the crack the tangential force along the fracture surface has a tendency to increase. When a semicircular model is pressed vertically to a model which has a vertical edge crack and the contact load comes adjacent to one side of the crack, there acts the largest tangential force along the fracture surface and the shearing stresses concentrate at the end of the crack, but the tensile stress does not appear. It is supposed from the above facts that the direction of a shelling crack in rail developing under contact loading will be affected by the shearing stresses solely or at least predominantly.

Enomoto, N Tanaka, N *Railway Technical Research Institute* Vol. 3 N3 Sept. 1962, pp 34-37, 6 Fig, 3 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1448)
DOTL RP

A1 039986
CONTACT PRESSURE BETWEEN WHEEL AND RAIL AND ITS INFLUENCES ON MECHANICAL PROPERTIES OF RAIL STEEL
Since it was felt that there was still some uncertainty regarding various investigations on the very high contact pressure between wheel and rail and in relation to failures occurred in the heads of rails. It was decided to obtain additional data on the phenomena. This article addresses the following: contact pressure between rail and wheel, plastic deformation of rail steel due to local compression hardness distribution under running surfaces of used rail, and workbrittleness of rail steel.

Ito, A *Railway Technical Research Institute* Vol. 3 No. 1, Mar. 1962, pp 21-25, 8 Fig, 2 Tab, 7 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1451)
DOTL RP

A1 039988
TRACK SURFACE AND CAR DERAILMENTS
Tests under laboratory conditions to determine the effect of warped track surface as a cause of derailment of freight cars and the flange pressure required to turn the trucks under freight cars have led to certain conclusions contrary to the accepted beliefs of many competent engineers and railroad officers. Among the definite conclusions indicated by these tests may be mentioned the following: That a rigid and a flexible track are equally effective in resisting a tendency to derailment caused by warped track surface; that center-plate resistance plays little part in the total resistance which must be overcome in turning trucks on curves, and that grease lubrication of center plates has no appreciable effect on truck turning resistance. It is interesting to note that, in general derailment occurred with less depression than super elevation of the outer rail. In general, it is evident that side-bearing clearance is the most important single factor, so far as the car is concerned, affecting derailments caused by warped track surface, and it is evident that flexibility of car structures plays no small part in keeping cars on the track where side-bearing clearance is small or altogether absent.

Railway Age Vol. 85 No. 17, Oct. 1928, p 794

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1453)
DOTL RP

A1 039990
INVESTIGATION TO DETERMINE THE CAUSE OF "SUDDEN" WIDE GAGE ON THE DELAWARE AND HUDSON RAILROAD
The purpose of this investigation was to determine the cause of this "sudden" gage widening. It would appear that this gage widening would most probably be caused by a jackknifing condition. This investigation measured the jackknifing forces developed under heavy pushing. The first part of the investigation was made on a 3 deg curve. A special test train was used consisting of a number of diesel units in dynamic braking and 15 loaded hopper cars, including one 100 ton car, to provide the pushing resistance at one end, an 89 ft. TTX flat car and short hopper in the middle and the pushing diesel units under test at the other end. Four special ties and eight roller bearing tie plates were installed near the middle of the 3 deg curve to measure and record the lateral forces exerted by the equipment on both inner and outer rails. Strain gages were placed on the rail webs to measure the vertical wheel loads. The lateral displacement between the first and second diesel units and the total locomoitve drawbar force were also measured. The investigation did not result in finding any clear cut and specific answer as to the cause of the occurrences of "sudden" wide gage. However, it appears most likely that the occurrences were due to lateral forces exerted against the outer rail as a result of locomotive jackknifing under dynamic braking.

Sckinke, R Akalin, MT
Association of American Railroads Technical Center Test Rpt Oct. 1966, 44 pp, 21 Fig, 9 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1455)
DOTL RP

A1 040008
REPORT OF BOARD OF INQUIRY ON ACCIDENT AT COLISEUM STATION, BAY AREA RAPID TRANSIT DISTRICT, SAN FRANCISCO, CALIFORNIA
The accident occurred during test operations at the Coliseum Station on November 2, 1971, when a BART vehicle travelling about 25 MPH, collided with the rear car of a parked BART train. The train operator was injured. The accident, which occurred in manual mode, underscores the wisdom of the early planning decisions to design the BART system on the most fully automatic basis possible. Such a collision will be very unlikely once the automatic system is in operation because of the basic fail-safe design. Despite the speed of impact, there was little damage beyond the bulk heads of the attendant's compartments in the impacting cars. The accident was attributed to human failure to apply the brakes in sufficient time or at a sufficient rate to effect the stop.

Stokes, BR
Bay Area Rapid Transit District 19 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1491)
DOTL RP

A1 040011
RECENT EVOLUTION IN ON THE RAIL INSPECTION ON THE S.N.C.F.
Ultrasonic probing enables an operator, shifting a transductor over the surface of the railhead, to assess the extent of a crack. Rail inspection by ultrasonic apparatus employs two methods: vertical probing by a straight line transductor where the steel is subjected to a longitudinal beam of waves; and oblique probing by a transductor subjecting the steel to a refracted beam of transversal waves forming an angle of 65 degrees to 70 degrees with the vertical. The transversal fatigue cracks due to rail-head fatigue often causing railbreaks are detected by oblique probing. The present permissible speed at which the transductors are made to move along the rail is 12 km/h. The annual number of rail-breaks on the inspected lines which was about 1,100 has fallen to under 400, the majority of breaks being due to defects non-spottable by probing.

French Rail News Vol. 1 1969, pp 12-13, 9 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1494)
DOTL RP

A1 040015
TRAFFIC IN A CURVE WITH RAILWAY COACHES FITTED WITH INCLINABLE BODIES
Further tests of the pendular type coach have been effected, during which the body has been given a boost to speed up the time taken for it to get the correct inclination when negotiating connecting transition. This is done by means of a hydraulic ram monitored by a accelerometer detecting, permanently, the non-compensated acceleration. Another arrangement is being worked out with a coach for which the axis of oscillation is below the center of inertia of the body. Tests are described which show that it is possible to get a coach to negotiate a curve with 0.3 insufficient cant, which is considerable, by employing assisted pendular motion. The first tests have shown that the assisted pendular motion gives considerably improved smooth riding while negotiating the transition as compared with natural pendular motion.

French Rail News Vol. 3 1970, pp 40-42, 8 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1498)
DOTL RP

A1 040026
RESEARCH INTO STRESSES IN TRACK
The extensive investigations that have been made in the past few years into the stress conditions obtained in the track structure (from rail to sub-structure) have resulted in positive evolution of the design and dimensioning of rails, ties and ballast bed. The results of this research are detailed, showing by graphs and tables the stresses in rail heads and flanges. The service requirements for the various sizes and strengths of rail are described. [German]

Eisenmann, J (Munich Technical University) *Eisenbahntechnische Rundschau* Vol. 20 No. 1,2, Feb. 1971, pp 64-70, 9 Fig, 2 Tab, 8 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1509)
DOTL RP

A1 040031
THE INFLUENCE OF BALLAST BED THICKNESS AND TIE SIZE AND SPACING ON SUB-STRUCTURE LOADING
The steady increase in axle loading of railway vehicles and in train speeds not only cause greater stressing of the rails, but also higher loading of the sub-structure. Test results and theoretical considerations show the influence that the size, shape and spacing of the ties, the thickness of the ballast bed and depth of the formation, have on the loading of the sub-structure. Conclusions included the following: a ballast bed over a bad substructure that will carry 20 tons axle load, when over a good substructure, cannot carry more than 25 tons axle load. For axle loads of 30 tons, a protective layer over the substructure and a deepening of the ballast bed are necessary. With regard to the stresses on the ballast bed from an axle load of 25 tons to 30 tons, the tie spacing must be made smaller and with longer ties, the depth of the ballast bed and the thickness of the protective layer over the road bed can be kept to lesser limits. [German]

Eisenmann, J (Munich Technische Hochschule) *Eisenbahntechnische Rundschau* Vol. 19 No. 8, Aug. 1970, pp 309-317, 11 Fig, 3 Tab, 1 Phot, 11 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1514)
DOTL RP

A1 040043
CRITERIA FOR TRACK GEOMETRY DESIGN AS RELATED TO MODERN EQUIPMENT
A proposal is being considered for establishing standards for the minimum tangent distance between reverse points of various degrees of curves to permit negotiation of the curves by long, box cars having 68-ft. truck centers and coupler force less than 200,000 lb. A list of tangent lengths with corresponding degrees of curvature are shown.

Hillman, AB *AREA Bulletin* 1970, p 414

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1526)
DOTL RP

A1 040061
STUDY OF RAIL FAILURES IN THE TRACK--STANDARD RAIL FAILURE STATISTICS
The main object was to define the type and form of presentation of rail-failure information to be supplied by various ORE Member Administrations so as to permit the better use of such information-and to draw some concrete conclusions. Committee D 88 found great difficulty in identifying a suitable denominator to which the rail failures could be related for purposes of comparison between administrations. In the absence of a more reliable denominator rail failures were related to the kilometres of track concerned with the type of failure being compared. This should enable Administrations to decide whether their present policies in regard to choice of rail section, steel quality, rail welding, joint design, track maintenance policy, rail renewal frequency (only to quote the main factors), require any alteration.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Intrm Rpt. D88/RP 1/E, Apr. 1965, 22 pp, Tabs., 9 App.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1544)
PURCHASE FROM: UIC Repr. PC
DOTL RP

A1 040065
LATERAL FORCES ACTING ON THE TRACK DUE TO NOSING OF CARS
Depending on the type of motion, equations for determination of lateral forces produced by motion of cars on tangent track can be divided into two main groups: (a) without contact of flange and rail, (b) with contact of flange and rail. it is pointed out that Verigo's equation for calculating lateral forces accounts for such factors as angle of impact, condition of track and suspension component and equivalent mass and overall elasticity much more realistically than previously developed solutions.

Railroad Transport Vol. 8 1964, 6 pp, 1 Tab, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1560)
DOTL RP

A1 040078
DYNAMIC LOADING AT RAIL JOINTS--EFFECT OF RESILIENT WHEELS
This study of a simplified vehicle model passing over an idealised dipped rail joint using values applying to a BR Class 86 locomotive shows that resilient wheels give an equivalent reduction in unsprung axle mass of 2,500 kg. The following conclusions were made: The suggested model for a broadened analysis of the vertical response of vehicle and track at a dipped rail joint is workable and produces dynamic wheel load values which are in full agreement with observed data. Fitting a Class 86 locomotive with resilient wheels will have the effect of reducing the dynamic wheel load increment at severe dipped rail joints by some 40 percent. The effect of resilient wheels on a Class 86 locomotive--based on the dynamic loading at rail joints--is equivalent to a reduction of the unsprung mass from 4,200 kg to 1,700 kg on the leading axle. Thus the results of the analysis suggest that a power-unit comprising axle-hung motors and resilient wheels is a highly competitive alternative to conventional, mechanically complicated and expensive arrangements used to obtain fully-suspended traction motors.

Bjork, J (Svenska Aktiebolaget Bromsregulator) *Railway Gazette* Vol. 126 June 1970, pp 430-434, 9 Fig, 1 Tab, 7 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1574)
DOTL RP

A1 040080
LOADING OF LIGHT RAILS
Highlights of a paper presented at a meeting of ICE. The author describes cases of known damage to rails and sleepers caused by excessive loading and reviews some investigations which have been carried out into the problem. It is suggested that further attention to rail design is needed to ensure that the maximum loading benefit is obtained. There is a need for establishing the maximum loading and best arrangement of locomotive axles for any given weight of rail. One of the conclusions reached by the author is that use of the continuous elastic-support theory as a means of assessing the safe loads and stresses caused on the track by locomotives is useful in designing the axleloading and layout, but with heavy axleloads the curve effects on rail-fillet stresses become the critical factor. With smaller wheel diameters the local railhead stressing effects must also be watched.

Kesson, JM (East African Railways and Harbours) *Railway Gazette* Vol. 114 Jan. 1961, pp 35-36

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1576)
DOTL RP

A1 040082
STABILITY OF LONG-WELDED RAILS
In 1953 an exhaustive testing programme was initiated by the Civil Engineering Laboratory to investigate the conditions and factors affecting the stability of long-welded rails, mainly pertaining to British Railways field conditions. To study the factors involved in track buckling, lateral deflection was induced on a 120-ft. length of track mounted on rollers with a distance between lateral reaction points of 20 to 106 ft. It was soon seen that conventional deflection formulae did not apply, especially in respect of overall stiffness of track, and that this varied with the length deflected,

amount of deflection, sleeper-spacing, type of rail fastening, and rail section. These preliminary investigations took no account of the effect of ballast. To obtain information on the behavior of sleepers, rails, and fastenings simultaneously, a lateral bending test was devised for deflecting a 30-ft. section of track under lateral point-loading. Various sleeper-spacings and types of fastening were used and suitable formulae were evolved. The effect of ballast was investigated in a series of tests to ascertain its resistance to the lateral and longitudinal movement of both timber and concrete sleepers. In the main buckling tests on a 120-ft. test-bed, a length of track was subjected to thermal stresses in such a way as to simulate the central portion of a length of long-welded rail which does not move with changes of temperature. Loss of load in the track when buckling occurred as a result of rail expansion could be calculated from the gauge readings and the alignment of the buckled track.

Railway Gazette Vol. 115 Aug. 1961, pp 180-181

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1578)
DOTL RP

A1 040093
SIDE THRUST ON TRACK AT HIGH SPEEDS
Measurement of lateral forces on wheels and track for high speed running on the Tokaido line were carried out in two different ways; by measuring and recording the stresses in the wheels of an inspection test car, and by measurements on the track. These measurements were made for speeds up to 150 mile/h.

Railway Gazette Vol. 121 July 1965, pp 529-530, 3 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1589)
DOTL RP

A1 040096
PROPULSION OF TRAINS ON SHARP CURVES
A model to simulate the forces resulting in overturning and flange-climbing with propelled trains on sharp curves led to a series of tests arranged on a sharp curve at Dover. An axlebox lateral-force gear was used to measure the elements of the flange force present at the axleboxes, and load measuring baseplates were fixed between the outer rail and the sleepers to measure the vertical loads imposed by the wheels as well as the lateral loads. The latter are equal to the flang forces, less the lateral tread friction at the outer rail. The results of these tests showed that the increased lateral force when propelling exceeded considerably the value attributable to the propulsive effort and the angle between the coaches.

Pocklington, AR (British Railways Board) *Railway Gazette* Vol. 121 Nov. 1965, pp 909-912, 7 Fig, 1 Phot, 2 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1592)
DOTL RP

A1 040099
HIGH LATERAL FORCES ON SHARP CURVES WITH PROPELLED TRAINS
In an effort to explain why the outward forces on the trucks of propelled trains are greater than can be explained by the angle present between center lines of the vehicles, British Railways conducted a test on curved track to determine vertical loads and lateral forces. Six special baseplates were installed on adjacent sleepers on the test curve to record vertical loads and lateral forces between rail and sleeper. It was found that lateral forces towards the outer rail when propelled are considerably greater than when hauled. A more severe speed restriction on a particular curve is of little assistance because speed, and hence centrifugal force, is low anyway. The increase of lateral force towards the outer rail when the train is propelled is accompanied, at the leading outer wheel of a bogie, by increased vertical load so that the possibility of flange-climbing derailment is not altered appreciably. Propulsion on a sharp curve produces an overturning movement on the train. For severe locations its magnitude should be restricted by a limitation on tractive effort.

Pocklington, AR Brown, TP (British Railways Board) *Railway Gazette* Vol. 121 Dec. 1965, pp 993-996, 4 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1595)
DOTL RP

A1 040116
RUNNING THROUGH CURVES
Simple methods for the determination of forces and wear are discussed. Flange forces are determined by constructing a Heumann Minimum Diagram of the friction moment curve. A Vogel diagram is plotted to show the center line of the vehicle in a curve. The center of friction is located mathematically in the Vogel diagram. Axlebox clearance values are determined from the diagrams and corresponding force diagrams are plotted.

Koffman, JL (British Railways Board) *Railway Gazette* Vol. 123 Apr. 1967, pp 307-311, 7 Fig, 1 Tab, 27 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1612)
DOTL RP

A1 040120
RELATION BETWEEN TRACK IRREGULARITIES UNDER TRAIN LOADS AND NO LOAD
Track irregularities were measured under train load conditions using a new high speed inspection car, Maya 341. The sizes of the irregularities were compared with the sizes measured under no load conditions with a light weight, Yoshiike type, inspection car. A unique rule connecting measurement under load versus no load conditions could not be formulated. Relationships are established for load versus no load conditions in a mathematical model.

Ikemori, M *Railway Technical Research Institute* Vol. 4 N2 June 1963, pp 48-50, 4 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1616)
DOTL RP

A1 040122
DYNAMICS OF RAIL FAILURES IN THE TRACK
The propagation conditions of the following defects were studied: transverse cracks in the head; horizontal cracks in the head; and starcracking at fish-bolt holes. The main object was to attempt to determine the length of time after the appearance of detection of the failures during which the rails could be left in the track before dangerous failure became imminent. Laboratory tests failed to determine this time factor. Field test results from the Paris suburban railway are briefly described for the three types of defects. Laboratory measurement of transverse defects showed the electric method gave more accurate results than the ultrasonic method using pulse echoes.
Question D88

International Union of Railways Rpt ORE PU-25, July 1967, pp 33-35

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1618)
DOTL RP

A1 040158
DERAILMENT REPORTS
This document consists of a collection of 12 derailment reports covering freight train accidents in 1970 and 1971 on both curved and tangent track. Speed, consist, damage, injuries, and causes are among the data presented.
Unpublished Reports

Magee, GM 18 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1900)
DOTL RP

A1 040171
PERMISSIBLE SPEED OF FREIGHT CARS ON CURVES
In Part I, the dynamic effects due to lateral roll motion of a freight car are analyzed and the position of the resultant dynamic force with respect to center line of track for cars having 71, 85 and 99 inches combined center of gravity heights is calculated. These calculations use data on the amplitudes of the lateral roll motion of a fully loaded 70-ton 55-ft gondola which were measures during an extensive series of running tests on the Lackawanna Railroad in 1955. In Part II, calculations, based on extensive tests with freight cars having center-of-gravity heights of 71, 85 and 99 in with 3 11/16 in travel springs and conventional snubbing, were used to establish the elevation for curves and maximum permissible speeds for the operation of freight trains.

American Railway Engineering Association Vol. 70 1969, pp 1019-10, 29

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-697)
DOTL RP

A1 040173
1964 EARTHQUAKE DAMAGES TO THE ALASKA RAILROAD
The 536-mile Alaska Railroad, which operates from two tidewater ports, Seward and Whittier, on the north Pacific Coast, through to central interior Alaska suffered intense damage. Some 200 miles of railroad were totally immobilized. All communication with line points were disrupted. The damage was such that it was impossible to use the railroad to reach the distressed areas. In excess of 110 bridges were rendered unserviceable; miles of track were warped out of line and rails twisted. Landslides accounted for over 2 1/2 miles of lost grade, leaving rails suspended in mid-air. The port and terminal facilities at Seward were all but wiped out by a combination of seismic action, tidal waves and fire. Whittier fared somewhat better, but was far from operable. Two hundred and twentyfive pieces of rolling stock were either lost or badly damaged. The Railroad property loss was estimated at $35,000,000. Photographs of some damaged areas are shown. Railroad repair problems are briefly discussed.

Cook, IP (Alaska Railroad)
American Railway Engineering Association Vol. 66 1965, pp 750-755, 7 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-898)
DOTL RP

A1 040176
DETECTION OF WHEELS WITH DEFORMED TREADS
The operation of rolling stock with defection wheels can have a detrimental effect on the track, causing additional rail stress and ultimately rail breakage. In addition, axleboxes and underframes can be damaged and to a lesser extent vehicle bodies. The degree of damage depends on the depth and length of wheelflat and the train speed. Presently, harmful effects of defective wheels are controlled through the implementation of regulations which define tolerances for wheelflats and wheels with material accumulations. Also, some administrations have adopted certain braking designs and procedures to minimize wheel damage. However, it is suggested that what is needed is better detection methods for early identification of problems.
Question A110

International Union of Railways ORE PUB NO 29, July 1969, pp 29-30, 4 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1442)
DOTL RP

A1 040177
STUDY OF RAIL FAILURES IN THE TRACK--STUDY ON THE DYNAMICS OF RAIL DEFECTS
The following rail defects were investigated: star-cracking at holes within fishplate limits; horizontal cracks in the head; and transverse cracks (kidney-shaped fatigue crack) starting within the head. The report also formulates some observations on the dynamics of each of the defects, namely: irregular development of star-cracks; checking or "stagnation" of horizontal cracks in the head; propagation of transverse cracks, according to an exponential law. The report concluded that the irregular development of star cracks depended on a large number of factors, of which the condition of the rail-joint and the maintenance conditions appeared to be the most important. The same was true in the case of horizontal cracks in the head at the rail-end.
Restriction on the use of this document are contained in the explanatory material.

International Union of Railways Intrm Rpt. D88/RP 2/E, Oct. 1965, 14 pp, 5 App.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1545)
PURCHASE FROM: UIC Repr. PC
DOTL RP

A1 040178
STUDY OF RAIL FAILURES IN THE TRACK--MEASUREMENTS IN THE TRACK OF THE SIZE OF INTERNAL TRANSVERSE RAIL FAILURES-- STUDIES OF THE SNCB CONCERNING THE DYNAMICS OF FAILURES IN THE RAIL-ENDS
This report deals with the tests for assessing the extent of transverse cracks of internal origin in the rail-head; these tests were made in the ORE track at Villeneuve-Triage marshalling yard. The studies were concerned with test methods and instruments used and an evaluation of the results obtained by each method considered. It was found that for the determination of the extent of transverse failures of this order of magnitude and for those which should be examined in the track within the scope of studies of the dynamics of rail failures, both the ultrasonic and electric procedures can lead to comparable results, which are, moreover, nearer to reality.
Restriction on the use of this document are contained in the explanatory material.

International Union of Railways Intrm Rpt. D88/RP 4/E, Oct. 1966, 14 pp, Figs., 16 App.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1546)
PURCHASE FROM: UIC Repr. PC
DOTL RP

A1 040179
STUDY OF RAIL FAULTS IN THE TRACK--STANDARD RAIL FAILURE STATISTICS 1965 RAIL FRACTURES CAUSING DERAILMENTS
This report provides an account of rail failures for 1965 compiled by nineteen Administrations. The report also includes a study on broken rails having caused derailments. A primary distribution of the failures bases on their location is failures at rail-ends, failures away from rail-ends, and butt-weld failures. The principle rail defects classified according to their cause are failures attributable to manufacturing defects, failures attributable to service, failures which may be attributed either to manufacturing defects or to service, and failures due to butt-welding or thermit-welding and rebuilding of surfaces.
Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Final Rpt. D88/RP 5/E, Apr. 1968, 15 pp, Figs., Apps.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1547)
PURCHASE FROM: UIC Repr. PC
DOTL RP

A1 040187
ROCK OFF DERAILMENTS
A tabular summary of rock-off derailments indicating curvature, elevation, velocity and cause is provided for about 30 accidents.
Unpublished Report

Baltimore and Ohio Railroad, Chesapeake and Ohio Railway 5 pp, 5 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1555)
DOTL RP

A1 040189
REVIEW OF A RUSSIAN ARTICLE CONCERNING THEIR APPROACH TO TRACK DESIGN AND MAINTENANCE
Three means of reducing track maintenance are being instituted in Russia in order to counter the 30-60% reduction in productivity of gangs caused by heavy traffic. It is estimated that each kilogram of rail weight reduces cost of track maintenance by 1.4-1.6%. Therefore use of the lightest size P-43 is being discontinued. New standards of track design utilizing welded rail would reduce maintenance of way by 14-20%. A 5 cm. increase of depth of ballast in 20 x 10 to the 6th power ton/klm. areas reduces labor cost by 5-7% and an annual reduction of stone by 500,000 cubic meters. [Russian]
Translation of Russian article prepared by S.G. Guins

Railroad Transport Vol. 2 1965, 2 pp, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1570)
DOTL RP

A1 040194
ON THE RELATION BETWEEN SUPERELEVATION AND CAR ROLLING
Weighting function of the track inspection car for rolling is obtained by random data analysis and this weighting function is verified practically. Some applications of this function are shown.

Nakamura, I (Japanese National Railways)
Japan Railway Civil Engineering Association Vol. 9 N1 Dec. 1961, pp 10-16, 14 Fig, 5 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1653)
DOTL RP

A1 040195
VEHICLE SUSPENSION AND BOGIE DESIGN IN RELATION TO TRACK CONDITIONS
The relationship of vehicle suspension to track conditions is expressed analytically. Significance of coning lies in its property to transmit and magnify the effects of track misalignment to the vehicle body. This effect will become greater as tread wear develops. In the event of build-up of wheel movement, flang-climbing and bogie hunting oscillations may occur. The effects of conicity can be reduced in new designs by the provision of positive guiding of axles by means of telescopic or other guides, together with roller bearing boxes and wheels having a minimum of coning, to avoid running against one rail. Frictional effects of laminated springs and suspension links transmit shock vertically and laterally from the track, and the elimination of such friction is desirable and beneficial. Suspension link length is important, and an increase in length will diminish the transmitted shock. A relationship has been established between track shape and vehicle response, which may be applied by a special application to an analog.

Hancock, RM (British Railways) *Institution of Locomotive Engineers Journal* pp 457-565, 35 Fig, 10 Ref, 6 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1654)
DOTL RP

A1 040206
INVESTIGATION OF FAILURES IN CONTROL-COOLED RAILS
The failure analysis of eight rails is reported. Three failed due to transverse fissures from shatter cracks; three failed due to transverse fissures from hot torn steel; and two failed by compound fissure from overheated ingot. This last mode of failure had not previously been recognized.

Cramer, RE (Illinois University, Urbana)
American Railway Engineering Association Vol. 65 N No. 84, Feb. 1964, pp 525-529, 2 Tab, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1665)
DOTL RP

A1 040208
METALLURGICAL EFFECT OF RAIL-CROPPING METHODS
The results of a questionnaire, returned by 24 of 36 railroads, regarding uses of cropped rail and methods used for cropping are reported. Micrographs are shows of the grain structure and hardness resulting from cutting using a friction saw. The cutting caused the metal to flow. If cropped rail is to be used for welded rail by the flash-butt welding process, the heat effect of the cutting is of no consequence.

Hall, VE
American Railway Engineering Association Vol. 65 N No. 84, Feb. 1964, pp 573-576, 3 Tab, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1667)
DOTL RP

A1 040209
SHELLY RAIL STUDIES AT THE UNIVERSITY OF ILLINOIS
Three rolling-load tests of induction-hardened rails from Japan averaged 2,715,000 cycles. Two rolling-load tests of a standard carbon 115-lb rail averaged 3,063,000 cycles. Two rolling-load tests of 100-lb continuous-cast rail from Europe averaged 2,027,000 cycles. Flame-hardened high-silicon rails failed at 1,005,800 cycles and 3,834,000 cycles. Rolling-load tests of a series of rails flame-hardened at different speeds are reported. One group averaged 2,947,000 cycles and the other two groups all failed at less than 1,000,000 cycles. Rolling-load tests on one flame-hardened specimen from Dominion Steel Co. ran 3,857,000 cycles.

Cramer, RE (Illinois University, Urbana)
American Railway Engineering Association Vol. 65 N No. 84, Feb. 1964, pp 598-605, 1 Tab, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1668)
DOTL RP

A1 040210
INVESTIGATION OF FAILURES OF WELDED RAILS AT THE UNIVERSITY OF ILLINOIS
Three weld failures are reported in 115-lb rail. One was caused by poor fusion in the weld. The second was believed caused by a flake of mill scale caught between the rail ends during welding. The third failure was a web crack through the head on both sides of the weld. Thirteen bend test are reported, which were made on full-section rails.

Cramer, RE (Illinois University, Urbana)
American Railway Engineering Association Vol. 65 N No. 84, Feb. 1964, pp 611-614, 1 Tab, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1669)
DOTL RP

A1 040211
INVESTIGATION OF WELDED RAILS AT THE AAR RESEARCH CENTER
Results of the investigation of 13 welded rail failures are reported. Two were oxyacetylene pressure butt welds and 11 were flash butt welds. Five defects were in the rail before welding; the remainder were in the weld itself.

American Railway Engineering Association Vol. 65 N No. 84, Feb. 1964, pp 615-629, 1 Tab, 25 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1670)
DOTL RP

A1 040213
DISCUSSION ON STRESSES IN RAILROAD TRACK
The inspection tests of rail-joints in track made for the purpose of learning the source of the wear of the joint bars and the rail, the places of wear, information bearing on the mutual interaction of the worn bars and rail when under load and when the bolts are newly tightened, and other information relating to the stability and maintenance of the rail-joints have given desirable information. The occurrence of high stresses in the unloaded worn joint bars in track due to the tightening of the bolts was found to be as great as 30,000 and 40,000 lb. per sq. in. and in a few cases as high as 60,000 lb. per sq. in. The stresses were fairly proportional to the amount of the lateral bending put into the bar by tightening the joints, measured from the loose condition. The instruments designed and built to facilitate the measurement of profiles and shapes and straightness of joint bars and rail and their position with respect to each other in the joint have proved satisfactory.

Talbot, AN (Illinois University, Urbana)
American Railway Engineering Association Vol. 36 pp 957-958

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1676)
DOTL RP

A1 040217
WHEEL, AXLE, AND RAIL STRESS PROBLEMS RELATED TO HIGHER CAPACITY CARS--PART IV-EFFECT ON RAIL
Those items that have been found advantageous in reducing shelling caused by higher capacity (85 to 100-ton) cars are wheel loads should be limited in proportion to wheel diameter. Higher strength material in the rail will greatly reduce shelling but not entirely eliminate it (under the wheel loading conditions existing with 70-ton capacity cars before the allowable load was increased 5%). Modified rail head contours in today's modern rail sections which approach the average worn wheel condition, have been helpful in reducing shelling. Rail lubrication on curves extends the rail life but results in the removal of more rails for shelling rather than abrasive wear.

Stampfle, RB
American Society of Mechanical Engineers Paper Nov. 1963, 13 pp, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1680)
DOTL RP

A1 040220
RESEARCH ON THE OPERATING STRESSES IN PATH RAILCAR AXLES, DRIVE SYSTEMS, WHEELS, AND RAIL JOINTS
This paper identifies the cause of premature cracking of axles with inboard bearings as being the bending-mode oscillation of the axle. It points out the importance of gear-tooth separation produced by torsional oscillations in the drive motor system in both right angle and parallel drive gear failures. A unique technique of simultaneous measurement of impulse and thermal loads on the wheel tread is explained and the test data are presented. The relation between the wheel impact loads and the dynamic behavior of rail joints is shown.

Yontar, M (New York Port Authority :)
American Society of Mechanical Engineers Conf Paper 66-RR-6, May 1966, 21 pp, 33 Fig, 2 Phot, 36 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1683)
DOTL RP

A1 040227
LATERAL LOADING BETWEEN LOCOMOTIVE TRUCK WHEELS AND RAIL DUE TO CURVE NEGOTIATION
Curve-negotiation mechanics and forces resulting when locomotive trucks negotiate curves are well recognized. However, meaningful and reasonable prediction of forces resulting in service conditions has been limited. An instrumented wheel-axle assembly was developed and used on 2,3, and 4-axle trucks to study the effect of creep and the transverse load reactions resulting between wheel and rail. Instrumentation was used to measure these forces and the reactions between axles and truck frame under operating conditions. Test results confirm predicted phenomena and indicate the effect of creep on resulting loads. This paper includes a brief and general review of curve-negotiation mechanics and presents the test results and their relation to the theoretical analysis.

Contributed by the Railroad Division of the ASME at the Annual Winter Meeting, Chicago, Illinois, November 7-11,1965.

Koci, LF Marta, HA (General Motors Corporation)
American Society of Mechanical Engineers Paper 65-WA/RR-4, Nov, 1965, 11 pp, 7 Fig, 18 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1691)
DOTL RP

A1 040234
NUMBER OF TRAIN ACCIDENTS BY GENERAL CAUSES EXPRESSED AS PERCENT OF TOTAL
The total train accidents in the United States from 1935 to 1969, are divided into the percentage caused by the following factors: negligence of employees, defect in or failure of equipment, defects in or improper maintenance of way and structures, and all other causes. The first two categories together accounted for about 70 percent of the accidents through 1960. These two causes dropped as a percentage of the total to only 55 percent in 1968 and 1969.

Unpublished Data

Abex Corporation Sept. 1971, 1 pp, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1698)
DOTL RP

A1 040249
WHEEL AND RAIL LOADING FROM DIESEL LOCOMOTIVES
A review of various test programs conducted jointly by the Electro-Motive Division of GM and selected railroads is presented. These tests covered not only the wheel-rail loadings of locomotives but the effects of some on rail. This review is divided into the following six areas: 1. Sample Derailment Data; 2. Basic Curve Negotiation Mechanics; 3. Experimentally Determined Wheel-to-Rail Forces; 4. Rail Profile Data; 5. The Effect of Dynamic Brake Levels; and 6. Mechanical Considerations.

Koci, LF
General Motors Corporation Apr. 1971, 50 pp, 28 Fig, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1713)
DOTL RP

A1 040250
CRACKS AT RAIL ENDS
The occurrence of cracks at rail ends in the upper fillet and at the first bolt hole were investigated by the Engineering Division Research Staff. It appears that the development of these cracks is related to the use of rail joint packing, consisting of a mixture of wood flour and oil. The accompanying photographs are typical of the cracks found; the corrosive attack is clearly indicated. Seven railways have reported the development of these cracks where joint packing has been used. Others have removed rail joints where the packing was applied and found no cracks. It seems evident that in some instances the rail joint packing has contributed to the development of rail end cracks, and the indications are that a corrosive effect has either so lowered the fatigue strength of the steel that crack developed or that stress corrosion cracking has developed in the areas of high tensile stress in the upper fillet and around the first bolt hole.

Magee, GM
Association of American Railroads e4083, Oct. 1947, 7 pp, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1714)
DOTL RP

A1 040251
LETTER ON OCCURRENCE OF CRACKS IN RAIL ENDS
Results of a survey on inspection of rail joints with and without rail joint packing are presented. Table A includes those railways which report the development of fillet or bolt hole cracks where the packing has been used. Table B includes those railways which report no cracks. The Corrosion Research Laboratory of the Illinois Institute of Technology has been conducting tests with rail joint packing to determine whether stress corrosion cracks can be produced in accelerated laboratory tests in specimens of rail steel. These tests included both new packing and user packing removed from rail ends that had developed cracks. It has not been found possible to produce stress corrosion cracks with extracts from either the new or used packing in the accelerated laboratory tests. Accordingly, it has not been possible to determine that any chemical action of the joint packing is responsible for the cracks that have developed in service.

Magee
Association of American Railroads e7191 File IV-3-C, Oct. 1948, 3 pp, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1715)
DOTL RP

A1 040252
JOINT DEFLECTION AND RAIL END BATTER ON 130 LB RAIL EMPLOYING UNCONVENTIONAL METHOD OF LAYING
The purpose of this test was to determine if rails matched and laid in a continuous stretch of track with ends in same position as when passing through the hot saws at the rail mill show less joint deflection and rail end batter than rails received from the mills and laid in the usual way. The matching and laying of rails for the test produced 92 joints where ends were matched due to different ingots and rail classification. Initial measurements of joint deflections and rail end batter were taken during May 1930, and these measurements were repeated at intervals over a period of eight years. The final inspection was made during May 1938. It was concluded that to load, identify, distribute and lay rail matched in the same order as rolled and hot sawed at the mill would unquestionably result in higher manufactoring and rail laying costs than now exist. The results of this test with a limited number of rails matched, compared with rails not matched, show no improvement over the usual method of shipping and laying rail.

Penn Central Transportation Company Test No. 72, Apr. 1945, 7 pp, 2 Fig, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1716)
DOTL RP

A1 040254
COMPARISON OF RAIL ABRASION, END BATTER AND DEFLECTION FOR 130 LB., 131 LB., AND 152 LB. RAIL
Rail abrasion, and batter, and joint deflection measurements were made on 130 lb., 131 lb., and 152 lb. rail on adjacent stretches of track east of Tyrone,

Pa. Various joint bars were employed. Maintenance cost records were also recorded for this stretch of track. Early measurements, particularly of joint deflection, gave large variations in deflections from joint to joint, and led to removing and measuring a considerable number of bars showing high and low joint deflection. The results of these measurements indicated a need for better mill inspection to control vertical camber and led to a more thorough control of camber ranges during manufacture. Also the initial use of the "Toeless" type of bar such as applied in this test indicated a pronounced tendency to "cocking" the bars during first application and led to development of the present yoke gauge now in general use for applying the "F" types of bars to prevent "cocking". The 152 lb. and 131 lb. "F" type bars in this test were badly cocked when first applied. In the joint deflection comparison a good showing is made by the 131 lb. rail (untreated) with the B-1 type bar (Plan 66194-B) both on tangent and sharp curves. As to rail end batter the 131 lb. (untreated) rail with B-1 bars also gives the least amount of batter on tangent and sharp curves after eliminating the 131 lb. (heat treated) rail from which it would be expected less batter would occur. For the various weights of rail (untreated) on curves the 152 lb. rail had an additional service of one year over 130 lb. rail and three-fourths year over 131 lb. rail before it was necessary to transpose the rail. Measurements of rail abrasion during the period of test shows a marked decrease in abrasion on both tangents and curves for the 152 lb. and 131 lb. rails over the 130 lb. rails all untreated. Maintenance costs have been largely affected by local conditions, particularly differences in drainage and in the new tie territory of 130 lb. rail previously mentioned.

Graham, FM
Penn Central Transportation Company Test No. 142, May 1938, 10 pp, 4 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1719)
DOTL RP

A1 040256
ROLLER AND DROP TESTS OF POTENTIALLY DEFECTIVE RAIL

Roller tests and drop tests were conducted on a batch of rail suspected of having interior defects. A Sperry hand testing device had been used to indicate the defects. A total of 25 rails were subjected to the roller test. A camber of 13/16" on rolls spaced 90 in. apart was used. All 25 rails endured the test with out fracture. Next, the rails were submitted for drop testing. This was carried out with the rail placed on a 48" span with a drop of 22 feet and the blow of the tap was directed at the location marked by the Sperry hand check. Results indicated that interior defects were not present.

Penn Central Transportation Company Test No. 172, July 1931, 2 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1721)
DOTL RP

A1 040257
WEAR OF IN-SERVICE SWITCH RAILS

A series of three related letters address the problem of excessive wear in switch points. Attempts to relate the wear problem to rail chemistry and hardness are described. It was thought that rail with higher carbon content would resist flow and show less wear than rail low carbon contents. Hardness could not consistently be related to wear.

Penn Central Transportation Company Test No. 181, July 1931, 4 pp, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1722)
DOTL RP

A1 040258
BATTER TEST OF 151 LB. R.E. RAIL

This report covers a test of 151 lb. R.E. rail in which the base and lower portion of the web at the rail ends is cut square while the head and upper portion of the web is mitred, the change in angle of out taking place about the center of height of web. The mitre makes an angle of 60 degrees with the line of track. For the purpose of test the above rails were laid on the Pittsburgh Division in No. 1 Eastward Freight Track east and west of Ardara on April 27, 1935. For comparison, 67, 131 lb. X-Rails with ordinary square ends were laid at same time adjacent and west of the mitred rails on the same track. After one night's traffic had passed over the rail initial measurements of rail and batter were taken. It was concluded that insofar as rail end batter there is no advantage in the use of mitred end rails over ordinary square cut end rails as determined by batter measurements over a period of one year and-1/2 months service in heavy tonnage freight track.

Graham, FM
Penn Central Transportation Company Test No. 240, June 1937, 5 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1723)
DOTL RP

A1 040259
RAIL ABRASION AND END BATTER OF CONTROL COOLED 131 LB. R.E. RAILS

This is a progress report showing results of rail abrasion and end batter of control cooled 131 lb. R.E. rails rolled and treated by various manufacturers and laid during 1935. The Illinois and Bethlehem rails were laid on the Middle division No. 4 westbound passenger tracks on tangent and 4 degrees 0" curve east and west of Lewistown, Pa. The Carnegie and Inland rails were laid on the Panhandle Division No. 1 eastbound passenger and freight track on tangents and curves ranging from 3 degrees 14' to 7 degrees o" west of Carnegie, Pa. It was found that for the tangent track the differences in both abrasion and batter as between thermal treated and ordinary hot bed cooled rails are hardness of the rail has resulted from the thremal treatment. The information for curve is not directly comparable on account of wide variations in curvature where measurements were obtained. There have been no transverse fissures or other failures in either the test or comparative rails during the three year period between measurements.

Penn Central Transportation Company Prog Rpt Test No. 245, July 1939, 3 pp, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1724)
DOTL RP

A1 040273
STRESS CORROSION OF RAIL WEB STEEL (STATIC)

The test included six rail joint segments containing one bolt hole with a bolt inserted to make the joint. It also included twenty steel specimens taken from rail steel which were subjected to static bending stresses. The twenty corrosion test specimens were tested after nearly twelve and one half years of exposure to the elements. The joint segments were tested approximately one month later. All of the test specimens were cleaned throughly and examined in the laboratory by Magnaflux and Magnaglow methods for the presence of corrosion cracks. While there was considerable pitting to be found, the laboratory examination disclosed no cracks in any of the specimens. This test shows that static stress combined with corrosion has little or no effect upon the development of cracks in rail web steel.

Code, CJ (Pennsylvania Railroad)
Penn Central Transportation Company Test Rpt Test 475, Nov. 1960, 16 pp, 2 Fig, 1 Tab, 9 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1742)
DOTL RP

A1 040274
ARRANGEMENT OF RAIL ANCHORS ON TRACK HAVING MAJOR TRAFFIC IN ONE DIRECTION BUT SIGNALLED FOR MOVEMENT IN BOTH DIRECTIONS

The test consisted of two stretches, one at Metuchen on the New York Division and one at Edgewood on the Maryland Division. Each stretch was signalled for movement in both directions. Application of rail anchors in five different arrangements was made on new 155# rail. From experience gained in this test it may be concluded that six anchors with traffic are seldom sufficient on a main line track. With regard to reverse anchoring it may be concluded that two reverse anchors are sometimes, but not usually sufficient. Four reverse anchors appear to be sufficient in all cases. For track having major traffic in one direction but signalled for use in both directions, a minimum of 8 normal and 4 reverse anchors be used and that they be applied in the present conventional arrangement with reverse anchors being applied to the opposite side of normally anchored ties.

Code, CJ
Penn Central Transportation Company Test Rpt Test No. 482, July 1957, 5 pp, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1743)
DOTL RP

A1 040277
140-LB. RAILS TO FINE GRAIN STEEL (ALUMINUM ADDED TO THE INGOT)
The purpose of this test was to determine if inherently fine-grain steel will resist shelling better than rails of ordinary steel. Frequent inspections of the test installation were made, and it was observed that the fine-grain and ordinary rails performed nearly alike. In 18 months' time the flaking and head checks were much in evidence, and after two years of service, head checking and flaking were well advanced. A derailment in November 1956 damaged three of the fine-grain rails. A previous laboratory examination of the rails had revealed that the fine grain steel had practically the same mechanical properties as the coarse grain steel as measured by tensile tests and Brinnel hardness. It was concluded that fine grain steel produced by addition of aluminum to the ingot as used in this test, offers no advantage for use in rails.

Code, CJ
Penn Central Transportation Company Test Rpt Test No. 588, Dec. 1959, 9 pp, 2 Fig, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1750)
DOTL RP

A1 040278
DETERMINATION OF PLASTIC FLOW IN RAIL HEAD
The purpose of the test was to determine the amount of plastic flow which takes place in the gauge corner of a rail on the high side of a curve under conditions which produce shelling. The rails were laid on the Bolivar Curve. At this location the track was laid with 140-lb., 1948 rail, which in August 1953, was showing flaking and light shelling. This is a 4-degree curve with 4-inches superelevation, authorized speed 45-mph, and carries moderate to heavy eastward freight traffic. Records kept in connection with another test indicate a tonnage of approximately 29,000,000 gross tons annually. The three test rails were installed August 17, 1953. Inspection September 12, 1955, showed light flaking on all three rails. On the high rail of curves there is a flow of metal at the top gauge corner of the rail toward the gauge side. This flow of metal extends to a depth of 1/4-inch to 3/8-inch below the rail surface. The magnitude of deformation is positive evidence of shear stresses well beyond the yield point of the steel.

Code, CJ
Penn Central Transportation Company Test No. 591, Aug. 1971, 19 pp, 5 Fig, 1 Tab, 7 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1751)
DOTL RP

A1 040279
RAIL WEB STRESSES IN HIGH SPEED TERRITORY
The purpose of the present test was to determine if possible the cause of frequent split web failures in the joint on 131-lb. RE rail on the Fort Wayne Division, and in 152-lb. PS rail on the New York Division. Web failures in 131-lb. and 152-lb. rail on the Fort Wayne and New York Divisions are adequately explained by the corrosion fatigue theory. The ocassional bolt hole failures in 133, 140, and 155-lb. rail are not readily explained. A 50% allowance for impact is justifiable based on measured wheel loads. Application of reformed bars changes stress distribution in the rail web and in many cases increases web stresses, accelerating rail web failure. Loose bolts and increase in rail end gaps increase rail web stress. The results of this test emphasize the need for protection of rail steel against corrosion, for maintaining standard bolt tension, a good fit between bars and rail, and good surface through joints.

Code, CJ
Penn Central Transportation Company Test Rpt Test No. 597, June 1960, 6 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1752)
DOTL RP

A1 040281
ALLOY STEEL RAIL (CHROME-VANADIUM OR "CV")
The CV rail was laid in October 1953, in connection with regular rail renewals. The location was selected because it was one where moderate shelling had developed in the previous 131-lb. rail over a period of about 11 years. A total of 47 CV rails were laid--16 on the low side and 31 on the high side of the curve. Measurements of gauge superelevation, ordinates and rail head wear were made. A final inspection of CV rail was made on October 29, 1959, at which time 30 CV rails remained in track. There was no indication of shelling, although, some flaking was noted on the CV rail, and there was no indication of rail and defects. The results of this test have shown the CV alloy steel of the composition used to be unreliable. Its good wearing qualities and superior resistance to shelling are over-shadowed by its poor resistance to impact.

Code, CJ
Penn Central Transportation Company Test Rpt Test No. 645, Jan. 1960, 23 pp, 3 Fig, 1 Tab, 15 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1754)
DOTL RP

A1 040282
FLAME HARDENED AND HEAT TREATED STOCK RAILS
Flame hardened and heat treated stock rails were installed at locations where the open hearth stock rail had shown short life due to excessive wear, primarily flange wear. Flame hardening and heat treating produced a Brinell hardness on the rail head of approximately 350. Both the flame hardened and heat treated stock rails gave better performance than the open hearth stock rail; however, the flame hardening process resulted in considerable vertical distortion of the stock rail, as much as five feet in 60-ft. As a result, this type of hardening was discontinued. While this test was installed initially to investigate the reduction in flange wear, the use of heat treated stock rails to date and the results of heat treated rails used for other purposes indicate that they provide greatly increased life and reduced maintenance as compared with ordinary stock rails where crushing and plastic flow cause frequent renewal.

Code, CJ
Penn Central Transportation Company Test Rpt Test No. 608, Apr. 1960, 10 pp, 1 Tab, 6 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1755)
DOTL RP

A1 040283
FLAME HARDENED VS HEAT TREATED AND MANGANESE CROSSINGS
The purpose of this test was to determine the relative value from a service point of view of flame hardened crossings, as compared with heat treated and manganese crossings. Two flame hardened, one heat treated and one maganese crossings were installed on new timber supports in a two over two track crossings, making an angle of 71 degrees 38'. All crossings were interchangeable. These crossings were installed on May 2, 1953. On the September 8, 1954, inspection it was found that excessive batter on one of the flame hardened crossings made renewal necessary. Initial cost, maintenance required, as well as service life indicate a preference for the heat treated crossing over the flame hardened.

Code, CJ
Penn Central Transportation Company Test Rpt Test No. 613, Dec. 1957, 9 pp, 3 Fig, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1756)
DOTL RP

A1 040290
APPLICATION OF AMERICAN CURVE LINING CORPORATION CROSS LEVEL INDICATOR TO TRACK PATROL CAR
The cross level indicator is rectangular, eleven inches long, ten inches high and two inches deep. The dial opening is about ten inches long and four inches wide. The dial scale is graduated to read cross level in inches, from zero at the center of the dial to eight inches at the extreme ends of the dial. The indicator is geared to and actuated by a pendulum which is dampened with oil. The instrument had an accumulative error of 3/64 of an inch for every inch of superelevation reading on the dial. The indicator did not always return to zero when the instrument was returned to level. This unit is very sensitive to vibrations. To date the results of this test indicate that this unit is unsatisfactory. The present instrument should be retained for trial application to a separate unit to be propelled by hand or track car.

Code, CJ
Penn Central Transportation Company Test Rpt Test No. 729, Apr. 1959, 3 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1763)
DOTL RP

A1 040293
RAIL ANCHOR RESISTANCE IN TRACK
Six panels of track were tested at two locations. Resistance to rail anchors was developed by applying a longitudinal load to the end of each rail in a panel of track; this load was transmitted through rail anchors and ties to ballast. The load was applied by means of two hydraulic jacks and manually operated hydraulic pump. The panels at Lewistown having every tie anchored failed at a total load of 32,000 pounds while the panel having alternative ties anchored failed at 29,000 poinds. Panels at Parkersburg having every tie anchored failed at an average total load of 20,000 pounds while the panels having alternate ties anchored failed at an average total load of 18,000 pounds. Actual resistance to longitudinal movement, per panel, depends on type and quality of track structure.

Code, CJ
Penn Central Transportation Company Test Rpt Test No. 767, Oct. 1961, 17 pp, 3 Fig, 6 Tab, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1766)
DOTL RP

A1 040295
RELATIVE HAZARD INVOLVED IN WEB CRACKS OF VARYING LENGTH DETECTED BY AUDIGAGE
For testing, eight rails having web cracks from 0.25 to 9 inches in length along the centerline of the web were prepared by joining them with a pair of reformed joint bars, to a sound rail end of the same section, making a combined specimen somewhat over six feet in length with a joint at the center. These specimens were placed under the million pound machine with supports 60-inches apart, the joint at the center, and the load applied at the extreme end of the sound rail at the center of the joint. The loading was increased until ultimate failure in the rail end was obvious. Two rails with cracks through the bolt hole were also tested. On the first series of tests, except for one rail which had a nine inch crack, the load had to be carried beyond that which gives a bending moment corresponding to what can be expected in track. In the second set of tests rail loading caused the cracks to lengthen. It is still recommended that rails with cracks over 5 inch in length be removed as is required by Audigage testing procedure.

Code, CJ
Penn Central Transportation Company Test Rpt Test No. 784, Nov. 1962, 6 pp, 1 Fig, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1768)
DOTL RP

A1 040296
REPORT TESTS OF STABILITY OF 100 TON CAPACITY HOPPER CARS UNDER VARIOUS TRACK CONDITIONS HOLLIDAYBURG, PA.
Tests were started in June 1966 and completed in January 1967. No. 14 track, approximately 3600 feet in length, including 1000 feet of two degree curve, was selected as a suitable test site. Tangent track test runs were made with the track warped successively at intervals of 19'-6", which is normal joint stagger for 39 foot rails, and intervals of 31 and 39 feet. Curve track tests were made with the track warped at 19'06" and 15'-6" intervals. The modified H43 loaded hopper car and the H46 loaded covered hopper car should satisfactorily negotiate an indefinite succession of cross level changes in opposing directions of 1-1/2 inches in tangent track, 1 inch on curves with no more than 5 inches of superelevation and 1/2 inch where the superelevation exceeds 5 inches, regardless of speed. Continuous succession of cross level changes limits speed to 15 mph. The unmodified H43 loaded hopper car should satisfactorily negotiate an indefinite succession of cross level changes in opposing directions of 1 inch in tangent track, but not more than 1/2 inch on superelevated curve track regardless of speed. Continuous succession of cross level changes limits speed to 10 mph.

Hammond, WT Dixon, LA
Penn Central Company Test Rpt 4 pp, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1769)
DOTL RP

A1 040299
CHARTS OF SELECTED TEST RUNS ON AAR TEST CURVE ON LOUISVILLE AND NASHVILLE RR
Lateral acceleration and roll angle are shown for test runs on the AAR test track. Three and six inch elevations, and 0.5, 0.25, and 0.34 inch shims were used. The vehicles had 2.5 or 3.7 inch springs, and in one test, volute snubbers and widened gibs. Wheel lifts were recorded.
Unpublished Data.

Association of American Railroads Technical Center 8 pp, 8 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1772)
DOTL RP

A1 040315
WEAR LIFE OF HEAT TREATED 131 LB., 18 FT. SWITCHES
This brief letter correspondence records the fact that an in-service test of heat treated switches progressed to the point where the first switch was removed because of excessive wear after 27 months of service. This was considered about seven times the life of an ordinary switch. The cost of this 130 lb., 18', heat-treated switch was $161 which was thought to be the cost of untreated switches at the date of purchase.
Unpublished Correspondence.

Penn Central Transportation Company Test No. 129, July 1933, 1 p

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1718)
DOTL RP

A1 040375
A COMPUTER STUDY OF DYNAMIC LOADS CAUSED BY VEHICLE-TRACK INTERACTION
Computer analyses of vehicle and track are producing enlightening results regarding actual dynamic loads and the manner in which various parameters of vehicle and track structure affect these loads. Using this information, it is possible to decide more intelligently how to alleviate the high wheel-rail stresses caused by today's unique traffic and track conditions. Possible solutions range from better track maintenance to different wheel rail geometries to changes in stiffness and damping of trucks and the track structure itself.

Meacham, HC Ahlbeck, DR (Battelle Memorial Institute) *ASME Journal of Engineering for Industry* Aug. 1969, pp 808-816, 12 Fig, 3 Tab, 3 Phot, 11 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1825)
DOTL RP

A1 040381
THE RELATION BETWEEN THE SWAYING OF HOPPER CARS AND THE STAGGER OF RAIL JOINTS IN TRACK
Freight cars with high-center-of-gravity loads sway considerably, especially on tracks with low joints. To produce synchronism, the time of swaying must have a definite relation to the speed of the train. A principle that maybe used to destroy cumulative swaying is that the stagger of rail joints must be such that a car must hit, simultaneously, a pair of joints, the joints being in opposite lines of rails. A second principle is that the stagger should be unequal in such a way that enough joints occur at suitable phases of swaying to neutralize the effects of the other joints. Frictional resistance helps in this principle. The amplitude of swaying may be increased by a series of low joints, provided that the swaying of cars synchronizes with the impulses given by the joints.

Leffler, BR
American Railway Engineering Association Vol. 27 1926, pp 1243-51, 2 Fig, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1831)
DOTL RP

A1 040397
REPORT ON A STUDY OF TANK CARS INVOLVED IN A COLLISION AT CRETE, NEBRASKA
On February 18, 1969, a Chicago, Burlington & Quincy eastbound freight train derailed cars and freight cars standing on an adjacent double-end

siding. The group of standing cars included three tank cars loaded with anhydrous ammonia. The center car of this standing group of tank cars was a stub-sill, non-insulated tank with a nominal capacity of 33,500 gal. In the collision, the tank ruptured, permitting contents to escape. Temperature-impact energy transition curves from the Charpy tests are shown. The fracture of the Crete tank car was almost entirely of a brittle nature. The metallurgical processing of the tank led to a microstructure conducive to low toughness and a high NDTT.

Byrne, R
Association of American Railroads Technical Center Test Rpt MR-454, July 1969, 83 pp, 15 Fig, 10 Tab, 37 Phot, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1860)
DOTL RP

A1 040413
QUALITY OF RAILS AND MEANS OF GUARANTEEING IT--FALLING WEIGHT TESTS AND DEFINITION TESTS (1ST AND 2ND SERIES OF TESTS)
The main object of these tests--was to define and to standardize the conditions of use of the falling weight tests laid-down in UIC Leaflets 860-1-0 and 860-2-0, for the acceptance of rails of current quality and rails of nontreated steel of a quality resistant to wear. It was concluded that a falling weight test, irrespective of its type, is not representative of the fatigue behavior of rails in the track, but it was considered advisable to retain for the time being, such a test on complete pieces of rail, to make it possible to detect and eliminate brittle rails with a large degree of probable success and to maintain each rail production within a truly characteristic and correct scatter range.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Intrm Rpt. D45/RP 5/E, Apr. 1963, 35 pp, Figs., Apps.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1876)
PURCHASE FROM: UIC Repr. PC
DOTL RP

A1 040414
QUALITY OF RAILS AND MEANS OF GUARANTEEING IT--CONDITIONS OF USE FOR TECHNICAL SPECIFICATION UIC 860-1 CONCERNING: DIMENSIONAL TOLERANCES, FALLING WEIGHT TEST, TENSILS TEST-PIECE, DETECTION OF PIPING
The conditions of application of UIC Specification No. 860-1 were investigated relative to dimensional tolerance, falling weight test, tensile test piece, and detection of piping. Initially, rail tolerance measurements indicated that the majority of mill-produced rails were not acceptable, but if specified tolerances were strictly adhered to, it was felt the price of rail would increase greatly. Since users were reasonably satisfied with currently produced rail, the tolerance applicable to web thickness, inclination, and openings of the fishing angles were relaxed. When UIC Specification No 860-1 was initiated in 1954, it constituted the first step towards the standardization of the falling weight test. The Committee now offers a choice between two methods of carrying out the falling weight test; one method involves two successive blows applied to the test pieces rolled from a certain number of ingots, the other involves one blow and is applied to test pieces rolled from every ingot. Because of the nature of the steel used for wear-resisting rails, the corresponding UIC Specification 860-2 has been drafted to include a tensile test piece of 10 mm diameter. The Committee to propose the standardization of the 10 mm diameter test piece. One result of this decision is that the minimum elongation will have to be raised from 12 to 14% in the case of ordinary rails. This test has been found to be not very accurate and of limited interest, since in reality it only permitted the revelation of piping in the rail without offering the possibility of its true appreciation. The Committee therefore sought another test for inspection purposes which would reveal piping in an indisputable manner. After considerable research, they have decided on a test which consists of the examination of the polished slice of rail intended for the macrographic (sulpher print) test.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways D45/RP 2/E, Mar. 1962, 37 pp, Figs., Tabs., 34 App.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1877)
PURCHASE FROM: UIC Repr. PC

A1 040416
BEHAVIOUR OF THE METAL OF RAILS AND WHEELS IN THE CONTACT ZONE-RESIDUAL STRESSES IN THE RAIL (CONTINUED) STUDY OF THE WORK-HARDENED ZONE
This report contains the results of measurements taken to study the work-hardening caused by traffic, and more especially the changes in the residual stresses in the rails near the running tread which constitute an important factor in the study of rail fatigue phenomena. About 5 mm below the surface the work-hardening is very large, and the rail is the center of a hydrostatic pressure zone extending down to a depth of approximately 10 mm, this then changing into a tensile one with a maximum at about 15 mm. This may explain why the fatigue cracks (of the kidney-shaped flaw type) tend to originate at a depth of 10 to 20 mm but do not develop in the upper highly compressed zone. Furthermore, the residual-stress fields vary from one section of the rail to another, probably as a result of the oscillations of the wheel-loads due to short-wave rail corrugations.

Question C53 Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Report No. 6, Oct. 1970, 58 pp, 36 Fig
DOTL RP

A1 040417
BEHAVIOUR OF THE STEEL AT THE POINT OF RAIL-WHEEL CONTACT- INTRODUCTORY STUDY ON THE CAUSES OF SHELLING CRACKS IN RAILS
This report reviews pertinent literature on the subject of shelling cracks in rail head. From the research conducted at the University of Illinois it is concluded that shelling cracks in rail heads are primarily due to fatigue under repeated rolling action. Obvious methods of reducing the development of shelling cracks would be to reduce wheel loads on the rails, to use larger diameter wheels or to use stronger rail steels. Future research should be directed towards the closing of the gap between standard fatigue data and the fatigue phenomenon as it occurs under contact stresses due to rolling action. At the moment, the prime difficulty in correlating tensile or torsion and rolling contact fatigue data stems from insufficient knowledge of stress distributions modified with respect to elastic theory by plastic deformation.

Question C53. Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Document No. 1, Oct. 1961, 10 pp, 9 Ref
DOTL RP

A1 040420
INVESTIGATION OF FAILURES IN CONTROL-COOLED RAILS
During the period 13 failed control-cooled rails were submitted to the AAR Research Center for metallurgical examination. All the specimens submitted were checked for metallurgical quality by means of cross sectional and longitudinal macrographs. Failures included, shelling, transverse fissures, base seam, and bolt hole fissures. Photographic evidence illustrates each type of failure.

AREA Bulletin Vol. 66 Bulletin 591, Feb. 1965, pp 447-453, 7 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1885)
DOTL RP

A1 040421
SHELLY RAIL STUDIES AT THE AAR RESEARCH CENTER
Rolling-load test results obtained in a cradle-type machine are listed. Macrographs are presented to reveal cross-sectional qualities of shelly rail. Slow-bend test results are tabulated for flame and induction-hardened rail. It can be noted that all of the rails tested showed excellent results and that no effective stresses were set up between the head and web due to flame and induction hardening.

AREA Bulletin Vol. 66 Bulletin 591, Feb. 1965, pp 484-493, 7 Fig, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1886)
DOTL RP

A1 040422
SERVICE AND DETECTED FAILURES OF BUTT-WELDED RAIL JOINTS
During the period 14 service and detected failures of butt-welded rail joints were submitted for examination to the AAR Research Center. Macrographic and Microscopic examinations of the welds and of both rails adjacent to the joint were made. Since the majority of the butt welding rail in the United States is done by means of the electric flash process, the failures reported in Table 1 are predominantly in the welds produced by this process. Because of the thermal shock produced by this process in the relatively short heated portions at the ends of the rail, failures occur in rails with heavy segregation or fish tail which, before welding were in a homogeneous state, but opened into a discontinuity during the welding.

American Railway Engineering Association Vol. 66 Bulletin 591, Feb. 1965, pp 509-513, 3 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1887)
DOTL RP

A1 040425
INVESTIGATION OF SERVICE AND DETECTED BUTT-WELDED RAIL JOINT FAILURES
In the period between October 1, 1965, and October 1, 1966, sixteen failures, service and detected, in butt-welded rail joints were submitted to the Association of American Railroads Research Center for a metallurgical examination. To date, the investigation has been completed on 9 of these 16 failures, in two oxyacetylene pressure butt weld: It is believed that a result of improper welding practice. Failure in an electric-flash butt weld was attributed to the presence of an electrode burn introduced during the welding process. In other electric-flash butt welds it was disclosed that the rail ends were cropped with a petrogen torch and that the time between cutting and welding ranged from a few days to several weeks. This time lapse is of concern because of the incipient cracks that may form and further develop on subsequent heating operations. A second possible cause for these failures is that the amount of rail cropped from the ends of these secondhand rails was insufficient to remove existing bolt-hole cracks that extend back into the web. In still other electric-flash butt welds, heavy segregation patterns were found.

AREA Bulletin Vol. 68 Bulletin 605, Feb. 1967, pp 372-383, 18 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1890)
DOTL RP

A1 040426
ROLLING-LOAD AND SLOW-BEND TEST RESULTS OF BUTT-WELDED RAIL JOINTS
In the period from October 1, 1965, to October 1,1966, sixteen rolling load tests and six slow bend tests were conducted on butt-welded rail joints at the Association of American Railroads Research Center. The joints were made by the thermite (Thermex Metallurgical, Exomet and Orgotherm), submerged-arc and oxyacetylene pressure-butt-welding process. The rolling-load tests were made on a 12-in-stroke rolling-load machine. Welded specimens were tested for various reasons including: (1) to determine the quality of the submerged-arc-welded rail joints, (2) to evaluate 115-lb thermite welded rail joints made by the Exomet process, (3) to determine the seriousness of making butt welds from rails with hairline cracks of (pipe) in the web. (4) to investigate the possible detrimental effects of a collar that was not removed from an Orgotherm thermite welded rail joint. The slow bend tests were made with the rail resting on supports 4 ft. apart and loaded at 2 points, one on each side of and 6 in. from the weld. These tests were made with the rail base down, thereby subjecting the head to a compressive stress and the base to a tension stress. For satisfactory service performance a minimum of 1.5 in. of deflection and 140,000 psi modulus of rupture are being used as tentative criteria for oxyacetylene and electric-flash pressure butt welds. A summary of the slow bend test results is provided.

AREA Bulletin Vol. 68 Bulletin 605, Feb. 1967, pp 383-396, 16 Fig, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1891)
DOTL RP

A1 040427
BUTT WELD FAILURES
A record of failures in various types of butt-welded rail is presented and briefly analyzed. On the basis of failures per 100 weld years, the failure rates for the oxyacetylene pressure butt welds and electric flash pressure butt welds are low, and about the same, for new rail. It should be noted, however, that the average service period of the oxyacetylene pressure butt welds is 68 percent longer than that of the electric-flash pressure butt welds. For relay rail, the performance of the oxyacetylene pressure weld is somewhat better than that of the electric-flash pressure weld. The failure rate in thermite welds is substantially higher than that for either of the two pressure processes.

AREA Bulletin Vol. 68 Bulletin 605, Feb. 1967, p 397, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1892)
DOTL RP

A1 040428
RAIL FAILURE STATISTICS COVERING (A) ALL FAILURES, (B) TRANSVERSE FISSURES, (C) PERFORMANCE OF CONTROL-COOLED RAIL
These statistics are based on the rail failures reported to December 31, 1965, and are submitted as information. They include the service and detected failures reported by 45 railroads on all of their main-track milage, which constitutes approximately 90 percent of the main track of Class 1 Railroads in the United States. The accompanying tables and diagrams indicate the extent of control of the transverse fissure problem that has been obtained by the use of control-cooled rail and detector car testing, give data on the quality of each year's rollings for the various mills, and show the types of failures that are occurring on the various railroads as related to the mill producing the rail. Also included are data reported on all failures in rail of all ages and sections.

AREA Bulletin Vol. 68 Bulletin 605, Feb. 1967, pp 418-436, 10 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1893)
DOTL RP

A1 040429
EVALUATION OF LINDE'S EXPERIMENTAL 936-89 WIRE FOR BATTERED RAIL END BUILD UP USE
An investigation to evaluate Linde's experimental 936-89 cored wire for rail end build up was conducted based on rolling-load test results, hardness survey results and a metallurgical examination to determine the quality of the weld. Information supplied by Linde relating to the welding procedure indicates that prior to welding, all joints were preheated to 700 F. A Tempil stick was used to determine the preheat temperature. Immediately following the preheat the joints were welded using 425 amperes, 27 volts. Sample rail joint were resurfaced at the butt edge to bring the deposit closer to the edge. These welded, battered rail end sample joints were subjected to rolling-load testing in the 12-in-stroke rolling-load machine. Testing of one sample was discontinued after the joint had been subjected to 4,002,200 cycles in the rolling-load machine because of excessive batter. Testing specimen 154 C was subjected to 2,000,000 cycles in the rolling-load machine. This test was discontinued because of a failure, originally starting as a progressive-type failure from a bolt hole, and later resulting in a head and web separation when the bolts were tightened to a desired tension. Speciments cut from joint 154 A show a normal heat pattern and good weld-metal deposit penetration. A good weld-metal deposit penetration was noted.

AREA Bulletin Vol. 68 Bulletin 605, Feb. 1967, pp 437-452, 16 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1894)
DOTL RP

A1 040431
METALLURGICAL EXAMINATION OF FOUR ELECTRIC-FLASH BUTT WELD SERVICE FAILURES SUBMITTED BY THE FLORIDA EAST COAST RAILWAY
An investigation was made to determine the cause of four electric-flash butt welded rail joint service failures. These four failures are representative of a group of 13 or more failures that occurred in a short period after laying. From the results of this investigation it is believed that these failures are not related to the quality of the rails or the soundness of the welds. It was later disclosed that the rail ends were cropped with a petrogen torch prior to welding. Information was also received that the time between cutting and welding could range from a few days to several weeks. It is possible that incipient cracks formed during cropping of rail ends. Once these incipient cracks have formed, further development of the crack can occur on

reheating, such as during the welding operation. A second possible cause for these failures is that the amount of rail cropped from the ends of these secondhand rails was insufficient to remove bolt-hole cracks that extend back into the web. From this investigation it is believed that these failures can be attributed to (1) cutting the rail ends with a petrogen torch, (2) incomplete removal of existing bolt-hole cracks, or a combination of both these factors.

AREA Bulletin Vol. 68 Bulletin 605, Feb. 1967, pp 460-462, 4 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1896)
DOTL RP

A1 040432
SHELLY RAIL INVESTIGATION, ROLLING-LOAD AND SLOW-BEND TEST RESULTS

Two methods presently employed for improving shelling resistance is the addition of alloying elements and the heat treating of rail. The rolling-load tests in a cradle-type machine are designed to evaluate these methods of improving the resistance to shelling. Rolling-load test results obtained from these cradle-type machines for the period between October 1, 1965, and October 1, 1966, are shown. The S-13 series were initiated to compare the effects of welding prior to flame hardening and flame hardening prior to welding. The electric-flash butt welds were made from secondhand 132-lb HF rail and flame hardened by the Hammon process. Specimens S-13A and S-13C failed after being subjected to 389,800 and 656,900 cycles, respectively. As a result of this performance, rolling-load tests were conducted on welded joints made from 132-lb HF secondhand rail having no flame hardening applied. These joints, S-13E and S-13J, shelled after being subjected to 1,088,000 and 1,163,000 cycles, respectively. Rails flame hardened by the Linde process developed shells after being subjected to 1,254,400 and 844,900 cycles in the cradle-type rolling-load machine. During this period there were no slow-bend tests.

AREA Bulletin Vol. 68 Bulletin 605, Feb. 1967, pp 477-487, 3 Fig, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1897)
DOTL RP

A1 040435
BEHAVIOR OF THE METALS OF RAILS AND WHEELS IN THE CONTACT ZONE--THREE-DIMENSIONAL PHOTO-ELASTIC STUDY OF A LOADED BUT NON-BENT RAIL

The mathematical and modeling studies are being conducted to determine the stresses produced by the strains applied to rails and wheels. The early results of these simulation tests are presented.

Partial Copy-summary only. Question C53 Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Interim Report No. 2, Oct. 1965, 2 pp, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1901)
DOTL RP

A1 040436
BEHAVIOUR OF THE METAL OF THE RAILS AND WHEELS IN THE CONTACT ZONE--ENQUIRY INTO THE PROBLEM OF SMALL DIAMETER WHEELS APPENDIX 3

The observations made at the Mairy mine concerning the wheel-rail dynamics are discussed. The width of the rolling band is wider than on the SNCF and can be explained by wear of the wheel and rail. It could also be due to transverse elastic deformation of the wheel. The calculations and measurements are summarized which were carried out in the laboratory of the SNCF to investigate the influence of the load, the curvature of the rail and the tire, and more particularly of wheel diameter on the stresses to which these components are subjected.

Partial Copy--Appendix Only-Summary of Report Abstracted Separately, Question C53. Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Interim Report No. 3, Oct. 1966, 11 pp, 5 Fig

RESPONSIBLE INDIVIDUAL:

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1902)
DOTL RP

A1 040437
BEHAVIOUR OF THE METAL OF THE RAILS AND WHEELS IN THE CONTACT ZONE--ENQUIRY INTO THE PROBLEM OF SMALL DIAMETER WHEELS

This report summarizes the responses to an enquiry into the effect that a reduction in the diameter of wheels would have on the behavior in service of the rails and wheels. Information was collected on the subject of P/D ratios (P = load per wheel in tons, D = diameter in meters) and includes an analysis of tests carried out by the U.S., Russia, Germany, the British and the French. Very different values of P/D were found, depending on the railway and especially on the type of steel in the rails.

Partial Copy--Appendix 3 Abstracted Separately, Question C53. Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Interim Report No. 3, Oct. 1966, 6 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1903)
DOTL RP

A1 040438
BEHAVIOUR OF THE METAL OF THE RAILS UNDER THE REPEATED ACTION OF THE WHEELS--RESIDUAL LONGITUDINAL STRESSES IN THE RAIL (PART 1)

The residual stresses result: from heat effects during the cooling of the rail after it leaves the rolling mill; from trimming, after rolling in the vertical and horizontal directions; and, from the cold rolling of the top surface of the rail by the passage of loads. The object of this report is: to lay down a method for the determination of residual stresses, and to supply the results obtained by applying such a method in some special cases.

Partial Copy, Question C53. Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Interim Report No. 4, Oct. 1966, 11 pp, 6 Fig, 8 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1904)
DOTL RP

A1 040440
TWO LETTERS REGARDING A DERAILMENT ON JUNE 7, 1968

Two differing opinions are given concerning the roll played by crosslevel variations in the derailment. Prior to the derailment car rocking was aggrevated by changes in crosslevel as much as 2.4 inches in 2.5 rail lengths. Crosslevel differentials are given for several rails near the point where flange marks appeared on the ties.

Letter referred to Abstracted as 1907.

Eisemann, JE Angold, JA (Archison, Topeka and Santa Fe Railway) July 1968, 7 pp, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1906)
DOTL RP

A1 040441
DERAILMENT OF A FREIGHT CAR LOADED WITH LUMBER ATTRIBUTED TO TRACK IRREGULARITIES

The examination of freight cars carrying lumber is reported following their derailment on June 6, 1968. The train was travelling at 52 mph over track having alternating differentials in crosslevel in a few rail lengths. Vertical acceleration coupled with a car with a fairly high center of gravity is believed responsible for the derailment.

Angold, JA (Atchison, Topeka and Santa Fe Railway) July 1968, 3 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1907)
DOTL RP

A1 040442
TESTS CONDUCTED ON CURVE OF THE SANTA FE RAILWAY NEAR ARGENTINE, KANSAS, TO DETERMINE THE CAUSE OF DERAILMENT OF PASSENGER TRAIN NO. 17 ON FEBRUARY 3, 1968

A test was made of four classes of diesel locomotives, followed by a baggage car and 12 additional cars. The train consists simulated the passenger train which derailed February 3, 1968. The maximum lateral and vertical rail forces and lateral to vertical ratios are tabulated for each consist. No L/V values were measured in the tests that were high enough to indicate a

derailment condition was being approached. Tests were made at various speeds and throttle positions and a few runs with dynamic braking. Large variations in axle thrust were measured along the track, so it is unlikely the track measurements were made at a location that would give maximum L/V values.

Letter Correspondence.

Magee, GM
Association of American Railroads July 1968, 28 pp, 12 Fig, 5 Tab, 6 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1908)
DOTL RP

A1 040443
DERAILMENT OF A PASSENGER TRAIN CONSISTING OF A DIESEL LOCOMOTIVE WITH SIX-WHEEL TRUCKS, A BAGGAGE CAR, AND A COACH

Three letters discuss the derailment of June 7, 1968. A sketch of the derailment area and photographs of sections of the track involved are included. This derailment is characteristic of a number of derailments that have occurred on curves at or near permissible speed of passenger trains having locomotives with six-wheel trucks, derailment apparently occurring first of the rear truck of the locomotive unit or the lead truck of the baggage car following. In each case the high rail of the curve was overturned. A high ratio of L/V is required to overtrun a rail and it is unlikely that this high a L/V ratio would be developed in track unless there is some unusual condition such as a jack-knifing of couplers between cars, an unloading of the lead wheel of the truck on the high rail, or some severe wedging action of the truck between rails due to a malfunction of the truck components.

Letter Correspondence.

Angold, JA (Atchison, Topkea and Santa Fe Railway); Stuppi, FN 14 pp, 1 Fig, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1909)
DOTL RP

A1 040444
TESTS CONDUCTED ON A 3-DEG. CURVE ON THE SANTA FE RAILWAY NEAR CHILLICOTHE, ILLINOIS, ON MARCH 3 AND 4, 1969

Two letters described the instrumented location, the locomotives used, the test speeds and throttle positions and the results obtained in a field test. These tests were conducted because two passenger train derailments had occurred on this same curve within less than one year's time. In both derailments the train was powered with GE six axle locomotives. The tests were not considered conclusive because with the instrumentation used the L/V ratio could be determined at only the one location in track.

Letter Correspondence.

Angold, JA (Atchison, Topkka and Santa Fe Railway); Voorhees, JE (Battelle Columbus Laboratories) 15 pp, 6 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1910)
DOTL RP

A1 040445
TEST TO DETERMINE VERTICAL AND LATERAL FORCES IMPARTED TO THE RAIL BY A TYPE U28CG GENERAL ELECTRIC LOCOMOTIVE, SANTA FE CLASS 350

The test runs were made using a train consisting of two lightweight chair cars and three baggage cars and a locomotive of two units, one having the instrumented truck. Tests were run at speeds up to 90 mph on dry rail and moderate temperature. The test results show lateral forces of substantial magnitude being exerted on the rails, an occasional one having a finite duration of ten feet. They also show vertical wheel loads of low value in some locations. The test results indicate it is possible for these two conditions to occur simultaneously on two or three adjacent wheels of a truck and produce an effective L/V ratio of sufficient magnitude to overturn the rail.

Angold, JA
Atchison, Topeka and Santa Fe Railway Test Rpt Aug. 1969, 37 pp, 17 Fig, 3 Tab, 2 Phot, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1911)
DOTL RP

A1 040446
MEMORANDA ON CONFERENCES HELD TO DISCUSS THE DERAILMENT PROBLEM WITH 6-AXLE TRUCK LOCOMOTIVES

Two memoranda discuss derailments involving 6-wheel truck locomotives in which the high rail of a curve has been rolled over. An itemization is made of 20 derailments involving six railroads during the time period 1964 to 1970. The memoranda discuss the deliberations of a meeting between representatives of each of the railroads involved and the AAR.

Angold, JA Lanning, HK
Atchison, Topeka and Santa Fe Railway File 32-03.07, 3 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1912)
DOTL RP

A1 040447
DERAILMENT DATA

A series of derailments are discussed. The majority of the derailments involve a loaded car connected at one or both ends with a cushion underframe car. A test plan is suggested to simulate the derailments by using a loaded hopper car and an adjoining box car with cushioned underframe containing instruments trucks. The instruments would measure lateral and vertical forces exerted on curves similar to the derailment sites.

Derailments described in BCL-1914, Letter Correspondence.

Magee, GM
Association of American Railroads Feb. 1968, 5 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1913)
DOTL RP

A1 040448
LETTER TO AAR REGARDING DERAILMENTS OF HIGH CUBE CARS

Eight derailments occurring between November 1966, and July 1967, are briefly described. All have been written off as the result of wheel climbing on the high rail during rocking.

AAR Reply Abstracted as BCL-1913, Letter Correspondence.

Aug. 1967, 2 pp, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1914)
DOTL RP

A1 040449
DERAILMENTS OF TWO PASSENGER TRAINS

The pertinent facts are given for the two derailment sites and the train consist. In both cases derailment occurred at the rear truck of the last locomotive unit or front of the following car. A drawing of the wide gage is shown of the actual worn wheel and rail contour of the derailed axle involved in the first derailment. Both derailments are not satisfactorily explained.

Unpublished Data.

Magee, GM (Association of American Railroads) 1967, 2 pp, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1915)
DOTL RP

A1 040450
DERAILMENT ON REVERSE CURVE

Four data sheets concern derailments on reverse curves and turnouts. The derailment on the reverse curve involved a hopper car, loaded with bulk clay, which climbed the high rail at 15 mph. The Santa Fe rules for laying and maintaining turnouts are given. One derailment at a No. 8 turnout involved splitting a switch by entering the turnout at 18 mph, proscribed speed was 10 mph. Crosslevel information is given for a derailment at the point of a frog.

See also BCL-1913 and BCL-1914, Unpublished Data.

Magee, GM
Association of American Railroads Oct. 1971, 4 pp, 1 Fig, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1916)
DOTL RP

A1 040452
ANALYSIS OF COVERED HOPPER CAR DERAILMENTS ON THE BALTIMORE AND OHIO RAILROAD
Covered hopper car derailments on the B&O system during 1967 were analyzed to update previous work. The analysis confirmed and strengthened the conclusions found earlier. The conclusions reached were that (1) in-service life has a significant effect on rock-off derailments, and (2) the April 1964 speed restriction was effective in reducing early age derailments of the cars covered. For the year 1967, it was found that derailments of C&O-B&O covered hopper cars that generated L&D claims were nonexistent. The B&O series 602000 cars have made it through their critical first-year period with only two minor derailments, neither of which generated L&D claims. This fact tends to indicate that the increased snubbing in the trucks under this series of cars has reduced their early life derailment susceptibility. Based on these results as well as on the fact that all new 100-ton covered hopper cars in AAR interchange service must now have increased snubbing, it is recommended that the April 1964 speed restrictions be expanded to cover all covered hopper cars built in 1967 which have not been modified to control the roll problem. The restriction could be withdrawn in January 1969, when all cars of this type either will have completed their "wear-in" period or will have been equipped with additional snubbing.

Luebke, RW
Baltimore and Ohio Railroad, Chesapeake and Ohio Railway Test Rpt 68-108, 1967, 8 pp, 3 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1918)
DOTL RP

A1 040454
DERAILMENT REPORT
A collection of 23 derailment reports is presented. Track condition, type of train, speed, causes and comments are recorded for each incident. Only freight train derailments are examined. Rails that are heat-treated, have a variance in chemical
Unpublished Data.

Magee, GM 7111-7112 45 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1920)
DOTL RP

A1 040455
DERAILMENT DATA
A total of 88 freight-train derailment reports is presented. Type of consist, track conditions, train speed and nature and cause of accident are reported.
Unpublished Data.

89 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1921)
DOTL RP

A1 040456
INVESTIGATION OF SERVICE AND DETECTED BUTT WELDED RAIL JOINT FAILURES
Eight service failures and three detected failures in butt welded rail joints were investigated by the AAR between October 1967 and September 1968. A summary is given of the causes of failure, type of weld, size of rail, date of rolling, and the fabricator. Photographs of the rails at the point of failure are shown.

AREA Bulletin Vol. 70 No. 619, Feb. 1969, pp 681-698, 1 Tab, 25 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1922)
DOTL RP

A1 040457
RESULTS OF ROLLING-LOAD TESTS OF BUTT WELDED RAIL JOINTS
Between October 1, 1967 and September 30, 1968 fifteen butt welded rail joints were tested on the rolling-load machines at the AAR. The rails were tested to a maximum of 2,000,000 cycles, or to failure, of repeated loading. The rolling-load tests are tabulated. For the failed rails the damage points are shown.

AREA Bulletin Vol. 70 No. 619, Feb. 1969, pp 699-711, 1 Fig, 1 Tab, 10 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1923)
DOTL RP

A1 040458
BUTT WELD FAILURES
A summary of the butt weld failures accumulated up to December 1967 is tabulated. On the basis of failures per 100 weld years, the failure rate for the oxyacetylene pressure butt welds is slightly higher than for the electric flash pressure butt welds for new rail (0.0072 to 0.0046). The average service period of the oxyacetylene pressure butt welds is 48 percent longer than that of the electric flash pressure butt weld. For relay rail, the performance of the electric flash pressure weld is somewhat better than that of the oxyacetylene pressure weld.

AREA Bulletin Vol. 70 No. 619, Feb. 1969, p 712, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1924)
DOTL RP

A1 040459
INVESTIGATION OF FAILURES IN CONTORL-COOLED RAIL
Between October 1, 1967 and September 30, 1968 six service failures and one detected failure in control-cooled rail were investigated by the AAR. A summary of the failures is given and each failure is described and photographed.

AREA Bulletin Vol. 70 No. 619, Feb. 1969, pp 718-733, 1 Fig, 1 Tab, 17 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1925)
DOTL RP

A1 040460
RAIL FAILURE STATISTICS COVERING (A) ALL FAILURES, (B) TRANSVERSE FISSURES, (C) PERFORMANCE OF CONTROL-COOLED RAIL
These statistics are based on the rail failures reported to December 31, 1967, and are submitted as information. They include the service and detected failures reported by 45 railroads on all of their main track mileage, which constitutes approximately 90 percent of the main track of Class I railroads in the United States. The annual statistics for 1967 are itemized separately along with being included in the totals for previous years.

Faries, DT *AREA Bulletin* Vol. 70 No. 619, Feb. 1969, pp 734-754, 4 Fig, 10 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1926)
DOTL RP

A1 040461
SHELLY RAIL INVESTIGATION--RESULTS OF ROLLING-LOAD AND SLOW-BEND TESTS
Addition of alloying elements and heat treating rail are used to improved the shelling resistance. Cradle-type rolling-load tests are conducted by the AAR to evaluate these methods. Rolling-load test results obtained from these cradle-type machines for the period between October 1, 1967 and September 30, 1968 are shown.

AREA Bulletin Vol. 70 No. 619, Feb. 1969, pp 772-780, 2 Tab, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1927)
DOTL RP

A1 040462
INVESTIGATION OF SERVICE AND DETECTED BUTT-WELDED RAIL JOINT FAILURES
The results of the investigation of five butt-welded rail joints of the seven failures reported from October 1964 to October 1965 are discussed. Three of the five failures were service failures and the other two were detected failures. Photographs of the damaged rails are shown.

AREA Bulletin Vol. 67 No. 598, Feb. 1966, pp 423-428, 1 Tab, 6 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1928)
DOTL RP

A1 040463
BUTT-WELD-FAILURE STATISTICS
Failure statistics are shown from 1962 to December 1963 and to December 1964. The failure rate in thermit welds is substantially higher than for either oxyacetylene or flash-pressure butt welded rail.

AREA Bulletin Vol. 67 No. 598, Feb. 1966, pp 436-437, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1929)
DOTL RP

A1 040464
INVESTIGATION OF FAILURES IN CONTROL-COOLED RAIL
Investigation of six of eight failures in control-cooled rail reported from October 1964 to October 1966 are complete by the AAR and are discussed. Five of the six failures were service failures attributed to martensite formation or hot torn steel. The detected failure resulted from shelling.

AREA Bulletin Vol. 67 No. 598, Feb. 1966, pp 446-451, 1 Tab, 9 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1930)
DOTL RP

A1 040465
RAIL FAILURE STATISTICS COVERING (A) ALL FAILURES, (B) TRANSVERSE FISSURES, (C) PERFORMANCE OF CONTROL-COOLED RAIL
These statistics are based on the rail failures reported to December 31, 1964. They include the service and detected failures reported by 47 railroads on all of their main-track mileage, which constitutes approximately 90 percent of the main track of Class I railroads in the It is pointed out that Verigo's equation for calculating 1964, are reported as annual totals along with being accumulated with figures from previous years.

Faries, DT *AREA Bulletin* Vol. 67 No. 598, Feb. 1966, pp 451-472, 4 Fig, 10 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1931)
DOTL RP

A1 040466
INSULATED RAIL JOINT DEVELOPMENT AND RESEARCH--THIRD PROGRESS REPORT
The results of rolling-load tests on 15 AAR-Veelcaboned joints are given. Two 132-lb joints completed the 2,000,000 cycles without failure. One permali insulated joint was tested, but failed after only 600 cycles. Results are tabulated.

AREA Bulletin Vol. 67 No. 598, Feb. 1966, pp 478-482, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1932)
DOTL RP

A1 040469
SHELLY RAIL INVESTIGATION--RESULTS OF ROLLING-LOAD AND SLOW-BEND TESTS
The rolling-load test results obtained in the cradle-type machine on tests conducted between October 1, 1964, and October 1, 1965, are shown. During this period there were no slow-bend tests conducted. The cycles to failure under a wheel load of 50,000 lb. are given for 36 specimens; for the majority of these specimens, hardness values are reported.

AREA Bulletin Vol. 67 No. 598, Feb. 1966, pp 500-508, 3 Fig, 1 Tab, 12 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1935)
DOTL RP

A1 040471
INVESTIGATION OF SERVICE AND DETECTED BUTT WELDED RAIL JOINT FAILURES
In the period between October 1, 1966, and October 1, 1967, there were seven service and no detected failures in butt welded rail joints investigated by the metallurgical laboratory of the AAR. A summary of these service failures is tabulated. Investigation 136-22 involved an electric flash butt welded joint that failed in service. The rails used in the fabrication of this joint were 112-lb RE sections rolled July 1942. This failure could be attributed to an entrapment introduced during the welding process. Investigation 136-25 involved a rail, part of a continuous welded string, that failed in service. This rail was identified as a 140-lb PS section rolled in 1959. This failure can be attributed to these electrode burns which were introduced during the welding process. Investigation 136-27A, B, and C involved three electric flash butt welded joints that failed in service. The rails used in the fabrication of these joints were 132-lb RE sections rolled in August 1965. These electric flash butt weld failures can be attributed to pipe and heavy segregration. Investigation 136-31 involved an Orgotherm thermite welded rail joint that failed in service. The rails used in the fabrication of this joint were 115-lb RE sections rolled in June 1966. This failure could be attributed to the presence of a martensite formation that resulted from a heavy grinding of the thermite weld collar after the weld metal had cooled. Investigation 136-34 involved an electric flash butt welded joint that failed in service. The rails used in the fabrication of this joint were 136-lb RE sections rolled in 1967. This failure could be attributed to the presence of this cementite.

AREA Bulletin Vol. 69 Bulletin 612, Feb. 1968, pp 574-588, 23 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1937)
DOTL RP

A1 040472
RESULTS OF ROLLING-LOAD AND SLOW-BEND TESTS OF BUTT WELDED RAIL JOINTS
In the period between October 1, 1966 and October 1, 1967, 22 rolling-load tests were conducted on butt welded rail joints but no slow-bend tests were conducted. These butt welded rail joints were made by the oxyacetylene and electric flash butt welding process. The rolling-load tests were made on a 12-in-stroke rolling-load machine. Investigation 214 (samples A through F) was conducted to determine the seriousness of hairline cracks (segregation and pipe) on oxyacetylene pressure butt weld quality. Five of the six joints with stood 2,000,000 cycles of repeated loadings without failure, which is considered a run-out, and one joint (214E) failed after 897,100 cycles. A macroscopic examination made on transverse sections cut from the end of each rail prior to welding indicates that this failure originated from a fishtail. Investigation 220 (samples A through F) is a continuation of the problem presented in investigation 214 but was conducted to determine the effects of hairline cracks on joints from rails of heavier sections. It was found that fatigue of the failed specimens originated in the fillet between the head and web and can be attributed to a shear drag introduced while removing the weld upset. Investigation 226 (samples A and B) was conducted to evaluate two electric flash butt welded joints from which the upset metal had been ground from the top and sides of the head and bottom and sides of the base but not removed from the web. An examination of the fracture surface to determine the fracture mechanics indicates that this failure originated in the fillets between the web and upset metal. Investigation 230 (samples A and B) was conduced to evaluate oxyacetylene pressure butt welded joints made with a new type of welding head. Joint 230A failed after 33,500 cycles of repeated loading and joint 230B withstood the 2,000,000 cycle minimum requirement without failure. This failure can be attributed to the lack of fusion at the weld interface.

AREA Bulletin Vol. 69 Bulletin 612, Feb. 1968, pp 589-597, 11 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1938)
DOTL RP

A1 040473
PROGRESS REPORT ON ANCHORAGE OF CONTINUOUS WELDED RAIL
Measurements were made on a test installation for the study of rail anchorage for continuous welded rail. The purpose was to obtain data on (1) the effect of train movements on rail anchorage forces (static before and after) and (2) the relation between rail anchorage force and tie movement. This installation was on tangent track with 115 RE continuous welded rail. All weight bars were loosened for the first train to obtain zero readings and a 100-lb force was applied to eastbound anchors (anchors to restrain easterly rail movement). All westbound anchors had the bolts adjusted to just be in contact. The joint gap and rail temperature were measured periodically. Also, the rail position lengthwise of the track was measured at each of 7 test locations. These measurements were then repeated after each of four trains had passed to show the change that had been effected by the train passage. Tests were also made to determine the resistance or force required to move the ties in the ballast. Specific results from the various tests are presented

in several tables. Truck housing dynamic recording equipment was driven to the test site and information was recorded under all trains during a two-day period. The recording equipment consisted of 12-carrier amplifiers and a direct writing oscillograph. Ten channels recorded the longitudinal rail forces exerted through rail anchors to the weigh bars on the ties. The remaining two channels, connected to extensometers, were used to measure the longitudinal movement of the rail and tie with respect to the reference pipe.

AREA Bulletin Vol. 69 Bulletin 612, Feb. 1968, pp 600-617, 16 Fig, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1939)
DOTL RP

A1 040474
INVESTIGATION OF FAILURES IN CONTROL-COOLED RAIL
In the period between October 1, 1966 and October 1, 1967 there were seven failures in control-cooled rail, three service and four detected, investigated by the metallurgical laboratory of the AAR. Investigations 132-10A and B involved two rail specimens both having a detected transverse discontinuity in the head. These transverse discontinuities were detected by a detector car. Rail specimen 132-10A was identified as a 100-lb RE. This failure should be classified as a transverse fissure from hot torn steel. Rail specimen 132-10B was identified as a 132-lb RE. This failure should be classified as a detailed fracture from a shell. Investigations 132-12A and B involved two rail specimens both having a detected internal imperfection in the web. These internal imperfections were detected by a detector car and a hand test. Both rail specimens were identified as 132-lb RE. It was noted that both these rails have a pipe, and a non-metallic entrapment (slag) commonly associated with pipe, in the web. Investigation 135-16 involved a rail that failed in service. This rail was identified as a 112-lb RE. A photograph of the fractured faces showed a fatigue ring development. This fatigue ring development (detail fracture) started from a longitudinal separation close to the running surface of the rail head, then turned downward to form a transverse separation at a right angle to the running surface. This failure should be classified as a detail fracture from a shell. Investigation 135-28 involved a service failure that resulted from a derailment. This rail was identified as a 112-lb RE. This failure was caused by an impact force of unusually high magnitude that is believed to have been the result of a derailment. Investigation 135-29 involved a rail that failed in service. This rail was identified as a 115-lb RE. This failure was attributed to the presence of a base seam in conjunction with a high impact loading at subzero temperatures.

AREA Bulletin Vol. 69 Bulletin 612, Feb. 1968, pp 620-631, 19 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1940)
DOTL RP

A1 040475
RAIL FAILURE STATISTICS COVERING (A) ALL FAILURES, (B) TRANSVERSE FISSURES, (C) PERFORMANCE OF CONTROL-COOLED RAIL
These statistics are based on the rail failures reported to December 31, 1966. They include the service and detected failures reported by 47 railroads on all their main-track mileage, which consititutes approximately 90 percent of the main track of Class I railroads in the United States. The accompanying tables and diagrams indicate the extent of control of the transverse fissure problem that has been obtained by the use of control-cooled rail and detector car testing, give data on the quality of each year's rollings for the various mills, and show the types of failures that are occurring on the various railroads as related to the mill producing the rail. Also included are data reported on all failures in rail of all ages and sections.

AREA Bulletin Vol. 69 Bulletin 612, Feb. 1968, pp 632-651, 4 Fig, 10 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1941)
DOTL RP

A1 040476
SHELLY RAIL INVESTIGATION--RESULTS OF ROLLING-LOAD AND SLOW-BEND TESTS
The S-15 series was initiated to evaluate rail heat treated by the flame-hardening process. Rolling-load test results for specimens S-15A through S-15W were reported last year and are included in this report for information. Specimens S-15W, S-15X, S-15E-2 and S-15F-2 are all secondhand 132-lb head-free rail heat treated to 3/16 in depth. Specimens S-15G-2 and S-15H-2 were not heat treated (secondhand 132-lb head-free rail) and used as control samples. The S-16 series was initiated to evaluate rail heat treated by the Linde process. During this period there were no slow bend tests.

AREA Bulletin Vol. 69 Bulletin 612, Feb. 1968, pp 699-707, 5 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1942)
DOTL RP

A1 040502
ULTRASONIC TESTING OF RAILWAY COMPONENTS
Ultrasonic testing has expanded to the stage where it is a vitally important inspection method for two major railway components, axles and rails. It is likely that the use of the method will extend in many other fields. The success with which ultrasonic testing is now practiced is dependent upon three factors. They are: a thorough understanding of the type and position of flaws likely to occur in the component and the significance of flaw size; a sound knowledge of the principles underlying the use of ultrasonics for this purpose; and, a testing organization which can put sound techniques, well-trained men, and well-maintained instruments of the right type to work.

Wise, S (British Railways Board) *Institution of Locomotive Engineers Journal* Vol. 58 No. 321, Part 1, pp 77-110, 12 Fig, 8 Phot, 4 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1989)
DOTL RP

A1 040510
TWO-VIBRATOR TYPE SEARCHING UNIT AND ITS APPLICATION TO ULTRASONIC FLAW DETECTOR
In order to detect flaws located closely near surface in a metal material using a ultrasonic flaw detector, a two-vibrator type searching unit was invented. One of the two vibrators is a transmitter and the other a receiver. This unit can be used to inspect Thermit welded part of rails. Two-vibrator type searching unit is applied to an audigauge type flaw detector for use in rails. The unit can detect big flaws if they exist more than 1 to 5 mm apart from surface. In case of small flaws, they can be detected if their distances from surface are more than 5 mm.

Mano, K *Railway Technical Research Institute* Vol. 3 No. 4, Dec. 1962, pp 11-13, 2 Fig, 7 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2016)
DOTL RP

A1 040511
REPEATED SHOCK TEST OF RAILWAY TRACK
By means of a repeated shock tester for track, the dynamic properties are studied of the test track. Test tracks were selected one on a wooden tie section and the other on a concrete tie section. There were laid 50 kg PS rails, wooden ties without tie-plates or pre-stressed concrete ties with a spacing of 60 cm. Ballast was crushed stone with a depth of 25 cm and a shoulder width of 35 cm. Before every test the ballast was tamped. To know the pressure on rails, bending stress was measured. Displacement of rail depression was calculated on the data of measurements by the velocity vibrometer. Dynamic force upon rails was calculated on the data of rail bending stress. This force exceeds the centrifugal force under 1400 to 1900 rpm and this is considered to be caused through resonance.

Satoh, Y Hirata, G *Railway Technical Research Institute* Vol. 4 No. 2, June 1963, pp 42-45, 6 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2017)
DOTL RP

A1 040512
BUCKLING STRENGTH OF RAILWAY TRACK (REPORT 3)
A theoretical formula is presented for the buckling strength of railway track with welded joints. The minimum value of buckling strength is commonly adopted as the buckling strength for designing the track construction, on the assumption that it represents the statistic value of track irregularity.

Numata, M *Railway Technical Research Institute* Vol. 1 No. 4, Dec. 1960, pp 78-79

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2108)
DOTL RP

A1 040513
INVESTIGATION OF FAILURES IN CONTROL-COOLED RAILROAD RAILS
The causes of failure of 49 control-cooled rails evaluated during a one year period are summarized. A graph summarized the number of years 150-hot torn steel rails were in service before failure developed. Laboratory tests are described of Tigerbraze rail bonds which gave results that were superior to previous tests of other kinds of welded rail bonds.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 56 No. 521, Feb. 1955, pp 896-904, 1 Fig, 3 Tab, 8 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2067)
DOTL RP

A1 040515
THIRTEENTH PROGRESS REPORT ON SHELLY RAIL STUDIES AT THE UNIVERSITY OF ILLINOIS
One specimen of a chromium-vanadium rail, heat treated to 490 Brinell hardness gave a rolling-load test of 21 million cycles. Ten specimens of high-silicon rails gave rolling-land tests that averaged 2,307,000 cycles. Two specimens of 140-lb. chrome-vanadium alloy rail, gave rolling-load tests that averaged 3,625,000 cycles. One shelling crack started at a segregation streak in the rail. Rolling-load tests to produce detail fractures from shelling indicate that both chrome-vanadium alloy rails and heat-treated carbon-steel rails resist the production of detail fractures better than standard carbon-steel rails. All rolling-load tests to produce shelling indicate that rails with higher hardness, with corresponding increase in mechanical strength, give longer laboratory rolling-load tests.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 56 No. 521, Feb. 1955, pp 954-959, 1 Tab, 14 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2069)
DOTL RP

A1 040516
THE EFFECT OF STRESS RAISERS AROUND A BOLT HOLE ON THE FATIGUE LIFE OF A RAIL
A universal fatigue testing machine was obtained and a bending fixture was designed. The function of the machine is to apply a vertical vibratory force to any specimen. The alternating force is applied 1800 times a minute to an elastic test specimen, and can be adjusted between zero and 5000 lb. The 132-lb. RE section was used because it represents the heaviest of AREA sections, and the 140-lb. PS section was used because it had a bolt hole location in the heavier web area. The severity of the defects varied from light to heavy drill gouges, and from light to heavy burrs, as well as the location of the brand one the edge of the hole. The effect of the stress raisers on the fatigue life of the rail sections is very pronounced. All these stress raisers around the bolt hole were produced in the manufacturing process. The statistical data indicates that a bolt hole drilled with a dull or improperly sharpened drill through a brand reduces the fatigue life of the rail by 50 percent.

AREA Bulletin Vol. 56 No. 521, Feb. 1952, pp 960-975, 4 Fig, 2 Tab, 14 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2070)
DOTL RP

A1 040522
INVESTIGATION OF FAILURES OF WELDED RAILS
Six failed welds were sent to this laboratory for evaluation. One electric-flash butt weld failed after about two years in service because of a fatigue fracture starting at near midheight of the rail web at a small ball of the molted sparks which ordinarily fly away as the rails are being heated but which in this case became trapped in the weld. Another electric-flash butt weld had also been in service about two years when it failed because of a fatigue fracture starting in the rail web about 3/4 in above the rail base. These two failures can be attributed to a combination of three circumstances: High tensile stresses due to cold weather. Stress concentration at the small imperfections in the welds. Stress concentration due to the flash under the rail bases. Four additional failures are described. Eleven bend test results are reported.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 64 No. 577, Feb. 1963, pp 451-459, 2 Tab, 8 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1949)
DOTL RP

A1 040523
INVESTIGATION OF FAILURES IN CONTROL COOLED RAILS
Photographs and discussions are included on the following types of rail failures: transverse fissure from shatter crack; transverse fissure from hot-torn steel; transverse fissure from inclusion; detail fractures from shelling; fracture from welded engine burn; three weeping cracks from grinding; detail fracture from porous bond weld.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 64 No. 577, Feb. 1963, pp 500-508, 1 Tab, 7 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1950)
DOTL RP

A1 040524
RAIL FAILURE STATISTICS COVERING (A) ALL FAILURES, (B) TRANSVERSE FISSURES, (C) PERFORMANCE OF CONTROL-COOLED RAIL
These statistics are based on the rail failures reported to December 31, 1961, and are submitted as information. They include the service and detected failures reported by 50 railroads on all of their main-track mileage which constitute approximately 90 percent of the main track in the United States and Canada. The accompanying tables and diagrams indicate the extent of control of the transverse fissure problem that has been obtained by the use of control-cooled rail and detector car testing, give data on the quality of each year's rollings for the various mills, and show the types of failures that are occurring on the various railroads as related to the mill producing the rail.

Faries, DT Kannowski, K (Association of American Railroads) *AREA Bulletin* Vol. 64 No. 577, Feb. 1963, pp 500-508, 4 Fig, 14 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1951)
DOTL RP

A1 040525
SHELLY RAIL STUDIES AT THE UNIVERSITY OF ILLINOIS
Rolling-load tests are reported for the following types of rail: (1) German abrasion-resistant rails; (2) basic-oxygen standard carbon-steel rails; (3) basic-oxygen high-silicon steel rails; (4) 115-lb. standard carbon-steel rails; and (5) flame-hardened rails. Mechanical tests are presented for Japanese induction-hardened 119-lb. rails.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 64 No. 577, Feb. 1963, pp 534-541, 6 Tab, 4 Phot, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2079)
DOTL RP

A1 040557
LATERAL BALLAST RESISTANCE AND STABILITY OF TRACK IN EARTHQUAKE
The behavior of the railway track in earthquake was studied through experiment and theoretical analysis. The experiment was performed with real tracks in the RC-box placed on the vibrational table of 5 times 5 sq m in dimensions. The conclusions are as follows: against the earthquake acceleration with which railway structures are designed, 83% of the static lateral ballast resistance of track is maintained in the track on the Shin Kansen and 78% in the track with PC-ties and crushed stone ballast on the narrow gauge lines. The long weld rail track holds the safety factor at least 1.15 for the buckling due to temperature rise in the earthquake with the same acceleration mentioned above.

Sato, Y *Railway Technical Research Institute* Vol. 11 No. 1, Mar. 1970, pp 3-6, 3 Fig, 4 Tab, 1 Phot, 3 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2020)
DOTL RP

A1 040560
WHEN AND WHERE DID TRAIN ACCIDENTS OCCUR? (REPORT 4)--STATISTICAL ANALYSES OF DERAILMENT ACCIDENTS OF FREIGHT TRAINS
Thirty freight train derailment accidents, which occurred from 1953 to 1967, were analyzed by regression analysis using 15 variables describing track

conditions, train consists and driving technics. The variables included: the view of the tracks at the derailed position, the radius of the curve at the same position, the vertical view of the tracks, the slope of the tracks, the weight of the rail per unit length set at derailed position, the direction of derailment, the interval of the derailed car wheel shafts, the shock absorbing equipments in the coupler of the derailed car, the suspension mechanism for wheels, the running condition of the train when it derailed, the weight of loaded goods, the location of the derailed car in the train, the total number of cars in the train, the scheduled velocity of the derailed train, and the year when the derailment happened.

Railway Technical Research Institute Vol. 9 No. 2, June 1968, pp 120-121

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2023)
DOTL RP

A1 040564
PREVENTING RAIL FAILURES IN TRACK
U.S. and German rail inspection cars are briefly described and illustrated. Rail head defects are determined by a combination of induction and ultrasonic examination. A separate examination for web defects is conducted at joint bars by ultrasonic inspection. Some 20,000 defective rails are replaced each year with sound rails before service failure occurs. It is estimated that these replacements avoid derailment expense of 200 million dollars at an inspection cost of 6 million dollars.

Magee, GM (Association of Americah Railroads) *AREA Bulletin* Vol. 64 1962, pp 47-55, 8 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2043)
DOTL RP

A1 040566
TESTS TO DETERMINE THE EFFECT OF REMOVING THE BULGE FROM THE BOTTOM OF THE RAIL BASE ON THE STRENGTH OF ACETYLENE PRESSURE BUTT WELDS
Eight specimens were welded from 3-ft lengths sawed from two 115 RE Inland rails, and welded in the normal fashion. On four of the specimens the bulge was left on the base and on four of the specimens the bulge was ground off. A ninth specimen was cut from a 78-ft length from a previous welding run leaving the bulge on the base. Slow bend tests were made. There was considerable variation in the maximum load before fracture and especially in the energy for fracture. Observation of the fractured surfaces showed smooth areas predominately in the base and web indicating that full fusion had not been obtained in the welding process. The results obtained in the drop tests showed the same lack of complete fusion in the appearance of the fractured area. It is concluded that there is no significant difference in the strength of the weld whether or not the bulge on the base of acetylene pressure welds is removed by grinding or left on as has been the past practice.

Kannowski, K (Association of American Railroads) *AREA Bulletin* Vol. 61 No. 556, Feb. 1960, pp 898-904, 2 Tab, 7 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2045)
DOTL RP

A1 040567
PHYSICAL TESTS OF NORMALIZED AND NOT-NORMALIZED OXYACETYLENE PRESSURE-BUTT-WELDED 115 RE RAIL
The welds were made using three 39-ft rails, according to the normal procedure with the exception of not normalizing eight of the welds. The rolling-load tests were made using 48,000-lb and 60,000-lb wheel loads. The data indicate that all the failures produced in the rolling-load tests were from causes other than the effects of normalizing or not normalizing. The slow bend test of two normalized and two not-normalized oxyacetylene pressure butt-welded rails made. The results indicate a trend toward greater load, energy absorption and deflection in favor of the not-normalized tests. The drop tests of two normalized and two not-normalized oxyacetylene pressure but-welded rails were conducted. Again no significant difference can be found in the data for the normalized compared with the not-normalized welds.

AREA Bulletin Vol. 61 No. 556, Feb. 1960, pp 905-914, 2 Fig, 4 Tab, 13 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2046)
DOTL RP

A1 040569
INVESTIGATION OF FAILURES IN CONTROL-COOLED RAILS
Eleven control-cooled rail failures were analyzed and the results of the analysis are tabulated. The following types of rail failures are described and photographed: transverse fissure from inclusion; split web at electric flash weld; fatigue of switch point; detail fracture at bond wire weld; fracture from deformed tie plate; and vertical and horizontal split heads from fishtail defects.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 63 No. 570, Part 1, Feb. 1962, pp 503-511, 1 Tab, 14 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2048)
DOTL RP

A1 040572
INVESTIGATION OF FAILRUES IN CONTROL-COOLED RAILS
A summary is given of the failure analysis of 32 failed control-cooled rails. Photographs of failures due to detail fracture from shelling, horizontal split head from fishtail, and head and web separation failure, are shown.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 62 No. 563, 1961, pp 593-597, 2 Tab, 6 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2051)
DOTL RP

A1 040573
SHELLY RAIL STUDIES AT THE UNIVERSITY OF ILLINOIS
Four rolling load tests of high silicon-vanadium rails averaged 1,850,000 cycles. Two similar tests of high silicon-chromium-vanadium rails ran 1,682,000 and 5,805,400 cycles. One more test of standard carbon rails flame hardened by the Union Pacific Railroad ran 11,501,100 cycles. Two rails containing 0.047 percent columbium ran 2,051,000 and 2,304,800 cycles, and the rails developed excessive flow at the gauge corner. Pictures are shown of induction-hardened rails from service. This method of treatment did not prevent early shelling failures. Five specimens were tested to develop detail fractures from shelling.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 62 No. 563, 1961, pp 630-634, 1 Tab, 12 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2052)
DOTL RP

A1 040574
INVESTIGATION OF FAILURES IN CONTROL-COOLED RAILS
Seventeen types of defects were found in 25 failed rails. The largest group consisted of four piped webs. The following defects are illustrated: transverse fissure from hot-torn steel; transverse fissure from large inclusion; vertical split head from fishtail structure; fracture from welded engine burn; vertical and horizontal split head from fishtail structure; vertical split head from porosity in hand-made butt weld; corrosion at junction of web and base, and vertical split webs from fishtails.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 61 No. 556, 1960, pp 835-844

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2053)
DOTL RP

A1 040575
RAIL FAILURES STATISTICS, COVERING (A) ALL FAILURES; (B) TRANSVERSE FISSURES; (C) PERFORMANCE OF CONTROL-COOLED RAIL
These statistics are based on the rail failures reported to December 31, 1958. They include the service and detected failures reported by 59 railroads on all of their main-track mileage. The tables and diagrams indicate that extent of control of the transverse-fissure problem that has been obtained by the use of control-cooled rail and detector-car testing, give data on the quality of each year's rollings for the various mills, and show the types of failures that are occurring on the various railroads as related to the mill producing the rail.

Code, CJ *AREA Bulletin* Vol. 61 No. 556, 1960, pp 845-866, 4 Fig, 8 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2054)
DOTL RP

A1 040576
SHELLY RAIL STUDIES AT THE UNIVERSITY OF ILLINOIS
Two rolling load tests were made on a high-silicon rail which ran 1,944,400 and 1,480,000 cycles. A standard carbon-steel rail gave unusually long tests of 4,371,000 cycles. These specimens deformed considerably before the shelling cracks were visible on the side of the rail head. Two induction-hardened 50-kg rails from Japan gave rolling-load tests of 517,400 and 718,300 cycles. One double-flame hardened specimen ran 4,185,000 cycles in the rolling-load test. This is a much higher test than previous flame-hardened specimens. Single flame-hardened rails ran from 1,490,000 cycles to 3,403,800 cycles, which are also very high rolling-load tests for flame-hardened rails. Two rails with high manganese and high silicon were tested. The rolling load tests varied from 1,792,400 cycles to 3,260,500 cycles. Three specimens were tested to develop detail fractures from shelling. They developed failures at 2,007,400; 5,204,900 and 4,492,200.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 61 No. 556, 1960, pp 874-881, 1 Tab, 20 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2055)
DOTL RP

A1 040577
ROLLING-LOAD-TEST RESULTS OF WELDED ENGINE-WHEEL BURNS ON RAIL SUPPLIED BY THE SEABOARD AIR LINE RAILROAD
The oxyacetylene-welding method is the standard procedure for repairing wheel burns. Two welds of this type were prepared as controls. Eight engine-wheel burns were then welded by means of the electric-arc method. The first six welds were made on 115-lb RE rail and the last four welds were made on 132-lb RE rail. In this type of test 2,000,000 cycles without failure are considered a run-out. All of the welds were checked ultrasonically for defects. The oxyacetylene welds had the best results, in that one ran to 2,000,000 cycles without a failure and the other ran to 589,000 cycles, failing from a detected inclusion. The electric-arc welds failed prematurely at 49,000 to 159,000 cycles. The microscipic examination of fractures revealed taht a sharp line of demarcation between the weld metal and rail metal existed as well as very fine porosity on the interface. This porosity in all of the electric-arc welds was the cause of the failure. The microsocpic porosity in the interface could not be detected ultrasonically whereas the indication of the inclusion was very definite.

AREA Bulletin Vol. 61 No. 556, 1960, pp 891-896, 2 Tab, 8 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2056)
DOTL RP

A1 040578
INVESTIGATION OF FAILURES IN CONTROL-COOLED RAILS
Twenty-five failed control-cooled rails were examined. Only two failures were transverse fissures from shatter cracks. Six failures were from hot torn steel. One failure was a transverse fissure from an inclusion. A vertical split head developed from a rolling defect in the bottom rail from an ingot. There were only one or two each of several other common types of rail failures.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 60 No. 549, 1959, pp 878-882, 2 Tab, 8 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2057)
DOTL RP

A1 040579
SHELLY RAIL STUDIES AT THE UNIVERSITY OF ILLINOIS
Laboratory tests of chrome-vanadium rails give high cycles for failure but with considerable scatter in results. Rolling-load tests are reported on six extremely high-silicon rails with 1.63 percent silicon. These specimens did not give as good results as previous tests on rails with less than 1 percent silicon content. Rolling-load tests are reported on six induction-hardened rails. These rails resist flow or abrasion on the gauge corner but develop shelling cracks in the laboratory tests sooner than standard carbon-steel rails. Two detail fractures from shelling were produced in laboratory rolling-load tests of 136-lb chrome-vanadium rails with Brinell hardness of 368 and 373. These two rails ran 2,837,900 and 9,258,500 cycles.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 60 No. 549, 1959, pp 941-948, 1 Tab, 23 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2058)
DOTL RP

A1 040580
FINAL REPORT ON A THREE-DIMENSIONAL PHOTOELASTIC INVESTIGATION OF THE STRESS DISTRIBUTION IN THE HEAD OF A RAILROAD RAIL ALONG LINES PARALLEL TO THE AXIS OF THE RAIL
The complete state of interior principal stresses along critical lines parallel to the axis of the rail have been determined photoleastically in the head of a model of a railroad rail. The curves of the stress distributions revealed several dangerous states of stress which may contribute to, or produce, the shelly failure. The normal stress components alternate between large compressions and relatively small tensions; there exist oblique planes, which are subjected to completely reversed large normal stresses; the range of the alternating shears is plus or minus 35,000 psi approximately, and the endurance limit for completely reversed shear is 37,000 psi; and the planes on which the maximum shears during each loading cycle act, are subjected to fluctuating shears and normal stresses. The range of the variable shear on these planes is at least from 0 to 54,000 psi, which comes dangerously close to the endurance limit of 59,000 psi.

Frocht, MM (Illinois Institute of Technology) *AREA Bulletin* Vol. 60 No. 549, 1959, pp 951-969, 13 Fig, 1 Tab, 2 Phot, 10 Ref, 4 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2059)
DOTL RP

A1 040581
INVESTIGATION OF FAILURES IN CONTROL-COOLED RAILROAD RAILS
A summary is given of the analysis of 35 failed control-cooled rails submitted for evaluation during a one year period. Nine failures were transverse fissures from shatter cracks. Six were transverse fissures from hot torn steel. Eight shelled rails were submitted. Other type of defects included web failures, head splitting from segregation, wheel burn, defective welds, and electrode burn.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 59 No. 542, Feb. 1958, pp 907-914, 2 Tab, 17 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2060)
DOTL RP

A1 040582
SIXTEENTH PROGRESS REPORT ON THE ROLLING-LOAD TESTS OF JOINT BARS
Seven tests using 115 RE bars with easements on the top bar surfaces to depths of approximately 0.220 and 0.110 in were completed. The shallow easements were effective in eliminating gouging of the bars by the rail ends. Six joints with shallow easements averaged 349,080 cycles. Twelve tests of joints using 132 RE bars with the same type of milled easement were completed. Two bars with deep easements failed. The shallow easements were effective in preventing gouging of the bars. Average cycles for failure for 6 joints with deep easements were 611,630 and average cycles for failrue for 6 joints with shallow easements were 583,530 cycles.

Jensen, RS (Illinois University) *AREA Bulletin* Vol. 59 No. 542, Feb. 1958, pp 938-946, 2 Tab, 13 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2061)
DOTL RP

A1 040583
REPORT ON PENNSYLVANIA RAILROAD M. OF W. TEST NO. 591, DETERMINATION OF PLASTIC FLOW IN RAIL HEAD
On the high rail of curves there is a flow of metal at the top gauge corner of the rail toward the gauge side. This flow of metal extends to a depth of 1/4 in. to 3/8 in. below the rail surface. The flow of metal toward the gate side extends back to the edge of the center arc and beyond, probably to the center of the rail head. The magnitude of deformation is positive evidence of shear stresses well beyond the yield point of the steel. This condition was demonstrated on the high rail of a 4-deg curve under moderately heavy freight traffic after 75,000,000 gross tons. This was at a location of moderate shelling on previous rail. Only light flaking had developed in the test rail at the time of removal.

AREA Bulletin Vol. 59 No. 542, Feb. 1958, pp 962-975, 4 Fig, 1 Tab, 16 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2062)
DOTL RP

A1 040584
SIXTEENTH PROGRESS REPORT ON SHELLY RAIL STUDIES AT THE UNIVERSITY OF ILLINOIS
Three rolling-load tests are reported on chrome-vanadium rails. One specimen ran 4,874,000 cycles. One failed at 14,831,000 cycles, a record for this type of rail. A third specimen ran 2,857,000 cycles before it developed shelling. Seven rolling-load tests to produce shelling failures in high-silicon rails averaged 2,277,000 cycles. Past tests of standard carbon steel rails have averaged 1,000,000 cycles in the same rolling-load test. Results are given of the examination of several detail fractures and one shelly rail from service.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 59 No. 542, Feb. 1958, pp 975-981, 2 Tab, 14 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2063)
DOTL RP

A1 040585
INVESTIGATION OF FAILURES IN CONTROL-COOLED RAILRAOD RAILS
Thirty-two failed control-cooled rails were examined. Causes of failure included: transverse fissures--two from shatter cracks, eight from hot torn steel and one from inclusion; 13 detail fractures from shelling; five fractures from wheel burns, weld defects or electride burns; and three other types of breaks.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 58 No. 535, Feb. 1957, pp 965-971, 1 Fig, 4 Tab, 8 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2064)
DOTL RP

A1 040587
FIFTEENTH PROGRESS REPORT ON SHELLY RAIL STUDIES AT THE UNIVERSITY OF ILLINOIS
Mechanical tests and rolling-load tests produced shelling on 16 different rails: four standard carbon rails averaged 1,358,000 cycles; five silicon rails averaged 1,692,000 cycles; four higher silicon rails averaged 1,940,000 cycles; two silicon-vanadium rails averaged 2,038,000 cycles; and one chrome-vanadium rail ran 4,874,000 cycles; Laboratory examinations were made of six rails which developed detail fractures in service. Rolling-load tests produced detail fractures from shelling in 10 rails.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 58 No. 535, Feb. 1957, pp 1041-47, 1 Fig, 2 Tab, 16 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2066)
DOTL RP

A1 040588
INVESTIGATION OF FAILURES IN RAILROAD RAILS
Twenty-three failed control-cooled rails were examined during the year. The failures included: eleven transverse fissures, three from shatter cracks and eight from hot torn steel; eight detail fractures, seven from shelling and one from head check; two web cracks; one base brake from welded electric bond, and one lap on rail tread.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 52 No. 493, Feb. 1951, pp 605-617, 1 Fig, 5 Tab, 7 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2094)
DOTL RP

A1 040592
FATIGUE TESTS OF RAIL WEBS
This report covers corrosion fatigue tests using a corroding agent of tap water mixed with sufficient sulfuric acid. Specimens were stressed at a rate of 150 cycles per minute for the first 1,000,000 cycles or until a crack had been detected. After 1,000,000 cycles, the speed of testing was increased to 800 cycles per minute and maintained at that rate until the specimen cracked, or until 10,000,000 cycles had been reached. From these tests it may be concluded: that the stresses in the upper rail fillets on tangent track outside of the joint bar limits at the rail end and at the first bolt hole with the new 115 RE rail section and new AREA bolt spacing are well within limits that can be tolerated, provided no unusual corrosion conditions exist that substantially reduce the fatigue strength of the rail steel.

Jensen, RS (Illinois University) *AREA Bulletin* Vol. 52 No. 493, Feb. 1951, pp 680-690, 5 Fig, 2 Tab, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2098)
DOTL RP

A1 040781
TESTS OF ELECTRIC FLASH BUTT-WELDED RAILS
This paper describes rolling-load tests and physical tests of specimens of 131 and 130-lb electric flash butt-welded rails which were undertaken to determine if stress relief treatment would be necessary. The 131-lb. rail was set up for rolling-load tests of weld 73 in. in a 33-in. stroke rolling-load machine. The second rolling-load test was made on weld 52 in the 131-lb. rail, which was supplied with all the flash metal ground off except under the rail base. 1. The first two-rolling load tests that failed at a bolt hole and stress raiser on the rail webs emphasize the damaging effects of such conditions. 2. The rolling-load tests which ran over 2,000,000 cycles with 60,000-lb. wheel load without failure, are considered very satisfactory for welded rails. 3. The bend tests of 132-lb rails gave higher tests than unwelded 131-lb. rails, and as high as any previously tested rail welds. 4. Some of the physical tests indicate that the welds which were not stress relieved were slightly stronger than the stress relieved welds. However, the difference is negligible and no conclusions on this subject should be based on tests of only two welds.

Cramer, RE Jensen, RS (Illinois University) *AREA Bulletin* Vol. 55 1954, pp 684-694, 2 Tab, 12 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2077)
DOTL RP

A1 040786
DETERMINATION OF THE SNAKING EFFORT IN TRACK LAID WITH LONG WELDED RAILS BY MEANS OF A NON-LINEAR CALCULATION
The author describes a method to ascertain, with the assistance of an electronic computer, the axial effort due to snaking in a track laid with long welded rails. In these calculations, the influence of the lateral resistance and that of the angular rigidity can be introduced in their true nonlinear form, so accurately that the stress under which snaking occurs can be determined exactly. It is necessary to establish by measurements the lateral resistance and the angular rigidity. After this has been done, the admissible value of the preliminary deformation, free of stress, of a track with long welded rails can be calculated fairly rapidly. Provisionally we can affirm that the critical wave length will be considerably shorter than that obtained by the methods of calculation previously suggested.
Translated from De Ingenieur, No. 39, Sept. 1964.

Bijl, F (N.V. Nederlandse Spoorwegen) *Rail International* Aug. 1965, pp 580-588, 9 Fig, 3 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2035)
DOTL RP

A1 040791
TRACKING CHARACTERISTICS OF GREAT NORTHERN ELECTRIC LOCOMOTIVES ON A 10-DEG CURVE
This report covers a test program to measure the loads imposed on curved track by electric locomotives to determine if their power and size could be correlated with increased maintenance. The test locomotive was No. 5019 of Class W-1, but the other similar locomotive (No. 5018) was also used in the tests. Measurements were also made on two other locomotives as a matter of general interest and for comparison with the test locomotive. Both vertical and lateral forces were measured.

Ferguson, R Magee, GM (Association of American Railroads) *AREA Bulletin* Vol. 55 1953, pp 223-244, 12 Fig, 9 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2078)
DOTL RP

A1 040797
PANEL DISCUSSION--C&NW WAGES WAR AGAINST TRAIN ACCIDENTS
This paper surveys the creation and current operation of the C&NW, Accident and Loss Prevention Department. Topics include procedures for analysis of derailments, review of hot box and dragging equipment detector systems and implementation and rules education. The first year after creation of this department, the costs of our train accidents were down over 30% from the previous year of 1966. Even more encouraging was the fact that losses resulting from human failures decreased over 90%.

Waugh, TL Hoffman, RP McKerr, JD Ingram, CW (Chicago and North Western Railway) *AREA Bulletin* Vol. 70 70-621-12, 1969, pp 936-945

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2039)
DOTL RP

A1 040801
INVESTIGATION OF FAILURES IN RAILROAD RAILS
Twenty-four failed control cooled rails were evaluated. The causes of failure are described. Preliminary tests were conducted to determine possible damage to rails by welding bond wires. A free held acetylene torch and the thermit welding methods were used to produce the bonds. The metallographic hardness tests and Charpy tests indicate that some martensite was produced in the rails which is hard and brittle. However, this did not seem to produce early failure in the rolling-load tests.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 51 No. 486, Feb. 1950, pp 543-550, 2 Tab, 16 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2100)
DOTL RP

A1 040803
RAIL FRACTURES RESULTING FROM ENGINE WHEEL BURNS, INCLUDING EFFECT OF REPAIRING SUCH BURNS BY OXYACETYLENE OR ELECTRIC WELDING
Twenty-one specimens were artificially burned with the wheel rotating at a speed of 15 mph, the rails being applied to the moving surface of the wheel for 3-sec. intervals. The burns produced by this method were approximately 1-1/2 in. wide by 2-1/2 in. long and appeared to be quite uniform in nature. A tabulation of the rolling-load tests completed on these specimens up to the present time is shown. Up to the present time no explanation can be offered for the difference in fatigue life due to the location of the built-up metal on the engine burn. Tests have not progressed far enough to lead to any conclusions.

Akers, JB *AREA Bulletin* Vol. 51 No. 486, Feb. 1950, pp 594-595

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2102)
DOTL RP

A1 040804
EIGHTH PROGRESS REPORT OF THE SHELLY RAIL STUDIES AT THE UNIVERSITY OF ILLINOIS
Two rails were selected from the high side of a 4-deg curve. These rails had carried 63,385,600 tons of traffic at average speeds of 35 mph. One rail showed flaking along the gauge corner over its entire length and had also developed 6 or 7 small black shelly spots. The second rail contained 30 black shelly spots. During the past year, 23 specimens have been tested in the cradle type rolling load machine. The chemical analysis, physical properties and results of rolling-load tests of these specimens are shown. The laboratory rolling-load tests produce shelling failures similar to the deeper type of shelling which develops in service. It is also believed that the laboratory tests give a quick method of determining the relative length of service which can be expected in track as compared with standard carbon steel rails. Preliminary results of service tests of rails tested in the rolling-load machines last year give indications of this correlation but the service tests are not as yet completed.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 51 No. 486, Feb. 1950, pp 597-607, 1 Fig, 1 Tab, 26 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2103)
DOTL RP

A1 040805
SUMMARY REPORT ON THE EXAMINATION OF RAILS WHICH CONTAIN DETAIL FRACTURES
This study examined detail fractures from shelling which had been found in rail by detector cars and determined if the chemistry, mechanical properties or structures of detail fracture rails varied from those of random rails. Examination of 54 detail fractures showed that such fractures may assume a wide range of size and shape. Of the fractures examined, 28 percent had bright, unoxidized surfaces; indicating no contact with the surface of the rail. About 70 percent of the rails containing detail fractures were taken from the high side of curves. The average chemical analyses and mechanical properties of 44 rails having detail fractures and 26 random rails were so nearly the same that no distinction between the two groups was possible. The mechanical tests included hardness, tensile properties, and impact properties.

Campbell, JE McIntire, HO Manning, GK (Battelle Memorial Institute) *AREA Bulletin* Vol. 51 No. 486, Feb. 1950, pp 608-620, 5 Fig, 3 Tab, 6 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2104)
DOTL RP

A1 040806
MEASUREMENTS OF STRESSES IN 132 RE RAIL ON TANGENT TRACK--SANTA FE RAILWAY
Three test sections are as follows: new AREA design, headfree 36 in. joint bar for 132 RE rail, with bolt spacing of a 3-1/2--6--6 in.; same joint bar design with bolt spacing of 4-1/2--9 in.; and same joint bar design with bolt spacing of 2-1/2--6-1/2--6-1/2 in. This installation offered an opportunity to obtain measurements of stresses developed under regular traffic in the new 132 RE section. On tangent track under conditions typical of main line operation, it may be concluded: that the stresses in the upper rail fillets on tangent track outside of the joint bar limits have been reduced with the new 132 RE section to well within the fatigue strength of rail, steel, and that the concentrated rail web stresses within joint bar limits at the rail end and at the first bolt hole with the new 132 RE rail section and the new AREA bolt spacing are well within limits that can be tolerated, provided no unusual corrosion conditions exist that substantially reduce the fatigue strength of the rail steel.

AREA Bulletin Vol. 51 No. 486, Feb. 1950, pp 626-640, 11 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2105)
DOTL RP

A1 040807
FATIGUE TESTS OF RAIL WEBS
Two sets of tensile specimens were cut from the webs of the rails; one set parallel to direction of rolling, and the second set transverse to direction of rolling. Physical properties of the rail web steel as determined by these tensile tests are listed. Only slight differences in the physical properties of the two groups of specimens were disclosed. Previous studies of the fatigue of rail webs in the laboratory indicated a fatigue life several times greater than was actually obtained in service at some locations. Since corrosion of the rail web was quite heavy at the locations where early service failures occurred, it was thought that the discrepancy was due to corrosion. The S-N diagrams are shown for the tests completed to date with no corrosion on the specimens. The S-N diagram is shown for specimens under completely reversed stress, with tap water corrosion, have not revealed as great a reduction in fatigue corrosion, hav not revealed as great a reduction in fatigue life of rail webs as service failures indicate.

Jensen, RS (Illinois University) *AREA Bulletin* Vol. 51 No. 486, Feb. 1950, pp 640-647, 7 Fig, 1 Tab, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2106)
DOTL RP

A1 040809
FATIGUE TESTS OF MANGANESE STEEL
All specimens were tested under a range of stress from a maximum compressive stress to a tensile stress 50 percent as great. Endurance limits at 10 million cycles were indicated as follows: As-cast surface 38,000 psi; ground surface 42,000 psi; shot peened surface 48,000 psi. Corrosion fatigue tests using a 5-percent solution of sulfuric acid were made on unprotected

specimens with as-cast, ground, and shot peened surfaces, and the S-N diagrams approached a vertical line at approximately one million cycles for all specimens. The protective paint coating applied to three groups of specimens proved to be beneficial, although not totally effective in increasing their fatigue life under 5-percent acid corrosion. A few hardness tests on unstressed specimens indicated little difference in hardness for as-cast and ground surfaces and a much greater hardness for shot peened specimens.

Jensen, RS (Illinois University) *AREA Bulletin* Vol. 50 No. 479, Feb. 1949, pp 579-588, 4 Fig, 2 Tab, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2110)
DOTL RP

A1 040810
EFFECT OF BOLT SPACING ON RAIL WEB STRESSES WITHIN THE RAIL JOINT

Tests were conducted to study the effect of bolt tension, applied wheel loads and bolt hole spacing, upon rail web stresses within the limits of the joint bar. Tests were made with bolt tensions of 10,000 lb., 20,000 lb. and 30,000 lb. Three bolt spacings from the rail end were used as follows: 2-1/2 in., 6-1/2 in.,6-1/2 in.; 3-1/2 in., 6 in., 6 in., and 4-1/2 in., 5-1/2 in., 5-1/2 in. The rail used was the new 115-lb RE section with 36-in. headfree joint bars and 1-in. diameter bolts. Similar stress measurements were also made on two 131-lb RE rail joints in tangent track during the passage of regular trains. Vertical tensile stresses in the rail web that would be expected to be in the range of 15,000 to 20,000 psi, with 30,000 lb. bolt tension were found to be as high as 50,000 to 70,000 psi at the bolt holes. Moving the first bolt hole farther away from the high stress area near the rail end not only lowered the tension stress at the bolt hole, but also reduced the stress in the upper and lower fillets and web area at the rail end. It is recommended that the present spacing of bolt holes at the rail ends of 2-1/2 in., 6-1/2 in., 6-1/2 in. be revised to 3-1/2 in., 6 in., 6 in. for six hole joint bars and from 2-1/2 in., 6-1/2 in., to 3-1/2 in., 6 in. for four-hole joint bars.

AREA Bulletin Vol. 49 1947, pp 464-485, 17 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2076)
DOTL RP

A1 040811
FATIGUE TESTS OF RAIL WEBS

Corrosion fatigue tests were made on T-shaped specimens cut from the web of a 112 lb-RE rail under bending stresses ranging from a maximum compressive stress to a tensile stress 20 percent as great. A solution of 36 percent sulfuric acid was used as a corroding agent and was allowed to drip at the rate of 10 drops per min. on the specimens. in addition, corrosion fatigue tests were made on three groups of painted specimens in order to test the practicability of different types of paint as protective coatings for rails in tunnels, highway crossings, and other places where corrosion fatigue failures are likely to occur.

Jensen, RS (Illinois University) *AREA Bulletin* Vol. 49 1947, pp 485-490, 1 Fig, 1 Tab, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2108)
DOTL RP

A1 040813
INVESTIGATION OF FAILURES IN RAILRAOD RAILS

During the year, 52 failed control-cooled rails were evaluated. The causes of failures follow: 17 failed due to transverse fissures, four from shatter cracks, seven from hot torn steel, one from inclusion, one from welded engine burn and four from hand gas butt welds; 16 failed due to detail fractures from shelling; seven from head and web separation cracks; three from crushed head and web; five fractured from base break at seam; 1 contained black shelly spots; and three had bolt hole cracks.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 53 No. 500, Feb. 1952, pp 843-849, 2 Tab, 9 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2084)
DOTL RP

A1 040815
RAIL FAILURES RESULTING FROM ENGINE WHEEL BURNS, INCLUDING EFFECT OF REPAIRING SUCH BURNS BY OXYACETYLENE OR ELECTRIC WELDING

Service failures of repaired burns have been negligible. One railroad reports that of 500,000 burns repaired in the last 8 years only 6 service or detected failures of welded engine burns have occurred. Benefits derived from welding repair are: elimination of undesirable microstructure and quench cracks; which serve as potential stress raisers or reduce the fatigue strength of the rail steel elimination of low spots on the rail surface; and building up of engine burns permits recovery of much rail for main line use which would otherwise be scrapped or consigned to secondary service.

Akers, JB *AREA Bulletin* Vol. 53 No. 500, Feb. 1952, pp 894-898, 3 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2086)
DOTL RP

A1 040816
TENTH PROGRESS REPORT OF THE SHELLY RAIL STUDIES AT THE UNIVERSITY OF ILLINOIS

Repeat cradle type rolling-load tests on two specimens of manganese chrome, vanadium alloy rails gave high cycles for failure 8,117,000 and 9,635,000 indicating that these alloy rails may be several times as good as standard carbon steel rails. A 115-lb. heat-treated standard carbon rail gave 9,625,000 cycles in the cradle rolling machine, which indicates that this type of rail is as good as the manganese, chrome, vanadium alloy rails. Rolling-load tests are reported on high silicon rails, nickel alloy bars and rails, and flame-hardened rails, but none of these particular specimens gave tests comparable with the maganese, chrome, vanadium alloy steel or the heat-treated standard carbon steel rails. Metallographic examination of 14 failed rails which had developed detail fractures in service located rather large inclusions in the steel near the fractures in half of these rails.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 53 No. 500, Feb. 1952, pp 902-915, 2 Tab, 42 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2087)
DOTL RP

A1 040817
SUMMARY OF PROGRESS OF INVESTIGATION OF STRESS RELAXATION IN RAIL STEEL

Relaxation of stresses in small bar specimens is being studied as a function of time and temperature, and rolling-load fatigue tests are being run on small specimens. These specimens were cut from a 152-lb rail rolled in 1939. The rail had shelly spots throughout its length. Measurements are made before bending after bending and before heating and after heating and removal from the jig. A summary of test results is shown in a plot of percent stress relaxation versus time at temperature. For temperatures lower than 900 deg F., the amount of relation is quite small. After an initial period, the amount of relaxation at a given temperature increases only slightly as time at temperature increases.

Jenkins, DR Grover, HJ (Battelle Memorial Institute) *AREA Bulletin* Vol. 53 No. 500, Feb. 1952, pp 916-920, 2 Fig, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2088)
DOTL RP

A1 040820
STRESS MEASUREMENTS IN 115 RE AND 132 RE RAIL ON CURVED TRACK

Stress distribution in 112, 115, 131, and 132 RE rails on curved track is shown. Most measurements were made for steam locomotive wheel load; however, a diesel locomotive was used for one measurement with 115 RE rail. Fatigue test results are shown on a Goodman diagram.

Magee, GM (Association of American Railroads) *AREA Bulletin* Vol. 53 1952, pp 1140-50, 10 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2091)
DOTL RP

A1 040821
SUPERSONIC INSPECTION FOR DEFECTS IN RAIL ENDS
Statistical data on rail defects found in 1951 by use of the Audigage flaw detector and the ultrasonic detector car are reported. Pennsylvania Railroad located 3400 defects in joints and 417 defective rails at highway crossings. Photographs of the detectors and some defective rails are shown.

Code, CJ (Pennsylvania Railroad) *AREA Bulletin* Vol. 53 1952, pp 1151-58, 10 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2092)
DOTL RP

A1 040823
INVESTIGATION OF FAILURES IN CONTROL-COOLED RAILROAD RAILS
Since October 1, 1052 reports have been prepared on 41 failures in control-cooled rails. The majority of failure were due to shelly rail and transverse fissures from hot torn steel. Others occurred from shatter cracks, inclusions, engine burn, bolt hole cracks, head and web separations, and head checks.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 55 1954, pp 779-783, 2 Fig, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2071)
DOTL RP

A1 040825
TWELFTH PROGRESS REPORT ON SHELLY RAIL STUDIES AT THE UNIVERSITY OF ILLINOIS
This paper summarized the past year's progress on shelly rail studies at the University of Illinois: 1. Stress relieving of specimens during laboratory rolling-load tests at either 1000 or 800 deg F have not appreciably increased the life of the rails. 2. Rolling-load tests of commercially flame-hardened rails gave tests about 50 percent above the average for standard carbon steel rails. 3. Rolling-load tests of high silicon steel rails gave tests almost double the average for standard carbon steel rails. 4. An electric furnace 60-lb steel rail with European chemistry gave very low tests in the rolling-load machine--94,400 cycles. 5. Metallographic examination of 17 shelly rails from service found only 1 rail which contained extra large non-metallic inclusions, which could explain why it had developed shelling in service. 6. Using a special rolling-load machine, detail fractures from shelling were produced in five standard steel rails and one alloy rail. 6. The cause of shelling in service appears to be that present wheel loads are too heavy for the small area of contact between wheel and rail, so that as a result of the flow of the steel, internal stresses are produced that exceed the capacity of the steel to withstand such stresses. 7. Laboratory rolling-load tests indicate that stronger rail steel, such as high silicon steel rails, intermediate manganese chrome-vanadium alloy rails, or heat-treated rails should give longer life before shelling develops in service.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 55 1954, pp 832-840, 6 Tab, 19 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2073)
DOTL RP

A1 040826
FINAL REPORT ON THE STUDY OF SIMULATED RAILS UNDER REPEATED ROLLING LOAD
This investigation has studied some of the factors which might contribute to shelly failure formation. The investigation has been directed particularly toward a study of the effects of progressive plastic deformation resulting from repeated rolling-wheel loads. Some variables introduced were wheel load, wheel radius, and cycles of repeated rolling load. Experimental evidence suggests that plastic deformation occurs in a rail with early successive load repetition. Further, the tests show that, although deformation is inelastic, many of the effects of the variables studied would be qualitatively predictable by elastic equations such as the Herz equations and this work suggest that smaller wheel loads or larger diameter wheels would be quite helpful. It is also interesting to note that the Herz equations would suggest the use of higher strength rails for longer rail life. This is also in agreement with general observations from actual service and from laboratory tests of rail.

Hyler, WS Grover, HJ (Battelle Memorial Institute) *AREA Bulletin* Vol. 55 1954, pp 840-854, 5 Fig, 5 Tab, 3 Phot, 6 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2074)
DOTL RP

A1 040827
FINAL REPORT ON A THREE-DIMENSIONAL PHOTOELASTIC INVESTIGATION OF THE PRINCIPAL STRESSES AND MAXIMUM SHEARS IN THE HEAD OF A MODEL OF A RAILROAD RAIL
This report deals with a photoelastic study of the stresses in a model of the head of a railroad rail, utilizing for this purpose the most recent developments in three-dimensional photoelasticity. The study was undertaken in the expectation that the results would lead to a better understanding of the phenomenon of shelling in rails. It is concluded that: 1. Near the region of contact the principal stresses in the model are all compressive both for the vertical load and for the combined loads used. 2. Below the region of contact the longitudinal stresses become tensile for both types of loading. 3. The maximum shear lies in the transverse section of symmetry for both types of loading. 4. The effect of the horizontal thrust is primarily to increase the shear in the immediate vicinity of the area of contact by 30 percent. 5. On the side of the rail away from the load the stresses are predominantly tensile and are much smaller than on the loaded side for both types of loading.

Frocht, MM (Illinois Institute of Technology) *AREA Bulletin* Vol. 55 1954, pp 854-897, 22 Fig, 6 Phot, 5 Ref, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2075)
DOTL RP

A1 040829
DISCUSSION ON "THE ENGINEERING ASPECTS OF HIGH-SPEED TRAINS" (1) MOTIVE POWER; (2) PASSENGER ROLLING STOCK; (3) BRAKING AND SIGNALLING; (4) PERMANENT WAY
This paper surveys the engineering aspects of high-speed trains in terms of motive power, passenger rolling stock, braking and signaling, and permanent way. In developing high-speed trains there is clearly a need to examine all aspects of vehicle performance on the track, and also a need to subject every item of traction equipment to the closest secrutiny to ensure that it is suitable for onerous high-speed duties. The car of the future will probably be lower and smoother, and with smaller windows than present-day cars. It will be pressurized and adjacent body ends will be closer to incorporate peripheral coupling and improve passenger access. It will also cost more. A basic consideration in obtaining the best brake performance of high-speed trains is the maximum braking retardation. When high retardations are used and as the maximum speed of trains increases from about 100 mph to 120 mph (or even 150 mph) two problems of braking which become increasingly important are adhesion and heat dissipation. Both necessitate modifications to present braking practice when higher speed stops are to be made. It is generally agreed that at high speeds some form of cab signaling is essential, and systems in use vary from the relatively simple A.W.S. as used in this country to apparatus which starts, controls, and stops the train automatically. There is every justification to believe that, from the point of construction, modern track would be quite suitable for speeds up to 160 mph--possibly more--where it is straight or flat-curved.

Sharp, E Thring, JF Peacock, DW Loach, JC *Institution of Locomotive Engineers Journal* Vol. 56 No. t 2, pp 196-219, 9 Fig, 1 Tab, 1 Phot, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1963)

A1 040833
FATIGUE TESTS OF RAIL WEBS
Two specially designed vibratory machines were used to determine the fatigue of less-than-full-size rails because rolling-load machines were unable to break the web of full-sized sections. In all tests a constant ratio of compressive to tensile stress was maintained, the bending stress on the top side ranging from a maximum compressive stress to a tensile stress 20 percent as great. The specimens were cut from two sections of 112-lb. RE rail. The fatigue curves show that reduced fatigue strength results from stamping. These data would indicate an endurance limit of approximately

59,000 psi, for unstamped specimens, and 51,000 psi for stamped specimens at 40 million cycles. At one million cycles, the reduction in fatigue strength for the stamped specimens is slightly over 20 percent. Although these tests were made on specimens instead of a complete rail section, the stresses were of the same order of magnitude as the web stresses which occur in the field, thus affording a measure of the reduction in fatigue strength of a full-sized web which may be ascribed to the presence of stamped numbers.

Jensen, RS (Illinois University) *AREA Bulletin* Vol. 47 1946, pp 464-466, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2113)

DOTL RP

A1 040870
RAIL DESIGN AND SERVICE MEASUREMENT OF RAIL WEB STRESSES OUTSIDE OF JOINT

The report on rail design deals primarily with the revisions of design to improve the strength in the upper web fillet of the rail to better resist the high range of stress that occurs on curved track on the gauge side at this location. The work described on rail design in the report was occasioned by the occurrence of web failures in the 131 lb. RE rail section on the low rail of curves after considerable traffic had been carried and there had been a reduction in height of section because of rail wear. The cause of split web failures (head and web separations) in 131 RE rail has been found to be corrosion fatigue. Laboratory and service stress measurements have demonstrated that this section develops high stresses in the upper web fillet gauge side, on the low rail of sharp curves. Based on practical experience, mathematical theory, and laboratory and service tests using modern strain measuring equipment, the 140 PS rail section has been developed to retain all the desirable characteristics of the 131 RE section and eliminate its weaknesses. The report contains a detailed drawing of the 140 PS rail section developed from this research and which is now known as the 140 RE rail section, having been adopted by the American Railway Engineering Association as a standard standard section. A detailed drawing of the 133 PS section and of the 155 PS section which were developed from this research are also included in the report.

Code, CJ (Pennsylvania Railroad)
Penn Central Transportation Company Test 405, 416, 8 pp, 3 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1732)

A1 040871
THERMIT WELDED RAILS, FULL FUSION PROCESS

The purpose of the test was to determine the strength and safety of Thermit welded rails (Full Fusion Process). Eight specimens of 131 lb. RE rail 8 ft. long, including a Thermit weld at the center, were provided for laboratory tests. For comparative purposes, eight similar specimens, including an Oxweld pressure weld, were furnished for test. All specimens were 131 lb. RE rail. Three specimens of each kind of weld were tested head down, and three specimens, head up, under the drop test machine. One specimen of each type of weld was tested head up and one head down, under static load, under the million pound testing machine. Results of the drop tests and static tests and of the hardness survey are shown on attached tabulated statements. Every Thermit welded rail broke with the first drop under the drop test machine, even though in one case with the rail tested head up the drop was reduced from 59" to 6" and the energy from 44,000 ft. pounds to 4500 ft. pounds. The Oxweld specimens each withstood the first and second blows with the full 44,000 ft. pounds energy. On the static test the Thermit rail tested head up broke at 262,000 pounds load on a 48" span, and the Thermit rail tested head down broke at 251,000 pounds load. The Oxweld specimen tested head down broke at 375,000 pounds with a square break directly through the weld. The Oxweld specimen tested head up did not break with a load of 375,000 pounds. The strength of the Thermit full fusion weld as determined by these tests does not approach the strength of a full section rail or that of a bolted joint. The grain structure is coarse, the fractures are brittle, indicating the probability that failures in service might be sudden and without warning.

Code, CJ (Pennsylvania Railroad)
Penn Central Transportation Company Test 407, Aug. 1945, 9 pp, 4 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1733)

A1 041097
ON THE PERFORMANCE OF THE RAIL FASTENING DEVICE FOR THE SHARP-CURVED, STEEP-GRADED TRACK

In order to examine the performance of rail fastening device Type 6 designed for PC sleepers used in the sharp-curved, steep-graded section where a severe load condition is assumed, and to make clear the distribution of train load on sharp curve, the lateral wheel force and wheel load, stress of spring clip and rail inclination angle were measured in the field test. These measured results were used for the examination of the fatigue limit of spring clip, the relationship between the lateral wheel force and stress of string clip and the distribution of lateral wheel force.

Umeda, S Aihara, K Kumazaki, H *Railway Technical Research Institute* Vol. 13 No. 1, Mar. 1972, pp 8-10, 5 Fig

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Japanese National Railways Kunitachi, Box 9, Tokyo, Japan Repr PC

DOTL JC

A1 041107
NUMERICAL CALCULATION AND APPROXIMATE FORMULA OF BUCKLING STRENGTH OF TRACK

In 1967, the adoption of 60 kg rail in the track of the Sanyo Shin Kansen was determined. For this determination, it was considered that the temperature difference corresponding to the buckling strength of the track with this rail would not be different so far from that of the track with 50 T rail. To confirm this, the authors made the calculation program of the buckling strength of track and computed this for every rail in Japan including the new 60 kg rail. Through the investigation of calculated results, it was found that there would be simple approximate formula to calculate the buckling strength of track. This paper contains the calculating method of the buckling strength, calculated results, the composition of the approximate formula and its application.

Sato, Y Kobayashi, S *Railway Technical Research Institute* Vol. 13 No. 1, Mar. 1972, pp 35-39, 4 Fig, 1 Tab

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Japanese National Railways Kunitachi, Box 9, Tokyo, Japan Repr PC

DOTL JC

A1 041108
THEORETICAL ANALYSIS OF VARIATION OF WHEEL LOAD

A three mass model was developed for theoretical analysis of the variation of the wheel load for a high speed railway like the Shin Kansen. The calculation of the frequency response function and transient response are demonstrated, with particular emphasis on passage through very small low spots of track.

Hirano, M *Railway Technical Research Institute* Vol. 13 No. 1, Mar. 1972, pp 42-44, 4 Fig

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Japanese National Railways Kunitachi, Box 9, Tokyo, Japan Repr PC

DOTL JC

A1 041111
RUNNING PERFORMANCE TESTS ON THE CAR BODY VIBRATIONS OF THE 591-PROTOTYPE ELECTRIC CARS

For the purpose of raising running speeds on curves, the 591 prototype electric cars were produced, and various tests were performed on Tohoku line in April 1970. As for riding comfort, it was confirmed that the allowable maximum speeds on curves are determined not by stationary lateral accelerations but by shock vibrations at the entrances of curves.

Koyanagi, S Uetake, Y *Railway Technical Research Institute* Vol. 13 No. 1, Mar. 1972, pp 50-51, 2 Fig

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Japanese National Railways Kunitachi, Box 9, Tokyo, Japan Repr PC

DOTL JC

A1 041321
RETAINING GAUGE ON CURVES: THE L&N APPROACH
Louisville and Nashville has found that powerful diesel units with three axle trucks cause problems with holding gauge on curves. L&N launched three point plan: a laboratory study, use of gauge-measuring devices, and new standards for tie-plate sizes and spiking patterns for curves. Use of a common tie-plate for 100 lb and 132 lb rail meant that the 132 lb rail base covered one of the spike holes on the gauge side. To help prevent rail overturning under those conditions, a compression clip anchor was used in place of the spike on curves. L&N has adopted a new 18 inch tie-plate for problem curves. Diesel locomotive truck side thrust was suspected as a source of wide gauge on curves, so a gauge sensing device was mounted on a locomotive truck. Tests confirmed the rail moved outward under dynamic loading. Measuring devices attached to the rails also confirmed movement. A pickup truck equipped for rail/highway operation was also equipped with gauge recording instruments. On heavy-tonnage routes, curves of 5 degrees or more or troublesome curves get the new 18 inch tie-plate. Three line spikes are now used on the outer rail of the curve, with one screw spike in the hold down holes on either side of the rail. Still another technique being tried is the use of washer head screw spikes which are driven as line spikes.

A similar article on the L&N approach to curve problems appeared in Railway Track and Structures, V69, N1, January 1973.

Dove, RE *Railway Age* Vol. 174 No. 1, Jan. 1973, pp 28-30, 1 Fig, 4 Phot

ACKNOWLEDGMENT: Railway Age
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

A1 041665
SPECIAL BIBLIOGRAPHY: SAFETY-RELATED TECHNOLOGY
This book contains over 1,900 abstracts of journal articles and research reports provided to RRIS by the Federal Railroad Administration. These abstracts are primarily in the subject areas of Track Structure, Train-Track Dynamics, and Rail Vehicles and Components. The abstracts are arranged according to the RRIS Classification Scheme. The book also contains Subject Term, Author, and Source Indexes.

Highway Research Board 7351, Mar. 1973, 339 pp

Contract DOT-OS-00035

PURCHASE FROM: NTIS Repr PC, Microfiche

PB-220220

A1 041672
MEASUREMENT AND ANALYSIS OF WHEEL-RAIL FORCES
Described is a method used to continuously measure, record, and analyze the lateral and vertical forces between wheels and rails of several types of railroad freight cars under a variety of car and track conditions. The method, using analog-to-digital conversion and computerized data handling, has produced results relating to a multitude of car and track behavior subject areas. Especially important is the definition, development, and verification of performance "signatures" which are generated in a unique and characteristic manner by each car in negotiating a given curve. The finding of such "signatures" to be completely reproducible and yet sensitive enough to change with relatively minor track or car component variations, i.e., modifications, supports the belief that these techniques can be applied beyond pure experimental scopes into routine (a) trackside inspection of cars in passing trains; (b) mechanized track inspection; and (c) truck design evaluation.

This paper was presented at the ASME Winter Annual Meeting, November 28-December 2, 1971. The notification of this paper appeared in Mechanical Engineering.

Peterson, LA (Bessemer and Lake Erie Railroad); Freeman, WH (Quebec Cartier Mining Company Railroad); Wandrisco, JM (United States Steel Corporation)
American Society of Mechanical Engineers 71-WA/RT-4, 1971

ACKNOWLEDGMENT: Mechanical Engineering
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL TF5.A72 1971

A1 044281
TECHNICAL STUDIES TO EVALUATE THE INFLUENCE OF OPERATIONAL FACTORS ON TRACK LOADING
This paper describes briefly theoretical and physical investigations which have recently been performed by Canadian National Railways. The objective of investigations has been to establish means of reducing the probability of train derailment. While the scope of the derailment study is indicated, two efforts have been singled out for more detailed description. The first effort was directed to determine through computer simulation and analysis programs the lateral loading on curved track which can result from longitudinal train action forces. The second effort to be reviewed was directed to determine, through field measurement, actual lateral tieplate loads on curved track imposed by various vehicle types.

Contributed by the Rail Transportation Division of ASME for presentation at the Winter Annual Meeting, New York, New York, November 26-30, 1972.

Scott, JF Belevins, WG Wilson, JT (Canadian National Railways)
American Society of Mechanical Engineers Paper 72-WA/RT-11, Nov. 1972, 11 pp, 14 Ref

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL RP

A1 044285
THE INFLUENCE OF WHEEL-RAIL CONTACT FORCES ON THE FORMATION OF RAIL SHELLS
This paper describes an analytical and experimental investigation of the problem of rail shelling; in particular the influence of the stresses resulting from wheel-rail contact forces is studied. These contact forces are due to the weight of the car, and the tracking of the wheel on the rail. An analytical analysis includes the yielding of the rail material, the subsequent development of residual stresses, and plastic flow due to a moving load. Explanations are given for the mechanics of shelling and other associated behavior that is found in rail.

Contributed by the Rail Transportation Division of ASME for presentation at the Winter Annual Meeting, New York, New York, November 26-30, 1972.

Martin, GC (Association of American Railroads); Hay, WW (Illinois University, Urbana)
American Society of Mechanical Engineers Paper 72-WA/RT-8, Nov. 1972, 13 pp, 1 Tab, 19 Ref

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL RP

A1 044431
FRA GEARING UP TO ENFORCE TRACK SAFETY STANDARDS
The Federal Railroad Administration's Bureau of Railroad Safety has been enlarged and reorganized under the name of Office of Safety. The result of the reorganization which became effective November 13, 1972, was to establish the activities of the Office of Safety under two groupings, one called the Compliance Division and the other the Standard and Procedures Division. Activities of the Compliance Division will include the training of personnel involved in administration of safety programs, the monitoring of programs in states that have been certified to participate in administration of the Safety Act, the evaluation of field performance, the development of guidelines for field programs, and the coordination of field safety activities. Under the Standards and Procedures Division will come such activities as the development of rules and standards, the provision of technical advice and counsel to the headquarters and field forces, the analysis of reports and data and the development of enforcement procedures and policies. Inspection and surveillance activities of the Office of Safety will be handled through the same regional setup as prevailed under the Bureau of Railroad Safety. Personnel are being recruited and trained, regulations are being prepared for the certification of states, and a track manual of uniform practices is being readied.

Railway Track and Structures Vol. 69 No. 1, Jan. 1973, pp 19-21, 1 Fig

ACKNOWLEDGMENT: Railway Track and Structures
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

A1 044503
SERVICE FAILURES AND THEIR IMPLICATIONS FOR BRITISH RAILWAYS
Failures in welded and bolted track, tram wheels, nozzle rings, frames and similar components, due to fatigue cracking, thermal cracking, spalling, voids, fracture, and similar mechanisms are discussed. Photomicrographs are used to evaluate failure modes.

Waldron, GWJ (British Rail Research Division); Wise, S *Sheffield University Metallurgical Society, Journ* Vol. 11 1972, pp 31-42

ACKNOWLEDGMENT: EI (EI 73 022603)
PURCHASE FROM: ESL Repr PC, Microfilm

A1 046216
RAILROAD ACCIDENT REPORT: DERAILMENT OF MISSOURI PACIFIC RAILROAD COMPANY'S TRAIN 94 AT HOUSTON, TEXAS, OCTOBER 19, 1971
The Missouri Pacific Railroad's freight train 94 was traveling north on track which belongs to the Atchison, Topeka and Santa Fe Railway when 20 of its cars derailed in Houston, Texas, on October 19, 1971, at 1:44 p.m. There were four diesel-electric locomotive units and 82 cars in the train. Derailed cars included six tank cars containing vinyl chloride monomer and two cars containing other hazardous materials. Two tank cars were punctured in the derailment. The vinyl chloride monomer escaped and ignited. The Houston Fire Department attempted to control the fire. Approximately 45 minutes after the initial derailment, one tank car ruptured violently and another tank car 'rocketed' approximately 300 feet from its initial resting place. This sequence of events caused the death of a fireman. Fifty people were injured and there was considerable property damage. Most of the injured were firemen. The Safety Board determines that the probable cause of this accident was an unexplained emergency brake application which induced lateral forces exceeding the holding capacity of the track fasteners.

National Transportation Safety Board NTSB-RAR-72-6, SS-R-16, Dec. 1972, 58 pp

ACKNOWLEDGMENT: NTIS (PB-216608/0)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-216608/0, DOTL NTIS

A1 046320
MAINTENANCE OF TRACK ON SHINKANSEN
This article discusses the train operation, track construction, quality standards, and maintenance program of the high speed railway in Japan. Train vibrations are related to track conditions. Use of Track Inspection Car to measure track quality is discussed. Maintenance operations are carried out at night when no trains are running.

Fukusawa, Y *Japanese Railway Engineering* Vol. 14 No. 1, 1973, pp 3-7

PURCHASE FROM: Japan Railway Engineers' Association 2-5-18 Otemachi, Chiyoda-ku, Tokyo, Japan Repr PC
DOTL JC

A1 046362
DETECTING THE PROPAGATION OF KIDNEY-SHAPED FATIGUE FLAWS IN RAIL HEADS ON THE LINES OF THE HUNGARIAN STATE RAILWAYS
The author discusses the cause and propagation of kidney-shaped fatigue flaws in the rail head as well as the measures designed to prevent fractures. The main purpose is the description of the functional relationship between the propagation of the fatigue flaw and the traffic load. The formation of flakes in the rail material, the hardness of the rail head and the notch effect set up in the rail head by internal flaws are discussed. It is found that the propagation of the flaws is jointly caused by a number of processes such as microinclusions, oscillatory movements of dislocations, high stresses in the rail head, etc. The positions of the initial centres have been investigated by examining and measuring several fractures. Methods for calculating the height of the fissure and its inclination towards the vertical are developed. An analysis is made of the development of fatigue flaws as a function of the traffic load, and the existing relationship is established by an equation. In determining the effective cross-sectional area of the rail, the wear of the rail is also taken into account and added to the area of the fatigue flaw. After an analysis of the permissible threshold values, certain specifications are suggested, and the size of the flaw area in percent of the total cross-sectional area of the rail head is indicated with the aid of nomographs. In addition to the manual examinations, the introduction of ultrasonic high-speed testing vehicles is urgently recommended. In modern railway operation, ultrasonic testing is the most suitable method of detecting dangerous flaws; but the influence of human subjectivity in evaluating the results must be eliminated by using modern computers.

Kecskes, OS *Rail International* Vol. 3 No. 9, Sept. 1972, pp 493-506, 12 Fig, 14 Ref

PURCHASE FROM: International Railway Congress Association 17-21 rue de Louvrain, 1000 Brussels, Belgium Repr PC
DOTL JC

A1 046437
CHANGE-OUT OF DEFECTIVE RAILS IS MECHANIZED ON L&N
The two rail-defect detector cars on the Louisville & Nashville have been finding a considerable number of rails with transverse defects and bolt-hole breaks. Work is done by crew using on/off-track carrier equipped with crane and a variety of power-operated devices, including rail drill, rail saw, wrench, spike puller and spike driver.

Railway Track and Structures Vol. 68 No. 9, Sept. 1972, pp 38-39

ACKNOWLEDGMENT: EI (EI 73 004001)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

A1 046820
RAIL STEELS APPRAISED INTERNATIONALLY
Iron & Steel Institute's full-day conference 'Rail Steels' in London discusses 13 papers and establishes a two-fold concept, the Continental focus on combatting wear and British preventive measures to eliminate rail breakage. An international gathering of some 150 attend from railways and industry with senior BR civil engineers in the chair.

Jones, EG *Rail Engineering International* Vol. 3 No. 4, Apr. 1973, 12 pp, 6 Fig, 4 Tab

PURCHASE FROM: Broadfields (Technical Publishers) Limited Little Leighs, Chelmsford, Essex CM3 1PF, England Repr PC
DOTL JC

A1 046837
CONTINUOUSLY SUPPORTED RAIL SUBJECTED TO AN AXIAL FORCE AND A MOVING LOAD
The recent practice of welding railroad rails to each other suggests that considerable axial compression forces may be induced in the rails because of a rise in temperature. This in turn may reduce the critical velocity for the track to the range of operational velocities of modern high-speed trains. The purpose of the paper is to demonstrate that this is indeed a possibility.

Kerr, AD (New York University, New York) *International Journal of Mechanical Sciences* Vol. 14 No. 1, Jan. 1972, pp 71-78, 8 Ref

ACKNOWLEDGMENT: EI (EI 73 029643)
PURCHASE FROM: ESL Repr PC, Microfilm

A1 046934
EFFECT OF BALLAST CONDITIONS ON TRACK STABILITY
It is shown how installation of long-welded rail on Europe's principal trunk routes has created problems of track stability caused by the presence of thermal stresses in the track, affected by local climatic conditions. The measurements obtained by the tests conducted at the Technical University in Munich, West Germany showed that the lateral resistance is greatest when the track has settled under traffic. After tamping combined with a rise of 2 to 3 cm, the lateral resistance decreases by approximately 70%.

Eisenmann, J (Munich Technical University); Gnad, H *Railway Gazette* Vol. 126 No. 9, May 1970, p 349

ACKNOWLEDGMENT: EI (EI 72 27294)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

A1 046943
NOTCH TOUGHNESS AND CRACK PROPAGATION RATE OF LOW CARBON STEEL ALLOY RAIL
A new movable nose crossing for Shinkansen is made of low carbon alloy steel. In order to test the mechanical properties of this steel, the falling weight test and the bending fatigue test have been done. These tests indicate that this steel has the sufficient mechanical properties.

Kurihara, T Sugiyma, T *Railway Technical Research Institute* Quart Rpt. Vol. 14 No. 2, 148, 1972, June 1973, pp 116-117, 4 Fig., 2 Tab.

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Ken-yusha #1-45-6, Hikari-cho, Kokubunji, Tokyo, Japan Repr PC

DOTL JC

A1 046947
REMOVAL OF PRESSED AND FROZEN SNOW AT THE FLANGE WAY OF THE TRACK
For the project of the nation-wide SHIN KANSEN network, the countermeasure against snow along deep snowy lines is important. For example, it arouses anxiety that the pressed and frozen snow formed on the flange way of the track may influence the running stability of the high speed vehicles. The report is concerned with the fundamental tests which were carried out in order to develop the way and apparatus for removing it efficiently.

Ohyama, T Sekiguchi, H *Railway Technical Research Institute* Quart Rpt Vol. 14 No. 2, 217, 1972, June 1973, pp 104-105, 3 Fig

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Japanese National Railways Kunitachi, Box 9, Tokyo, Japan Repr PC, Microfilm

DOTL JC

A1 047454
EXPERIMENTS HAVE DETERMINED THE FORCES BETWEEN THE WHEELS AND RAIL
This is the third of a series of articles discussing the wheel and rail loadings developed by diesel locomotives. The data is based on calculations and experiments conducted by Electro-Motive. The information may assist in explaining and preventing some of the derailments which railroads encounter. The next installment will discuss the "dynamic" profile of track and its measurement.

Koci, LF *Railway Locomotives and Cars* Vol. 145 No. 12, Dec. 1971, p 16

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

A1 047458
IMPORTANCE OF RAIL PROFILES IN WHEEL LOADING IS DEMONSTRATED
This is the fourth of a series of articles discussing the wheel and rail loadings developed by diesel locomotives. Data are based on calculations and experiments conducted by Electro-Motive. The information may assist in explaining and preventing some of the derailments which railroads experience. The next installment will discuss the effects of dynamic braking.

Railway Locomotives and Cars Vol. 146 No. 1, Jan. 1972, p 20

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

A1 047460
DYNAMIC BRAKING MUST BE CAREFULLY CONTROLLED
This is the fifth of a series of articles discussing the wheel and rail loadings developed by diesel locomotives. Data are based on calculations and experiments conducted by Electro-Motive. The information may assist in explaining and preventing some of the derailments which railroads experience. The next installment will mark the conclusion of this series.

Koci, LF (General Motors Corporation) *Railway Locomotives and Cars* Vol. 146 No. 2, Feb. 1972, p 13

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

A1 047466
WHEEL AND RAIL LOADINGS FROM CONTEMPORARY DIESEL LOCOMOTIVES
This is the first of a series of articles discussing the wheel and rail loadings developed by diesel locomotives. The data is based on calculations and experiments conducted by Electro-Motive Division. The information may assist in explaining and preventing some of the derailments which railroads encounter.

Koci, LF (General Motors Corporation) *Railway Locomotives and Cars* Vol. 145 No. 10, p 19

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

A1 048075
THE EFFECT OF SURFACE FILMS ON FATIGUE CRACK INITIATION
The suppression of fatigue crack initiation by surface films can be viewed in terms of two mechanisms: (1) protection against environmental attack, and (2) suppression of surface plasticity. These two mechanisms are described in detail. Environmental protection requires a flawless coating which is impermeable to the active component of the environment and resistant to fracture under repeated cyclic strain. Suppression of plasticity requires a film with an elastic modulus greater than the substrate metal. The stiffer coating repels dislocations from the surface and suppresses the development of slip bands and crack initiation. (Author)
Availability: Pub. in Corrosion Fatigue, p201-210 1972.

Crosskteutz, JC
Midwest Research Institute Tech Rpt TR-12, 1972, 14 pp

Contract N00014-71-C-0020

ACKNOWLEDGMENT: NTIS (AD-760072)
PURCHASE FROM: NTIS Repr PC, Microfiche

AD-760072, DOTL NTIS

A1 048180
TRACK SAFETY STANDARDS
The Track Safety Standards, with the amendments issued December 22, 1972, are reproduced in full in this pocketbook.
Write in care of R. Mowatt-Larssen, Office of Safety.

Federal Railroad Administration May 1973, 37 pp

PURCHASE FROM: FRA Repr PC

DOTL RP

A1 048240
TECHNICAL STUDIES TO EVALUATE THE INFLUENCE OF OPERATIONAL FACTORS ON TRACK LOADING
This paper describes briefly theoretical and physical investigations which have recently been performed by Canadian National Railways. The objective of investigations has been to establish means of reducing the probability of train derailment. While the scope of the derailment study is indicated, two efforts have been singled out for more detailed description. The first effort was directed to determine through computer simulation and analysis programs the lateral loading on curved track which can result from longitudinal train action forces. The second effort to be reviewed was directed to determine, through field measurement, actual lateral tieplate loads on curved track imposed by various vehicle types.

Scott, JF Blevins, WG Wilson, JT
American Society of Mechanical Engineers Paper #72-WA/RT-11, Nov. 1972, 11 pp

ACKNOWLEDGMENT: British Railways (29375)
PURCHASE FROM: ESL Repr PC, Microfilm

A1 048277
EVALUATION OF THE BRITTLE FRACTURE OF RAILS [SPRODBRUCHABSCHATZUNG AN SCHIENEN]
The testing of rails provided for in the technical specifications of the railways (and particularly the UIC) gives incomplete information concerning the behaviour of rails subjected to certain frequent stresses in service, such as the effect of impacts caused by flats on the wheel treads. The author's purpose is to establish more satisfactory criteria for evaluation purposes, taking into account the triaxial character of the pressure in the rails by making use of the Schnadt diagram covering the index of the capacity of plastic deformation of the steel in relation to the pressures to which it is subjected. The above article contains an account of the work carried out by the author in order to establish characteristic parameters of the risk of brittle fractures of the rails in relation to a coefficient covering eventual cracks, or grooves, in the rail surface, as well as the temperature, the load, and the speed, and numerical formulae are provided covering the German State Railway's S 49 rails. [German]

Tutzchky, G *Deutsche Eisenbahntechnik* No. 9, 1972, 4 pp, 7 Fig, 16 Ref

ACKNOWLEDGMENT: International Railway Documentation (326)
PURCHASE FROM: International Union of Railways, BDC 14 rue Jean Rey, 75015 Paris, France Repr PC

A1 050072
EFFECT OF FLAT WHEELS ON TRACK AND EQUIPMENT
Although old, this work is generally considered to be an excellent reference on this subject. The report describes the Test Apparatus and the Tests, presents the results of the tests, and presents some conclusions from the tests. The conclusions cover the effect of train speed, the effect of flat spot length, the effect of wheel load, and the impact force of a flat spot; and recommend guidelines for removing wheels from service and for running cars with flat wheels to terminals for service.

Association of American Railroads Technical Center May 1951, 81 pp, 27 Fig, 3 Tab, 9 Ref

ACKNOWLEDGMENT: Association of American Railroads Research Center (f4196)
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr PC
DOTL RP

A1 050083
RAIL STEELS: STRONGER, HARDER OR TOUGHER?
A conflict emerged at an Iron and Steel Institute Conference, held in London recently, between the commercial demand for steels that resist wear and the requirements to reduce the number of brittle fractures likely to occur which might lead to derailment.

Railway Gazette International Vol. 128 No. 12, Dec. 1972, pp 471-472

ACKNOWLEDGMENT: British Railways (29078)
PURCHASE FROM: IPC Transport Press Repr PC
DOTL JC

A1 050323
WHAT THE DESIGNER MUST KNOW ABOUT FRACTURE MECHANICS
Traditional design criteria make no attempt to account for the failure mode which is characteristic of a flawed, frangible structure. A design rationale is outlined for brittle and brittle-ductile transition materials which contain flaws caused, for example, by metallurgical inclusions; fabrication and erection overloads, and fatigue cracking. Linear elastic fracture mechanics can be employed successfully for high strength-low toughness materials design. Laboratory test results for critical values of Kc, the stress intensity factor, may be applied to combined load problems by use of the strain-energy-density factor Sc. Design with materials of higher toughness-/yield strengh ratios follows essentially the same procedure with a slight modification in interpretation of the fracture toughness parameter. A number of example problems are solved and the results compared with those obtained using the traditional failure criterion.
Copies are $1.00 to ASME members.

Sih, GC (Lehigh University); MacDonald, B (Bethlehem Steel Corporation)
American Society of Mechanical Engineers Paper ASME #73-DE-19, Jan. 1973, 17 pp, 26 Fig, 15 Ref
ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL RP

A1 050363
MAGNETIC INSPECTION AND THE DYE PENETRANT TECHNIQUE AS AIDS FOR CONFIRMING RAIL DEFECTS
Two alternative methods which can be used as an aid to the Pulse-Echo method of rail testing are described. Magnetic crack detection and dye penetrant testing produce a visual picture of the surface defect which contains all the relevant information except that of relating to the actual depth of the crack.

Banks, J *Permanent Way Institution, Journ & Rpt of Proceed* Proceeding Vol. 91 No. t1, 1973, pp 33-39, 3 Fig

PURCHASE FROM: Derry and Sons, Limited Canal Street, Nottingham, England Repr PC
DOTL JC

A1 050367
C & NW PINPOINTS ITS DERAILMENT PROBLEMS
Chicago & North Western is taking an electronic approach to the prevention of derailments by determining the precise locations where track conditions are conducive to rock-and-roll wheel uplift. The system measures track deviations in cross level and alignment and relates their combined effect in producing rock-and-roll action that will cause a car's wheels to lift from the rail at a critical speed. Pick-up device includes two gyroscopes, one sensitive to the roll axis of the axle and the other to the turn axis. Both are in fixed position with respect to the axle.
See also Railway Track Structures, Vol. 67, No. 11, Nov. 1971, pp 22-24.

Railway Age Vol. 171 No. 9, Nov. 1971, 2 pp

ACKNOWLEDGMENT: EI (EI 72 34131)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

A1 050373
DEVICE MEASURES TRACK-CENTER DISTANCES
Apparatus described was used for checking track centers on 120 mi between main tracks and 30 mi between main and side tracks in test. Truck is propelled by the outrigger pipes, but sliding frame permits it to move laterally so connecting cable actuates a transducer. Output voltage from potentiometric displacement transducer is fed into a recording voltmeter to produce a continuous tape for reading.

Railway Track and Structures Vol. 67 No. 9, Sept. 1917, pp 24-25

ACKNOWLEDGMENT: EI (EI 72 23287)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

A1 050381
WHAT PRECAUTIONS WHEN WORKING CWR TRAFFIC
Report on the subject of when and how to timber and surface locations having continuous welded rail to avoid or minimize expansion or contraction. Prepatory measures taken to tie the renewals under continuous welded rail.

Sorrels, BD *Railway Track and Structures* Vol. 67 No. 11, Nov. 1971, pp 26-27

ACKNOWLEDGMENT: EI (EI 72 39995)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

A1 050415
FRA TRACK SAFETY STANDARDS: MODIFICATIONS ARE NOW OFFICIAL
The amendments are: 213.61 Curve data for classes 4 through 6 track; 213.9 Classes of track: Operating speed limits; 213.13 Measuring track not under load; 213.109 Cross ties; 213.113 Defective rails; 213.133 Turnouts and track crossings generally; 213.233 Track inspections; 213.237 Inspection of rail; 213.241 Inspection records.

Railway Track and Structures Vol. 69 No. 2, Feb. 1973, pp 25-26, Tabs

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

A1 050473
USING FERROPROBES FOR TESTING THE RAILS OF ELECTROMAGNETIC WAGON/DEFECTOSCOPES

The parameters of the cores of a ferroprobe for operation of a high-speed rail defectoscope in relative strong fields are calculated by an approximate method. The possibility of using ferroprobes to indicate defects by high-speed electromagnetic nondestructive testing of railroad rails for low traveling speed is shown.

Shcherbinia, VA (All-Union Scientific Res Inst for Railw Transport); Valasov, VV Dovnar, DP *Soviet Journal of Nondestructive Testing* Vol. 8 No. 6, Nov. 1972, pp 641-647, 15 Ref

ACKNOWLEDGMENT: EI (EI 73 050854)
PURCHASE FROM: ESL Repr PC, Microfilm

A1 050564
HANDY GUIDE TO FRA TRACK STANDARDS

United States railroads are now subject to the track safety standards developed under the Federal Railroad Safety Act of 1970. The initial standards were promulgated by the Federal Railroad Administrator on October 15, 1971; most of them became effective October 16, 1972. In September 1972, FRA issued a notice of proposed rule making to amend the initial standards. After subsequent written comments and a public hearing, a number of amendments were adopted. The reference chart incorporates thes amendments to the initial standards as issued by FRA on December 22, 1972.

Modern Railroads Vol. 28 No. 3, Mar. 1973, 5 pp, 3 Tab

PURCHASE FROM: Cahners Publishing Company, Incorporated 5 South Wabash Avenue, Chicago, Illinois, 60603 Repr PC

DOTL JC

A1 050727
ON THE STABILITY OF THE RAILROAD TRACK IN THE VERTICAL PLANE

The report reviews and discusses various aspects of railroad track buckling in the vertical plane. Buckling tests of straight tracks are reviewed first. A review of the published analyses on vertical track buckling reveals that they may be grouped into two main categories. In one category, the authors assume that the track is an elastic beam which is continuously supported by a Winkler base, before as well as during buckling. In the other group, the authors assume that the track is a beam of uniform weight, which rests on a 'rigid' base and that the buckling load is reached when part of the track lifts itself off the base. To clarify the validity of some of the assumptions made, two simple models which represent the assumptions made are studied first. This is followed by a review of the literature. (Modified author abstract)

Kerr, AD
New York University, Bronx NYU-AA-72-35, Nov. 1972, 39 pp

Contract DOT-FR-20064

ACKNOWLEDGMENT: NTIS (PB-222362/6)
PURCHASE FROM: NTIS Repr PC, Microfiche

PB-222362/6

A1 050868
DYNAMIC VARIATION OF WHEEL LOAD ATTRIBUTED TO VERTICAL DEFORMATION OF RAIL END

Vertical deformation of rail end within the allowable tolerance when supplied from manufacturer often causes unevenness of running surface of rail at welded rail. The transient vibration caused by this local unevenness at welded part was theoretically discussed for the vehicle-track vibration system. The relationships among train speed, length of unevenness, spring coefficient of rail support, damping coefficient of rail support and dynamic variation of wheel load were discussed.

Kuroda, S *Railway Technical Research Institute* Quart Rpt Vol. 14 No. 3, Sept. 1973, pp 143-144, 5 Fig

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

A1 051536
APPLICATION OF GUIDEWAY ROUGHNESS POWER SPECTRAL DENSITY AS A MANAGEMENT TOOL

Ground surface vehicles such as trucks or railway cars can be considered as mechanical systems suspended on vibrating wheels. The source of vibrational energy is the roughness in the roadway or the guideway. A portion of the vibrational energy is transmitted through the vehicle suspension system and to the passengers or lading inside the vehicle. The magnitude of the transmitted energy and its frequency content depend on the roughness of the surface, the speed of the vehicle, and the mechanical characteristics of the suspension system. If the roads and guideways are categorized by the Power Spectral Density (PSD) of their surface roughness, the amount of vibrational energy can be predicted if the speed and the characteristics of the vehicle suspension system are known. Conversely, if a safe limit of the vibration has been established for a particular lading, management can render a cost effective decision on guideway maintenance, speed practices, and vehicle design from knowledge of the PSD characteristics of a proposed route.

Contributed by the Intersociety Committee on Transportation for presentation at the Intersociety Conference on Transportation, Denver, Colo., Sept. 23-27, 1973.

Corbin, JC Yang, TL (ENSCO, Incorporated)
American Society of Mechanical Engineers Paper 73-ICT-114, Sept. 1973, 8 pp, 3 Fig, 11 Ref

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL RP

A1 051964
STRESSES TO WHICH THE TRACK, THE BALLAST, AND THE SUBGRADE ARE SUBJECT, UNDER THE ACTION OF MOVING LOADS [SOLLICITATIONS DE LA VOIE, DU BALLAST ET DE LA PLATE-FORME SOUS L'ACTION DES CHARGES ROULANTES.]

The above article contains a synthesis of the research carried out by ORE D 71 Committee. Details are shown, in a condensed form, of the partial results set out in the 12 reports prepared by that Committee. So far as concerns research into the stresses to which the fastenings and sleepers are subjected, additional information is provided, showing the present concerning the studies carried out by the SNCF, after the general report had been drawn up. Progress effected in the field of the extensometric technique enables certain pressures to be more clearly established, and the use to be avoided of corrective coefficients, or empirical formulae, for the study of the rheological characteristics of the ballast and the subgrade. These investigations are carried out within the framework of research into the interaction between the track and the vehicle, and the optimum equipment of the conventional track. [French]

Revue Generale des Chemins de Fer May 1973, 11 pp, 5 Fig

ACKNOWLEDGMENT: UIC (1017)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

A1 051967
FORMATION OF FATIGUE CRACKS IN RAILS [ERMUEDUNGSBRUCHBILDUNG IN SCHIENEN]

The rates of unlimited fatigue strength resisting flexion, traction-compression, and shearing, are, in the case of a perfect steel, linear functions of the resistance to fracture caused by traction, in the author's view. He provides diagrams showing these rates, as well as their variation in relation to the rail surface. He makes brief reference to the distribution of pressures in the rail, and explains the manner in which the rates of unlimited fatigue strength can be exceeded when the rail contains inclusions of slag, segregations, or concentrations of ferrite. He explains, in detail, the mechanism of the propagation of the oval flaw and concludes with a number of observations concerning the means of improving the resistance of rails. [German]

Beres, L *Eisenbahntechnische Rundschau* No. 3, Mar. 1973, 6 pp, Figs, Refs

ACKNOWLEDGMENT: UIC (1004)
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr PC

1004, DOTL JC

A1 052253
JOINT BARS-DESIGN SPECIFICATIONS AND SERVICE TESTS INCLUDING INSULATED JOINTS AND COMPROMISE JOINTS
Various tests and application procedures of joints are discussed. Insulated joints, glued joints, web-contact joint bars, Huck fasteners, and joints with structural adhesives are studied in service tests, both in the laboratory and in field installations. The field installations are varied in location. Static stresses in rail and dynamic stresses in rail joint are studied in connection with field installations Huck fasteners. Among the conclusions are: 1)service tests of redesigned vulcabond insulated joints showed much chipping and flaking off; 2) Huck fasteners on polyurethane insulated joints were in satisfactory condition after two to twelve months installation; 3) Huck fasteners in standard head-free toeless angle bars would not satisfactorily restrain rail movement.

AREA Bulletin Proceeding Vol. 73 N No. 36, Feb. 1972, pp 312-337, 2 Fig, 7 Tab, 22 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052254
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
Part one of this report discusses a laboratory investigation of 132-pound rail made from vacuum degassed steel. The purpose of this investigation is to determine whether rails made from vacuum degassed steel and air cooled are comparable in properties with rail steel produced by currently common practices. The manufacturing process and test specimens are described. Rolling load tests, drop tests, slow bend tests, Charpy impact tests, hardness tests, and chemical analysis are performed. Macroscopic and microscopic examinations and physical property determinations are examined. The properties of vacuum degassed steel rails without controlled cooling were comparable to those manufactured by conventional techniques. Part two is a report on a field inspection of vacuum degassed steel rail on the Norfolk & Western Railway. Slight curve wear was noted in the high side rails, and slight rail wear was noted on the low side rails. No shelling or head checking was noted.

AREA Bulletin Proceeding Vol. 73 N No. 36, Feb. 1972, pp 338-394, 16 Fig, 16 Tab, 31 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052256
RAIL FAILURE STATISTICS COVERING (A) ALL FAILURES (B) TRANSVERSE FISSURES (C) PERFORMANCE OF CONTROL-COOLED RAIL
This report of rail failure statistics covers all failures, transverse fissures, and performance of control-cooled rail. Mill performance with regard to service failures is discussed. Statistics for both accumulated service failures and detected number of defects are given. No additional transverse fissure failures in control-cooled rail were reported in 1971 indicating that good quality control and mill practices have been followed in the manufacture of this rail to avoid shatter cracks. The low incidence of rail failure from welded engine burns indicates that practice of welding these burns is showing good service performance. Butt weld failures are tabulated.

AREA Bulletin Proceeding Vol. 73 N No. 38, July 1972, pp 723-740, 4 Fig, 15 Tab

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052261
WHEEL AND RAIL LOADINGS FROM DIESEL LOCOMOTIVES
A review of wheel and rail loadings from diesel locomotives is presented in six areas: 1) sample derailment data, 2) basic curve negotiation mechanics, 3) experimentally determined wheel-to-rail forces, 4) rail profile data, 5) the effect of dynamic brake levels, and 6) mechanical considerations. In summarizing all of these factors the following areas deserve the most attention: 1) locomotive braking practice with regard to delay in power to brake transfer, gradual buildup of braking level and control of braking level over crossovers, turnouts, and curves; 2) track in relation to gage widening, level of rail irregularities, and possible thermal strain investigations; and 3) mechanical factors including proper alignment control in draft gears, and proper bolster stops on units without alignment control.

Koci, LF (General Motors Corporation) *AREA Bulletin* Proceeding Vol. 72 N No. 33, July 1971, pp 500-528, 6 Fig, 22 Tab

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052262
SOME ASPECTS OF SERVICE DEVELOPMENTS IN RAIL-HEAD METAL
Service developments in rail-head metal characterized by the presence of white etching regions have been studied. After the development of microstructural white-etching regions resulting from traction and adhesion conditions, spalling begins as a result of trains passing repeatedly over these hard and increasingly brittle areas. White-etching regions on a car-dumper hoop rail resulted from impact during loading and unloading of the dumper, because these areas were in contact with mating guide wheels in the normal load and unload positions of the car dumper. White-etching also results from the effects of repeated loads on the vertical face of non-end-hardened bolted rail. A rolling-contact fatigue test concludes that rail steels have longer life at lower maximum static contact stress levels than at higher stress levels.

Henry, RJ (Bethlehem Steel Company) *AREA Bulletin* Proceeding Vol. 72 N No. 33, 72-733-13, July 1971, pp 586-599, 1 Fig, 1 Tab, 10 Phot, 4 Ref

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052263
STRESS DISTRIBUTION IN THE PERMANENT WAY DUE TO HEAVY AXLE LOADS AND HIGH SPEEDS
The stress distribution in the rail head near the contact surface between rail and wheel with heavy axle loads at high speeds is discussed. An experimental investigation of the stress distribution was performed. Tensile bending stresses in the rail head and rail foot, and lateral forces are discussed. In Germany a test track of prefabricated concrete slab was constructed, and the measurements taken showed that scattering of stresses in the rail foot were small and did not vary with the driving speed.

Eisenmann, J (Munich Technical University) *AREA Bulletin* Proceeding Vol. 71 N No. 22, 71-622-3, Oct. 1969, pp 24-59, 15 Fig, 13 Tab, 1 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052265
THE THERMAL ELONGATION OF RAILS ON ELASTIC MOUNTINGS
Elongation and contraction of rails due to temperature changes is a primary factor affecting the variation in length of rails and their associated strains and stresses. This report considers thermal elongation in conjunction with the longitudinal elasticity of rail fastenings. The sequence of longitudinal loads on elastic rail mountings and the thermal elongation involving rail creep are mathematically presented. Numerical values worked out on a study of the Delft Viaduct show that the assumption of continuous distribution of rail mounting resistance provides a workable theory by which thermal elongation of rail systems can be effectively analyzed.

Verge, OH (Seetru Limited) *AREA Bulletin* Proceeding Vol. 71 N No. 26, 71-626-1, Feb. 1970, pp 621-643, 2 Fig, 2 Tab

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052266
AAR STUDIES OF BUTT WELDED RAIL JOINTS
The purpose of this study was to obtain a correlation between defects shown by radiographs of thermit butt welds in track and results obtained in rolling-load tests in the laboratory. Thermit welds in the Canadian National

Railway and the Denver & Rio Grande Western Railroad were evaluated. The Research Center's repeated load tests did not correspond exactly to service conditions. More study is needed on the effectiveness of the radiographic examination technique in determining if thermit welds contain defects that would seriously impair their serviceability in track.

AREA Bulletin Proceeding Vol. 71 N No. 26, Feb. 1970, pp 646-651, 1 Fig, 1 Tab, 2 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052267
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL METHODS FOR THEIR PREVENTION
This report is in two parts. Part one presents the causes of shelly spots and head checks in rail. Samples of these service defects were analyzed and then duplicated at the Association of American Railroads Research Center. Results showed that they were stress induced microstructural changes, not foreign material attributable to manufacturing practice. Part two presents a summary of the test using fully heat-treated rails and alloy rails installed on curves with shelly histories. Changes in rail design were included in this test. For fully heat-treated rails wear on the low side rails was relatively less than on the high side rails. Use of high silicon rails was also tested. Chipping was noted in both the high-silicon and regular rails where bond wires had been attached by welding.

Henry, RJ (Bethlehem Steel Company) *AREA Bulletin* Proceeding Vol. 71 N No. 26, Feb. 1970, pp 682-709, 16 Fig, 3 Phot, 20 Ref

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052275
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL--METHODS FOR THEIR PREVENTION
The information in this report on shelly spots and head checks in rail and methods for their prevention is contained in the two appendixes. Appendix 8a is concerned with the investigation of heat-treated rail and alloy-rail service test installations on curves with histories of shelling. Appendix 8b presents the laboratory investigation and results involving rolling-load and slow-bend tests. This information is presented in tables and figures.

AREA Bulletin Proceeding Vol. 69 N No. 12, Feb. 1968, pp 664-707, 24 Fig, 3 Tab, 4 Phot, 2 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052280
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
Causes of shelly spots and head checks in rail are discussed and methods for their prevention are presented. Two phases of the project include the inspection of heat-treated rail and alloy-rail service test installation on curves with a history of shelling, and the laboratory investigation of shelling rail involving rolling-load and slow-bend tests. Field inspections are made at test installations on the Norfolk and Western, Cheseapeake and Ohio, Great Northern, and Pennsylvania Railroads. Results of the inspections are presented for each respective railway. It is concluded that the heat-treated rails show generally good results and promise considerably more service.

AREA Bulletin Proceeding Vol. 68 N No. 05, Feb. 1967, pp 463-487, 3 Tab, 3 Phot, 2 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052284
EFFECT OF LUBRICATION IN PREVENTING FROZEN RAIL JOINTS AND RETARDING CORROSION OF RAIL AND FASTENINGS
The effect of lubrication is investigated in preventing frozen rail joints and retarding corrosion of rail and fastenings on a five-mile service test of North Western's eastward main track, relaid with 78-ft butt-welded 115 RE rail in 1957. Four of the five miles were sprayed out-of-face; the other mile, the control, had no protection until July, 1962, when special compounds or paints were applied to some of the welds after flame cleaning and wire brushing. Applications of metal preservatives are described for each mile of test track, indicating where corrosion was minimized. It is concluded that the spray and brush coats of Texaco 55 and NO-OX-ID provide the best protection against corrosion of rail and fastenings.

AREA Bulletin Proceeding Vol. 67 N No. 98, Feb. 1966, pp 414-415, 1 Tab

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052287
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
Causes of shelly spots and head checks in rail are explored and methods for their prevention are presented. Heat-treated-rail and alloy rail service test installations are inspected on curves with shelly histories, and laboratory investigations of shelly rail involving rolling-load and slow-bend tests are also made. Service test installations on the Great Northern Railway of rails rolled from continuously cast blooms, fully heat-treated rails, Columbium-treated rail, and Curve-master rail, were inspected, and contour tracings of the rail inspected were made. Service test installations on curves are designed to study both resistance to wear and flow and resistance to shelling. Two methods presently employed in improving these properties are the addition of alloying elements and heat treating. The addition of certain alloying elements improves resistance to wear and flow but does not necessarily improve resistance to shelling. The use of other alloying elements may improve both of these properties. It is shown that rail if properly heat treated, will be improved in both of these properties. If improperly heat treated, the results are detrimental rather than beneficial.

AREA Bulletin Proceeding Vol. 67 N No. 98, Feb. 1966, pp 493-508, 4 Fig, 3 Tab, 12 Phot, 2 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052294
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
Causes of shelly spots and head checks in rail are determined, and methods for their prevention are discussed. Two phases of the investigation include the inspection of heat treated and alloy rail service test installations on curves with shelly histories and the laboratory investigations of shelly rail involving rolling-load and slow-bend tests. The usual service test inspections are made of the fully heat-treated and alloy rail installations to corroborate the observations of previous years. Investigations featured include the service test installation of induction-hardened rail on the Great Northern Railway and on the Norfolk and Western Railway and the test installation to compare high-carbon rail with blue-end rail on the Pennsylvania Railroad. New developments in induction and flame hardening of rails to increase their resistance to shelling are also reported.

AREA Bulletin Proceeding Vol. 66 N No. 91, Feb. 1965, pp 479-493, 1 Fig, 2 Tab, 6 Phot, 2 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052295
RESULTS OF ROLLING-LOAD AND SLOW-BEND TEST OF BUTT-WELDED RAIL JOINTS
Results of rolling-load and slow-bend tests of butt-welded rail joints are reported. Welding methods include submerged arc, thermit process, and oxyacetylene pressure process with abrasive-wheel-cut weld faces and with variations in upset pressure and Btu input. Welds with magnaflux and ultrasonic indications of defects are also included in tests. It is noted that results, particularly results of submerged arc process, represent initial work on developments needing considerable further refinement. Results on thermit welds are representative of the results obtained in previous test of such welds, except those made by the Southern Railway, which show results meeting the standards established by tests of oxyacetylene pressure butt welds and flash butt welds for the first time. Investigations of welds with magnaflux and ultrasonic indications indicate a lack of uniformity existing in judging these indications at the inspection stations.

AREA Bulletin Proceeding Vol. 66 No. 591, Feb. 1965, pp 514-516, 1 Fig, 2 Tab

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052308
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAILS; METHODS FOR THEIR PREVENTION
Causes of shelly spots and head checks in rail are reviewed, and methods for their prevention are recommended. Data on rolling load tests of rail flame hardened for the SP, UP, and the QNS & L, rail of Japanese manufacture, hardened by the induction method, and high-silicon rail, as well as standard carbon rail, is presented. Topics discussed include results of inspections of heat-treated and alloy rail service test installations on curves with shelly histories, and shelly rail studies at the University of Illinois.

AREA Bulletin Proceeding Vol. 65 N No. 84, Feb. 1964, pp 576-605, 12 Fig, 5 Tab, 8 Phot, 2 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052310
ENGINEERING ASPECTS IN THE OPERATION OF LONG CARS
Engineering aspects are discussed in the operation of long cars. Problems discussed include loading and unloading, clearances, negotiability of sharp curves, derailment, fatigue cracks, and rocking action. Geometry of coupled cars is noted. Problems are being continually investigated, and progress has been made in increasing clearances, suggesting new car design, and analyzing tests dealing with impact and lateral car motion.

Magee, GM (Association of American Railroads) *AREA Bulletin* Proceeding Vol. 65 N No. 86, July 1964, pp 743-747, 2 Fig

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052319
RAIL WEAR TESTS ON THE ST. LOUIS-SAN FRANCISCO RAILWAY
Two curves on the St. Louis-San Francisco Railway were selected for rail wear tests. The section having a slightly lower rate of wear in past service was not lubricated. The other curve had a "Meco" single rail lubrication using graphite grease at the far end of its two curves. The effectiveness of the lubrication was gaged by taking rail profiles at various intervals of time. These profiles show the amount of steel worn from the heads of the rail gage. Elevation and curvature of the high rail were measured at each point where a profile was taken. Seven sets of profiles were taken of the rails undergoing the tests. The profiles show significantly less wear on the curve with the track lubricator than on the curve with no lubrication. The effectiveness of molybdenum-disulphide was tested as a rail lubricant. Its application showed less wear rate. These service tests definitely show that track lubricators are effective and can double the life of the outer rail in the presence of heavy sanding.

AREA Bulletin Proceeding Vol. 63 N No. 66, Oct. 1961, pp 17-25, 4 Fig, 1 Tab

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052326
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL: METHODS FOR THEIR PREVENTION
This report is presented in two appendices. Appendix 8-a covers the inspection of service tests of fully heat-treated and alloy rail installations. There are five tests of fully heat-treated rail, three of high-silicon rail, one of chrome-vanadium, and one of columbium-treated rail. The heat treatment in some locations has shown considerable value in extending rail life under shelly conditions and in resisting head flow on the low side of curves. The high silicon and low-alloy rails show a resistance to wear and shelling. The chrome-vanadium rail shows excellent performance. Appendix 8-b covers 1) rolling-load tests to produce shelling in high-silicon chrome-vanadium rail, columbium-treated rails, basic-oxygen standard carbon rails and flame-hardened rails; and 2) end-quench hardenability curves determining the quenching characteristics of some of the low-alloy rail steels. High-silicon chrome-vanadium rails rated high in rolling-load tests. End-quench hardenability curves are given for four rail steels to furnish information on the quenching characteristics of low-alloy rail steels.

AREA Bulletin Proceeding Vol. 63 N No. 70, Feb. 1962, pp 532-552, 2 Fig, 11 Tab, 12 Phot, 2 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052327
ENGINEERING ASPECTS OF CURRENT RAIL SECTIONS
This investigation of the engineering aspects of current rail sections falls into four phases. 1) Flexural Stiffness and Strength--The additional stiffness as indicated by the moment of inertia and strength as indicated by the section modulus of the 106 CF&I, 119 CF&I and 136 CF&I sections are increased approximately in proportion to the additional amount of metal provided in these sections. 2) Shape of Head Contour--Measurements indicate the rolled contour of the 115 RE and 132 RE sections fit the worn wheel contour better than the 119 CR&I and 136 CF&I sections. Better service performance as to the development of shelling is concerned can be expected from them. Narrowing of the rail head decreases the radius of hollowing of worn car wheels with resultant increase in wheel contact pressures and internal direct stresses and shearing stresses within the rail head. 3) Depth of Rail Head--Increased depth of rail head in the CF&I sections provides additional metal for vertical head wear. Measurements of actual vertical head wear as related to traffic and traffic densities indicate the present RE sections have adequate depth of head to provide a full usable life of the rail. 4) Localized Web and Fillet Stresses--Measurements indicate that upper fillet stresses in the web are reduced with the CF&I sections as compared to corresponding RE sections.

This article is an abstract of Report No. ER-15.

AREA Bulletin Proceeding Vol. 63 N No. 70, Feb. 1962, pp 553-569, 10 Fig, 1 Tab

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052333
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
This informational progress report is contained in two appendices. Appendix 8-a covers inspections of service tests of heat-treated and alloy-rail installations at 11 locations. There were five tests of heat-treated rail, three of high-silicon rail, and three of chrome-vanadium alloy rail. Heat-treated rail continues to show decided increased life over standard rail. Use of heat-treated rail on the low side of curves has increased life of rail 5 to 8 times, and on high sides 1 1/2 to 4 times. High-silicon rails have shown greater resistance to the detrimental effects of heavy wheel loads on the low side of curves than standard rails. Chrome-vanadium alloy rails show greater resistance to wear than standard rails. However, in this test the chrome-vanadium alloy steel of the composition used was unreliable. Appendix 8-b covers rolling-load tests to produce shelling in 136-lb high-silicon vanadium rails, failed shelly rails from service, and rolling-load tests to produce detail fractures from shelling. Results of tests of 115-lb columbian rail and tests of 133-lb rail single flame hardened by the Union Pacific Railroad are also reported.

AREA Bulletin Proceeding Vol. 62 N No. 63, Feb. 1961, pp 622-634, 1 Tab, 5 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052352
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
Most of the information in this report on causes of shelly spots and head checks in rail is contained in the two appendices. Appendix 8a covers inspections of service test of heat-treated and alloy steel rail installations at five locations. There are three tests of heat-treated rail and two of high-silicon rail. Heat-treated rail in tests on the Norfolk & Western Railway continues to show increased life over standard rail. High-silicon have shown greater resistance to the detrimental effects of heavy wheel loads in the low

side of curves than standard rails. Appendix 8b contains studies done at the University of Illinois. Three rolling-load tests to produce shelling in high-silicon rails, standard carbon-steel rails and 50-kg rails induction hardened in Japan are presented and discussed. Two rolling-load tests on a high-silicon rail ran 1,944,400 and 1,480,000 cycles. A standard-carbon-steel rail gave unusually long tests of 4,347,000 and 4,371,000 cycles. These specimens deformed considerably before the shelling cracks were visible on the side of the headrail. Two induction-hardened 50-kg rails from Japan gave rolling-load tests of 577,400 and 718,300 cycles.

AREA Bulletin Proceeding Vol. 61 1960, pp 869-881, 1 Tab, 4 Phot, 2 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052361
WHEEL LOAD, WHEEL DIAMETER AND RAIL DAMAGE
The dual study of wheel load, wheel diameter and rail damage is presented. It is concluded that formulas derived from earlier studies should be applied to today's situations for worn wheel on worn rail. A report on shelly rail reviews previously gathered information before discussing a recommendation that a limitation be placed on wheel loads for diesel and turbine locomotives. The recommended limit for wheel loads is 800-lb per inch of diameter. The study concludes that shelly rail stress increases in proportion to the cube root of the load; the life of the rail up until the time failure occurs decreases very sharply for any small increase in stress.

Code, CJ (Pennsylvania Railroad) *AREA Bulletin* Proceeding Vol. 61 1960, 8 pp, 2 Fig, 1 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052362
STATIC AND FATIGUE TESTS ON PRESTRESSED CONCRETE RAILWAY SLABS
The fatigue properties of prestressed pretensioned concrete railway slabs are discussed. A theoretical study of the fatigue resistance of such members is first presented, followed by a description of laboratory tests on six beams. Test results are discussed and interpreted. The theory of fatigue failure is based on three diagrams including a failure envelope based on a limited amount of fatigue test data on prestressing strands and a diagram of the fatigue characteristics of plain concrete. The two failure envelopes are combined with curves expressing the moment-stress relationship for a given beam. The investigator is able to predict the critical loading. It is concluded that the test results check reasonably well with the critical fatigue loads predicted on the basis of the stated theory of fatigue failure.

AREA Bulletin Proceeding Vol. 60 1959, pp 3-50, 15 Fig, 11 Tab, 11 Phot, 6 Ref

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052372
RAIL FAILURES STATISTICS COVERING (A) ALL FAILURES (B) TRANSVERSE FISSURES (C) PERFORMANCE OF CONTROL-COOLED RAIL
Rail failures statistics are reported, considering all failures, transverse fissures, and performance of control-cooled rail. Statistics include service and detected failures reported by 62 railroads on all of their main-track railway mileage, constituting the major part of the main track in the United States and Canada. The extent of the control of the transverse fissure problem is obtained by the use of control-cooled rail and detector car testing, giving data on the quality of each year's rollings for the various mills, and showing the types of failures occurring on the various railroads as related to the mill producing the rail.

AREA Bulletin Proceeding Vol. 60 1959, pp 883-902, 4 Fig, 9 Tab

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052374
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
Causes of shelly spots and head checks in rail are discussed, and methods for their prevention are recommended. Topics considered include six tests of heat-treated rail, a final report of service tests of 155-lb rail on the Pennsylvania RR laid on the high side of a 6-deg curve, a University of Illinois study of rolling tests, investigation into the significance of the hydrogen level in rail steel, and report on a three-dimensional photoelastic investigation to study the internal stresses within the rail head due to wheel contact pressures.

AREA Bulletin Proceeding Vol. 60 1959, pp 917-969, 19 Fig, 4 Tab, 19 Phot, 10 Ref

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052398
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS OF THEIR PREVENTION
Causes of shelly spots and head checks in rail are discussed, and methods for their prevention are recommended. Research conducted by the research staff of the Engineering Division of AAR and by the University of Illinois is reported. Inspections of service tests of heat-treated and alloy rail are made at nine locations, including five tests of heat-treated rail, two of chrome vanadium alloy, and two of high-silicon rail. The final report of heat-treated rails on the Norfolk & Western Railway reveals a very definite advantage of heat-treated rail over standard control-cooled rail, with rail life increased by 2 1/2 times in the case of shelling. Economic advantage of heat-treated rail involves a rail life 4 1/2 times that of standard rail. University of Illinois reports results of mechanical and rolling-load tests to produce shelling failure and details fractures and tests of six rails which developed detail fractures in service.

AREA Bulletin Proceeding Vol. 58 1957, pp 1026-10, 3 Fig, 4 Tab, 13 Phot, 1 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052401
INVESTIGATION OF FAILURES IN CONTROL COOLED RAILROAD RAILS
Failures in 43 control cooled rails were investigated and tabulated. There were no transverse fissures from shatter cracks and no rails which contained shatter cracks. Five fractures from welded engine burns were examined. Three appeared to have failed from porosity at the bottom of the weld deposited metal and two apparently developed from cracks not removed before making the welds. One head and web separation failure representing 432 track failures in insulated joints was examined. It was determined that the cracks were the results of corrosion fatigue.

Cramer, RE (Illinois University, Urbana) *AREA Bulletin* Proceeding Vol. 57 1956, pp 787-793, 2 Tab, 3 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052403
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL METHODS FOR THEIR PREVENTION
Continuing investigations confirmed that heat-treated or alloy rails were effective in extending the service interval before gage corner shelling occurs in track. A description and summary of eight test installations of heat-treated and alloy rails in areas of high shelling was presented. Appendix 8-a presented the progress of shelly rail studies. Rolling-load tests of high-silicon rails and one chrome-vanadium rail were performed. Shelly rail failures from service were examined and rolling-load tests to produce detail fractures in the laboratory were performed. Detail fractures from shelling in European rails were discussed. High-silicon rails gave rolling-load tests 50 to 100 percent better than standard carbon-steel rails before developing shelling failures. Three tests of a chrome-vanadium alloy rail gave two tests over 5,000,000 cycles and one test of 1,846,000 cycles. Rolling-load tests of high-silicon rails to develop detail fractures from shelling produce failures similar to those produced in track.

AREA Bulletin Proceeding Vol. 57 1956, pp 830-857, 5 Fig, 3 Tab, 20 Phot, 1 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052406
CURVE WEAR WITH DIESEL LOCOMOTIVES ON THE BESSEMER AND LAKE ERIE RAILROAD
A series of test runs were made to obtain definite information on the amount of rail curve wear produced by diesel locomotives relative to that produced by the remainder of the train. A second series of tests was made for the purpose of relating the effectiveness of flange oilers on the locomotive and rail lubricators in the track in controlling the amount of curve wear. Instrumentation consisted of a box to catch metal abraided by diesel units from the track and a motion picture camera to photograph the passing wheel flange on the high rail. The tests show that although the rate of rail and wheel wear with a diesel unit is greater than for a heavily loaded freight car, the greater amount of rail wear is due to the train rather than the diesel units. Rail and wheel flange wear on curved track can be practically eliminated by lubrication with either flange oilers on the diesel units or rail lubricators in track, or a combination of the two.

AREA Bulletin Proceeding Vol. 56 1955, pp 269-281, 1 Fig, 2 Tab, 9 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052410
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
Progress in the continuing study of the causes of shelly spots and head checks was reported. The performances of various installations of heat-treated and alloy-steel rail have been tabulated. Appendix 8-a presented rolling-load tests of heat-treated chrome-vanadium rail, high-silicon rails, and 140-lb. chrome-vanadium alloy rail. Examination of shelly rails from service and rolling-load tests to produce detail fractures in the laboratory were discussed. One specimen of chrome-vanadium rail, heat-treated to 490 Brinell hardness, ran 21 million cycles in a rolling-load test. Ten specimens of high-silicon rails averaged 2,307,000 cycles in rolling-load tests. Two specimens of 140-lb. chrome-vanadium alloy rail averaged 3,625,000 rolling-load cycles. Photographs of one shelling crack in a service rail indicate the crack started at a segregation streak in the rail. All rolling-load tests to produce shelling indicate that rails with higher hardness, with corresponding increase in mechanical strength, give longer laboratory rolling-load tests.

AREA Bulletin Proceeding Vol. 56 1955, pp 951-959, 2 Tab, 3 Phot, 1 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052418
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
Five service tests of rail are discussed. There are four of heat-treated rail and one of alloy rail. In the progressive study of shelly rail rolling-load tests of flame-hardened rails, high-silicon rails, and electric furnace steel rails were performed. Examination of shelly rails from service was performed. Rolling-load tests to produce detail fractures were done. The rolling-load tests indicate that stronger rail steel should give longer life before shelling develops in service. Study and testing on simulated rails indicated that plastic deformation is the major factor in shelly failure. Design changes and metallurgical changes to limit plastic deformation would improve rail life. Use of lower wheel loads, larger wheels and higher strength material is indicated. A photoelastic study of the stresses in a model of a railhead utilizing developments in three dimensional photoelasticity for a better understanding of rail shelling was presented. Plastic models of the prototype were thinly sliced and the data obtained were subjected to a field of polarized light. Processing the data was done by the shear difference method. Principal stresses and maximum shears were studied through loading tests. Principal stresses and maximum shears were found in the transverse section of the rail under the center of the wheel.

AREA Bulletin Proceeding Vol. 55 1954, pp 828-897, 27 Fig, 5 Tab, 14 Phot, 4 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052426
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
A summary of the performance of heat-treated rail at five installations is presented. Results of rolling-load tests for each installation was presented. The progress on shelly rail studies was presented. Rolling-load rests on heat-treated rail, three experimentally flame-hardened rails and commercially flame-hardened rails were performed. Rolling-load tests to develop detail fractures and stress relaxation tests were made. The tests of the experimentally flame-hardened rails did not compare favorably with tests of heat-treated or alloy rail. Progress in the studies of stress relaxation in rail steel and deformational behavior of rails is reported. Bending fatigue tests of rail steel specimens were run to investigate whether a subcritical thermal treatment might heal progressive fatigue damage. No beneficial effect was noted. The mechanisms involved in rolling-load failures were then studied by work with low-carbon steels sensitive to the Fry "strain-etch" technique and with silver chloride which has optical properties and metal-like mechanical behavior. More work will be done with these two materials.

AREA Bulletin Proceeding Vol. 54 1953, 14 pp, 2 Tab, 4 Phot, 2 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052427
STRESS CONCENTRATION IN BUILT-UP STRUCTURAL MEMBERS
This report covers a description and analysis of tests made to determine stress concentrations in plates in the vicinity of rivet or bolt holes under varying conditions of pitch, gage, edge distance, bearing and clamping force. Measurements of strains with SR-4 strain gages and the methods of photoelasicity were the two test procedures employed in the investigation. The items investigated by each of these methods and the results are as follows. Stress concentrations at the sides of open holes in plates will vary within relatively small limits if the conventional spacing of 3 hole diameters and edge distances of 1 1/2 diameters is maintained. Stress concentrations at the sides of holes with pins in bearing in double shear will be higher than for open holes. Plates connected by pins bearing in double shear will be higher than for open holes. Plates connected by pins bearing in single shear have stresses at the sides of the holes 20 to 40 or more times the average stress on the gross section of the plate when load is applied centrally with respect to width of plate. In joints connected by high clamping bolts, the stresses inside the hole produced by clamping applied through washer only are compressive. In correlating the magnitudes of stress concentrations with the results of fatigue tests on typical specimens it can be concluded that elastic stress concentration is a valid criterion for establishing the fatigue strength of fabricated structural members. Appendix I presents a qualitative explanation of stress concentration and change of direction of stress path or trajectory.

Carter, JW (Purdue University) *AREA Bulletin* Proceeding Vol. 53 1952, pp 1-34, 20 Fig, 1 Tab, 9 Phot, 10 Ref, 1 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052434
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
A summary of the performance of five test installations of heat-treated rail was presented. Appendix 9-a presented the progress of shelly rail studies at the University of Illinois. Repeat cradle type rolling-load tests on two specimens of manganese chrome, vanadium alloy rail indicated that these rails may be several times as good as standard carbon steel rails. A test of 115-lb heat-treated standard carbon rail indicated that this type was as good as the manganese, chrome, vanadium alloy steel of the heat-treated standard carbon steel rails. An electron micrograph of nickel alloy steel showed detail in fine pearlite structure which was not revealed by a light microscope. Appendix 9-b presented a summary of progress on the investigation of stress relaxation in rail steel. The work was in two areas: 1) Relaxation of stresses in small bar specimens was studied as a function of time and temperature, and 2) rolling-load fatigue tests on small systems. Specimens cut from the

top section of the rail were tested and results indicated possibly larger values of relaxation in percent of applied stress than for other specimens. Rolling-load fatigue tests produced failures that require further investigation of the effect of alleviation of damage by stress relaxing heat-treatment.

AREA Bulletin Proceeding Vol. 53 1952, pp 899-920, 2 Fig, 2 Tab, 12 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052440
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
A summary of the performance of heat-treated rail in two test installations was presented. Progress on shelly rail studies at the University of Illinois was presented in appendix 10-a. Rolling-load tests of heat-treated rails, flame-hardened rails, alloy rails and headfree rails were performed. Laboratory examination of detail fractures from shelling was performed. Design and construction of a new cradle-type rolling machine was discussed. A description of the technique used to produce electron micrographs at 35,000X magnification was given. Rolling load tests continued on 132-lb heat-treated rail revealed that yield strength was increased 65 percent, tensile strength 31 percent, elongation 18 percent, reduction of area 100 percent, and endurance limit 40 percent. Results of rolling-load tests on seven rails flame-hardened different amounts on the rail treads showed four specimens failed by head and web separation cracks, and three failed by shelling. Rolling-load and physical tests on two specimens of alloy rail steel showed that these rails have physical properties which compare closely with those of heat-treated rails. Examinations of seven detail fractures from shelling revealed that the shelling cracks started longitudinally in the steel and then turned into transverse detailed fractures.

AREA Bulletin Proceeding Vol. 52 1951, pp 661-679, 1 Tab, 12 Phot, 1 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052447
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
Progress on the continuous study of shelly spots and head checks in rail was presented. Heat-treated rail tests indicate that its use extended the life of a rail before gage corner shelling occured. Appendix 10-a described studies at the University of Illinois where examinations of shelly rails from service and laboratory tests to produce shelling were performed. It was observed that the black shelly spots developed by two processes. Two rolling-load test on an alloy rail were high. Examination of the failed specimen revealed non-metallic inclusions. Rolling-load tests on heat-treated rail specimens of standard chemical analysis compared with non-heat-treated companions revealed that heat-treated specimens gave 3 to 4 times the performance of the non-heat-treated specimens. Appendix 10-b presented a summary report on the examination of rails containing detail fractures found by detector cars. The purpose was to determine if the chemistry, mechanical properties, or structures of detail fracture rails varied from those of random rails. The average chemical analyses and mechanical properties of 44 rails having detail fractures and 26 random rails were so nearly the same that no distinction between the two groups was possible. The mechanical tests included hardness, tensile properties, and impact properties. Examination of deep etched structures and microstructures of detail fracture rails indicated that the steel used was of relatively good quality.

AREA Bulletin Proceeding Vol. 51 1950, pp 595-620, 4 Fig, 4 Tab, 16 Phot, 2 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052457
TEST RESULTS ON RELATION OF IMPACT TO SPEED
Test results on relation of impact to speed are reported to support the proposed Article 107 of the Rules for Rating Existing Iron and Steel Bridges. It is noted that a study of short span steel bridges 20 to 40 ft. long and deck plate girder spans 40 to 130 ft. long subjected to live loads with or without hammer blow indicates that the reduction of impact as a result of speed should occur at 40 mph or less, rather than synchronous speed or less as was proposed in 1947 for spans longer than 50 ft. The value of 40 mph was selected as the maximum practical speed where allowable reduction in impact might be permitted since rolling equipment without hammer blow has no synchronous speed. It is noted that some values of total impact on truss spans approximately 120-150 ft. long, subjected to equipment with hammer blow, receive more impact than is provided by Article 206 of the Specifications for Steel Railway Bridges. The character of the reduction equation for truss spans subjected to rolling equipment with hammer blow is consistent with the data.

AREA Bulletin Proceeding Vol. 50 1949, pp 432-443, 9 Fig, 1 Tab

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052460
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-MEASURES FOR THEIR PREVENTION
Causes of shelly spots and head checks in rail are reported and measures for their prevention are recommended. Reports of four study groups are presented. It is noted that no definite relationships or trends exist in the relationship between chemistry and shelling, or curvature, elevations, speeds, and grades. It is found that transposing shelly high rails to the low rail, if done in time, is worthwhile. Rail slow-cold worked under traffic in nonshelling locations and relaid in shelling locations possesses very little, if any, greater resistance to shelling than ordinary rail. Studies of high carbon rail indicate that it will retard but not eliminate shelling and that it has a tendency to head check and this in turn causes gage corner flaking or minute shelling. A seven-year summary report of shelly rail investigation at the University of Illinois is presented. Also presented is a summary report on the examination of 300 shelled spots selected from the track of 11 major roads, indicating that the shelled spots were predominantly of surface origin.

AREA Bulletin Proceeding Vol. 50 1949, pp 534-557, 3 Fig, 2 Tab, 16 Phot, 2 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052461
COMPARISON OF WEB STRESSES IN 131-LB RE AND 140 PS -(PENNSYLVANIA) SECTIONS
Report is made of field measurement of stresses made by the Pennsylvania Railroad in 131-lb. RE and 140 PS sections of rail. The 140 rail section is designed to compensate for the inadequacy of the 131 section, and the two sections are compared. Stresses reported include the maximum stress in the web in a vertical plane occurring under a concentrated load. It is noted that in the service tests, made under conditions where rails were failing, the maximum stress is always found on the gage side of the low rail and that is where fatigue cracks develop. It is concluded from these service measurements that the laboratory basis of design of the new section is sound and that the laboratory stress measurements forecast the reduction in service stress with satisfactory accuracy.

AREA Bulletin Proceeding Vol. 50 1949, pp 558-566, 7 Fig, 3 Tab

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052462
REPORT ON SERVICE TEST OF SOLID MANGANESE CROSSINGS FROGS AT MCCOOK, ILLINOIS
Service tests of solid manganese crossing frogs at McCook, Illinois, are reported. Stress measurements are covered in the flangeways and at other significant stress areas of five different designs of manganese castings placed in the crossings of the Baltimore & Ohio Chicago Terminal Railroad and the Atchinson, Topeka & Santa Fe Railway. Service tests include tests of the original design of casting by Taylor-Wharton and the Carnegie-Illinois casting. It is concluded that some of the designs included in the tests are more resistant to the development of fatigue cracks than others, but in none were the developed stresses low enough relative to the fatigue strength of the manganese steel to give the service life under heavy traffic that should be expected, and efforts to further reduce these stresses are recommended.

AREA Bulletin Proceeding Vol. 50 1949, pp 572-576, 1 Fig, 2 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052468
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL SURFACES-DEVELOP MEASURES FOR THEIR PREVENTION
Causes of shelly spots and head checks in rail surfaces are investigated, and preventative measures are recommended. It is found that no definite relationship exists between chemistry and shelling, and no definite trend regarding curvature, elevations, speeds and grades. Transposing shelly high rails to the low rail, if done in time, is worthwhile. Rail slow-cold worked under traffic in non-shelling locations and relaid in shelling locations possesses little resistance to shelling compared to ordinary rail. It is also found that high carbon rail does not eliminate shelling but retards it more than ordinary carbon rail; however, the high carbon rail tends to head check and in turn cause gage corner flaking or minute shelling. Reports are submitted by the Norfolk & Western, Pennsylvania, Duluth, Missabe & Iron Range, and Chesapeake & Ohio Railroads.

AREA Bulletin Proceeding Vol. 49 1948, pp 434-463, 10 Fig, 5 Tab, 19 Phot, 3 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052469
FOURTEENTH PROGRESS REPORT OF THE COOPERATIVE INVESTIGATION OF FAILURES IN RAILROAD RAILS IN SERVICE AND THEIR PREVENTION
Report is made of the cooperative investigation of failures in railroad rails in service and their prevention. Careful examination of transverse fissures is made. Laboratory rolling-load tests are studied to find a type of rail steel to resist shelling failures which occur in rails on curves. Work on end-hardened rails is continuing. Failed rail conditions are summarized and illustrated.

Conducted by the Engineering Experiment Station, University of Illinois in cooperation with the Association of American Railroads and the American Iron and Steel Institute.

Cramer, RE (Illinois University, Urbana) *AREA Bulletin* Proceeding Vol. 49 1948, pp 490-495, 3 Tab, 3 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052470
INVESTIGATE CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL SURFACES FOR THE PURPOSE OF DEVELOPING MEASURES FOR THEIR PREVENTION
Causes of shelly spots and head checks in rail surfaces are investigated, and preventative measures are presented. Topics discussed include mill chemistry records; curvature tabulation, elevation, speeds, and grades; effect of rail lubricators, transposing rails, slow cold rolling; field tests of special rails; experience of roads having these defects; radius of gage corners of rail, tread of wheels, radius between flange and tread of wheels; relationship between wear of rail and wheel; bearing pressure of wheel on rail; cant of rail; superelevation of rail on curves; examination of service rail failures caused by these defects; rolling-load tests to produce these effects under laboratory conditions; resistance of rail steel of various composition to the development of these defects under laboratory conditions; resistance of different heat treatments of rails to the development of these defects under laboratory conditions. Progress is made but no definite solution has been found.

AREA Bulletin Proceeding Vol. 46 1945, pp 643-659, 6 Fig, 3 Tab, 6 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052471
INVESTIGATE CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL SURFACES FOR THE PURPOSE OF DEVELOPING MEASURES FOR THEIR PREVENTION
Causes of shelly spots and head checks in rail surfaces are investigated to develop measures for their prevention. Topics discussed include study of rail steel compositions, heat treatments, wheel and rail contacts and pressures, mill practices, and consideration of larger diameter wheels or lighter loads on the wheels. It is cautioned that new chemistry or heat treatment may induce other types of defects or excessive expense. Study of shelling reveals no definite trend or definite conclusions. It is noted that the control cooled process will not prevent shelling. Rolling load machines and tests are discussed.

AREA Bulletin Proceeding Vol. 45 1944, pp 446-469, 14 Fig, 1 Tab, 9 Phot, 2 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052472
INVESTIGATE CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL SURFACES FOR THE PURPOSE OF DEVELOPING MEASURES FOR THEIR PREVENTION
The investigation into the causes of shelly spots and head checks in rail surfaces was presented. A definition and description of shelly spots, the most serious type of rail damage, was presented. The division of the work of this subcommittee was described. Appendix A presented the shelly rail studies conducted at the University of Illinois. Laboratory studies of failed shelly rails concluded that shelling appears to be the result of cold working of the rail steel by "line contact" with car wheels. The presence of imperfections accelerated the formation of cracks. Laboratory rolling-load tests to produce shelling were performed. Different rail steel compositions were studied through rolling-load tests. The Brinell hardness of the wheel path after rolling was measured. Full sections specimens of heat-treated carbon rail were tested under rolling-load. No conclusions were reached.

AREA Bulletin Proceeding Vol. 44 1943, pp 597-610, 3 Fig, 12 Phot, 1 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052473
NINTH PROGRESS REPORT OF THE JOINT INVESTIGATION OF FISSURES IN RAILROAD RAILS
The information in this report of the joint investigation of fissures in rails was contained in five sections. Field tests for batter of end-hardened rails in service on the Chesapeake and Ohio Railway were performed. The summary of the batter values was tabulated. Rail ends with large cracks had approximately three times the batter of uncracked ends. Examination of end-hardened rails from the C and O test track in Carey, Ohio revealed that most damage, weeping cracks and flow of the metal over the ends and sideways, produced batter and drooping of the rail ends. Tests of mill cooling containers for rails were discussed. Examination of control-cooled and Brunorized rails which failed in service revealed that none of the control-cooled rails contained shatter cracks, but did have transverse fissures from blow holes and welded spots, horizontal split heads, detailed fractures from engine wheel burn, fatigue failures starting in the web, and detailed fractures from shelly spots. The Brunorized rails had developed transverse fissures from shatter cracks as nuclei. A comparison of drop and bend tests was summarized.

Conducted by the Engineering Experiment Station, University of Illinois in cooperation with the Association of American Railroads and the Rail Manufacturers' Technical Committee.

Moore, HF Alleman, NJ Cramer, RE Jensen, RS (Illinois University, Urbana) *AREA Bulletin* Proceeding Vol. 44 1943, pp 611-621, 9 Fig, 2 Tab, 1 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052474
EIGHTH PROGRESS REPORT OF THE JOINT INVESTIGATION OF FISSURES IN RAILROAD RAILS
Field tests for batter of end-hardened rails in service on the Chesapeake and Ohio Railroad were presented. Batter values for the leaving rails increase with the amount of traffic, whereas the values for receiving rails decrease. Laboratory tests of cracked end-hardened rails from test track revealed that a large number of the rails developed weeping cracks which will require building up by welding. The proposed recommended practive for the control cooling of railroad rails for consideration by the mills and railroads was presented. Mill tests of control cooling and mill tests to determine the temperature and manner of the growth of shatter cracks in steel rails were performed. It was concluded that shatter cracks develop gradually in size and number in shatter sensitive carbon steel rails as they are allowed to cool between the ranges of 400 and 70 degrees F. Control-cooled and Brunorized

rails in service were discussed. A comparison of drop tests and bend tests on "A" rails was tabulated. A study of the drop test for rails was presented in the appendix. The force of a blow, its measurement by deflection and its measurement by measurement of the permanent elongation in the bottom fiber of the rail at mid-span were discussed.

Moore, HF (Illinois University, Urbana) *AREA Bulletin* Proceeding Vol. 43 1942, pp 607-640, 8 Fig, 10 Tab, 6 Phot, 1 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052476
FIRST PROGRESS REPORT-JOINT INVESTIGATION OF CONTINUOUS WELDED RAIL
Progress on the investigation of continuous welded rail was reported. Data and preliminary results of 1) metallographic studies of welded joints, 2) mechanical tests of specimens cut from rail metal, weld metal and metal in the junction zone between weld and rail, 3) tests of full-size welded-joint specimens under repeated wheel load, and 4) drop tests and bend tests of full-sized specimens of welded joints. The rolling-load testing machine for subjecting rail-joint specimens to repeated wheel load was described, as the testing rig for making bend tests of full-size rail joints. Attention was directed to the fact that all results obtained were preliminary and tentative.

Moore, HF Thomas, HR Cramer, RE (Illinois University, Urbana) *AREA Bulletin* Proceeding Vol. 40 1939, pp 687-613, 8 Fig, 6 Tab, 6 Phot, 1 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052477
DISCUSSION ON STRESSES IN RAILROAD TRACK. PART 1
A discussion of the comparison of tests on stretches of welded track under observation was presented. The purpose was to learn of the magnitude and distribution of the anchorage given between the ties and ballast at the ends of the welded stretch and along its length to resist the forces set up by chance changes in the temperature of the rail, and to learn how the influences tending to change the length and alignment are met in the track. Stress measurements were made on the web of the rail, and the temperature of the rail was taken with the open ended thermocouple and portable potentiometer. The observations were reduced by temperature corrections of gage readings and made comparable for both strains and stresses. Throughout the intermediate part of the welded stretch very little change occurred throughout the variations in summer and winter temperatures. The rails changed length through an average distance of seven rail lengths for the end portions of the rails for both the summer and winter tests. For the higher summer temperatures and lower winter temperatures the stresses may be expected to increase in proportion to the increase in change of temperature from the 63 F base. Lateral deflection of angle bars occurred when bolts were tightened. Tightening of the inner bolts in worn bars also developed lateral bending stresses in the bars. The stresses were generally compressive and the bars bend about an axis appproaching the vertical and high tensile stresses occurred on the inner flanges of the bar. These will add to the tensile bending stresses produced by wheel loads.

Talbot, AN (Illinois University, Urbana) *AREA Bulletin* Proceeding Vol. 38 1937, pp 674-681, 6 Fig

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052478
DISCUSSION ON STRESSES IN RAILROAD TRACK. PART 2
Observations and tests made on the stretches of welded rail of the Delaware and Hudson Railroad, one section at Albany, and two at Schenectady, were presented. The purpose of the tests was to find changes in length in rail at any place along the stretch, anchorage or restraint at any place along the length and temperature stresses set up in the rail at any place. Readings were taken with strain gages. Temperature of the rail was taken with a thermocouple and potentiometer. Summer and winter measurements were taken. All the welded stretches kept their alignment well even on curves. The longitudinal movement at the ends of the welded stretches and at points along the length due to temperature changes was small. No noticeable movement of the ties in a direction longitudinal of the track was seen. At the end of a welded stretch a tensile or compressive force of considerable magnitude may be transmitted to the adjoining rail. Variable anchorage forces developed in the summer at points due to the presence of under-crossings and viaducts. The flexural stresses developed in the rail by the loads of traffic will be superimposed on the temperature stresses and the two sets of stresses at any point in the height of the rail must be added or subtracted according to their nature.

Talbot, AN (Illinois University, Urbana) *AREA Bulletin* Proceeding Vol. 37 1936, pp 954-961, 3 Fig, 1 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A1 052548
OPTIMUM ADAPTATION OF THE CONVENTIONAL TRACK TO FUTURE TRAFFIC. STUDY OF THE CHANGE IN THE TRACK LEVEL AS A FUNCTION OF THE TRAFFIC AND OF THE TRACK COMPONENTS (FIRST RESULTS OF LABORATORY AND SITE TESTS)
The report deals with the change in the longitudinal level of conventional tracks under the effect of operating loads. Tests have been carried out in the laboratory and on actual sites on differently equipped tracks, with a view to defining the influence of the various track component parameters. The discovered evolution law of defects has shown that the reduction in sleeper spacing and of crib and shoulder consolidation exert a rather clear influence. It has also become apparent that the quality of the maintenance operations exerts a very large influence. These findings should however be treated with caution. The influence of the inertia of the rail, the thickness of the rail pads, the types of sleepers and the conditions of the formation and of the ballast, will be accurately defined later.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B117/RP 2/E, Apr. 1973, 54 pp, Figs., Tabs.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

A1 052555
BEHAVIOUR OF THE METAL OF RAILS AND WHEELS IN THE CONTACT ZONE. CALCULATION OF THE COMPLEX STRESS CYCLES IN THE RAIL SUBJECTED TO ROLLING LOADS. ASSESSEMENT OF THE DANGER OF DAMAGE (CONTINUED)
This study deals with new calculations of the composition of the residual stresses and the stresses induced in the rail during the passage of wheels, for different loading values, wheel diameters and wheel-tyre transverse curvatures. One thermal stress and three residual stresses have been considered. The latter have been calcuated and then measured with the help of an original strain-gauge method. The danger of rail damage has then been evaluated by means of the damage line criterion proposed by Mr. Dang Van (see C 53/RP 7 and C 53/RP 8). It has been possible in this way to define the danger factor for each loading case. It has been shown that two types of danger exist, namely, fatigue and plastic deformation.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways C53/RP 9/E, Oct. 1973, 27 pp, 26 Fig., 5 Tab., 2 App.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

A1 052682
CONSTRUCTIONAL ARRANGEMENTS FOR IMPROVING THE RIDING STABILITY AND THE GUIDING QUALITY OF ELECTRIC AND DIESEL LOCOMOTIVES AND VEHICLES. COMPARISON OF THREE MEASURING METHODS FOR DETERMINING THE FORCES EXERTED BY THE WHEELS OF A MOTIVE POWER UNIT ON THE RAILS IN A CURVE OF 300M RADIUS (GIORNICO 1957)
In order to make a comparison between the measuring methods developed by the NS and the SJ for determining the forces occurring between wheel

and rail, comparative tests were carried out on a curve of 300 m radius on the Gothardline in October 1957. For these tests the following measuring apparatuses were used: one measuring rail of the CFF; six measuring base plates of the NS; six measuring base plates of the SJ. For an initial series of tests, the measuring rail was laid on six adjacent sleepers fitted with the measuring base plates of the NS and, for a second series of tests, on six adjacent sleepers fitted with the measuring base plates of the SJ. The measuring rail was secured to the other sleepers by means of the usual CFF fastenings. The forces indicated by the CFF measuring rail on the one hand and by the NS measuring baseplates and the SJ measuring baseplates on the other hand, were determined at various speeds and compared with each other. Considerable differences were shown by the lateral forces determined in this way, by means of the measuring rail and the measuring baseplates of the NS and the measuring rail and the measuring baseplates of the Sj, respectively. Better agreement was displayed by the vertical forces, though, in this case, comparison was only possible between the measuring rail and the measuring baseplates of the NS (the measuring baseplates of the SJ not being designed for the measurement of the vertical forces). The considerable differences between the measured values were considered to have been caused chiefly by the mutual influence of the measuring rail and the measuring baseplates of the NS and the measuring rail and the measuring baseplate s of the SJ respectively, on each other. Since the test arrangement used at Giornico-measuring rail laid on measuring baseplates-did not prove satisfactory, it is suggested, when making comparative tests in the future, to have the three methods of rail measuring equipment arranged at adjacent sites on a curve. The relationship between the values supplied by the three measuring methods should be established with the aid of a fourth measuring method, e.g. by means of directly measuring on the wheel of the vehicle under test the forces exerted on the rails (as already developed by the SJ to a certain degree of perfection).

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B10/RP 4/E, Nov. 1960, 14 pp, Figs., Tabs., Apps.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

A1 052683
CONSTRUCTIONAL ARRANGEMENTS FOR IMPROVING THE RIDING STABILITY AND THE GUIDING QUALITY OF ELECTRIC AND DIESEL LOCOMOTIVES AND VEHICLES. MEASUREMENTS OF THE FORCES EXERTED ON THE RAILS BY VARIOUS TYPES OF MOTIVE POWER UINTS (MEASURED IN A CURVE OF 300M RADIUS AT GIORNICO)

In 1955 the CFF decided to intitiate investigations in order to determine by means of experiments the extent of the wear to which the track would be subjected in a curve of 300 m radius by the then newly developed locomtive types of the series Ac 4/4 (BoBo) and Ac 6/6 (CoCo). The measuring rail working according to the Schlumpf system was used as measuring apparatus. The results of these measurements have shown that the modern bogie locomotives subject the track to less wear at the same speed (BoBo) or to hardly any heavier wear (CoCo) than the rigid frame locomotives of not so recent date. Following the tests which had been made at the suggestion of the Working Group "Measurements on the track" of the B 10 Specialists Committee, for the comparison between three different measuring methods (see B 10 RP 4), arose the possibility of repeating the tests made in 1955. The measuring rail was again used as measuring apparatus, as it had been done for the tests made in 1957, but the tests included a larger number of locomotive types and a considerable versine error was intentionally arranged in the test track. The tests made in 1957 have confirmed the fundamental results of 1955, moreover they have shown that 1) a transverse coupling between the bogies and 2) the lateral movement of the rubber cushioned leading axles of the CoCo locomotives considerably reduce the forces exerted on the track.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B10/RP 5/E, Nov. 1960, 18 pp, Figs., Apps.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC

DOTL RP

A1 054011
STATISTICAL CHARACTERIZATIONS OF RAILWAY TRACK BEHAVIOR

Absolute space curve data of railway track, representing the vertical and lateral perturbations of both running rails, was collected and analyzed. A variety of track is studied, including high speed versus yard, bolted versus continuous welded rail (CWR), and old versus new construction. Analytical techniques include Signal Averaging, Analysis of Variances, and Correlation analysis. As a result, it is concluded that railway track is characterized by a pure Markovian process, a periodic process, and a periodically modulated random process.

A paper recommended by the IEEE Land Transportation Committee of the IEEE Industry Applications Society for presentation at the 1974 Joint ASME/IEEE Railroad Conference, Pittsburgh, Pa., April 2-4, 1974.

Corbin, JC (ENSCO, Incorporated)
Institute of Electrical and Electronics Engineers Dec. 1973, 15 pp, 18 Fig, 13 Ref

ACKNOWLEDGMENT: IEEE
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL RP

A1 054413
SPECIAL STUDY. BROKEN RAILS: A MAJOR CAUSE OF TRAIN ACCIDENTS

The report identifies broken rails as the largest single cause (in 1972) of train accidents and suggests that the problem will magnify. The study analyzes the current means for controlling rail failures, such as rail manufacture, use, inspection, research, and regulation. Recommendations are directed to the Federal Railroad Administration to revise accident reporting methods, to determine the reason for the drastic increase in train accidents resulting from broken rails, to promulgate additional regulations prescribing rail use and maintenance, to develop criteria for rail inspection, and to initiate research of rail and rail flaw detection methods. Recommendations also are directed to the railroad industry to initiate rail research, to accumulate rail failure statistics, and to institute track maintenance policies that will reduce the number of train accidents resulting from broken rails.

National Transportation Safety Board Spec Rpt NTSB-RSS-74-1, Jan. 1974, 21 pp

ACKNOWLEDGMENT: NTIS (PB-227631/9)
PURCHASE FROM: NTIS Repr PC, Microfiche

PB-227631/9, DOTL NTIS

A1 054781
IMPROVEMENTS OF MAINTENANCE CRITERIA COVERING THE RUNNING GEAR OF SHIN-KANSEN RAILCARS BY MEASURING THE TRANSVERSAL ACCELERATIONS OF THE BODY [SHIN-KANSEN DENSHA SOKO KANRI SHIRYO SEIDO UO KOJO NI KANSURU KENKYU]

Osaka engine shed officials measure, under 200 km/h on line conditions, the body accelerations of Shin-Kansen railcars each time the wheels are re-profiled (every 70,000 km). Following these measurements, an index is calculated in accordance with an empirical formula that is a linear combination of the acceleration occurrence frequencies classified by section (linear combination of the values of the acceleration distribution analysis). Bogie overhaul is scheduled in accordance with the value of this index. In applying this method, the JNR encountered difficulties due to the effect of 3 factors on transversal accelerations: the state of the track, the speed (the index is very sensitive to speed variations of only a few km/h), weather conditions (transversal stability is distinctly improved in rainy weather). The article describes how corrective laws were worked out to eliminate the effect of the first 2 factors. For the 3rd factor, it was decided to limit measurements to periods of wet weather. [Japanese]

Tanida, I *Denkisha No Kagaku/Railway Electric Rolling Stocks* Vol. 26 No. 6, 1973, 5 pp, 8 Fig

ACKNOWLEDGMENT: UIC (95)
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr PC

95

A1 054782
THE BEHAVIOUR OF RAILS IN RELATION TO THEIR CONDITIONS OF USE
The principal rail failure statistics of 5 Administrations have been analysed with a view to determining the respective influence of the different features involved in the behaviour of rails in service. Some recommendations are proposed concerning the choice of rail-section as a function of the traffic, the grade and quality of the rail steel and the construction of rail joints. The problems raised by welds in continuously welded rails, by the substructure and by the environment are also mentioned. It seems that the rail withdrawals for fatigue defects increase proportionally with the total traffic load on the one hand with the cube of the average axle-load on the other.
Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways D 117/RP 3, Apr. 1973, 34 pp, 27 Fig, 8 Tab

ACKNOWLEDGMENT: UIC (33)
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr PC

33

A1 054786
ELASTIC DEFORMATIONS IN TRACKS WITH S 60 RAILS [Zroznicowanie Odksztatcen Sprezystych Nawierzchni S 60]
The author looks back over studies carried out by the PKP over a four-year period into the behavioural pattern of tracks with S 60 rails on wooden or concrete sleepers, on main intercity routes. The article gives the results obtained for elastic depression of rails, their side-slip and stress, for rail deflection (including its height) or the coefficient of rigidity of track formation and rail, the effect of ballast grain size on depression, etc. He also gives forecasts for increases in track irregularities in relation to the loads carried in practice according to mathematical models and analysis of the measurements. The conclusions drawn underline the considerable advantages provided by the S 60 rail tracks which could be increased still more by perfecting the technology and quality of laying and maintenance work. [Polish]

Baluch, H *Przeglad Kolejowy Drogowy* No. 9, 1973, 11 pp, 14 Fig, 15 Ref

ACKNOWLEDGMENT: UIC (52)
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr PC

52

A1 056842
PERFORMANCE OF WELDED JOINTS IN RAILS
It is shown that high-carbon and chromium alloy steel joints, produced by butt welding, possess reduced resistance to impact loading in comparison with the base metal although they have otherwise excellent mechanical properties. Gas-pressure welding insures greater resistance of the joints to impact loading in comparison with resistance flash welding.

Mel'ko, YG *Welding Production* Vol. 20 No. 2, Feb. 1973, pp 53-55, 2 Ref

ACKNOWLEDGMENT: EI (EIX740301796)
PURCHASE FROM: ESL Repr PC, Microfilm

A1 056860
MODEL STUDY FOR VERTICAL TRACK BUCKLING
A study is presented of two models which represent the mechanism of vertical buckling of a track when subjected to a mechanical or to a thermal compression force, respectively. The postbuckling equilibrium curves and their stability are discussed and a stability criterion is defined. The effect of various track model parameters, upon the buckling load or buckling temperature, is shown. Graphs reveal that the range of safe compression forces for the mechanically compressed structure is much smaller than the range of the safe forces due to constrained thermal expansions; indicating a possible explanation why in the tests in which the compression forces are induced by jacks the track buckles predominantly in the vertical plane, whereas when the track is compressed by constrained thermal expansions it exhibits mainly horizontal buckling modes. It was found that the buckling loads, or temperatures, obtained from a linearized analysis have no relevance to the actual values obtained from a nonlinear analysis; the difference in results being substantial for buckling temperatures.

Kerr, AD (Princeton University) *High Speed Ground Transportation Journal* Vol. 7 No. 3, 1973, pp 351-368, 1 Ref

ACKNOWLEDGMENT: EI (EIX740304468)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

A1 057461
RAIL STRESS DUE TO LOADING AND ROUTE PROPERTIES [Beanspruchung der Schiene durch die Belastung und die Gegebenheiten des Fahrweges]
The authors report on extensive measurements of transverse forces with test wheelsets against the background of steadily higher loading as a result of heavier and faster trains. These results are placed in relation to stationary measurements of transverse forces, stresses and track subsidence, and from this deductions are made with respect to the design of permanent way and vehicles. [German]

Birmann, F Herbst, W (Berlin Technische Universitaet) *Eisenbahntechnische Rundschau* Vol. 23 No. 3, Mar. 1974, pp 104-112, Figs., 18 Ref.

ACKNOWLEDGMENT: Eisenbahntechnische Rundschau
PURCHASE FROM: Hestra-Verlag Hernichel und Dr. Strauss, Darmstadt, West Germany Repr. PC

DOTL JC

A1 057462
INVESTIGATIONS ON THE FORM STABILITY OF RAILS AND CONCLUSIONS FOR THE PRACTICE [Untersuchung zur Gestaltfestigkeit der Schienen und Folgerungen fur die Praxis]
Investigations were made into the effects of tensile strength and steel qualities on the form stability of rails when subjected to flexural or bending stress, also the part played by the condition of the rail surface. The results showed that there was a danger of fatigue with the S 49 rail on main lines, with the result that the UIC 60 was recommended. [German]

Eisenmann, J Oberweiler, G (Munich Technical University); Schweitzer, R Heller, H (Krupp Huttenwerke AG) *Eisenbahntechnische Rundschau* Vol. 23 No. 3, Mar. 1974, pp 122-126, Figs., 6 Ref.

ACKNOWLEDGMENT: Eisenbahntechnische Rundschau
PURCHASE FROM: Hestra-Verlag Hernichel und Dr. Strauss, Darmstadt, West Germany Repr. PC

DOTL JC

A1 071614
SPECIAL STUDY OF PROPOSED TRACK SAFETY STANDARDS
The report reviews the initial track safety standards proposed by the Federal Railroad Administration in response to the mandate of the Federal Railroad Safety Act of 1970. The report discusses the risks involved in promulgating nonobjective, incompatible, or nonadaptable standards and suggests alternate approaches that may promote effective and enforceable track safety standards. The report recommends that standards not be advanced unless they are objective, compatible with the system, and adaptable to circumstances, including changes in technology. Additional recommendations are directed at methods of strengthening the standards including such items as definitions, and the inclusion of standards for the promotion of safety at grade crossings and reducing the incidence of rail failure.

National Transportation Safety Board NTSB-RSS-71-2, Aug. 1971, 28 pp, Apps.

ACKNOWLEDGMENT: National Transportation Safety Board
PURCHASE FROM: NTIS Repr. PC, Microfiche

DOTL NTIS

A1 071747
RAILROAD ACCIDENT REPORT: CHICAGO, BURLINGTON AND QUINCY RAILROAD COMPANY TRAIN 64 AND TRAIN 824 DERAILMENT AND COLLISION WITH TANK CAR EXPLOSION CRETE, NEBRASKA, FEBRUARY 18, 1969
At about 6:30 a.m., on February 18, 1969, Chicago, Burlington, and Quincy Train No. 64 derailed the 72nd to the 90th cars, inclusive, at a turnout located on the spiral of a 2 degree curve as the train was entering Crete, Nebraska, at a speed of about 52 miles per hour. The derailed cars struck standing cars on a siding south of the main track and the cars of train 824

A1 072593
RAILROAD ACCIDENT REPORT: PENN CENTRAL COMPANY TRAIN SECOND 115 (SILVER STAR) DERAILMENT AT GLENN DALE, MARYLAND, JUNE 28, 1969
The "Silver Star" operating as Penn Central Train 2nd 115, derailed on Penn Central tracks at Glenn Dale, Md. about 1:23 p.m. June 28, 1969. Among the 541 passengers in the 18 cars, 144 persons were transported to area hospitals, 12 of whom were admitted. Total estimated damage, excluding personal injuries, were in excess of $300,000. The derailment was caused by lateral movement of the track under the train. The lateral movement was caused by buckling of the track because of high compressive forces caused by heat expansion and the tendency of rail to creep in the direction of the predominant flow of traffic and descending grade. A number of injuries to passengers were caused by their being thrown from the seats and striking interior parts of the cars, and by luggage being thrown about inside the cars.

National Transportation Safety Board NTSB-RAR-70-1, June 1970, 43 pp, 6 Fig., 4 App.

ACKNOWLEDGMENT: National Transportation Safety Board
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-192456, DOTL NTIS

A1 072656
THE STRESS AND STABILITY ANALYSES OF RAILROAD TRACKS
The paper presents a survey of the state of knowledge in the fields of stress and stability determination of a railroad track. At first, the evolution of the railroad track structure is briefly summarized. This is followed by sections which discuss the development of the methods for the determination of stresses in the rails and ties, and the stability of the railroad track due to constrained thermal expansions.

This paper was contributed by the ASME Applied Mechanics Division for presentation at the Winter Annual Meeting, 17-21 November 1974. The research was sponsored by the Department of Transportation, Federal Railroad Administration, Rails Systems Division, Washington, D.C.

Kerr, AD (Princeton University)
American Society of Mechanical Engineers No. 74-WA/APM-23, June 1974, 7 pp, 3 Fig., 41 Ref.

Contract DOT-FR-40017

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ASME Repr. PC
DOTL RP

A1 072658
RAILROAD ACCIDENTS AND NONDESTRUCTIVE INSPECTION
Railroad accident data published annually by the Office of Safety in the Federal Railroad Administration are analyzed to indicate the most severe causes of railroad accidents. The severity is judged by viewing both the frequency of accidents and the dollar damage per accident. Most of the components or conditions in the groups found to be severe accident causes are amenable to non-destructive inspection. An analysis shows the maximum benefits of an extensive non-destructive inspection program to appear in the wheel and axle category followed in order by track geometric and dynamic conditions and rails and joints. A review is provided for non-destructive inspection methods in current railroad use and potentially useful for the future.

This paper was contributed by the Rail Transportation Divison of ASME for presentation at the winter Annual Meeting, 17-22 November 1974, New York, New York.

Bray, DE (Oklahoma University)
American Society of Mechanical Engineers No. 74-WA/RT-4, June 1974, 15 pp, 3 Fig., 6 Tab., 59 Ref., 2 App.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ASME Repr. PC
DOTL RP

A1 072770
CONTRIBUTION TO THE THEORETICAL EXAMINATION AND EXPERIMENTAL TESTING OF RAILS [Ein Beitrag zur Theoretischen Untersuchung und Experimentallen Pruefung von Eisenbahnschienen]
The forces acting on rails under different conditions of service stress were calculated. Calculations were compared with results of fatigue tests on S49 and UIC60 rails. The variables investigated for their specific effects included locomotives vs freight cars and fast succession of trains. Fracture formation and propagation are discussed. It is concluded that high axle loads require a large rail section, and small wheel diameters also require a high tensile rail steel. The UIC60 rail of steel with 900 N/mm2 minimum tensile strength meets the two requirements and offers ample reserves. [German]

Oberweiler, G *Archiv fuer das Eisenhuettenwesen* Vol. 45 No. 8, Aug. 1974, pp 545-550

ACKNOWLEDGMENT: EI (EI 74 072845)
PURCHASE FROM: ESL Repr. PC, Microfilm

A1 072771
FAILURES OF RAILS AND TRACK SWITCHES [Schadensfaelle an Eisenbahnschienen und Weichen]
Statistics of failures and investigation of the rail material point out to the specific kind of failure of rails. In particular there occur fractures in the form of the running edge peeling off as well as of cross fractures. Even the rails manufactured of high-strength steels cannot cope with heavy loading, occurring in curves with a narrow radius. This led to the development of rails with a yield point exceeding 600 N/sq mm that are being successfully used. A method for analysis of failures is suggested. [German]

Augustin, H Laizner, H Schossmann, R *Berg und Huettenmaennische Monatshefte* Vol. 119 No. 7, July 1974, pp 268-275, 9 Ref.

ACKNOWLEDGMENT: EI (EI 74 072843)
PURCHASE FROM: ESL Repr. PC, Microfilm

A1 072775
DERAILMENTS: THE PROBLEM ONLY DOLLARS CAN SOLVE
The purpose of the study described was to develop the condition of the railroad plant in the United States with respect to tie and rail replacement. The study involved the use of a computer program to determine the long-term maintenance-of-way requirements of railroads and to estimate the amount of deferred maintenance which exists on the railroads. The analysis was made for 25 railroads having a total of 236,000 miles of track.

Dick, MH *Railway Age* Vol. 175 No. 17, Sept. 1974, 3 pp

ACKNOWLEDGMENT: EI (EI 74 072838)
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

A1 072797
FATIGUE-WEAR TESTING OF RAILS UNDER ROLLING LOAD
The fatigue-wear endurance model tests conducted on surface hardened and untreated low-carbon rails, as well as the test results, are presented. Both the wear and fatigue load resistance of the surface hardened rails surmounted those of the untreated rails.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Toth, L *Acta Technica* Vol. 70 No. 3-4, 1971, pp 445-457

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: ESL Repr. PC, Microfilm

A1 072813
ULTRASONIC 'EYES' ABOARD BRITISH TESTING TRAIN LOCATE RAIL DEFECTS
Ultrasonic "eyes" capable of detecting and recording hidden flaws in railroad tracks have been placed in use in Great Britain aboard a new rail testing train which travels as it works at speeds up to 25 mph. This paper reports the technique.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

standing on a track north of the main track. A tank car in train 824 was completely fractured on impact with the derailed cars which released the lading of 29,200 gallons of anhydrous ammonia into the atmosphere. A gas cloud was formed which blanketed the surrounding area for a considerable time due to the weather conditions. Three trespassers riding on train 64 were killed as a result of the derailment and six people were killed and 53 were injured as a result of exposure to the cloud of ammonia. The Safety Board determined that the derailment was caused by the movement of a rail of the turnout due to lateral forces produced by the locomotive as it moved over track alignment and surface deficiencies of the track. The complete fracture of the tank car on impact was contributed to by the brittleness of the steel of the car caused by the low ambient temperature.

National Transportation Safety Board NTIS-RAR-71-2, Feb. 1971, 79 pp, Figs., Tabs.

ACKNOWLEDGMENT: National Transportation Safety Board
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-198790, DOTL NTIS

A1 071754
RAILROAD ACCIDENT REPORT: RICHMOND, FREDERICKSBURG AND POTOMAC RAILROAD COMPANY TRAIN NO. 10/76 DERAILMENT WITH THREE FATALITIES AND NUMEROUS PERSONAL INJURIES, FRANCONIA, VIRGINIA, JANUARY 27, 1970
Train No. 10/76 derailed on Richmond, Fredericksburg and Potomac (RF&P) 1970. The train consisted of one express car, one postal car, two baggage cars, four coaches, two sleeping cars, and three diesel-electric locomotive units. The train proceeded northbound on No. 2 track and at Possum Point, 80 miles north of Richmond, crossed over to No. 3 track to avoid conflict with a local freight. On approaching Franconia, speed was reduced from 80 miles per hour to 70 miles per hour; at Franconia, speed was further reduced to 65 miles per hour, and as the train traversed the north end of a curve, the locomotive lurched severely to the left. Immediately thereafter, the derailment occurred. The accident resulted in the derailment of the eight rear cars of the train. The third, fourth, and fifth cars remained upright and coupled to the head end of the train. A separation occurred between the fifth and sixth cars, and between each of the following cars. The sixth through 10th car veered to the left down a bank, and either partially or completely overturned. Of the 101 passengers in the 10 cars, three were killed, five incurred injuries requiring hospitalization and 45 persons were treated for less serious injuries. The National Transportation Safety Board determines that the probable cause of the derailment was the lateral movement of the track immediately ahead of the locomotive, due to conditions resulting from inadequate track maintenance procedures.

National Transportation Safety Board, (SS-R-9) NTSB-RAR-71-1, Feb. 1971, 57 pp, Figs., 5 App.

ACKNOWLEDGMENT: National Transportation Safety Board
PURCHASE FROM: NTIS Repr. PC, Repr. PC
PB-198263, DOTL NTIS

A1 071782
MEAN STRESS EFFECTS ON FATIGUE CRACK GROWTH AND FAILURE IN A RAIL STEEL
Over a limited range, the effect of mean stress has been studied on fatigue crack propagation and on the critical fatigue crack size associated with sudden fast fracture in center-notched plate specimens of a rail steel under pulsating loading. The results have been presented in terms of the stress intensity factor range K and the ratio R of the minimum to maximum stress. Increasing R was found to both accelerate cracking and reduce the critical crack size at instability. The data have been correlated with three crack growth equations currently used in the literature and it was found that the equation of Forman et al. relating crack growth rate to K and R gave the best fit. This equation was used to predict life in the finite range of the S-N curve. Fractographic examination revealed that the fracture surfaces were complex and a number of fracture modes contributed to cracking.

Evans, PR (National Physical Laboratory); Owen, NB McCartney, LN *Engineering Fracture Mechanics* Vol. 6 No. 1, Mar. 1974, pp 183-193, 8 Ref.

ACKNOWLEDGMENT: EI (EI 74 0801972)
PURCHASE FROM: ESL Repr. PC, Microfilm

A1 071810
RAILS FOR HIGHLY STRESSED TRACKS [Schienen fuer Hochbeanspruchte Geleise]
The increasing tonnage and speeds in grade operation, such as on the Gotthard line of the Swiss National Railways impose exacting demands on the quality of the rails. Qualification of Krupp's nominally 0.7C-0.7Si-1Mn-1Cr steel for such service is indicated by its tensile strength of 110 to 125 kp/sq mm, wear and shelling resistance, strain hardening, impact resistance, and weldability. [German]

Heller, W Schumacher, G *Technische Mitteilungen Krupp, Werksberichte* Vol. 32 No. 1, Mar. 1974, pp 21-27, 19 Ref.

ACKNOWLEDGMENT: EI (EIX740701609)
PURCHASE FROM: ESL Repr PC, Microfilm

A1 072450
NUMERICAL PROCESSING OF MEASUREMENT DATA TO MEET FEDERAL TRACK STANDARDS
U.S. railways face a heavy program of track renewal and maintenance following application of government standards to all lines from October 1973. Operators must now insure that Federal requirements for different speed classifications are complied with says M. Robert Rousse, honorary chief engineer of French National Railways, who explains how recording cars equipped for numerical processing of geometric data are being used for programming the work needed to keep permanent way within the new limits.

Rousse, R (French National Railways) *Railway Gazette International* Vol. 130 No. 9, Sept. 1974, pp 345-349, 3 Fig., 1 Phot., 3 Ref.

PURCHASE FROM: XUM Repr. PC
DOTL JC

A1 072592
RAILROAD ACCIDENT REPORT: PENNSYLVANIA RAILROAD TRAIN PR-11A, EXTRA 2210 WEST AND TRAIN SW-6, EXTRA 2217 EAST DERAILMENT AND COLLISION DUNREITH, INDIANA, JANUARY 1, 1968
About 9:30 p.m., January 1, 1968, Pennsylvania Westbound freight train PR-11A, consisting of 98 cars and five-unit diesel-electric locomotive, was passing Dunreith, Indiana, at 42 miles per hour when the trailing wheels of the 88th car, an empty tank car, AESX 850, derailed at a broken rail near the eastern edge of the town. At the same time, eastbound freight train SW-6 consisting of a five-unit diesel-electric locomotive and 106 cars, was moving eastward at 32 miles per hour on the adjacent track. The derailed car in train PR-11A continued westward until it became disengaged from its trailing truck when it struck the crossing board at a grade crossing about 723 feet west of the point of original derailment. One or more cars collided with cars of hazardous materials moving in the opposite direction in SW-6's train, causing a general derailment and puncturing several tank cars of flammable materials. A large-scale fire ensued, followed by a violent explosion of a tank car of ethylene oxide forty-five minutes later. Immediately after the derailment and outbreak of fire the population of Dunreith was evacuated without injury. A cannery and several residences and businesses were destroyed. Three firemen and two police- men were slightly injured in the fire and explosion. The probable cause of the initial derailment in train PR-11A was the broken rail within the compromise joint where two different sizes of rail were joined. A contributing causal factor was the inadequate track maintenance which left the joint unsupported and allowed the development of the break in the rail. This initial derailment and the design of the lift-off type of center-pin connection between the truck and body of AESX car 850 which allowed the truck to separate from the car under impacts of a simple derailment, led to the secondary collision and general derailment.

National Transportation Safety Board No. SS-R-2, Dec. 1968, 73 pp, 11 App.

ACKNOWLEDGMENT: National Transportation Safety Board
PURCHASE FROM: NTIS Repr. PC
PB-190213, DOTL NTIS

Materials Evaluation Vol. 39 No. 6, June 1971, pp 16A-18A
ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: ESL Repr. PC, Microfilm

A1 072815
TRACKING DOWN JOINT-AREA RAIL DEFECTS
Now by using hand-held testing devices Santa Fe is testing joint-bar areas with ultrasonic devices for detecting bolthole cracks and head-and-web separations. A mirror is used to reflect light into joint gap to reveal presence of defects. Stepped-up method of joint-area inspection has produced big increase in detected defects.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Railway Track and Structures Vol. 66 No. 7, July 1970, pp 21-23

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: XUM Repr. PC

A1 072816
COMPUTER SPOTS RAIL DEFECTS FAST
Survey of applications of computer complex in the computerizing of rail-defect information developed by a fleet of rail detector cars and a variety of portable ultrasonic testing instruments. A monthly printout from Penn Central computer shows rail defects found by special cars and ultrasonic devices. Computer data is also shown to be useful in programming rail renewals.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Railway Age Vol. 169 No. 1, July 1970, pp 32-33

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: XUM Repr. PC

A1 072817
SIGNIFICANCE OF A DETECTION OF DEFECTS IN RAILS
The articles describe the principal types of defects which may be found in rails, and indicates those which are inherent in the manufacturing processes and those which arise as a result of service loads. The principles of resonance and pulse-echo ultrasonic flaw detection as applied to rails are given, and the current ultrasonic testing practice at the British Railway is described.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Johnson, PC Wise, S *Non-Destructive Testing* Vol. 3 N Apr. 1970, pp 111-116

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: ESL Repr. PC, Microfilm

A1 072818
DETECTION OF BASE SEAMS IN INLAID RAILS
A description of a test apparatus that has made possible the detection of rolling mill defects in the seams, located at the base of new rails, installed less than 2 yrs is presented. A semi-automated ultrasonic rail test car, operated at 5 km/hr, is demonstrated.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Veniza, GE *Intl Conf on Nondestructive Testing, 6th Proc* Vol. 3 Session H, Rept. 4, 1970, pp 37-46

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: Society for Nondestructive Testing 704 47th Street, Los Alamos, New Mexico, 87544 Repr. PC

A1 072821
WHEEL AND RAIL LOADINGS FROM DIESEL LOCOMOTIVES
This presentation was prepared to review Electro-Motive Division's background, particularly regarding locomotives in the area of wheel-to-rail loadings as they affect maintenance, wear, and potential train derailments. This review is divided into the following six areas: sample derailment data; basic curve negotiation mechanics; experimentally determined wheel-to-rail forces; rail profile data; the effect of dynamic brake levels; and mechanical considerations.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration. The report was presented at the AREA Convention, Chicago, Illinois, 1971.

Koci, LF Marta, HA
General Motors Corporation 1971, 15 pp

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: ESL Repr. PC, Microfilm

A1 072831
SCANNING ELECTRON MICROSCOPY OF EARTHQUAKE--INDUCED RAIL FRACTURES
This investigation has as its purpose a somewhat systematic scanning electron fractography study of railroad-rail fracture resulting from stresses induced by earth movements associated with an earthquake measuring 6.6 on the Richter scale which struck the Los Angeles, California area on February 9, 1971, having a primary shock duration ranging from 1 to 2 min.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Murr, LE Hodgkin, NM Lowe, BV (University of Southern California)
Metallography Vol. 4 No. 6, Dec. 1971, pp 477-486

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: ESL Repr. PC, Microfilm

A1 072840
FASTENING THE RAILS ON TRACKS FOR VERY HEAVY LOADS [Schienenbefestigung fuer Schwerstbelastete Gleise]
On a special testing machine, which is described and illustrated, rail assemblies were fatigue tested under pulsating loads. The assemblies consisted of the rail, fastened by double shank spring spikes to a steel base plate separated from the tar-oil saturated beechwood tie by a layer of plastic material. The results, which are given in great detail, lead to the conclusion that such an assembly can be expected to have a long service life even in 300 to 500 m long curves, when the mean axle loads are 360 kN and loads occasionally increase to 450 kN. [German]

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Eisenmann, J *Stahl und Eisen* Vol. 91 No. 22, Nov. 1971, 3 pp

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: ESL Repr. PC, Microfilm

A1 072846
THE EFFECT OF FORCES ON THE RAIL JOINTS, AND THE NOSE-SUSPENDED MOTOR DRIVES OF LOCOMOTIVES
With the help of an analogue computer, the author analyses the reciprocal effects in relation to the speed, the uneveness, and the resilience of the joints. It is concluded that there is close interdependence between the quality of the motor suspension and the reaction on the motor axle. [German]

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Handel, H *Deutsche Eisenbahntechnik* Jan. 1972, pp 31

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: VEB Verlag Technik Oranienburgerstrasse 13-14, 102 Berlin, East Germany Repr. PC

A1 080284
SUMMARY OF HEAT-TREATED AND ALLOY RAIL SERVICE TEST INSTALLATIONS ON CURVES WITH SHELLY HISTORIES--1972
The AAR, in its program of Rail Research, has a project of field inspection and analysis of those rails that continue in service which show some potential

for improvement in performance. The field inspections are carried out as a cooperative effort of the American Railway Engineering Association (AREA) Rail Committee, the American Iron and Steel Institute (AISI), and the AAR Research and Test Department. This report is a summary of results of the August and September 1972 inspections of seven field test installations of High-Silicon, Curvemaster, Fully Heat-Treated and Columbium Treated Rails.

An RPI-AAR Cooperative Project.

Schoeneberg, KW
Association of American Railroads Technical Center, (R009) Res. Rpt. R-121, Apr. 1973, 59 pp, 28 Fig.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

A1 080285
RAIL RESEARCH-PROBLEM DEFINITION
A program was initiated to determine and define the problems associated with rail. The purpose was to collect and analyze facts regarding national and international experience on rail behavior, in order to focus attention on the major unresolved problems in rail. These are (1) Joint area problems, both bolted and welded, (2) Plastic deformation of rail head causing shelling, (3) Rail defects and premature removal of rail from track, and (4) Appropriate selection of rail based upon service requirements-use criterion. This report presents a background study of rail design, chemical composition and heat treatment of rail, manufacturing and rolling of rail-reviewing problem areas of each. A discussion of rail defects and the background and techniques of rail defect (flaw) detection is also presented. Recommendations are made for further research and study on bolt hole drilling, rail straightness, new rail steel process and manufacturing techniques, wheel/rail interaction, fracture properties and defect propagation of present and proposed rail steels, rail flaw detection technology, and economic use criterion of rail.

Schoeneberg, KW
Association of American Railroads Technical Center, (70-R-66) Res. Rpt. R-120, Mar. 1973, 81 pp, 45 Ref.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

A1 080413
ANALYSIS OF NAD CRANE MAINTENANCE OF WAY
The report represents an in-depth comprehensive analysis of NAD Crane's railroad maintenance of way (M/W) program. Quantitative tools have been developed to provide a rational framework for decision making for M/W. This analysis was prompted by the occurrence of numerous derailments attributed to poor track conditions. The safety aspects of derailments of hazardous material including high explosives required a thorough analysis of causes related to operations of the Ordnance Department and the Public Works Transportation, Maintenance, and Maintenance Control Division. The report presents several recommendations for the establishment of annual levels of maintenance, recommendations on the equipment required, and recommendations on the priority use of maintenance resources. (Author)

Lueking, JR Hinkle, GJJ
Naval Ammunition Depot NAD-CR-RDTR-285, Sept. 1974, 133p

ACKNOWLEDGMENT: NTIS (AD/A-000066/1SL)
PURCHASE FROM: NTIS Repr. PC, Microfiche
AD/A-000066/1SL, DOTL NTIS

A1 080772
TRAIN HANDLING AND OVERTURNED RAIL
The Canadian Pacific Railway recently used the EMD's dynamometer car to explore the problem of harmonic roll and over-turned rail. The problem is particularly bad in the Rockies. The tests indicated several methods by which train handling procedures could be improved to reduce the chance of a derailment.

Progressive Railroading Vol. 17 No. 8, Aug. 1974, pp 33-34

ACKNOWLEDGMENT: CNR
PURCHASE FROM: Murphy-Richter Publishing Company 9 South Clinton Street, Chicago, Illinois, 60606 Repr. PC
DOTL JC

A1 080973
MEANS AND METHODS TO INCREASE TRACK STABILITY
The stability of track is a serious problem for every railroad, especially since the introduction of welded rail. The primary concern of this paper is the behavior of track after trackwork has been carried out with particular regard to its geometry. Such work affects the resistance of track to all types of movement, both under traffic and induced by climatic conditions. The attention is directed at conventional track structures because too little is so far known about other types. It is concluded that a high standard of track geometry can only be maintained by lining machines; modern equipment can efficiently increase the lateral resistance of the ballast bed; and track stiffness can be increased with appropriate fasteners and new types of ties.

Riessberger, KH *AREA Bulletin* Vol. 75 Bulletin No. 648, June 1974, pp 797-811, 15 Fig.

PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

A1 081268
TESTING LATERAL SLIPPING OF THE TRACK WITH A NEW DESIGN OF SLEEPER IN THE AUSTRIAN FEDERAL RAILWAYS [Gleisverwerfungsversuche der Oesterreichischen Bundesbahnen mit neuen Schwellenformen]
Tests on the lateral slipping of the track on a curve with a radius of 189 m have shown that the track's resistance to lateral displacement was considerably improved by modifying the shape of the sleepers, and that the welding of the rails was also possible with smaller radii. The resistance to lateral displacement of the Be 14 d sleeper with lugs is twice that of the B 14 sleeper without lugs, and 50% higher than the resistance of the Be 17 sleeper, which has about the same basic surface as the Be 14 d sleeper. [German]

Klugar, K *Eisenbahningenieur* Vol. 25 No. 3, Mar. 1974, pp 70-75, 12 Fig., 3 Ref.

ACKNOWLEDGMENT: International Railway Documentation, Selection of (UIC Serial No. 876)
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr. PC
DOTL JC

A1 082174
TRACK TRAIN DYNAMICS. ACCIDENT INVESTIGATION
This manual, a report marking the completion of one assignment of the International Government-Industry Research Program on Track-Train Dynamics, is a guide to systematic investigation of any derailment in order to establish a cause, or combination of causes. It presents information stressing the close relationships between track, train and vehicle characteristics, train handling, and track-train dynamics. Stressed is the need to recognize that a derailment may be combination-caused, rather than mandating the investigators to report a single cause. This is necessary if information from the accident investigation is to accurately reflect the true situation. The manual concludes with six recommendations for individual railroad users.

This project was sponsored by the Association of American Railroads, the Federal Railroad Administration, the Railway Progress Institute and the Transportation Development Agency of Canada.

Association of American Railroads Technical Center 1974, 77 pp, Figs.

PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

A1 083042
ULTRASONIC FLAW DETECTION IN THERMIT-WELDED JOINTS
Although not usually considered suitable for testing thermit welds, ultrasonic flaw detection equipment has been used for this purpose in India where gamma ray testing equipment could not be made available.

Bhatnager, SK *Railway Gazette International* Vol. 131 No. 1, Jan. 1975, p 31, 1 Fig.

PURCHASE FROM: XUM Repr. PC

DOTL JC

A1 083920
THE TRIBOLOGY OF WHEEL ON RAIL
The functioning of wheels and rails as a supporting and guiding system depends on a Hertzian contact of 1.2 x 10 to minus 4th power sq m (0.2 in sq) area. In addition to its supporting function, this area must withstand tangential forces to enable the functions of traction, braking and guidance to be fulfilled. Such traction forces are accompanied by a deflection known as 'creep' and classical estimates of this quantity are compared with measurements made on the track. Modes of wear of wheel and rail are described and alternative systems which avoid contact are discussed.

Barwell, FT *Tribology* Vol. 7 No. 4, Aug. 1974, pp 146-150

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: ESL Repr. PC, Microfilm

A1 084924
UNSTABLE TRACK: CAUSES AND CURES
The effectiveness of ballast is of prime importance to the stability of track. Burlington Northern has found there are four main factors affecting the durability of ballast. Continuous welded rail is the most significant development. In addition, the quality of the ballast, the condition of the sub-grade and the compactions of the ballast all affect the condition of the track.

Progressive Railroading Vol. 17 No. 11, Nov. 1974, pp 61-64

ACKNOWLEDGMENT: CNR
PURCHASE FROM: Murphy-Richter Publishing Company 9 South Clinton Street, Chicago, Illinois, 60606 Repr. PC

DOTL JC

A1 084927
WELDED RAIL ALL THE WAY ON THE SANTA FE
The Santa Fe has laid over 5,000 miles of welded rail on its system. A new rail welding plant has been constructed at Amarillo, Texas. The plant also reclaims rail that has been removed when welded rail is installed. The old rail is shipped to the Amarillo plant in 1,440 sections where it is disassembled and reclaimed.

Progressive Railroading Vol. 17 No. 9, Sept. 1974, pp 82-88

ACKNOWLEDGMENT: CNR
PURCHASE FROM: Murphy-Richter Publishing Company 9 South Clinton Street, Chicago, Illinois, 60606 Repr. PC

DOTL JC

A1 092316
A METHODOLOGY FOR EVALUATING THE ECONOMIC IMPACTS OF APPLYING RAILROAD SAFETY STANDARDS. VOLUME I
The report presents a methodology for evaluating the economic impacts of applying railroad safety standards. The scope is considered broad enough to permit evaluation of all the safety standards thus far proposed by the Federal Railroad Administration and to allow for detailed analysis of individual equipment, track, and human factors standards. At the same time, the details and examples are fairly specific in order to present insight into the techniques and problems which might be encountered. Volume 2 of this report is the manual whose step-by-step procedures are intended for the implementation of economic impact analysis. Portions of this document are not fully legible.
See also Volume 2, PB-244 267.

Kennedy, RG, III Lloyd, FH Lowrey, R
Consad Research Corporation, Federal Railroad Administration Final Rpt. FRA/RP-41-Vol-1, Oct. 1974, 278 pp

Contract DOT-FR-20047

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-244266/3ST, DOTL NTIS

A1 092317
A METHODOLOGY FOR EVALUATING THE ECONOMIC IMPACTS OF APPLYING RAILROAD SAFETY STANDARDS. VOLUME II
This manual is intended as a working document for Federal Railroad Administration personnel, and provides step-by-step procedures which are intended for use in determining the economic impact of proposed railroad safety standards. It is a companion piece to Volume I, the Final Report. The procedural framework described is broad enough to encompass safety standards in equipment, track, and human factors standards. At the same time, the details and examples are fairly specific in order to present insight into the techniques and problems which might be encountered. In developing this manual, high priority was placed on presenting workable procedures that can be used immediately for economic impact evaluation. Special attention is given to accidents and accident prediction, discounting, quantification problems and the role of sensitivity analysis. A completely worked example is presented in the appendix. Portions of this document are not fully legible.
See also Volume 1, PB-244 266.

Lloyd, FH Crisafulli, RJ
Consad Research Corporation, Federal Railroad Administration Final Rpt. FRA/RP-41-Vol-2, Oct. 1974, 169 pp

Contract DOT-FR-20047

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-244267/1ST, DOTL NTIS

A1 092320
DEVELOPMENT OF THE RAIL SAFETY INSPECTION PROGRAM. VOLUME I
This Final Report, contained in two volumes, summarizes the results of a study which included an analysis of the present rail safety program, a review of similar governmental and private programs, the presentation of proposed alternative approaches to the inspection program, an analysis of the functional responsibilities of the organizations supporting the program and a description of the tasks required to implement the proposed improvements to the rail safety program. This volume of the report, Executive Summary, summarizes the project team findings and recommendations and outlines executive action items or decision points which must be considered by top level FRA and DOT management.
See also Volume 2, PB-244 276.

Feldman, S Becker, H Mendenhall, G Coffey, J
Young (Arthur) and Company, Federal Railroad Administration Final Rpt. FRA/RAD-75/1-Vol-1, June 1975, 24p

Contract DOT-FR-53060

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-244275/4ST, DOTL NTIS

A1 092321
DEVELOPMENT OF THE RAIL SAFETY INSPECTION PROGRAM. VOLUME II. FINDINGS AND RECOMMENDATIONS
This Final Report, contained in two volumes, summarizes the results of a study which included an analysis of the present rail safety program, a review of similar governmental and private programs, the presentation of proposed alternative approaches to the inspection program, an analysis of the functional responsibilities of the organizations supporting the program, a projection of the staffing requirements to support the program and a description of the tasks required to implement the proposed improvements to the rail safety program. This volume, Findings and Recommendations, contains the main body of the Final Report including proposed methodologies for the enhancement of the FRA safety effort and the evaluation procedures for measuring the program's success.
See also Volume 1, PB-244 275.

Feldman, S Becker, H Mendenhall, G Coffey, J
Young (Arthur) and Company, Federal Railroad Administration Final Rpt. FRA/RAD-75/1-Vol-2, June 1975, 164p

Contract DOT-FR-53060

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-244276/2ST, DOTL NTIS

A1 092464
SOAC: STATE-OF-THE-ART CAR ENGINEERING TESTS AT DEPARTMENT OF TRANSPORTATION HIGH SPEED GROUND TEST CENTER. FINAL TEST REPORT. VOLUME I. PROGRAM DESCRIPTION AND TEST SUMMARY
The six-volume report presents the technical methodology, data samples, and results of tests conducted on the SOAC on the Rail Transit Test Track at the High Speed Ground Test Center in Pueblo, Colorado during the period April to July 1973. The Test program comprises three areas: Vehicle testing, ways and structures testing and track geometry measurement. The objective of the SOAC program is to demonstrate the current state-of-the-art in rail rapid transit vehicle technology, with passenger convenience and operating efficiency as primary goals. In this series, Vol. I contains a description of the SOAC test program and vehicle, and a summary of the test results; Vol. II, Performance Test data; Vol. III, Ride Quality Test data; Vol. IV, Noise Test data; Vol. V, Structural, Voltage, and Radio Frequency Interference Test data; and Vol. VI a description of the Instrumentation system used for performance, ride quality and structural testing.
Paper copy also available in set of 6 reports as PB-244 746-SET, PC$28.00.

Boeing Company, Urban Mass Transportation Administration, Transportation Systems Center, (UMTA-MA-06-0025) Final Rpt. UMTA-MA-06-0025-75-1, Jan. 1975, 88 pp

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-244747/2ST, DOTL NTIS

A1 093435
DEVELOPMENT OF A NEW SYSTEM FOR DETECTING FATIGUE CRACKS IN STEEL BRIDGES
The nondestructive detection and characterization of fatigue cracks during field inspection of steel bridge structures are put in perspective in terms of the magnitude of the problem and viable nondestructive methods. The results of nondestructive method assessment, selection, evaluation, and experimental confirmation are presented in detail. Developed as a useful and effective solution to the problem, the inspection system consists of two independent, complementary, lightweight, battery-powered electronic instruments-an acoustic crack detector (ACD), which uses ultrasonic principles, automatic signal analysis, and a simple digital data display for rapid survey, and a magnetic crack definer (MCD), which uses magnetic principles and a simple ON-OFF light data display for defining the precise location and crack length. The features and functioning of the equipment are briefly described, and laboratory and field demonstrations, presentations, and field inspections are reviewed. The technical basis for equipment development, including equipment concepts, is summarized.

Barton, JR Kusenberger, FN Birchak, JR
Southwest Research Institute, Federal Highway Administration, (HPR) Final Rpt. FHWA-RD-73-89, June 1973, 147 pp
RESPONSIBLE INDIVIDUAL: McGogney, CH (HRS-11)

Contract FH-11-7794

ACKNOWLEDGMENT: NTIS, Federal Highway Administration (S0374)
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-245606/9ST, DOTL NTIS

A1 093600
TEST TRAIN PROGRAM SIXTH PROGRESS REPORT
The report describes the progress of the Rail Research Program involving operation of the FRA test cars and the performance of other rail research efforts during the period 1 July 1973 to 30 June 1974. High-lights of the work reported include operation of the FRA test cars to perform track surveys and other rail research activities; test car upgrading; expansion of the Rail Research Program; and data management and data analysis tasks which have been undertaken to benefit railroad technology. The Rail Research Program primarily involves the operation and instrumentation of the FRA test cars. This research program is designed to provide high-speed measurement of railroad track characteristics, development of comprehensive track measurement techniques, development of special testing instrumentation, and data evaluation through analysis and electronic processing.
See also PB-241 419.

Peterson, C Kaufman, W Yang, TL Corbin, J
ENSCO, Incorporated, Federal Railroad Administration FRA/ORD/D-75-25, June 1974, 128 pp

Contract DOT-FR-20032

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-247084/7ST, DOTL NTIS

A1 095213
THE EFFECTS OF VARIATIONS IN HEAT TREATMENT ON THE STRENGTH AND TOUGHNESS OF RAIL STREEL
Because of the growing number of incidents due to rail failures, research is being made into possible improvements. The AAR and Carnegie-Mellon University have jointly sponsored a research programme into the possiblity of improving rail strength (which determines what axle load can be supported without any permanent rail deformation), and toughness (defined as the measure of the steel's resistance to brittle fracture or the slowness with which a defect spreads) by simply altering the heat treatment conditions (rolling or austenization temperature, isothermal transformation temperature or cooling rate). The general tendencies of the phenomenon have been determined. Strength and hardness are unaffected by austenization temperatures between 1470 degrees F and 1830 degrees F but toughness decreases. Resistance increases as isothermal transformation temperature rises (between 1010 degrees F and 1155 degrees F and toughness would reach its maximum at about the lowest temperatures tested). This unfinished study should make it possible to decide whether the improvements that can thus be obtained are adequate for justifying a transformation of the heat treatment process or whether this line of research is pointless.

Hyzak, JM *AREA Bulletin* No. 648, June 1974, pp 776-778, 2 Fig.

ACKNOWLEDGMENT: International Railway Documentation, Selection of
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

A1 095214
MEANS AND METHODS TO INCREASE TRACK STABILITY
The author deals with the means and methods of preventing the decreases in track stability following maintenance operations. Above all, he refers to the so-called Plasser-all-side-system RS-System and gives an account of some tests to determine the best conditions for its use. He goes on to provide graphs showing: the results of a large number of measurements of track resistance to lateral deformation; the conditions of buckling stability deduced from theoretical and relative formulae either in the case of simple buckling of a perfectly straight track or that of deformation of a track with a slight flaw at the outset. He comes to the familiar conclusions as far as conditions for good stability are concerned: high standard of track geometry; increased lateral resistance of the ballast bed by use of modern equipment; increased track stiffness with wing-ties, used so successfully by the Austrian Federal Railways.

Riessberger, KH *AREA Bulletin* No. 648, June 1974, pp 797-811, 3 Fig., 6 Ref.

ACKNOWLEDGMENT: International Railway Documentation, Selection of
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

A1 095225
STEADY-STATE VIBRATIONS OF RAIL ON AN ELASTIC DAMPED FOUNDATION SUBJECTED TO AN AXIAL FORCE AND A MOVING LOAD
The recent practice of continuously welded railroad rails suggests that considerable axial forces may be induced in the rails due to a change in temperature. This paper presents an analytical solution for the effect of an axial force on the steady-state vibrations of a rail continuously supported on an elastic damped (viscoelastic of the Kelvin type) foundation and subjected to a moving load. The presence of damping is shown to result in an unsymmetric dynamic deflection of the rail. Due to phase shift the largest deflection occurs slightly behind the point of application of the moving load, and the deflection ahead is always larger than the deflection behind the point

of maximum deflection. The results are relevant to present studies of the temperature buckling of continuously welded railway rails. If the rail is near to the point of buckling due to thermal strains, additional longitudinal strain in the rail due to a moving load may result in buckling of the rail ahead of the moving load.

Contributed by the Rail Transportation Division of The American Society of Mechanical Engineers for presentation at the IEEE-ASME Joint Railroad Conference, San Francisco, California, April 15-17, 1975.

Dokainish, MA Elmaraghy, W (McMaster University)
American Society of Mechanical Engineers 75-RT-3, Apr. 1975, 8 pp, 6 Fig., 10 Ref.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL RP

A1 095294
A NON-DESTRUCTIVE METHOD OF MEASURING INTERNAL RAIL FORCE

Stability of continuously welded rail (cwr) can be monitored by determining the longitudinal force that exists at all times in the rail. British Rail Scientists have developed a rail-force transducer which permits rapid simple accurate measurements to be made of stress changes unaccompanied by changes of length. Using the results, the stress-free temperature of the rail is easily calculated. Transducers are cylindrical in shape and are installed by gluing in holes of the standard fishbolt size drilled in the rail's neutral axis. Readings from the transducers are taken at any time by using a portable measuring instrument.

Modern Railways Vol. 32 No. 318, Mar. 1975, p 123

PURCHASE FROM: XUM Repr. PC

DOTL JC

A1 095414
ANALYSIS OF TRACK PARAMETER HETEROGENEITY AS A COMPLEMENT TO GEOMETRICAL METHODS OF TRACK CONDITION RATING

The condition of a track may be defined by track rating indices (W indices at the PKP) taken from recordings by a track inspection car, or obtained by geometrical measurements (longitudinal dip and cross-sectional irregularities, without load or with a moving load, lateral displacement, etc.). By track heterogeneity, the writer means the differences that such indices reveal on lengths of line with identical make-up, similar age, and used by the same traffic. These heterogeneities, which may be caused by the laying or maintenance of the track, or by constructional features with different characteristics, are also likely to result in great differences in the rapidity with which these lengths of line deteriorate, necessitating earlier continuous track renewal. The article proposes methods of assessing these heterogeneities by tests based on classic statistics laws. Numerical examples thus deal with: heterogeneities in the W index, by the X to the 2nd power test; heterogeneities in the track gauge by a method called the "ZM test" taken from an American book referred to in the bibliography; correlations between rail dip and lateral displacement under a moving load, by an analysis of sequential correlation. These complex analyses are not used as a basis of routine maintenance decisions, but in investigations for the purpose of explaining abnormal phenomena.

Baluch, H *Rail International* Vol. 5 No. 7-8, Aug. 1974, pp 537-546, 6 Fig., 4 Tab., 6 Ref.

ACKNOWLEDGMENT: International Railway Documentation, Selection of
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

A1 095633
CHARACTERISTICS OF THE ORIGIN AND DEVELOPMENT OF INTERNAL FATIGUE CRACKS AS EXEMPLIFIED BY RAIL FRACTURE [Osobennosti Zarozhdeniya i Razvitiya Vnutrennikh Treshchin Ustalosti na Primere Razrusheniya Rel'sov]

Experimental data are presented that have been obtained during an investigation into the failure of railroad rails. Specific features of this kind of fracture are studied. They are connected with cold hardening of the rail surface layer and generation of cracks within the material. [Russian]

Ravitskaya, TM *Problemy Prochnosti* Vol. 6 No. 11, Nov. 1974, pp 77-82, 23 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

A1 095698
VERTICAL ACTION OF FORCES BETWEEN WHEEL AND RAIL WHEN CROSSING A RAIL JOINT

An example serves to determine the maximum dynamic vertical wheel force when a modern coach crosses a rail joint. The problem is described mathematically by a system of ordinary differential equations and is solved by means of an analog computer. The high dynamic vertical wheel forces obtained linearly increase with the travelling speed. As a result, the demand of more elastic wheels is made for railway vehicles travelling at high speed, besides that of a high quality of the permanent way. [German]

Beer, R Gudacker, E Ebert, J *DET Eisenbahntechnik* Vol. 22 No. 11, Nov. 1974, pp 509-511

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: VEB Verlag Technik Oranienburgerstrasse 13-14, 102 Berlin, East Germany Repr. PC

A1 095874
RAIL STUDY BESSEMER AND LAKE ERIE RAILROAD

Because of the ever increasing concern with shelling of rail and its possible connection with wheel loads and the present day trend to still heavier wheel loads, a study was conducted on the Bessemer and Lake Erie Railroad to analyze their rail conditions in conjunction with their use of 90-ton cars for transporting of ore. This railroad has been using these 90-ton capacity hopper cars since 1931, with practice being to load ore for southbound movement to capacity, thus creating loads averaging 32,300 lbs. per wheel. It has been noted over the years that even with these wheel loads and rather high annual tonnages, the Bessemer has had little or not shelling of their rail. This study was prompted to see if an answer could be derived as to why no shelling problem exists here. In particular, two locations on the railroad were checked where the present rail in track is 131 lb., laid in 1938, and has had over 400,000,000 gross tons of traffic, most of which consisted of are carried in these 90-ton hopper cars. The northmost location is at Springboro, Pennsylvania, where there is a length of one mile of the 131 lb. rail in track (north and south of Mile Post 116). The other location is through and to the south of Grove City, Pennsylvania, Mile Post 60-63, where there is a 3-mile section of 131 lb. rail in track. Both of these sections of 131 lb. rail now carry both northbound and southbound tonnage, but prior to single tracking and installation of C.T.C. in 1957, this trackage was the southbound main track in both instances and carried the predominant southbound ore traffic. At both locations of 131 lb. rail, rail profiles were taken, degree and superelevation of curves were noted, predominant speeds of tonnage trains in both directions were noted, condition of the entire track structure and, in particular, condition of the rail both on tangent and curves were noted. Photographs were taken to show the rail condition. Because of curvature in the locations not exceeding 3 degrees, other locations on the railroad were chosen to make like studies, these locations having the same or less annual tonnages, and having different weights of rail of shorter service life, but having greater degree of curvature. Rail profiles and photographs were taken at these locations also. Along with the study of the rail and track conditions, a study of the 90-ton B & LE hopper cars was conducted, obtaining all pertinent data, prints, and photographs having to do with their construction and maintenance. The Bessemer's rail replacement policy is guided by the formula--T = .703xWxD.565 where T = Life of rail in million gross tons. W = Weight of rail in lbs. per yard. D = Traffic density in million gross tons per year.

Conducted under sponsorship of AAR Joint Committee on Relation Between Track and Equipment.

Association of American Railroads Technical Center ER-55, Mar. 1965, 3 pp, 4 Fig., 3 Phot.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC

DOTL RP

A1 095879
METALLURIGICAL, PHYSICAL AND ROLLING LOAD TEST RESULTS OF RAIL ROLLED FROM CONTINUOUSLY CAST BLOOMS

The development of information relative to any new process applicable to producing rail more economically is of interest to the industry. The opportunity of investigating the application of continuous casting in rolling rail presented itself when the M.W. Kellog Company became interested in investigating this process on behalf of a Mexican client. The AAR Research Center cooperated in developing the metallurgical, physical and rolling load test results of rail rolled to the S49 section from continuously cast blooms. The results on the same type of of tests as described above tested in the 12 in stroke rolling load machine are shown on Table 4. The S49 rails and the oxyacetylene pressure butt welded rail joints did not fail. The flash butt welded rail joints failed prematurely due to grinding cracks away from the weld caused by heavy cold grinding as shown in Figs. 8 and 9. The drop test results of the rail as shown on Table 5 indicate that the rail met the AREA specification. Fig. 10 illustrates the effect of the drop test. As mentioned before, very few butt welded rail joints have withstood the standard drop test for rail. The structure of these fractures were noted to be fiberous. The results of the investigation of the S49 rail rolled from continuously cast blooms at the AAR Research Center and comparable results of the investigation by Dr. Janiche indicate that rail produced by this process is of equal quality to rail produced by the standard process. The results are surprising in this first attempt of producing rail in this manner. As the art of of continuous casting in reference to rail is advanced, all of the defects such as segregations will undoubtedly be eliminated. The economy of the process is predicated on the elimination of mold and teeming practices as well as soaking pits and primary mill installations. It is of interest to call attention to the last paragraph of the attached report which states that the UIC specification for rolling rail calling for a bloom cross section of at least 20 times larger than the rail cross section was not met in this case. In the above rolling, the ratio amounted to 15 to 1 in the case of the 30 d rail and 9 to 1 in the case of the S49 rail.

Association of American Railroads Technical Center ER-45, Aug. 1964, 6 pp, 13 Fig., 6 Tab.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

A1 096574
FIELD INVESTIGATION OF LONGITUDINAL FORCES IN A SANTA FE RAILWAY CONCRETE TRESTLE

This report contains a description and analysis of data obtained on a 660 ft long concrete trestle. The trestle contains 20 spans of 33 ft prestressed concrete box beams on reinforced concrete caps and columns. The height, base of rail to ground line, was uniform throughout at 26 ft. The purpose of this investigation was to determine the effect on the trestle of braking and traction as developed by a 278 ft long test train. Direct and bending stresses were obtained in the bents and axial stresses obtained in the rails at each abutment. Runs were made with both tight and loosened rail joints. In addition to the braking and traction runs, normal speed runs were made to determine stresses in the box beams and columns. On the basis of tests on this structure it may be concluded that: 1) The maximum longitudinal bent force measured was from braking and was 23 percent of the force computed on the basis of 15 percent of the test train bent reaction. 2) With tight rail joints the percentage range of total longitudinal braking force resisted by the bents was 41 to 56 percent, by the rails was 20 to 46 percent and by the backwalls apparently was 5 to 30 percent. 3) That portion of the longitudinal braking force transmitted to the bents was resisted by all bents of the bridge, acting as cantilevers, including those which carried no vertical live load. The distribution of longitudinal force was not uniform throughout the length of the bridge, but was highest for bents under the test train and gradually decreased with increase in distance from the test train. Loosening the rail joints at the ends of the bridge increased the longitudinal force resisted by the bents. 4) The maximum longitudinal force resulting from braking was 158 kips, which was 12 percent of the weight of the train. 5) The maximum longitudinal force resulting from traction of the locomotives was 76 kips, which was 15 percent of the weight on drivers. 6) Bending stresses were lower than those resulting from longitudinal forces. Also, bending stresses due to eccentricity were highest near the tops of the bents, while the stresses due to longitudinal forces were highest near the ground line. 7) For the test span, the arrangement of transverse tie rods, and the shear keys used was effective in producing a very nearly uniform distribution of the live load to each of the box beams comprising the span. 8) For the test span, the ratio of recorded to calculated strains due to bending, ranged from 0.83 to 0.94.

Conducted under sponsorship of AREA Committee 30-Impact and Bridge Stresses.

Association of American Railroads Technical Center ER-67, Aug. 1966, 22 pp, 46 Fig., 5 Tab.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

A1 096596
PROBLEMS ASSOCIATED WITH ROLLER TEST BENCH INVESTIGATIONS WITH VIEWS TO THE DETERMINATION OF THE RESPONSE OF FRICTIONAL CONNECTION BETWEEN WHEEL AND RAIL [Zur Problematik von Waelzpruefstandsversuchen im Hinblick auf die Ermittlung des Kraftschlussverhaltens Zwischen rad und Schiene]

The theorem associated with frictional connection and its most important parameters are discussed, with emphasis on the effects of location and time. The study is of importance in conjunction with plans for increasing the speed of railroad trains. [German]

Kretterk, O (Tech Hochsch, Germany) *Elektrische Bahnen* Vol. 45 No. 11, Nov. 1974, pp 258-264, 9 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

A1 097265
THE EFFECT OF UNIT TRAINS ON STRESS OCCURRENCES IN A CHICAGO AND NORTH WESTERN RAILWAY BRIDGE

This report contains a description and analysis of data obtained on the stringers and floor beams of a Chicago and North Western railway bridge to determine the frequency of occurrence of maximum stresses in these short span bridge elements which carry unit trains as well as regular service freight trains. The results may be summarized as follows: Track without rail Joint: 1. The frequency of occurrence of maximum stress was in the range of 3.0 to 4.0 ksi in the stringers and the floor beam under the combined loading of unit trains and regular service freights and was on the order of 2 to 9 percent of the total occurrence respectively. 2. The loaded unit trains comprised 5 percent of the total cars recorded and produced 46 percent of the maximum stress occurrences greater than 3 ksi in the floor beam and 7 percent in the stringers respectively. Track with Rail Joint: 1. The frequency of occurrence of maximum stress under combined loading of unit trains and regular service freights was on the order of 4 percent for the floor beam and 1 to 3 percent for the stringers of the total occurrence.

Conducted under sponsorship of AREA Committee 30-Impact and Bridge Stresses.

Association of American Railroads Technical Center ER-87, June 1969, 12 pp, 7 Fig., 6 Tab.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

A1 097297
THE CONTINUOUSLY SUPPORTED RAIL SUBJECTED TO AN AXIAL FORCE AND A MOVING LOAD

The recent practice of welding railroad rails to each other suggests that considerable axial compression forces may be induced in the rails because of a rise in temperature. This in turn may reduce the critical velocity for the track to the range of operational velocities of modern high-speed trains. The purpose of the paper is to demonstrate that this is indeed a possibility.

Kerr, AD (New York University, New York) *International Journal of Mechanical Sciences* Vol. 14 1972, pp 71-78, 5 Fig., 8 Ref.

ACKNOWLEDGMENT: International Journal of Mechanical Sciences
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL RP

A1 098079
THE FRACTURE TOUGHNESS OF CARBON-STEEL, ALLOY-STEEL AND HEAT-TREATED RAILWAY RAILS
The static and dynamic fracture toughness of standard carbon steel rail was determined using precracked Charpy bars. The static, fracture toughness was found to be higher than the dynamic fracture toughness across the entire range of railway operating conditions. Since rails are subjected to dynamic loading conditions, dynamic fracture toughness tests were conducted on specimens from alloy-steel and heat-treated rails in order to compare fracture properties. In addition, the standard British rail steel and two heat-treated grades of British rail steel were evaluated. It was found that carbon levels above 0.55 w/o did not affect fracture toughness while increasing silicon decreased fracture toughness in both high and low carbon rails. In line with earlier work, it was found that decreasing pearlite spacing increased fracture toughness. In addition, the effects of manganese, chromium and molybdenum are discussed.

Stone, DH
Association of American Railroads Technical Center, (R-014) R-163, Sept. 1974, 23 pp, 7 Fig., 1 Ref.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

A1 098080
THE EFFECTS OF MICROSTRUCTURAL VARIATIONS ON THE STRENGTH AND TOUGHNESS OF RAIL STEELS
An experimental program was carried out on fully-pearlitic rail steel to determine the effects of microstructural variations on tensile and impact properties. A heat treating schedule was developed to isolate the effects of prior austenitic grain size, pearlite interlamellar spacing, and to a minor extent, pearlite colony size. Grain size was varied by a factor of ten, and pearlite spacing by a factor of two. Room temperature yield strength increased monotonically with decreasing interlameller spacing, with the latter controlled by the transformation temerature and prior austenitic grain size. Charpy impact tests were performed to obtain an evaluation of toughness, and showed that toughness increased with decreasing grain size, and was largely independent of an influence of pearlite spacing. Dynamic fracture toughness values, (KID), obtained from instrumented impact testing of precracked Charpy bars, were compared with the standard Charpy results, and yielded Similar findings. Thus, it was found that strength and toughness are controlled by different microstructural parameters, and can be varied independent of each other to optimize service performance.

Hyzak, JM Bernstein, IM (Carnegie-Mellon University); Stone, DH
Association of American Railroads Technical Center, (R-021) R-168, Apr. 1974, 33 pp, Figs., 16 Ref.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

A1 098081
SUMMARY OF PERFORMANCE OF STANDARD-CARBON AND VARIOUS WEAR-RESISTANT RAILS IN TEST CURVES ON THE CHESSIE SYSTEM-SECOND REPORT
This report contains the summary of the second annual inspection of a service test installation of fully heat-treated, induction head-hardened, intermediate- manganese and standard control-cooled rail on the Chessie System. The field inspection is part of the cooperative effort on rail research of the American Railway Engineering Association, the American Iron and Steel Institute and the Association of American Railroads to observe and analyze those rails in curved track that display some potential for improvement in wear-resistance and retarding the onset of shelling. Measurements were made and recorded of curvature, superelevation and gage of four service test curves located near Oakland, Maryland. General track conditions were observed also. Rail head cross-section contours were taken and recorded of the 80 test rails contained in these curves. Rail wear has been calculated for the second year of service for the various types of rail in test.

Schoeneberg, KW
Association of American Railroads Technical Center, (R-057) R-171, Apr. 1975, 70 pp, 25 Fig., 1 Tab.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

A1 098699
TRACK ECCENTRICITIES CALCULATION
The file name is CURVBR. Auxiliary program to compute track eccentricities for various elements of bridge on curve, needed as input data for CARES steel bridge analysis program. Input: Curve radius, span length, back-wall to back-wall distance, panel number and length. Output: Eccentricities of track at middspan and at support and eccentricities for each bridge element.

Granitow, WW
Southern Pacific Transportation Company Mar. 1968

ACKNOWLEDGMENT: AREA (AREA 01-03-008)
PURCHASE FROM: Southern Pacific Transportation Company 1 Market Street, San Francisco, California, 94105

A1 098701
RAIL FAILURE SYSTEM
File name is ENRF. Computer program. The "Rail Failure" application is designed to compile statistics of all types of rail failures. The system employes two highly regimented input forms entitled "Rail Removal Order" and "Rail Insertion Report" which also serve to cause the appropriate physical action to take place. The system is modular and as such contains over twenty (20) separate programs re: data validity edits, maintenance and print routines which can provide monthly, year-to-date and yearly statistics, e.g.: (a) "Audigage and Reflectoscope; Detector Car; and Service Rail Failure Statement": a three part statement, i.e., a separate report for each potential input source, giving a complete description by Division and District of type of track, location of rail, position, grade, weight, mill, etc. of all failures reported. (b) "Rail Insertion Report Statement Covering Service and Detected Rail Removal Orders"; this statement lists all rail that has had a defect and that has been replaced by a new rail, angle bar repaired or taken out of service. (c) "Annual Report of Rail Failures, Service and Detected, in Rail of All Ages and Sections". (d) "Rail Removal Orders not Covered by Insertion Reports on the Eastern, Western and Coast Lines". Report will flag any removal order over 30 days old for which as insertion report has not been issued. (e) The "Transverse Fissure Rail Heat Statement": This statement provides listing of all transverse fissure heat failures over the system. The statement is written out in mill order and year rolled plus pertinent detail data. (f) The "Thermite and Butt Welded Joint Failure Statement"; This statement lists all thermite and butt welded rail failures by division, district, mile post, type track, weight or rail, mill and year rolled. Each report is year to date.

Robinson, RE
Atchison, Topeka and Santa Fe Railway 1972

ACKNOWLEDGMENT: AREA (AREA 02-01-001)
PURCHASE FROM: Atchison, Topeka and Santa Fe Railway 9th and Jackson Streets, Information Systems Department, Topeka, Kansas, 66628

A1 098702
RAIL STRESS CALCULATIONS-UNIT LOAD OF 1 KIP
For given rail sections, the program produces a table of rail stresses by inches from the load point up to 300 inches, for a unit load of 1 Kip. The stress values are shown for various values of the modulus of foundation, ranging from 400 to 3,000 lb/in.

Holt, RW
Canadian Pacific 1974

ACKNOWLEDGMENT: AREA (AREA 02-01-002)
PURCHASE FROM: Canadian Pacific Windsor Station, Montreal, Quebec H3C 3E4, Canada

A1 098703
RAIL STRESS CALCULATIONS FOR MULTIPLE LOADS
For a given set of rail sections, the program calculates stress values for given load configurations. For each loading, the rail stress is calculated under each axle and at the mid-point between axles. Also, for each rail section, the program calculates maximum equipment operating speeds within a stress safety limit of 35 Kips (30 Kips for C.W.R.) using maximum tension value found on the rail base.

Holt, RW
Canadian Pacific 1972

ACKNOWLEDGMENT: AREA (AREA 02-01-003)
PURCHASE FROM: Canadian Pacific Windsor Station, Montreal, Quebec H3C 3E4, Canada

A1 098704
ALLOWABLE GROSS LOADS ON VARIOUS RAIL SECTIONS
File name is RAILSTR. Computer Program. Application: Used as a one-time guide for determining the maximum allowable loading on various rail sections. Contains many assumptions and some "retrofit" based on actual loadings previously known to have been carried. This program computes the maximum allowable total gross weight for any type rail equipment with identical axle loads on 15 different rail sections. The theory and formulas are based on the rail acting as a continuous beam on a continuous elastic base (AREA proceedings of 1918, Vol. 19, pages 875-1058). Two moduli of elasticity of rail support are assumed for each rail section, one for "good roadbed and one for "poor" roadbed. Input consists of all information required about the axle configuration of the equipment being considered. Output includes documentation of the input, a listing of each rail weight and the assumed impact for each, and the allowable gross weight for good and poor roadbed for each rail section. This program makes many assumptions having to do with roadbed, impact, and unit stresses which may or may not be justified.

Alford, HT
Southern Railway System Apr. 1970

ACKNOWLEDGMENT: AREA (AREA 02-01-004)
PURCHASE FROM: Southern Railway System 99 Spring Street, SW, Atlanta, Georgia, 30303

A1 098705
RAIL AND TRACK CHARACTERISTICS PICKER PROGRAM
File name is Track Characteristics Master, Rail Defect Master, Derailment Master. Computer Program. The purpose of the rail and track characteristics picker program is to provide the information with which to develop the relationships between various rail and track characteristics and their correlation with rail failures, rail defects, and derailment frequency. The Track Characteristics Master contains rail type (jointed versus welded, kind of steel) weight, rail rolled and laid dates, history of surfacing dates, rail and track inspection and test data, grades, curves, load limits, and traffic density (tons per year) for all system track. Locations of rail failures, rail defects, and exceptions to track geometry standards found by testing and inspection are contained in the rail defect master. The derailment master contains pertinent data on all derailments. The rail and track characteristics picker program selects and prints out track locations from the track characteristics master with user-defined selection criteria; these can be minimums and/or maximum for any combination of the characteristics listed above. Up to 50 different combinations, i.e., cells in a matrix can be requested at one time. For each cell or specific request, the number of miles of track and the number of ton-miles is printed out. In addition for each cell, the progrm gives the types and numbers of rail defects and derailments reported over a time period selected by the user. Once relationships have been established, the program can be used for developing rail laying and timbering and surfacing programs, anchor and double spiking programs, problem area identification, budgeting, and other applications.

Brooks, BL
Southern Railway System 1974

ACKNOWLEDGMENT: AREA (AREA 02-01-005)
PURCHASE FROM: Southern Railway System 99 Spring Street, SW, Atlanta, Georgia, 30303

A1 098706
RAIL CONSIST AND HISTORY
File name is EN980930. Computer reporting program of all pertinent information on main line and branch track of Union Pacific Railroad. This track information can be reported to one one-hundredth of a mile accuracy for main line and branch track. The output shows milepost from, milepost to, track miles involved, degrees of curve, weight of rail, what company rolled the steel and type of treatment of the steel, the length of the rail in either 39 feet, 78 feet, or CWR, the year laid, work order number, if the steel was transposed, cropped, welded, or ground the size of the plates and year installed, million gross tons, of traffic over given segments of rail, passenger and freight speed allowable, and failures reported for the last two years broken done into three classes fo failure, then combined to show defects per mile per month. This Consist and History program evolves from four other basic programs plus a failed rail master. The four programs used to generate Consist and History are a tonnage master (EN9601), the description table (EN9602), an initial track master file (EN9603), and a revolving track master file (EN9805). EN9601 is a program which generates a tonnage table and a tonnage code. The railroad is broken down into segments depending on the million gross ton miles per year run over those segments. This program is fed into the initial track master file, EN9805, for a basis to calculate the million gross ton miles in the Consist and History report. The tonnage table for a given section of track has been calculated from our Way Bills to insure accuracy. EN9602 is a program which generates heading information for given sections of track (e.g. direction, and milepost limits). Also, it generates a cost center description so that the final report can be produced either by cost center or divisions. This program also genrates an order number, which we have assigned to help us segregate different parts of track. EN9601 and EN9602 are combined into EN9603 which begins to set up the initial master file. EN9603 at this time inputs all of the curve information of the railroad. EN9805 then adds the actual track relay information into the program.

Zednik, EV Jenkins, JW
Union Pacific Railroad Mar. 1970

ACKNOWLEDGMENT: AREA (AREA 02-01-006)
PURCHASE FROM: Union Pacific Railroad 1416 Dodge Street, Omaha, Nebraska, 68102

A1 098708
SLOW SPEED DERAILMENTS ON CURVES
File name is RECLIMB. Computer program measures, through simulation, forces tending to derail empty cars positioned near the head end of high powered heavy trains negotiating sharp curves, lugging down to slow speeds because of steep grades. Input consists of punched cards describing the track, train , speed, and throttle setting. The output details lateral and vertical forces promoting wheel climb and rail roll.

Stane, RA
Atchison, Topeka and Santa Fe Railway No Date

ACKNOWLEDGMENT: AREA (AREA 02-01-008)
PURCHASE FROM: Atchison, Topeka and Santa Fe Railway 9th and Jackson Streets, Information Systems Department, Topeka, Kansas, 66628

A1 098710
COMPUTE RAIL STRESSES
File name is RAILST. Computer program. Computer Rail Stresses for non-standard and in various road bed conditions. Input: Rail Wt. moment of inertia, Section Modulus, Foundation Modulus, No. of Units (LOCO or CAR), Class of LOCO, Series number, Length, Axle Load, spacing. Output: Stress in base of rail, Section for various speeds.

Luttrell, NW
Southern Pacific Transportation Company 1969

ACKNOWLEDGMENT: AREA (AREA 02-01-010)
PURCHASE FROM: Southern Pacific Transportation Company 1 Market Street, San Francisco, California, 94105

A1 098770
SLOW ORDER REPORT
The file name is SLOW 1. The computer program keeps all slow orders on file and lists them in various formats. The data base consists of location, mile post, condition of track, reason for slow order, and allowable speed for

Passenger and Freight Trains. Also recorded is travel time lost and estimated date of slow order release. The reports are generated to give management an idea about the condition of the railroad and priority of repair.

Glickstein, DL
Penn Central Transportation Company 1970

ACKNOWLEDGMENT: AREA (AREA 10-05-002)
PURCHASE FROM: Penn Central Transportation Company 6 Penn Central Plaza, Philadelphia, Pennsylvania, 19104

A1 099180
TRACK TRAIN DYNAMICS INTERACTION. SECOND CONFERENCE, VOLUME 2
These proceedings record the accomplishments of Phase I of the International Government-Industry Research Program on Track Train Dynamics by December 1974. The papers in this volume; Locomotive Tests and Model; Locomotive Curving and Hunting Models; Truck Component Characterization; Roller Bearing Characterization; Freight Car System Tests; Introduction to Truck Hunting, Curving and Ride Quality Problems; Truck-Carbody Model; Rock and Roll Report; Methodology for Car Characterization Via Simplified Mathematic Models; Mathematical Model; Characterizing Alignment Control; Lateral Stability Tests; Quasi-Static Lateral Train Stability Model; Introduction to L/V; L/V Testing; L/V Model; Vertical Train Stability Efforts; An Investigation of Factors Contributing to Wide Gage on Tangent Railroad Track; Application of Models to Investigate Operating and Component Parameters; Canadian Research Activities in Connections with Track-Train Dynamics; Introduction to Phase II.

Proceedings of an International Government-Industry Research Program on Train-Track Dynamics conference held at Chicago, Illinois, 4-6 December 1974. The cost of the 2 volumes is $20.00.

Association of American Railroads Technical Center 1975, 450 pp

PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616
DOTL RP

A1 125894
RAILWAY TRACK RESEARCH--THEORETICAL AND EXPERIMENTAL
Presents theoretical approach for determining stresses that result from vertical and lateral bending of track and stresses that act in the vicinity of the contact area between wheel and rail. The influence of thermal and residual stresses on track behavior is discussed and the dynamic deflections and stress resulting from the action of moving wheels and track irregularities are considered. The occurrence of track failure is analyzed on the basis of failure criteria and fatigue theories.

Hanna, AN
Portland Cement Association Bulletin RD030.01R, 1975, 15 pp, 30 Fig., 24 Ref.

ACKNOWLEDGMENT: Portland Cement Association
PURCHASE FROM: Portland Cement Association Old Orchard Road, Skokie, Illinois, 60076 Repr. PC
DOTL RP

A1 126451
SOME PROBLEMS OF RAILWAY OPERATION AT HIGH AXLELOADS
Long high-axle-load trains create cracking, shelling, crushing and corrugation of the rail head while weight transfer further accentuates the situation. "Worn" tire profiles can reduce contact pressure by 30 percent, but excess cant will increase crushing on the inner rail and axle-loading must be considered in relation to rail steel quality in the track. Three-axle locomotive power trucks set up higher lateral forces than two-axle types. Locomotive and car suspension characteristics must be considered in three planes.

Koffman, JL Fairweather, DMS *Rail Engineering International* Vol. 5 No. 4, June 1975, pp 156-161, 10 Fig., 18 Ref.

PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

A1 126970
STRESS OF THE SUBGRADE BY DIFFERENT TYPES OF SLEEPERS
The stress of the subgrade by prestressed-concrete sleepers BS 65 and BS 66 mainly used by the German Railways is different. Early measurements obtained with tests of the prestressed-concrete sleeper BS 72 showed that subgrade stresses are lower than for BS 62, BS 65 and for the timber sleeper, and are of the order of the values calculated. However, for a statistically safe statement the number of measurements is still insufficient. Therefore trials will be made in tests sections to obtain early results. [German]

Just, H Schmidt, E *DET Eisenbahntechnik* Vol. 23 No. 7, July 1975, pp 298-302

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: VEB Verlag Technik Oranienburgerstrasse 13-14, 102 Berlin, East Germany Repr. PC

A1 127627
STUDIES IN ENGINE SIMULATION
Present investigations for exhaust emission control, alternative fuels and combustion research have highlighted the possible advantages of an analytical approach to engine development and there are at present a large number of working computer simulations of internal combustion engines of one sort or another. This paper investigates the advantages or otherwise of engine simulation for various areas of development and describes a simulation exercise carried out at Queen Mary College of the University of London.

This is a paper from the 3rd Int'l Symposium held September 25-29, 1974. It was sponsored by Queen Mary College, Dept. of Mechanical Engineering, London.

Gravestock, RE (London University, England)
Intl Symp on Autom of Eng Test: Perf, Emiss & Diag Vol. 2 1974, 11 pp, 6 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

A1 127709
TRACK TESTING FOR VALIDATION OF COMPUTER MODELS
The purpose of the track stiffness test was to obtain data to assist in validation of the L/V and Lateral Train Stability models as an extension of earlier dynamic tests conducted at the Transportation Test Center. The first series of tests conducted was to obtain instrumented data on Vertical Track Modulus (VTM). The second series of tests were designed to collect data on rail to rail stiffness using various rail loads combined with and without static vertical loads. The third series of tests were conducted to measure lateral track stiffness with and without rail loads on a tangent segment of the track, on both left and right hand curves.

An International government-Industry Research Program on Train-Track Dynamics. Requests for this publication should be directed to J.G. Britton, Director of Operations, AAR.

Association of American Railroads AAR R-181, 1975, 20 pp, Phots.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

A1 127711
WIDE GAGE INVESTIGATION. VOLUME 1
One of the immediate problems in track maintenance and improvement is Gage Widening. Track lateral stability has been of great concern in recent years, both from the thermal load aspects involved in the use of continuous welded rail, and the train dynamics aspects of heavier equipment and rail, and the train dynamics aspects of heavier equipment and longer trains. Two particular problems attributed to track-train dynamics interactions are wide gage and rail rollover. For this investigation of wide gage in tangent track, an experiment was conducted on a stretch of track on the Union Pacific Railroad near Pocatello, Idaho. Eight sections of track with different combinations of tie plates and fasteners were installed by the Union Pacific at a site noted for recent wide gage problems. The purpose of the experiment was two-fold: first, as a track train dynamics study, to identify specific factors contributing to development of wide gage; second, as a fatigue test,

to evaluate the ability of various test sections to maintain gage under heavy, high speed traffic conditions. Measurements of gage and observations of track conditions at the test site were periodically collected by Union Pacific personnel, so that long term trends could be established. In addition, field experiments measured the dynamic response of the track to traffic during both summer and winter ambient conditions. Volume 1 presents a description of the wide gage experiments and results from the summer field experiment, during which 315 trains were recorded over a 3-week period about 1.5 million gross tons of traffic.

An International Government-Industry Research Program on Track-Train Dynamics. Requests for the publication should be directed to J.G. Britton, Director of Operations, AAR.

Association of American Railroads AAR-R178, 1975, 120 pp, 34 Fig., 13 Tab., 6 App.

PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

A1 128630
AN INVESTIGATION OF FACTORS CONTRIBUTING TO WIDE GAGE ON TANGENT RAILROAD TRACK
Wide gage--a fatigue failure of the track to maintain the nominal lateral distance between rail heads--is one of several modes of track failure on which the AAR-FRA-RPI-TDA Track Train Dynamics Program has focused attention. To investigate the generation of wide gage on tangent track, experiments were conducted to measure track dynamic response and long-term fatigue life of track sections on the Union Pacific Railroad in Idaho. Results of these experiments have defined the important factors in this mode of track fatigue.

This paper was contributed by the Rail Transportation Division of the ASME for presentation at the Winter Annual Meeting, Houston, Texas, November 30-December 5, 1975.

Ahlbeck, DR Harrison, HD Noble, SL (Battelle Columbus Laboratories)
American Society of Mechanical Engineers 75-WA/RT-1, July 1975, 9 pp, 9 Fig., 1 Tab., 5 Ref.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL RP

A1 128875
AXIALLY STRESSED RAILROAD TRACK ON AN ELASTIC CONTINUUM SUBJECTED TO A MOVING LOAD
The recent introduction of the welded railroad track raises the possibility that high axial compressive forces may occur in the rails due to constrained thermal expansions. This in turn may reduce the critical velocity of the track to within the operational velocities of present day trains. Recently the effect of axial forces upon the critical velocities of the track was analyzed by A.D. Kerr using the Winkler model for the base response. In this study, the effect of the axial compressive force on the critical velocity of the track is studied assuming for the base an elastic half space with inertia.

Labra, JJ (ENSCO, Incorporated) *Acta Technica* Vol. 22 No. 1-2, 1975, pp 113-129, 11 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

A1 129096
MEASUREMENT AND ANALYSIS OF THE IMPACTS APPLIED TO THE RAILROAD TRACK UNDER THE RUNNING VEHICLES
No Abstract. [Japanese]

Ono, K Ito, Y *Japan Society of Civil Engineers, Proceedings* 240, Aug. 1975, pp 93-102, 11 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

A1 129170
LIMITED ANALYSIS OF THE SAFETY IMPLICATIONS OF THE PRELIMINARY SYSTEM PLAN FOR RAILROAD CONSOLIDATION
This Study looks at the safety impact of the system changes resulting from the reorganization of the railroads of the Northeast and Midwest due to the reduction of ton-miles of freight transported by rail, the increase by truck, the elimination of rail-highway crossings, and the upgrading and improved maintenance of the system. The subjects considered are the rail system itself, interaction with its surroundings, and interaction with other types of transportation. Only the change in transport mode of freight originating or terminating on the lines scheduled for abandonment is considered. Tables comparing safety performance for different transport modes are included.

Sponsored by USRA.

Allen, JD
Battelle Columbus Laboratories, United States Railway Association Final Rpt. USRA-R-129, June 1975, 51 pp, 12 Ref.

Contract USRA-C-50039

ACKNOWLEDGMENT: United States Railway Association, NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-247368/4ST, DOTL NTIS

A1 129311
ARE FRA RAIL STANDARDS RESTRICTING RAIL-FLAW DETECTION
Since the FRA Track Safety Standards were implemented the number of defective rails has decreased, but the number of accidents due to rail failures has increased. The article tries to explain this discrepancy. A 10% increase in the availability of test equipment has resulted in only 6% increase in test mileage. In fact, Railway Companies lack the means of applying regulations concerning defective rails and this could lead them, in some cases, to put off inspection. Moreover, there is no flexibility in existing standards in so far as the priority removal of potentially hazardous defects known to be in the rail is concerned. The article discusses the need to tighten regulations or make them more flexible.

Railway Age Vol. 176 No. 11, June 1975, pp 42-43

ACKNOWLEDGMENT: International Union of Railways, BD
PURCHASE FROM: XUM Repr. PC
DOTL JC

A1 129312
MAKING BAD TRACK GOOD: WHAT ARE THE ECONOMICS
Reduced maintenance costs are not the only economy to be expected from track repair. Other aspects must be taken into consideration: reduction in the number of accidents, in supervision and routine maintenance costs, higher train speeds, increase in car utilization and better quality of service. No exhaustive study on this subject has ever been carried out, but the article gives an outline of the degradation and repair process for a track over an eight-year period, with quantified assessments by heading of expenditure and foreseeable economics.

Merwin, HD *Railway Age* Vol. 176 No. 11, June 1975, pp 36-37, 2 Fig.

ACKNOWLEDGMENT: International Union of Railways, BD
PURCHASE FROM: XUM Repr. PC
DOTL JC

A1 129403
COUPLED VEHICLE/TRACK DYNAMICS
Dynamic coupling occurs between a railway vehicle and the track due to the reaction forces acting between the wheels and the track, and the elasticity of the track and the foundation. It has become apparent that track elasticity can influence the dynamic behaviour of the railway vehicle, yet in most of the research work in the area of railway vehicle dynamics reported so far, the track is regarded simply as a rigid structure, providing the reactions to the loads of passing vehicles. In this paper the models used for the analyses of the vehicle dynamics (on rigid track) and for the coupled vehicle/track dynamics are described. The equations of motion are derived, and the results obtained for the coupled vehicle/track model are presented and compared with those obtained for the case of an infinitely rigid track. Particular empahsis is on the lateral stability and the response to vertical track irregularities.

Maraghy, WHE Dokainish, MA *Vehicle System Dynamics* Vol. 4 No. 2-3, 1975, pp 203-207

ACKNOWLEDGMENT: International Union of Railways, BD
PURCHASE FROM: ESL Repr. PC, Microfilm

A1 129411
ELASTICITY OF RAIL STRETCHES IN RELATION TO THE PARAMETERS OF THE FASTENINGS [Uprugost' rel'sovyh nitcj v zavisimosti ot parametrov promezutocnyh skreplenij]
The article examines the theoretical correlation between, on the one hand, the rigidity parameters of rail fastenings during the intermittent actions of loads on the bearings and, on the other, the elasticity of the track during wheel stresses on the rail segment. Results are given concerning the experimental research into these problems. On the basis of tests with the fastening devices both in laboratory and under operating conditions, the theoretical research explained in the article provides an overall insight of wheel action, which is vital when defining the optimum parameters of fastenings. [Russian]

Kupcov, VV *Vestnik Vniizt* Vol. 34 No. 3, 1975, pp 28-34, 5 Fig., 2 Tab., 7 Ref.

ACKNOWLEDGMENT: International Union of Railways, BD
PURCHASE FROM: Vestnik Vniizt Moscow, USSR Repr. PC

A1 129422
TROUBLED TRACK
This article puts the industry in perspective, noting deferred maintenance is not confined to the publicized difficulties of the Northeast railroads. Over the past two decades railroads have worked themselves into an overwhelming imbalance with equipment money being available and investments having been primarily above the rail. Money-starved track has then been punished by higher speeds and heavier axle loading. Government could decide it is time to equalize the "public cost" for transportation right-of-way betterment. Technology is of little use unless the railroad right-of-way is fit to serve contemporary needs and railroad personnel learn to use technology to best advantage.

Sillcox, LK *Bent* Vol. 66 No. 3, June 1975, pp 10-16, 2 Phot.

PURCHASE FROM: Tau Beta Pi Association, Incorporated P.O. Box 8840, University Station, Knoxville, Tennessee, 37916 Repr. PC

A1 129787
EFFECT OF RESIDUAL STRESSES IN HARDENED RAILS ON THE FORMATION AND PROPAGATION OF STRESS FISSURES DUE TO CYCLIC STRAINS [Vlijanie ostatocnyh naprjazenij V Zakalennyh rel'sah Vozniknovenie i rasprostranenie ustalostnyh trescin pri Cikliceskom izgibe]
The authors have reached the following conclusions: The railhead, as a result of heat treatment or cold straightening, can develop a considerable drop in the stress limit, a drop in the number of cycles completed before stress fissures occur, a drop in the number of cycles completed during the stress fissure propagation period, a reduction in the critical size of each stress fissure, or a drop in the curability of hardened rail, 2) the residual compression stresses which occur in the rail head accentuate the above characteristics. [Russian]

Sur, EA Konjuhov, AD *Trudy CNII MPS: Ostat naprja i Proc Zelez relsov* Vol. 491 1973, pp 29-37, 1 Tab., 13 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Trudy CNII MPS: Ostat naprja i Proc Zelez relsov Moscow, USSR Repr. PC

A1 129796
RESIDUAL STRESSES IN SERIES P65 HARDENED RAILS [Ostotocnye naprjazenija v Zakalennyh relsah P65]
This article gives the results of a study on residual stresses in core hardened rail produced by the Nijni Taghil (Central Urals) steel combine. The authors discuss new rail, as well as rail over which trains of various tonnages have been hauled. A comparison of diagrams showing residual stresses in new rail and those in rail over which 152 and 235 million gross tonnes have been hauled show that, for the most part, there is no difference between the location of these stresses in the web and the rail flange of new rails, and those in rails which show wear. However, the study showed that the type and extent of residual stress on the contact area of the rail head is modified when trains run on these rails. Traction stresses of 8.1 kgf/mm2 were recorded on the rail head of new rails, whilst stresses of 4.5 and 3.1 kgf/mm2 were recorded on rail heads over which 152 and 235 million gross tonnes had been hauled. [Russian]

Sahunjanc, GM Nikonov, AM *Trudy CNII MPS: Ostat naprja i proc zelez relsov* Vol. 491 1973, pp 27-29

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Trudy CNII MPS: Ostat naprja i proc zelez relsov Moscow, USSR Repr. PC

A1 129834
RESIDUAL STRESSES IN RAILS [Ostatocyne naprjazenija v zeleznodoroznyh relsah]
The article examines the effect of residual stresses on rail breaks along the length of the web and on stability during rupture tests on core hardened rail: the aim of decreasing residual stresses in core hardened rails and the formation of residual stresses in the rail head can be achieved by making further improvements to the cold hardening process; residual stresses do not have any substantial effect on stability during rupture tests on rails when the break begins because of a drop hammer failure and, before the break occurs, the rail changes considerably; this is precisely what happens in tests on core hardened rails when the temperature changes from-60 degrees to 20 degrees C. [Russian]

Konjuhov, AD *Trudy CNII MPS: Ostat naprja i proc zelez relsov* Vol. 491 1973, pp 10-27, 3 Tab., 11 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Trudy CNII MPS: Ostat naprja i proc zelez relsov Moscow, USSR

A1 129839
USE OF THE MAGNETIC ANISTROPIC METHOD TO ASSESS THE STRESSES OF TEMPERED RAILS [O vozmoznosti ispolzovanija metoda magnitnoj anizotropii dlja ocenki ostatocnogo naprjazennogo sostojanija zakalennyh relsov]
The most practical method of determining residual stresses without damaging the rail is by magnetic anisotropy which makes it possible to obtain information rapidly and without difficulty. A special device called "Pion" was built in the Soviet Union for application of this method. It is made up of a magnetic core in the form of a cross with a coil which generates a magnetic field in the centre and measurement coils (2 to 5) on the sides making up the arm of the bridge. The article gives the results of tests on certain types of rail in the Soviet Union using this device. [Russian]

Sahov, VI Konjuhov, AD *Trudy CNII MPS: Ostat naprja i proc zelez relsov* Vol. 491 1973, pp 56-65, 2 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Trudy CNII MPS: Ostat naprja i proc zelez relsov Moscow, USSR Repr. PC

A1 129849
INFLUENCE OF THE CONCRETE CONDITIONS OF CONTACT BETWEEN WHEEL AND RAIL ON THE RUNNING OF VEHICLES OVER RAILWAY LINES [Einfluss konkreter Rad-Schiene Beruhrungsverhaltnisse auf das Laufverhalten von Schienenfahrzeugen]
The authors speak of the effects of a number of different wheel, and rail profiles on the stability of rolling stock, and also of the influence on such stability of the wheel/rail friction coefficient. From the studies carried out, it transpires that a wheel profile close to the shapes created by natural wear between wheel and rail is more advantageous than conical profiles as regards maintenance and running stability. [German]

Hanneforth, W Fischer, W *DET Eisenbahntechnik* Vol. 23 No. 9, Sept. 1975, pp 409-412, 1 Tab., 11 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: VEB Verlag Technik Oranienburgerstrasse 13-14, 102 Berlin, East Germany Repr. PC

A1 130812
LONGITUDINAL FORCES IN A TRAIN WHEN TAKING A CONVEX CURVE CONNECTING WITH A LONGITUDINAL SECTION [Prodolnye sily v poezde na soprjazenii ogranicivajuscih uklonov vypuklyh ucastkov profilja puti]
The article studies the profiles to be given to these connecting curves, and their effects when they are taken by heavy trains under traction conditions. Recommendations are made for reducing the dynamic longitudinal forces of quasi-static nature appearing in the couplings of such trains. [Russian]

Versinskij, SV Sakovic, LA *Vestnik Vniizt* Vol. 34 No. 7, 1975, pp 34-38, 3 Tab., 4 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Vestnik Vniizt Moscow, USSR Repr. PC

A1 130827
THE DEVELOPMENT OF ANALYTICAL MODELS FOR RAILROAD TRACK DYNAMICS
A renewed interest during the past decade in high-speed rail transportation has underlined a need for better understanding of the dynamic interaction between vehicle and track. Speeds in excess of 160 km/h tax the presently used rail-tie-ballast track structure in terms of long-term stability and required track accuracy. Hence, the investigation of improved structures with better dynamic response characteristics and greater stability has followed in the wake of improved high-speed railcar design. This paper presented some recent developments in analytical modeling of railroad track structures for the study of vehicle-track dynamic interaction by computer simulation. Field measurements taken on main-line track of several North American railroads were used to evaluate the accuracy and define the necessary modifications of the computer model. Predictions of better overall system response and long-term stability from this computer model have aided in the preliminary design of several new track structures which are currently undergoing field evaluation.

This article is extracted from Symposium on Railroad Track Mechanics, RRIS 01 130826, Publication 7602. The complete volume is $3.75, Microfiche $2.25.

Ahlback, DR Meacham, HC Prause, RH (Battelle Columbus Laboratories)
Princeton University 76-TR-1, Oct. 1975, pp 21-22

Contract DOT-FR-54175

ACKNOWLEDGMENT: Princeton University
PURCHASE FROM: NTIS

DOTL RP

A1 130834
STRESSES AND BEHAVIOR OF RAIL TRACKS DURING THE PASSAGE OF TRAINS TRAVELLING AT VERY HIGH SPEEDS; STANDARDS ADOPTED BY THE SNCF FOR ITS FUTURE VERY HIGH SPEEDS LINES (250/300 KM/H)
On the Paris-Madrid line in Southwest France, between Bordeaux and Dax, there is a section on which there are two straight stretches of 20 to 45 km, separated by a curve with a radius of 2850 meters. This SNCF line allows tests to be carried out at speeds of over 250 km/h. Since August 1972, two prototype trains, the TGV 001 turbotrain, and the Z 7001 electric motor train, have been traveling four times a day at speeds between 250 and 320 km/h. This paper summarized the knowledge acquired in France as the result of systematic tests carried out at those speeds in anticipation of the new Paris-Sud-Est line on which trains will travel at speeds of over 250 km/h. Although the problems are not yet completely solved, they are at least now defined very clearly, and none of them is of a fundamental type. The doubts raised a few years ago now appear to be baseless, at least for speeds of up to 300 km/h.

This article is extracted from Symposium on Railroad Track Mechanics, RRIS 01 130826, Publication 7602. The complete volume is $3.75, Microfiche $2.25.

Prud'Homme, A (French National Railways)
Princeton University 76-TR-1, Oct. 1975, pp 29-31

Contract DOT-FR-54175

ACKNOWLEDGMENT: Princeton University
PURCHASE FROM: NTIS

DOTL RP

A1 131244
RECORDING AND ANALYSING TRACK IRREGULARITIES [Die Registrierung und Analyse von Gleisunregelmaessigkeiten]
The author discusses the possible procedures for recording track irregularities, and methods of analysing this data. He then explains the relationship between the duration of the analysis and the evaluation errors to be expected, indicating the respective analytical reports both for analogical and digital evaluation. He also gives the results from the testing vehicle running on the lines of the DB and other railways. Finally, the article explains a procedure based on power spectral density, using multivariable regression analysis. [German]

Krettek, O *Glasers Annalen ZEV* Vol. 98 No. 11, Nov. 1975, pp 326-334, 1 Tab., 14 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

A1 131258
METHOD FOR THE RAPID MEASUREMENT OF WHEEL AND RAIL WEAR BY MEANS OF RADIOACTIVE ISOTOPES [Kurzzeitverschleiss-Messverfahren an Rad und Schiene mit Hilfe radioaktiver Isotope]
No Abstract. [German]

Grohmann, HD *DET Eisenbahntechnik* Vol. 23 No. 12, Dec. 1975, pp 560-62, 1 Fig., 8 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: VEB Verlag Technik Oranienburgerstrasse 13-14, 102 Berlin, East Germany Repr. PC

A1 131263
WEAR ON EXTERNAL SURFACES OF WHEELS AND RAIL DUE TO FRICTION [Verschleissvorgang im Grenzschichtbereich der Reibpaarung Rad/Schiene]
The stresses borne by rail and wheel elements are analysed on the basis of several fundamental definitions of wear by Fleischer. A number of studies were carried out on plastic deformation, running surfaces and wear characteristics. Partial oxidation can occur when the external surfaces of wheels or rails are deformed because the materials come into contact with the surrounding atmosphere. Oxidised metallic particles are then worn away. Wear is often affected by the characteristics of the process itself or by layers of martensite which are produced by shoe brakes. [German]

Pigors, O *DET Eisenbahntechnik* Vol. 23 No. 11, Nov. 1975, pp 495-498, 5 Fig., 12 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: VEB Verlag Technik Oranienburgerstrasse 13-14, 102 Berlin, East Germany Repr. PC

A1 131272
EFFECT ON TRACK OF HEAVY AXLE LOADS
The author recalls and makes reference to numerous studies on the problems of damage to rails caused by heavy axle loads. He quotes recommendations developed by AREA with regard to permissible axle loads in relation to wheel diameter and vehicle speed, and the ultimate tensile strength of rail steels. He mentions the experience of Australian Railways operating meneral lines with block- trains made up of very heavy wagons. He then gives formulae and tables in which the track maintenace cost, as per traffic unit, is expressed in relation to various variables and parameters: speed, axle weight on rail, age of ballast, linear weight of rail, curve radius, etc.

International Engineering Conference Paper. 150th Anniversary of passenger railways.

Gordon, ER Brew, JR
Institution of Mechanical Engineers Sept. 1975, pp 40-43, 3 Tab., 14 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: ESL Repr. PC, icrofilm 3

DOTL JC

A1 131280
THE EFFECT OF LATERAL RESISTANCE ON TRACK BUCKLING ANALYSIS
A model which exhibits the essential features of track buckling mechanisms is used. It is represented by four bars constrained at the interconnecting joints by spiral springs. The bars deform axially according to Hooke's law and the law of linear thermal expansion, but are "rigid" in bending. The author analyses the mathematical model according to three different assumptions. He compares the results obtained and draws conclusions as to the critical temperature at which buckling can occur and the assumption which is most representative of track buckling.

Kerr, AD *Rail International* Vol. 7 No. 1, Jan. 1976, pp 30-38, 1 Fig., 16 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

A1 131302
STUDY INTO THE STABILITY OF EMPTY CARS RUNNING AT HIGH SPEEDS OVER LINE SECTIONS WITH ARTIFICIALLY-CREATED IRREGULARITIES [Issledovanie ustojcivosti prooznih gruzovyh vagonov pri povysennyh skorostjah na ucastkah puti s iskusstvennymi nerovnostjami]
The article gives the results of dynamic tests with empty cars worked at up to 300 km/h; then tests took place in a test yard, over line sections with artificially- created irregularities. Proof is given of the possibility for freight cars equipped with MT-50 trucks to run at speeds of up to 100 km/h. The creation of irregularities on the track is an efficient and promising method for studying the dynamic properties of rolling stock. [Russian]

Versinskiji, SV Kondrasov, VM *Vestnik Vniizt* Vol. 34 No. 3, 1975, pp 3-8, 1 Tab., 6 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Vestnik Vniizt Moscow, USSR

A1 131530
TEST TRAIN PROGRAM, SEVENTH PROGRESS REPORT
This report describes the progress of the Rail Engineering and Test Support Program during the period July 1, 1974 to June 30, 1975. Primary emphasis of the program was placed on the establishment of a viable operational track measurement capability. This emphasis resulted from efforts to meet the requirements of the National Track Inspection Program under implementation by the FRA's Office of Safety. Also covered in this report are special tests performed by the FRA test cars; operational improvements to the test car track measurement instrumentation; improvements in data-processing techniques that permit an analysis of track conditions in a more timely and more efficient manner; and highlights of other efforts performed under the Rail Engineering and Test Support Program.

Gunn, W
ENSCO, Incorporated, (DOT-FR-75-13) Prog. Rpt. FRA-ORD&D-76-140, June 1975, 140 pp, 28 Fig., Tab., 2 App.

Contract DOT-FR-54174

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-261186/AS, DOTL NTIS

A1 131634
HI-RAIL TRACK GEOMETRY CAR
The purpose of this paper is to describe the track geometry vehicle presently operating on the Louisville & Nashville Railroad. The reasoning behind this unique approach to the measurement of track geometry was based on the experience of operating gage measuring equipment on dissimilar types of vehicles and on fulfilling specified objectives set forth at the outset of our track geometry program.
Presented at the 1976 Joint ASME/IEEE Railroad Technical Conference, Chicago, Illinois, April 6-8, 1976.

Borntraeger, JE Hopkins, GE
Institute of Electrical and Electronics Engineers C76 456-9 IA, Jan. 1976, 4 pp, 1 Fig.

ACKNOWLEDGMENT: ASME, IEEE
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL RP

A1 132206
WIDE-GAUGE RESEARCH LEADS TO A NEW STANDARD ON UP
Following research on the causes of wide gauge, Union Pacific has adopted as standard a 16-inch tie plate with a 1:30 cant. Gauge widening is a problem common on high-speed,heavy-duty mainline track and this phenomenon was investigated on UP as part of the industry's Track Train Dynamics Research Program. Tie-plate cant varied from standard 1:40 down to 1:14. The 1:30 design finally chosen is to reduce the incidence of rail rollover and to reduce overloading on the gauge side so that the wear pattern was down the center of the rail.

Railway Track and Structures Vol. 72 No. 3, Mar. 1976, 5 pp

PURCHASE FROM: XUM Repr. PC
DOTL JC

A1 132958
EFFECT OF HEAVY AXLE LOADS ON TRACK
Sessions included track developments, suspension developments and track/-train interaction. Eighteen papers were presented by authors from the United States, Canada, Mexico and Europe.
Proceedings of the 12th Annual Railroad Engineering Conference held at Pueblo, Colorado, October 23 and 24, 1975. Individual papers are RRIS Numbers 02 132959, 01 132960, 01 132961, 02 132962, 01 132963, 01 132964, 03 132965, 03 132966, 03 132967, 03 132968, 03 132969, 24 132970, 02 132971, 02 132972, 18 132973, 00 132974, 02 132975, and 00 132976.

Federal Railroad Administration FRA OR&D 76-243, Oct. 1975, 174 pp, Figs., Refs.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-252968/AS, DOTL NTIS, DOTL RP

A1 132962
OBSERVATIONS ON THE EFFECT OF HEAVY WHEEL LOADS ON RAIL LIFE
The Bessemer and Lake Erie Railroad has operated 90-59 open-top cars since 1931 and has some statistics on rail wear and rail life under the stresses imposed by such equipment. Rail life on tangent track has been around 440 million gross tons for jointed rail and beyond 650 million gross tons for continuous welded rail. Statistics are also available for Curvemaster and controlled cooled rail on curves. On newer ore carrying railways, rail life appears to be appreciably shorter. Among possible reasons are the bidirectional operation of loaded trains on B&LE, the mixing of various capacities of cars, and the predominance of traffic on solid, rather than roller-type, journal bearings.
Proceedings of the 12th Annual Railroad Engineering Conference held at Pueblo, Colorado, October 23-24, 1975. The complete volume is RRIS 02 132958, Pricing is for the complete volume: Repr. PC $6.75, Microfiche$2.25, NTIS PB-252968/AS.

Rougas, M (Bessemer and Lake Erie Railroad)
Federal Railroad Administration FRA OR&D 76-243, Oct. 1975, pp 41-44, 5 Fig.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS
DOTL NTIS, DOTL RP

A1 132963
EFFECT OF HEAVY AXLE LOADS ON RAIL AND TIES
The Quebec North Shore and Labrador Railway was built in 1953 to handle iron ore from mines 350 miles north of the St. Lawrence River. Trains of up to 280 cars with five locomotive units are operated. This presentation reports the maintenance experience on track which carries up to 50 million net tons annually, and has handled almost 700 million gross tons since opening. Among the findings: line, surface and gauge must be maintained even on tangent track; corrugated rail develops quickly on grades and curves and must be countered promptly; joint bars must be kept tight and rail ends restored; oilers are all-important on curves.
Proceedings of the 12th Annual Railroad Engineering Conference held at

Pueblo, Colorado, October 23-24, 1975. The complete volume is RRIS 02 132958, Pricing is for the complete volume: Repr. PC $6.75, Microfiche$2.25, NTIS PB-252968/AS.

Monaghan, BM (Iron Ore Company of Canada)
Federal Railroad Administration FRA OR&D 76-243, Oct. 1975, pp 45-48, 9 Fig.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS

DOTL NTIS, DOTL RP

A1 132974
EFFECT OF HEAVY AXLE LOADS ON BRIDGES
It is estimated there are 3500 miles of bridges on American railroads; replacement cost is estimated at $10 billion. The problem is not the spectacular, long-span steel bridges, but the many structures built many years ago for much lighter loading. As reconstruction is deferred, more speed and weight restrictions will have to be imposed; modern equipment may have to be prohibited from many lines. With scarce capital it will be many years before the frail steel spans of 1880-1900 are replaced. The Cooper E-60 rating permitted by the AAR Mechanical Division does not produce cars capable of unrestricted operation over the rail network. Timber trestles are particularly vulnerable to closely spaced axles.

Proceedings of the 12th Annual Railroad Engineering Conference held at Pueblo, Colorado, October 23-24, 1975. The complete volume is RRIS 02 132958, Pricing is for the complete volume: Repr. PC $6.75, Microfiche$2.25, NTIS PB-252968/AS.

Noyszewski, M (Illinois Central Gulf Railroad)
Federal Railroad Administration FRA OR&D 76-243, Oct. 1975, pp 133-138, 9 Fig.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS

DOTL NTIS, DOTL RP

A2 033072
RAILWAY TRACK STRUCTURE FOR HIGH-SPEED TRAIN
The article discusses problems of railway track structure for high speed trains. The topics include axial pressure of long welded rail, rail welding, the ignition of creosoted bridge sleepers, the impact coefficient of steel bridges, and a rail defect inspection car.

Satoh, Y (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 7 No. 1, Mar. 1966, pp39-41

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-007)
DOTL RP

A2 033083
WHEEL-RAIL ADHESION
The subject of adhesion between locomotive wheels and rails has been an area of vital interest to locomotive manufactures and to the railroads. Horsepower of internally powered locomotives has continued to increase significantly, thereby providing more power for traction. The trend of increasing horsepower has been the product of progress in technology and engineering development. Wheel-to-rail adhesion within the lower speed range has been a limiting factor in tonnage ratings for locomotives in drag service on U.S. railroads. Factors Affecting Adhesion are: (1) Vehicle Factors, (2) Track Factors, and (3) Contact-Area Common Factors. Additional discussion of the conclusions follows.

Marta, HA Mels, KD (General Motors Corporation) *ASME Journal of Engineering for Industry* 68-WA/RR-1, Aug. 1969, pp839-854, 69 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-019)
DOTL RP

A2 033084
FRICTION CREEP PHENOMENON OF ADHESION BETWEEN STEEL WHEELS AND RAILS
The purpose of this article is to present a summary of the laboratory and field tests which have been conducted by EMD to evaluate the friction and creep phenomenon of adhesion between steel wheels and rails. The available adhesion coefficient between the driven wheels and rail is a primary factor in determining the amount of power that can be converted to tractive force by the locomotive. For this reason, experimental investigations into rolling contact friction-creep phenomenon were conducted on model equipment in 1968 along with full scale field tests on an SD-45 model locomotive.
Conference sponsored by the American Society of Mechanical Engineers and the Institute of Electrical and Electronics Engineers.

Marta, HA Mels, KD Itami, GS (General Motors Corporation) *ASME/IEEE Railroad Conference* 1971, 35pp, 31 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-020)
DOTL RP

A2 033091
STRESSES AT RAIL JOINTS AS INFLUENCED BY BOLT HOLES
The failures of rails caused by bolt holes of joints (end breaks) have recently come to occupy the majority of rail breaks. In order to prevent such breaks it was customary to reduce the diameter of the bolt holes or to keep the holes away from the rail ends. The present writers conducted experiments upon joints of the structure actually used for 50 kg/m rails, bolts of different diameters, rails with bolt holes of different intervals and fishplates with bolt holes of different diameters and different intervals with an aim of ascertaining what type of a fish joint is the most durable.

Koyama, K Sasaki, N (Japanese National Railways) *Railway Technical Research Institute* Vol. 1 No. 3, Sept. 1960, pp45-49

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-028)
DOTL RP

A2 033093
EXPERIMENTAL STUDIES OF CONCRETE-PAVED RAILWAY TRACK
A concrete-paved railway track is proposed as a tentative plan to make a radical change in the construction of track that can cope with excessive traffic volume presently imposed on major lines of the Japanese National Railways and with super-high speed expected on the projected new Tokaido line. A tentative track 10m long was laid within the premises. Various kinds of strength tests and measurements were carried out on the track to explore the possibilities of adopting such a track in the future.

Hoshino, Y Sato, Y Miura, I (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 1 No. 3, Sept. 1960, p68

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-030)
DOTL RP

A2 033095
RAILWAY TRACK VIBRATION INDUCED BY TRAIN MOVEMENT
The railway track under train movement suffers progressive deterioration, which is equivalent to multiplication of repeated train load and vibration induced. The paper presents the results of measurements on the aggravated track vibration and the comparative study of track vibration on the concrete ties and on the traditional ties. Ballast acceleration in two sections laid with concrete ties using tie-pads of 110 t/cm spring constant averaged 23 percent and 35 percent respectively, less than that of the section laid with common ties. The value in a section laid with concrete ties using tie-pads of 250 t/cm spring constant averaged 24 percent larger. There is a conspicuous difference in occurrence distribution of acceleration at the welded joint.

Sato, Y Toyoda, M Kobayashi, S (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 1 No. 4, Dec. 1960, pp28-31

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-032)
DOTL RP

A2 033109
SOME DATA ON DAMAGE TO MANGANESE STEEL CROSSING IN SERVICE
The failure of manganese steel crossings because of tranverse cracks at head and tail ends is investigated. The cracks tend to re-occur even though corrective welding has been attempted. Failure tends to occur after 100 million tons are carried, repair welding is not adequate. Suggested cause is insufficient design strength or incomplete removal of cavities in repair welds.

Ooi, I Kimata, N (Japanese National Laboratory) *Railway Technical Research Institute* Quart Rpt Vol. 11 No. 3, Sept. 1970, pp167-168

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-048)
DOTL RP

A2 033116
DEVELOPMENT AND USE OF A TRACK QUALITY INDEX
Discusses the factors used to make up the track quality index. These are the items which are measured by the Southern Railway's track inspection car. The factors measured include gauge, twist, surface, superelevation, and alignment. The measurement of these factors is an aid in scheduling and controlling track maintenance.

Crane, LS Sullivan, JH Kaelin, CR (Southern Railway) *American Society of Mechanical Engineers Trans* Jan. 1969, pp1-10

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-055)
DOTL RP

A2 033120
RAIL WEAR LIMITS
The Southern Railway, after reviewing rail wear conditions which were thought to have been a principal contributing factor to derailments, found that approximately 40 percent of loss of rail head wear for 130-132 lb. rail was the amount beyond which such derailments had occurred. Limits to show the top wear limit and side wear limit to be allowed for the different rail sections for various classes of track. The corresponding limits for the smaller sections of rail were pretty much a matter of judgment, using the limits for the 130-132 lb. sections as a guide.
Private Communication

Magee, GM (Southern Railway) June 1971, 4pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-059)
DOTL RP

A2 033126
EXPERIMENTS ON LOCAL STRESSES OF RAILS IN PRINCIPAL USE IN SEVERAL COUNTRIES
There is room for improvement in the current JNR standards for rail section with respect to their effectiveness as beam members and also to their pattern of distributed local stress. The project of the new Tokaido trunk line construction now being pushed forward has prompted JNR to the renewed design of its rail section from various angles since 1958. Laboratory and field tests were conducted for contributing to a better design to the two tentatively designed rail sections of 67 kg/m for the new trunk line and to the current 50 kg/m one, as well as to the five sections of imported rails.

Sasaki, N Kakisawa, M *Railway Technical Research Institute* Quart Rpt Vol. 2 No. 3, Sept. 1961, pp34-39

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-066)
DOTL RP

A2 033127
RAILS OF NEWLY DESIGNED SECTIONS
Rail section should be reformed and anti-corrosion measures taken to prevent rail fractures. Discussion of factors considered to improve rail characteristics include fundamental studies, disadvantages of current rail, specifications of new rail sections-50N, 40N, and T50 for Tokaido Trunk line.

Sasaki, N *Railway Technical Research Institute* Quart Rpt Vol. 2 No. 4, Dec. 1961, pp32-37

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-067)
DOTL RP

A2 033132
TECHNICAL PROCEEDINGS OF THE ENGINEERING EXCHANGE FORUM
Papers from a railroad forum which discuss car design trends, high speed track design, roll and wheel lift tests, coupling requirements. Also included with the papers are comments and questions concerning the papers presented at the forum.

Engineering Exchange Forum Sept. 1966, 53pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-072)
DOTL RP

A2 033133
FORMULAS FOR LENGTH OF TRANSITION SPIRALS
A series of mathematical formulae relate the determination of a comfortable rate of lateral acceleration to the forces required to change the direction of a locomotive or cars from a straight to a curved path.
Private Communication

Ferguson, R (Association of American Railroads)
Association of American Railroads Feb. 1957, 2pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-073)
DOTL RP

A2 033138
THE DESIGN OF 60 KG RAIL AND FISH-PLATE
A new type rail for a trunk line has been designed. The weight of this rail is 60.8 kg/m. The process of designing this rail and the fish-plate is described. This rail is head free type in cross section.

Watanabe, K Sugiyama, T (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 10 No. 2, June 1969, pp71-72

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-078)
DOTL RP

A2 033140
AUTOMATIC SUBMERGED-SLAG WELDING OF RAILS (REPORT 3)
Article details the specifications for a prototype rail welding car as developed to weld long rails in the field. Extracted from a larger article which discusses technique of welding rails and tests for weld failure.

Oi, I Hakamada, S (Japanese National Railways); Muramoto, T *Railway Technical Research Institute* Quart Rpt Vol. 10 No. 3, Sept. 1969

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-080)
DOTL RP

A2 033147
GAS-SHIELDED ARC WELDING OF HIGH-MANGANESE STEEL RAILS
In the present study the aim was to realize automation of the welding of manganese crossings which has been conventionally executed by manual arc welding process, thereby sharply raising the welding efficiency and obtaining sound welds with good mechanical properties and free from welding defects. As a basic step to automatic welding of manganese crossings, the case of automatic welding of cast high-manganese steel rails is treated here.

Ando, S Uchida, A Kimata, N (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 8 No. 1, Mar. 1967, pp11-17

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-101)
DOTL RP

A2 033160
DISPLACEMENT OF ADJACENT ROADWAY AND GROUND SURFACE DURING CONSTRUCTION PERIOD OF OPEN CAISSON
As the open caisson pier foundation was to be constructed very close to the existing roadway of embankment of weak strata in recent double tracking work on Chuoh line, observation of displacement was carried out to judge the degree of danger for running a train during construction period. According to the results of observation it was confirmed that the protection method by sheet piling was very effective and in this case the displacements or strains were too small to disturb the track or to interrupt the traffic.

Muromachi, T Komine, T Yasuda, Y (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 8 No. 3, Sept. 1967, pp157-160

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-114)
DOTL RP

A2 033164
EXPERIMENTAL STUDY OF NEW-TYPE TRACK--TRACK LAID ON CONCRETE SLAB WITH ADJUSTING BLOCK
The experiment consists of static and dynamic loading tests. Through these tests the safety factor of the concrete slab and the pedestals for the operating traffic load, the vibrational characteristics of the track and the durability of the adjusting blocks, and the fastening devices were examined. The results of the experiment have shown that the new track will be used under operating traffic load.

Tsumenaga, T Saito, T (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 8 No. 3, Sept. 1967, p182

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-118)
DOTL RP

A2 033165
AUTOMATIC SUBMERGED-SLAG WELDING OF RAILS (REPORT 2)
A new method of automatic fusion welding of rail has been developed. The rail base is welded with the submerged arc welding process, then the area above the web with the electroslag welding process. This method assures good quality of welded joint, high productivity and applicability to the field conditions. Preheating and postheating are not necessary. The process of welding, countermeasures for prevention of welding defects and test results on welded joint are described.

Oi, I Muramoto, T Hakamata, S (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 8 No. 4, Dec. 1967, pp205-209

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-119)
DOTL RP

A2 033166
NEW RAILWAY TRACK STRUCTURES
Examples of new track structures ever tried in the world are reviewed and some examples being carried out in the JNR laboratory are commented in this paper.

Satoh, Y (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 8 No. 4, Dec. 1967, pp215-217

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-120)
DOTL RP

A2 033175
FIELD TEST OF CORROSION PREVENTED RAILS ON THEIR ENDURANCE LIMIT TO RAIL END FRACTURE
In order to prevent rail end fracture by corrosion fatigue cracking, various measures for prevention of corrosion were examined by field tests. In the preliminary test, 25 measures for prevention of corrosion were examined in tunnels under steam traction. Considering the test results, 4 measures were selected for life test. The most remarkable result of life test was as follows: In the tunnel, in which the mean life of non-treated rail was only 3 years, that of shot-peened rail covered with zinc metalicon was elongated up to 5 or 6 years.

Takihara, M Tomita, K Takeuchi, Y Tsuyuki, S Hirose, S Kose, Y Sato, Y (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 9 No. 1, Mar. 1968, pp17-20, 1 Ref

SPONSORING AGENCY: Maritime Administration, /Department of Commerce

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-129)
DOTL RP

A2 033180
RAILWAY TRACK
Discusses factors involved in track construction where PC sleepers are used, double elastic fastening, and continuous rail. The factors to be considered in bridge and tunnels where expansions of rail, structure must be considered is also discussed. The design and construction of a movable nose rail turnout for high speed operation is explained. The use of modern methods is the laying of PC sleepers and continuous welded rail is also outlined.

Matsubara, K *Japanese Railway Engineering* Quart Rpt Vol. 4 No. 1, Mar. 1963, pp 25-29

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-134)
DOTL RP

A2 033181
TRACK STRUCTURE FOR HIGH-SPEED TRAFFIC
Results of tests of factors related to a speed test of equipment at 200 km/h are studied with effects of ordinary track, track on a solid bed (without ballast) an expansion and insulated joint, a PC sleeper, deformation of loamy embankment, ground vibration and finally, train wind force. The second section is devoted to thermit welding of various types of rail and standards to be followed.
Special Issue

Hojo, T (Japanese National Railways) *Railway Technical Research Institute* Oct. 1963, pp2-6

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-135)
DOTL RP

A2 033182
RAILWAY TRACK STRUCTURE FOR HIGH-SPEED TRAIN OPERATION
The aspects of rail structure for high speed operations are discussed. The drop test for rails, chemical and mechanical properties of rail steel, rail fastenings, PC railway ties (sleepers), grading of ballast, ballast agitation by train wind, and finally, the effects of loading and repeated water sprinkling on railroad embankments are discussed.
Special Issue

Hirakawa, T (Japanese National Railways) *Railway Technical Research Institute* Nov. 1962, pp2-4

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-136)
DOTL RP

A2 033183
RAILWAY TRACK STRUCTURE FOR HIGH-SPEED TRAIN
Examines the specifications of rail, fastenings, ballast vs. precoated with asphalt ballast, subgrade construction, longitudinal forces present when welded rail used on a bridge, transition curves and PC ties to be used on the New Tokaido Line. Results of tests of the above under high speed conditions are also discussed.
Special Issue

Hoshino, Y (Japanese National Railways) *Railway Technical Research Institute* Nov. 1961, pp4-14

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-137)
DOTL RP

A2 033185
ARC WELDING OF AUSTENITIC MANGANESE STEEL RAIL TO CARBON STEEL RAIL--IN CASE OF WELDING WITH COVERED ELECTRODE
This study is to establish the procedure to weld manganese crossing and carbon steel rail together which has been thought to be very difficult due to the difference of their metallurgical properties and others. The authors paid special attention to the procedure to join them by manual arc welding after buttering the groove face of carbon steel rail. Various fundamental experiments were performed to select electrodes for buttering and joining, and welding conditions. Based on the results obtained, austenitic manganese steel rail and carbon steel rail were welded together, and the welded rails were subjected to bending test, drop-weight test and so forth. The results show that considerably reliable welds are obtained in case the authors' proposal is adopted.

Ando, S Kimata, N (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 9 No. 4, Dec. 1968, pp186-191, 2 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-141)
DOTL RP

A2 033192
TEST ON REPAIR OF RAIL SLIP DAMAGE THROUGH HEATING CORRECTION (REPORT 1)
Tests were made to establish the possibility of heating the top and web of a slip-damaged rail and correcting it as laid in the track without replacing it with a new one. The results proved the feasibility of this rail correction method.

Takahashi, T Aoyama, S Kodama, J Hiruma, M (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 9 No. 3, Sept. 1968, pp182-183

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-148)
DOTL RP

A2 033198
FATIGUE STRENGTH TESTS ON RAILS
Fatigue strength data on rails have seldom been published. Japanese National Railways, in connection with the adoption of long rails (0.5, 1.0, 1.5 or 2.0 km) and speed-up of train operation, is vigorously pushing fatigue strength investigations as well as qualitative study of rails. Soundness of the welded rail is hard to evaluate through a mere external inspection; therefore, nondestructive testing methods such as ultrasonic, magnetic detection and mechanical methods such as static bending, repeated drop weight should be coupled with it. Present demand is to secure a sound welded rail in the field through fatigue strength comparison between the base metal of rail and the welded joint.

Yamanaka, Y (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 5 No. 2, June 1964, pp44-50

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-155)
DOTL RP

A2 033207
BEHAVIOUR OF THE METAL OF RAILS UNDER THE REPEATED ACTION OF WHEELS. STUDY OF THE FIELD OF STRESSES IN THE ELASTO-PLASTIC ZONE
This report contains the results of the various calculations effected so far. These can be considered as preliminary calculations carried out before proceeding to the complete calculation of the stresses in a railhead. The report likewise contains several analytical studies, both for the purpose of gaining a better insight of the stresses (the methods and the formulae are, as a rule, well known, though, generally speaking, the numerical results are

not published) and for rendering possible a comparison of the results obtained by means of the numerical method with those obtained by means of exact calculations.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Interm Rpt Mar. 1964, 102pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-165)

DOTL RP

A2 033213
QUALITY OF RAILS AND MEANS OF GUARANTEEING IT

This report represents a collection of documentary leaflets covering principal rail defects. In a leaflet on star cracking in fishbolt holes, discussion includes causes, propagation, detection and remedies. Photographic evidence of defect is presented. A second document covers progressive transverse cracking in rail heads and includes origin of cracks, detection and remedies. Numerous photographs illustrate this defect. A final section deals with transverse fractures at longitudinal fissures at the foot of rails. Again, specific fractures are illustrated photographically.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Intrm Rpt Rpt 3, Question D45, Mar. 1952, 96pp, 12 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-171)

DOTL RP

A2 033215
QUALITY OF RAILS AND MEANS OF GUARANTEEING IT; EXAMINATION OF THOMAS STEEL RAILS OF THE THIRD SERIES OF TESTS BY MEANS OF THE RALUS ULTRASONIC PROCEDURE; DOCUMENTARY REPORTS OF IRSID AND BAM

The investigation of the quality of steel rails and the means of guaranteeing it has been entrusted to the D 45 Specialists Committee at the request of the 7th UIC Commission. Two series of tests have already been made within the scope of this work. A third series of tests was then carried out on rails having shown a 'good' performance in the track and on those having shown a 'bad' performance, these performances being defined beforehand according to some accurate criteria. The definition tests and the special tests on the Thomas steel rails of this series have been dealt with in Interim Report No. 9. As many as possible of the Thomas steel rail samples of the third series of test have been examined by means of the RALUS ultrasonic equipment, developed by IRSID and designed for the automatic industrial ultrasonic inspection of the rail head. The results of this examination have been dealt with in this report (RP 10), which also contains a documentary report by IRSID on the RALUS method and one by BAM on the investigation of rails for non-metallic inclusions.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways D45/RP 10/E, Nov. 1967, 23 pp, Figs., Tabs.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-173)
PURCHASE FROM: UIC Repr. PC

DOTL RP

A2 033218
UPPER STRUCTURE OF RAILWAY TRACK UNDER SUPER-HIGH-SPEED TRAINS

The possibility of constructing railway track for operating rolling stock of wheel-set type at super-high speed up to 350 km/h upon its rails is discussed from the viewpoint of the bearing strength of track for train operation and maintenance for track irregularities.

Satoh, Y (Japanese National Railways) *Railway Technical Research Institute* Vol. 9 No. 3, Sept. 1968, pp168-169

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-177)

DOTL RP

A2 033259
NEW SHAPE OF TRANSITION CURVE IN HIGH-SPEED RAILWAY TRACK AND ITS ALIGNING

The quantity called "Track Irregularities" is usually used as basic data and technical inferences are made from it. From the view-point of safety and comfort of traveling, we are requested to decrease the track irregularity especially with regard to high speed railway track. Must first of all grasp the essential meaning of "Track Irregularity" and consequently the next two quantities clearly: (i) difference between geometrically practicable shape and the actual shape of railway track. (ii) difference between physically rational shape and geometrically practicable shape of railway track. These two items are almost self-evident for the straight railway track, but for the curved railway track, especially transition curve, there are many problems yet to be solved.

Taya, T (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 3 No. 2, June 1962, pp38-45

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-208)

DOTL RP

A2 033268
THE STABILITY OF LONG WELDED RAILS

A report of British Railways testing of long welded railroad track. Testing program to determine the stability of welded rails by tests for buckling, torsional resistance, lateral moment of resistance and lateral ballast resistance. Conclusions that track can buckle but factors controling stability are torsional resistance of fastenings, sleeper spacing, ballast resistance.

Bartlett, DL (British Railways) *Rail International* Vol. 38 No. 10, Oct. 1961, pp679-708

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-218)

DOTL RP

A2 033273
ADAPTATION OF THE METHODS OF LAYING, ALIGNING AND MAINTAINING THE PERMANENT WAY TO CARRY TRAFFIC AT VERY HIGH SPEEDS (120 KM/H AND MORE): A) ON THE STRAIGHT: B) ON CURVES: SO FAR AS THEY AFFECT SAFETY AND TAKING INTO ACCOUNT THE TYPE OF ROLLING STOCK USED

The following topics are discussed: effects of rolling stock on track, layout of lines; points and crossings, loading gauges; distances between running lines, equipment, ballast and track renewal of high speed lines, and finally safety of trains, staff and inspection processes of high speed lines. Appendices include answers related to railway technology from responding members.

Thille, M (French National Railways) *Rail International* Vol. 39 No. 4, 1962, pp492-725

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-224)

DOTL RP

A2 033275
NO MORE TROUBLE WITH INSULATED JOINTS

Discusses the problems of insulated joints and problems caused by low and high temperatures. Suggests the way to cope with the problem is by using the "Schmitz" insulated joint which has an insulated joint with steel fish plates attached by adhesive and high tensile prestressed fish bolts. After a development of 5 years during 1,000 joints were replaced in this fashion with excellent service some for more than four years of use.

Krofges, P (HTL, Cologne) *Eisenbahningenieur* No. 12, Dec. 1963, pp360

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-226)

DOTL RP

A2 033276
FROM THE INSULATED RAIL JOINT TO THE INSULATED ADHESIVE JOINT. FOR THE CONSTRUCTION ENGINEER'S EXPERT GUIDANCE

Defines a rail joint and the requirements of insulating materials which are part of the construction. Further discusses the criterion of rail expansion which is continuous rail in stress. Finally, discusses the procedures, materials of producing the "S" type insulated adhesive joint and the insulated steel fish plate M joint.

Eisenbahn-Praxis No. 3, 1965, pp2-5
ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-227)
DOTL RP

A2 033277
TESTS WITH REGARD TO IMPROVING THE INSULATION OF STRESSED CONCRETE SLEEPERS BY MEANS OF EPOXY RESIN
Discusses the problems involved in the transition from beechwood to prestressed concrete sleepers as related to insulation qualities. As a means to make concrete sleepers good insulators by developing an insulating epoxy which would be used to treat the wooden dowels which insulate the rail from the sleepers. Projected tests call for 40,000 sleepers to be tested at some future date.

Deutsche Eisenbahntechnik No. 5, May 1964, pp226-228

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-228)
DOTL RP

A2 033278
PLASTICS IN TRACK CONSTRUCTION
Discusses the factors in the use of flat fishplates with epoxy joints. Includes tests of static characteristics, tensile tests, pulsation tests and deflection tests between bolted and epoxical joints. In addition, in service tests along with comparisons of initial cost of material, labor and upkeep. Plus, projected cost-savings analysis for five years is included.

Knauthe, C (German Federal Railways) *Deutsche Eisenbahntechnik* No. 3, Mar. 1964, pp134-138

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-229)
DOTL RP

A2 033279
PLASTICS IN TRACK CONSTRUCTION
Discusses new problems of Gapless tracks, concrete sleepers and the placement of insulated joints as necessary to the operation of automatic block systems. The use of Miramid Fish plates, and epoxy cemented joints is described and discussed. The epoxy cemented joints include those without and those with flat fish plates.

Knauthe, C (German Federal Railways) *Eisenbahntechnik* No. 2-3-, 5, 1964

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-230)
DOTL RP

A2 033281
APPLICATION OF POLYMER MATERIALS TO BALLASTLESS TRACK STRUCTURE--PERFORMANCE TESTS FOR RUBBER MATS USED IN OPEN-BED, SLAB-TYPE TRACK STRUCTURE
JNR is making large-scale trials with several new forms of ballastless track. One of these is of an open-bed, slab type, and consists of reinforced concrete supporting beds fixed at certain intervals on a concrete floor, rubber mats each placed at predetermined positions on the supporting beds, a series of prefabricated, well-finished reinforced concrete slabs resting on the rubber mats, and standard flat-bottom rails laid directly on the slabs. The open-bed, slab type tracks were laid tentatively in 1966 and are now still in service.

Usami, T Sawada, T Kobayashi, T (Japanese National Railways) *Railway Technical Research Institute*

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-232)
DOTL RP

A2 033284
SHOCK AND VIBRATION THEORY
It defines terms used in a mathematical representation of shock and vibration which are part of railroad phenomenon and discusses mass, inertia, momentum, force as related to "railroad impact shock". In addition the relationship of railroad car spring, and effect of flat wheels or rail joints upon the suspension of the car are represented and discussed.

The Railroad Environment: A Guide for Shippers and Railroad Personnel.

Railroad Environment pp27-32

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-235)
DOTL RP

A2 033297
TRACK-TRAIN DYNAMICS STUDY PROJECT TR-14 RAIL-VEHICLE INTERACTION STUDY REPORT NO. 1 (PRELIMINARY ANALYSIS OF SAMPLE DATA)
As a result of various derailments, a task force was formed to investigate the dynamic forces exerted by locomotive and freight car wheels against the rail. Critical study was directed at the 3 and 2 axle trucks of high horsepower locomotives, 85 feet TFC cars, and 50 feet box cars. The objective of this investigation was to determine if dynamic forces of sufficient magnitude to cause derailment were being generated by equipment, track structure and operating practice, and to recommend whatever corrective action might be indicated. Extensive field tests of wheel-rail interaction were conducted in various territories between Los Angeles and Pine Bluff, Arkansas. An analysis of these test results led to the following general conclusions: 1. Dynamic forces of sufficient magnitude to cause derailments are being generated in every day operation of revenue trains. 2. The forces are also sufficient to cause greatly accelerated wheel and rail wear. 3. Forces of sufficient magnitude to exceed the ability of the track structure to resist permanent deformation in alignment are also being generated.

Lynch, JP TenBroeck, HR Wagner, TB (Southern Pacific Company) Southern Pacific Company Report No.1, June 1970, 126pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-250)
DOTL RP

A2 033303
FIFTH PROGRESS REPORT OF THE ROLLING-LOAD TESTS OF JOINT BARS
This is a report on the tests of joint bar failures and it gives consideration to the revision of design and specifications Observations of tests are: Joint bars for 131-lb RE rail subjected to a wheel load increased in proportion to the increased section modulus of the bars, thus giving equivalent bending stress, render approximately the same joint bar life as the 112-lb bars. The cyclic life of the 131-K14 36-in. bars tested was somewhat longer than that of 24-in. bars of the same type. Top surface bearing at the rail end is wider on TR bars with the 11/16-in. fillet radius than on 112-lb headfree bars with 3/8-in. fillet radius. The average cyclic life of TR bars greater than that found with 112-B34 bars. Rolling-load tests on one lot of 112-B34 bars show an increase of cyclic life resulting from shot-peening. Variations in hardness from bar to bar of the same heat may result from variations in quenching temperature. Surface decarburization usually found on joint bars is readily detected in the Rockwell Test.

Alleman, NJ (Illinois University) *AREA Bulletin* Vol. 48 1947, pp714-729

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-257)
DOTL RP

A2 033304
EXPLANATION TO ACCOMPANY LETTER BALLOT ON ADOPTION OF REVISIONS OF THE 112-LB AND 131-LB RE RAIL SECTIONS AND JOINT BARS
Report discusses the revisions recommended for 112 lb RE rail and joint bars, especially the proportions, design of upper web and fillet, lower web, fillet and base flanges and the head contour. The design of the joint bar for this rail is explained along with factors relating to the new design. Finally, revisions of 131 lb RE rail, 133 lb RE rail and respective joint bars is covered along with descriptions.

AREA Bulletin Vol. 48 pp658-671

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-258)
DOTL RP

A2 033305
RECOMMENDATIONS ON NUMBER AND PLACING OF ANTI-CREEPERS FOR VARIOUS CONDITIONS
The rail creepage measurements were made from reference stakes set at 1/8-mile intervals. Considering the performance of the anchorage methods in respect to holding the rail against creepage and maintenance of line and gage during the test period. Test sections have shown equally good results. Some local condition in section G-2 probably caused the larger westward

movement of the south rail. Methods H and I of the arrangements initially installed, have shown superior performance throughout the 33-month test, and with only 8 and 10 anchors, respectively. The problem of anchoring rail in track carrying traffic in both directions is considerably different from that on tracks with traffic in only one direction. In a majority of the miles in this test the south and north rails have moved in opposite directions. It therefore seems logical to anchor the rail to resist creepage in both directions. Further, for the best conditions of maintenance, staggered anchoring seems undesirable because of the excessive tie skewing and the adverse affect on the line and gage of the track. Also, for greater efficiency in resisting the rail movement immediately, the rail anchors should be boxed. However, an adequate number of anchors should be used to arrest creepage in both directions and to avoid having the anchor ties churn and lose their trmping. To obtain maximum rail restraint with the minimum number of anchors they should be spaced evenly throughout each half panel, as in most of the methods where consecutive ties were anchored the resistance of one crub of ballast proved to be insufficient to hold the anchored tie in place.

Martin, EE Adams, LL Aker, JC *AREA Bulletin* Vol. 48 1947, pp619-634

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-259)
DOTL RP

A2 033306
THE EFFECT OF THE RATIO OF WHEEL DIAMETER TO WHEEL LOAD ON EXTENT OF RAIL DAMAGE
This is a report of progress on studies of pressure as affected by the area of contact between wheel and rail. One phase of this investigation involves the conduct of rolling load tests of rails subjected to wheels of various diameters and loads. To summarize, a depth hardness survey on a 112-lb rail removed from service after approximately 12,000,000 tons of traffic shows the maximum hardness to be at a depth of approximately 0.04 in. at a distance of 1-3/6 in. from the center of the head toward the gage side, the maximum hardness being Rockwell C 34.6. Tests on a full section 131-lb rail under a 75,000-lb load after 1,333,000 cycles (100,000,000 tons) of testing are as follows: For the 33 in. wheel--a hardness of Rc 15 on the tread and a maximum of Rc 32 at a depth of 0.15 in.; for the 50 in. wheel--a hardness on the tread of Rc 23 and a maximum hardness of Rc 27.4 at a depth of 0.10 in. Using "mutilated" head specimens and a 50-in. wheel it was found that a 58,000-lb load could be carried for 100,000,000 tons, but that a 63,000-lb load would break down the rail tread after 15-45 million tons.

Alleman, NJ (Illinois University) *AREA Bulletin* Vol. 47 No. 453, June 1945, pp725-741

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-260)
DOTL RP

A2 033307
EXPERIENCE WITH CORRUGATED RAILS IN AUSTRALIA
Article discusses the problems of rail corrugation in Australia. A case study is included which covers rail corrugation of the New South Wales Railways. The unique conditions present are analyzed and the probable contributors to corrugation are mentioned and discussed. Finally, American engineers analyze the conclusions and make suggestions and offer critiques.

Cowdery, GE (New South Wales Railways) *AREA Bulletin* Vol. 46 pp37-56

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-261)
DOTL RP

A2 033310
INVESTIGATE RECENT DEVELOPMENTS AFFECTING RAIL SECTIONS
This assignment is concerned principally with an investigation of stresses in the web of the 112-lb RE rail section, undertaken because of failures developing the web member. New and improved scientific instruments and equipment have made it possible to conduct explorations obtain data far beyond anything previously attempted. Concurrently with the field studies, mathematical analyses and laboratory studies are being made. The occurrence of web failures in rail in track is an indication of the extent to which web stresses developed in service exceed the capacity of the rail steel. It will be noted that the rate of failure occurrence for any of the rails shown is quite small.

Bronson, CB Barnes, WC Bryant, CB *AREA Bulletin* Vol. 45 pp470-479

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-264)
DOTL RP

A2 033312
SECOND PROGRESS REPORT OF THE ROLLING-LOAD TESTS OF JOINT BARS
Discusses the results of rolling load tests on joint bars. Details of test equipment, specimens, are discussed as well as table illustrating the test program of cantilever bending moment. Brinell hardness readings, wheel load position, design, bolt tension, bar reflectors and spring actions. Finally, a short report in the development and characteristics of the fractures which are formed beneath wheel bars in rail.

Alleman, NJ (Illinois University) *AREA Bulletin* Vol. 45 1944, pp434-445

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-266)
DOTL RP

A2 033313
INVESTIGATION OF THE IMPACT EFFECT OF FLAT WHEELS PRELIMINARY REPORT
The test reported the effect of wheel flat upon rail, tie plates, ties. Test situation included a test track over which a loaded coal car with a 4 inch long flat spot, was run. Stress was measured by special M.I.T. testing gear and a high speed camera. The tests were run at speeds of 5 to 40 mph to determine effect of speed upon stresses created by out-of-round wheels.

Magee, GM Cress, EE (Association of American Railroads) *AREA Bulletin* Vol. 45 1944, pp9-23, 6 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-267)
DOTL RP

A2 033314
STUDIES OF THE PRESSURE AS AFFECTED BY THE AREA OF CONTACT BETWEEN WHEEL AND RAIL. EFFECT OF WHEEL SIZE
The following is a progress report on one phase of this investigation, namely, rolling-load tests in which wheels of various diameters are rolled to and fro on a short length of rail for the purpose of determining the number of cycles of load application required to produce failure. The results of the rolling-load tests to fracture show considerable "scatter" and no very marked difference between the results of tests under a 50-in. wheel and those from tests under a 33-inch wheel. The vertical wear on rail 757C (33-in. wheel) was 0.046 in. at failure, whereas the wear on rail 757C1 (50-in. wheel) at 580,900 cycles was 0.041 in. At failure, 750,100 cycles, the wear on rail 757C1 was 0.0425 in. A second type of test being tried to ascertain the effect of wheel size on the rail is to measure the depth of work hardening in the rail head. The rail head appeared to have been work hardened down to a depth of about 0.45 in. by the 33-in. wheel with a maximum hardness of 296 at a depth of 0.15 in. A test on a section from the same rail rolled with the 50-in. wheel appears to have been work hardened down to a depth of 0.20 in. with a maximum hardness of 269 at a depth of 0.10 in.

Alleman, NJ (Illinois University) *AREA Bulletin* Vol. 45 1944, pp3-8

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-268)
DOTL RP

A2 033315
STRESS MEASUREMENTS IN THE WEB OF RAIL ON THE DENVER AND RIO GRANDE WESTERN
Progress on stress measurement in rail located in curved and tangent situations was measured, and reported. The vertical web stresses under different locomotives is included, and the varying speeds are listed. A comparison of stresses between 112 lb and 115 lb rail as well as 112 lb and 131 lb rail is included in the discussion.

Magee, GM Cress, EE (Association of American Railroads) *AREA Bulletin* Vol. 44 1943

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-269)
DOTL RP

A2 033316
FIELD TESTS FOR BATTER OF END-HARDENED RAILS IN SERVICE ON THE CHESAPEAKE AND OHIO RAILWAY
A series of reports are presented for various aspects of rail, including field tests for batter of end-hardened rail, examination of rail for weeping cracks, control cooled rail with in-service failure and comparison of drop and bend tests.

Jensen, RS (Illinois University) *AREA Bulletin* Vol. 44 II, 1943, pp611-621

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-270)
DOTL RP

A2 033318
FIELD TESTS FOR BATTER OF END-HARDENED RAILS IN SERVICE ON THE CHESAPEAKE AND OHIO RAILROAD
Progress report which discusses the measurement of batter and hardness, testing of cracked and hardened rails with "weeping cracks", and a summary of these rails. Photos illustrate the weeping and shatter cracks found. Recommended practice for the controlled cooling of rails as a means to avoid or to minimize the formation of shatter cracks. A comparative study of control cooled and Brunorized rails--with the results of controlled cooled rails having reduced fissures and more improvements with improved insulation at the mills. Finally, a study and comparison of the drop and bend tests to determine rail quality and acceptability.

Jensen, R Alleman, NJ *AREA Bulletin* Vol. 43 I, 1942, pp607-640, 5 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-272)
DOTL RP

A2 033320
SPECIAL COMMITTEE ON STRESSES IN RAILROAD TRACK. SEVENTH PROGRESS REPORT
Since 1914 this committee has conducted analytical and experimental investigations on the action of railroad track under the loads of locomotives and cars running at various speeds and for a variety of conditions. The tests herein reported were made to obtain information on the action of various types of rail joints in track when subjected to the loads of locomotives and cars at speeds up to 90 miles per hour. Testing equipment enabled tests to be made accurately and expeditiously in a way that had not been accomplished before. Tests were undertaken particularly to obtain information on the action of different forms of rail joints in track under the traffic of locomotives and cars running at various speeds and to learn the magnitude of the bending moments developed in the joint bars as compared with those developed in the full rail away from a joint. It was also desired to learn if possible how speed of train affects these various matters. To serve as a basis of comparison, the stresses and moments and depressions of the full rail in the same track under the action of the same locomotive and cars were needed. Tests were conducted at Elkton, Md. The test site was on a 14-min. curve to the right with superelevation of 1-1/2 in. Ahead of and behind this curve the compound curve became 33 min. The total curve extended over a distance of about a mile.

Talbot, AN Bronson, CB Burton, WJ *AREA Bulletin*

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-274)
DOTL RP

A2 033321
MANUFACTURE AND TEST OF TRIAL PC TIES FOR FROST-HEAVE SECTIONS
The intensity of frost heave varies depending on the soil components or the weather and accordingly the distribution of reaction differs from tie to tie. The main objective of the present test is to know the changes of supporting conditions for ties through measurement of the bending moment produced in them by the train load. Though the changes due to frost heaving and thawing could be definitely noted, there were observed no remarkable phenomenon as initially feared of ties being supported only at midpoint; they were seemingly supported more often at both ends as the result of frost heaving.

Miura, I Iwasaki, I (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 7 No. 3, Sept. 1966, pp35-36

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-001)
DOTL RP

A2 033322
ON THE LIFE OF RAIL
Annual trend of rail failures of the Japanese National Railways in recent years amounted to 5264 in 1963. There are included in rail failures the numbers of broken rails, cracked rails and defective rails all together, they do not always cause interference to train operation. It is known from the figures that end break ranks the first and amounts to more than 60 percent. The number of end breaks is divided into two parts, namely in tunnels and out of tunnels. End breaks in tunnels are more frequent for their track length and the rails in tunnel have shorter life than the ones out of tunnels, due to unfavorable conditions of corrosion in tunnels of our country. End breaks almost occur as results of rail fatigue by train loads. Stress induced on rail varies in magnitude according to train speed, wheel load, lateral force and position of wheel contact on rail, and the stress distribution was found in many measurements to be a normal distribution or its combination in most cases.

Sato, Y (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 7 No. 1, Mar. 1966, pp28-31

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-004)
DOTL RP

A2 033326
SECOND PROGRESS REPORT--JOINT INVESTIGATION OF CONTINUOUS WELDED RAIL
Report of committee on welded rail includes a brief resume of past research and then continues into the present research area. The first covered is the testing of welded rail joints under repeated wheel load. The procedure, the endurance limit and fractures developed are included. A comparison between welds and joint bars was included. Metallographic tests of the welds are included and such tests as hardness, etching and metallographic examination of the welds are also included. Mechanical tests of the welded joints were also part of the test sequence. A complete comparison of the test are indicative of metal qualities rather than joints, and that the quality of metal is important to the joint strength as weld outline, cracks and other stress raisers in the joint.

Moore, HF Thomas, HR Cramer, RE (Illinois University) *AREA Bulletin* Vol. 40 1940, pp737-755

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-277)
DOTL RP

A2 033327
AN INVESTIGATION OF RAIL-TO-CONCRETE FASTENERS
Prestressed concrete railroad ties are being increasingly used. This investigation deals with the rail-to-concrete fasteners for concrete ties, bridge decks, and tunnel linings. For spring-clip fasteners in concrete ties, three methods of electrical insulation were studied. These fasteners were subjected to tie-wear tests, longitudinal-slip tests and electrical-resistance tests. The anchors used were also subjected to pullout tests. For fasteners in bridges and tunnels, three different fasteners were tested under repeated loading. In addition, the "second-cast" method of construction was studied.

Hsu, TC Hanson, NW (Portland Cement Association)
Portland Cement Association Res Rpt Bulletin D146, 22pp, 9 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-278)
DOTL RP

A2 033330
TESTS WITH ASPHALT-TREATED BALLAST ON THE SOBU LINE
Discussion of testing of asphalt treated ballast of several types as a means to reduce track destruction. Results suggest that the asphalt treated ballast was more stable but there were problems in the use of a tie-tamper because ballast does not move freely. When loose ties are replaced, small crushed stones are required underneath. In addition, it is suggested that where renewal of the track in conjunction with ballast renewal of asphalt treated ballast, better results may be expected.

Satoh, Y Hirata, G (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-281)
DOTL RP

A2 033341
TEST OF VACUUM DEGASSED RAIL
One of the problems of rolling rail in lengths longer than 39 feet has been the problem of the cooling beds for producing controlled cooled rail. A potential alternate to controlled cooling is a process of vacuum degassing of rail. Such rail has been produced in small quantities by United States Steel and is under test in the tracks of the Penn Central Railroad. Analysis of the vacuum degassed rail indicates a chemistry superior to that in the present controlled cooled rail, and it is heavily indicated that this process will provide a somewhat superior rail and in lengths in excess of 39 feet. The rail under test on the Penn Central Railroad in the vicinity of Lancaster has now been in service one year and has carried some 49 million gross tons, and appears to show no noticeable wear even though it has been laid in a 3 deg 45' curve. The Norfolk and Western Railway Company is in the process of installing approximately 400-132 lb vacuum degassed rail for test in heavily traversed and heavy tonnage territory, some of which has already been laid.
Unpublished data.

Norfolk and Western Railway

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-294)
DOTL RP

A2 033350
PROTECTION OF RAIL JOINTS FROM CORROSION TO PREVENT RAIL END BREAKS
Many parts of the railway track including the rails are made of carbon steel. Carbon steel excels in strength but is prone to be corroded. Rail end breaks are considered as fatigue destruction caused by corrosion. Since stress and corrosion act at the same time, cracking is developed easily. It is because the fatigue strength of a rail decreases sharply in acid environments, that end breaks are more liable to occur in non-electrified sections than in electrified sections. Since corrosion has much to do with end breaks of rails in tunnels, the application of a proper protective method prevents end breaks of rails.

Kose, Y (Japanese National Railways) *Permanent Way* Vol. 6 No. 3, No. 22, Sept. 1963, pp1-13

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-304)
DOTL RP

A2 033355
EXPERIMENTALLY DESIGNED NEW TURNOUT WITH MOVABLE NOSE RAIL
Discusses the needs for new turnout design for smooth operation of high speed rolling stock. The two new types of turnout are discussed including the design and the benefit to operation of equipment.

Tomonaga, K Kurokochi, H (Japanese National Railways) *Permanent Way* Vol. 4 No. 2, No. 11, June 1961, pp1-8

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-309)
DOTL RP

A2 033359
ABSTRACT FROM REPORT OF COMMITTEE FOR "QUALITY OF RAILS AND MEANS OF IMPROVING IT"
Studies concerning means to improve the quality of the material of rails, undertaken in 1960 by the Committee for "Quality of Rails and Means of Improving it" under the guidance of Dr. Tokushichi Mishima, an authority on iron and steel metallurgy and chairman of the committee, were finished in fiscal 1965. Report of the committee is divided into five parts: (1) The outline of the results of researches; (2) The investigation of rail failures caused by manufacturing defects; (3) Prevention of rail failures caused by manufacturing defects; (4) Means to strengthen rail ends; (5) Studies of the chemical composition of rails; (6) Problems for the future and general remarks.

Takahara, K (Japanese National Railways) *Permanent Way* Vol. 9 No. 2, No. 32, 1966, pp19-26

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-313)
DOTL RP

A2 033360
TRACK FOR JAPAN'S 210 KM/H TRAINS
Detailed report of high speed operation. Details of maintenance of the right of way are discussed. The main features of the system are outlined, track cross sections and construction are further examined. The planning, organization and personnel of the maintenance operation are further discussed. The use of high speed inspection vehicles and their operation is included. Finally, protective devices against earthquake, rain and snow damage are mentioned and studied in detail.

Matsubara, K (Japan Transportation Consultants, Incorporated) *Permanent Way* Vol. 11 No. 3-4, Nos. 40-41, 67pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-314)
DOTL RP

A2 033361
NEW SANYO LINE 1. NEW SANYO LINE 2. THE ADJUSTABLE BALLASTLESS TRACK APPENDIX TRACK FOR HIGH-SPEED RAILWAYS IN THE WORLD
The publication discusses three major topics. First, the plan of the New Sanyo Line, its description, and aspects of the planning of the extension of the line are discussed in detail. The second section considers the design of an adjustable ballastless track which will be used on part of the New Sanyo. The problems of design and engineering are discussed. The third part is a series of appendices which compare maintenance processes and controls of the railroads of the major countries of the world.

Matsubara, K (Japan Transportation Consultants, Incorporated) *Permanent Way* Vol. 12 No. 1-2, No. 42-43, pp1-98

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-315)
DOTL RP

A2 033362
THE LONG WELDED RAILS
Article deals with the techniques used to mechanize the laying of long rails with welded joints. Subjects considered include the method of laying the new rail, the removal of the rail from the trains, the organization of such a train how it is unloaded and reloaded. The flash welding plant used, is described, along with its operation.

French Railway Techniques No. 3, 1967, pp31-34

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-316)
DOTL RP

A2 033378
THE STABILITY OF TRACKS LAID WITH LONG WELDED RAILS
A study of the behavior of track under traffic situation. Factors considered are axle loading, pliability of the formation, mechanical characteristic of the rail, temperature, type of sleepers and fastenings. Included is a study of the deformation of the track in its plane which initiates a differential equation of variable and non-linear coefficients. Recommendations for the requirements of 250 km/h plus 300 km/h systems are included at the end.

Prud'Homme, MA Janin, MG (French National Railways) *Rail International* Oct. 1969, pp601-620, 34 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-335)
DOTL RP

A2 033379
THE STABILITY OF TRACKS LAID WITH LONG WELDED RAILS
Primarily devoted to the stability of non-loaded track under thermic stresses. Tracks as compared include wooden sleeper construction opposed to pot sleepers. (2 concrete blocks joined by a steel tiebar). The qualities of stabilized and nonstabilized track are further considered under the headings of wooden and pot sleeper.

Prud'Homme, MA Janin, MG (French National Railways) *Rail International* Aug. 1969, pp459-487, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-337)
DOTL RP

A2 033381
SHOP MANUFACTURE OF GLUED INSULATED RAIL JOINTS
Discusses the means to construct glued insulated rail joints. The methods of joining rail in the shop are discussed, though the process may be performed in the field. Costs of construction are detailed and a plan of the plant are included.

Volker, A *Rail International* Sept. 1966, pp1411-413

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-340)
DOTL RP

A2 033383
RAILWAY TRACK STRUCTURE FOR HIGH-SPEED TRAIN OPERATION
Discussion of factors related to track structure for high speed operation. Running tests include running stability over a ruptured rail, dynamic effects of wheel flat, dynamic stresses of prestressed concrete ties, behavior of embankments under high speed traffic loads, and measurements of train wind. Additionally, comparative studies of welded rails, wooden sleepers, and a test vehicle to be used for high speed track inspection are discussed.

Hojoh, T (Japanese National Railways) *Rail International* Mar. 1965

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-342)
DOTL RP

A2 033388
WORK-HARDENING BOLT HOLES IN RAIL ENDS
Causes of rail failure occurring at holes near the rail head are discussed. These are radial or star cracking caused by high shear stress in the web aggravated by presence of fish bolt holes. Stresses are caused by locomotives with small driving wheels. Improvement in rail resistance is the result of work hardening the surface of the holes. Accomplished by drilling undersize holes, and broaching or drifting with a spherical tool.

Wise, S (British Railways) *Rail International* Oct. 1960, pp863-865

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-348)
DOTL RP

A2 033393
ASPHALT-COATED BALLAST. POTENTIAL BENEFITS SPUR FURTHER TESTS
Earlier tests have suggested that definite savings in maintenance costs are possible through the use of asphalt-impregnated ballast. Some of the test sections will be located on track laid with continuous welded rail, with 78-feet and 117-feet rails, and with tight joints as well as with conventional joints. The A.R.E.A. Roadway and Ballast committee concluded that asphalt-treated ballast is practical and beneficial. It also concluded that the economic life of this test section was seven years, because the section labor required during the last three years of the test period was in excess of that for the entire division on a permile basis.

Rail International Oct. 1960, pp845-850

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-354)
DOTL RP

A2 033395
PROTECTING THE TRACK FORMATION BY MEANS OF PVC FOILS
Description of the use of PVC foils to protect track formation against surface water. The foil is placed between the ballast and the subgrade. Thus far, the PVC foil has succeeded as protection against surface water. Preferable system when the bearing capacity of the subgrade is reduced by inadequate surface drainage or with certain types of stone which deteriorate. The PVC does not work with water percolating from beneath.

Tyc, P (Hochschule fur Verkehrsesen, Prague) *Rail International* Oct. 1962, pp1344-350

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-356)
DOTL RP

A2 033396
RATE OF RUNNING UP CANT ON RAILWAY CURVES AS APPLICABLE TO DIFFERENT GAUGES
To correct for centrifugal force and its effect upon rolling stock, it is a practice to elevate or to cant the outer rail of a curve. To avoid the abrupt transition from a tangent to a curve, a transition curve may be introduced. This article discusses the amount of cant which is necessary to balance the centrifugal force, and the cant which is necessary in the transition curve to make up the deficiency for a smooth transition.

Dickshit, G (Government of India) *Rail International* pp449-458

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-357)
DOTL RP

A2 033398
SUPERIMPOSITION OF HORIZONTAL CURVES ON VERTICAL CURVES
The rate of change in grade as recommended by Wellington is no longer applicable to modern rolling stock with low train resistance. Neither are long vertical curves needed since it is more economical to use train brakes to prevent the crowding of cars when descending. When high speeds and vertical curves are present, an increase in the equilibrium superelevation to a maximum of 12 percent is recommended.

Ganpati, KB (Advanced Permanent Way Training School) *Rail International* Aug. 1963, pp523-528

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-359)
DOTL RP

A2 033399
FASTENING THE RAIL
French type of doubly-resilient rail fastening features vertical holding of the rail between two components of well defined resiliency: 1. Grooved sleeper (tie) pad in rubber, positioned under the rail. 2. A spring-temper steel leaf type clip, the bearing of which is exerted on the rail by means of bolt (in concrete or steel tie) or screw fastening in wooden tie. Advantages of these fastenings are shown as extending into the economics, as retightening is extended to every four to six years, as against the yearly maintenance required with rigid fastenings, and the reduction of the number of tie screw reconditionings required.

French Railway News No. 2, 1967, pp23-24

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-360)
DOTL RP

A2 033402
HIGH SPEED RUNNING AND RELATED TRACK PROBLEMS
High-speed running does not set any track-make-up problems. The conventional type is quite suitable. Strengthening the track is not a must, neither from the angle of safety nor that of fatigue. Strengthening, which could be useful on the lines carrying both dense fast traffic and numerous slow heavy trains, could be carried out simply at the time of the scheduled renewals. The layout problem is more difficult. On certain important lines on the S.N.C.F. there are sufficiently long sections where the radii are over the minima indicated above. Consequently, scheduled service traffic at 200 km/h could be envisaged on these sections in a not too far distant future.

Prud'Homme, A (French National Railways) *French Railway Techniques* No. 2, 1966, pp83-92, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-363)
DOTL RP

A2 033409
THE RAIL
Article on rail is descriptive, highlighting the development of appropriate specifications for the necessary requirements of resilience and strength. Rails in the process of manufacture are subject to continuous ultrasonic testing by an instrument called the RALUS. Rails in service are tested regularly by an electro-magnetic system for detection of fatigue faults. The elimination of joints has further improved rail life in track and the choice of the proper weight and profile of rail for the service to be imposed needs to be considered.
Catalogue-Track Equipment

Lebrun, F (French National Railways) *French Railway Techniques* 1967, pp3-10

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-371)
DOTL RP

A2 033410
BOUTET PROCESS FOR WELDING RAIL JOINTS
Boutet welding process for rail joints, which uses the "aluminothermie", has been advanced to a three piece mold, which permits the welding of joints, even over the ties without moving them aside, and the use of a small portable machine for making the molds. This makes possible the speedier welding of joints at the rate of a joint per man-hour or less. Technical advantages of being able to center accurately all parts of the mold around the joint, and the practical elimination of any bead under the flange. Limited preheating welding (a rapid process) has been developed to minimize the effect of rail movement during the welding preparations. The elimination of the bead has made possible a high quality joint, highly resistant to the drop and fatigue tests.

French Railway Techniques 1967, pp11-16

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-372)
DOTL RP

A2 033411
THE SLEEPER (WOOD, STEEL OR CONCRETE)
The Purpose of Sleepers: transmission of loads from rail to ballast; maintaining correct gauge; angling the rail (1/20). Subjected to a whole lot of complex actions: vertical and horizontal efforts exerted by the rail flange on the upper surface of the sleeper; contact with the ballast, exerted on a narrow area at rail level, alternate dynamic bending at the centre part due to the passing traffic. It may happen that the sleeper is not correctly bedded, and there is a float of a few millimeters so that the passing traffic bangs the sleeper on to ballast.

French Railway Techniques 1967, pp17-18

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-373)
DOTL RP

A2 033414
END-HARDENED RAIL
Rail joints are the most vulnerable spots in the track structure and many manhours are spent on their maintenance. These parts are subjected to repeated impacts which are far larger than those inflicted to the other parts of the track. Moreover, the rails with joint holes bored in the web are structurally weak. Since the quality at the end of the rail, in spite of these weak conditions, is the same as the other part, the rail end has been apt to suffer a battering and rail joint depression. Because of progress in the rail welding technique and the improvement in the quality of the rail fastenings, the rails have come to be increasingly welded to "long rails". Standard length rails are expected to continue in use in considerable quantities. Strengthening the rail ends through production of rail steels with less non-metallic inclusions and heat treatment of rail ends to making them a better impact resistant structure was taken up as a research project.

Katayama, M (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 9 No. 4, 1968, pp17-19

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-377)
DOTL RP

A2 033416
STRENGTHENING OF TRACK STRUCTURES
On the JNR, the passing tonnage has nearly doubled and the average train speed has increased approximately 20 percent, in the last 30 years. Increasing traffic, coupled with unfavourable conditions such as a shortened train interval for maintenance due to increased frequency of train operation and a decrease of manpower for maintenance, it becomes very difficult to keep the track in good condition to meet the increased traffic. Necessity of strengthening the track structures to cope with such trends and overcome these unfavourable conditions, is stressed.

Kitaoka, H (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 8 No. 2, June 1967, pp36-38

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-379)
DOTL RP

A2 033419
TURNOUT WITH NOSE RAIL MOVABLE CROSSING
For the New Tokaido Line the Japanese National Railways required that the turnout at stations should allow passing trains the same maximum speed of 200 km/h as they use on the rest of the line. It is necessary to have a special turnout which would minimize the wheel shock to the turnout structure, both vertically and laterally. Worked out was a turnout with a nose rail movable crossing having welded joints, skew joints, no guard rail, and no guiding flangeway of wing rail. Several types of such turnouts having nose rail movable crossings have been experimentally designed in JNR beginning in 1960. Experience of service so far made suggests no troublesome problem concerning track maintenance. Furthermore this new turnout needs only a little maintenance labor.

Kurokochi, H (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 6 No. 4, Dec. 1965, pp16-19

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-383)
DOTL RP

A2 033426
TURNOUT FOR N TYPE RAIL
At present, there are about 58,000 sets of ordinary turnouts. Most of them, however are of antiquated designs, being based on designs worked out as early as 1925. As they have become inadequate, under the present train load conditions, from the points of track maintenance and train operation, JNR has been doing its best to improve them. Yet such improvements have been only partial; no systematic overall improvement has been made yet. But extensive research work to design turnouts capable of allowing high speed train operation has been done in the last 10 years, and has enabled us to understand, theoretically, how turnouts can be improved. So, JNR is pushing forward design and development of improved turnouts which can meet all possible requirements placed on them under present and expected future train loads, paying at the same time, attention to make them interchangeable with existing turnouts. Marked improvements are expected, not only in maintenance efficiency but also in transportation capacity, with the introduction and full-scale use of these new turnouts designed for N type rails.

Chujo, R *Railway Technical Research Institute* Quart Rpt Vol. 4 No. 2, June 1963, pp27-28

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-390)
DOTL RP

A2 033428
MECHANIZED MAINTENANCE OF TRACK ON THE JNR
The Japanese National Railways are making continuous efforts to mechanize track maintenance work in line with the policy towards general modernization of operation. Emphasis is laid on the wider employment of small-sized equipment which will allow a train to pass or which can easily be taken out of the track when a train is coming. So-called overall track renewal using heavy equipment is carried out where an interval of 3 or 4 hours is available between midnight and 4 o'clock in the morning as in the case of the electric multiple unit train lines in and around Tokyo and Osaka. This method is also used on some trunk lines, such as the Tokaido Line in cases where sufficient work time is available by blocking one side of the double track. Outlined are the principal kinds of maintenance work in which such equipment is used, and the measuring devices.

Ijichi, K (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 1 No. 4, Sept. 1960, pp24-26

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-392)
DOTL RP

A2 033430
THE STRENGTH OF FISH-BOLTS
A report on performance of hardened and non-hardened fish bolts, also bending-free bolts are included. Tests included the use of Vibrogir to determine the effect of vibration in the loosening of a rail-fish plate and bolt unit. Under the equivalent of a passage of 85 million tons, no looseness because of nut turning was found.

Umekubo, S (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 6 No. 2, June 1965, pp23-26

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-394)
DOTL RP

A2 033431
A 101 TYPE RAIL FASTENING DEVICE (THE NEW TOKAIDO LINE STANDARD TYPE) FOR P.S. CONCRETE SLEEPER
Numerous variations of rail fastening devices have been tentatively fabricated for the new Tokaido line. As the final prototype, the rail fastening device, which was originally developed for 50 kg PS rail, has been modified for application to the new Tokaido line 50 kg T rails. Statical characteristic test and lateral fatigue test were conducted on the tentative product and the results were checked with the anticipated values. The most suitable plastics and compound materials were sought for spring support and the durability of fastening parts was confirmed. The results suggest that a spring clip in the setting area will present no trouble. In this type of fastening, where a hexagonal bolt is screwed into the insert plug embedded in the concrete itself, special care should be taken in designing, so that the bending moment may not directly act on the bolt. There will be no practical trouble with this device, provided the above point is fully attended to.

Minemura, Y Ichikawa, S (Japanese National Railways) *Railway Technical Research Institute* Vol. 5 No. 4, 1964

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-395)
DOTL RP

A2 033433
GLUED RAIL JOINT FOR INSULATION
To develop the new type rail joint for insulation having not only sufficient vertical rigidity but also sufficient strength to be able to bear the axial force due to temperature variation in a long welded rail, the following study has been undertaken. Rail and fishplates of the joint are glued with high-polymer adhesive. This type of rail joint will not only make maintenance of the track easy but also make riding quality good.

Hojo, T Umekubo, S Sekiguchi, K (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 6 No. 3, Sept. 1965, pp29-33

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-397)
DOTL RP

A2 033435
EFFECT OF WHEEL FLAT ON THE CAR VIBRATION
A series of running tests was performed with the prototype "B" train for the new Tokaido line. The object is to investigate the effect of the wheel flat on the car body and truck vibration. The data were expected to give a reference for design and maintenance of car, and to give a base for determining the allowable limit of the flat length in practical operation. The running speed was 200 km/h for the flat up to 90 mm, and 50 km/h for 110 mm. So far as the truck and car body vibration is concerned, flat caused more vibration at a low speed than at a high speed. So car vibration is not considered the most decisive factor limiting the allowable length of flat.

Matsui, N Miyoshi, K (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 6 No. 3, Sept. 1965, pp51

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-399)
DOTL RP

A2 033436
PROBLEM OF INCREASE OF SPEED, AS FACED BY THE RAILWAYS IN DEVELOPING COUNTRIES
The immediate problem, in many of the developing countries, is not that of attaining very high speeds, but is that of reaching moderately high speeds. The economic conditions in these countries require that such increase of speeds should not entail any appreciable additional capital investment nor should it result in an increase in the maintenance and operating costs. The Indian Railways have undertaken investigations, research and studies with a view to achieve moderately high speeds on their "broad gauge" and "metre gauge" railway systems. The results of these studies are discussed.

Joseph, TV (Indian Railways) *Rail International* May 1968, pp591-609, 16 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-401)
DOTL RP

A2 033437
GENERAL PROCEEDINGS OF THE TECHNICAL MEETINGS
Present trends in the methods of maintenance and renewal of the permanent way, with particular reference to: a) the influence of track design thereon having regard to the demand for higher speeds; b) organization of the employment of labour and of mechanical equipment; c) costs; d) safety measures for staff and trains and their effect on operational requirements. 19th Session.

International Railway Congress Association Dec. 1966, pp1534-552

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-402)
DOTL RP

A2 033438
SPECIAL ACCOUNTS SUMMING UP THE REPORTS ON THE QUESTIONS FOR DISCUSSION AT THE NINETEENTH SESSION OF THE INTERNATIONAL RAILWAY CONGRESS ASSOCIATION (PARIS, 1966)
Present trends in the methods of maintenance and renewal of the permanent way, with particular reference to: a) the specifications. Observations of tests are: Joint bars for demand for higher speeds; b) organization of the employment of labour and of mechanical equipment; c) costs; d) safety measures for staff and trains and their effect on operational requirements.

Alias, J (French National Railways) *Rail International* Vol. 43 No. 6, June 1966, pp1037-056

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-404)
DOTL RP

A2 033441
DESIGN AND MAINTENANCE OF HIGH-SPEED PERMANENT WAY IN THE U.S.S.R.
The track on high-speed lines is subject to special criteria. A high level of design including the use of long welded rail sections, temperature-stressed concrete sleepers is required. Maintenance requirements are severe. Of vital importance is the control of track in the horizontal plane. The wear of rails and the permissible magnitude of corrugations, etc., are strictly limited. Great attention in the U.S.S.R. is paid to the increasing of speeds of trains since a comparatively small increase in maintenance gives a considerable economy in railway stock, reduces the cost of freight and passenger services, increases railway capacity. Experience, maintenance, design and labour problems are discussed.

Troyitzky, LF (Ministry of Railways, USSR) *Rail International* Aug. 1968, pp837-853

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-407)
DOTL RP

A2 033446
DETERMINING THE INCREASE IN BALLAST DENSITY UNDER TRAFFIC BY MEANS OF THE GAMMA ABSORPTION METHOD
The increase of running speeds on main lines to 140 km/h or 160 km/h and the increase of axle loads of motive power units and goods wagons, the question has been studied for some years whether the undoubtedly higher maintenance cost to be incurred for the permanent way could be reduced by special measures. The mechanical compaction of ballast between sleepers will repay after 2-1/2 years because the extension of the interval between track overhauls will also entail a reduction in the number of tamping machines required.

Birmann, F Cabos, P (German Federal Railways) *Rail International* Mar. 1967, pp229-249, 9 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-414)
DOTL RP

A2 033453
A REVIEW OF THE FIRST THREE YEARS OPERATION OF THE NEW TOKAIDO LINE
Discusses the aspects of the operation of the New Tokaido Line in Japan. The history of the line, reasons for the construction are included. The aspects

of multiple train units and technical description, the design of catenary and collection system, aerodynamic considerations are also included. Finally, the maintenance of the train and all of its systems is discussed. The maintenance schedule of the units is detailed as well as the revenue and expenditures of the operation.

Hoather, SJ *Railway Division Journal* Vol. 1 No. 6, 1970, pp664-677

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-425)
DOTL RP

A2 033723
DEFORMATION OF RAILWAY TRACK UNDER HIGH-SPEED TRAIN--MEASUREMENTS ON THE TEST-RUN SECTION OF THE NEW TOKAIDO LINE
In designing the new Tokaido line, many tests through actual operations of trains at high speed were conducted in parallel with model experiments, laboratory tests and theoretical analyses. Major items of measurement on the ground were rail deflections, rail stress, stress on fastening device, track vibration acceleration and sleeper stress. Major measured items on the car were wheel side thrust, wheel load, bogie stress, car body vibration, axle box vibration and similar forces.

Satoh, Y Toyoda, M (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 7 No. 2, June 1966, pp20-23

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-003)
DOTL RP

A2 033729
RAILWAY TRACK STRUCTURE FOR HIGH-SPEED TRAIN OPERATION
Discusses the results of testing of structure and materials for high speed operation. Tests of ruptured rail, effect of flat wheel on the track, stresses of PC ties, behavior of high embankment with high speed traffic are considered. Additionally, the testing of Japanese rail as welded by German and French methods and equipments. The use of wooden sleepers (ties) in the construction of the New Tokaido Line is also detailed. Finally, the design and use of a high speed track inspection car is discussed.
Special Issue.

Hojoh, T (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Aug. 1964, pp3-8

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-138)
DOTL RP

A2 033730
TRACK STRUCTURE
Discusses the relationship between track structure, train speed, gross tonnage and the relationship to construction and maintenance. The cumulative effects of speed and weight to the destruction of the track is discussed and possible structural solutions and maintenance solutions are offered.
Special Issue.

Hoshino, Y (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Apr. 1960, pp20-23

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-139)
DOTL RP

A2 033731
DYNAMICS OF HIGH SPEED ROLLING STOCK
Basic researches on running safety and riding quality were required for the design of vehicles for the new Tokaido line, and high speed tests of the prototype vehicles on the test track section have been almost finished in the fiscal year 1962. In the fiscal year 1963 researches on some remaining problems for the final design of production type vehicles, especially, minute researches on the hunting prevention and on the lateral load-deflection characteristics of air springs, have been made continuously. In March 1964 the running performance test of the first built six production type vehicles was performed. The main results of these researches and test are described.

Matsudaira, T (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. .I. Sept. 1964, pp21-25

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-149)
DOTL RP

A2 033733
GUIDING PRINCIPLES FOR THE DESIGN OF POINTS AND CROSSINGS (UIC 54 AND UIC 60 RAIL PROFILES). FACTORS AFFECTING THE CONSTRUCTION OF SWITCHES
The present interim report-Document No. 2-deals with the 3rd part of the Programme of Work "Conception of Switches". Based upon the three fundamental requirements of safety from derailment, steady riding of vehicles and economy in construction and maintenance, the interim report examines particularly the incidence of high speeds and heavy axles in the negotiation of switches. The calculations and the measurements taken to this end, are developed in two appendices where a study is made on bogie coaches for an analysis of accelerations in respect of comfort and on a V60 diesel shunting locomotive of the DB 25,000 series electric locomotive of the SNCF for an analysis of forces causing wear and fatigue. The reduction in basic components, the simplification of machining and increased life in service, with a choice of assemblies and materials which should ensure mainimum maintenance cost while retaining the maximum traffic availability, are sought in the choice of "pose" (3-20) and "Construction" (3-30).
Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Intrm Rpt. D72/RP 2/E, June 1966, 22 pp, Figs., 4 App.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-175)
PURCHASE FROM: UIC Repr. PC
DOTL RP

A2 033739
ADAPTATION OF THE METHODS OF LAYING, ALIGNING AND MAINTAINING THE PERMANENT WAY TO CARRY TRAFFIC AT VERY HIGH SPEEDS (120 KM/H AND MORE): A) ON THE STRAIGHT; B) ON CURVES; SO FAR AS THEY AFFECT SAFETY AND TAKING INTO ACCOUNT THE TYPE OF ROLLING STOCK USED
A report on the results of a questionnaire which was sent to 36 railways. The questions deal with the manner in which the railways are dealing with the laying, aligning, and maintenance of railroads where traffic at speeds in excess of 120 km/h. The conclusions of the report include a general view of the elements of maintenance of the permanent way as practices on an international scale.

Matsubara, K (Japanese National Railways) *Rail International* Dec. 1961, pp960-1039

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-220)
DOTL RP

A2 033741
THE ANALYSIS OF TRUCK FORCES ON CURVED TRACK
This report contains an analysis of the static, steady state forces on a four-wheel truck moving on curved track. The truck is used in the general sense to describe any four-wheel rigid wheel base of conventional truck size or as large as experimental four-wheel cars. This work should represent one phase of a program to attempt a rationalization of various truck phenomena. Appended to this report is an 8-part series of published articles: "The Mechanics of a Locomotive on Curved Track". These articles appeared in The Railway Engineer, 1934-1935.
Unpublished Data.

Johnson, MR Apr. 1957, 40pp, 8 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-240)
DOTL RP

A2 033742
TRACK-TRAIN DYNAMICS STUDY PROJECT TR-14 RAIL-VEHICLE INTERACTION STUDY--REPORT NO. 2 (COMPLETE ANALYSIS OF DATA USING COMPUTER TECHNOLOGY)
Following a description of the problem involved in preparing a hybrid computer program for the analysis and reduction of transient data taken in the actual field tests of the TRACK-TRAIN DYNAMICS STUDY

PROJECT and an explanation of the computational approach, there is a description of the method of interfacing the digitized data with the digital computers used to obtain an in-depth engineering analysis of the results of the tests. The evaluation of the numerical data indicated that under controlled operating conditions, the L/V ratios were significantly repetitive, which fact can be helpful in future studies. However, the inability to measure the track lateral deflections simultaneously to obtain the combined effect of vertical and lateral displacements in the rail was a severe limitation, and it was not possible to derive any information concerning track stresses and probable damage due to high dynamic loads. Graphs and bar charts were developed from the computational results to show the relationship between speed, drawbar load and L/V ratios for locomotives and cars, and graphs were used to illustrate the accumulative distribution of dynamic rail deflections on various segments of the railroad where the tests were run. Parameters that were not included in the field measurements which could have possibly contributed to the establishment of a more definite pattern include: the relative velocity between instrumented cars, track curvature and truck hunting action and the cross-level of track.
Company Report.

Lind, EF Nuttrell, NW (Southern Pacific Company)
Southern Pacific Company Report 2, Apr. 1971, 104pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-251)
DOTL RP

A2 033847
THE RIDING QUALITY OF A TRAIN PASSING A CURVE AS DETERMINED BY SUPERELEVATION AND CENTRIFUGAL FORCE
The purpose of this report is to clarify the relationship between the riding quality and a lateral acceleration on a curved track. The author has polled the opinions of 50 persons who took part in the test by riding a test train and correlated the findings of such polling with different degrees of lateral acceleration. Thus, the limit of excessive acceleration on curved tracks was examined from the standpoint of riding quality.

Koyama, M (Japanese National Railways) *Permanent Way* Vol. 6 No. 2, June 1963, pp19-25

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-302)
DOTL RP

A2 033848
THE TRACK
Stresses caused to the track by future trains intended to operate at a maximum speed of 300 km/h will remain within acceptable limits for the orthodox type of track and comfort will be excellent without the necessity of maintaining a quality of track better than that already achieved on our present high-speed lines. The laying of concrete slab track is not justified neither from the technical or economic point of view.

Prud-Homme, A (French National Railways) *French Railway Techniques* No. 2, 1970, pp67-79

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-327)
DOTL RP

A2 033850
RAILWAY TRACK STABILITY IN RELATION TO TRANSVERSE STRESSES EXERTED BY ROLLING STOCK. A THEORETICAL STUDY OF TRACK BEHAVIOUR. A PRACTICAL METHOD FOR DETERMINING THE RESISTANCE OF THE TRACK TO TRANSVERSE STRESSES EXERTED BY ROLLING STOCK
Part one studies the behaviour of railway track subjected to the stress of rolling stock and the experimental results on a test track with formulae for the pressures on the track through ballast or by rails through sleepers. Part two contains a computer solution to a fourth degree equation representing equilibrium equation of a track segment. Last, the interrelationship between rails, ballast, temperature and stress upon track behaviour are discussed.

Amans, F Sauvage, R (French National Railways) *Rail International* Nov. 1969, pp685-716, 2 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-334)
DOTL RP

A2 033852
GENERAL CONSIDERATIONS CONCERNING THE DESIGN OF CHANGE-OF-GRADIENT POINTS
Discusses the engineering aspects of changes necessary in change of gradient points in railroad tracks to increase maximum rail speed. Vertical transition curves for change of gradient points date to early days of railways. Only recently have factors of geometry, dynamics of the vehicles been considered. The earlier determination was done empirically without practical equipment consideration.

Henker, H *Rail International* June 1965, pp410-429, 7 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-339)
DOTL RP

A2 033854
TRACK GEOMETRY AND DESIGN OF THE PERMANENT WAY OF HIGH-SPEED LINES
The increase in maximum speed envisaged by many railway administrations makes exacting demands on the permanent way. In the following, the resulting problems associated with the railway track are discussed mainly on the basis of theoretical considerations and on the strength of the results of experimental research carried out by the German Federal Railway (D.B.) at speeds of 200 km/h. The resulting conclusions are also applied to even higher speeds. Comparisons are made with similar developments abroad.

Birmann, F (German Federal Railways) *Rail International* June 1969, pp393-428, 34 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-349)
DOTL RP

A2 033856
INCREASE OF TRAIN SPEED ON CURVES
For a train to reach the destination in shorter time is to increase speed on curves and gradients. It would involve enormous investment to eliminate curves and gradients through re-routing the track in a mountainous country like Japan. Thus, the alternative would be to achieve an effect of speed by selectively investing in certain high-speed trains. Introduced a bogie truck TR96 which is an experimental one built for the purpose of exploring the possibilities of increase speed on curves. The data collected using this truck will offer the basis upon which a new high-speed train will be developed for actual service in a few years.

Sakai, S (Japanese National Railways) *Railway Technical Research Institute*

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-376)
DOTL RP

A2 033857
HOW HIGH CAN TRAIN SPEED BE INCREASED?--A REVIEW OF PRESENT AND FUTURE
Discusses the factors which are the practical limits of trains speeds. These include obstacle by wave formation, adhesion limits, vibrational disturbance, problems of curved track, and the speed limits of existing trains. The summary discusses probable limits of present and future trains with differences in power-adhesion systems.

Matsudaira, T (Japanese National Railways) *Railway Technical Research Institute* Vol. 7 No. 2, June 1966, pp4-7

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-381)
DOTL RP

A2 033858
SOME PROBLEMS ABOUT TRACK AND MAINTENANCE OF WAY UNDER HIGH-SPEED TRAIN OPERATION
The railway is bound to offer speedier and more pleasant services. As the result, it is intensely desired that the future maximum train speed be advanced from the present 140-160 km/h or so to 200-250 km/h. It then becomes necessary to carefully examine such items as the effect on track and its maintenance of high speed train operation; what sort of measures will be necessary in order to ensure safety in such train operation as well as excellent riding quality and the most economical track structure and maintenance system thereof, taking into consideration both the initial and maintenance costs.

Ban, Y Murayama, H Satou, Y (Japanese National Railways) *Rail International* Feb. 1968

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-400)
DOTL RP

A2 033859
TRACK BED AND TRACK MAINTENANCE ON HIGH-SPEED TRACKS. EARLY EXPERIENCE FROM THE HIGH-SPEED RUNS BETWEEN MUNICH AND AUGSBURG AT THE TIME OF THE INTERNATIONAL TRANSPORT EXHIBITION
Remarks concerning alignment, design and maintenance condition of the permanent way on the high-speed section between Munich and Augsburg are followed by a discussion of test run results, with special reference to the relationships between track bed faults and vehicle accelerations at high speeds. The technical problems associated with high-speed tracks and their maintenance have been largely clarified.

Henn, W (German Federal Railways) *Rail International* July 1967, pp513-525, 10 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-403)
DOTL RP

A2 033860
EXPERIMENTAL RESEARCH ON THE EFFECT OF VEHICLES ON RAILWAY TRACK AT HIGH RUNNING SPEEDS
The methods adopted by the Soviet railways for testing the effect of ultra-high-speed vehicles on the track are primarily designed for fixing safe speed limits for vehicles. These conditions are determined by different criteria and characteristics; the determination is based on the evaluation of extensive statistical data obtained by measurements on the track and on the vehicles.

Verigo, MF (Ministry of Communications, USSR) *Rail International* Jan. 1968, pp39-70

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-412)
DOTL RP

A2 033861
"HIGH-SPEEDS" SYMPOSIUM
Theoretical and experimental solutions of track problems for high speeds, especially in regard to the design of curves and transition curves, track laying and maintenance tolerances as well as dynamic stability. Conclusions are given as regards the design of tracks and points.

Birmann, F (German Federal Railway) *Rail International* Apr. 1968, pp391-460

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-413)
DOTL RP

A2 033862
HOW HIGH CAN TRAIN SPEED BE INCREASED?
Discusses the factors which influence the maximum speed for railroad operations. Factors of wave formation, adhesion, vibrational disturbance, track curvature, are among those discussed. The limits of present track wheel system, linear motor-wheel system, linear-motor and air cushion and gas turbine air cushion are discussed and compared as to their limits within the speed spectrum.

Matsudaira, T (Japanese National Railways) *Rail International* Jan. 1967, pp93-99

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-415)
DOTL RP

A2 033863
WORK SESSION
Discussion of rolling stock for high speed operation. Includes discussion of bogie-suspension systems, comparison of 4 2h33l vs. bogie systems, locomotive design and relationship to track for determining speed limits. Part II which concerns fixed installations, discusses the theoretical and experimental solutions to the problems of track design for high speed operation. Note as these are records of working sessions, the papers are abstracted, and there are questions and discussion of many points raised in the meetings.

Rail International June 1968, pp1018-98
ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-417)
DOTL RP

A2 033864
DESIGN AND MAINTENANCE ASPECTS OF FREIGHT ROLLING STOCK RELATIVE TO THE EFFECTS ON THE TRACK
A modern Railway has grown up in this country with new and more powerful forms of traction and improved signaling and track, but the majority of wagons in use still consist of small four-wheelers, the basic design of which has not changed for over 50 years. These wagons incorporate a 'Box-on-Wheels' design which was robust and cheap, suitable for the low axle weight, low speeds, and low utilization of their day. They are, however, incapable of meeting today's conditions of high utilization and speeds without an unacceptable degree of maintenance and inspection. Until recently very little was known of the behaviour and design parameters necessary for high-speed wagons, and because of this, in 1963 when it became obvious that improved wagon suspension was required B.R. adopted the U.I.C. Double Link Suspension. This was a proven design which was, and still is, in wide use on the Continent, but here again problems arose when operating at higher speeds and axle loads permitted in this country. These problems concerned the rapid wear of the links and saddles due to the friction necessary for lateral damping and spring failures caused by the torsion induced in the spring superimposed on the normal vertical loading.

Love, A Sugden, EA *Railway Division Journal* Vol. 2 No. 4, 1971, pp467-482

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-423)
DOTL RP

A2 037169
COMPUTER STUDY OF DYNAMIC LOADS CAUSED BY VEHICLE-TRACK INTERACTION
Computer analyses of vehicle and track described produce results regarding actual dynamic loads and manner in which various parameters of vehicle and track structure affect these loads; it is possible to decide how to alleviate high wheel-rail stresses caused by modern traffic and track conditions; possible solutions range from better track maintenance to different wheel-rail geometries to changes in stiffness and damping of trucks and track structure.
ASME Meeting, April 15-16, 1969.

Meacham, HC (Battelle Memorial Institute); Ahlbeck, DR
American Society of Mechanical Engineers Paper 69-RR-1, 12pp, 11 Ref
SPONSORING AGENCY: Urban Mass Transportation Administration

ACKNOWLEDGMENT: EI (EI 70 18066)
PURCHASE FROM: ESL Repr PC, Microfilm

A2 037199
EFFECTIVENESS OF ALLOYING RAIL STEEL WITH CHROMIUM
Service tests have proved that type R-50 railway rails made of steel containing 0.63 to 0.75% C and 0.7 to 1.0% Mn and alloyed with chromium (0.5 to 1.0%) have an increased (by a mean 25%) resistance to contact-fatigue defects, less wear per 100 million gross tons of freight, and less rippling of the surface after use than carbon steel rails of standard composition. These advantages are obtained if the total C1/4 Mn content of the steel is not lower than 0.88%.
Original text published in "Stal" n9, September 1969, pp828-30, published by Mezhdunarodynaya Kniga, Moscow G-200, USSR.

Kazarhovskii, DS Shnaperman, LY Kravtsova, IP Ravitskaya, TM Pavlenko, YP Skvortsov, OS Shvarts, YF *Steels in the USSR* No. 9, Sept. 1969, pp823-5

ACKNOWLEDGMENT: EI (EI 70 34498)
PURCHASE FROM: ESL Repr PC, Microfilm

A2 037203
THE RAILS ON THE GERMAN FEDERATED RAILWAYS [DIE SCHIENEN DER DEUTSCHEN BUNDESBAHN]
With the introduction in Germany of greater train loads and higher operating speeds, it was necessary to replace earlier rail, known as S49 with heavier rail, designated S54. Its usage is on main lines at operating speeds

of 140 km/hr and tonnage in excess of 30,000 gross tons per day. Another rail, S64, is used where axle loads are in the range of 30 to 35 tons and in tunnels on German railways. Rail breakages are compared for the various rail. Qualities and properties of the steel are discussed and theoretical stress lines in the rail sections are depicted. The shape of the rail head on the newer designs was changed to provide improved contact with the profile of the wheel tread. Specific costs of rail replacements on the German Railways are given for the various rail designs. [German]

Doll, A *Eisenbahntechnische Rundschau* No. 10, Oct. 1967, pp 341-350, 10 Fig, 4 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-464)
DOTL RP

A2 037204
STRESSES IN RAIL HEADS--COMPARISON BETWEEN THEORY AND EXPERIENCE [SCHIENENKIPFBEANSPRUCHUNG-VERGLEICH ZWISCHEN THEORIE UND PRAXIS]

This article describes the latest investigations into the problems of rail loading and stresses. Laboratory experiments with a plastic model of a rail are described, with the results charted. These are related to the tests and experience of the German Railways in their investigations of rail failures and damage. Charts are included which show the relations of the shearing stresses in the rail head to the wheel diameter and axle loading, the stresses increasing as the wheel diameter decreases or as the axle load increases. [German]

Eisenmann, J *Eisenbahntechnische Rundschau* No. 10, Oct. 1967, pp 355-361, 17 Fig, 4 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-465)
DOTL RP

A2 037214
THE TOLERANCE OF TRACK LONGITUDINAL LEVEL IRREGULARITY DETERMINED BY RIDING QUALITY

This investigation was concerned with the vertical vibration of bogie car which was caused by track longitudinal level irregularity. It delineated the characteristics of the longitudinal level irregularity which can occur on track and proposed a method to determine the tolerance of longitudinal level irregularity from the view point of riding quality. In addition, the study examined the relation between the riding quality, the car structure and condition, the running speed and the measuring method of track longitudinal level irregularity.

Sato, Y (Japanese National Railways) *Railway Technical Research Institute* Vol. 8 No. 1, Mar. 1967, pp 43-48, 13 Fig, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-634)
DOTL RP

A2 037227
NEW SYSTEM OF TRACK MAINTENANCE

A new track maintenance system is described for high-volume train traffic which hopefully will result in reduced maintenance costs. Features of both new and old systems are compared.

Shibata, M *Railway Technical Research Institute* Vol. 2 No. 2, June 1961, pp 3-5, 7 Fig, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-648)
DOTL RP

A2 037228
ECONOMICS OF TRACK IMPROVEMENT ATTENDANT ON SPEED-UP

This article discusses some of the factors involved in determining the maximum speed of trains in the context of achieving maximum economic benefit at minimum risk of safety and minimum maintenance. Train speed is examined in terms of its effect on (1) strength of track structure; (2) fatigue of track; (3) strength for lateral thrust; (4) safety against derailment; (5) ride comfort index and vibrations of car.

Yamamoto, H *Railway Technical Research Institute* Vol. 3 No. 1, Mar. 1962, pp 6-8, 3 Fig, 3 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-649)
DOTL RP

A2 037230
STATISTICAL CONTROL OF TRACK MAINTENANCE

The subject of this paper concerns a method of control of maintenance of track making use of statistics and probability theory. The control of track maintenance should be handled on the basis of probability or statistics, while observing the phenomena from the rules of mechanics. A few examples of statistical treatment are given.

Onogi, J *Railway Technical Research Institute* Vol. 1 No. 3, June 1960, pp 3-5, 4 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-651)
DOTL RP

A2 037239
WEATHER AND SITE EFFECTS ON RAIL TEMPERATURES

The effective operation of de-icing baths installed on open sections of the London Transport Board system is dependent on advance warning of icing risk so that they can be switched on before traffic ceases at night. When these baths were installed there was a lack of information on the relationship between weather and rail temperature, and led to an investigation to provide this information. It was decided to try to relate rail temperature to air temperature. Analysis of the data provided by the chart records was carried out in a variety of ways, according to the particular information desired. The maximum and minimum values of rail temperature or air temperature was plotted so as to show seasonal trends; diurnal variations of rail temperature at different times of the year, were studied; and the extent to which rail temperatures fall below air temperatures is of interest in connection with icing risk forecasts. The results of some such analyses are discussed.

Richards, J (London Transport Board) *Railway Gazette* Vol. 120 June 1964, pp 505-512, 6 Fig, 3 Tab, 5 Phot, 5 Ref, 2 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-935)
DOTL RP

A2 037241
RAIL FASTENINGS

This survey of rail fastening hardware for use with timber or concrete sleepers describes and compares commonly used baseplates, elastic spike fastenings, single spikes or stud-screws, baseplate type fastenings and rail seat pads.

Railway Gazette Vol. 120 Feb. 1964, pp 111-113, 10 Fig, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-937)
DOTL RP

A2 037244
PERMANENT WAY TECHNIQUES ON THE NETHERLANDS RAILWAYS

The use of block sleepers with steel tie-bars and universal type of spring fastening by Netherland Railways is described in terms of track resistance to longitudinal and transverse displacement. Epoxy resins are used to bond the steel tube cross ties in the concrete blocks, and a DE (Deenik and Eisses) spring clip is the common rail fastening.

Railway Gazette Vol. 121 Nov. 1965, pp 865-866, 9 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-940)
DOTL RP

A2 037249
TRACK STRESS RESEARCH

The purpose of this work was (1) to verify the speed allowance formula, (2) to investigate the increment of stress over and above the static effect under normal conditions from track defects, (3) to investigate the conditions of support at rail joints, (4) to investigate the stability of ballast, and (5) to investigate the effects on rails and sleepers of the lateral forces set up by the hunting movement of locomotives. In regard to (1) and (2) it was found that experimental static deflections and stresses are in reasonably close agreement with calculated values. In regard to (3), it was concluded that stronger fishplates are needed to facilitate maintenance and rail joints of inadequate strength are the cause of much of the impact effect. Increasing the number

of sleepers will reduce this impact effect. In regard to (4), the shape of the sleeper was found experimentally to have no noticeable influence on its deflection under a given load, but stress distribution between the sleepers and subsoil requires investigation. In regard to (5), further investigation on curved track was recommended to confirm the consideration that design to rolling stock to reduce nosing on the sharper main-line curves would reduce the secondary stresses and thus offset the increased stress due to centrifugal effects.

Gelson, WE Blackwood, FA (Railway Department, India) *Railway Gazette* Vol. 73 Feb. 1940, pp 254-255, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-945)
DOTL RP

A2 037258
BRITISH RAILWAYS TRACK-SPRAYING TRAIN
The article describes a track spraying train for weed control that incorporates re-designed equipment to reduce water consumption and which permits operation at 40 mph. Water consumption has been reduced from 80 to 40 gallons/acre at 20 mph and is still further reduced to 20 gallons/acre at 40 mph. This led to a reduction in size of the main diesel engine from 12 hp to 7 hp, and in the main pump output from 260 to 100 gallons/mile, effecting considerable space savings. The train stores sufficient weed killer for 130 miles of spraying at 14-1/2 feet swath or over 400 miles of cess-only treatment.

Railway Gazette Vol. 118 1963, p 465, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-965)
DOTL RP

A2 037263
TRACK-LINING EQUIPMENT
The Matisa range of equipment for simple and accurate track lining is described. The equipment consists of a roll ordinator, a slewing gauge, and a curve corrector. The conventional method of surveying track for lining purposes is by "string-lining." It is claimed that one man, using a roll ordinator can string-line a curve at twice the speed and with more accuracy than the normal three-man team. Following string-lining, an alignment adjustment can be arrived at, by operating on the measured versines, either mathematically or mechanically, by using a multistation curve calculator.

Railway Gazette Vol. 118 Mar. 1963, pp 251-252, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-970)
DOTL RP

A2 037267
CONSOLIDATION OF RAILWAY FOUNDATIONS IN THE WESTERN REGION
This article discusses the consolidation of railway foundations where the tracks run along a ledge cut out of solid rock. The cliff was found to be settling and disintegrating. Repair works included (1) demolition of the rock cliff (2) trimming the new rock face to a batter fixed on site and to suit existing walls on each side, and (3) building of a 2-ft thick granite face wall to protect the exposed rock face.

Railway Gazette Vol. 118 Feb. 1963, p 132, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-974)
DOTL RP

A2 037269
THE EVOLUTION OF THE AMERICAN RAIL
A review is presented of the development of the railway rail in America, including the change from iron to steel, the evolution of the modern American flat-bottom section, up to 152 lb. per yd. in weight, and present-day American rolling methods. Rail sections arranged in chronological order from the 5 ft. long, cast iron plate, used in 1767, to the 131 and 152 lb. rails introduced in 1930, are shown to trace the development of the American rail. Results are reported of a study to compare 100 lb. and 131 lb. rails as to maintenance costs and life, as affected by increasing weight loads. The heavier rails extended the life, not only of the rails, but also the sleepers and fishplates.

Allen, CJ (Massachusetts Institute of Technology) *Railway Gazette* Vol. 75 Dec. 1941, pp 581-584, 1 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-976)
DOTL RP

A2 037271
THE HEY-BACK METHOD OF RAIL FASTENING
The Hey-Back rail fastening has two components. One is a rolled-steel base plate with parallel ribs on each side of the rail seat to hold the rails to gauge. The outer side of each rib is curved over in such a manner as to form a keyway, into which there is driven a spring steel clip. The lower side of each clip is tapered from both ends at a leading angle to facilitate its entry into the keyway; as the clip is driven in, the taper forces the clip forward, with its double bend acting as a fulcrum in the keyway, until the opposite side is exerting considerable pressure on the rail-foot. To ensure perfect contact between key and keyway, each keyway is machined to a fine tolerance. The baseplate is held down to the sleeper by coachscrews, chair-bolts, or other fastenings of a normal type. Additional information is given relating to advantages and use with timber and concrete sleepers.

Railway Gazette Vol. 116 No. 10, Mar. 1962, pp 274-75, 1 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-978)
DOTL RP

A2 037276
HEAVY-DUTY RAIL CLIPS WITH CAST-IRON BASEPLATES
The article gives some particulars of the Mills clip, an easily-applied rail fastening widely used on wood and concrete sleepers. The Mills clip is made of special ribbed-section spring-steel bar, having a width of 2-1/8 in. and thickness of 15/32 in., heat treated. It generates its grip between the extremities of the upper and lower arms, not relying on any contact with the baseplate except directly under the point of application of load on the rail foot.

Railway Gazette Vol. 114 Apr. 1961, pp 395-397, 4 Fig, 7 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-983)
DOTL RP

A2 037277
HIGHER SPEEDS THROUGH CURVES
Investigation of rail friction (mu (sub y)), made on both wet and sanded rock, at speeds between 6 and 72 km/h, showed values ranging between 0.4 mu (sub y) and 0.5 mu (sub y) with banding leading to higher values. Values of mu (sub y) for lateral slip versus wheel-load are given as are values of mu (sub y) for a range of R(m) from 300 to 890 at speeds from 80 to 110 km/h. It was noted that the use of bogie intercouplers reduce rail friction (mu (sub y)) and flange wear.
Letter to the editor of the Railway Gazette.

Koffman, JL *Railway Gazette* Vol. 126 May 1970, p 367, 2 Fig, 3 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-984)
DOTL RP

A2 037278
TRACK-RELAYING EQUIPMENT
A number of Secmafer Boyer Schwarz M.6 track-relaying gantries have been supplied to British Railways. Each gantry weighs 7-1/2 tons, and the overall width is 11 feet 4 in., with 9 feet 6 in. inside clearance for lifting the load. With the twin rams and screw-jacks mounted in the side frames both fully extended a pair, or one unit, of gantries can load or unload up to four concrete-sleepered sections high on a standard Salmon wagon, with 2-in. of timber packing on the wagon deck. Power is supplied by a standard Renault Dauphine engine. The machines have operated successfully on an incline of 1 in 40. The speed of lift of the twin rams is 22 ft. per min., and of the screw jacks is 12-8 ft. per min. when the two movements are made simulatneously, these speeds are approximately halved.

Railway Gazette Vol. 116 Oct. 1962, pp 400-401, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-985)
DOTL RP

A2 037279
PRODUCTION AND MAINTENANCE OF LONG WELDED RAILS
From 1938-1948, flash-butt welded rails, 300-ft. long, have become the accepted practice of London Transport, for both maintenance renewals and

new works, and were used on more than 70 miles of main line by 1949. Some of the problems involved in the production and maintenance of this type of track are described. The machined joints, in tunnels, and the expansion switches, on open sections, were used to relieve rail stresses. Wooden keys were also used instead of steel key for stress relief. Methods used by two automatic flash-butt welding plants to produce and test the long rails are briefly discussed. A temperature variation of 50 deg F, is the maximum to which this type of track should be subjected without being freed from stress. The long rails are unkeyed during early spring and at mid-summer. Examination of track maintenance records on 60 ft and 300 ft long welded rail revealed a savings in favor of the 300-ft rail.

Railway Gazette Vol. 90 Mar. 1949, pp 284-285

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1068)
DOTL RP

A2 037281
FASTENINGS BETWEEN STEEL SLEEPERS AND FLAT-BOTTOM RAILS

As a result of extensive trails on main lines in India, the Mills spring steel loose jaw has become a standard type of fastening used with steel sleepers throughout India and Pakistan. It is used not only in plain track, but also in turnouts with steel sleepers, if track-circuiting is not required. The formation of the jaw and its installation on the rail is described. A longitudinal section of the center of the steel sleeper, showing details of the rail fastening, is illustrated. Fifteen years' experience using the Mills jaw has shown that no wear has taken place, and that gauge has been maintained.

Railway Gazette Vol. 90 Apr. 1949, p 446, 1 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1070)
DOTL RP

A2 037282
TRACK FORMATION IMPROVEMENT IN HOLLAND

On the main line of the Netherlands Railways from Utrecht to Rotterdam, a seven mile section between Oudewater and Gouda passes through an area of waterlogged peat moor. Two methods were tried, in 1938, to strengthen the foundation for the track. The first method provided for the construction of two dams of sand, which completely enclosed the embankment. Large quantities of sand were deposited quickly, and the weight of this material pushed the semi-liquid peat aside. In the second method, the sand was deposited gradually, so that the peat became more compact, and less likely to move. The second method was used until 1948 due to the expense and the risk of serious disturbance of the track present with use of the first method. A third method was introduced in 1949. The top of the embankment is removed and replaced by a reinforced layer of fine sludge slag. This slag hardens into a substance resembling concrete. A layer of sand is placed between the top surface of the slag and the gravel ballast. Some 5-1/2 miles of double track are to be strengthened in this way.

Railway Gazette Vol. 90 May 1949, pp 543-544

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1071)
DOTL RP

A2 037284
THE RAILWAY FIGHT AGAINST SNOW AND ICE

The problem on the 2,387 miles of electrified track of the main-line companies and the 174 miles comprising the London underground network is ice. Probably the best protection against icing is to keep trains constantly running so that the ice does not form. London Transport has a fleet of "sleet" locomotives to keep conductor rails clear. These are fitted with pneumatically operated wire brushes carried on the collector shoe; they have roller ice crushers and can also eject on to the live rail a stream of de-icing fluid to prevent the ice-re-forming after the locomotive has once cleared it away. No fewer than 1,376 sets of points operating in the London area are provided with direct or indirect heating equipment, but other points and junctions have to be kept clear largely by use of rail scrapers, salt, or portable de-icing apparatus.

Railway Gazette Vol. 82 Jan. 1945, p 81

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1135)
DOTL RP

A2 037287
TRUE GAUGE IN STRAIGHT TRACK

The permissible amount of slack gauge in straight track in relation to the lateral oscillation or nosing of locomotives is considered. S or slack gauge, for any one locomotive and type of track will vary inversely as the square of the speed. Mathematical derivations for engineering physics aspects of the problem are given.

Inglis, RA *Railway Gazette* Vol. 82 May 1945, p 445, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1138)
DOTL RP

A2 037289
A NEGLECTED POINT IN SWITCH DESIGN

A derailment of the first car behind a 6-coupled saddle-tank shunting locomotive at the marshalling yard at Kantara during World War I is analyzed. Kantara was at the beginning of the military railway from Egypt to Palestine The locomotive, in a facing direction through a turnout to the right-hand diverging road, took the turnout correctly. The wheel flanges of both the locomotive and the car were considerably worn; those of the car more so that those of the locomotive. Rail climbing by the rather sharp flange of the car wheel was suspected, but no signs of this were visible. There were signs which showed that the wheels had dropped on to the sleepers as soon as the space between the diverging rails permitted. The events leading to the derailment were reenacted under observation. When the leading wheels of the locomotive were partly through the switches the point of the left-hand switch commenced to open about 0.375 in. The fire of the leading wheel of the wagon entered this opening with the result described. The switches, which had a heel joint with a standard clear flangeway of 1.75 in., were struck by the wheel flange at the right rear of the locomotive as the locomotive's worn tire ran hard against the left rail. Detailed illustrations are given to describe the derailment cause.

Railway Gazette Vol. 84 May 1946, pp 484-486, 9 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1152)
DOTL RP

A2 037291
DEVELOPMENT AND MANUFACTURE OF PRE-STRESSED CONCRETE SLEEPERS

The Tallington factory, completed in August, 1944, has 20 lines, each accommodating 100 standard main-line sleepers. Filling the moulds at one fixed place in the production line, allowed a vibrating table to be used and a water cement ratio of 0.39 for the concrete. For wiring, the coils of wire are carried on a track and the wires are drawn off under semi-tension, which obviates the need of first straightening the wires. As they leave the wire carrying truck they are automatically cleaned by passing through a scrubbing box containing carborundum granules. The method of manufacture allowed three minutes of working time per pair of sleepers during concreting and removal, this time factor also being maintained for the wiring processes. The reduction in labor costs using the mechanized mass-production process showed a savings of 88 percent over an earlier method described.

Railway Gazette Vol. 84 May 1946, p 538

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1154)
DOTL RP

A2 037294
FLAT-BOTTOM TRACK IN GREAT BRITAIN

The L.N.E.R. laid a system of switch-and-crossing work in flat-bottom rail in 1944, for experimental purposes. The turnout, which used 110-lb. flat bottom rails, is illustrated. The normal 1 in 20 rail cant or tilt is retained through the connections, and heel-less switches are used; the lifting of the switch above the stock rail has been eliminated. In general the switch angles, radium of switch curve, and the top planing are similar to bull head British Standard design. The usual type of fastening used in this flat-bottom switch and crossing work is the hook bolt and malleable iron clip to secure the rail to the cast-iron base plates, and chair screws to fasten these plates to the timbers.

Railway Gazette Vol. 85 Aug. 1946, pp 178-179, 2 Fig, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1157)
DOTL RP

A2 037295
PORTABLE WELDERS FOR JOINING RAILS
The portable welder is mounted on a wheeled chassis complete with transport rollers, cold saw, centrifugal pump for cooling water, tanks for water, fuel, and lubricant, milling machine, and guide pieces, besides the usual alternator, exciter, and switchgear. Two sections of the rail to be joined are clamped in the machine and brought together, and as the current passes through the point of contact, the metal is warmed; by repeated separation and re-union, an effective preheat is accorded to the ends. Flashing then follows, during which, by applying moderate force to the fixed piece, the rail is slowly pressed forward, and to the accompaniment of a shower of sparks, molten metal is ejected. The rails attain the desired temperature for welding during this treatment, and with a powerful upset motion become united. The system is completely automated. When the rail ends to be joined are at hand, from 7 to 10 joints an hour are made. Each weld requires two to three minutes.

Railway Gazette Vol. 85 Sept. 1946, pp 296-305, 3 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1158)
DOTL RP

A2 037298
WOODEN SLEEPER LENGTHS
This article discusses an appeal by a U.S. engineer to adopt wooden sleepers 9 ft long for all lines carrying heavy traffic. The longer sleepers would add resistance to forces tending to distort the track, reduce maintenance, secure smoother riding, and minimize the risk of center binding. The British in 1946 were using sleepers 10 in. times 5 in. times 8.5 ft. Due to the timber shortage, broader sleepers, 12 in times 5 in times 8.5 ft., were no longer being used adjacent to joints.

Railway Gazette Vol. 85 Nov. 1946, p 572

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1161)
DOTL RP

A2 037301
USE OF CONCRETE SLEEPERS AND STEEL SLEEPERS ON THE SOUTHERN RAILWAY
War time shortage of timber in England prompted experimentation with concrete and steel for sleeper construction. The first experience with the use of reinforced concrete sleepers on a main line in 1912 resulted in shattering after only 5 years' life. Concrete 1:1-1/2:3 unvibrated, reinforced with four 3/4 in. main bars were in good condition after 14 year's service on the main line between Exeter and Plymouth. Speed of trains in this section rarely exceeds 25 to 30 mph. Testing results of concrete sleepers on fast-running main line is incomplete since these sleepers have been in service less than one year. Steel is difficult to obtain during wartime; however some results on the use of steel sleepers are reported. Weight losses are reported for three types of steel sleepers. Steel sleepers are unsatisfactory when the track is to be electrified or track circuited.

Railway Gazette Vol. 79 Oct. 1943, pp 383-388, 3 Fig, 1 Tab, 8 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1287)
DOTL RP

A2 037302
ALTERNATIVES TO THE WOODEN RAILWAY SLEEPER
Due to the difficulty of importing timber during World Wars I and II to make wooden sleepers in Britain, this study examines the limited data available on substituting steel and concrete for wooden sleepers. A half million steel sleepers, 98 percent consisting of mild steel, were laid from 1922-1929, under all types of service conditions. Five percent were removed after 13 to 14 years' life due to excessive corrosion. Two other steel sleepers, the Sandberg and the United Steel Type 2-A, may have longer life, but further testing is required. Only small scale trials on concrete sleepers have been made due to failures encountered in early trials, and the comparatively high cost and greater weight of concrete sleepers.

Railway Gazette Vol. 79 Nov. 1943, p 477

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1288)
DOTL RP

A2 037303
CEMENT GROUTING RAILWAY FORMATION
To eliminate water pockets and weak spots in the railway formation, pressure grouting with cement has proved satisfactory in the United States. To prepare the roadbed for grouting, water is injected to remove air, clay and other solids to make room for the grout and to test the subsoil to show whether it is suitable for grouting. Measures to avoid wasting of grout and upheaving the track during grouting are described. The proper mix of cement, sand and water and the amount of grout needed are briefly discussed.

Railway Gazette Vol. 79 Nov. 1943, p 508, 3 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1289)
DOTL RP

A2 037305
MECHANICAL BALLAST DRESSING
The mechanical ballast dressing unit of the Erie Railroad is described. The unit is a 40-foot steel flat car fitted with scraper blades on each side. The blades are operated by one full-time operator using compressed air for blade adjustment. The blade can be lifted to clear obstructions and can be folded against the car when not in use. The unit is propelled by a locomotive at about 3 mph.

Railway Gazette Vol. 80 Jan. 1944, pp 41-42, 5 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1291)
DOTL RP

A2 037307
PRE-STRESSED CONCRETE SLEEPERS
During concrete sleeper manufacturing, the steel reinforcement is subjected to a high tensile stress. This stress is then utilized to induce in the concrete compressive stresses which will be directly opposite to those tensile stresses produced by the external forces imposed on the sleeper. A high-tensile steel is used and the value of the applied force is calculated so that the advantage of pre-stressing is retained permanently in the sleeper. The tensile stresses by the process of pre-stressing are so reduced as to permit dispensing with all shear reinforcing, which results in a saving of steel of between 70 percent, and 80 percent, over the ordinary reinforced concrete sleeper.

Barber, RSV *Railway Gazette* Vol. 80 Feb. 1944, p 39, 3 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1293)
DOTL RP

A2 037422
PERMANENT WAY OF THE FUTURE
The properties of the ballast bed and the savings in maintenance obtained by using a concrete bed in its place are apparasied. For 300 km/h service, the use of U 80 rails of 60 kg/m mounted on concrete blocks with cross-ties and double-elastic fastenings is recommended. Such fastenings allow a greater degree of vertical movement of the rail and the sleepers would be laid on a ballast bed 35-cm deep. Japanese experience with continuous welded track and 53.5 kg/m rail mounted on pre-stressed monlithic concrete sleepers with double-elastic French-type fastenings is cited. Mention is made of the problem of ballast and the continual maintenance it incurs. Swiss studies on ballastless track for tunnels is reviewed.

Railway Gazette Vol. 126 Sept. 1970, pp 710-711, 3 Phot, 2 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-878)
PURCHASE FROM: NTIS Repr PC
DOTL RP

A2 037423
SAR EVOLVES A MODERN PERMANENT WAY
To help cope with increasing freight and passenger traffic, South African Railways has made many improvements to the track on its trunk routes. A rail of 115 lb/yd section is now being used to replace the 96 lb/yd rail on the more heavily-loaded lines. Only 400,000 wood sleepers are used annually. Fist and Pandrol types of fastenings are used. Maintenance is mechanized, including the use of 62 heavy, on-track tampers. Concrete sleepers are being laid at the rate of about 1,300,000 a year. Concrete track is being laid in tunnels. The weed control program is described.

Townsend, BP (South African Railways) *Railway Gazette* 3 Phot Vol. 126

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-879)
DOTL RP

A2 037428
DEVELOPMENTS IN BR TRACK MAINTENANCE PROCEDURES AND MECHANISATION EQUIPMENT
To minimize adverse effects upon long welded track, British Railways has established a policy of assuring that extensive track work will not commence during temperature extremes (above 32 degrees C nor below 0 degree C). To minimize lateral movement of the track attention to shoulder widths as well as to cribs being well filled. To increase efficiency, new types of maintenance equipment are described and discussed.

Railway Gazette Vol. 126 May 1970, pp 345-347, 1 Tab, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-788)
DOTL RP

A2 037433
NS ADOPTS GLUED INSULATED RAIL JOINTS
Netherlands Railways has devised a simple solution to the insertion of an insulated joint into a length of long-welded rail for signalling purposes. It involves sawing through most of the rail section from below, but leaving the rail head intact while a strong glued joint is made with special fishplates. Holes for the fishplates are drilled before sawing begins. Because this technique produces such a perfect joint between the two rail ends, its use has now been extended to insulated joints in jointed track or point-work.

Railway Gazette Vol. 125 Feb. 1969, p 144, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-867)
DOTL RP

A2 037435
DB EXPERIMENTS WITH POWERED TILTING OF COACH BODIES
A three-car diesel train with air suspension has undergone field testing to develop an electro-pneumatic servo which tilts the body inward on curves. The three-car diesel train has been run experimentally at 130 km/h over a route that is largely limited to 105 km/h. If the train itself was capable of higher speeds it is claimed that 135 km/h could have been attained safely. Air springing provides the tilting mechanism, the servo system being arranged so that the air bellows on the outside of the curve are inflated and those on the inside deflated, thus tilting the body relative to the bogie towards the inside of the curve. The centrifugal force that can be tolerated without discomfort is taken as 0.067 g, which is equivalent to a cant deficiency of 100 mm.

Railway Gazette Vol. 125 Jan. 1969, pp 57-58, 2 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-870)
DOTL RP

A2 037436
REFURBISHING BR TRACK FOR HIGH SPEEDS
British experience on improving track for increasing traffic is recounted. Track designs and construction methods are covered and a section on crane design is included.

Railway Gazette Vol. 125 Nov. 1969, pp 863-865, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-876)
DOTL RP

A2 037438
PLASMA TORCH PROVED FOR LOW SPEED APPLICATIONS
The article discusses research results of the British Railways attempts to improve adhesion of rail vehicles by using a plasma torch to remove materials from rail surfaces. Laboratory tests confirmed the feasibility of using such a device, in two areas: low speed operation for freight trains and high speed operation for passenger trains. A test vehicle was made up to field test the plasma rail vehicle. Results of the testing show that mechanical condition of the rail head is important; old rail with large areas of contact required higher output than new rail. The tests show conclusively that starting and low speed operation of freight vehicles with low adhesion can be resolved by the application of the plasma torch.

Dobbs, DJ (British Railways Board) *Railway Gazette* Vol. 125 Nov. 1969, pp 812-814, 5 Fig, 1 Phot, 3 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-863)
DOTL RP

A2 037442
LOADING OF THE RAIL REGARDED AS A BEAM [BEANSPRUCHUNG DER SCHIENE ALS TRAGER]
The author presents a procedure whereby rail loading as a result of bending, eccentric imposition of load, internal, thermal and other stresses, as well as the ballast coefficient, can be determined. From data and formulae presented, it is possible to calculate the permissible speed and axle loading for a given rail profile. The condition of the soil foundation and the ballast bed are also considered in this study. [German]

Eisenmann, J *Eisenbahntechnische Rundschau* Vol. 18 No. 8, Aug. 1969, pp 306-312, 10 Fig, 2 Tab, 10 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-571)
DOTL RP

A2 037443
GERMAN FEDERAL RAILWAY EXPERIMENTS WITH CONCRETE TRACK BEDS
If sleepers and ballast prove inadequate for speeds over 200 km/h, some form of structural support for the track will be necessary. Because of the vibrations induced by high speed trains and the need to maintain the line and level of track within closer limits, the upper speed limit for sleeper track may be regarded as 260 km/h. Three types of track and three types of fastenings are examined. Comparative stresses in the ground under concrete bed track and conventional sleeper track in ballast are shown.

Birmann, F (German Federal Railways) *Railway Gazette* Vol. 125 Apr. 1969, pp 308-310, 3 Fig, 6 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-850)
DOTL RP

A2 037447
EXPERIMENTAL CONCRETE TRACK-BED AT RADCLIFFE
Using a slip form continuous road making machine, British Railways has laid a trial length of concrete slab foundation on which six kinds of fastenings are being tested. All systems were laid to give rail alignment level and gauge tolerances considered adequate for 200 km/h conventional trains, although the actual speed of trains through Radcliffe will not exceed 110 km/h. Axleloads are up to 25 tons. Acoustic and vibrational measurements will be made, together with general structural and component performance. Load-detection tests are being made in the laboratory on the different fastening assemblies and site measurements will be made under service conditions.

Lucas, JC Lindsay, D Aitken, WK (British Railways) *Railway Gazette* Vol. 125 July 1969, pp 547-549, 4 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-854)
DOTL RP

A2 037449
RAIL TO SLEEPER FASTENINGS
Laying the rail on a sleeper and fixing the two together can be done in four ways: direct laying and direct fixing; direct laying and indirect fixing; indirect laying and direct fixing; and indirect laying and fixing. A sample of each type is shown. Methods of fastening to wood, concrete and steel cross ties are discussed. The fit-and forged fastenings, such as the SAF fastener, the heyback and the Pandrol clip are illustrated in use.

Srinvasan, M (Indian Railways) *Railway Gazette* Vol. 125 Aug. 1969, pp 611-615, 6 Fig, 6 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-856)
DOTL RP

A2 037450
BALLAST CONSOLIDATION AND DISTRIBUTION ON THE TRACK
Two machines introduced by Robel and Company for ballast distribution and consolidation after the track has been laid have been introduced. The

ballast plough incorporates a novel design to meet the higher capacity of the modern 32-tool tamper. High-speed vibrators mounted on the guiding forks exert a compacting force of up to 10 tons. The machine exceeds along the track at 1,000 to 1,500 m/h and consolidates continuously. This matches the greatest working speed of double head tamping machines and guarantees a consistent compacting effect for the whole length of the bed over which it is run.

Railway Gazette Vol. 125 Sept. 1969, pp 670-671, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-857)
DOTL RP

A2 037453
KEEPING THE TRACK IN ITS PLACE
The lateral stability of track laid with continuous welded rail may be affected by unusually warm periods which cause trouble at points where insufficient care was taken in clamping at correct combination of rail temperature and stress. Adding ballast to the shoulders is only part of the answer. If the shoulders are to resist lateral movement they must be compacted after the track has been lined and levelled and the sleepers tamped. Machines are now available to do this work.

Railway Gazette Vol. 125 Oct. 1969, p 720

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-860)
DOTL RP

A2 037454
HYDRAULIC TENSIONING OF CONTINUOUS WELDED RAIL
Stretches the rail to the expansion which would occur by a temperature rise from the installed temperature to the mean of the normal extremes of heat and cold to which the rail is subjected in the annual weather cycle. Rails installed in ambient temperature conditions higher than the specified ideal temperature range are not adjusted at the time of installation. The rail is laid, the temperature is noted, and at the first suitable opportunity it is brought into the optimum stress condition.

MacLeod, NJ (British Railways); Martyn, PH (Greenside Hydraulics Limited) *Railway Gazette* Vol. 125 Jan. 1969, pp 31-33, 2 Fig, 1 Tab, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-872)
DOTL RP

A2 037456
PRESENT TRENDS IN MACHINES FOR TRACK MAINTENANCE
This article provides a general discussion of the importance of coordinating materials and machines for track construction. Detailed discussion focuses on the operations involved in tamper--leveller--liner activities and the limitations of them.

Diaz Del Rio Y Jaudenes, M (Fixed Installations RENFE) *Railway Gazette* Vol. 124 Nov. 1968, pp 845-846

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-871)
DOTL RP

A2 037457
ULTRASONIC RAIL TESTING AT THE ROLLING MILL
Studies have shown that fatigue defects which appear in rails in the track can always be traced back to segregations in the metal, inclusions or micro-cracks. Metallographic tests which show up these defects are lengthy, costly and must inevitably be restricted in scope because they involve destruction of the specimen tested. Consequently, it was necessary to find a non-destructive method of detecting these defects by sounding the whole length of the rail head. The ultrasonic method using echoes was chosen by SNCF and ORE. The Ralus equipment was designed to detect heteorogeneities which are particularly harmful to the performance of the rail in the track: non-metallic inclusions and flakes located in the critical zone of the rail-head where most fatigue defects originate. Studies have shown that the Ralus testing method does give a reasonable indication as to the quality of the rails.

Railway Gazette Vol. 124 Oct. 1968, p 752, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-873)
DOTL RP

A2 037459
NEW RAIL FASTENINGS FOR CONCRETE TIES [EIN NEUE SCHIENENBEFESTIGUNG AUF BETONSCHWELLEN]
The development of concrete ties has produced a rigid reinforced, pre-stressed concrete tie that has proven so successful that there are more than twenty million of them in use today on the German Railways. From both the engineering and economic standpoints, they are giving fully satisfactory service, even on heavy travelled routes. However, the search is still going on for a fastening to hold the rail in proper relation to the tie. Hopefully a fastening will hold the rail firmly to guage under both vertical and horizontal load; provide the necessary elasticity; afford resistance to lateral and longitudinal movement of the rail; provide full electrical insulation between rail and tie: and have the lowest total cost. Data and charts are included to show the relative worth of the various fastenings that have been tried, and are in use today. [German]

Henn, W *Railway Gazette* pp 96-102, 10 Fig, 1 Tab, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-507)
DOTL RP

A2 037460
THE REQUIREMENTS OF THE RAILWAY AND ITS FURTHER DEVELOPMENT FOR HIGHER SPEEDS AND AXLE LOADS [BEANSPRUCHUNG DES EISENBAHNOBERBAUES UNE SEINE WEITERENTWICKLUNG FUR HOHERE GESCHWINDIGKEITEN UND ACHSLASTEN]
Constant research has been conducted in the permanent way with the rails, ties, ballast bed and the underneath ground structure for improvements to cope with the increasing axle loads and higher speeds. This article considers the more sophisticated concrete rail bed structure. The conclusions are as follows: The present ballasted rail structure with rails of 90 kp per mm (super 2) is suitable for axle loadings of 25 to 28 tons, at present speeds. With rails of 110 kp/mm (super 2) and weight per meter of 70 kg, the axle loading can be increased to 37 to 42 tons. However, the ballast bed must be strengthened. For speeds greater than 220 to 250 km/h, there will need to be new developments for the railroad track structure. Because the present ballasted right of way would require too much maintenance under such conditions. The concrete rail bed for urban railways has a potential for effecting substantial savings in track maintenance costs, thereby reducing the over all cost of the track structure. [German]

Eisenmann, J *Eisenbahntechnische Rundschau* Vol. 17 No. 5, May 1968, pp 184-196, 26 Fig, 12 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-510)
DOTL RP

A2 037462
REAL PROSPECTS FOR INCREASED SPEEDS ON THE RAILWAYS [REALE MOGLICHKEITEN FUR EINE STEIGERUNG DER GESCHWINDIGKEITEN BEI DEN EISENBAHNEN]
A comparison is made of door-to-door times for automobile, train and plane travel between cities separated by up to 200 Km, 200 to 400 Km, and 400 to 800 Km. The potential for the railways to offer service more competitive in elapsed time to that of air travel is explored. The increase in speed must take into account passenger comfort as well as safety. The closer spacing of ties will improve the riding qualities and provide more favorable stresses in the track structure. The use of curvature of 2400 m radius in switch turnouts to permit speeds up to 140 Km/h is possible. Signalling developments are also considered. The prospects for higher speeds in passenger service on the railways are necessary. [German]

Kracke, R *Eisenbahntechnische Rundschau* Vol. 17 No. 3, Mar. 1968, pp 65-76, 8 Fig, 3 Tab, 25 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-471)
DOTL RP

A2 037467
TRACK GEOMETRY AND PERMANENT WAY CONSTRUCTION FOR HIGH SPEED LINES [GLEISGEOMETRIE UND KONSTRUKTION DES OBERBAUES VON SCHNELLFAHRSTRECKEN]
This article discussed the heavier demands imposed on the track structure by the maximum operating speeds on railways. The problems are presented

and considered as determined by both theoretical studies and the results of field tests of 200 Km/h operations consideration of the line construction and the alignment, superelevation and transition run-offs on curves is shown by actual data and charts, including theoretical studies of speeds up to 400 Km/h. The stability of the track structure, horizontally and longitudinally, under different axle loads and spacings are considered, and the relations thereto of rail strength, type of fastening, the ballast bed and the underneath soil foundation. Switch, turnout and frog designs are dealt with: This article gives a comprehensive, detailed study of the requirements for track geometry and construction for high speed operations. [German]

Birmann, F (Bundesbahndirektion, Nurnberg) *Eisenbahntechnische Rundschau* Vol. 17 No. 12, Dec. 1968, pp 513-532, 24 Fig, 4 Tab, 6 Phot, 34 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-572)
DOTL RP

A2 037468
TRACK FOUNDATION DESIGN
Procedure has been evolved for relating the depth between sleeper and sub-grade to the axle loading and traffic speed. This article describes the first phase of an investigation into the effects of cyclic loading upon the behaviour of soils in general and London Clay in particular. Derivation of tentative design curves is illustrated relating speed, axleload and depth of track construction to the results obtained when a sample of the subsoil is deformed in a triaxial testing machine applying cyclic loadings.

Waters, JM Shenton, MJ (British Railways) *Railway Gazette* Vol. 124 Oct. 1968, pp 734-737, 7 Fig, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-818)
DOTL RP

A2 037474
HIGH SPEEDS RECENT EXPERIENCE IN ECONOMICS AND IN PRACTICE
A thorough examination of current problems and evaluation of feasibility and economic justification of speeds over 200 km/h discussed by 500 delegates to the IRCA-UIC symposium at Vienna and of the 27 papers presented and discussed, 17 dealt with experience and design development obtained in revenue earning services and then examined the immediate future or long-term problems. Brief summaries of the topics presented are reviewed in this article.

Railway Gazette Vol. 124 July 1968, pp 545-546

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-820)
DOTL RP

A2 037476
PREPARING BRITISH RAILWAYS TRACK FOR HIGH SPEED RUNNING
Before speed limits are raised to 125 mile/h or higher, action must be taken to eliminate bolted rail joints and gaps in the rail at crossings. Experience with 100 mile/h trains running in quantity indicates that the standard continuous welded rail track on prestressed concrete sleepers will be capable of carrying trains at 125 mile/h without any particular difficulty. At speeds of 100 mile/h or over, the presence of all kinds of rail joints and of crossings present an increasing problem in maintenance. The desirability of providing monoblock or swing-nose crossings increases as the speed rise.

Paterson, A (British Railways Board) *Railway Gazette* Vol. 124 June 1968, pp 413-416, 1 Tab, 6 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-823)
DOTL RP

A2 037480
RESILIENT RAIL-SEAT PADS IN BONDED RUBBER CORK
Concrete cross ties are less resilient than the flexibility of a roadbed of ballast, and wooden cross ties. Therefore, it is necessary to insert a pad between the concrete crosstie and the rail or baseplate. Such padding is important to avoid abrasion of the rail and to damp out noise and vibration, as well as an insulator of track circuits. Rubber has been used, but when compressed, solid rubber tends to spread sideways, leading to abrasion and finally to rupture. Combinations of cork with synthetic or natural rubber permit use of pads of pre-determined load/deflection characteristics. The rubber also seals the cork from moisture, as well as helping the pads to adhere to rail foot and crosstie.

Railway Gazette Vol. 124 Mar. 1968, p 182, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-827)
DOTL RP

A2 037481
BROACHING HOLES IN RAILS
Anything that can be done to reduce bolt hole stresses will increase the fatigue life of rails. The perfect result is achieved by completely eliminating fishbolt holes. Four methods of improving fishbolt holes are: 1. careful drilling to produce holes of smooth fish; 2. radiusing the edges of the holes; 3. reducing the diameter of the holes; 4. work hardening the internal surface of the holes. Work hardening the hole is achieved by forcibly increasing its diameter after the initial drilling. The fatigue strength of the drilled rails is improved by at least 25 percent by work hardening.

Railway Gazette Vol. 124 Nov. 1968, p 892, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-907)
DOTL RP

A2 037588
REDUCING ERRORS IN CURVE REALIGNMENT PROCEDURES
The author discusses the differences between the realignment of curves by the old manual method and the use of track aligning machines for this purpose. The methods of reducing the errors for the mechanized realignment of curves are compared, and graphs are shown depicting the conditions for the various methods. The conclusion reached is that be using the two chord procedures, it is possible to correct the alignment to double the accuracy.

Schubert, E *Eisenbahntechnische Rundschau* Vol. 15 No. 6, June 1966, pp 229-231, 8 Fig, 7 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-472)
DOTL RP

A2 037597
THE NATURE, MAGNITUDE, AND FREQUENCY OF LOADS AND FORCES APPLIED TO RAILROAD ROADBED
The magnitude, nature and frequency of loads imposed on railway roadbed by track structures and by traffic on the track structure is summarized for use by engineers in designing alternate types of roadbed construction. An SD-40 locomotive was studied to test severe loads Magnitude of reactions in the roadbed depends not only on the loads themselves but also in the spacing of the loads and the type and composition of support. In conventional track, the contact pressure on the bottom of a tie is not uniformly distributed either laterally or longitudinally. The total load on an individual tie depends on track conditions, size and distribution of load, and size, spacing and condition of the ties. There are traditionally two ways of handling impact loads, i.e. "equivalent static load" and "energy load." Of the two, "equivalent static load" is usually given for railroad situations and will be used here. Longitudinal loads come from inherent stress (from manufacture and laying of rails), reaction to locomotive traction, wheel flange friction and braking, thermal rail stress, and longitudinal component of train weight on grades. The longitudinal component of train weight can be calculated statistically knowing gross weight, grade, length of train, etc. Fortunately, this load is not concentrated but is spread out over a considerable distance. With conventional track construction the perpendicular component of train weight increases the frictional restraint of ties in ballast so that this is of little consequence. Longitudinal loads applied to the track by traffic have been the subject of considerable study in both this country and Europe. They are difficult to analyze because they are affected by so many variables, and uncontrolled variables at that. Transverse, or lateral, forces are particularly important since if they exceed roadway resistance they cause unstable alignment or buckled track and likelihood of derailment. Mathematical calculations show the rail reaction for the SD-40 on 122 lbs rail.

Way, GH
Chesapeake and Ohio Railway, Baltimore and Ohio Railroad Tech Rpt May 1967, 22 pp, 7 Fig, 2 Tab, 9 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-483)
DOTL RP

A2 037599
THE SELECTION OF AN ECONOMICAL RAIL SECTION
Six existing rail sections of 6 different weights from 115 to 140 alloys were analyzed, which have been designed or improved to meet requirements of heavy, high speed loads with an adequate margin of safety. With at least a 9% rate of return for both railroads, a combination of the existing sections is needed to satisfy the various requirements of the new rail territories-140 lb for the high, 133 lb. for medium and 115 lb. for the low traffic density and speed territories. A new 122 lb. rail section has been designed which embraces 98% of the B and O-C and O new rail territories. Cost savings by use of the single 122 lb. section for both railroads is estimated.

Chesapeake and Ohio Railway 80 pp, 34 Fig, 30 Tab, 10 Ref, 8 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-486)
DOTL RP

A2 037600
ENGINEERING AND ECONOMIC ANALYSES OF WOOD TIE-VS. CONCRETE TIE TACK
Engineering and economic studies were conducted to determine the conditions under which concrete cross ties would be justified. In the process of comparing wood and concrete ties the following factors influence the outcome: (a) in-place cost of ties, (b) service life of ties, (c) service life of rail, (d) cost of rail renewal, (e) tie spacing. The investigation of engineering aspects has been confined to the effect of tie spacing on the track stability, with particular attention to the allowable increase of spacing when concrete ties of selected types (MR-2 and B-58) are used instead of wood ties. For a realistic evaluation of the economics of wooden ties vs. concrete ties, the discounted differential cash flow method was applied.

Reiner, IA
Chesapeake and Ohio Railway, Baltimore and Ohio Railroad Comp Rpt Feb. 1966, 56 pp, 18 Fig, 2 Tab, 13 Ref, 2 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-487)
DOTL RP

A2 037601
PROBLEMS OF RAILWAY MAINTENANCE OF WAY
A historical discussion is presented on the achievements of heavier axle loads and higher speeds. The planning of new and larger cars for the Rheinische Braunkohlenrevier is included. These cars will have an axle load of 50 tons. This is followed by both a theoretical presentation and actual results of tests of the behavior of the track structure under the loading of locomotives and cars. One interesting point brought out is that there is practically no difference in the depth and frequency of the deflection of the track under an E-10 locomotive at 10 KM/H versus 200 KM/H. Studies show the effect on track deflections with closer spacing of narrower ties, and also on a concrete track bed plate. Problems encountered with long, continuous welded rail are presented, and the stresses in the rail are shown under the varying conditions of temperature. The importance of exact alignment of the track laid in curves is stressed. It is concluded that with stiffer section, harder rails of steel free of impurities, heavier axle loads may be safely carried without damage, especially when the track is laid on narrower ties spaced more closely together (50 cm) on a deeper rock ballast bed. Further research will be required to determine if a new concept of track bed will be required for speeds of 250 KM/H and 40 ton axle loads.

Meier, H *Jahrbuch des Eisenbahnwesens* 1967, pp 7-35, 39 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-489)
DOTL RP

A2 037602
RAIL GUIDANCE TECHNIQUES AND SWITCH DESIGN
With railways endeavoring to reduce running times, in addition to increasing trains speeds, particular emphasis attaches to improving the design of switch points and track connections in stations to avoid speed reductions there. This article deals with the application of theory and practical experience to the design of switches, from the points through the frog. The importance of a proper design of switch configurations is emphasized by charts of force reactions of vehicles moving through switches.

Miller, CT Muench, W *Eisenbahntechnische Rundschau* Oct. 1967, pp 350-355, 8 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-501)
DOTL RP

A2 037615
CONTINUOUS WELDED TRACK IN RAILWAY OPERATIONS (HUNGARIAN STATE RAILWAYS)
The author evaluates the engineering and economics of continuous welded track on the Hungarian State Railways. The details of the engineering of the track construction are described, and show the continuous welded rails are laid on concrete ties 8 feet long, spaced 24 inches apart, on a rock ballast bed 20 inches deep, with 16 inch shoulders, and having a base 16 feet wide. A theoretical consideration of the improved riding conditions provided by the continuous welded track, and the reduced maintenance made possible reveals that this construction can effect substantial savings over the jointed track to justify its extra cost, depending on the traffic density.

Kerkapnly, E *Eisenbahntechnische Rundschau* Vol. 14 No. 1-2, Jan. 1965, pp 6-24, 14 Fig, 15 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-516)
DOTL RP

A2 037616
THEORETICAL OBSERVATIONS OF RAIL HEAD STRESSES AT POINT OF LOADING
The author presents a theoretical treatment of the stresses in rail heads resulting from both vertical and lateral pressures, as well as the oblique loading from imposed wheel loads, including the torsional as well as the vertical and horizontal stresses. Specific attention is directed to the "S 49" and "S 54" rail sections.

Eisenmann, J *Eisenbahntechnische Rundschau* Vol. 14 No. 1-2, Jan. 1965, pp 25-34, 16 Fig, 16 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-517)
DOTL RP

A2 037617
TRACK WARPING OVER A FINITE LENGTH
The author presents a theoretical study of the distortion of an infinite length of track subject to critical rail temperatures in wave lengths of various patterns, as applied to track of finite length as continuous welded rail, under the influence of high ambient temperatures.

Schweda, F *Eisenbahntechnische Rundschau* Vol. 14 No. 1-2, Jan. 1965, pp 44-48, 4 Fig, 2 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-518)
DOTL RP

A2 037619
DETERMINATION OF THE COMPACTING OF BALLAST UNDER SERVICE LOADING BY THE GAMMA ABSORPTION PROCESS
Increased train speed and axle loadings require effective measures to keep maintenance costs and maintenance work on the track within acceptable limits. An important factor in this is a well compacted road bed. The authors describe how the effectiveness of compacting of the road beds performed by the various makes of tamping machines had hitherto been measured by a so-called "water substitution" method. The new gamma absorption method of making this determination of the specific gravity of the compacted ballast bed, and the measuring procedure associated with it, are described. Charts of measurements are given, showing the correlation of this new with the old method. Data as well as theory are included. Information is also given, showing the increase in resistance of the track structure to lateral displacement and longitudinal creep from a well compacted ballast bed.

Birmann, F Cabos, P *Eisenbahntechnische Rundschau* Vol. 14 No. 1-2, Jan. 1965, pp 59-69, 27 Fig, 9 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-520)
DOTL RP

A2 037622
WORK STUDY IN ENGINEERING MAINTENANCE
The pilot schemes for use of work study for railway civil engineering maintenance are summarized from a paper presented to the Institution of

Civil Engineers. In 1956, permanent-way length-gang maintenance was applied to eight inspectors' sections, and also to steelwork fabrication in the civil engineering workshops, to bridge and station repairs and to painting on the Southern Region. The advantages to both management and staff of work-study techniques include reduced costs, better-quality work, more consistent work loading, higher pay, shorter hours and better management and working conditions.

Railway Gazette Vol. 106 Jan. 1957, pp 96-97

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-524)
DOTL RP

A2 037623
LONDON TRANSPORT DE-ICING EXPERIMENTS
Sleet tenders attached to the front and rear of an empty service train are being used to de-ice conductor rails. One prototype tender has already been completed at Acton Works and another is under construction. The tender consists of a specially constructed four-wheel bogie to which is fitted de-icing equipment similar to that of a sleet locomotive i.e., three sets of crushing rollers, steel brushes and de-icing sprays. One of the three sets deals with the center negative rail, and the other two with the positive rail.

Railway Gazette Vol. 106 Feb. 1957, p 164, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-525)
DOTL RP

A2 037628
EXPERIMENTS WITH POINTS AND CROSSINGS
The partially welded type of frog, in which the only loose parts are the through securing bolts and nuts has been installed on the German Federal Railway, with, considerable success. As much as 80 percent saving in maintenance is claimed, compared with the ordinary built-up type. Hardening is done by a special process which gives a maximum value of 120-130 Kg/mm 2. That part of the frog forming the distance piece and the nose at the point rail is made up from a forging which is welded to the point rails by flash welding. The life of welded frogs is twice that of the normal type, but cost of maintenance is almost negligible, furthermore gauge widening is eliminated.

Railway Gazette Vol. 106 Mar. 1957, p 363, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-530)
DOTL RP

A2 037629
LONG WELDED RAIL INVESTIGATIONS
The Western Region of British Railways has been carrying out valuable investigations into the behavior, control, and economic factors relating to long continuous lengths of welded rail. The test lengths of long welded rail in South Wales were subjected to apparatus for measuring and recording movements of the rail. Nine pairs of instrument stations 100 yd. apart were initially established with recording instruments grouped at a central point. The behavior of the track recorded was mainly longitudinal movement due to changes in temperature but transverse movement was also registered. Laboratory static tests were for resistance to longitudinal movement of a rail through its fastenings, and a dynamic testing machine was also evolved for equating track loading and deflection under the equivalent of the passage of a locomotive at 60 mph. Long continuous rail lengths carrying fast traffic must be provided with ample ballast and a firm foundation. Maintenance must be to a first-class alignment and special attention must be paid to the maintenance of the fastenings. More accurate means of costing maintenance will also have to be devised for ascertaining the economics of long welded rails.

Railway Gazette Vol. 106 Apr. 1957, pp 472-473

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-531)
DOTL RP

A2 037632
SOIL MECHANICS ON BRITISH RAILWAYS
Fresh evidence of research work is provided in a lecture entitled "Soil in British Railway Civil Engineering", by Mr. A.H. Toms. The properties of clay soils, the test methods to determine these properties, and the design of railway structures for problem soil conditions are discussed.

Toms, AH (British Railways) *Railway Gazette* Vol. 108 Apr. 1958, p 384

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-534)
DOTL RP

A2 037636
WELDED RAIL IN THE U.S.A.
The elimination of rail-joint maintenance is claimed to be more than covering the additional cost of welding, transporting the welded strings to site, and handling them. In general, few troubles have been experienced. Expansion and contraction at the ends of welded strings has been little more than normal, and has been restrained by increasing the number of rail anchors applied over the last six lengths of rail (234 ft) at the end of each string. Given proper anchorage, no trouble is experienced with buckling, but that considerable care has to be exercised as to the temperatures at which continuously-welded rail is surfaced.

Railway Gazette Vol. 107 July 1957, pp 65-66

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-538)
DOTL RP

A2 037638
QUALITY OF RAILS AND MEANS OF GUARANTEEING IT
The revisions of the album of sample sulfur prints appended to UIC leaflet No. 860 for the supply of rails are summarized. Results are reported of the correlation between performance of Thomas steel rails with test results. The object was to develop a single test or group of tests to project performance during the initial acceptance of the rails. These tests show that with Thomas steel rails, there is a specific relationship between the results of the transverse tensile test, the compression test, the turning-by-stages test, the magnetic powder test, the dye penetration test, deep etching and the microscopic determination of silicate inclusions and the liability of the rails to "shelling" (dark patches), horizontal longitudinal cracks and transverse cracks.

Question D45. Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways ORE Publication 24, Jan. 1967, pp 19-23, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-540)
DOTL RP

A2 037641
REINFORCED CONCRETE SLEEPERS
The Stanton Ironworks Co., Ltd. is producing reinforced concrete railway sleepers. Modified into sub-standards to suit either bull-head rails used with standard chairs, or flat-bottom rails. There is provision for adjustment of gauge to suit requirements. The sleepers are manufactured with 3/8 in. graded granite, local sand, and portland cement. The reinforcing is with bars and wire to B.S.S. No. 785-1938. For fixing flat-bottom rails, patent creosoted wooden blocks to take coach screws are inserted during manufacture; or the sleeper may be provided with cored holes and square-headed recess to prevent rotation of 7/8 in. diameter bolts. Another type of fastening consists of plastic inserts cast during manufacture to take special coach screws.

Railway Gazette Vol. 73 Nov. 1940, p 545, 1 Fig, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-544)
DOTL RP

A2 037642
CHEMICAL CONSOLIDATION OF GROUND IN RAILWAY WORK
Some applications of a successful chemical injection process to tube railway construction work in London are described. The extension of the Central Line tube railway between Bow and Leyton was carried out in water-logged ground by means of compressed air. At Leyton station the lines are carried from the tunnels to the surface in an open cut. On approaching this open cut the two shields of the 12-ft. running tunnels were carried through with a cover of only 4-5 ft. of ballast, with water level almost at the surface. The method of foundation strengthening is discussed and the tunnel network and track foundation is illustrated in drawings and photography.

Railway Gazette Vol. 72 Feb. 1940, pp 147-151, 3 Fig, 6 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-545)
DOTL RP

A2 037643
UNDERPINNING AND STRENGTHENING TRACK
Five methods were tested to strengthen the black cotton subsoil under a section of the Great Indian Peninsula Bombay-Nagpur main line. One method used a wooden sleeper mattress under the ballast. Two methods used trough sleepers. The fourth method used a reinforced-concrete mattress under the present track. The fifth method used a corrugated-iron mattress. Only the reinforced-concrete mattress stabilized the track.

Railway Gazette Vol. 77 Sept. 1942, p 224

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-546)
DOTL RP

A2 037644
CONCRETE SLEEPER BLOCKS ON THE L.N.E.R.
L.N.E.R. has used concrete blocks, with wrought-iron tie bars, as a substitute for, or in conjunction with, timber sleepers for more than 20 years. Current uses for concrete block are limited to sidings and tracks used by slow traffic. The applications are shown in photographs.

Railway Gazette Vol. 77 July 1942, p 86, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-547)
DOTL RP

A2 037645
TRACK DRAINAGE ON THE NEW HAVEN RAILROAD
Two sections of four-track road, one in a tunnel and one in a cutting, are effectively drained by systems of Armco corrugated pipes. In the tunnel the 8-in. perforated pipe was installed between the track at 6 to 7 ft. below rail level, a fall of 1 in. 250. In 24 hr 3500 gal. of water were pumped out. The ballast at the 1500-ft. shallow cutting was 3 to 4 ft. deep. Two lines of subsurface 12 in. diameter longitudinal drains were installed beside the ballast. Volume of drainage varies from 350 gal. per hour during a dry spell to 2500 gal. per hour after several days of intermittent heavy rain.

Railway Gazette Vol. 75 Oct. 1941, p 437, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-548)
DOTL RP

A2 037646
TIMBER FOR RAILWAY SLEEPERS
Due to the war shortage of wood in England, alternate sources of timber, possessing insect and weather resistant characteristics, were sought. Three include European larch, Japanese larch, Scots pine or fir, Douglas fir, Weymouth pine, Austrian pine, and Corsican pine. The Indian Pyinkodo and African Iroko were also considered.

Hardy, E *Railway Gazette* Vol. 76 p 160

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-549)
DOTL RP

A2 037648
HIGH-SPEED JUNCTIONS AND CROSSOVERS
British Railways has developed two new switches in 109-lb. f.b. rail. They are the "Curved F" and "G" switches and are both of the chamfered type, which, by the undercutting of the stock rail, permits the retention of sufficient metal in the switch rail to provide the robust section desirable at and near the switch toe when very fine entry angles are used. In the Southern Region a speed restriction of 50 mph is considered suitable for Curved F switches diverging from the straight. G switches will be used where higher speed restrictions up to 75 mph from straight are required and site conditions permit. Layout drawings for a double junction embodying G/24 turnouts have been completed. By the use of two-level baseplates and transition curves as necessary, a practially constant cant deficiency of just over 2-1/2 in. at 75 mph is possible.

Railway Gazette Vol. 107 Sept. 1957, pp 333-334, 1 Tab, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-551)
DOTL RP

A2 037649
RAIL-END HARDENING IN NEW ZEALAND
Flash-butt welded, 91-lb. rail is being flame-hardened to increase the Brinell hardness of the rail end 50 to 100 points above the remainder of the rail. The hardening extends 1.5 to 2 in. from the rail-ends, to a depth of 0.189 to 0.25 in. Experiments have been carried out at temperatures from 32 to 90F, with practically no variation in results. The hardening process is described in detail.

Railway Gazette Vol. 107 Oct. 1957, p 412

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-552)
DOTL RP

A2 037650
HANDLING CONTINUOUSLY WELDED RAIL
The Denver & Rio Grande Western Railroad has perfected a new unloading method for continuously welded rail, which pushes the rails off the rail train rather than to pull them off. This eliminates the danger of damaging the rail as it drops from the train in the pulling method. The new method uses specially adapted flat cars located directly behind the locomotive to thread and push the long rail onto the track. A crew of 4 or 5 section men in addition to the train crew are needed to lay the rail.

Railway Gazette Vol. 107 Oct. 1957, p 483, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-553)
DOTL RP

A2 037652
LONG-WELDED RAILS ON EAST COAST MAIN LINE
The first long-welded rails on the East Coast main line were laid on a section of line where a continuous stretch of almost a mile now exists. Normal 60-ft. rails were first flash butt welded into 300-ft. sections. On the site, the ends of the rails to be joined together were held in a mold and heated. A mixture of powered metal and magnesium was ignited and the powered metal melted into the gap between the rail-ends. The mold was knocked off as soon as possible and spare metal trimmed by cold chisel and grinder. Each weld took about 45 min. to complete.

Railway Gazette Vol. 107 Nov. 1957, p 594, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-556)
DOTL RP

A2 037655
EXPERIENCE OF UNDULATORY WEAR OF RAILS
Undulatory wear on corrugation in rails is universally considered to be of two main types: roaring rails or washboard track; and what is sometimes described as saddles. The majority of railways consider that speed has no relationship with corrugations. Undulatory wear appears from 3 to 12 months after laying. The general opinion is that braking decreases washboarding but increases saddles. In the U.S.A. experiments with an acetylene torch to temper the Martensitic area of the high polished spots of washboard corrugations caused the ridges in the track to disappear. Various methods of grinding have been tried, but none have proved permanently successful.

Railway Gazette Vol. 109 July 1958, p 90

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-559)
DOTL RP

A2 037657
LONG WELDED RAILS
A survey was taken to determine the uses and value of long welded rails, their manufacturing and laying techniques, and maintenance. The results were reported to the Seventeenth International Railway Congress. The maintenance costs are at least 15 percent less for the welded rail than for conventional track. The most suitable length for welded rail and anti-creep devices are discussed. Isolated cases of breakage due to welded defects, buckling due to disregard of temperature regulations of poor ballasting, and creep due to thermal stress are cited.

Railway Gazette Vol. 109 Aug. 1958, pp 242-243

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-564)
DOTL RP

A2 037660
HEAT-TREATED RAILS
There has been a considerable increase in the heat treatment of rails for U.S.A. railways. Apart from controlled cooling, which is applied universally as a protection against the development of transverse fissures, rail-end hardening is extensively practiced, to reduce batter of the rails at the joint. In one specific case mentioned the addition to the basic price for rails control-cooled, end-hardened, chamfered at the extreme ends on the running surface, and drilled for fishbolts, was about 59 percent. It was considered advantageous to use heat-treated rails in switch and crossing work. For trackwork subject to exceptionally heavy wear an alloy steel, such as chrome-vanadium is preferable, though this is more costly than heat-treated rail. The disadvantage of such alloys is that it is impractical to weld them by the oxyacetylene method, so that on site repairs by welding are ruled out.

Railway Gazette Vol. 109 Nov. 1958, pp 589-590

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-567)
DOTL RP

A2 037661
LONG-WELDED RAILS LAID IN CONTINUOUS OPERATION
The method allows one track-mile to be laid in 600-ft. lengths in one continuous operation. Up to 36 welded rails, 300 ft. long, can be loaded on to the bolster wagons at the new rail welding depot. Pairs of these rails are fishplated together to form 600-ft. lengths. Eventually continuous welded rails 600 ft. long will be available. The rear wagon of the train has special gantry equipment designed for guiding the lengths of rail off the wagons at normal rail spacing of 4 ft. 8-1/2 in. and for lowering the rail ends.

Railway Gazette Vol. 109 Nov. 1958, pp 625-626, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-568)
DOTL RP

A2 037662
RUBBER RAIL-TO-SLEEPER FASTENING
A rail-to-sleeper fastening on trial on British Railways is applicable to ordinary flat-bottom rails, but is specially designed to resist any tendency towards buckling in long-welded rails. The advantages claimed are: simplicity; cheapness in first, maintenance, and replacement costs; safety, sufficient elasticity to protect the sleepers against impact and so increase their lives; and no interference with track-circuiting. The fastening consists of a cast-iron baseplate enclosing a rubber pad upon which the rail-base is held securely both vertically, transversely and laterally by metal-rubber wedges fitting tightly into jaws cast integrally as part of the baseplate.

Railway Gazette Vol. 109 Nov. 1958, p 54, 4 Fig, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-569)
DOTL RP

A2 037663
ADHESIVES IN RAIL-JOINT ASSEMBLIES
Railways are testing the use of adhesives in rigidifying rail-joints to eliminate rail-end batter and reduce maintenance. Preliminary tests showed that joints so rendered inflexible ensured a smooth-running continuous rail likely to add 10 to 15 years to the life of existing track. The glued joints also reduced maintenance by eliminating the expansion and contraction in ordinary joints. A 300,000-lb resistance to slipping is reported with Bondarc applied to clean, sand-blasted fishing surfaces, and by butt-glueing the rail-ends additionally a further 40,000 lb is obtained. As no fishbold tension in excess of 20,000 lb was needed it was not found necessary to use high-strength bolts. Tests were conducted in Northeast Canada to ascertain the effects of a combination of the lowest temperatures and heavy traffic on glued joints.

Railway Gazette Vol. 109 Dec. 1958, p 677

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-570)
DOTL RP

A2 037665
THE IMPORTANCE OF RESEARCH AT THE GERMAN FEDERATED RAILWAYS' CENTRAL OFFICE AT MUNICH FOR ENGINEERING AND DEVELOPMENT
The achievements are described of the German Federated Railways in Research and Development in the following fields: preventive measures toward noise suppression in railway vehicle bodies; problems of mechanical engineering and material chemical composition technology of locomotive components; research in lubricants for all classes of rolling stock equipment, journal bearings and diesel engines, paints for vehicles, corrosion inhibitors for diesel engine cooling water, fire resistance of plastic materials used in railway vehicle construction; problems of the railroad track and right of way; the influence of stray electric currents on signals and communications as well as the electrolytic action of buried pipes and conduits; and, high frequency technology for remote communications and signal installations.

Hegenbarth, F *Jahrbuch Des Eisenbahnwesens* 1967, pp 141-166, 8 Fig, 30 Phot, 41 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-578)
DOTL RP

A2 037669
"FROZEN" RAIL JOINTS
The Delaware and Hudson, on its main line stretching from Albany, New York, to Montreal, has experimented with frozen joints for continuous-welded rails. For frozen joints, the rails are laid tight, allowing for no expansion at the joints. The elimination of joint maintenance is a main argument in favour of welding into long lengths. The weld itself is expensive, not to speak of the extra cost of handling the long lengths of "ribbon rail." Furthermore, if a rail is damaged, it can easily be replaced, whereas with ribbon rail the section damaged has to be cut out. There may be extensive potential maintenance economics to be effected by laying rail tight with frozen joints.

Railway Gazette Vol. 108 Feb. 1958, p 180

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-582)
DOTL RP

A2 037670
RAIL-END HARDENING IN NEW ZEALAND
A paper from the British Commonwealth Welding Conference is summarized. In New Zealand the rails as originally received are from 30 to 40 feet. long but the 91-lb rails are now being flash-butt welded into 210-feet lengths, and it is the ends of these long rails that are hardened at three main depots. The composition of the rail has the greatest influence upon the results obtained from flame hardening. The methods used to harden and quench the rails and the apparatus used are described. The principal aim in heat treating a rail is to obtain a definite percentage increase in hardness over that of the untreated rail. To this end in New Zealand, the 91-lb rails now being end-hardened are treated for 1-1/2 to 2 in. from the end and to a depth of from 3/16 to 1/4 in. To avoid surface cracking or shelling there should be a definite hardness range which should not be exceeded.

Colligan, GK (New Zealand Institute of Welding) *Railway Gazette* Vol. 109 Dec. 1958, pp 765-766

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-583)
DOTL RP

A2 037672
CONCRETE SLEEPERS
A thesis discussing concrete sleeper development is summarized. This thesis explains the necessity for an exhaustive study to counteract the results of severe high-frequency vibration by damping it down and so protecting the concrete from damage. Typical examples of modern concrete sleepers are reviewed, notably the English Dow-Mac and Stent, the German "B53V", and the French "V.W.", all with their tensioning steel and concrete bonded together and pretensioned.

Harmsen, JL *Railway Gazette* Vol. 108 May 1958, pp 560-561

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-585)
DOTL RP

A2 037673
RAIL-MOUNTED TRENCH-DIGGING MACHINE
A rail-mounted trench-digging machine developed by the Western Region of British Railways enables seven men to do the work of 40, in less than one-third of the time, when excavating trenches for surface water drains alongside the track. The machine saves 86 percent of labor costs on the site, the major portion of expense in any drainage scheme. It can dig a 6-ft. length

of trench, 6 ft. deep and 2 ft. wide, in one min. The rail-mounted trench digger is driven by a 48-hp Perkins P6 diesel engine. The power to all motions is transmitted hydraulically. The weight of the machine in working order is about 30 tons, and during the past two years it has operated without significant mechanical failure.

Railway Gazette Vol. 108 Mar. 1958, 3 pp, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-586)
DOTL RP

A2 037674
LONG-WELDED RAILS
A comparative study of methods for welding very long rails was made for Great Britain, South Africa, New Zealand, Australia, Sweden, Japan and the U.S.A. The use of long rails is largely experimental and no definite policy has been reached as to the length of section to be laid with them. Wood, steel, and concrete sleepers are being used and their numbers vary from 1,240 to 1,920 per km. Methods of fastening the rails to the sleepers include dog spikes, elastic spikes, clips and bolts, and cast iron chairs with keys. The most favored method of manufacturing long-welded rails is by flash-butt welding in the depot into transportable lengths and then by thermit welding into long sections on site.

Jackson, F (South African Railways & Harbours) *Railway Gazette* Vol. 108 May 1958, p 622

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-587)
DOTL RP

A2 037675
RAIL WELDING AND METHODS OF LAYING IN NEW ZEALAND
At the Woburn machine-welding depot, 117-ft, 126-ft, and 351-ft welded rail sections were fabricated using a British-built flash-butt electric welding machine and a post-heating machine. The shorter rails were then transported to and laid at the approaches to the Rimutaka Tunnel. This 5.5-mile tunnel was laid wih 351 ft pre-fabricated track. The 351-ft rails were unloaded and pre-fabricated into track at a special temporary depot designed for that purpose. The fabrication method is described.

Railway Gazette Vol. 108 Apr. 1958, pp 421-422, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-588)
DOTL RP

A2 037677
SPECIAL COMMITTEE ON CONTINUOUS WELDED RAIL
Rolling-load tests were made of specimens of continuous welded rail in the 12-in stroke machine on four acetylene welds, 4 electric welds, and 4 thermit welds. All of the thermit welds failed in this test. One acetylene weld also failed just below 2 million cycles. Other rolling-load tests were made in a 33-in. stroke rolling machine primarily to test the welds in the rail bases. All the acetylene and electric welds ran to over 2 million cycles without failure. Two thermit welds developed failures in the rail heads. A few other observations on possible causes of weld failures are listed, including grinding burns electrode burns, and cases where the flame goes out in oxyacetylene welding. The fastenings subcommittee reports five methods used to anchor welded rail across open-deck steel viaducts or long deck steel spans.

Cramer, RE (Illinois University); Wise, E, Jr *AREA Bulletin* Vol. 59 Feb. 1958, pp 895-904, 3 Tab, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-590)
DOTL RP

A2 037678
SERVICE TESTS OF DESIGNS OF MANGANESE STEEL CASTINGS IN CROSSINGS AT MCCOOK, ILLINOIS
This report covers the service performance of the solid manganese test castings in the crossings between the double-track lines of the Baltimore and Ohio Chicago Terminal Railroad and the Atchison, Topeka and Santa Fe Railway at McCook, Illinois. This solid pedestal design that was not depth hardened on the tread corners was retired after a service life of 3.60 years. This casting was removed from service because of the combined weakening effect of the cracks from the top to the bottom of the casting. On June 3, 1957, for the same defects, the solid pedestal design with depth hardening was retired after 4.44 years of service in the same crossing. Although the USS depth-hardened casting had more cracks at its retirement than the unhardened specimen, it is judged that the major portion of the increase in life for the depth-hardened one can be attributed to that treatment.

AREA Bulletin Vol. 59 1958, p 1010

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-591)
DOTL RP

A2 037686
MEASUREMENT OF RAIL HEAD WEAR
A novel method of rail wear measurement is being used on the London Midland and Scottish Railway in order to compare rails of special composition or rails which have been specially treated to increase resistance to wear. The apparatus is simple, and consists of a jig formed to the contour of the part of the rail to be measured, and a dial gauge reading to 0.5 in. by 0.001 in. graduations. The actual gauging can be done at the rate of about one minute per section.

Railway Gazette Vol. 73 Aug. 1940, p 228, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-600)
DOTL RP

A2 037687
ESTIMATING WEIGHTS OF RAILS IN THE TRACK
The Railimeter measures rail in two directions simultaneously, and indicates the weight of the section in lb. per year by a pointer on a scale. If side cutting is present, a reading from a side-cut gage is subtracted from the reading of the Railimeter. Where the rail is galled it is of course necessary to displace the chair at the gall when measuring the weight of this section. A chart estimating rail life based on the Railimeter reading is illustrated. The results obtained with this instrument compare favorably with more laborious methods previously used.

Brown, GW (London Midland & Scottish Railway) *Railway Gazette* Vol. 73 Aug. 1940, pp 203-204, 2 Fig, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-601)
DOTL RP

A2 037691
VEHICLE DESIGN RELATED TO TRACK CONDITIONS
Recommendations which may influence improvements in the safety and comfort of passenger-train rolling stock are made in a paper, Vehicle Suspension and Bogie Design in Relation to Track Conditions, by Mr. R.M. Hancock of British Railways. The paper deals with the necessity of relating vehicle suspension and bogie design to the track conditions likely to be encountered in practice, particularly where lateral and crosslevel wave shape are concerned, as these are most likely to produce discomfort. The vehicle-response basis of systematic testing main routes as carried out with the Western Region track-testing car has provided much of the experience from which the illustrations in the paper are drawn. The effects of coning and track shape, in relation to the riding of four-wheel vehicles, are considered with reference to an investigation of their derailment in fast trains.

Hancock, RM (British Railways) *Railway Gazette* Vol. 110 Apr. 1959, pp 445-446

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-605)
DOTL RP

A2 037693
THE EFFECT OF TRACK GEOMETRY ON RIDE QUALITY
In this test, acceleration measurements were taken with one lateral and one vertical accelerometer attached to the floor of the test car. The sensitivity of ride roughness to changes in crosslevel during the negotiation of a curve is shown. Also shown is the change in ride response due to bolted to welded rail transition. The track geometry measurements used in this investigation were: centerline profile, the average profile of both rails; alignment; gauge; rate of change of gauge; and warp. The track and ride data were then sorted according to speed. The data for the 100-110 mph tests are plotted on scatter diagrams. Correlation coefficients were then computed for each of the six track exception densitites and the density of the sum of all exceptions with vertical, lateral, and mean lateral/vertical ride. The results are shown.

Though sample populations are small, data correlation is sufficiently reasonable to lend support to the approach.

Paper recommended by IEEE Land Transport Committee of the IEEE Industry and General Applications Group for presentation at the joint IEEE/ASME Railroad Conference, Montreal, Quebec, Canada.

Ullman, KB O'Sullivan, WB (Department of Transportation) Institute of Electrical and Electronics Engineers Paper 69CP355-IEA, Apr. 1969, 8 pp, 3 Fig, 1 Tab, 4 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-607)
DOTL RP

A2 037699
THE SUPERELEVATION OF RAILWAY CURVES

The most suitable superelevation for a given curve is determined as follows: the average speed on a tonnage basis should be ascertained from the actual known speeds of all trains, and the curve given the full theoretical superelevation corresponding to this average speed; and the maximum permissible speed on the curve should then be fixed as that corresponding to the above superelevation plus 4 inches. The first condition will result in equal loading of the two rails, and hence equal head wear and even maintenance of surface. The second ensures passenger comfort, and gives an ample factor of safety against derailment which is uniform for all curves, while at the same time it fixes an upper limit to the lateral forces acting on the track which is also the same for all radii. A table gives the superelevation for various radii for different average speeds, and the corresponding maximum permissible speeds.

Rapley, F (Buenos Aires Great Southern Railway) *Railway Gazette* Vol. 78 May 1943, pp 509-511, 2 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-613)
DOTL RP

A2 037709
CONTROL OF TRACK IRREGULARITIES IN JNR

The existing rules in Japan regulating track irregularities are given. Inspection cars and techniques used for examining track are described. Recommendations are made for revisions of track irregularities limits considering their effect on safe operation, riding quality, and economic aspects.

Ban, Y (Japanese National Railways) *Japanese National Railways* Vol. 4 No. 4, Dec. 1963, pp 30-32, 2 Tab, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-627)
DOTL RP

A2 037710
THE EFFECT OF LONGITUDINAL FORCES ON CONTINUOUSLY WELDED TRACK AND ON TRACK BALLAST

The properties of the ballast under the influence of longitudinal forces or longitudinal stresses in continuously welded track are discussed. The first part of the paper deals with the different causes of longitudinal stresses. The second part is concerned with research on the mechanical properties of the ballast. From theoretical considerations and on the strength of test results, characteristic data for the resistance to longitudinal displacement are obtained. The third part deals with measurements of rail stresses encountered in tracks under traffic. A description is given of investigations based on train braking tests on continuously welded track.

Siekmeier, EW (Hanover Technical University) *Rail International* July 1965, pp 446-489, 20 Fig, 8 Tab, 3 Phot, 53 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-671)
DOTL RP

A2 037712
LANDSLIDES

Replies to 12 questionnaires on landslides returned from U.S. and Canadian railroads are summarized. The responding roads represent 24 percent of the line mileage in the two countries. Direct annual maintenance costs due to landslides are reported for each railroad. An estimation is made both of average direct maintenance costs for all U.S. and Canadian railroads due to landslides and an estimate of the indirect costs. Preventative maintenance methods in use by the lines are outlined.

AREA Bulletin Vol. 58 1957, pp 735-737

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-703)
DOTL RP

A2 037713
TRACK MAINTENANCE AND HIGH CAPACITY TRUCKS

The high capacity truck from the maintenance of way standpoint is the means by which the increased gross weight of the large modern freight car is transmitted to the track, roadbed, bridges, trestles, viaducts and culverts, over which it must pass. As such, its design, dimensions and position are of vital concern to those responsible for the satisfactory operating condition of the railroad. Stress in rails and joint bars, track deflection, maximum load on ties and effect on undergrade bridges require specific consideration in determining whether or not a car can be accepted for movement; and if so whether it will be free-running or whether it will be restricted as to speed and routing. An immediate concern in relation to high capacity car trucks is the anticipated increase in shelling rail failures due to increased bearing pressure. Shelling rail failures are the result of the plastic flow of metal from the middle portion of the head toward the guage corner under high shearing stresses produced by intense wheel loads eventually starting a horizontal crack. The Joint Committee on Relation between Track and Equipment has recommended maximum axle loads of 52,800 pounds on 33 inch wheels, 58,400 pounds on 36 inch wheels, and 62,400 pounds on 38 inch diameter wheels.

Hammond, WT (Pennsylvania Railroad) *Engineering Interchange for Railroad Advancement* Tech Proc Sept. 1965, pp 1-3

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-714)
DOTL RP

A2 037756
RECLAMATION OF RAILS BY POWDER WELDING

In site repair of wheel burn and cupped thermit welds is now a practical proposition using the powder deposition process. The powder welding process requires a brightly ground or scurfed surface and the usual precautions obligatory with any welding procedure, that of removing fatigued metal, flow ridges and lapping. Should the weld fail, the failure will occur at the weld/base metal interface and experience has shown that a few microns of weld metal still remain, and consequently protection is afforded against atmospheric oxidation.

Cookson, C Shawe, F (British Railways Board) *Railway Gazette* Vol. 126 May 1970, pp 350-351, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-766)
DOTL RP

A2 037759
COMPREHENSIVE TRACK MAINTENANCE SYSTEM

Railway engineers aim to achieve as economically as possible a long-life track and a stable relationship with the vehicles running over it at high speed. Flaw detection and track laying and cleaning equipment is described. Ballast site rehabilitation, track material renewal, and track lifting lining and tamping procedures are discussed.

Genton, D *Railway Gazette* Vol. 126 June 1970, pp 465-467, 1 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-769)
DOTL RP

A2 037762
PERMANENT WAY IN AN AGE OF HIGH SPEED

Rails of adequate weight, rigid fastenings and good ballast, as well as programmed mechanized maintenance procedures, are essential for high speed lines. Methods used for track construction and maintenance by several European countries, Japan, U.S. and U.S.S.R. are briefly presented.

Diaz Del Rio Y Jaudenes, M (Spanish National Railways) *Railway Gazette* Vol. 126 Aug. 1970, pp 588-590, 1 Fig, 1 Tab, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-772)
DOTL RP

A2 037763
SNCF PROBES THE 200-300 KM/H SPEED BAND

Recent tests at high speeds have shown that ample adhesion exists to overcome train resistance at 300 km/h and no technical factors need prevent

commercial operation on steel rails at this speed. High speed running does not seem to produce any particular wear of parts other than wheels, although a close eye is kept on the friction linings that damp the pantograph. For the track, the SNCF does not consider it economically desirable to raise maintenance standards beyond those now considered necessary for speeds of 150 km/h. The policy is to build the rolling stock in such a way as to exert no greater forces on the track at high speeds than the trains of 20 years ago caused at the lower speeds then prevailing. Ride quality and current collection are discussed.

Nouvion, FF (French National Railways) *Railway Gazette* Vol. 126 Aug. 1970, 5 pp, 6 Fig, 1 Tab, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-773)
DOTL RP

A2 037765
RAIL FASTENING TEST CENTRE OPENED
The test center is part of the Elastic Railspike Company manufacturer of the Pandrol Clip. Key personnel are listed. The Amsler hydraulic rig for simulating dynamic rail loading conditions is described. The laboratory also has nine fatigue testing machines to accommodate various types of rail fastenings.

Railway Gazette Vol. 126 Sept. 1970, p 687

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-775)
DOTL RP

A2 037766
SOME RECENT FACETS OF CONTINUOUS-WELDED TRACK PRACTICE IN BRITAIN
Maximum working temperatures have been laid down for continuous welded rail above which it is not permissible for consolidation of the track or work to be undertaken on it. With slag or crushed stone ballast this temperature has been set at 32 deg C. Should slewings at any time exceed 1-1/4 in. the whole of the rail length affected must be restressed. An important aspect of continuously welded track is the strict adherence to restressing and destressing procedures. These have been developed to ensure that continuously welded track is kept in a uniform and safely stressed condition at all temperatures.

Railway Gazette Vol. 126 Sept. 1970, pp 705-707, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-776)
DOTL RP

A2 037772
WEAR OF RAILS ON CURVES
Abrasion caused by locomotives and electric motor coaches, the condition of the track, and methods of alleviation are discussed. Insufficient information is available to say what type of vehicle produces the most rapid wear in the outer rails on curves. Increase in tractive effort may result in increased transversal reaction and greater lateral wear of the rails. Rate of wear varies inversely as the radius of the curve, but no quantitative relation between degree of wear and radius has yet been established, nor have the effects of irregularities in curvature. What is certain is that excess or deficiency in cant causes unequal wear on rails.

Railway Gazette Vol. 100 Mar. 1954, pp 266-267

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-782)
DOTL RP

A2 037774
RULES FOR THE DESIGN OF CURVES
To ensure safety and the riding comfort consideration has to be given to the cant of the track, the rate of gain of the cant, the gradient leading up to, or down cant deficiency, and rate of gain of cant deficiency. In providing cant on a curve, precise rules alone cannot be applied. Usually it should be the equalibrium cant for a selected or equilibrium speed. On curves carrying mixed speed running, a mean speed should be selected-- usually the average speed of ordinary passenger trains-- and equilibrium cant should be provided for that speed. The maximum speeds for turnouts and reverses for some typical crossovers between straight mainlines with various spacings, and laid without cant are shown.

Railway Gazette Vol. 97 Aug. 1952, pp 116-117

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-786)
DOTL RP

A2 037776
INTERIM REPORTS ON DERAILMENTS AT LICHFIELD, SOMERTON AND SANDY
This is an accident report of three derailments in England which occurred during June-July, 1969. All took place in welded rail and all were caused by distortions or buckling of the rail. No definite conclusions as to the cause of the incidents aside from an inherent track weakness were reached. Causes for track distortions, during the period 1958 to 1968, are reviewed.

Railway Gazette Vol. 126 Apr. 1970, pp 314-315

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-790)
DOTL RP

A2 037781
INSPECTION AND MAINTENANCE ON A HIGH SPEED RAILWAY
Despite consistent operation at 200 km/h, cars on the Tokaido Shin Kansen now cost less to maintain on a distance-run basis than JNR's 3-ft 6-in gauge electric railcar fleet which is limited to 120 km/h. As a result of a review of maintenance procedures for rolling stock and fixed equipment, the labor force now used to maintain 515 km will be redeployed in 1972 to cover the 165-km San-yo extension as well. Periodic inspection and maintenance routines are given and failures of electrical equipment over a five year period are itemized.

Railway Gazette International Jan. 1971, pp 22-24, 2 Fig, 3 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-796)
DOTL RP

A2 037782
RUNNING THROUGH CURVES
Economic considerations demand high average, rather than occasional high maximum speeds. Rapid acceleration and retardation are essential and vehicles must also be able to negotiate curves at high speeds, which is of particular importance for lines with many curves. The forces acting on a vehicle running in a curve are shown and the limiting valves of speed and the effect of axle load on speed through curves are established mathematically. Transverse flexibility is important in reducing dynamic forces at curve irregularities. Time-speed and time-distance curves for a single car and for a car and trailer are plotted for electric hydraulic and mechanical transmissions.

Railway Gazette Vol. 96 June 1952, pp 682-684, 9 Fig, 12 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-797)
DOTL RP

A2 037792
DEVELOPMENT OF THE CONCRETE SLEEPER
The article discusses the unique advantages of concrete crossties as outlined by the French National Railways. There are three basic types of concrete crossties; reinforced concrete, prestressed concrete and special, which is defined as asbestos cement, longitudinal and zig-gag. Representative crossties within the categories are described and some are illustrated. The manufacture of these ties is described as well as experience with them on French, German, Swedish, Italian and Netherlands railroads.

Shrinivasan, M (Indian Railway Board) *Railway Gazette* Vol. 124 Jan. 1968, pp 25-28, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-833)
DOTL RP

A2 037803
BALLAST COMPACTOR
The windhoff ballast compactor has been designed to follow immediately behind a tamping machine, reprofiling and compacting the ballast to its previous standards. It is self-propelled and has 10 vibratory compacting arms. Eight of these are mounted vertically, two on each side of each rail, while the remaining two are larger side-mounted units for compacting the ballast shoulders. Shoulder compactors are adjustable to suit the cross-section of the ballast, and the static pressure, frequency and intensity of

vibration, as well as its duration, can all be regulated to obtain optimum results.

Railway Gazette International Aug. 1971, p 325, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-844)
DOTL RP

A2 037804
DESIGN STANDARDS FOR EUROPE'S FIRST 250 KM/H RAILWAY

This article is concerned with changes made in the rail line which runs from Rome to Florence, Italy, so that speeds of 250 km/h may be attained. Problems include the rough terrain such that 31% of the route will be tunnel and 13% will be over viaduct. Details of bridge design, electrification, as well as characteristics of tunnel design and roadbed construction are discussed in relation to the requirements of high speed operation.

Robert, G (Italian State Railways) *Railway Gazette International* Vol. 126 July 1971, pp 269-272, 4 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-845)
DOTL RP

A2 037812
PERMANENT WAY CONSTRUCTION AND PROCEDURE STANDARDS ON THE FRENCH NATIONAL RAILWAYS

The author details the standards of track construction and track maintenance procedures on the French National Railways. Prescribed superelevations are given, together with the transitions. The shape and form of the standard cross-section of the ballast are shown on a drawing. The tracks are grouped in classes as to usage and load, ranging from IA, IB, II, IIA, IIIB, to IV. Many other details are given relating to rail fastenings, rail joint bars (6 hole), concrete ties, and expansion joints in the rails. Altogether, this is a comprehensive presentation of the French track standards.

Nagel, H *Eisenbahntechnische Rundschau* Vol. 13 No. 10, Oct. 1965, pp 449-460, 15 Fig, 5 Tab, 12 Phot, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-891)
DOTL RP

A2 037817
ELASTIC RAIL SPIKE DEVELOPMENT

The development of a simple and economical fastening for use with flat-bottom rail resulted in development of the elastic rail spike. This provided a simple and economical fastening for use with flat-bottom rail on wood sleepers. The lockspike baseplate fastening, which is an alternative to the elastic rail spike, is a simple one-piece spring spike designed specifically to secure baseplates to wood sleepers. It fills the hole in the baseplate by spring action in a lateral direction, and holds the track gauge secure with the baseplate fixed firmly to the sleeper. For high speed track it is evident that an indirect rail fastening is desirable. A large number of designs have been developed and tried on many railways in an attempt to obtain the ideal independent rail fastening. The need to reduce track maintenance led to the development of spring clip. The Pandrol fastening, which is designed for reduced track maintenance, provides an adequate toe load on the rail, and this toe load is the result of considerable deflection which is more than adequate to absorb normal manufacturing tolerances and small wear which could occur in service. The Pandrol rail fastening is also ideally suited for use with steel sleepers. This assembly is one of the most economic methods of securing a rail to a steel sleeper and at the same time providing adequate resilience and freedom from maintenance problems.

Railway Gazette Vol. 123 Apr. 1967, pp 255-257, 5 Fig, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-895)
DOTL RP

A2 037820
WELDING JOINTS FOR HIGH-MANGANESE CROSSINGS

The efforts by the Budapest Research Institute for the steel industry to develop a technique for welding Hadfields steel to ordinary rail steel so as to enable these fishplated joints to be eliminated have been successful, and patent rights have been taken out. The process developed by Kalman and Kisfaludy enables welding to be carried out without allotropic conversions taking place, and the two types of steel can be welded without difficulty. Joints welded in this way have been submitted to a mechanical bending-rupture test with 1-m separation of the supports. The joints withstood the specified 15 mm buckling with cracks. These joints have already been in service without a failure for over a year.

Railway Gazette Vol. 123 July 1967, pp 510-511, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-902)
DOTL RP

A2 037827
FLANGE AND RAIL LUBRICATION

The Japanese National Railways has experimented with systems to reduce wheel and rail wear. Results of tests show that rail oiling reduces electric current consumption by 66%, reduces wheel wear to 1.25%, and reduces rail wear to 1%, compared with dry rail. Three systems have been suggested for lubricating the rails: site lubrication where it is picked up by the flange; flange lubrication in the vehicle; and automatic lubrication of the inside rail edge. A comparison of various devices to accomplish lubrication is included as well as a description of each system. Benefits of lubrication for different situations are included in a series of tables and charts.

Fujinawa, I (Kinki Nippon Railway) *Railway Gazette* Vol. 123 Dec. 1967, pp 899-902, 10 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-909)
DOTL RP

A2 037832
STRESSES BENEATH A RAILWAY TRACK

By physically testing track structure the British Railways attempted to confirm the validity of theoretical stress calculations. Those stresses studied were located beneath the track, between the sleeper and ballast, and within the track formation proper. Results show blanket material does not influence stress level. They found agreement between measured and theoretical results. There is a greater degree of reversing shear in the formation than in the blanket layer.

Heath, DL Cottram, M (British Railways) *Railway Gazette* Vol. 122 Dec. 1966, pp 1001-7, 13 Fig, 1 Tab, 4 Phot, 6 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-916)
DOTL RP

A2 037833
SIMPLE STABLE RAIL FASTENING

The Springlock fastening, designed and patented for use with pre-or post-stressed concrete cross ties and long welded rails, comprises a steel stirrup cast into the sleeper body, a spring-steel vee-clip, an insulator and a heel block. The last two items are precision-injection mouldings in thermo-setting plastic materials. The stirrup is an accurate pressing made in Corten steel to resist corrosion, and the vee-clip is hardened and tempered to ensure a constant and consistent grip loading. Insulators are positioned on the rail feet, the vee-clip is slipped in beneath the stirrup by hand, the heel of the clip is then raised and lowered on to the heel block. The whole procedure is quick, no further adjustments are needed.

Railway Gazette Vol. 122 Dec. 1966, pp 968-71, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-917)
DOTL RP

A2 037834
SYNTHETIC RESIN BONDING

Solventless adhesives do not require heat or pressure to provide sound joints, and therefore, have proved useful in railway engineering for they are amenable to site application. Two types of adhesive in particular have permitted these advances: polyesters and epoxides. A sleeper which has been made good with epoxide resin mortar is illustrated. Repair of E4 concrete sleepers under chaired track is carried out by displacing the sleeper and drilling holes, so that fastenings may be made good by using a polyester resin to secure rubber inserts in the concrete. Resins have been used to repair manganese steel crossings. Limitations on the use of adhesives for fixing chairs and baseplates to concrete sleepers appeared to be the difficulty of surface preparation of the metal, large glue line thickness, and low resistance to impact and peeling forces of the adhesives used. Cable hangers have been attached to a tunnel wall using an epoxide adhesive.

Perrett, ME (British Railways Board) *Railway Gazette* Vol. 122 Nov. 1966, pp 861-65, 14 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-918)
DOTL RP

A2 037836
ANCHORING BALLAST BY CEMENT GROUTING
Cement injection has prevented the scouring of ballast by high seas at Dawlish, England. The grout used consisted of four parts of pulverised fuel to one part of cement. All points were driven vertically except those nearest the sea, which were at 58 deg to the vertical. The grout was injected until breakout occurred. Experience showed that some points could be dispensed with because grout from the others covered the whole area satisfactorily.

Railway Gazette Vol. 122 Sept. 1966, p 694, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-920)
DOTL RP

A2 037837
CONCRETE SLEEPER TO RESIST THE EFFECTS OF FROST
Serious frost heaving is a menace which is encountered frequently in Japan. The pre-requisites of a prestressed sleeper to be used in such winter climates are that it must resist the distructive action of frost, and the metal and rubber parts of its fastenings must not become brittle or deteriorate at low temperatures. To ensure this resistance, air-entrained concrete should be used and its surface must have no holes, hollows or depressions, however slight, in which water can lodge. Rough edges and corners where deterioration in the concrete begins must be avoided, and the whole must be of fine concrete and quite smooth. The design of both sleeper and fastenings must be such that they will resist abnormal rail-loading and ballast reaction during frost-heaving and subsequent thawing. A special sleeper, Type 3F, was prepared for a series of tests in mid-winter in Japan. This prestressed sleeper contains 20 pairs of 2.9 mm diameter prestressing wires. Stresses were recorded during the most severe season of frost heaving. The expected centre-binding of the sleepers did not take place during the frost-heaving; instead many sleepers were supported under the ends as beams. In the cross-sections of the sleepers under the rails the measured values of the resisting moments were below the design values during both frost-heaving and the following thaw. Further testing is considered necessary before these sleepers are accepted as a standard.

Railway Gazette Vol. 122 Oct. 1966, p 789, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-921)
DOTL RP

A2 037845
RAILWAY SLEEPERS
The unique qualities of wooden, concrete and steel crossties are described and their application throughout the world noted. Those crossties which are being tested for future utilization are indicated.

Railway Gazette Vol. 119 Nov. 1963, pp 486-89, 2 Fig, 6 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-956)
DOTL RP

A2 037846
LONDON TRANSPORT RAIL DE-STRESSER
A new device was designed for de-stressing long-welded rail after any disturbance to them in cold weather. The machine, a rail-heating trolley is so geared that it is easily propelled along the track by one man at the low operating speed required--about 2 mile/h. At each corner of the trolley is carried a 100-lb bottle of propane, and from these, flexible hoses run to the rail heaters. The equipment is designed for use on the open sections of line. De-stressing is not necessary in tunnels as the temperature remains almost constant throughout the year. On open lines, rails are de-stressed after they are installed, and it is only necessary then to de-stress them again when they have been disturbing for changing a block-joint or resleepering outside the mid-range temperature.

Railway Gazette Vol. 119 Nov. 1963, pp 519-20, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-957)
DOTL RP

A2 037849
STRADDLE VEHICLE FOR LAYING LONG-WELDED RAILS
A machine was developed for unloading and laying long-welded rail. Straddling the sleepers, this device is a self-propelled unit having a steel underframe and deck mounted on four large pneumatic-tire wheels. It is powered by a diesel engine.

Railway Gazette Vol. 119 Oct. 1963, p 438, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-961)
DOTL RP

A2 037850
CROSS-SECTIONS BY PHOTOGRAMMETRY
When exceptional loads have to be conveyed by rail, measurements must be made along the route to determine by how much the normal loading gauge may be infringed. The Swiss Federal Railways has devised a method based on stereoscopic photography and has built a special measuring vehicle that houses the appropriate equipment. Stereo photographs coupled with a special viewing attachment permit the recording of continuous profiles as a cross-sectional diagram. The vehicle is equipped with a dark room to provide immediate on site inspection of exposures. An electric tractor is used to take the vehicle to site and also provides a 220V supply for the spotlight, heating, and charging of the car-lighting batteries. In transit speeds up to 56 mph are permitted. While operating, the speed is limited to 18 mph.

Railway Gazette Vol. 118 June 1963, p 723, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-962)
DOTL RP

A2 037852
RAIL CURVE CALCULATOR
The Matisa Multi-Station Curve Calculator functions according to the simple three point principle of curve correction. By using the calculator, an alignment may be set up in the form of a versine diagram and modified or corrected at will without calculation or possibility of error. The slews necessary for the realignment are automatically registered at each point. The unit has 30 indicators with which to set up the versine diagram, on graduated scales of 250-mm length. The operator can couple together two or more calculator units, and thereby use 60 or more versine stations, according to the length of the alignment. The unit can be supplied with a tracing equipment, which makes it possible to trace a record on paper of the original versine diagrams, the corrected diagram, the slews and any other desired information; for example, a cant diagram.

Railway Gazette Vol. 117 Oct. 1962, p 487, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-986)
DOTL RP

A2 037854
WEAR AND CORROSION OF RAILS
The use of the Shaw Rail Contourograph to measure vertical wear is described and illustrated. The wide limits of specific rail wear on the British Railways and London Transport are shown as a result of corrosive influence of atmospheric pollution in tunnels and industrial areas. Annual wear is approximately proportional to the square root of the number of axles passing per annum. A comparison between the British and American rail wear values shows much lower values in America for specific wear at the same traffic intensity. This may be partly because of the higher carbon content in America where the relative humidity is above 80 percent for much fewer hours per annum, and atmospheric pollution from industry is less concentrated than in Britain. The effects of steel composition, axleload and braking on rail wear are discussed.

Dearden, J (British Railways) *Railway Gazette* Vol. 121 Jan. 1965, pp 518-521, 3 Fig, 2 Tab, 1 Phot, 13 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-989)
DOTL RP

A2 037855
TRACK REPAIRS USING EPOXY RESIN
The water and cleaning chemicals at the railway car washing plant deteriorated the precast concrete pot cross ties. Rather than imbedding the new concrete cross ties in mortar, epoxy resin mixed with a special sand was

used. Although much more expensive, the epoxy-sand mixture is unaffected by the cleaning solutions used thus, it should prolong the track life.

Railway Gazette Vol. 121 Jan. 1965, p 68, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-990)
DOTL RP

A2 037858
V-CLIP RAIL FASTENING FOR CONCRETE SLEEPERS
This fastener was developed for S.H.C.-type concrete sleepers, in hope of achieving a larger working deflection than the standard S.H.C. rail-fastening. Whereas the rectangular clip has a thickness of 0.225 in. the V-clip is 0.196-in. thick, to provide a toe-deflection of 0.420 in. with a minimum toe-load of 3.4 ton. The toe-load and deflection of the rectangular clip were 0.90 tons and 0.30 in. so that the improvement effected by using the V-clip made the effect of rail, sleeper, and hoop tolerances much less significant. The V-clip is less expensive to manufacture than the standard clip and laboratory and track tests confirmed the technical advantages of the V-clip.

Railway Gazette Vol. 121 Mar. 1965, p 245, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-994)
DOTL RP

A2 037862
ASBESTOS-CEMENT SLEEPERS
These Italian cross ties are manufactured by compressing a number of asbestos-cement sheets, interspersed with steel rods at very high perssure. The compression, flexure, and shearing strengths are given. Because of the material's intrinsic elasticity, a smooth ride results due to the reduction of rail hammer and hunting. Springs clips with rubber seating cushions and securing bolts with mushroom heads are used as the fasteners. The cross ties have operated satisfactorily under extreme climatic conditions and under heavy traffic.

Railway Gazette Vol. 121 Apr. 1965, p 289, 1 Tab, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-998)
DOTL RP

A2 037863
MEASURED SHOVEL PACKING
The packing of the track by the L.M.S.R. method of shovel packing is accomplished in three stages. First, low places on the rail are measured by means of slighting boards; secondly, the depth of any voids there may be between the underside of the sleepers and the ballast when the track is unloaded is recorded on a series of Abtus voidmeters; and thirdly, the requisite amount of chippings, determined by the two measurements, is spread under the sleepers. These stages are described in detail and photographers show the use of the sighting board, voidmeters installed on the track, and the spreading of clippings under the sleepers.

Railway Gazette Vol. 70 Feb. 1939, pp 180-182, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1044)
DOTL RP

A2 037864
TRANSITION CURVES
A monogram for readily finding the cant required on the arc and the length of transition for specified conditions is illustrated and the mathematical proof is shown. This method is an improvement over a prior method in which cant was dependent only on speed and radius of curvature. This earlier method did not account for the relationship between speed and rate of curvature, which exists as a governing factor in the maximum permissible speed. The monogram is simple enough to use that it can be used for designing and setting out of transition curves on the site.

Reddington, CG *Railway Gazette* Vol. 75 July 1941, pp 55-56, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1045)
DOTL RP

A2 037865
PACKING BALLAST UNDER THE RAILS
The ballast packing machine illustrated, designed by August Scheuchzer, is claimed to permit even packing without crushing the stones. It is carried on a four-wheel frame and is operated by a 45 h.p. petrol motor, with a four-speed gearbox providing forward and reverse speeds varying from 4 to 28 m.p.h. The packing device is a pair of vibrating tool frames, which is illustrated. The tool is automatic, and depends on the amount of resistance of the packed ballast to release the packing mechanism of the tool.

Railway Gazette Vol. 71 Sept. 1939, p 373, 1 Fig, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1046)
DOTL RP

A2 037867
CURVE REDUCTION ON ROUTE OF SUPER CHIEF
By extensive realignment works, hundreds of speed restrictions have been eliminated on the 2,227-mile main line of the Santa Fe Railroad between Chicago and Los Angeles. Isolated curves, rather than curves forming a series, were removed to eliminate the speed restrictions placed on a very limited stretch of track necessitating appreciable deceleration below that allowed beyond both ends of the curve. The costs of removing single curves were also modest in comparison to removing curves in a series. In two years, 479-track curves were removed, 228 by realignment and 251 by slewing. The realignments eliminated 3626 degrees of curvature and 325 miles of track length.

Railway Gazette Vol. 71 Aug. 1939, p 208

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1048)
DOTL RP

A2 037868
RAIL-WELDING IN SOUTH AFRICA
The first of six flash-butt rail welding depots on the South African Railway is in operation and the method of producing 120 ft. welded rails is briefly described. The Thermit or Boutet process is used for welding. Existing rolling stock has been converted to insure safe transport of the rails to the point of use. An unloading system is used whereby the rails are unloaded from the converted bogie vehicle as they are being laid on the track.

Railway Gazette Vol. 71 Aug. 1939, p 205

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1049)
DOTL RP

A2 037869
LONG WELDED RAILS
The experiments conducted using welded rails in Great Britain and the U.S. are reviewed. The expansion and contraction of the long rails caused by temperature changes are discussed. Ballasting and sleeper spacing techniques are important in developing a strong support against the expansion and compressive stresses created in the rails. Photographs of welded rails at Southern Railway installations are shown.

Cantrell, AH *Railway Gazette* Vol. 71 July 1939, pp 101-103, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1050)
DOTL RP

A2 037871
SEVEN YEARS OF CONTINUOUS WELDED RAIL
The Delaware and Hudson has installed 10,984 butt-welded joints in 12 locations comprising 446,024 feet of rail. The longest continuous stretch of rail is 7018 feet. Of the welded joints, there have been only 29 failures, a failure rate of 0.26 percent; 25 failures occurred in thermit welds and four in flash welds. The causes of failure are itemized. Comparative maintenance costs between the welded rail and jointed rail for two locations are presented in tabular form. The man-hours expended per annum per mile were 19.75 and 25.71 for welded and jointed track, respectively, for the Port Henry, N.Y., installation.

Railway Gazette Vol. 76 Jan. 1942, 3 pp, 3 Tab, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1052)
DOTL RP

A2 037872
RECENT PROGRESS IN RAIL FISSURE DETECTION
The experience with Sperry detector cars during 10 years of service in the U.S. is reported. Changes in the design of the car to increase sensitivity and

reliability are reported. The rails are pre-energized by a magnetic flux, followed by the magnetic flux from the search unit. The searching unit has four-coils which are staggered rather than in line. The Type 80 modification is described which contains special amplifiers and recording pens to differentiate defects of certain types. During 5 years of experience 40 percent of the defects detected were transverse or compound fissures, 40 percent were vertical split heads, 15 percent were horizontal split heads, and 5 percent were miscellaneous defects. Five hundred miles of fissure-containing rails have been removed during the last 10 years after detection with Sperry detector cars.

Railway Gazette Vol. 75 Aug. 1941, pp 216-17

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1053)
DOTL RP

A2 037873
CONCRETE SLEEPERS ON THE G.W.R.
The limited experience of the Great Western Railway with pot type concrete sleepers is reported. The pot type is less than half the weight of the transverse pattern and requires less reinforcement. The pot sleeper weighs 246 lb when chaired and contains 5.75 lb of reinforcement. The design of the pot sleeper is illustrated. Thus far no abnormal maintenance has been required on the track laid on pot sleepers.

Railway Gazette Vol. 75 Nov. 1941, p 504, 1 Fig, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1054)
DOTL RP

A2 037874
A NEW RAIL JOINT
The ends of the two rails to be joined are recessed on the outside for the reception of an angle bridging piece of rail quality steel which forms the outer fishplate, and a standard fishplate is used on the inner side. A cast-iron base plate takes the bearing of the rails and the angle fishplate bearing directly on to the bedplate, assisted by the inner fishplate and the base plate itself. As these three elements develop the full strength of the rail across the space between the joint sleepers there is practically no deflection of the rail ends, and noise and pounding of the joint sleepers are eliminated. The iron bedplate is secured to the sleepers by means of through bolts. The elevation, plan, and section of the rail joint are illustrated. The joints have operated satisfactorily under heavy and fast traffic on the Southern Railway.

Railway Gazette Vol. 76 June 1942, pp 632-33, 4 Fig, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1057)
DOTL RP

A2 037875
THE BOUTET RAIL-WELDING PROCESS
The Boutet method of thermit welding appears to have overcome the objection to the older thermit welding, that the high temperatures involved tend to produce brittleness in the finished weld. It provides a reliable weld at a relatively small cost, either in situ, by means of portable apparatus, or at a rail depot. On the Southern Railway, with a gang of twelve men it was possible to make ten to twelve welds a day. The welding operation is in three stages--pre-heating, welding, and post-heating.

Railway Gazette Vol. 76 Feb. 1942, p 266

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1055)
DOTL RP

A2 037877
ELECTRIC CATCHPOINT WORKING ON SINGLE LINES
An accident occurred in March 1940, on a single line between Aviemore and Carrbridge, on the L.M.S.R., when a number of cars became detached and ran back to meet an oncoming train. The accident report recommended that electrically operated catchpoints be installed north of Carrbridge. The signalling layout is shown indicating the general layout of the section and the gradient profile. The circuits designed to ensure proper control being obtained over the working of the points is illustrated. The process for operating the signalling system is described.

Railway Gazette Vol. 76 June 1942, pp 695-696, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1058)
DOTL RP

A2 037878
RECLAIMING MANGANESE STEEL TRACKWORK BY WELDING
Cast manganese alloy steel is used for trackwork in the U.S. because of the prevalence of railway level crossings. The manganese alloy steel is subject to an exceptional degree of work hardening. Prior to welding the worn rail, the work-hardened layer should be removed by griding to a depth of at least 0.25 in. Nickel-manganese electrodes, carefully selected for diameter and amperage, are used for welding. The metal is deposited in two or more layers to protect the rail from absorbing the extreme heat generated by the welding process. The welded area must be ground down to a straight and level surface, to avoid high spots which work-harden so rapidly under load that permanent stresses result.

Railway Gazette Vol. 77 July 1942, pp 57-58

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1059)
DOTL RP

A2 037880
RECENT AMERICAN STEEL RAIL DEVELOPMENTS
The practice of taking impression tests on rail-heads, with a hardened steel ball under an applied load of 100,000 lb., is being abandoned. The controlled cooling and Brunorizing processes used on rails to eliminate shatter-cracking are described. The steps being taken to detect longitudinal fissures, which result in split webs and split heads, are described. The detection methods still fail to detect some transverse fissuring. Other causes of rail failure include engine burn fracture, piping, enclosed gas pockets, and rolling overlaps. Rail-ends are being flame-hardened or quench-hardened to arrest battering of rail-ends under extremely severe load, speed, and traffic conditions.

Railway Gazette Vol. 77 Oct. 1942, p 370-71

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1061)
DOTL RP

A2 037881
BRITISH RAILWAYS TO STANDARDISE F.B. RAILS
The conversion of the British Railways, excluding the London Transport railways, to 109-lb flat-bottom rail for main lines and heavily travelled secondary lines and high speed lines and 98-lb flat-bottom rail for lightly travelled lines is discussed. The conversion from bull-head rail for 22,000 track miles is projected to take 40-50 years. The 109-lb rail will be 4 percent heavier than the 95-lb bull-head rail per track mile. Cost savings are expected due to increased life, reduced maintenance and fewer components, such as fasteners, needed when compared to the bull-head rails.

Railway Gazette Vol. 90 Feb. 1949, p 115

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1064)
DOTL RP

A2 037882
THE NEW STANDARD BRITISH RAIL
The British Railways, excluding the London Transport lines, has adopted as standard the flat-bottom rail instead of the traditional bull-head type. Diagrams are given of 113-lb, 109-lb, and 98-lb flat-bottom rails. The 109-lb rail will be used on main-lines and others carrying intensive traffic at high speeds. It will replace the 95-lb bull-head rails. The 98-lb flat bottom rail supersedes the 85-lb bull-head rail for secondary lines. The new rails will be much stronger both vertically and laterally than the bull-head types they are replacing and will keep better alignment. Comparisons of the properties of the 109 lb and 98-lb flat-bottom, rails are made with the bull-head rails they will replace.

Railway Gazette Vol. 90 Feb. 1949, pp 124-25, 3 Fig, 4 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1065)
DOTL RP

A2 037883
EXPANSION IN LONG RAILS
Experiments have been conducted on rails up to 1 mile long. These rails are fixed by means of the resistance of the fishplates, sleeper fastenings, and

sleepers themselves embedded in the ballast; thus, for a 75 degrees F temperature variation above and below the temperature at which the rail was laid, a total force of about 61.3 tons (137,800 lb) is brought into play for a 96-lb rail, and the tendency to push the rail ends away from the center of the rail is resisted, and contained within the rail in the form of compressive stress (or with the tendency to contraction, tensile stress). The prevention of a rail from expanding or contracting causes an internal stress of 195 lb per sq. in. for each 1 degree F change in temperature. To minimize these high internal stresses, it is customary to lay long rails at the mean average annual temperature, and thus reduce the tendency of the rail to buckle, if the fastenings should become weakened. One of the great difficulties with long rails, apart from the practical limitations provided by transport, is that the opening up of the track can be done only at approximately the same temperature as that at which the rail was laid. The London Transport railways has used sliding expansion joints at the ends of the long sections. this expansion joint enables the keys to be knocked out, and any tendency toward expansion or contraction which may be imprisoned in the rail can exhaust itself at each end before further operations are begun.

Railway Gazette Vol. 90 Feb. 1949, p 144

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1066)
DOTL RP

A2 037886
FORMATION STRENGTHENING ON THE BOURNEMOUTH LINE, SOUTHERN REGION

Extensive blanketing work was undertaken to stabilize the roadbed. Most of the worst trouble was experienced in the neighborhood of certain of the bridges over cuttings where lifting of the track to provide a greater depth of ballast over the soft formation has been impossible. Rather than raise the bridges, which are mostly brick arches in good condition, it was decided to dig out the weak formation materials. In 1948 and 1949 nearly a mile of double track was treated in this way, and in addition, extensive drainage work was undertaken to collect the water flowing into the cuttings. All of this work was highly mechanized and one of the characteristics was the small amount of labor required. A diagram of a four-mile section between Brockenhurst and New Milton shows the location of blanketing works.

Railway Gazette Vol. 91 Aug. 1949, pp 240-41, 2 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1077)
DOTL RP

A2 037889
LONG WELDED RAILS IN THE CASCADE TUNNEL, U.S.A.

The long welded rails were used in the recent renewal of four miles of track in the Cascade Tunnel. The tunnel, which is 7 miles 1,397 yd. long carries the main line of the Great Northern Railway from St. Paul to the Pacific coast through the Cascade Mountains. The railway was laid with 110-lb rails, rolled to the standard American length of 1,326 feet de-stressed by heat treatment, tested magnetically for flaws, cleaned, and given a coat of anti-corrosive paint. The new rails are secured by four cut spikes in every baseplate. The rails are anchored by 48 grip-type anchors in each 39-foot panel. To provide anchorage in both directions, these are applied in pairs for each rail against both faces of alternate sleepers. Insulated joints are inserted in the track at intervals of one mile.

Railway Gazette Vol. 91 Nov. 1949, pp 551-52

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1080)
DOTL RP

A2 037891
A DIESEL-ELECTRIC TRACK SWEEPER

To remove cinders and wagon spillings from the track, a combined diesel-electric scarifer, sweeper, and conveyor machine is now in service on the Pennsylvania Railroad. The scarifier consists of 18 curved strips of spring steel each having a detachable digging tooth. Ten of the prongs rake between the rails and the other eight outside the rails. The sweeper is a rotating broom comprising a metal shaft with a number of arms or brackets to which are bolted steel segments forming a closed cylinder. The train travels about 2 mph and the broom rotates at 100 rpm. Refuse is removed to a level just above the sleepers and is thrown onto a series of three conveyors, which deposit the sweepings into a series of hoppers. Photographs show the sweeper train and the sweeping equipment.

Railway Gazette Vol. 91 Dec. 1949, pp 680-81, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1082)
DOTL RP

A2 037892
IMPROVEMENT OF TRACK FORMATION

The problems involved in maintaining a satisfactory track on unstable formations, and the remedial measures adopted are considered. In recent years, it has become the practice to remove all overstressed and disturbed materials with the best load spreading properties. The biggest range of problems arises on formation renewal work of the blanketing type. Considerable success has been claimed in America for pressure grouting and driving a pointed "spud" at close spacing into the formation, and filling the holes with sand. In France and in Denmark, blanketing with sand has proved satisfactory. On the Netherlands Railways, fine sand or ashes are used for blanketing clay formations. In Sweden, weak tracks have been strengthened with a continuous mattress of logs laid transversely under the ballast on a blanket of fir tree branches or a layer of fascines. On the Norwegian railways, dried peat has been used as a precaution against frost-heave.

Toms, AH Beatty, WF (British Railways) *Railway Gazette* Vol. 91 Dec. 1949, p 697

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1083)
DOTL RP

A2 037893
TRACK STABILIZATION AT WADDESDON, EASTERN REGION

Sand piling was adopted as part of the treatment of soft clay formation in a shallow cutting. The operation consists of driving a 9 in. dia. steel spud into the formation between and at the ends of the sleepers, withdrawing on reaching a specified depth and finally filling the hole with sand. A pattern of four piles every sleeper was found to be satisfactory. The track, as was expected, heaved as the piles were driven, the average heave being 2 inches. the rock layer was encountered at depths varying from 3 feet to 5 feet and was missing altogether in places. The drainage is being renewed; precast concrete channel drains are being used.

Railway Gazette Vol. 91 Dec. 1949, pp 704-05, 3 Fig, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1084)
DOTL RP

A2 037902
NORWEGIAN RAIL-SPREADING AND LIFTING EQUIPMENT

A series of detachable rollers, partly arranged as a vertical S-curved ramp, and fitted to a flat-wagon train are utilized for rapid rail spreading and lifting. A typical standard-gauge train to which the equipment has been fitted consists of an engine followed by a safety wagon, 21 flat wagons, a brake wagon and a control wagon. A description of the use of the equipment and the rails to be laid is given.

Railway Gazette Vol. 93 Oct. 1950, pp 399-400, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1093)
DOTL RP

A2 037903
PERMANENT WAY ON CONTINENTAL SECONDARY RAILWAYS

A summary is given for replies received from 31 administrations, to whom a questionnaire was circulated by the International Railway Congress Association. The report covers both lines worked by secondary railway companies and the secondary lines of main-line railway systems. Large and small gang maintenance categories are examined and their characteristics discussed. Maintenance cycles and their structure and methodologies are discussed. The article concludes that long-distance gangs, being better organized, supervised and checked, definitely improve the quality of the work and facilitate supervision by the district officer.

Ripert, L (French Light Railways) *Railway Gazette* Vol. 93 Nov. 1950, p 429

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1094)
DOTL RP

A2 037904
OVERHEAD LINE EQUIPMENT INSPECTION VEHICLE
A diesel-driven vehicle for overhead line inspection is described. Of steel construction, the interior provides space for eight men and necessary working equipment. Drive is from either end with speed options of 1.5, 5.6, 9.8, 14.8, and 23.1 mph. A hydraulically operated tower is housed in a well in the vehicle body. Windows are set at 45 degrees to permit inspection from inside the vehicle. Accessory lighting is provided by two separate battery-operated 24 volt circuits.

Railway Gazette Vol. 93 Dec. 1950, pp 489-92, 4 Fig, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1095)
DOTL RP

A2 037906
THE WOODEN SLEEPER
The position of the wooden sleeper is reviewed in relation to concrete and steel ones. Emphasis is on usage and economic considerations as they exist in 1947.

Railway Gazette Vol. 86 Feb. 1947, p 152

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1097)
DOTL RP

A2 037907
LONG WELDED RAILS
The item gives an historical and an evolutionary account of the development of long welded rails. Mention is made of the practice in the U.K., U.S.A., Germany and elsewhere. The use of welded rails has proven technically sound and comparative maintenance labor costs between continuously-welded rail and fishplated rail show savings in lining and surfacing ranging from 31 to 46 percent, and in gauging of from 33 to 39 percent.

Railway Gazette Vol. 86 Feb. 1947, pp 180-81

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1098)
DOTL RP

A2 037912
TYPES OF SLEEPERS AND SLEEPER MAINTENANCE
Wood, steel, and concrete sleepers are compared based on experience to date with each type. No alternative has been found to the cross-tie or sleeper and timber was almost universally preferred at the time. Steel sleepers begin to fail from corrosion followed by cracks around the baseplate. Concrete sleepers may fail through cracking with ultimate exposure of the reinforcement. On an annual cost basis concrete may prove to be the cheapest sleeper-but this opinion is based on an estimated 50 year life for pre-stressed sleepers and experience is insufficient to justify the estimate. Preservation of wood sleepers is usualy by creosoting. The article concludes that treated timber sleepers with fastenings are approximate in cost to steel sleepers, with concrete sleepers costing more than either.

Train, JCL (British Railways) *Railway Gazette* Vol. 86 June 1947, p 615

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1104)
DOTL RP

A2 037913
LONG WELDED RAILS IN THE U.S.A.
Experience to date with continuously-welded rail has revealed the following facts: (1) A sound practicable welded joint can be made. (2) Welded rail in long lengths can be transported and installed readily. (3) In the climate of that part of the U.S.A., welded rail should not be installed at a temperature under 60 degrees. (4) Welded track can be surfaced, lined, and otherwise worked without risk when done at a temperature equal to or less than that at which laid. (5) There are fewer failures in welded rail than in jointed rail. (6) Proper superelevation must be maintained on curves for the type of traffic handled to secure the maximum life of the rail on curves. (7) It is practicable to transpose welded rail on curves to increase rail life. (8) It appears that a less expensive fastening for welded rail is possible. (9) Difficulties experienced with continuously-welded rail can be eliminated by proper construction and maintenance. Considerable statistical data are included on costs and number of welds.

Railway Gazette Vol. 87 July 1947, pp 10-11, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1105)
DOTL RP

A2 037916
L.M.S.R. PERMANENT WAY DEVELOPMENTS-3
The L.M.S.R. is at present making use of welding for four main categories of trackwork, namely, re-conditioning worn and damaged switches and crossings; welding of rails into longer lengths; welding electric track components; and welding other track components, such as buffer stops, damaged rails, and wheel stops. For repairs on site portable oxy-acetylene equipment is used, and the welders usually work in pairs so that a lookout man protects both welders. The welding of water troughs into long lengths has also proved satisfactory.

Railway Gazette Vol. 87 Aug. 1947, pp 181-182, 8 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1108)
DOTL RP

A2 037917
AN AUTOMATIC TAMPING MACHINE
This machine is Swiss made and takes the form of a 4-wheel rail trolley which can travel from the depot to the site under its own power at a speed of about 25 miles an hour. It draws a trailer consisting of a shunting or parking platform which can be set up near the site of the work and enables the machine to be pushed clear of the running line for the passage of traffic. An essential feature of the machine is the tamping mechanism, which is housed in a pair of vertically-reciprocating tool frames operated by compressed air. Each frame holds four pairs of opposed tools.

Railway Gazette Vol. 87 Aug. 1947, pp 211-213, 2 Fig, 7 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1109)
DOTL RP

A2 037918
BALLAST CLEANING
The cause and cleaning of dirty ballast are summarized. Information presented was extracted from a technical paper. It was found that if the ballast shoulders and the "cribs", or ballast between the sleepers-together comprising under 40 per cent of the total section-are cleaned, the work will be more than 60 per cent effective. In opening out the ballast preparatory to cleaning, care must be taken not to disturb the part under each sleeper and, in removing the shoulders and cribs, at least 1 in. or 1-1/2 in. should be left intact against the sleeper and the excavation sloped off thence at 1 to 1. Permanent way staff are warned against scooping 3 in. or 4 in. of ballast from under the ends of sleepers to remove the mud which tends to collect there to form compact dams round and under the sleeper-ends. Good ballast cleaning with modern plant will remove 85 to 90 per cent of the dirt.

Protzeller, HW *Railway Gazette* Vol. 87 Aug. 1947, pp 229-230

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1110)
DOTL RP

A2 037923
BLANKETING OF TRACK, SOUTHERN RAILWAY
Soft formations underlying roadbed layed on marsh ground fill were treated by excavation and backfilled with quarry waste. Followed consolidation of the material, ballast was spread and tamped, and the track replaced. Another method utilized precast concrete slabs emplaced between a 12 in. blacket of quarry waste and the ballast. Additional details are given on the two methods as employed at specific sites, and include information on the typical "soft formation" conditions encountered and test procedures prior to rebuilding the roadbeds.

Railway Gazette Vol. 87 Dec. 1947, pp 673-675, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1115)
DOTL RP

A2 037925
SPEED ON CURVES ON THE L.N.E.R.
The item comments upon early standards for alignment and superelevation of curved track and extracts from the text of Technical Booklet No. 11 "Speed on Curves." Portions of the extract include information related to the determination of the permissible rates of change of cant and diffusing,

nd their relation to the form and dimensions of the transition curve of the rack. A portion of the booklet is devoted to the consideration of curves vithout transition, and formulae are developed which cover permissible peeds through crossover roads, double junctions, and reverse curves.

Railway Gazette Vol. 87 Dec. 1947, pp 692-693

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1117)
DOTL RP

A2 037927
ICE REMOVAL ON TYNESIDE ELECTRIFIED LINES
Kilfrost No. 1 Railway Solution is applied by means of two special-y-equipped vans which carry sufficient fluid to treat the whole of the 90 miles of electrified running lines at least once every trip. In operation, the van is attached to an engine and brake van and is restricted to a maximum speed of 15 mph but experience has proved that the ideal operating speed s about 10 mph. If it is found necessary to scrape the third rail before applying the fluid, this is done quite readily, as the van is equipped with scrapers, and so arranged that no matter in which direction the train is traveling, it is always possible to scrape the rail before applying the Kilfrost solution.

Railway Gazette Vol. 88 Feb. 1948, p 166, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1121)
DOTL RP

A2 037929
PREVENTION AND DESTRUCTION OF WEEDS ON THE PERMANENT WAY
A number of suggestions are advanced for clearing tracks of weeds that have gained a foothold in the ballast. The expedient of renewing the ballast has been tried on certain lengths, where perennial weeds have become particularly troublesome. This has not always had the desired effect as the new material appears to have acted as a fertilizer. Annual weeds, although not so deeply-rooted as many perennials, call for special attention, as they grow quickly. The grasses growing on embankments and the sides of cuttings can give serious trouble, if they are allowed to seed on to the ballast. This can be prevented by cutting the grass early in the summer, before the seeds have formed. A second cutting, in August or September, is advisable, to prevent late seeding. The disposal of old and dirty ballast has an important bearing on the problem of weed prevention. The introduction of weed-killing trains, fitted with chemical sprayers, has alleviated considerably the task of the maintenance gangs, but it is not always easy to find paths for these trains on lines that carry a heavy traffic.

Railway Gazette Apr. 1948, p 453

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1123)
DOTL RP

A2 037935
UNBROKEN MAIN-LINE CROSSING FOR CATCH POINTS
A special crossing was designed and tested for heavily traveled sections of the London Transport system. The advantages of this unbroken crossing are: (a) elimination of wear on the wing rail and nose of a normal crossing, resulting in much longer life; (b) elimination of the jolt as every wheel passes over a normal crossing, with reduction in wear on rolling stock; (c) reduction of maintenance packing of the crossing; and (d) elimination of one crossing check rail. This same type of crossing may be used in turnouts to sidings which are little used.

Railway Gazette Vol. 88 May 1948, p 549, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1129)
DOTL RP

A2 037937
AUTOMATIC BALLAST CLEANING
An automatic ballast cleaning machine is described. This machine automatically removes and riddles deteriorated ballast from beneath and between the sleepers while it is moving along the track. The rate of progress when working varies with the depth of the ballast removed. The main body of the machine is in the form of a trolley about 18 ft. long, mounted on two four-wheel bogies. Most of the mechanism is on this trolley, including the diesel generator, the vibrating screen, and the means of disposing of the screenings and the cleaned ballast. It is claimed by the maker that with a team of eight men, this machine can deal with about 130 linear yards of track an hour.

Railway Gazette Vol. 88 May 1948, p 632, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1131)
DOTL RP

A2 037938
FLAT-BOTTOM TRACK
In a comprehensive review of the potentialities and development of flat-bottom track extensive reference was made to experiments on the L.M.S.R. and showed that compared with the 100-lb B.S. bull-head rail, the 110-lb. B.S. flat-bottom section had the advantage or 41 percent, increased strength in the vertical plane, and the wide foot (6 in.) gave considerably greater resistance to bending in the horizontal plane. Taking the standard 95-lb B.S. bull-head as a basis, the 100-lb. flat-bottom was 43 percent stronger in the vertical plane, the 113-lb 62 percent, and the former 131 lb. American section 85 percent stronger. Considered as a beam, the 113-lb. flat-bottom rail was 62 percent stronger and 88 percent stiffer than the B.S. 95-lb. rail. The 113-lb. flat-bottomed rail was approximately two and a half times as stiff laterally as the bull-head section, due to the bottom flange of 5-1/2 in. The B.S. 110-lb. flat-bottomed was even better in this respect and with its 6-in. base, was three times as stiff. The article concludes that a considerable period of experiment would be necessary before it became possible to translate into terms of an accurate financial comparison, the relative merits of full-head and flat-bottom track.

Lee, CE (Railway Gazette) *Railway Gazette* Vol. 88 June 1948, p 649

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1132)
DOTL RP

A2 037942
TRACK AND ROADBED FOR HIGH-SPEED TRAINS
The article discusses the factors of roadbed and track as related to high speed operations, as well as the importance of maintenance for such operations. Track layout and the relationship of curves and superelevation are also discussed.

Johnson, RP (Baldwin Locomotive Works) *Railway Gazette* Vol. 83 Aug. 1945, pp 113-114, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1141)
DOTL RP

A2 037944
GROUTING SOFT SPOTS IN TRACK
The New York Central System improved its main lines by systematic pressure grouting between the ballast and the formation of soft places. The total cost in 1942 of grouting 31 soft spots was only $4,300. The next year the saving in maintenance at these points amounted to more than $13,000--thus both repaying the original investment and gaining more than 200 percent profit in a single year. The cost is now averaging about $1.50 per ft. of track. No speed reduction is found to be necessary over the affected track while the grouting is in progress.

Railway Gazette Vol. 83 Nov. 1945, p 454, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1143)
DOTL RP

A2 037949
THE PROBLEM OF THE TOP RAIL
It is a matter of common knowledge that the least reliable part of any normal steel ingot is the top. Standard rail specifications require that the rail shall be free from all top-of-the-ingot defects, and though in principle this requirement is carried out, in actual practice the average top rail from the ingot is not 100 percent free from the influence of these defects, as the broken rail records of every railway show. Theoretically the top rail should be the equal in quality of the middle rail or the bottom rail; practically it is not always so. Things that can and cannot be done to insure sound top rails are reviewed. From the manufacturing point of view, additional precautions can be taken to assure sound top rails, but they add to manufacturing costs. One is to cast the ingot large end up and provide it with a head encased in a refractory lining, which keeps the top of the metal molten until the ingot

proper has solidified. Another precaution is to cast a larger ingot, so that a greater percentage of crop may be removed from the top end.

Railway Gazette Vol. 84 Mar. 1945, pp 272-273

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1148)
DOTL RP

A2 037951
BRITISH METAL PLATE SLEEPERS
A description of six types of British-made cast-iron plate sleepers is presented and their advantages noted. Severe breaking tests on both the bull-head and flat-bottom standard-gauge plates have proved that each individual plate has a safety factor of at least 100 percent. These cast-iron sleepers will last 100 percent longer than their wooden counterparts. The complete sleeper can be made up, readily inserted in the track, and the rail positioned in the jaws and keyed up.

Railway Gazette Vol. 84 Apr. 1946, pp 429-431, 1 Fig, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1150)
DOTL RP

A2 037962
IN SITU BALLAST CLEANING
The use of McWilliams' "Moles" and Speno Railroad Ballast Cleaning Co. ballast cleaning machines on the Illinois Central is described. This ballast consists mainly of crushed limestone. Dirt samples removed from this ballast showed it to consist of 41 percent limestone dust, 45 percent soil from adjacent fields and 11 percent coal dust. The remainder was moisture. Experiences in cleaning this ballast are explained in some detail.

Railway Gazette Vol. 80 Mar. 1944, p 480

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1295)
DOTL RP

A2 037963
NIGHT WELDING OF BATTERED RAIL-ENDS
The building up of the battered running surfaces of flat-bottom rails at the joints has been developed in two ways: the first method consists in the use of some small "off-track" welding units, the second method is by means of larger "on-track" units. While on-track welding units are in the daytime in yards, the most interesting methods are those for use at night on running lines. Procedures for night-time welding are described.

Railway Gazette Vol. 80 Mar. 1944, p 312

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1296)
DOTL RP

A2 037965
SIMPLIFIED SIDING-TRACK FORMULAE
Various formulae have been compiled for the design of "ladder tracks" for sidings, and those the author has seen so far have entailed the use of leads with special lengths for the stock rails and/or crossing rails. In the author's opinion, groups of sidings should be designed so as to reduce to the lowest the number of curves. The adoption of proposed formulae will eliminate reverse curves and so make a reduction of almost 50 percent in the number of curves, compared with some other forms of layouts.

Preston, A *Railway Gazette* Vol. 80 Apr. 1944, p 386

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1298)
DOTL RP

A2 037966
CONCRETE RAILWAY SLEEPERS
This article presents the salient features of British Standard 986 which was published in 1944 and which deals with concrete sleepers. The Standard covers transverse or block sleepers for standard-gauge track over which speeds higher than 30 mph are not attained and provides for separate designs as follow: Class A, for lightly worked and storage sidings; Class B, for heavily worked and refuge sidings, goods loops, etc.

Railway Gazette Vol. 80 Apr. 1944, pp 409-410

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1299)
DOTL RP

A2 037967
A COMPOSITE TIMBER AND CONCRETE RAILWAY SLEEPER
A composite timber and concrete sleeper of simple design was evolved to meet requirements for wartime purposes and which could be adopted also for post-war needs should the shortage of timber continue. Its chief merit lies in doubling the use of existing supplies of timber and halving future requirements of this material. The following advantages were claimed: The resilience of timber is retained; centre binding is eliminated; an adequate tie is ensured; the tilting of blocks is eliminated and better gauge is maintained.

Railway Gazette Vol. 80 May 1944, pp 467, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1300)
DOTL RP

A2 037969
CONCRETE POT SLEEPERS ON THE G.W.R.
A brief history of the evolution of "pot" sleepers on the G.W.R. is presented. Details of manufacturing and in-service experiences are also mentioned. Pot sleepers get a better bearing on ashes, but also have been used successfully with stone ballast. Discretion was used as to the employment of pot sleepers on new embankments but little trouble was experienced on banks up to 10 feet depth.

Cookson, EC (Great Western Railway) *Railway Gazette* Vol. 80 May 1944, pp 545-546, 3 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1302)
DOTL RP

A2 037973
CROPPING BATTERED RAIL-ENDS IN THE TRACK
The Southern Railway of America has perfected a method of cutting off the battered ends of rails in the track, and restoring the road without interruption of train service. The method involves cutting off rails in situ, re-drilling, drawing up the rails, and inserting closures as necessary to compensate for the removed materials. It is estimated that the life of the rails will be extended by 6 years, and joint maintenance will be reduced by 10 percent. A maximum of 263 rails has been cropped in a single day of light traffic, but the average is 150; cost has varied from $0.98 to $1.26 for each rail-end cropped, or an average of $1.10, which works out at $2.20 for an entire rail. In a year, 42 miles of track have been successfully reconditioned.

Railway Gazette Vol. 81 July 1944, p 88

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1306)
DOTL RP

A2 037975
UNIT TAMPERS FOR PACKING SLEEPERS
The unit power tampers in use on the Missouri Pacific are described. As compared with multiple-tool power tampers, the advantage of the unit tamper is its portability. On the job the unit tampers are used chiefly for spot tamping, and in particular for picking up low joints and for tamping ties that have been renewed.

Railway Gazette Vol. 81 Aug. 1944, p 133, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1308)
DOTL RP

A2 037976
WELDING IN MODERN PERMANENT WAY PRACTICE
A survey of recent welding developments is presented with particular reference to the experience of London Transport. Attention is focused on thermit, flash-butt, electric arc and oxy-acetylene welding procedures for producing long welded rail, and resurfacing crossings and switches.

Croom-Johnson, P (London Passenger Transport Board) *Railway Gazette* Vol. 81 Aug. 1944, pp 160-164, 12 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1309)
DOTL RP

A2 037977
MODERN BRITISH TRACK DEVELOPMENT
A brief survey is made of recent innovations in permanent way maintenance and design. The survey includes the following topics: transition curves for high speed, mechanical tamping; weed killing; sleepers and timber shortage; the rail joint problem; and flat-bottom track.

Railway Gazette Vol. 81 Sept. 1944, pp 234-235

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1310)
DOTL RP

A2 037978
HOW LONG CAN A RAIL BE?
The continuous welding of rails as practiced in the United States by five railways is summarized. Summarizing the collective views at the time of this article, it was clear that expansion and contraction would not present problems. It was equally clear that there are appreciable savings in the costs of maintenance as compared with standard jointed track. There are good prospects of longer rail life, because destructive action on the part of the rails is reduced. Rolling stock rides more quickly and smoothly. Track circuits give less trouble, and can be lengthened.

Railway Gazette Vol. 81 Oct. 1944, pp 281-282

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1311)
DOTL RP

A2 037981
LARGER SOLEPLATES FOR SLEEPER PRESERVATION
The Norfolk and Western Railway introduced a large steel soleplate to increase the life of bridge timbers directly used for the support of railway track. It was soon realized that if these plates were substituted for the 13-in. plates already in use on bad curves in main lines, the former would bridge the spike-killed portions of the timber, and make it possible to drive the holding-down spikes in sound wood. It was hoped also, with the greater length to reduce if not to eliminate plate-cutting. So far as possible the 18-in. plates have been inserted only as part of a complete relaying operation. Where desirable, special methods have been devised lengthening the existing soleplate seats in order to accommodate the longer plate. The operation of substituting the new plates is performed by a gang of 20 men, who first draw the old spikes, remove the old plates, adze the sleepers, plug the old spike-holes, and then insert and spike the 18-in. plates.

Railway Gazette Vol. 81 Nov. 1944, p 450, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1315)
DOTL RP

A2 037983
EXTENSIVE USE OF FORMATION GROUTING
Cement grouting as a cure for unstable railway formation is not intended to provide a concrete slab under the ballast, but to stabilize the existing formation by driving out from it all free water and semi-liquid soil, which surges under passing trains. In fact pressure grouting has a double function by filling all the voids and setting in them, it seals them against penetration of further water by pumping action from below, and also from above. The grout, which is usually one part cement to five parts of sand, forms with the lower ballast a cemented mass that distributes the load evenly over the formation. The experiences and technical achievements of the AT&SF Railway with cement grouting are reported.

Railway Gazette Vol. 81 Dec. 1944, p 616

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1317)
DOTL RP

A2 037989
FASTENING FLAT-BOTTOM RAILS ON CONCRETE SLEEPERS
The Skull Hoop Clip fastening consists essentially of two steel hoops cast into a class "F" concrete sleeper on each side of the rail seat, and two resilient spring steel clips. Insulation of the assembly is provided by a rubber rail pad and two insulators to fit between the rail flange, the vertical bars of the hoops, and the spring clips. Laboratory testing included torsion, creep, and moment of resistance tests. The results showed an efficiency superior to that of most other fastenings tested in the same manner. Besides a superior holding-down efficiency compared with a number of other types of fastenings, this clip features simplicity of design, ease of assembly, and extraction of the clip without the need for specially designed tools.

Railway Gazette Vol. 110 Mar. 1959, pp 275-276, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1409)
DOTL RP

A2 037990
THE A.D. RAIL FASTENING FOR CONCRETE SLEEPERS
A new type of rail fastening, for use with flat-bottom rails and Class F concrete sleepers with modified rail seatings, are in use with long welded rails on a main line of the British Railways Track sections are illustrated. The assembly consists of an insulating clamping block, malleable cast-iron containing collar, and triple-coil spring washer. These are secured firmly in position against the rail foot by a holding-down bolt, tightened by a flanged nut and restrained by a locking pin which passes transversely through the concrete sleeper and also through a hole in the end of the holding-down bolt. The rail is seated on a rubber pad.

Railway Gazette Vol. 110 Mar. 1959, 4 p, 4 Fig, 6 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1410)
DOTL RP

A2 037991
TRACK-SIDE FOUNDATIONS IN SUBSIDENCE AREAS
The main line between Manchester and Crewe, British Railways, passes through a section subject to serious subsidence caused by brine extraction. The average yearly subsidence is 8 in. The design of the overhead line equipment to maintain the contact wire within the maximum and minimum heights above rail level is discussed and is illustrated. The track can be lifted for a period of four to six years before the foundation for the overhead structure will need to be lifted.

Railway Gazette Vol. 110 Apr. 1959, pp 390-391, 2 Fig, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1411)
DOTL RP

A2 037993
NEW SERIES OF STEEL RAILS
Important changes in British Standard 11 for flat-bottom rails are given. These new rails, designated "A" series, have larger fillet radii, joining web to head; use equal top and bottom fishing angles resulting in the reversion to the double angle foot, to obviate an unbalanced section, with excess metal in the foot; have reduced foot widths to allow better disposition of metal within the section; have sides tapered 1 to 10 to give added metal to resist wear; and have a larger head radius.

Railway Gazette Vol. 110 May 1959, p 501

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1413)
DOTL RP

A2 037994
MODIFIED BLANKETING
The two main types of soil foundation failure are pumping and strength. Pumping failures derive from slurry formed from ballast or erosion in the vicinity of the sleepers, especially near rail joints. Strength failures occur with a greater time-lag than pumping failures, and are recognizable by heaves of soil in the cess, six-foot way, or four-foot way. A modified method of blanketing is described and cost estimates are made for the re-ballasting process.

Railway Gazette Vol. 110 May 1959, pp 506-508, 3 Fig, 1 Tab, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1414)
DOTL RP

A2 037995
AUTOMATIC WELDING, GRINDING, AND HANDLING OF LONG RAILS
An electric, automatic, flash welding machine, designed by a Swiss firm, is being used to weld 132-lb., 39-ft. rails for the Louisville & Nashville Raolroad. Rail ends are ground to remove rust, then heated to plastic consistency and forced together with a 30-ton force. A 50-ton hammer-blow

forces foreign matter, gases, and surplus molten metal from the weld. An automatic grinder removes mill-scale and hand-grinders are used to remove any remaining roughness. The welding unit, grinder, and pusher are mounted in tandem on a 60-ft. all-steel car. About 60 welds per 8-hr. shift can be made by a crew of 8.

Railway Gazette Vol. 110 May 1959, pp 537-538, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1415)
DOTL RP

A2 037996
TRACK RECORDING ON THE SOUTH AFRICAN RAILWAYS
Four track-recording trolleys, self-propelled by a 65-h.p. gas engine, purchased to mechanize track maintenance on the South African Railways, are described. As it travels along the track at 19 MPH, irregularities are detected by the combined movements of probes and wheel flanges carried on three sets of detector assemblies. The function of the trolley is to record high and low points on both rails, versines (curvature) of both rails, superelevation or cant of the track, twist or skew, gauge variations, recording speed, and mileage.

Railway Gazette Vol. 110 May 1959, p 624, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1416)
DOTL RP

A2 037997
THIMBLE DEVICE FOR LAYING LONG-WELDED RAILS
London Transport has introduced a thimble device which, attached to a crane hook, enables 300 ft. lengths of welded rail to be installed rapidly with a labor force of five men. Laying speeds of up to two miles of single rail an hour can be achieved. The new conductor or running rails to be laid are shop-welded into 300 ft. lengths. Conductor rails are then site welded into longer lengths, usually of half a mile.

Railway Gazette Vol. 110 June 1959, 2 pp, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1417)
DOTL RP

A2 037998
BLANKETING AND DRAINAGE AT LAPWORTH, WESTERN REGION
The bottom of the cutting slope adjacent to the down relief line was supported by a dry stone wall which was crumbling badly because of the earth pressure behind it and the constant flow of spring water through it. The spring water was diverted and a Gabion wall was constructed. The permanent way was then deep reballasted.

Railway Gazette Vol. 111 Aug. 1959, p 48, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1418)
DOTL RP

A2 039140
SOME PROBLEMS OF WHEEL/RAIL INTERACTION ASSOCIATED WITH HIGH-SPEED TRAINS
The objective of the study is to identify and evaluate potential problems involving wheel-rail interaction which could limit the speed of a high speed rail (HSR) system. The study is based upon a survey of existing knowledge in the areas pertinent to wheel-rail interaction; no extensive analytical work is presented, but several approximate calculations are given. An attempt has been made to investigate possible wheel-rail speed limitations and to set aside some of the 'non-problems' which may at first appear to constitute a serious constraint upon rolling HSR concepts. The results and discussion are concentrated in four main areas; estimation of the dynamic loads; wheel behavior and structural integrity; rail dynamics and structural integrity; adhesion, hunting, and related problems. (Author)

TRW Systems Group 06818-W318-R0-00, Mar. 1969, 57 pp

Contract C-353-66

ACKNOWLEDGMENT: NTIS (PB-183846)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-183846, DOTL NTIS

A2 039204
STABILIZED BALLAST INVESTIGATION
The purpose of the investigation was to evaluate the ability of a compound to enhance the load resistant characteristics of conventional stone ballast. This compound, an emulsion based on a new butadiene-styrene block copolymer, was sprayed on the stone ballast of a short section of railroad track. A second section of track, similar but untreated, provided the sample of conventional construction. In the conduct of the investigation pulsating, single point, vertical loads varying from 5000 lbs. to 50,000 lbs. (and to 75,000 lbs. in some cases) were applied to, first, the untreated track and, then, the treated specimen in a uniform manner for 4,000,000 cycles. The treated ballast was finally subjected to 11,000,000 vertical stress cycles. Static lateral stress was also applied to each section. Comparisons established through this study are, conservatively stated, that the permanent settlement of ties supported on the untreated ballast was 10 times that recorded for the ties of the treated ballast test phase. Resistance to lateral displacement was, at least, five times greater for the treated specimen than for its companion. (Author)

Magee, GM
Association of American Railroads Final Rpt Aug. 1969, 89 pp

Contract DOT-FR-3-0254

ACKNOWLEDGMENT: NTIS (PB-192720)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-192720, DOTL NTIS

A2 039255
STUDY OF NEW TRACK STRUCTURE DESIGN, PHASE I
Conventional (tie-type) and non-conventional rail vehicle track structures were studied with the constraint that standard gauge and rail head contour not be varied from current practices. Computer programs were developed and used to analyze track response to both static and dynamic vehicle loading. A major philosophy in the development of improved track structures was to reduce the magnitude and number of pressure cycles transmitted to the foundation by passing rail vehicles. The report contains detailed discussion of material summarized in: 'Studies For Rail Vehicle Track Structures,' PB-194 139, and is a reference source cited in that document. (Author)
See also report on Phase 2, PB-202 273 and Final rept., PB-194 139.

Meacham, HC Voorhees, JE Eggert, JG
Battelle Memorial Institute Prelim Rpt Sept. 1966, 146 pp

ACKNOWLEDGMENT: NTIS (PB-202272)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-202272, DOTL NTIS

A2 039256
A STUDY OF NEW TRACK STRUCTURE DESIGN, PHASE II
Phase 1 of this research investigation was undertaken in September, 1966, for the Office of High Speed Ground Transportation (OHSGT) of the Department of Commerce by Battelle Memorial Institute for the purpose of conceiving new and improved track structures for high-speed trains. As a result of the Phase 1 program, a number of track structures and fasteners were devised which met the specified requirements. Following the conclusion of the Phase 1 program, the OHSGT requested additional studies and computer analyses of track structures and rail fasteners. The additional track structures of interest were chosen by OHSGT from many designs which had been submitted to them. In addition to the analysis of the track structures, they were interested in a more detailed analysis of rail fasteners, particularly any analysis which was amendable to computer techniques. This project (which was then designated as Phase 2) was then conducted, and the results are summarized in this report. The report contains detailed discussion of material summarized in: 'Studies For Rail Vehicle Track Structures,' PB-194139, and is a reference source sited in that document.
See also report on Phase 1, PB-202272 and Final rept., PB-194139.

Meacham, HC Voorhees, JE Eggert, JG Enright, JJ
Battelle Memorial Institute Summ Rpt Aug. 1968, 64 pp

ACKNOWLEDGMENT: NTIS (PB-202273)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-202273, DOTL NTIS

A2 039263
EXPLORATORY SOIL BORINGS AT TWO LOCATIONS FOR THE U.S. DEPARTMENT OF TRANSPORTATION. DESIGN STUDIES
Exploratory borings and soil classification studies are reported on for two locations; southeast Kansas and northeast New Mexico. The objective of the work was the revelation of sufficient sub-soil information to enable a decision on the part of the sponsoring agency as to where to most appropriately install a railroad test track. Duplication of physical conditions most representative of present railroad track support conditions and economics of construction were important considerations. (Author)

Eidt, JT Marks, BD, III Stewart, JF
Hemphill Corporation Final Rpt Aug. 1971, 75 pp

ACKNOWLEDGMENT: NTIS (PB-202271)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-202271, DOTL NTIS

A2 039266
COMPACTION OF THE CRIB AND SHOULDER AREAS OF THE BALLAST SECTION SUPPORTING THE LINEAR INDUCTION MOTOR RESEARCH VEHICLE TEST TRACT IN PUEBLO, COLORADO
Observations concerning the problem of modifying a specifically identified unit of railroad ballast compacting equipment to achieve optimal working efficiency in one location are presented. The theories associated with the in-track compaction of railroad ballast are discussed and certain performance tests described. A comprehensive list of references is contained as an appendix. (Author)

Genton, DL
Ecole Polytechnique Federale de Lausanne Final Rpt IT-712, Aug. 1971, 38 pp

Contract DOT-PR-10191

ACKNOWLEDGMENT: NTIS (PB-203184)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-203184, DOTL NTIS

A2 039308
BALLAST TAMPING
The first types of mechanical tampers sought to imitate the action of the beater packing. These tampers resemble a road drill with a blunt T-head steel which delivers about 90 blows a min. to the ballast at the bottom of the sleeper. The type of mechanical tamper which has been most widely used is that having a "vibrate and squeeze" action. The use of vibration (about 2,000 blows a min.) causes the ballast to flow into a closer arrangement of particles, and by combining this with a squeeze it is possible to obtain the result more quickly and to control the formation of the ballast mold. The standard Matisa machine was produced to meet the special requirement for packing hollow steel sleepers. The Matisa machine applies its squeeze mechanically by means of left-and right-hand threaded shafts.

Railway Gazette Vol. 111 Nov. 1959, pp 388-389

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1424)
DOTL RP

A2 039309
CIVIL ENGINEERING MAINTENANCE WORK
Regular examination is the basis of railway civil engineering maintenance work, ranging from daily examination of passenger-carrying lines to underwater examination of the piers or abutments of a bridge at 20-year or longer intervals. The Matisa track-recording self-propelling trolley unit, introduced during the last two years, enables reliable records of cross level, track curvature and track gauge to be obtained at a running speed of about 20 mph. Examination of rails with manually-applied ultrasonic-type flaw probes was introduced in 1954. A special rail-mounted adaption of the principals and mechanism of the Simon hoist has been developed to provide better means of regular examination of high masonry vaiducts. At the end of 1958, only two major equipment developments were being pursued. First, a prototype "on track" self-propelling machine was under construction. This is designed to excavate track ballast from outside the ends of sleepers, and screen it, and replace the clean ballast. Secondly, a design of a type of low-loading lorry with both pneumatic-tired road wheels and steel flanged tired wheels is being developed.

Railway Gazette Vol. 111 Nov. 1959, pp 475-476

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1425)
DOTL RP

A2 039310
RAILWAY SLEEPERS IN ASBESTOS CEMENT
A brief description is given of asbestos cement sleepers, the method of manufacture, characteristics and present usage. Asbestos chrysotile a hydrated silicate of magnesia, is very pliable and contains an extremely high tensile strength approximating that of steel wire. Railway sleepers are manufactured by compressing several thin layers of asbestos cement while still in a pliable condition and arranged in such a way that the fibres are evenly oriented. The sleepers are supplied in two classes. These vary in thickness dependent on their intended use, principally in respect of traffic density and speed. Two types of rail fastening are offered; a rigid fixing for secondary lines and sidings and spring type clips for high speed traffic. Asbestos cement offers very high insulating characteristics. While the life of the asbestos cement sleeper can only be assumed, practical tests show that it remains unaltered after 20 years of use.

Hubbard, W *Railway Gazette* Vol. 111 Dec. 1959, pp 510-511, 4 Tab, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1426)
DOTL RP

A2 039312
CONCRETE SLEEPER TESTS ON AN L.M.S.R. MAIN LINE
Concrete sleepers are being tested to indicate their suitability for use on heavily worked main lines. Two types of reinforcement are being tested. The sleepers are 7 feet 6 inches long, 10 inches wide, and 5 inches deep; they are fitted with inserts to take standard chairs and screws. A felt pad has been inserted between the chairs and the surface of the sleepers; short 9 inches fishplates, with two bolts, are used at rail joints. The test track was laid on the Euston-Crewe main line.

Railway Gazette 420612, p 653

Contract DOT-FR-9-0004

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1428)
DOTL RP

A2 039315
STAGGERED RAIL-JOINTS
Pros and cons about staggered rail joints are examined. Both U.S. and British opinion are presented with emphasis on the experiences of the Great Eastern Railway of Great Britain. Rail-end batter, car rolling, and economics of each method is discussed.

Railway Gazette Vol. 110 May 1959, pp 612-613

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1431)
DOTL RP

A2 039320
WHEEL AND RAIL LUBRICATION
Remarkable increases in life of rails and wheel flanges through lubrication, by as much as 700 percent, are quoted by Dr. Fritz Birmann, in his paper "Lubrication of Rails and Wheels." The requirements of a lubricating system to reduce wear of rails and tires, are that the lubricant must be prevented from spreading to the running surface of the rail, thereby reducing traction; that the efficiency of the system must not be spoiled by dust, dirt or weather influences; that the lubricating devices and spray nozzles must be profile free on the rail and vehicle; and that lubrication must not start too late on the curve, so that it is preferable, where possible, to lubricate tires before entering the curve.

Birmann, F (German Federal Railways) *Railway Gazette* Vol. 107 Oct. 1957, p 413

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1483)
DOTL RP

A2 039436
INVESTIGATION OF THE DURABILITY OF IMPREGNATED TIES
The service life of cross ties and the factors which lead to their replacement were studied. The average life of wooden ties is 14.1 years with a variation of 4 years, depending on tonnage. The life of ties on curves is 2.4 years shorter than in straight sections. Tie plates increase this life. Rotting of the ties is less of a problem than cutting by the rails.

Kakegawa, Y *Railway Technical Research Institute* Vol. 4 No. 3, Aug. 1964, pp 41-44, 8 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-690)
DOTL RP

A2 039439
RAIL CORRUGATION--CAN IT BE PREVENTED
This is a research report which attempts to determine the causes of rail corrugation. The author suggests that higher rail speeds may cause rail corrugations or undulations as deep as 0.01, which accelerate rail wear. A relationship is established between the natural frequencies of rail vibration and the wear length of the corrugation. Further experiments are required into the possibility of eliminating corrugation by axle redesign as well as changes in rail profile and tie spacing.

Spaderna, CH *AREA Bulletin* pp 307-312, 3 Fig, 2 Tab, 3 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-693)
DOTL RP

A2 039440
EXPERIMENTAL RESULTS OBTAINED ON THE LATERAL PROBLEMS OF THE LONG WELDED RAIL CONTINUOUSLY LAID ON SEVERAL SPANS OF THE BRIDGE WITHOUT BALLAST
To show the lateral stability of continuous welded rail on a bridge, and the character of the lateral load to the bridge as a result of such rail, a test was conducted by the JNR on an actual bridge. The data resulting from this test shows that even though there were no problems resulting from unballasted rail on a bridge, the lateral forces between rail and sleepers varies and may reach a value which is ten times the calculated value. The phenomena is a result of continuous rail laid on a bridge resulting from the high lateral elastic coefficient of the rail supporting system.

Sato, Y Nagata, M (Japanese National Railways) *Railway Technical Research Institute* Vol. 10 No. 1, Mar. 1969, pp 8-10, 3 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-694)
DOTL RP

A2 039445
NOVEL BALLAST SCREENING MACHINE
This article describes a ballast screening machine which is to be used in the French railways. The equipment is capable of removing, screening and replacing in one night the ballast in a quarter mile of track without breaking the road or obstructing more than one track. The machine consists of two units, diesel powered, which can quickly be removed from the track, a process requiring about 15 minutes.

Railway Gazette Vol. 84 Feb. 1946, pp 222-223, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-700)
DOTL RP

A2 039446
TESTS OF RAIL JOINT IMPACT EFFECTS ON THE CHICAGO AND NORTH WESTERN
Tests were conducted to evaluate the economics of 78-foot rail. Fundamental information was obtained on the impact effects on joint ties due to rail end batter, joint gap, and joint bar fit of regular rail joints compared to the impact effects with a butt weld. Conclusions suggest that to compare welded rail joints with conventional joints, the costs of maintaining a rail joint in equally good condition including the maintenance of rail end batter not to exceed 0.015 in., replacement of joint bars, tightening of track bolts plus corrosion protection must be included.

AREA Bulletin Vol. 57 1956, pp 865-883, 7 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-702)
DOTL RP

A2 039448
FEATURES IN THE SELECTION OF WEIGHT OF RAIL FOR NEW OR REHABILITATED LINES
The principal features to be considered in the selection of the weight of rail for a new or rehabilitated line will be: the type and axle loading of motive power and cars; the physical characteristics of the line; and the type, intensity and speed of traffic. Given these controlling factors a reasonable decision should be possible, which will result in minimum annual total cost of maintenance with a satisfactory condition of line and surface. New locomotives require stress calculations to determine the results of using existing roadbeds and rail.

Code, CJ (Pennsylvania Railroad) *AREA Bulletin* Vol. 55 pp 343-345, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-705)
DOTL RP

A2 039451
ELEVENTH PROGRESS REPORT OF THE ROLLING-LOAD TESTS OF JOINT BARS
This report discusses the test program of rolling load tests of joint bars using 3-33 inch stroke rolling machines. The results of the tests of joint bars, which were heat treated and tempered are given. Hardness tests of the bars are included as well as the rolling load tests. Test results of 132 RE leadfree bars (oil quenched) averaged 573,100 cycles before failure which started at a rail end. Tests of 132 RE leadfree bars (water quenched) averaged 365,300 cycles. 4 bars failed, 2 from the top, 2 from the base.

Jensen, RS (Illinois University) *AREA Bulletin* Vol. 54 1953

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-708)
DOTL RP

A2 039460
TIGHT-JOINT LONG RAIL LENGTHS
The use of high torque bolts in a testing situation by U.S., railroads is discussed. These bolts were being tested as an alternative to continuous welded rail, to eliminate the problems of transport, laying, renewal which is inherent in use of welded rail. Rail used in 132 lb RE with six hole joints held by 1-1/8 in. bolts. So far, measurements have not given significant results except for the flow of metal at rail ends, plus shipping of rail joints.

Railway Gazette Vol. 105 Aug. 1956, p 32

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-755)
DOTL RP

A2 039468
AN ANTI-VIBRATION NUT
The Lester anti-vibration nut has successfully been tested on railway permanent way over a period of several years. It is free running when first screwed on to the bolt, but on tightening the nut, the conical discs tend to flatten, until the threads cut in them. A further feature of the Lester nut is its ability to be unscrewed without damage and the fact that it dispenses with washers. Since first being used, the nuts are estimated to have carried some 36 million tons of traffic at speeds of 40-45 m.p.h., without requiring retightening.

Railway Gazette Vol. 99 Aug. 1953, p 207, 1 Fig, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-784)
DOTL RP

A2 039473
SLIGHTLY STAGGERED RAIL JOINTS
The staggering of rail joints is logical because it avoids placing two weak spots, the joints directly opposite each other; it reduces the impact at the joints to that of a wheel load instead of an axle-load; and it produces a more uniform vertical continuity of the track. Certain railways in India experimented with short-pitch staggered joints. Graphs obtained with the Hallade track recorder showed that the running over the slightly staggered road was inferior to that over normal square-joint track. Selection of the optimum pitch for the stagger is half the length of the wheelbase of the standard type

of bogie fitted to passenger stock. This complies with the condition that the stagger must be less than the minimum wheelbase of any bogie allowed to run over the line, namely, 6 ft.

Railway Gazette Vol. 94 Feb. 1951, p 201

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-805)
DOTL RP

A2 039480
WHEEL HUNTING AND IRREGULAR RAIL WEAR
In addition to the "hunting" of rolling stock wheels, there is the constant side-to-side movement of individual pairs of wheels. The standard taper of coning of wheel-treads is at 1 in 20, so the tread of a new tyre may be at right-angles to the centre-line of the rails. Experiments have been tried in varying the angle of taper of the treads and the radius of the railhead, but the wear of tires and rails complicates the problem, and hitherto has made it difficult to come to any final conclusion as to how the hunting problem may be solved. Persistent bogie hunting can cause bogie stock to ride uncomfortably. Of even greater importance is the wear-and-tear of rolling stock and the damage to rails caused in this way.

Toms, AH *Railway Gazette* Vol. 83 Dec. 1945, p 636

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-812)
DOTL RP

A2 039481
THE MOVEMENTS OF RAILWAY VEHICLES ON THE TRACK AND THE FORCE ARISING THEREFROM
A critical analysis is given of the interaction of flanges and rails, together with a resume of the scientific principles involved. The friction arising between wheel and rail is fundamental for all railway transport. The frictional force R is equal to or less than the product of the frictional factor f and the wheel load Q, which are the variable quantities. As the direction of force R coincides with the resulting sliding motor between wheel and rail, its action is opposed to the direction of motion. Force R determines not only rolling resistance, but also that due to curves, guiding pressure, security against derailment, maximum tractive and braking power, axle strain, wear of rail and flange, and--last but not least--freedom from hunting. Methods to determine the precise position and value of R are discussed.

Liechty, MR *Railway Gazette* Vol. 83 Nov. 1945, pp 564-565

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-813)
DOTL RP

A2 039484
PROGRESS IN RAIL WELDING
The components necessary for rail preparation, rail welding and welded rail dispatch areas are discussed. Also discussed is the economics of using mainly automated equipment where labor costs are high, and using minimal automated equipment where labor is plentiful and inexpensive.

Railway Gazette Vol. 124 Mar. 1968, pp 177-179, 1 Fig, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-828)
DOTL RP

A2 039492
FASTENING RAILS TO A CONCRETE DECK
Engineering design criteria for rubber-bonded cork pads on concrete are developed to account for geometry, the compression characteristics of the pads, axle loading and compression spring characteristics. An inspection coach, wagon and modern train with rubber spring wheels were run over the test track and vibrations in the rails and concrete slabs were measured. It was found that soft pads have better damping properties than hard pads for all frequencies, and ballasted track has less satisfactory damping properties than soft rubber-bonded cork pads. From sound level measurements, it was concluded that rubber-bonded cork also produces less sound to be critical in eliminating a very noisy hammer effect caused by separation of the rail and pad.

Deenik, UJF Eisses, JA (Netherlands Railways) *Railway Gazette* Mar. 1966, pp 230-236, 15 Fig, 3 Phot, 4 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-927)
DOTL RP

A2 039525
THE REPLACEMENT PROGRAM
A decision analysis is conducted to determine if concrete cross ties should replace wooden cross ties. Tie spacing using concrete is about 4 or 5 inches wider than is required for wooden tie spacing to handle the same traffic conditions. The examples shown indicate that concrete ties are a sound investment in high traffic density, heavy grade and sharp curve territories where sufficient savings can be accumulated in a relatively short period of time. On the other hand, tracks carrying an insignificant amount of traffic cannot produce an acceptable rate of return if they are constructed with concrete ties.

Included in "Engineering Economic Analysis in Railroad Planning and Operations."

Reiner, IA (Chesapeake and Ohio Railway)
Railway Systems and Management Association Feb. 1969, pp 63-73, 5 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1037)
DOTL RP

A2 039533
MECHANISATION OF PERMANENT WAY MAINTENANCE AND RENEWAL
The use of specialized equipment for maintenance of the permanent way is reviewed. Activities in various countries are synopsized.

Robertson, VAM (British Railways); Mucherie, ML (French National Railways) *Railway Gazette* Vol. 90 June 1949, pp 607-608

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1072)
DOTL RP

A2 039534
RECENT IMPROVEMENTS IN REINFORCED AND PRE-STRESSED CONCRETE SLEEPERS
The report summarises the steps now being taken to improve the design of concrete sleepers, and widen their field of use. It includes details of the design and manufacture of concrete sleepers now in use, and a summary of research work undertaken during the past few years.

Robertson, VAM (British Railways); Gonon, M (French National Railways) *Railway Gazette* Vol. 90 June 1949, p 635

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1073)
DOTL RP

A2 039537
GUIDING PRINCIPLES FOR THE DESIGN OF POINTS AND CROSSINGS
Accelerations were analyzed with reference to comfort in passenger bogie coaches and two locomotives were used to ascertain the effects of the guide force on wear and fatigue of the switch fittings. The object of these studies were to discern the influence of the following factors on accelerations and forces at various speeds: size of the angle of impact; radius of curvature of the turnout; transverse stiffness of the track; and characteristics of the vehicle suspensions. An analogue computer and a digital computer were used for making the calculations. Results of the calculations are shown.

Question D72. Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways ORE-Pub-25, July 1967, pp 20-25, 7 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1102)
DOTL RP

A2 039548
DETAILED INVESTIGATIONS INTO SLEEPER DEFECTS
In 1950-51, 400,000 failed wooden cross ties were examined and classified as to the type of failure: (1) decay, (2) plate-cutting, (3) splitting, (4) shattering, (5) spike killing, (6) braking (7) ring separation, and (8) accident. Five types of wood were involved, but 85 percent of the sleepers examined were of pine or fir species more universally used then the other two, oak and gum. Plate-cutting, splitting and shattering accounted for about 1/3 each of the total failures.

Railway Gazette Vol. 98 June 1953, pp 725-726, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1187)
DOTL RP

A2 039554
BALLAST CLEANING WITH SINGLE-TRACK OCCUPATION
Experiments have been made with methods involving the occupation of only one track when using mechanical ballast cleaners. In the present experiment, the conveyor discharging the dirt, drops its material on to a second conveyor mounted on a rail wagon, which in turn delivers the material into a hopper on a simple steel framework carried on a flat wagon. This framework is of sufficient headroom to permit a low type of dumper to travel underneath it. The dirt is released from the top hopper into the dumper through drop doors and the dumper then travels the length of the train and tips the dirt into wagons standing on the same line. Results to date are most encouraging and an output has been achieved approaching that obtained when screening into wagons on an adjoining road.

Railway Gazette Vol. 99 Aug. 1953, p 240, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1193)
DOTL RP

A2 039555
RESEARCH ON INDIAN RAILWAYS
The main objectives of the Indian Directorate of the Railway Board, located at Lucknow, are maximum safety in rail travel, sufficiency in equipment, and economy. The Lucknow center carries out research on fuel, the dynamic effects of vehicles on track and bridges and riding quality and performance lists on locomotives and carriages. The sub-center at Lonavla is carrying out research on soil mechanics and foundation engineering problems; chemical and metallurgical studies on lubricants, paints, water softeners, and other aspects are being undertaken at Chittaranjan.

Railway Gazette Vol. 99 Sept. 1953, pp 312-313

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1194)
DOTL RP

A2 039557
TRACK DRAINAGE BETWEEN HARROW AND SOUTH KENTON, L.M.R.
The renewal of the formation and the provision of new track drainage between Harrow and South Kenton became necessary when ballast became choked, resulting in the prevention of effective drainage and the formation of slurry which flowed into the track drains. The first stage in the renewal is the removal of track in one line of the natural formation to withstand the loading of traffic. The next stage is the graduation of the formation to a crossfall to the new drainage system. A sand blanket of sufficient thickness to blind the clay and prevent it pumping and fouling the ballast is then laid to the required crossfall, the drainage system is placed, and the track ballast unloaded. The track is then reinstated and fettled up.

Railway Gazette Vol. 99 Oct. 1953, pp 436-437, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1196)
DOTL RP

A2 039558
PROTECTING RAILWAY SLEEPERS IN U.S.A.
A mastic-type coating, Protext Coat, manufactured by Nox Rust Chemical Corp., has been found to prevent splitting in wooden cross ties. It is fire resistant and easy and cheap to apply. Cost per tie is about 25 cents. Eight to ten years additional tie life is claimed.

Railway Gazette Vol. 99 Oct. 1953, p 465, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1197)
DOTL RP

A2 039559
GROUTING OF RAILWAY EMBANKMENTS
A new method of stabilizing fissures in clay formations was developed by British Railways. It involves the injection of a neat cement water grout into the clay under pressure. This method differ s from that known as track grouting inasmuch as the grout is introduced much deeper below track level from 15 to 17 ft. and at a relatively higher pressure. Cost per linear foot is about 8 pounds.

Railway Gazette Vol. 99 Nov. 1953, pp 547-548, 4 Phot
ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1198)
DOTL RP

A2 039560
FASTENING FLAT-BOTTOM TRACK
The Electric Rail Spike Co. has developed a new spike fastening for flat-bottom track which is claimed to solve rail movement, including creep, spike killing and wear of track components generally. The spike is made from one piece of silco-manganese steel bar, suitably formed to give a laminated shaft and head 5/8 in. square, then hardened and tempered. It is driven until the head makes contact with the rail foot, and thereafter a further amount of some 3/16 in. which flexes the head and puts proportionate (800 lb.) pressure on the rail base. The spikes stand up very well under derailment, and can be used with concrete sleepers in conjunction with a wood insert or for track circuits. The rubber-covered spikes can also be used with cast-iron or steel baseplates.

Railway Gazette Vol. 99 Nov. 1953, pp 573-575, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1199)
DOTL RP

A2 039562
ORGANIZATION OF TRACK MAINTENANCE
This article covers a report made to the sixteenth Inter- national Railway Congress on a survey of the maintenance policies of fourteen railway administrations. The focus is on organizational aspects of maintenance gangs, and track recording devices.

Railway Gazette Vol. 100 Jan. 1954, p 95

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1201)
DOTL RP

A2 039564
TRACK MAINTENANCE PROBLEMS
This summary of track maintenance problems was obtained from the railway administrators of the International Railway Congress. All the railways consulted are studying possible modifications in the traditional maintenance organization, but investigations are still in the experimental stage, and there are no indications what the final pattern will be. The experiments can be grouped into two categories: (1) Concentration of smaller into large gangs, and the various methods of transport for their mobility, and (b) mechanization. The article summarizes activities and equipment used by various countries in the areas of track recording equipment, speed restrictions and signals and mechanical tools and mechanization problems. Economic and financial aspects are included as well as the use of medium-sized gangs for maintenance.

Railway Gazette Vol. 100 Feb. 1954, pp 150-151, 1 Tab, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1203)
DOTL RP

A2 039566
FLAT-BOTTOM TRACK IN GREAT BRITAIN--II
A description is given of the first 110 lb. flat-bottom turnout installed in Britain, in 1944. Detailed illustrations and photos are included.

Railway Gazette Vol. 81 Oct. 1944, pp 379-381, 2 Fig, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1205)
DOTL RP

A2 039571
LONG WELDED RAILS
If very long weld rails are used to circumvent the many disadvantages of the jointed form of track, important safeguards are essential. The standard types of doubly-flexible rail-to-sleeper fastenings in use on the French railways are among the most efficient deterrents to the risk of fracture due to tension. With an 800 m. length an expansion joint of the sliding switch-blade and stock-rail type is used, allowing of a relative movement of up to 7 in. between the rail-ends. The French railways use arc-welding plant equipped with special finishing devices, in the shape of precision grinding and truing units working in both plan and profile, assisted by hydraulic jacks. It is too early to access precisely the economies resulting from welded track, but the

smallest calculated saving so far is about 30 percent, and was secured on the Paris-Marseilles line near l'Etang de Berre.

Railway Gazette Vol. 100 June 1954, p 687, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1216)
DOTL RP

A2 039573
TIMBER, STEEL OR CONCRETE SLEEPERS?
In recent years timber costs have risen so abruptly that railways have had to search for alternate materials for their sleepers. The battering to which a sleeper is subjected under traffic has generally proved too much for the normal reinforced concrete sleeper, but with the introduction of pre-stressing methods, the prospects of concrete in this field are much more promising, especially if some form of resilient cushion is provided between rail and sleeper. The concrete sleeper, though it would appear to outlive its wooden competitor as a rule, is heavier and generally more difficult to handle. Moreover, a road laid with either steel or concrete sleepers is less suitable than a wooden-sleeper track for track-circuiting. It must also be remembered that steel sleepers laid near the sea or in areas where the atmosphere contains corrosive ingredients are subject to serious erosion and deterioration. The relative costs of day-to-day maintenance of wooden, steel, and concrete sleepers are not readily comparable, largely because there are so many different types of fastening used with each.

Railway Gazette Vol. 101 July 1954, p 116

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1218)
DOTL RP

A2 039576
MATERIALS FOR TRACK BALLAST
It is generally agreed that the ideal ballast is hard stone broken to suitable sizes. The main characteristics of good ballast are that it should be hard, heavy, resistant to crushing, shock abrasion and weathering-- especially due to frost--clean, and reasonably binding but loose enough to permit of free drainage. Crushed stone such as granite, quartzite, igneous rock, or trap, has the advantage of being very hard and angular, and even broken limestone and sandstone may also be reasonably hard. Crushed slag has the characteristics of rock, but it induces dry rot in wooden sleepers. Cinders or ashes are the cheapest form of ballast; they provide good drainage, but powder and cake too easily for other than yard or unimportant branches. Their greatest fault is that they quickly corrode the feet of rails and steel sleepers in contact with them. Sand, as well as being cheap, makes a stable lower ballast.

Railway Gazette Vol. 101 Aug. 1954, p 229

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1221)
DOTL RP

A2 039577
MINISTRY OF TRANSPORT ACCIDENT REPORT
This accident report covers a passenger train derailment in a tunnel at 65 mph. Minor injuries were reported. The rail breakage which caused derailment was traced to a defective rail end caused by corrosion fatigue cracks at joints of stress concentration around bold holes.

Railway Gazette Vol. 101 Aug. 1954, pp 246-248, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1222)
DOTL RP

A2 039580
GRINDING TRAIN FOR CORRUGATED RAILS
A new type of rail grinding train has been constructed, and after trials a train was supplied to the German Federal Railway. Immediately behind the locomotive is a tool wagon, followed by a van containing two diesel units generating 300 kVa., with the necessary ancillary equipment for driving the grinding assemblies. The other three wagons are the grinding cars. They contain the grinding machine sets and the control gear for the grinding operation. Each grinding car contains eight grinding units; four arranged on either side, so that in the complete train 24 grinding units are available, 12 for either rail. To obtain good results a relatively low traveling speed when grinding of 1.8 mph is imperative It is expected that in a full operational year about 2,500 miles of heavily corrugated rail may be ground.

Railway Gazette Vol. 101 Nov. 1954, pp 520-522, 1 Fig, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1225)
DOTL RP

A2 039581
KEEPING DOWN WEEDS AND GRASS ON RAILWAY PREMISES
The present manpower shortage in Britain has aggravated the problem of preventing the growth of, and destroying, weeds and grass on railway premises. Weed-killers may be classified into two main groups: (a) non-selective, comprising materials which kill all vegetation with which they come in contact, and (b) selective, comprising materials which kill weeds only, without damage to the finer grasses. In the control of the growth of grass, maleic hydrazide is claimed to be of great assistance. It will also mix quite well with a 2, 4-D spray so that the whole growth of weeds and grass can be controlled with the one spray.

Railway Gazette Vol. 101 Dec. 1954, p 656

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1226)
DOTL RP

A2 039582
MECHANICAL REPLACEMENT OF SLEEPERS
A machine known as TieMaster was designed and manufactured to reduce labor and costs in sleeper renewal operations. It is track-mounted and can be operated without fouling traffic on adjacent tracks. Its primary functions are to remove old sleepers and place new ones in position in the track after clearing away sufficient ballast for this purpose. The actual changing of the sleepers is stated to consume only 30 sec. and requires only one operator and two labourers.

Railway Gazette Vol. 101 Dec. 1954, p 658, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1227)
DOTL RP

A2 039583
WEEDKILLING TRAIN AND PORTABLE EQUIPMENT
The weed spraying equipment used by the British Railways in the Western Region is described. The usual formation of the weedkilling train used is: engine; three converted tenders; tank wagons of weedkiller (usually not more than three); operator's living van; and brake-van.

Railway Gazette Vol. 101 Dec. 1954, pp 717-718, 6 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1228)
DOTL RP

A2 039585
MODERN DEVELOPMENTS IN TRACK MAINTENANCE
After tracing the history of the Permanent Way Institution's instructional and examining organization until its takeover by the railways in 1944, capabilities currently required of personnel in the field are mentioned, especially instrumentation expertise. Increasing use in the future of mechanized track construction and maintenance equipment is forecast, including the crane method of prefabricated relaying and twin-jib relayers. It is predicted that major formation improvements will be required in Clay county, and necessary resources due to nationalization under the British Railways will provide the right methods and materials.

Railway Gazette Vol. 94 Apr. 1951, p 479

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1230)
DOTL RP

A2 039586
TRACK MAINTENANCE AND RENEWAL
Excerpts of a paper entitled "Methods of Effecting Economy in Track Maintenance and Renewal" are presented. Topics such as the size of maintenance crews, sleeper comparisons, rail fastenings, and the effect of crane utilization on crew reductions are covered.

Cookson, EC (British Railways) *Railway Gazette* Vol. 84 May 1951, p 577, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1231)
DOTL RP

A2 039589
CONTINUOUSLY-WELDED RAILS
To offset the increased cost of laying welded as compared with bolted rail ($1000/mi) important savings are being effected. The first is in general track surfacing work. The initial 5-1/2 miles of Elgin Joliet and Eastern Railroad welded track, laid in 1943, will not require general surfacing for another two or three years yet, though it carries 20,000,000 gross tons of traffic annually; in the normal course it would need general surfacing every seven years, and joint surfacing, now no longer needed, at much shorter intervals. Also, construction methods, maintenance benefits and costs are discussed.

Railway Gazette Vol. 95 Aug. 1951, p 207

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1235)
DOTL RP

A2 039591
MECHANIZED APPLIANCES FOR PERMANENT WAY MAINTENANCE--1
The demonstration of the latest types of mechanized equipment used in the maintenance of British Railways permanent ways is described. Included is a discussion of mechanical equipment used for both temporary and permanent maintenance of foundations, with emphasis on methods for improving drainage and/or removing clay to stabilize the foundation from degradation by rain water.

Railway Gazette Vol. 95 Nov. 1951, pp 492-494, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1239)
DOTL RP

A2 039592
MECHANISED APPLIANCES FOR PERMANENT WAY MAINTENANCE--2
Effect of moving traffic on load-bearing structure formed by ballast, sleepers, and rails is examined and methods used in maintenance are described. Rail creep adjustment, measured shovel packing ballast cleaning and rail lubrication methods are mentioned.

Railway Gazette Vol. 95 Nov. 1951, pp 520-522, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1240)
DOTL RP

A2 039593
MECHANISED APPLIANCES FOR PERMANENT WAY MAINTENANCE--3
A comparison is made of the manual and mechanical methods of track renewal. The use of cranes for track relaying is emphasized.

Railway Gazette Vol. 95 Nov. 1951, pp 576-577, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1243)
DOTL RP

A2 039594
MECHANIZED APPLIANCES FOR PERMANENT WAY MAINTENANCE--4
Development of equipment for permanent way depots and for maintenance gangs is described. At a pre-assembly depot, lengths of new track are assembled and loaded, and lengths recovered from a renewal are unloaded and dismantled. On the other hand, at reclamation depots materials received from renewals are stripped, classified, and either reclaimed for use elsewhere, or disposed of as surplus to requirements. Details of these operations are reviewed.

Railway Gazette Vol. 95 Nov. 1951, pp 601-602, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1245)
DOTL RP

A2 039600
MODERNISING TRACK MAINTENANCE
This article is an excerpt of a paper entitled "Productivity on the Permanent Way". In that paper the author describes the essentials of adequate maintenance of the formation and of the upkeep and renewal of the track. In addition, the paper focuses on measured shovel packing and the different methods of laying prefabricated track; (a) using a diesel-electric crane with a streamlined rear profile to clear structures and passing traffic, and (b) with twin cranes having retractable horizontal jibs mounted in tandem.

Railway Gazette Feb. 1952, p 200, 2 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1252)
DOTL RP

A2 039603
TRACK STABILITY ON THE NETHERLANDS RAILWAYS
The science of soil mechanics is of greater importance in Holland than in almost any other country because the bearing capacity of the ground is generally low. For the preliminary exploration of the quality of the soil, two standard field tests are made by specially-trained inspectors. The first involves the measurement at intervals of the resistance to pressure when and as a cone of standard diameter and angle is forced down into the ground. The other is the sampling of the soil taken from borings at different depths; the samples are subsequently dried out and examined. Three track construction and stabilization works were in hand in 1950. A new 6-1/2 mile double line had to be constructed between Rotterdam and Nieuwerkerk, mainly over polder land 15 ft. below sea level. The second work was the strengthening of the formation under the double-track main line between Gouda and Oudewater where it is on embankment over peaty subsoil. In the third operation though an electrified and reballasted, traffic was maintained by laying a temporary track at one side complete with overhead conductor.

Railway Gazette Vol. 96 Apr. 1952, p 397, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1255)
DOTL RP

A2 039606
DISNEY RESILIENT RAIL CHAIR
These chairs were installed nine years ago on the double-line 350-ft. steel central span of the Victorian Bridge over the St. Lawrence and extensometer tests have shown "important reductions in impact stresses" in the superstructure. Other advantages claimed for this chair and its fittings include the elimination of sleepers and their renewal; of ballast, its cleaning, maintenance, and waterproofing; reduction of vibration, bridge dead load, and construction depth; also of excavation in tunneling. Moreover, the positive resilient grip on the rails minimizes wear between track and components, provides uniform distribution of stress, limits vibration, and ensures greater cleanliness and a truly-aligned track, as well as greater safety. It eliminates track maintenance, is economical and secures a long-enduring road and trouble-free operation.

Railway Gazette Vol. 96 Apr. 1952, pp 460-462, 5 Fig, 4 Phot, 1 Ref, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1258)
DOTL RP

A2 039615
THE LAVAL LONGITUDINAL CONCRETE SLEEPER
The Laval track consists of two longitudinal rows of reinforced concrete blocks, one under each rail. The blocks measure 1.3 m long 0.7 m wide, and 0.16 m deep. Each block weighs about 750 lb. Between successive blocks there is a space of 0.2 m in which steel tie-bars are fixed to the rails for retaining the correct gauge and the 1 in 20 cant of each rail. Details of track design and installation are examined.

Railway Gazette Vol. 97 Aug. 1952, pp 239-240, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1269)
DOTL RP

A2 039622
SOIL MECHANICS AND THE CIVIL ENGINEER
The most satisfactory methods to be adopted in the stabilization of troublesome banks and cuttings can be decided only after a proper examination of the site by means of borings or trial holes. Should bridges, tunnels or other structures be involved, the engineer will need to know at once what earth pressures will be exerted on the structures and also what bearing pressures can be adopted without risk of either complete shear failure or excessive settlement or other movement due to subsequent consolidation of any compressible strata. The fields in which railway engineers are most in need of knowledge are: inexpensive waterproof

coatings or carpets which can be used on the side slopes of banks or cuttings to prevent the penetration of rain, and which will be sufficiently resistant to frost, heave or other effects of weather; corresponding methods of treating the formation; swelling pressures of clays and active pressures on retaining walls and other similar structures and whether appreciable plastic movement of a foundation on clay can take place at pressures below those calculated, which are based on ultimate shear strength.

Toms, AH *Railway Gazette* 1 Phot Vol. p 24 No. -244, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1278)
DOTL RP

A2 039625
THE STEEL RAIL, PAST, PRESENT, AND FUTURE
The author makes a plea for more adequate research into problems concerning the manufacture and composition of railway rails. It is suggested that a joint committee of experts be formed from many railways to pool ideas for rail research. Cooperation should be sought from the manufacturers and information from all railways should be pooled to advance the technology to decrease rail defects.

Allen, CJ (London and North Eastern Railway) *Railway Gazette* Vol. 78 June 1943, p 557

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1281)
DOTL RP

A2 039627
A NEW FATIGUE DEFECT IN RAILS
The shelling defect has been most commonly encountered in the 131-lb standard flat-bottom section, though it has been reported in some degree in all sections from 100 lb. upwards. The first manifestation of the trouble is the appearance, on the running surface of the rail near the running edge of dark spots, which indicate the presence of horizontal planes of separation of the steel within the rail-head; these may occur at a number of different levels in the same rail. The shelling is the result of wheel action on the rail causing failure of the metal, either by direct stress exceeding the elastic limit, or by loss of ductility which is the outcome of constant reversals of stress. Factors which may influence the relative severity of the shelling are the inclination of the rail, the superelevation, the bearing pressure exerted by the wheels, the radius connecting the flanges and the treads of the wheels, and the radius of the gauge corner of the railhead.

Railway Gazette Vol. 79 July 1943, p 38

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1283)
DOTL RP

A2 039628
RAIL CORRUGATIONS
Methods by which this defect has been minimized on the Queensland Government Railways are discussed. The correction of railjoint dip, closing in of joint sleepers, and provision of clean elastic stone or gravel ballast has made an even top and a springy rail which has reduced the wheel-rail contact stress so much that rail rippling and corrugation is no longer a major problem. The greatest cause of overstress is the solidity of the rail bed which reduces tremendously the depression of the rail under wheel press and thus increases the local intensity of the stress. Other causes are open and dipped rail joints, easily deflected rail ends at joints, pumping sleepers, and track out of gauge and level. The metallurgical treatment of the rail steel, rolling and work effect when shaping, finished shape of the head, and chemical constituents of the metal, are very important. Higher strength rails such as sorbitic or chromium-steel rails oven-cooled will reduce the defects considerably. Long rails assist. There should be sufficient ballast to give an even bearing on the sub-grade. Elasticity of the whole track is most important and here sleeper spacing with depth of rail is to be considered for correct proportioning.

Burgess, JH (Queensland Government Railways) *Railway Gazette* Vol. 88 Aug. 1943, p 134

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1284)
DOTL RP

A2 039629
BESSEMER STEEL IN RAILWAY SERVICE
The reintroduction of the basic Bessemer process at the large new Corby works in Northamptonshire, chiefly for the purpose of making tube steel, has proved that with iron smelted from the ore-beds of this and adjacent Midland areas it is possible to make a reliable basic Bessemer steel from British raw materials. Similarly the Luxembourg and Lorraine ores, such as minette, have been well suited always to basic Bessemer steel production, and British railways which were compelled in 1921 to buy basic Bessemer rails from Luxembourg. The War Production Board has now laid it down that in the manufacture of certain details of railway equipment the railways must be prepared if necessary to accept Bessemer in place of open-hearth steel. The list of such material covers 66 items.

Railway Gazette Vol. 88 Aug. 1943, p 177

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1285)
DOTL RP

A2 039634
THE IMPROVEMENT OF THE STEEL RAIL
The article discusses differences in thermal treatment of rails between the U.S.A. and Europe. The quenching treatments used in Europe are described as well as the rationale for such treatment both of which are related to transverse cracking of rails. As a result, the controlled cooled rails are also proven to be stronger and more resistant to low temperature shocks.

Railway Gazette Vol. 73 July 1940, pp 39-40

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1329)
DOTL RP

A2 039638
CLEARANCE OF SNOW AND ICE
This article compares what has been done by European and North American railways to combat snow and ice. For snow clearance all railways seriously affected use ploughs which may be either of the ordinary steel-blade type for pushing snow aside, or of the rotary type. While the rotary type is more effective in deep drifts, it is more expensive in capital, maintenance, and operating costs. In addition, it is comparatively slow in operation. For removing packed snow and ice flame guns and steam lances are used in Great Britain. Electric point heaters are used in Great Britain, U.S. and Germany. Sheds and screens are used for avalanche protection in Switzerland and France.

Railway Gazette Vol. 102 Feb. 1955, pp 219-221

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1334)
DOTL RP

A2 039642
U.S.A. RAILWAY TECHNICAL DEVELOPMENT
The U.S. railroad equipment and technology in 1940 and 1953 are compared. Rail usage in 1953 was declining due to highway and air competition. The types of locomotives in use in both years are compared. American track design is compared to British technology. Closer spacing of ties in the U.S. allows the track to carry heavier axle loads; however, ballast maintenance is more expensive due to the spacing. The C.T.C. signaling installations are described.

Railway Gazette Vol. 102 June 1955, pp 704-705

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1338)
DOTL RP

A2 039650
RAIL-MOUNTED TRENCH DIGGING MACHINE
A diesel-powered machine for cutting trenches for drains alongside the permanent way is undergoing tests by the Civil Engineers Department of the Western Region, British Railways. The machine is mounted on a framework which rests in a cradle pivoted on a specially adapted railway wagon. The machine has a maximum cutting depth of 6 ft. 3 in. below rail level, and the boom can be set at any depth between this and ground level. The bucket width is 18 in. which can be increased to 21 or 24 in. by the fitting of side cutters. Speed is continuously variable up to 6 ft. per min.

Railway Gazette Vol. 103 Sept. 1955, pp 330-332, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1346)
DOTL RP

A2 039652
TRACK MAINTENANCE IN JAPAN
Due to heavy rains, extreme temperatures, excessive curves and grades, very heavy traffic and narrow gauge, track maintenance problems are intensive in Japan. Despite the use of greater depths and larger quantities of widespread stone ballast, closer-spaced sleepers, heavier rails, improved fittings and fishplates, and stronger joints generally, and a rapid extension of rail-joint welding, maintenance continues to be difficult. A rail-replacing machine and a mechanical ballast tamper are described. Both machine methods are labor intensive yet give more uniform results and are easier on sleepers than manual methods. The machines are designed to save time, since maintenance time is usually available in periods of less than 40 minutes between train traffic.

Railway Gazette Vol. 103 Sept. 1955, 3 pp, 1 Fig, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1348)
DOTL RP

A2 039653
EXPERIENCE WITH WELDED RAILS
The railroads in the U.S. in the early 1950's began substituting 78-ft. rails for the 39 ft. standards. The 78-ft. rails decreased the number of joints by 50 percent, which justified the longer rail on the basis of a corresponding savings on maintenance. The same equipment can be used to lay both size rails. Wild grinding to reduce the bulge at the weld is discussed. The repair of continuously welded rail is described.

Railway Gazette Vol. 103 Sept. 1955, pp 343-344

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1349)
DOTL RP

A2 039655
EASIER MAINTENANCE CONTROL FOR RAILWAYS
A small Canadian railway has initiated a planned maintenance system to detect excessive maintenance costs. The system is designed to point out when equipment should be replaced rather repaired. This method is applicable to anything that has to be maintained; locomotives and rolling stock; roadbeds and tracks; machine-shop equipment; buildings and their components (floors and roofs); paving of roads, and so on. Tables are shown as examples of the system. A measure of operating conditions are established using a Table of Wear Points. This Table shows arbitrary values for various degrees of operating conditions. Multiplying these wear points by each other a wear factor can be arrived at. History cards are kept on each piece of equipment to accumulate the wear factors.

Margo, BA *Railway Gazette* Vol. 103 Sept. 1955, pp 359-360, 5 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1351)
DOTL RP

A2 039664
FASTENING RAILS TO CONCRETE SLEEPERS
A new method of fastening rails to concrete sleepers has now been installed experimentally. The new type of fastening embodies certain features of German practice in conjunction with the use of a grooved rubber pad. The fastening is essentially of the clip type, the clip itself being secured by means of a long screw run into a corrugated wood plug cast in the concrete sleeper. The rail sits on a grooved rubber pad. The form of the wide V-shaped grooves, together with the hardness of the rubber selected, gives a very satisfactory load-deflection characteristic of the pad. Rubber has also been applied at both ends of the clip and rubber-bonded cork has been used under the head of the screw.

Railway Gazette Vol. 104 Apr. 1956, pp 232-233, 1 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1365)
DOTL RP

A2 039672
CONCRETE SLEEPER INSULATION ON SOUTH AFRICAN RAILWAYS
Large orders have been placed for two types of concrete sleepers suitable for neoprene pad insulation so that the programme of laying long-welded rails on concrete sleepers for main-line track may be carried out without hampering electrical signaling developments. One fastening uses a neoprene insulation pad, and a natural rubber resilient pad, togehter with a steel baseplate, coachscrews, and clips. Another has an alternative method of fastening of the Fist type. This also uses a neoprene pad between the rail and the concrete, but the fastening is a special spring-steel clip held in position by a bar that passes through the sleeper. This bar is insulated from the concrete with a phenolic resin compound. Experimental use of the pads has established the expectation of a five-year life for the pads at the minimum.

Railway Gazette Vol. 112 Apr. 1960, p 396, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1388)
DOTL RP

A2 039673
WORK-HARDENING BOLT HOLES IN RAIL ENDS
Analysis of rail failures has shown that the most frequently occurring type of failure is that classified as "4d" which takes the form of radial cracking from one or both boltholes known as star cracking. Various methods of improving the fatigue strength of drilled rails have been tested. The greatest improvement has been obtained by work-hardening the surface of the holes, by intially drilling undersize followed by broaching or drilling drifting with a spherical tool to the required size. The work hardening has resulted in increasing the fatigue strength of the rail by 50 percent, a figure which is maintained after exposure to corrosion. No trouble was experienced in workhardening any of the holes, including those where the axis is inclined to that of the rail.

Wise, S *Railway Gazette* Vol. 112 Apr. 1960, pp 511-512, 1 Fig, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1389)
DOTL RP

A2 039674
USE OF WEEDEX IN CHEMICAL WEED CONTROL ON BRITISH RAILWAYS
The future of chemical weed control on British Railways lies in the use of the insoluble specially synthesized compounds. It is within the power of Weedex and Weedex "A" to give a high standard of weed control, both on the track and in the cesses, by single treatment at intervals of 12 months or more, without the necessity of supplementary handweeding. A revision of the spray programme and the introduction of modern technique of application will give a much better return, in terms of efficiency, on the money spent on chemical. Efficient chemical weed control is cheaper than handweeding. By taking full advantage of modern chemicals, improved application techniques, and scientific planning, a higher standard of weed control can be obtained at a far lower cost.

West, RL (Fisons Pest Control Limited) *Railway Gazette* Vol. 112 Apr. 1960, pp 422-424, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1390)
DOTL RP

A2 039676
LONG-WELDED RAILS ON BRITISH RAILWAYS
Prior to installing long welded rail, British Railways conducted a thorough 5 year investigation of the factors and potential saving to be realized. Among other things, a formula was derived to predict the buckling load of any type of track under any conditions. Additionally, it was found that concrete sleepers were more suitable with long welded rail than wooden ones. Details on how the British accomplished their modernization--began in 1955--are provided.

Railway Gazette Vol. 112 June 1960, p 644

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1393)
DOTL RP

A2 039681
THE APPLICATION OF RUBBER TO RAILWAY USES
Two specific applications of rubber for railway use are described. The first is for rubber-faced guide grooves intended for use on the Milan underground railway which will use coaches with rubber ties that run on narrow wheel tracks between which is the guide-groove. The second application is that of rubber rail pads to reduce track maintenance and replacement costs.

Railway Gazette Vol. 113 Aug. 1960, pp 242-243, 3 Phot
ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1398)
DOTL RP

A2 039690
LENGTH OF RAILWAY TRANSITION SPIRAL ANALYSIS AND RUNNING TESTS
The report discusses the results of tests performed to determine the needed length and elevation of transittion spirals. Thus a test using a locomotive and passenger car with instrumentation and individuals is an attempt to correlate recorded data of ride quality and that observed by human beings.

Schinke, R Ferguson, R
Association of American Railroads Technical Center Tech Rpt ER-37, Nov. 1963, 48 pp, 20 Fig, 7 Tab, 20 Ref, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1469)
DOTL RP

A2 039692
TESTS OF BOLTED AND BONDED RAIL JOINTS
The report discusses a comparative study of bolted and bonded rail joints. All joints were on 133 lb. rail; the bolted joints used Huck high strength fasteners, while the bonded joints used high strength fasteners with different structural adhesives. Results of the tests showed the bonded joint is a satisfactory alternative to thermite welding. However, installation requires high temperatures to assure curing of the adhesives.
Unpublished Report.

Brown, RM
Union Pacific Railroad 1 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1471)
DOTL RP

A2 039792
WEIGHTS OF RAILS
Callipers used to measure rail-head wear were redesigned to allow for side wear. The callipers are made in a scissors pattern and are illustrated in use.

Peters, R (London North Eastern Region) *Railway Gazette* Vol. 71 Dec. 1939, p 805, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-543)
DOTL RP

A2 039794
BOGIE-MOUNTED UNIVERSAL TAMPING MACHINE
Principal machine in the new Plasser and Theurer's 07 series is the Mainliner Duomatic 07 to 32, combining leveling, tamping, lining and consolidating functions in one unit. Machine is specially designed for moving quickly between work sites, having a heavy truck-mounted chassis and normal drawgear. Two adjacent ties can be tamped at once. Full automation can be achieved by the addition of a cybernetic control system consisting of an electronic counter, an angle pace-setter and a rail fastening pulsator for determining tie spacing.

Railway Gazette International Vol. 127 No. 6, June 1971, p 236

ACKNOWLEDGMENT: EI (EI 72 49872)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

A2 039796
NEW ASPECTS OF CONCRETE-TIE TRACK
The article covers a discussion of the proposed American Railway Engineering Assoc concrete-tie specifications, a report on two investigations sponsored by the Federal Railroad Administration, and an account of experience with concrete-tie usage in England.

Way, GH, Jr *Railway Track and Structures* Vol. 67 No. 12, Dec. 1971, pp 22-5

ACKNOWLEDGMENT: EI (EI 72 48564)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

A2 039825
TRACKWORK STUDY. VOLUME II. RECOMMENDED TRACKWORK STANDARDS
The study provided the Washington Metropolitan Area Transit Authority with recommendations for trackwork design standards and criteria for use as a basis for the final design of trackwork for the entire METRO rail rapid transit system. The recommendations were based on analytical studies and the experiences reported by operating properties. Trackwork components were analyzed considering different combinations of components and varying physical parameters such as size, spacing, and estimated life of elements of the track structure. The report includes recommendations on rail weight, rail type, rail welding, fastener types and spacing, cross tie types and spacing, roadbed and ballast section, special trackwork, track appurtenances, track gauge and in-service test installations. (Author)
See also Volume 1, PB-204212.

Dunn, RH
Washington Metropolitan Area Transit Authority, (WMTA-NTA-66-1) Final Rpt Vol. 2 WMATA-DCCO-TWS-2, July 1969, 331p

ACKNOWLEDGMENT: NTIS (PB-204213)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-204213, DOTL NTIS

A2 039826
TRACKWORK STUDY. VOLUME I. TRACKWORK PRACTICES OF NORTH AMERICAN RAPID TRANSIT SYSTEMS
The report is a summary of the trackwork practices of seven North American rail transit properties: Boston, Chicago, Cleveland, New York, Philadelphia, San Francisco and Toronto. Responses to questionnaires sent to the properties covered construction standards for rail, rail welds, track gauge, rail fastenings, support spacing, rail anchorage, ties, roadbed and ballast sections, special trackwork and track appurtenances. The properties also reported their track maintenance criteria for rail wear, tie life, and ballast cleaning as well as test installations and recommendations for improving trackwork. The report contains a bibliography of over 100 publications on trackwork design, construction and maintenance. (Author)
See also Volume 2, PB-204213.

Dunn, RH
Washington Metropolitan Area Transit Authority, (WMTA-NTA-66-1) Final Rpt Vol. 1 WMATA-DCCO-TWS-1, Nov. 1967, 149p

ACKNOWLEDGMENT: NTIS (PB-204212)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-204212, DOTL NTIS

A2 039905
EXPERIENCE OF UNDULATORY WEAR OF RAILS
The results of a survey of 21 responding railroads from Europe and Africa on the subject of rail corrugation are presented. The types of corrugations are mentioned as well as possible causes. Means to eliminate or reduce the occurrence of these problems is also covered.

Railway Gazette Vol. 109 July 1958, pp 42

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-560)
DOTL RP

A2 039906
RESILIENT PADS ON PERMANENT WAY
The need for resilient fastening between rails and concrete cross ties is discussed. Parameters to be considered in the design of pads and fastenings is included. The loading of fastenings and pads under load is also considered in detail.

Railway Gazette Vol. 109 July 1958, pp 70-71, 2 Fig, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-561)
DOTL RP

A2 039912
RIGHT-OF-WAY ENGINEERING INPUT
The need to consider track as a variable to be accounted for in vehicle design and evaluation is discussed. The forces present in the interaction between car and track are enumerated and their effects are discussed. Factors of heavy wheel loads and body roll are among those considered.
Proceedings of 1968 Railroad Engineering Conference.

Hay, WW (Illinois University) *Car Design Inputs* Proceeding Sept. 1968, pp 18-27, 7 Fig, 1 Tab, 7 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1018)

A2 039926
FLEXIBLE RAIL CLIP FOR F.B. TRACK
The basic R.N. (Ressorts du Nord) clip and its modifications for use with insulated and welded rail and all types of cross ties are described. The clip consists of a heat-treated, manganese-chrome, spring-steel blade which is doubled back on itself and drop-forged so as to form an upper and lower leaf connected by a rounded portion in the shape of a spring "eye". The R.N. clamp for wooden sleepers differs from the clip already described in having a longer blade, so as to be less stiff and prevent fatigue of the coach-screw. The combination of rubber soleplates and R.N. fixings has been proved to afford a very strong and secure anchorage of the rail on sleepers of all kinds, resistant to the vibrations of express traffic.

Railway Gazette Vol. 98 Feb. 1953, p 234, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1179)
DOTL RP

A2 039927
LONG-WELDED CONDUCTOR RAILS ON THE SOUTHERN REGION
Improved methods have recently been introduced to enable the maximum length of conductor rail to be unloaded and renewed in the short possession times available, with the minimum amount of labour. Under the new system conductor rails are welded into 180 ft. lengths at the flash-butt welding depot and conveyed to the site on rakes of three 40-ton bogie rail wagons. Up to 26 conductor rails weighing 150 lb per yard are loaded on the rail wagons in four tiers of eight, seven, six and five rails. Using a tackle to pull-off the rail, a gang of six mean can unload 1-3/4 miles of conductor rail in a 4-1/2 hour track possession. Six lifting and traversing frames are used to transfer the rail from the four-foot way to the new insulators, and enable 16 men to complete the laying in, fishplating and bonding of 1/2-mile of 150-lb conductor rail in 4-1/2 hours.

Railway Gazette Vol. 98 Mar. 1953, pp 371-372, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1180)
DOTL RP

A2 039931
REPAIRING UNUSUAL SLIPS ON WESTERN REGION MAIN LINE--2
The cause of the slip at Sonning was known exactly and, paradoxically, this meant that the ways of dealing with it were numerous. The method decided on is described and other methods, with the reasons for their rejection, touched on briefly. The object of the method chosen was to fix the slipping mass to the solid stratum beneath. The prime cause of the slip at Twyford was the hydrostatic head which had collected in the sand lens. This was reduced to an economic minimum by the use of 6-in. dia. cast-iron pipes, with perforated ends, which were built into the buttresses, the perforations being at the level of the sand lens. This article shows how a new cutting may be threatened by the existence of permeable strata, which are below the limit of excavation. If a preliminary investigation has been carried out and the presence of a permeable stratum found, the correct slope of the new cutting can be found using the calculation methods proposed in this article.

Slee, J (British Railways) *Railway Gazette* Vol. 98 May 1953, pp 624-626, 3 Fig, 2 Phot, 2 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1185)
DOTL RP

A2 039932
DOUBLY-FLEXIBLE RAIL-TO-SLEEPER FASTENINGS
A grooved rubber pad or soleplate was designed by the French to protect concrete sleepers from shattering under impact of heavy traffic. To keep rail, solepad and sleeper in intimate contact, yet able to absorb vertical impact, a spring clip flexible in two directions was also designed. Experience with these fastenings and soleplates indicated long maintenance free service. A doubly-flexible fastening for wooden sleepers also was designed and experience with it is described.

Railway Gazette 54035, pp 357-358, 1 Tab, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1209)
DOTL RP

A2 039934
GRINDING TRAINS FOR CORRUGATED RAILS
Measures taken by the Federal Railway to eliminate roaring rail, in so far as it has been established that corrugation is the cause, include rail grinding trains. The first of two such trains was put into service last month. The rail grinding trains, hauled by diesel locomotives, are equipped with generators, compressors, fuel cisterns, workshops, and living accommodation, and are designed to move at 2 mph with their grinders in action. As the damage caused by rail corrugation is estimated at DM 20-30 million a year this development is watched with considerable interest.

Railway Gazette Vol. 100 Apr. 1954, p 426

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1211)
DOTL RP

A2 039936
MECHANIZATION OF PERMANENT WAY
To allow most economical use of mechanical equipment, British lines are classified in three categories: (1) lines with intensive traffic moving at high speeds, where no weekday occupation, day or night, can be obtained: (2) medium-traffic lines, where adequate occupation can be obtained on weekdays or weeknights; and (3) light-traffic lines where machine can be transported freely from place to place by rail or road. On open running lines in the first category, routine maintenance is likely to remain manual, but major repair and renewal works must be as fully mechanized as possible--with ballast-cleaners, cranes, track-lifting and tamping machines--so as to leave the track in nearly-perfect condition. On medium-traffic lines in the second category which are of sufficient mileage to make it economical, there are likely to be minimum-strength length gangs, the bulk of the maintenance being carried out by fully-mechanized gangs. On light-traffic lines in the third category accessible for the distribution of mechanical equipment, expensive highpowered on-track machines probably could not be justified except for renewal works.

Railway Gazette Vol. 100 May 1954, pp 596-597

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1213)
DOTL RP

A2 039941
FLAT-BOTTOM TRACK IN GREAT BRITAIN--I
A comparison was made of the physical characteristics of installed 95 lb B.S. bull head, 100 lb. B.S. bull head and 110 lb. B.S. flat bottom rail. This was done to provide the information necessary for financial comparison of these competing approaches taking into consideration initial cost, maintenance cost, life, and scrap value of rails and components. Detailed description of the installed rail, fastenings, etc. is provided.

Railway Gazette Vol. 81 Oct. 1944, 5 pp, 3 Fig, 8 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1312)
DOTL RP

A2 039944
RECENT PROGRESS IN RAILWAY WELDING PRACTICE
The article is a review of the different areas where welding has been successfully used in the construction of rail vehicles, railstructures, bridges and rail. As part of the latter, details of electric flash butt welding and oxy-acetylene rail butt welding are also discussed and illustrated. Girder alteration by welding at a railway station and bridge design using welded structures are shown.

Bondy, O *Railway Gazette* Vol. 73 Nov. 1940, pp 484-488, 3 Fig, 3 Phot, 28 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1322)
DOTL RP

A2 039947
BEHAVIOR OF THE METAL OF RAILS AND SMALL DIAMETER WHEELS
This question is concerned with small diameter wheels on rail vehicles and stresses present which limit wheel diameters. Tests were performed with a

derailment test stand and at an actual crossing to measure stresses. The test results were fragmentary and inconclusive.

Question C 53 Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Report ORE Pub No. 25,26, 4 pp, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1325)
DOTL RP

A2 039948
TRACKS WITHOUT BALLAST FOR UNDERGROUND LINES IN URBAN CENTERS

The article discusses a testing program to determine the feasibility of using non-ballasted track for underground railways. Problems of noise level, vibration, as well as tunnel characteristics are among those variables to be considered in the program.

Question D 87

International Union of Railways Rpt 2 ORE Pub No. 23,24, 6 pp, 7 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1326)
DOTL RP

A2 039949
TRACK TESTS AT WOOD GREEN

This appendix taken from an unidentified report, describes a test conducted between London and Edinburgh on a section of track which was causing maintenance problems due to soil instability. The following measurements were taken through the use of pressure transducers: (1) transverse distribution of vertical stress beneath a test sleeper, (2) vertical stresses on the rail to sleeper reaction axis beneath both rails of the adjacent sleepers, (3) transverse horizontal stresses beneath the test sleepers, and (4) longitudinal horizontal stresses acting across the rail to sleeper axis. As a supplement to the stresses, induced by traffic, the in situ changes in the density and moisture content of the track foundation was determined by means of radioactive probes. This was done to check the behavior of the individual layers of the ballast, the blanketing layer just down and the formation under traffic loads. Findings are presented graphically.

53pp, 38 Fig, 11 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1330)
DOTL RP

A2 039952
THOMAS STEEL FOR RAILS

The process adopted by a steel factory in France which supplies considerable quantities of Thomas rails to the French National Railways and to railways in several other countries is described. The chemical composition of the Thomas rail steel is shown and is compared to the British standard. The physical tests for the steel ingots and the internal controls are briefly described. The service performance of the Thomas rails is discussed.

Srinivasan, M *Railway Gazette* Vol. 104 Jan. 1956, pp 98-100, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1361)
DOTL RP

A2 039962
BALLAST CLEANING AND CESS LOWERING

The ballast must be cleaned periodically. This is done manually by shovelling out the dirty ballast and throwing it back with a fork designed to hold only the larger pieces, leaving behind the dirt and small ballast. The aim is to clean all ballast once in every 10 years, but this operation tends to augment the heaps of lineside dirt, which in the course of time fill up the paths and cesses alongside the ballast edge. The aim is to get a cess which wherever possible will be 3 ft. wide outside the ballast edge and about 9 inch below underside of sleeper level.

Railway Gazette Vol. 105 Sept. 1956, pp 379-380

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1373)
DOTL RP

A2 039963
BOGIE DESIGN FOR ELECTRIC LOCOMOTIVES--2

Suspension, adhesion, and good riding requirements of general service locomotives are discussed. Attention is given to three-point suspension, weight transfer reduction, Bo-Bo characteristics, bogie behavior on curves, and the need for three-dimensional rigidity in the frame types.

Croft, EH (General Electric Company) *Railway Gazette* Vol. 105 Sept. 1956, pp 384-385, 4 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1374)
DOTL RP

A2 039964
SYSTEM OF RESILIENT RAIL MOUNTING

The Sectru resilient-grip mounting bolt has been applied to railway track fastening problems resulting in a new rail mounting system for all types of sleepers, espically concrete sleepers. This method of rail fastening combines positive location for the rail (both against longitudinal slipping and lateral displacement) with an essential measure of resilience. The rail foot is carried on a compact and rigid baseplate, which, in turn, rests on a rubber pad of equal size placed direct on the surface of the sleeper. The rail is secured to the baseplate by means of two simple, strong clips and two bolts. The rail is tied to the baseplate with great strength, through direct metal to metal contact, and this can be made more than adequate to hold the rail against any longitudinal slipping, even under arduous conditions of heavy train braking. Laterally, the rail is firmly located between the ribs of the baseplate, clips, and bolts together form essentially one single, rigid, assembled structure.

Varga, OH Jebsen, LA *Railway Gazette* Vol. 105 Nov. 1956, pp 528-530, 2 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1375)
DOTL RP

A2 039968
SNOW PRECAUTIONS IN THE SCOTTISH REGION

Three different designs of snow plow are described. One design is an all-steel nose plow. The second is an all-steel heavy-duty snow plow which can deal with drifts of snow of 5--8 ft. deep. The third design an all-steel heavy duty snow plow, is complete with equipment to protect the locomotive cab and tender from snow displaced when forcing a passage through deep drifts. It can clear snow drifts up to 12 ft. deep.

Railway Gazette Vol. 105 Nov. 1956, 2 pp, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1379)
DOTL RP

A2 039969
FRENCH NATIONAL RAILWAYS RAIL GRINDING TRAIN

This train operates at a speed of 24 to 28 mph but in order to remove corrugations of a maximum depth of 0.02 in. from 60 to 120 runs have to be made over the section of line from which corrugations are to be removed. The train is normally moved by two locomotives, one at either end. There are two rail grinding vehicles in the train separated from the locomotives by runners and from each other by two locomotive tenders; these two tenders provide water to lubricate the grinding blocks and to cool the surface of the rails. Each vehicle is equipped with 16 grinding shoes. There are two groups of four grinding shoes on each side of the vehicle. Each block measures 15 in. long by 2.36 in. wide, and the effective grinding material on each block when new is 5.9 in. thick. On the average, the blocks have to be replaced after each 120 miles. The abrasive block is made of aluminium oxide grit. The grinding shoes are brought into contact with the rail and a total pressure of 4 to 5 tonnes applied to the 16 shoes. This pressures is gradually increased to 10 tonnes the speed of the train being maintained constantly at 24 to 28 mph. To get the best results from the economic point of view it is desirable for the train to cover, while working, at least 62 miles each day.

Railway Gazette Vol. 85 Dec. 1956, pp 667-668, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1380)
DOTL RP

A2 039970
RESEARCH BY U.I.C. INTO TYPES OF CONCRETE SLEEPER
The object of the tests is to compare in near-identical conditions: (1) The behavior in the track of various types of concrete sleepers and their fastenings; (2) behavior of track sections equipped with different types of concrete sleepers; and (3) costs of track-laying and maintenance operations. Periodical measurements, generally at six-monthly intervals, are taken of an Amsler track-recording coach; longitudinal levels to show general settlement; smoothness of riding; state of the surface of rails and welds creep, if any, of the long rails; movement of rails on pads or pads on sleepers; tension and condition of fastenings; any signs of cracking or spalling of the sleepers; and mechanical performance of the insulating components. Additional measurements are to be taken occasionally of the grading and shape of the ballast; Mauzin coach records; weight of particular sleepers; noise level; and static and dynamic track depression.

Railway Gazette Vol. 112 May 1960, p 596, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1392)
DOTL RP

A2 039980
THE RAIL SHELLY CRACK IN JAPAN
Investigation into the growth mechanism of shelly cracks and a method of prevention is reported. Examinations included track condition, materials quality, loading condition and friction and wearing phenomenon of affected rails. It was found that in the ordinary contact condition, the contact stress between tyre and rail is so large that plastic flow is caused. With the progress of plastic deformation, steel becomes hard and its elastic limit rises. After these changes, rail surface becomes fit for ordinary wheel load. Though before this time the progress of plastic flow nearly stops, the crack grows through the fatigue due to rolling with slide. It was also found that the existence of ferrite in the surface layer seems to take part in the growth of the crack. As a first step in preventing shelly cracks, rail steel should be strengthened against fatigue. Water decreases the wear of rail and accelerates the development of crack. These conditions promote the growth of the crack due to the rolling fatigue. Secondly, though the decrease of stress is difficult to realize in general, the decrease of lateral force and the decrease of contact stress by decreasing the difference of both curvatures in contact part of wheel and rail are found effective. Thirdly, as it is clear that the existance of water is unfavourable, total stop or restraint of watering is very effective. Since the same effect is achieved by oiling, it is necessary to be careful not to oil excessively.

Nakamura, R Owaku, S Enomoto, N *Railway Technical Research Institute* Vol. 6 No. 3, Sept. 1965, pp 34-44, 21 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1445)
DOTL RP

A2 039986
CONTACT PRESSURE BETWEEN WHEEL AND RAIL AND ITS INFLUENCES ON MECHANICAL PROPERTIES OF RAIL STEEL
Since it was felt that there was still some uncertainty regarding various investigations on the very high contact pressure between wheel and rail and in relation to failures occurred in the heads of rails. It was decided to obtain additional data on the phenomena. This article addresses the following: contact pressure between rail and wheel, plastic deformation of rail steel due to local compression hardness distribution under running surfaces of used rail, and workbrittleness of rail steel.

Ito, A *Railway Technical Research Institute* Vol. 3 No. 1, Mar. 1962, pp 21-25, 8 Fig, 2 Tab, 7 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1451)
DOTL RP

A2 039987
GROUND VIBRATION DUE TO TRAIN PASSAGE--ON EFFECTS OF RAIL JOINT GAP
Ground vibration due to train passage is described referring to the results of a measurement carried out between Matsukawa and Kanayagawa on the Tohoku Truck Line in October 1964. The main purpose of the measurement was to study effects of rail joint gap on the noise and ground vibration. Results can be summarized as follows: (1) Horizontal vibration caused by an expansion joint is smaller at 2.8 m from the track center than at 5.8 m. (2) The dominant frequency of horizontal displacement due to the joint with the gap of 15 mm is lower than that of the expansion joint and the joint with the gap of 5 mm.

Kobayashi, Y Kawamata, J Kumagai, K *Railway Technical Research Institute* Vol. 8 No. 2, June 1967, pp 119

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1452)
DOTL RP

A2 039991
LATERAL FORCES ON TRACK AND EQUIPMENT DUE TO DYNAMIC BRAKING ON THE SOUTHERN PACIFIC LINES
This report embraces a description and analysis of data secured during the operation of regular scheduled freight trains on the Southern Pacific Company between Roseville, California and Sparks, Nevada. The purpose of the investigation was to determine the coupler forces and resulting lateral forces exerted on the rails by the passage of an 85 ft. car coupled to a short car in a train with the locomotive using dynamic braking while operating on steep grades and curves up to 10 deg. During the investigation, data were secured on coupler and car angles, lateral and vertical truck forces and longitudinal acceleration of the 85 ft. car with the train operating at various speeds. The analysis of data contained in this report may be summarized as follows: 1. The steady or longitudinal coupler forces for both pull and push conditions, as expected, are in proportion to the weight of that portion of the train behind the point of measurement. The compressive coupler forces were reduced considerably when the train air line pressure was reduced with the locomotive under dynamic braking on the descending grades. 2. The coupler angles are in direct proportion to the track curvature with the values obtained under the pulling condition slightly greater than those under the pushing condition. 3. The data indicate there is a linear relationship between the track curvature or coupler angle and the lateral truck forces acting on the rail. 4. The occurrence of slack action was rather infrequent due to the long and almost continuous grades for but some coupler forces as large as 90,000 lb were obtained by an application of the dynamic brakes which permitted the slack to run-in. 5. The sprung weight of the 85 ft. car was subjected to longitudinal accelerations as large as 2.2 g but there does not appear to be any direct relationship between the direction and magnitude of this acceleration with respect to the direction and magnitude of the slack action coupler force.

Schinke Aggarwal
Association of American Railroads Technical Center ER-69, Oct. 1966, 30 pp, 9 Fig, 4 Tab, 3 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1456)
DOTL RP

A2 039993
TRACK IRREGULARITIES--JNR STUDIES IN SEARCH OF NEW TOLERANCES FOR TRACK MAINTENANCE
This article is a discussion of the investigation by JNR to determine maintenance standards for the track structure under demands for higher speeds and more frequent trains. The parameters which are used in determining standards are included as well as field tests of these standards.

Kitaoka, H (Japanese National Railways) *Japanese Railway Engineering* Vol. 7 No. 3, Sept. 1966, pp 10-13, 1 Fig, 4 Tab, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1460)
DOTL RP

A2 040007
THE MECHANIZATION OF CURVE REALIGNMENT
A new procedure is described for the mechanization of curve realignment without the necessity of resurveying or re-staking the curve, by the use of a track lining machine. This method can be used for the realignment of transition curves. Particular emphasis is placed on the theoretical basis of the method. The method divides the curve into equal small parts. A comparison is then made of the height of the arc over the chord of each part. [German]

Schubert, E *Eisenbahntechnische Rundschau* Vol. 13 N Feb. 1964, pp 45-49, 6 Fig, 10 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1490)
DOTL RP

A2 040015
TRAFFIC IN A CURVE WITH RAILWAY COACHES FITTED WITH INCLINABLE BODIES
Further tests of the pendular type coach have been effected, during which the body has been given a boost to speed up the time taken for it to get the correct inclination when negotiating connecting transition. This is done by means of a hydraulic ram monitored by a accelerometer detecting, permanently, the non-compensated acceleration. Another arrangement is being worked out with a coach for which the axis of oscillation is below the center of inertia of the body. Tests are described which show that it is possible to get a coach to negotiate a curve with 0.3 insufficient cant, which is considerable, by employing assisted pendular motion. The first tests have shown that the assisted pendular motion gives considerably improved smooth riding while negotiating the transition as compared with natural pendular motion.

French Rail News Vol. 3 1970, pp 40-42, 8 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1498)
DOTL RP

A2 040024
WHEEL AND RAIL LOADING FROM DIESEL LOCOMOTIVES
This review is divided into the following areas: sample derailment data; basic curve negotiation mechanics; experimentally determined wheel-to-rail forces; rail profile data; the effect of dynamic brake levels; and mechanical considerations. Sample derailment data was taken from all six areas and well illustrated with examples. A summary of results is shown. There are a number of mechanical areas involved in the locomoitve which can and do affect the wheel-rail loading. Among these, although there are many others, are the alignment control draft gear, matching wheel sizes, and maintenance of truck bolster stops.

Marta, HA Koci, LF (Electro-Motive) Conf Paper pp 146-177, 30 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1507)
DOTL RP

A2 040027
DEVELOPMENTS IN THE QUALITIES AND SERVICE CAPABILITIES OF PRESENT-DAY RAIL STEELS
The service requirements are discussed for steel rails, which are constantly increasing to bear the heavier axle loads and higher speeds, and with increased resistance to wear, fatigue and fractures. The progress in the manufacture of rails is related, including the improvements in profiles, dimensions, quality and physical properties, as shown by tables and charts. The forseeable limiting area of tensile strength for self-hardening alloy steel for the rails is given as 192,000-206,000 psi. Improved resistance must be developed to wear, plastic deformation crushing and fractures in the rail head, by raising the tensile strength, yield point and fatigue limit. [German]

Heller, W (Fried Krupp Huttenwerke AG) *Eisenbahntechnische Rundschau* Vol. 20 No. 1,2, Feb. 1971, pp 71-78, 8 Fig, 1 Tab, 6 Phot, 13 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1510)
DOTL RP

A2 040028
STEEL TIES FOR FIRST CLASS TRACKS
There is a revival of interest in steel ties due to newly designed shapes and improved manufacturing processes. The new ties have a higher moment of inertia and greater strength. Annealing after the cold working insures greater fatigue resistance and reduces the likelihood of cracks developing. Advantages of steel ties include: long life, the possibility of re-use later in secondary lines, and the reclamation possible after a derailment. Under switches, the longer lengths of steel ties are more easily provided. On electrified lines, steel ties provide an ideal grounding connection. The better quality of steel makes the welding process more usable for fastening the rail holding plates to the ties without the possibilities of fractures. [German]

Schmedders, H Bienzeisler, H (August Thyssen-Hutte AG) *Eisenbahntechnische Rundschau* Vol. 20 No. 1,2, Feb. 1971, pp 88-92, 5 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1511)
DOTL RP

A2 040031
THE INFLUENCE OF BALLAST BED THICKNESS AND TIE SIZE AND SPACING ON SUB-STRUCTURE LOADING
The steady increase in axle loading of railway vehicles and in train speeds not only cause greater stressing of the rails, but also higher loading of the sub-structure. Test results and theoretical considerations show the influence that the size, shape and spacing of the ties, the thickness of the ballast bed and depth of the formation, have on the loading of the sub-structure. Conclusions included the following: a ballast bed over a bad substructure that will carry 20 tons axle load, when over a good substructure, cannot carry more than 25 tons axle load. For axle loads of 30 tons, a protective layer over the substructure and a deepening of the ballast bed are necessary. With regard to the stresses on the ballast bed from an axle load of 25 tons to 30 tons, the tie spacing must be made smaller and with longer ties, the depth of the ballast bed and the thickness of the protective layer over the road bed can be kept to lesser limits. [German]

Eisenmann, J (Munich Technische Hochschule) *Eisenbahntechnische Rundschau* Vol. 19 No. 8, Aug. 1970, pp 309-317, 11 Fig, 3 Tab, 1 Phot, 11 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1514)
DOTL RP

A2 040034
A WAY OF ELIMINATING WATER-LOGGED AND MUDDY TRACK FORMATIONS
With normal cross-sections of the ballast bed and formations, the sub-structure normally insures sufficient drainage of the track bed. However, under unfavorable ground conditions, water may not drain away properly, with detrimental results for the track. This article describes a new method of providing the necessary drainage to prevent the accumulation of water and mud in the track bed.

Flandorfer, J (Bauabteilung Der Osterreichischen Bundesbahnen) *Eisenbahntechnische Rundschau* Vol 19 N Sept. 1970, pp 386-388, 2 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1517)
DOTL RP

A2 040037
TRACK MAINTENANCE ON HIGH SPEED RAILWAYS
The results of six years of operation of the Tokaido Line of the Japanese National Railways, the 200-210 km/h high speed, single purpose line for passenger service, are given in detail as relating to track alignment and level deformations and maintenance requirements of the track structure to keep it within the necessary limits for safety and comfort. This work has been found to be much higher in amount and cost than first envisioned, and instead of the nightly freight runs first planned, the track maintenance work is now scheduled for the night hours. The number of trains run on this line has now increased to 85 pairs daily, with a loading of 60,000 tons per day on the track structure. The details of the construction of this track is tabulated, including the type of rail, ties and ballast bed. For this line, 160,000 tons of ballast are required yearly. Track maintenance, which approximates 50% more than anticipated, is compared with that on the German railways, where, with the mixed operation of heavy freight trains at 80 km/h and 200 km/h passenger trains, such maintenance is about 30% higher than on the lower speed and lesser load lines. [German]

Birmann, F (Bundesbahn-Zentralamt, Minden) *Eisenbahntechnische Rundschau* Vol. 20 N No. -2, Feb. 1971, pp 55-64, 10 Fig, 5 Tab, 4 Phot, 15 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1520)
DOTL RP

A2 040041
STATUS OF COOPERATIVE RESEARCH ON WOOD TIES BETWEEN THE RAILWAY TIE ASSOCIATION AND THE AAR RESEARCH CENTER
Tie space was studied analytically using Talbot's formula, in laboratory tests using hydraulic pulsating loading jacks, and using test track on a field test. Cross ties of three cross sections, 6 x 8 inches, 7 x 9 inch, and 8 x 10 inch, and three lengths, 8 ft, 8.5 ft. and 9 ft. for a total of nine combinations, were used for all three tests. The study of the effects of tie size and spacing showed that irregularities in track cross level and rail surface are a function of the characteristics of the ballast and roadbed rather than of the tie arrangement. There is no evidence that the long ties are more effective in prevention of

center binding, because the shortest ties so far show no evidence of center binding. It seems probable that the cross section and spacing of the ties will be determined by the bending strength required to avoid tie breakage at the center of the track or under the rail. Further service use will indicate whether the increased tie plate load with the wider tie spacing used in some test sections will result in an increased amount of tie plate cutting into the ties.

Somogy, C Magee, GM
Association of American Railroads Res Rpt #R-111, Dec. 1971, 123 pp, 36 Fig, 11 Tab, 4 Phot, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1524)
DOTL RP

A2 040043
CRITERIA FOR TRACK GEOMETRY DESIGN AS RELATED TO MODERN EQUIPMENT
A proposal is being considered for establishing standards for the minimum tangent distance between reverse points of various degrees of curves to permit negotiation of the curves by long, box cars having 68-ft. truck centers and coupler force less than 200,000 lb. A list of tangent lengths with corresponding degrees of curvature are shown.

Hillman, AB *AREA Bulletin* 1970, p 414

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1526)
DOTL RP

A2 040057
GUIDING PRINCIPLES FOR THE DESIGN OF POINTS AND CROSSINGS (UIC 54 AND UIC 60 RAIL PROFILES) FACTORS AFFECTING THE CONSTRUCTION OF COMMON AND OBTUSE CROSSINGS
The present document studies the choise of a geometry and a construction for common and obtuse crossings. The choice of geometry, for safety and for comfort, takes account of the incidence of high speeds and heavy axles on common and obtuse crossings, and the consequences, on obtuse crossings, of a current tendency towards the reduction of wheel diameters. The choice of construction is of prime importance with speed and tonnage. Two methods of construction, one of which has the advantage of a long experience, are described with their respective characteristics.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Intrm Rpt. D72/RP 3/E, Oct. 1966, 26 pp, 16 Fig.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1540)
PURCHASE FROM: UIC Repr. PC
DOTL RP

A2 040058
GUIDING PRINCIPLES FOR THE DESIGN OF POINTS AND CROSSINGS (UIC 54 AND UIC 60 RAIL PROFILES) ADDITIONAL REQUIREMENTS CONCERNING THE DESIGN OF SWITCHES AND CROSSINGS
This report deals with requirements concerning the design of switches and crossings. It studies the installation of junction work in the general alignment of tracks notably concerning: their installation on curve, the effect on couplings, loading gauge, cant and speed of negotiation in curved or winding situations. It shows a method for choosing optimum forms of certain items of ironwork affecting safety against derialment (switch toes and crossing noses). Finally, the document defines economic conditions in the selection of constituent parts.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways D72/RP 5/E, Oct. 1968, 14 pp, Figs., 3 App.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1541)
PURCHASE FROM: UIC Repr. PC
DOTL RP

A2 040059
GUIDING PRINCIPLES FOR THE DESIGN OF POINTS AND CROSSINGS (UIC 54 AND UIC 60 RAIL PROFILES) RESULTS OF THE ENQUIRY INTO THE GEOMETRICAL PRINCIPLES AND THE PRINCIPLES OF CONSTRUCTION OF SINGLE SWITCHES AND CROSSINGS FOR STANDARD TRACK ACCORDING TO THE POSITION ON 12TH APRIL 1963
Survey data was gathered from various railroad administrations concerning the geometrical designs of existing switches and crossings and data about their manufacture and construction. All data are presented in tables for ease of comparison.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways D72/RP 4/E, July 1967, 59 pp, Figs.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1542)
PURCHASE FROM: UIC Repr. PC
DOTL RP

A2 040060
GUIDING PRINCIPLES FOR THE DESIGN OF POINTS AND CROSSINGS (UIC 54 AND UIC 60 RAIL PROFILES). GENERAL PRINCIPLES TAKING INTO CONSIDERATION THE INCREASE IN SPEED AND AXLE LOADS
The report summarises developments which have been published in the five preceding documents on this topic. Conclusions regarding the entire study are divided into three ranges of speed in relation to three criteria: security, comfort and maintenance: first for V where security appears to be the most restrictive condition: second for 40 less than V less than or equal to 160 km/h where comfort seems to be the most restrictive and which decides the limit of speed on a turnout according to the actual design of the switches; third: for V greater than 160 km/h where maintenance and layout assume the greatest importance in proportion to the cost they in volve in the general economy.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways D72/RP 6/E, Apr. 1969, 21 pp, 17 Fig., Tabs., Refs., 1 App.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1543)
PURCHASE FROM: UIC Repr. PC
DOTL RP

A2 040063
INCREASE IN SERVICE LIFE OF REINFORCED CONCRETE TIES
After some eight years of experience of mass application of reinforced concrete ties in Russia it has been found various ORE member administration so as to permit has been 3--3.5 times that of the intermediate ties. Successful remedial actions have included limiting irregulatities in welded joints to .3mm per running meter, use of heavier rail (P-56 vs P-50) and maintenance of sufficient foundation width and ballast depths. This should enable administrations to decide whether their [Russian]

Translation of Russian journal article accomplished by G. G. Guins at Chesapeake and Ohio Railway Company

Railroad Transport Vol. 7 1964, pp 5, 8 Fig, 1 Tab, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1558)
DOTL RP

A2 040065
LATERAL FORCES ACTING ON THE TRACK DUE TO NOSING OF CARS
Depending on the type of motion, equations for determination of lateral forces produced by motion of cars on tangent track can be divided into two main groups: (a) without contact of flange and rail, (b) with contact of flange and rail. it is pointed out that Verigo's equation for calculating lateral forces accounts for such factors as angle of impact, condition of track and suspension component and equivalent mass and overall elasticity much more realistically than previously developed solutions.

Railroad Transport Vol. 8 1964, 6 pp, 1 Tab, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1560)
DOTL RP

A2 040072
DYNAMIC CHARACTERISTICS OF RAIL FOUNDATION
An experiment was conducted on track with P-65 rail, with 1840 ties per kilometer, with both wood and concrete ties, and stone ballast to evaluate the dynamic characteristics, particularily elasticity of the rail K1, coefficient of elastic friction of ballast L1, and equivalent mass of the track M1. It has been proposed that the tie reaction consists of an elastic component proportional to the rail displacement and a nonelastic component proportional to the velocity of vertical rail movement, inertia of the tie and adjacent layers of ballast and underlying soil. Linear differential equation were derived to permit theoretical analysis. The equations thus obtained are grouped to give proper number of simultaneous equations and solved as such. The results for various groups give different values of the coefficients and again their averages and maximums are given.

This unpublished material is based on a Russian article appearing in Railroad Transport Issue 7, 1964, page 16.

Vol. 7 6 pp, 1 Fig, 3 Tab, 1 Phot 1, Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1567)
DOTL RP

A2 040076
SUITABILITY OF SIX-AXLE LOCOMOTIVES FOR C&O--B&O SERVICE--THE INTERACTION WITH TRACK STRUCTURE
A series of tests was conducted with 6-axle locomotives in heavy, coal drag service on Cranberry Grade to investigate the interaction of locomotive tractive power and track conditions. Particularly, the performance of 6-axle locomotives in this service was investigated to determine the relative merits of that design versus the 4-axle units previously used. Five major areas were found to be significant and completely interdependent: I. Locomotive wheel life with 6-axle units. II. Rail cleanliness affects locomotive adhesion. III. The condition of the track and the rail govern overall acceptability of 6-axle locomotives. IV. Operating practices covering the use of sand are related to increased wheel wear and increased track maintenance. V. Instrumented wheel tests: A. To determine to what extent and under what circumstances the wheel and rail wear attributable to 6-axle locomotives exceeds that of 4-axle units. B. To determine effect of track surface on locomotive riding qualities. C. To determine suitability of 6-axle locomotives.

Schmidt, JJ
Chesapeake and Ohio Railway, Baltimore and Ohio Railroad Res Rpt Feb. 1966, 27 pp, 3 Tab, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1572)
DOTL RP

A2 040078
DYNAMIC LOADING AT RAIL JOINTS--EFFECT OF RESILIENT WHEELS
This study of a simplified vehicle model passing over an idealised dipped rail joint using values applying to a BR Class 86 locomotive shows that resilient wheels give an equivalent reduction in unsprung axle mass of 2,500 kg. The following conclusions were made: The suggested model for a broadened analysis of the vertical response of vehicle and track at a dipped rail joint is workable and produces dynamic wheel load values which are in full agreement with observed data. Fitting a Class 86 locomotive with resilient wheels will have the effect of reducing the dynamic wheel load increment at severe dipped rail joints by some 40 percent. The effect of resilient wheels on a Class 86 locomotive--based on the dynamic loading at rail joints--is equivalent to a reduction of the unsprung mass from 4,200 kg to 1,700 kg on the leading axle. Thus the results of the analysis suggest that a power-unit comprising axle-hung motors and resilient wheels is a highly competitive alternative to conventional, mechanically complicated and expensive arrangements used to obtain fully-suspended traction motors.

Bjork, J (Svenska Aktiebolaget Bromsregulator) *Railway Gazette* Vol. 126 June 1970, pp 430-434, 9 Fig, 1 Tab, 7 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1574)
DOTL RP

A2 040079
DYNAMICS OF RAILWAY TRACK SYSTEMS AND THEIR ECONOMIC CONSEQUENCES
British Railways has adopted concrete sleepers and continuous-welded rails as the best means to provide a high performance low annual cost track. Assessing the dynamic loading effect of different axles at different speeds on a less than perfect joint has been done and has produced a very close confirmation between field measurements and a previously calculated formula. Over 50 percent of the rail breaks occur in rails which are not more than ten years old, by which time none have reached the replacement stage due to loss of weight. Maximum bolt-hole stresses occur at the second running-on bolt, but rail-end failures start at the first bolt-hole. The joint consideration of the track and vehicle circumstances has resulted in the design of a three-axle bogie which not only increases the payload by 9 tons for a 2-ton increase in tare weight but reduces the axleload to 13-1/2 tons at an extra cost of less than 2,000 lb. a vehicle. While welded track requires higher installation costs the reduction in day-to-day attention is very marked. Taking 1969 prices, the costs per mile are: (i) long-welded rails on concrete sleepers, 29,000 lb; and (ii) jointed rails timber sleepers, 25,000 lb. But the "equalized" cost per annum is affected by the relative lives and is considerably less for long-welded rails.

Railway Gazette Vol. 126 Jan. 1970, pp 19-24, 5 Fig, 8 Tab, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1575)
DOTL RP

A2 040080
LOADING OF LIGHT RAILS
Highlights of a paper presented at a meeting of ICE. The author describes cases of known damage to rails and sleepers caused by excessive loading and reviews some investigations which have been carried out into the problem. It is suggested that further attention to rail design is needed to ensure that the maximum loading benefit is obtained. There is a need for establishing the maximum loading and best arrangement of locomotive axles for any given weight of rail. One of the conclusions reached by the author is that use of the continuous elastic-support theory as a means of assessing the safe loads and stresses caused on the track by locomotives is useful in designing the axleloading and layout, but with heavy axleloads the curve effects on rail-fillet stresses become the critical factor. With smaller wheel diameters the local railhead stressing effects must also be watched.

Kesson, JM (East African Railways and Harbours) *Railway Gazette* Vol. 114 Jan. 1961, pp 35-36

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1576)
DOTL RP

A2 040082
STABILITY OF LONG-WELDED RAILS
In 1953 an exhaustive testing programme was initiated by the Civil Engineering Laboratory to investigate the conditions and factors affecting the stability of long-welded rails, mainly pertaining to British Railways field conditions. To study the factors involved in track buckling, lateral deflection was induced on a 120-ft. length of track mounted on rollers with a distance between lateral reaction points of 20 to 106 ft. It was soon seen that conventional deflection formulae did not apply, especially in respect of overall stiffness of track, and that this varied with the length deflected, amount of deflection, sleeper-spacing, type of rail fastening, and rail section. These preliminary investigations took no account of the effect of ballast. To obtain information on the behavior of sleepers, rails, and fastenings simultaneously, a lateral bending test was devised for deflecting a 30-ft. section of track under lateral point-loading. Various sleeper-spacings and types of fastening were used and suitable formulae were evolved. The effect of ballast was investigated in a series of tests to ascertain its resistance to the lateral and longitudinal movement of both timber and concrete sleepers. In the main buckling tests on a 120-ft. test-bed, a length of track was subjected to thermal stresses in such a way as to simulate the central portion of a length of long-welded rail which does not move with changes of temperature. Loss of load in the track when buckling occurred as a result of rail expansion could be calculated from the gauge readings and the alignment of the buckled track.

Railway Gazette Vol. 115 Aug. 1961, pp 180-181

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1578)
DOTL RP

A2 040093
SIDE THRUST ON TRACK AT HIGH SPEEDS
Measurement of lateral forces on wheels and track for high speed running on the Tokaido line were carried out in two different ways; by measuring and

recording the stresses in the wheels of an inspection test car, and by measurements on the track. These measurements were made for speeds up to 150 mile/h.

Railway Gazette Vol. 121 July 1965, pp 529-530, 3 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1589)
DOTL RP

A2 040094
MECHANICAL LINING OF TRACK
This article describes the Plasser and Theurer Limited mechanical equipment and procedures for alignment of track. Over 100 of these machines are in use in Britain, Germany, Austria, the United States and other countries, and are being used on bull-head as well as flat-bottom rail.

Schubert, E (Austrian Federal Railways) *Railway Gazette* Vol. 121 Aug. 1965, pp 617-619, 5 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1590)
DOTL RP

A2 040110
DYNAMIC TESTS ON RAIL FASTENINGS
Concrete sleepers are used throughout the Pakistan Western Railway system. Over 70,000 have been cast and have proved entirely satisfactory except that the fastenings tend to become loose in time. Three fastening were withdrawal tested. A dynamic test on fasteners is presented and the dynamic test apparatus is shown.

Railway Gazette Vol. 120 June 1964, pp 496-498, 3 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1606)
DOTL RP

A2 040138
TESTS WITH BALLAST-LESS TRACK
Maintenance work on the ballasted track bed in tunnels must be done at great disadvantage, therefore, research has been directed towards the design of a ballast-less track bed. A 210 meter long stretch is described of such a bed in the Boezberg Tunnel. This design has concrete ties laid upon suitable rubber cushioning over a reinforced concrete bed. The results of the tests of this track structure as to bending stresses, track level depression, rail stresses and noise levels are shown in graph form, and comparisons are made with similar test results in the ballast bed structure. Further development is necessary before a rapid program of changing to a ballast-less structure is indicated. [German]

Ensner, K Simon, W (Bauabteilung Der Generaldirektion Der SBB) *Eisenbahntechnische Rundschau* Vol. 19 N No. -2, Feb. 1970, pp 33-36, 7 Fig, 1 Phot, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1638)
DOTL RP

A2 040139
DEVELOPMENT TRENDS IN SWITCH POINT DESIGN
On the Swiss Federal Railways, with a total track length of 6,686 Km, there are a total of 14,669 switches, for an average 455 meters of track per switch. The Swiss Railways have had to engage in the development of switch designs to provide higher speeds for their train movements through switches. The design is described of the geometry of switch points and turnouts, with diagrams of four long radius switch turnouts from 900 m radius to 2200/3800 m radius. The design of various switches are shown. There is shown the arrangement of a switch lay-out on a ballastless concrete bed. The present maximum speed of trains, 140 km/h, is not foreseen as likely to be increased, so the development of switches capable of accepting trains at speeds of 125 to 140 km/h has become necessary, in order to maintain the flow of traffic as rapid as possible. In this development, the rail profile has been increased from 49 kg to 54 kg per meter. [German]

Simon, W Schumaker, G (Bauabteilung Der Generaldirektion Der SBB) *Eisenbahntechnische Rundschau* Vol. 19 N No. -2, Feb. 1970, pp 26-32, 7 Fig, 2 Phot, 2 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1639)
DOTL RP

A2 040140
THE TAMPING OF TIES
A ballast bed must keep the rail deflections at minimum under the train loading, must not retain water, and must permit the underneath soil to dry out quickly, and must hold the track in stable alignment. To achieve this condition, not only is cleaning of the ballast essential, but also, proper tamping of the ballast around the ties is required. The various methods of tamping are described, with an evaluation of the effectiveness of each process. Tests have proven that the asynchronous method of operation of the tamping machines, combined with the compacting between and at the ends of the ties, provides the more nearly uniform homogeneity of the ballast bed desired under the ties. [German]

Schubert, E (Osterreichischen Bundesbahnen) *Eisenbahntechnische Rundschau* Vol. 17 N Sept. 1968, pp 389-392, 7 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1640)
DOTL RP

A2 040141
THE PROBLEMS OF TRACKWAY AND SIGNAL TECHNIQUES FOR RAIL
The problems relating to high speed travel are outlined. For speeds up to 250 km/h, the conventional form of track structure, with ties on the ballasted road bed, will suffice, using the presently available equipment and motive power systems. The following improvements in the present rail permanent way are suggested for attaining the full benefit in travel time reduction from the high speed operation: strengthening the present track structure system; improving the soil foundation under the track structure; improving the track with consideration for the centrifugal forces of vehicles on curves; elimination of close track spacing; elimination of railway road crossings; and equipping the high speed sections with continuous train control. [German]

Kuemmell, KF *Eisenbahntechnische Rundschau* Vol. 17 N No. 2, Dec. 1968, pp 506-512, 3 Fig, 1 Tab, 6 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1641)
DOTL RP

A2 040142
DEVELOPMENTS AND EXPERIENCE WITH THE THERMIT SYSTEM WITH PARTICULAR REGARD TO WELDING OF DIFFERENT RAIL STEEL QUALITIES
The application is discussed of the Thermit welding process to rails, on the influence of the rail material on the quality of the weld, on the temperatures occurring in the rails during and after welding, on the changes in structure and hardness of the rail material adjacent to the welds as a result of the thermal processes. Detailed measurements show the expansion and contraction in the rail zones heated during Thermit welding, and the cooling behavior of various rail and Thermit steels, as well as possible damage to the welds and heated rail sections. The results of measurements of internal stress in the rail welds, with and without collar respectively complement the test data obtained in the laboratory. In addition to the practical experience derived from the many millions of rail welds, they are a valuable contribution to the metallurgy of rail metals, which should be taken into consideration in the development of new rail profiles.

Ahlert, W (Elektro-Thermit GmbH) *Eisenbahntechnische Rundschau* Vol. 18 N No. 2, Dec. 1969, pp 468-520, 18 Fig, 6 Tab, 27 Fig, 16 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1647)
DOTL RP

A2 040146
RAILWAY TRACK STRUCTURE WITHOUT TIES OR BALLAST
Three different types of concrete track bed were designed and built. Results of tests of rail deflections, both vertical and lateral, under dynamic loading are given and shown on charts. The static vertical deflections of the three types of track beds are compared with that of the standard tie and ballast road bed, over a period of 19 months service. The economics of the concrete railway road bed indicate that the cost reflects about an 18% increase over the standard tie and ballast structure. A comparison of the vertical and lateral accelerations of a locomotive and car, measured at the start of the tests over the concrete bed track structure and 8 months later show no marked change in their values over the 8 month period. The uniform and

small settling did not increase beyond the initial values. Good riding quality of the trains passing over these sections at 200 km/h continued throughout the test. The shelling damage to the rail laid on the concrete rail bed is not higher than on the conventional track structure. [German]

Birmann, F *Eisenbahntechnische Rundschau* Vol. 18 N Sept. 1969, pp 293-305, 11 Fig, 17 Phot, 27 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1645)
DOTL RP

A2 040159
THE USES OF TRACK INSPECTION INFORMATION IN RAILWAY ENGINEERING
Track inspection techniques are described. The purposes of the inspection is to develop a maintenance program; detect emergency track defects; evaluate methods, machines and material; and control work quality. Emphasis is placed on the analysis of data collected during the inspection.

Way, GH *AREA Bulletin* Vol. 71 1970, pp 767-774, 6 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-491)
DOTL RP

A2 040161
DIGITAL PROCESSING OF TRACK GEOMETRY DATA FOR MAINTENANCE PLANNING
The concepts for data processing described in this paper and the resulting preferred formats for the presentation of track geometry data resulted from discussions with knowledgeable people within the railroad industry. Data on 450 miles of track geometry are recorded by the test cars in less than 8 hours. The analog chart data is then scrutinized and edited. Within 48 hours after the test run, the digital gage printout and the annotated charts are ready for review by the maintenance engineer. By use of digital computer processing, a vast amount of track data can be collected and reduced into meaningful form quickly and efficiently. The Gage Data Reduction Program is a tool actively providing maintenance engineers and key management personnel with information to direct the planning of maintenance-of-way activities. The crosslevel program, presently under development, will be providing information on another key track parameter.

Woll, TP (Federal Railroad Administration) *AREA Bulletin* Vol. 71 1970, pp 785-797, 8 Fig, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-493)
DOTL RP

A2 040164
DETERMINATION OF MAINTENANCE OF WAY EXPENSE VARIATION WITH VARIOUS TRAFFIC VOLUMES AND EFFECT OF USING SUCH VARIATIONS, IN TERMS OF EQUATED MILEAGE OR OTHER DERIVED FACTORS, FOR ALLOCATION OF AVAILABLE FUNDS TO MAINTENANCE OF WAY
The purpose of this study was to determine the relationship between the characteristics of traffic and track and track maintenance costs. In this preliminary study a procedure was developed and checked in a general way against actual maintenance of way costs as reported by the C&O--B&O for the year 1966, with reasonable correlation. For general application it is believed that some further improvements can be made in the procedure that has been developed, to take into account the effect of climatic conditions on weed and brush control, of age of rail, etc. Extensive data are shown.

Christianson, HB *AREA Bulletin* Vol. 70 1968, pp 75-94, 8 Fig, 7 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-496)
DOTL RP

A2 040167
VENTILATION RESEARCH PROGRAM AT CASCADE TUNNEL, GREAT NORTHERN RAILWAY
A test and research program was conducted in April 1966 in the Great Northern Railway's Cascade Tunnel to ascertain the effects of diesel-powered trains moving through the tunnel from the standpoints of ventilation and engine heat dissipation. The test program included establishing measurement stations in the tunnel and on a locomotive consist, recording the pressures, air velocities and temperatures at these stations, analyzing the results and using an analytical approach previously developed to predict the effects of train movements through a tunnel. The test program was generally successful and fielded the desired results. A comparison of predicted and observed results confirmed the validity of the analytical approach used.

Aisiks, EG Danziger, NH (Parsons, Brinckerhoff, Quade & Douglas, Inc.) *AREA Bulletin* Vol. 71 1969, pp 108-128, 8 Fig, 3 Tab, 10 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-499)
DOTL RP

A2 040172
PERMANENT WAY WORK--A PROGRESS REPORT
Track maintenance techniques used by the British Railways are described and maintenance schedules are shown. Maintenances costs are shown as a function of track design, maximum speed, and number of trains per day.

Butland, AN (British Railways Board)
American Railway Engineering Association Vol. 70 1969, pp 814-822, 2 Fig, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-897)
DOTL RP

A2 040173
1964 EARTHQUAKE DAMAGES TO THE ALASKA RAILROAD
The 536-mile Alaska Railroad, which operates from two tidewater ports, Seward and Whittier, on the north Pacific Coast, through to central interior Alaska suffered intense damage. Some 200 miles of railroad were totally immobilized. All communication with line points were disrupted. The damage was such that it was impossible to use the railroad to reach the distressed areas. In excess of 110 bridges were rendered unserviceable; miles of track were warped out of line and rails twisted. Landslides accounted for over 2 1/2 miles of lost grade, leaving rails suspended in mid-air. The port and terminal facilities at Seward were all but wiped out by a combination of seismic action, tidal waves and fire. Whittier fared somewhat better, but was far from operable. Two hundred and twentyfive pieces of rolling stock were either lost or badly damaged. The Railroad property loss was estimated at $35,000,000. Photographs of some damaged areas are shown. Railroad repair problems are briefly discussed.

Cook, IP (Alaska Railroad)
American Railway Engineering Association Vol. 66 1965, pp 750-755, 7 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-898)
DOTL RP

A2 040184
VERTICAL RESILIENCE OF RAIL ATTACHMENT FOR TRACK WITH CONCRETE TIES
Stiffness of concrete tie track can be reduced by introduction of resilient pads under the rail; yet, if too much flexibility is introduced, there is danger of losing stability of the rail. Thus arises the problem of selecting optimal resilience of the pads. The system of the interaction of wheel and rail can be represented as a system with six degrees of freedom. Selection of values for the various parameters is quite complex. The author assumed the masses of various components taking part in the oscillation to be proportional to their deflection under a single concentrated force. It was concluded that: the reduction of joint stiffness for more universally used track reduces dynamic effect of wheel to rail action, reduces stresses in wheel and acceleration input to the car, the recommended value of stiffness is of the order of 100 x 10 to the third power Klg/cm, and the values of inertia force can be considered as a linear function of speed. [Russian]
English translation of Russian Article.

Hvostick, GC *Railroad Transport* Vol. 4 1967, pp 3-6, 5 Fig, 8 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1552)
DOTL RP

A2 040188
INSTRUCTION GOVERNING THE SUPERELEVATION OF OUTER RAIL AND THE SPEED OF TRAINS ON CURVES
This specification for operations practice provides four superelevation tables: Table A gives the equilibrium elevation for various speeds on curves at which the overturning forces are balanced by the superelevation. Table B gives the

speed at which conventional passenger equipment will ride comfortably around a curve. Three additional inches of superelevation would be required for balance of overturning forces. Table C gives a modified speed which may be authorized for freight trains. The superelevation is between equilibrium and comfortable. Table D gives a maximum theoretically safe speed assuming a center of gravity at 98 inches above the rails. This table is not to be used for elevating track. It is for information only. Change in superelevation will follow the alignment spiral where possible. The rate of change of superelevation should not exceed 1/2" in 31' for speeds up to 50 mph or 3/8" in 31' for speeds over 50 mph.

Baltimore and Ohio Railroad, Chesapeake and Ohio Railway Engr Rpt BULLETIN NO R-13, Apr. 1970, pp 8

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1556)
DOTL RP

A2 040189
REVIEW OF A RUSSIAN ARTICLE CONCERNING THEIR APPROACH TO TRACK DESIGN AND MAINTENANCE

Three means of reducing track maintenance are being instituted in Russia in order to counter the 30-60% reduction in productivity of gangs caused by heavy traffic. It is estimated that each kilogram of rail weight reduces cost of track maintenance by 1.4-1.6%. Therefore use of the lightest size P-43 is being discontinued. New standards of track design utilizing welded rail would reduce maintenance of way by 14-20%. A 5 cm. increase of depth of ballast in 20 x 10 to the 6th power ton/klm. areas reduces labor cost by 5-7% and an annual reduction of stone by 500,000 cubic meters. [Russian]
Translation of Russian article prepared by S.G. Guins

Railroad Transport Vol. 2 1965, 2 pp, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1570)
DOTL RP

A2 040196
VEHICLE DYNAMICS AND WHEEL-RAIL INTERFACE PROBLEMS

This paper reviews problems of wheel-rail contact in terms of present knowledge of the conventional steel-on-steel system and on possibilities for research and innovation arising out of extensions to this present knowledge. Specific directions for research suggested are: experimental work on wheel-rail contact forces, followed by refinements of theory to include effects such as surface chemistry, surface roughness and unsteady motion; studies of new structural forms for wheels and rails which might yield a superior overall system design; investigation of the wear-vehicle dynamics feedback process for steel wheels on steel rails, particularly where there are radical changes in vehicle suspension design; and studies of various wheel-track kinematic and guidance systems to provide basic information for overall system design.

Wickens, AH (British Railways Board) pp 157-171, 11 Fig, 34 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1655)
DOTL RP

A2 040200
HOW HIGH CAN TRAIN SPEED BE INCREASED? A REVIEW OF PRESENT AND FUTURE

The effect of wave propagation in air and on the rail is discussed as a theoretical limit for train speed. As practical limits to speed, the deflection by the pantograph to the wire at point of contact is described. By this principle the critical speed of the New Tokaido Line (NTL) train has been calculated as 400 km/h. Adhesion force is plotted versus tractive resistance for a 12-car NTL train, which gives the limit to speed as 370 km/h. Vibration limits speed to 230 km/h on straight track due to passenger comfort. The problems concerning curved track are also briefly discussed.

Matsudaira, T (Japanese National Railways) *Japanese Railway Engineering* June 1966, pp 131-134, 5 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1659)
DOTL RP

A2 040210
INVESTIGATION OF FAILURES OF WELDED RAILS AT THE UNIVERSITY OF ILLINOIS

Three weld failures are reported in 115-lb rail. One was caused by poor fusion in the weld. The second was believed caused by a flake of mill scale caught between the rail ends during welding. The third failure was a web crack through the head on both sides of the weld. Thirteen bend test are reported, which were made on full-section rails.

Cramer, RE (Illinois University, Urbana)
American Railway Engineering Association Vol. 65 N No. 84, Feb. 1964, pp 611-614, 1 Tab, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1669)
DOTL RP

A2 040211
INVESTIGATION OF WELDED RAILS AT THE AAR RESEARCH CENTER

Results of the investigation of 13 welded rail failures are reported. Two were oxyacetylene pressure butt welds and 11 were flash butt welds. Five defects were in the rail before welding; the remainder were in the weld itself.

American Railway Engineering Association Vol. 65 N No. 84, Feb. 1964, pp 615-629, 1 Tab, 25 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1670)
DOTL RP

A2 040213
DISCUSSION ON STRESSES IN RAILROAD TRACK

The inspection tests of rail-joints in track made for the purpose of learning the source of the wear of the joint bars and the rail, the places of wear, information bearing on the mutual interaction of the worn bars and rail when under load and when the bolts are newly tightened, and other information relating to the stability and maintenance of the rail-joints have given desirable information. The occurrence of high stresses in the unloaded worn joint bars in track due to the tightening of the bolts was found to be as great as 30,000 and 40,000 lb. per sq. in. and in a few cases as high as 60,000 lb. per sq. in. The stresses were fairly proportional to the amount of the lateral bending put into the bar by tightening the joints, measured from the loose condition. The instruments designed and built to facilitate the measurement of profiles and shapes and straightness of joint bars and rail and their position with respect to each other in the joint have proved satisfactory.

Talbot, AN (Illinois University, Urbana)
American Railway Engineering Association Vol. 36 pp 957-958

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1676)
DOTL RP

A2 040217
WHEEL, AXLE, AND RAIL STRESS PROBLEMS RELATED TO HIGHER CAPACITY CARS--PART IV-EFFECT ON RAIL

Those items that have been found advantageous in reducing shelling caused by higher capacity (85 to 100-ton) cars are wheel loads should be limited in proportion to wheel diameter. Higher strength material in the rail will greatly reduce shelling but not entirely eliminate it (under the wheel loading conditions existing with 70-ton capacity cars before the allowable load was increased 5%). Modified rail head contours in today's modern rail sections which approach the average worn wheel condition, have been helpful in reducing shelling. Rail lubrication on curves extends the rail life but results in the removal of more rails for shelling rather than abrasive wear.

Stampfle, RB
American Society of Mechanical Engineers Paper Nov. 1963, 13 pp, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1680)
DOTL RP

A2 040227
LATERAL LOADING BETWEEN LOCOMOTIVE TRUCK WHEELS AND RAIL DUE TO CURVE NEGOTIATION

Curve-negotiation mechanics and forces resulting when locomotive trucks negotiate curves are well recognized. However, meaningful and reasonable prediction of forces resulting in service conditions has been limited. An

instrumented wheel-axle assembly was developed and used on 2,3, and 4-axle trucks to study the effect of creep and the transverse load reactions resulting between wheel and rail. Instrumentation was used to measure these forces and the reactions between axles and truck frame under operating conditions. Test results confirm predicted phenomena and indicate the effect of creep on resulting loads. This paper includes a brief and general review of curve-negotiation mechanics and presents the test results and their relation to the theoretical analysis.

Contributed by the Railroad Division of the ASME at the Annual Winter Meeting, Chicago, Illinois, November 7-11,1965.

Koci, LF Marta, HA (General Motors Corporation)
American Society of Mechanical Engineers Paper 65-WA/RR-4, Nov. 1965, 11 pp, 7 Fig, 18 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1691)
DOTL RP

A2 040233
THE TRANSPORTATION ENVIRONMENT

Rail shipping is compared to truck shipping. In both cases the over-the-road environment is characterized by a continuous low amplitude vibration with random and periodic shock type inputs superimposed. The basic periodic inputs are rail joints for rail transportation and expansion joints for highway transportation. The random inputs for rail transportation are road crossings, bridges, switches, railroad crossings and the like. For highway transportation, the random inputs are railroad crossings, bridges, pot holes, etc. The continuous low level input is what creates resonant damage to products. The shock inputs create the dented, crushed, and broken hinge type of damage. Both types occur in both modes. The environment is divided into natural frequencies of vibration, vertical accelerations, shock spectra, impact forces and lateral acceleration, the magnitude of which is displayed graphically.

Received From General Motors Corporation Technical Center

Luebke, RW
Chesapeake and Ohio Railway, Baltimore and Ohio Railroad Conf Paper Mar. 1971, 22 pp, 12 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1697)
DOTL RP

A2 040252
JOINT DEFLECTION AND RAIL END BATTER ON 130 LB RAIL EMPLOYING UNCONVENTIONAL METHOD OF LAYING

The purpose of this test was to determine if rails matched and laid in a continuous stretch of track with ends in same position as when passing through the hot saws at the rail mill show less joint deflection and rail end batter than rails received from the mills and laid in the usual way. The matching and laying of rails for the test produced 92 joints where ends were matched due to different ingots and rail classification. Initial measurements of joint deflections and rail end batter were taken during May 1930, and these measurements were repeated at intervals over a period of eight years. The final inspection was made during May 1938. It was concluded that to load, identify, distribute and lay rail matched in the same order as rolled and hot sawed at the mill would unquestionably result in higher manufactoring and rail laying costs than now exist. The results of this test with a limited number of rails matched, compared with rails not matched, show no improvement over the usual method of shipping and laying rail.

Penn Central Transportation Company Test No. 72, Apr. 1945, 7 pp, 2 Fig, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1716)
DOTL RP

A2 040253
THE ABRASION OF EXPERIMENTAL HEAT TREATED AND UNTREATED RAIL ON THE HORSESHOE CURVE

After seven years and eight months in service, both rolled and heat treated and rolled and untreated rails were removed from the Horseshoe Curve at Altoona. Abrasion measurement were taken throughout the time interval. No broken or defective rails were encountered during the service period, but some rails particularly the untreated ones, were worn badly. Abrasion data are provided.

Penn Central Transportation Company Jan. 1935, 3 pp, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1717)
DOTL RP

A2 040254
COMPARISON OF RAIL ABRASION, END BATTER AND DEFLECTION FOR 130 LB., 131 LB., AND 152 LB. RAIL

Rail abrasion, and batter, and joint deflection measurements were made on 130 lb., 131 lb., and 152 lb. rail on adjacent stretches of track east of Tyrone, Pa. Various joint bars were employed. Maintenance cost records were also recorded for this stretch of track. Early measurements, particularly of joint deflection, gave large variations in deflections from joint to joint, and led to removing and measuring a considerable number of bars showing high and low joint deflection. The results of these measurements indicated a need for better mill inspection to control vertical camber and led to a more thorough control of camber ranges during manufacture. Also the initial use of the "Toeless" type of bar such as applied in this test indicated a pronounced tendency to "cocking" the bars during first application and led to development of the present yoke gauge now in general use for applying the "F" types of bars to prevent "cocking". The 152 lb. and 131 lb. "F" type bars in this test were badly cocked when first applied. In the joint deflection comparison a good showing is made by the 131 lb. rail (untreated) with the B-1 type bar (Plan 66194-B) both on tangent and sharp curves. As to rail end batter the 131 lb. (untreated) rail with B-1 bars also gives the least amount of batter on tangent and sharp curves after eliminating the 131 lb. (heat treated) rail from which it would be expected less batter would occur. For the various weights of rail (untreated) on curves the 152 lb. rail had an additional service of one year over 130 lb. rail and three-fourths year over 131 lb. rail before it was necessary to transpose the rail. Measurements of rail abrasion during the period of test shows a marked decrease in abrasion on both tangents and curves for the 152 lb. and 131 lb. rails over the 130 lb. rails all untreated. Maintenance costs have been largely affected by local conditions, particularly differences in drainage and in the new tie territory of 130 lb. rail previously mentioned.

Graham, FM
Penn Central Transportation Company Test No. 142, May 1938, 10 pp, 4 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1719)
DOTL RP

A2 040255
PERFORMANCE OF CHROME PLATED SWITCH POINTS

Chromium plated switch points were tested to determine whether chromium plating will increase resistance to abrasive wear sufficiently to warrant the added cost. Six pairs of 18' 130 lb. switch points were chromium plated on wear surfaces for a length of about six feet from the point. The plating process was preceded by a careful polishing of the surfaces to be plated. The cost per switch point was $14.53. An examination by chemical test of all of these points very shortly after they were placed in service showed that the plating was entirely removed wherever the wheels had contacted the switch points. This failure of the plating doubtless occurred immediately after they were placed in service and was probably due to deformation of the steel underlying the plating causing the plating to fracture and separate from the steel.

Graham, FM
Penn Central Transportation Company Test No. 171, July 1933, 2 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1720)
DOTL RP

A2 040257
WEAR OF IN-SERVICE SWITCH RAILS

A series of three related letters address the problem of excessive wear in switch points. Attempts to relate the wear problem to rail chemistry and hardness are described. It was thought that rail with higher carbon content would resist flow and show less wear than rail low carbon contents. Hardness could not consistently be related to wear.

Penn Central Transportation Company Test No. 181, July 1931, 4 pp, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1722)
DOTL RP

A2 040258
BATTER TEST OF 151 LB. R.E. RAIL
This report covers a test of 151 lb. R.E. rail in which the base and lower portion of the web at the rail ends is cut square while the head and upper portion of the web is mitred, the change in angle of out taking place about the center of height of web. The mitre makes an angle of 60 degrees with the line of track. For the purpose of test the above rails were laid on the Pittsburgh Division in No. 1 Eastward Freight Track east and west of Ardara on April 27, 1935. For comparison, 67, 131 lb. X-Rails with ordinary square ends were laid at same time adjacent and west of the mitred rails on the same track. After one night's traffic had passed over the rail initial measurements of rail and batter were taken. It was concluded that insofar as rail end batter there is no advantage in the use of mitred end rails over ordinary square cut end rails as determined by batter measurements over a period of one year and-1/2 months service in heavy tonnage freight track.

Graham, FM
Penn Central Transportation Company Test No. 240, June 1937, 5 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1723)
DOTL RP

A2 040259
RAIL ABRASION AND END BATTER OF CONTROL COOLED 131 LB. R.E. RAILS
This is a progress report showing results of rail abrasion and end batter of control cooled 131 lb. R.E. rails rolled and treated by various manufacturers and laid during 1935. The Illinois and Bethlehem rails were laid on the Middle division No. 4 westbound passenger tracks on tangent and 4 degrees 0" curve east and west of Lewistown, Pa. The Carnegie and Inland rails were laid on the Panhandle Division No. 1 eastbound passenger and freight track on tangents and curves ranging from 3 degrees 14' to 7 degrees o" west of Carnegie, Pa. It was found that for the tangent track the differences in both abrasion and batter as between thermal treated and ordinary hot bed cooled rails are hardness of the rail has resulted from the thremal treatment. The information for curve is not directly comparable on account of wide variations in curvature where measurements were obtained. There have been no transverse fissures or other failures in either the test or comparative rails during the three year period between measurements.

Penn Central Transportation Company Prog Rpt Test No. 245, July 1939, 3 pp, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1724)
DOTL RP

A2 040260
FINAL REPORT ON 131 LB., R.E. FERRO-TITANIUM RAIL TESTS NOS. 253 AND 300 CONDUCTED ON THE ALTONNA AND COLUMBUS DISTRICTS
It was the purpose of the tests to determine to what extent rail with ferro-titanium added would alleviate the presence of shatter cracks with ultimate formation of detail fractures or other kinds of failures. Also, to obtain information as to the service quality of the above rail by means of observations and measurements of wear and rail end batter. The ferro-titanium rail used in Tests Nos. 253 and 300 was rolled under standard specification C.E. 35-(b). It was concluded that there is no overall advantage, either in reduction of head wear or rail end batter, in the addition of ferro-titanium to rail steel. Shatter cracks have been eliminated in rail of normal composition by control cooling. There is no necessity for using rails of special composition for this purpose. While the reduction in flaking, often associated with the formation of shelly spots, was not marked, there may be justification in considering titanium along with higher silicon contact as an alloying element intended to reduce shelling. It is recommended that in the study of rail chemical composition intended to reduce shelling, consideration be given to titanium.
Unpublished Correspondence.

Code, CJ
Penn Central Company Final Rpt Test Nos. 253, 300, Jan. 1956, 9 pp, 6 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1725)
DOTL RP

A2 040261
RAIL END WELDING BY FIVE DIFFERENT PROCESSES
At the time of this test, a two-flame or three-flame welding torch was being used. Since a single flame welding torch is currently in use, it was felt that a reinvestigation of the thermal effects on joint bar camber and rail joint profile was desirable. This report covers the reinvestigation of this matter. Fifty joints were welded prior to applicaton of reformed joint bars and fifty joints were welded after application of reformed joint bars on the tangent east of Bellwood, Pa. Welds were made with a single flame welding torch on 152-lb. P.S. rail and joint bars reformed 1/16" oversize were applied to the joints. The measurements of camber of the bar itself, taken with a straight edge with the bar removed from the rail and reported above, show an average loss of camber of .004" in bars where welding was done after bars were applied, and a corresponding loss of .001" where bars were applied after welding was completed. The net loss of .003" is so small that it might be considered insignificant, except that it is an average and obviously represents a considerably greater loss in some individual bars. It is concluded that better top of rail profiles across joints result where joint bars are changed (reformed bars applied) after welding. The damaging effect of welding after application of reformed bars is less with the single flame torch than it was with the two or three-flame torch.
Unpublished Correspondence.

Code, CJ
Penn Central Transportation Company Test No. 363, Dec. 1957, 5 pp, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1726)
DOTL RP

A2 040262
JOINT BAR SHIMS
It was desired to determine by service test the possible merits, economy, and effectiveness of joint bar shims used with special machined joint bars for 130 lb PS 4-hole and 131 lb. RE 6-hole bars. Set up for the test comprised 200 joints, each constructed with two designs of shims at each location compared with reformed bars without shims to be used in same track and location adjacent to test material. The 4 hole 130 lb. shim joints used in this test have not shown merit, economy or effectiveness in producing improved joint conditions over ordinary joints with reformed bars used without shims. Other than the limited amount of information developed by the 6 hole 131 lb. shim joints included in the trial made in main track conclusive information from the standpoint of service effect is not available, however, it is believed the results would be comparable to those obtained with the 4 hole joints.
Unpublished Correspondence.

Code, CJ
Penn Central Transportation Company Test No. 318, Apr. 1949, 9 pp, 6 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1727)
DOTL RP

A2 040264
CONTROLLED BEARING JOINT BARS
The purpose of this test was to determine the efficiency and merit of controlled bearing bars of F-4 type with known vertical camber. The test was changed to include two stretches of 131 lb. F-7 joints and one stretch of 152 lb. F-3 joints. Test locations were as follows: Middle Division No. 4 Track; Middle Division No. 2 Track; and Panhandle Division No. 1 Track. All bars were installed in continuous stretches on light curves or tangent. All bars were to be furnished with vertical camber, not less than 0.015 inches nor more than 0.045 inches. Installation of test bars was made in connection with laying of new rail. Periodic wear and deflection measurements were made on C.B. and comparative bars. Measurements of joint wear and deflections were made periodically until January 1944. A table showing average inward movement of joint bars and differences in deflection of joints is attached. The record shows a slight advantage for the straight bar. The record of maintenance cost shows a small difference in favor of the straight bars. The record of deflection and joint bar take-up shows very slight differences, the balance being in favor of the straight bars. There appears to be no justification for the additional cost of the lateral deformation necessary. Based on the results of this test and of Test No. 391, it is concluded that the controlled bearing bar has no advantage over the straight bar and is in fact harmful in that it introduces higher rail web stresses.

Unpublished Correspondence.

Code, CJ
Penn Central Transportation Company Test No. 326, Feb. 1959, 4 pp, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1729)
DOTL RP

A2 040265
FLAME STRAIGHTENING OF JOINT BARS
The purpose of this test was to determine the effect on joint bars of the flame straightening process and the relative economy and benefits to be obtained from flame straightening joint bars in track, as compared with the application of reformed bars. It was concluded that consistent results in flame straightening fit bars were hard to achieve. Some few joints were properly straightened with good results, but most of them were left with either too much or too little camber. It was recommended that no further application of flame straightened bars be made.
Unpublished Correspondence.

Code, CJ
Penn Central Transportation Company Test No. 371, Aug. 1942, 12 pp, 11 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1730)
DOTL RP

A2 040266
MILL END HARDENED RAIL OF VARIOUS MANUFACTURERS AND WEIGHTS OF 131 LB. AND 152 LB.
The purpose of this test was to compare Mill end-hardened rail with non-end-hardened rail of various mills, weights and sections. The test includes 131 RE rail and also 152 PS and PSM rail laid in track near Newport and Mt. Union, Pa., 1944. Records of mill practices with respect to end-hardening processes were obtained. Laboratory hardness records were compared with mill values. Measurements were taken of rail end batter, joint deflection, and out-to-out dimensions of joint bars. These measurements were repeated after one year's service, and after two year's service. This report is based on an analysis of the 1946 measurements after a service of 2 years. It was concluded that rails properly end-hardened may be expected to show a marked improvement in resistance to batter, and in resistance to chipping and spalling when compared with non-end-hardened rail. The air quench method shows better performance than the water quench process. The reduction in batter and chipping should result in longer life of rail, and in reduced expenditures for repairing rail ends by welding.
Unpublished Correspondence.

Code, CJ
Penn Central Transportation Company Test No. 398, Mar. 1947, 19 pp, 2 Fig, 6 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1731)
DOTL RP

A2 040269
FASTENERS TEST REPORT
Effect of temperature decreases on experimental fasteners was determined in a series of field tests. One inch Huck fasteners did not provide adequate restraint to freeze conventional insulated joints, as movement occurred with a 30F drop in temperature. A similar test was conducted with 1.125 inch Huck fasteners. The holding capacity was adequate to a minimum temperature of plus 10F. Hi-flex structural adhesive was laboratory and field tested. Performance was satisfactory to minus 15F.

Test Rpt 22 pp, 1 Fig, 9 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1738)
DOTL RP

A2 040272
TEST 431--RAIL MODIFICATION
The test comprised modified rails applied on high side of 6 deg 00' curve in heavy tonnage territory. For the test rails 131 lb. No. 1 quality, open hearth high carbon steel were furnished. Performance of the rails in track was followed during 2 years service by occasional inspections, measurements of rail wear, and rail end batter. Carnegie rails with 10" head radius were heavily flaked but no shelling was evident, whereas, the Bethlehem rails with 14" head radius were shelling.

Gressitt, JL (Pennsylvania Railroad)
Penn Central Company Test Rpt Test 431, Feb. 1950, 3 pp, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1741)
DOTL RP

A2 040273
STRESS CORROSION OF RAIL WEB STEEL (STATIC)
The test included six rail joint segments containing one bolt hole with a bolt inserted to make the joint. It also included twenty steel specimens taken from rail steel which were subjected to static bending stresses. The twenty corrosion test specimens were tested after nearly twelve and one half years of exposure to the elements. The joint segments were tested approximately one month later. All of the test specimens were cleaned throughly and examined in the laboratory by Magnaflux and Magnaglow methods for the presence of corrosion cracks. While there was considerable pitting to be found, the laboratory examination disclosed no cracks in any of the specimens. This test shows that static stress combined with corrosion has little or no effect upon the development of cracks in rail web steel.

Code, CJ (Pennsylvania Railroad)
Penn Central Transportation Company Test Rpt Test 475, Nov. 1960, 16 pp, 2 Fig, 1 Tab, 9 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1742)
DOTL RP

A2 040274
ARRANGEMENT OF RAIL ANCHORS ON TRACK HAVING MAJOR TRAFFIC IN ONE DIRECTION BUT SIGNALLED FOR MOVEMENT IN BOTH DIRECTIONS
The test consisted of two stretches, one at Metuchen on the New York Division and one at Edgewood on the Maryland Division. Each stretch was signalled for movement in both directions. Application of rail anchors in five different arrangements was made on new 155# rail. From experience gained in this test it may be concluded that six anchors with traffic are seldom sufficient on a main line track. With regard to reverse anchoring it may be concluded that two reverse anchors are sometimes, but not usually sufficient. Four reverse anchors appear to be sufficient in all cases. For track having major traffic in one direction but signalled for use in both directions, a minimum of 8 normal and 4 reverse anchors be used and that they be applied in the present conventional arrangement with reverse anchors being applied to the opposite side of normally anchored ties.

Code, CJ
Penn Central Transportation Company Test Rpt Test No. 482, July 1957, 5 pp, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1743)
DOTL RP

A2 040275
FLAME CLEANING OF RAILS
The purpose of this test was to determine the possible advantage, effectiveness, and economy in flame cleaning of rails before the application of grease at rail ends for protection against corrosion. The rail ends in four stretches of new rail totaling seven miles were flame cleaned before greasing. Inspection made at the time of application and after seven years' service revealed that air cleaning and flame cleaning were equally effective. Under the circumstances of this test no advantage is shown for flame cleaning which is considerably more expensive than the usual method.

Code, CJ
Penn Central Transportation Company Test Rpt Test No. 557, Jan. 1958, 5 pp, 1 Tab, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1748)
DOTL RP

A2 040276
SWITCHES WITH RAILS END HARDENED AT THE HEELS AND RAIL BOUND MANGANESE FROGS WITH TOE AND HEEL RAIL END HARDENED
The purpose of this test was to determine the practicability and economy of end hardening for heat treating rail ends on frogs and switch points. The test

included four frogs and two complete switches with treated rail ends, and two frogs and complete switches without treatment for comparison. There was no apparent advantage to be gained by end hardening or heat treating rail ends. Results of this test indicate that joint batter is not a governing factor in determining need for renewal of frogs and switches. Pending further development the end hardening of frogs and switch rails is not recommended.

Code, CJ
Penn Central Transportation Company Test Rpt Test No. 559, Apr. 1959, 10 pp, 7 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1749)
DOTL RP

A2 040277
140-LB. RAILS TO FINE GRAIN STEEL (ALUMINUM ADDED TO THE INGOT)
The purpose of this test was to determine if inherently fine-grain steel will resist shelling better than rails of ordinary steel. Frequent inspections of the test installation were made, and it was observed that the fine-grain and ordinary rails performed nearly alike. In 18 months' time the flaking and head checks were much in evidence, and after two years of service, head checking and flaking were well advanced. A derailment in November 1956 damaged three of the fine-grain rails. A previous laboratory examination of the rails had revealed that the fine grain steel had practically the same mechanical properties as the coarse grain steel as measured by tensile tests and Brinnel hardness. It was concluded that fine grain steel produced by addition of aluminum to the ingot as used in this test, offers no advantage for use in rails.

Code, CJ
Penn Central Transportation Company Test Rpt Test No. 588, Dec. 1959, 9 pp, 2 Fig, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1750)
DOTL RP

A2 040278
DETERMINATION OF PLASTIC FLOW IN RAIL HEAD
The purpose of the test was to determine the amount of plastic flow which takes place in the gauge corner of a rail on the high side of a curve under conditions which produce shelling. The rails were laid on the Bolivar Curve. At this location the track was laid with 140-lb., 1948 rail, which in August 1953, was showing flaking and light shelling. This is a 4-degree curve with 4-inches superelevation, authorized speed 45-mph, and carries moderate to heavy eastward freight traffic. Records kept in connection with another test indicate a tonnage of approximately 29,000,000 gross tons annually. The three test rails were installed August 17, 1953. Inspection September 12, 1955, showed light flaking on all three rails. On the high rail of curves there is a flow of metal at the top gauge corner of the rail toward the gauge side. This flow of metal extends to a depth of 1/4-inch to 3/8-inch below the rail surface. The magnitude of deformation is positive evidence of shear stresses well beyond the yield point of the steel.

Code, CJ
Penn Central Transportation Company Test No. 591, Aug. 1971, 19 pp, 5 Fig, 1 Tab, 7 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1751)
DOTL RP

A2 040279
RAIL WEB STRESSES IN HIGH SPEED TERRITORY
The purpose of the present test was to determine if possible the cause of frequent split web failures in the joint on 131-lb. RE rail on the Fort Wayne Division, and in 152-lb. PS rail on the New York Division. Web failures in 131-lb. and 152-lb. rail on the Fort Wayne and New York Divisions are adequately explained by the corrosion fatigue theory. The ocassional bolt hole failures in 133, 140, and 155-lb. rail are not readily explained. A 50% allowance for impact is justifiable based on measured wheel loads. Application of reformed bars changes stress distribution in the rail web and in many cases increases web stresses, accelerating rail web failure. Loose bolts and increase in rail end gaps increase rail web stress. The results of this test emphasize the need for protection of rail steel against corrosion, for maintaining standard bolt tension, a good fit between bars and rail, and good surface through joints.

Code, CJ
Penn Central Transportation Company Test Rpt Test No. 597, June 1960, 6 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1752)
DOTL RP

A2 040280
AREA DESIGN OF RAIL BOUND MANGANESE FROG
For test purposes 4 AREA design #10 rail bound frogs were installed in main track in comparison with 3 PRR Standard rail bound frogs. At each of the three locations both types of frogs were placed in track having similar traffic conditions. A record of first cost, service performance and maintenance difficulties was kept for each location. It was concluded that the AREA design Rail Bound Frog will give longer service and be more economical than the PRR Standard Frog. Therefore it was recommended that the PRR Standard for Rail Bound Manganese Frogs be modified to include the basic AREA design at the heel of the frog which includes the 7" spread of the casting and the support and design of the heel rails.

Code, CJ
Penn Central Transportation Company Test Rpt Test No 600, Aug. 1956, 3 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1753)
DOTL RP

A2 040281
ALLOY STEEL RAIL (CHROME-VANADIUM OR "CV")
The CV rail was laid in October 1953, in connection with regular rail renewals. The location was selected because it was one where moderate shelling had developed in the previous 131-lb. rail over a period of about 11 years. A total of 47 CV rails were laid--16 on the low side and 31 on the high side of the curve. Measurements of gauge superelevation, ordinates and rail head wear were made. A final inspection of CV rail was made on October 29, 1959, at which time 30 CV rails remained in track. There was no indication of shelling, although, some flaking was noted on the CV rail, and there was no indication of rail and defects. The results of this test have shown the CV alloy steel of the composition used to be unreliable. Its good wearing qualities and superior resistance to shelling are over-shadowed by its poor resistance to impact.

Code, CJ
Penn Central Transportation Company Test Rpt Test No. 645, Jan. 1960, 23 pp, 3 Fig, 1 Tab, 15 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1754)
DOTL RP

A2 040282
FLAME HARDENED AND HEAT TREATED STOCK RAILS
Flame hardened and heat treated stock rails were installed at locations where the open hearth stock rail had shown short life due to excessive wear, primarily flange wear. Flame hardening and heat treating produced a Brinell hardness on the rail head of approximately 350. Both the flame hardened and heat treated stock rails gave better performance than the open hearth stock rail; however, the flame hardening process resulted in considerable vertical distortion of the stock rail, as much as five feet in 60-ft. As a result, this type of hardening was discontinued. While this test was installed initially to investigate the reduction in flange wear, the use of heat treated stock rails to date and the results of heat treated rails used for other purposes indicate that they provide greatly increased life and reduced maintenance as compared with ordinary stock rails where crushing and plastic flow cause frequent renewal.

Code, CJ
Penn Central Transportation Company Test Rpt Test No. 608, Apr. 1960, 10 pp, 1 Tab, 6 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1755)
DOTL RP

A2 040283
FLAME HARDENED VS HEAT TREATED AND MANGANESE CROSSINGS
The purpose of this test was to determine the relative value from a service point of view of flame hardened crossings, as compared with heat treated and

manganese crossings. Two flame hardened, one heat treated and one maganese crossings were installed on new timber supports in a two over two track crossings, making an angle of 71 degrees 38'. All crossings were interchangeable. These crossings were installed on May 2, 1953. On the September 8, 1954, inspection it was found that excessive batter on one of the flame hardened crossings made renewal necessary. Initial cost, maintenance required, as well as service life indicate a preference for the heat treated crossing over the flame hardened.

Code, CJ
Penn Central Transportation Company Test Rpt Test No. 613, Dec. 1957, 9 pp, 3 Fig, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1756)
DOTL RP

A2 040284
FOUR BOLTS VERSUS SIX BOLTS IN JOINT BARS FOR 155-LB., 140-LB., AND 133-LB. RAILS--JOINT BARS TO BE STANDARD LENGTH

Four different punchings of bars with compatible rail drillings were compared at three test locations. All the bars used were of standard length and design, the only difference being the hole location. The test was laid out in such a manner that measurements of batter and deflection of joints could be obtained on both tangent and curved track. The curve was 1 degree 52" in the portion of the 140-lb. test rail with AREA drilling, four hole special drilling, PRR standard drilling, and PRR standard with second hole from each end omitted was laid on tangent track only. There is no material difference in profile or in maintenance cost among the various combinations tested. The four hole bars tested will adequately fasten the rail, but the saving realized by elimination of two bolts would not be enough to justify the expense of the change of standard.

Code, CJ
Penn Central Transportation Company Test Rpt Test No. 614, June 1964, 12 pp, 6 Fig, 3 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1757)
DOTL RP

A2 040287
FIELD END HARDENING OF RAIL BY THE AIR REDUCTION CO. METHOD

Two and seven-tenths miles of 140-lb. PS rail, laid in No. 3 track were utilized for this test. End hardening rail in track was completed on June 18, 1953 in conjunction with the laying of new 140-lb. PS rail. A total of 279 joints were hardened at a cost of $0.39 per joint. The high temperatures necessary for the end hardening process had a damaging effect on the No-Ox-Id protective coating applied to the rail web in the joint area. The heat treatment caused an average increase in Brinell hardness of about 50 points. A visual inspection of the test stretch in 1959 confirmed previous observations that mill end hardened rail was more resistant to impact and had fewer battered joints than did either of the other two types. In view of the fact that mill end hardened rail is now available from all mills serving the Pennsylvania Railroad there is no advantage to be gained from end hardening new rail in the field, except as indicated above for cut ends in continuous welded rail.

Code, CJ
Penn Central Transportation Company Test Rpt Test No. 620, Feb. 1960, 22 pp, 11 Fig, 2 Tab, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1760)
DOTL RP

A2 040288
RUBBER TIE PADS UNDER CROSSING FROGS

The purpose of this test was to determine if rail abrasion pads applied between tie plates and crossing frogs and anchor seal pads applied between timber and tie plates in railroad crossings would result in reduction of noise, improved riding conditons, reduced maintenance, and increased life of frogs and timber foundations. The test locations are in heavy-tonnage tracks and in high speed territory. The frogs at Valparaiso developed considerable batter and tread wear after a very short period in track. Chipping and cracking of the castings was observed within six months. The pads were in long enough to determine that they did not have sufficient rigidity to withstand the large forces to which they were subjected. Both anchor seal and rail abrasion pads were deformed and torn. The crossings in both tracks at Orrville have given satisfactory service. There has been little difference in maintenance required for the crossings with and without pads. There was no significant reduction in noise to be realized from the use of pads. The use of tie pads will prevent tie plate penetration into crossing timbers.

Code, CJ
Penn Central Transportation Company Test Rpt Test No. 628, Apr. 1960

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1761)
DOTL RP

A2 040289
SWITCH POINT GUARDS

The test was begun with Bethlehem Steel Co. guards, but was later expanded to include guards manufactured by the Q. and C. Co. and American Brake Shoe Co. All three types of guards have been quite effective in reducing flange wear at the point of the switch rail. At each location, switch point life has been more than doubled. The Racor and Q. and C. types require some maintenance in that the bolts through the stock rail should be kept tight. Original cost and installation cost of the Bethlehem Steel Co. type is greater. Under certain conditions the wheels have a tendency to climb up the guarding face. In view of this climbing action these guards should be used only in yards or at slow speed locations. The switch point guards should not be used where L-6 and P-5 locomotives are operated.

Code, CJ
Penn Central Transportation Company Test Rpt Test No. 689, Aug. 1960, 11 pp, 3 Fig, 6 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1762)
DOTL RP

A2 040291
A.A.R.--DESIGNED INSULATING JOINT

The joint was built up from a new 115-lb. R.E. joint bar. A layer of neoprene rubber was vulcanized to the fishing surfaces of the bar and at the same time to a 1/16" sheet of steel previously formed to 132-lb. R.E. bar fishing surface contour. Two neoprene coated tie plates were used to support the joint on the ties. The test 132-lb. R.E. insulating joint was installed on July 2, 1959. An inspection of the joint on 7-9-59 showed that the joint bars were performing satisfactorily. The nut locks used with the bolts were obviously defective, since four of the six had failed. The neoprene was separating from the steel plates at the top of the end posts. The standard insulation test revealed no current leakage. Neither the scraping of the bolts nor the peeling of the neoprene should in any way affect the effective performance of the test joint.

Code, CJ
Penn Central Company Test Rpt Test No. 735, Oct. 1959, 5 pp, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1764)
DOTL RP

A2 040292
INVESTIGATION OF RAIL HEAD HARDNESS

Transverse rail head specimens were taken from three pieces of rail, 131-lb., 140-lb., and 155-lb. sections received for examination of failure. Hardness readings were taken from the running surface toward the interior of the rail head for a distance of approximately 1/2 inch. The hardness on the gauge side was usually maximum at 1/16 inch to 3/32 inch below the running surface, with slightly lower hardness between this point and the surface of the rail head. It is concluded that where rails have experienced sufficient traffic under heavy loads to develop approximately 1/8 inch head wear the hardened metal resulting from cold work extends 1/8" to 3/16" below the surface with a maximum hardness at a depth of 1/16" to 3/32". Rail grinding to a depth of .007" to .010" should cause no anxiety with respect to loss of surface hardness with such rails.

Code, CJ
Penn Central Transportation Company Test Rpt Test No. 745, Apr. 1960, 2 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1765)
DOTL RP

A2 040293
RAIL ANCHOR RESISTANCE IN TRACK
Six panels of track were tested at two locations. Resistance to rail anchors was developed by applying a longitudinal load to the end of each rail in a panel of track; this load was transmitted through rail anchors and ties to ballast. The load was applied by means of two hydraulic jacks and manually operated hydraulic pump. The panels at Lewistown having every tie anchored failed at a total load of 32,000 pounds while the panel having alternative ties anchored failed at 29,000 poinds. Panels at Parkersburg having every tie anchored failed at an average total load of 20,000 pounds while the panels having alternate ties anchored failed at an average total load of 18,000 pounds. Actual resistance to longitudinal movement, per panel, depends on type and quality of track structure.

Code, CJ
Penn Central Transportation Company Test Rpt Test No. 767, Oct. 1961, 17 pp, 3 Fig, 6 Tab, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1766)
DOTL RP

A2 040294
EFFECT ON RAIL OF KERSHAW TRACK LINER
Since this is the first track lining machine to operate on an impact principle, some question of doubt had been raised as to the possible effects of this impact on the rail under adverse conditions. As a practical test the machine was first used at a temperature of plus 30 degrees F. on curved yard track laid with 1903 100-lb. rail. It was used in attempting to line a yard track laid with 85-lb. rail with a rail temperature of plus 10 degrees F. an atmospheric temperature of approximately 0 degree F. In both cases the track was full of cinder ballast, frozen solid. Ties were spaced 23 inches apart and were in good condition. In the practical test the Mershaw Track Liner did not break or visibly kink either 85-lb. or 100-lb. rail under the very adverse conditions of the test. However, the track structure was weakened and track gauge spread 1/12 in. after five to eight impacts of the ram.

Code, CJ
Penn Central Transportation Company Test Rpt Test No. 774, Mar. 1962, 3 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1767)
DOTL RP

A2 040302
THERMITE WELDING PRACTICES OF RAIL IN THE UNITED STATES
The alumino-thermic welding method for joining the ribbons has become practical. Improved thermite welding methods have been introduced which produced rail joints meeting the quality of electic-flash butt-welded rail joints and oxyacetylene pressure butt welded rail joints. The alumino-thermic or thermite reaction is a strongly exothermic self-propagating reaction, where finely divided aluminum reacts with a metal oxide. A mixture of aluminum and iron oxide produces sufficient heat to weld steel, the filler metal being produced in the reaction. The reaction takes place at 5,000 F and produces a filler metal at 3,5000 F which, in entering the rail gap, welds and fuses the rail ends. This filler metal is pure iron with a low hardness, which has to be enriched with alloys and high carbon steel to produce a rail-quality filler metal.

Kannowski, KH (Illinois Central Railroad)
American Railway Engineering Association Vol. 69 1968, pp 914-916

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1783)
DOTL RP

A2 040315
WEAR LIFE OF HEAT TREATED 131 LB., 18 FT. SWITCHES
This brief letter correspondence records the fact that an in-service test of heat treated switches progressed to the point where the first switch was removed because of excessive wear after 27 months of service. This was considered about seven times the life of an ordinary switch. The cost of this 130 lb., 18', heat-treated switch was $161 which was thought to be the cost of untreated switches at the date of purchase.
Unpublished Correspondence.

Penn Central Transportation Company Test No. 129, July 1933, 1 p

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1718)
DOTL RP

A2 040338
JOINT BARS 152 LB F-3 AND 131 LB F-7 WITH VARIOUS RANGES OF UPWARD VERTICAL CAMBER
The purpose of these tests was to determine the effect with respect to service and maintenance labor of joint bars of various camber in heavy tonnage tracks. The test included application of bars with 4 ranges of camber in various joints applied in service at selected locations. Periodical measurements were made of joint deflection, rail end batter and out to out take up of joint bars; records of maintenance work and cracked or broken bars were obtained during a period of more than 3 years service. The best results require rails straight or with an upward sweep at the ends and bars of camber .030" to .060". It is recommended that if and when all mills produce rails with the desired end condition, the specification for joint bars be changed to provide for limits of .030" to .060" vertical camber.

Code, CJ
Penn Central Transportation Company Test No. 424, May 1949, 4 pp, 3 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1734)
DOTL RP

A2 040339
COMPUTERIZATION OF HIGH AND WIDE CLEARANCES
The clearance problem considered is limited to dimensional restrictions to movement. Weight distribution and axle-load restrictions are ignored. The operations of a typical railroad Clearance Bureau are outlined and the phases which would be simplified by the use of a computer are identified. Several photoelectric detector installations for measuring the clearance are photographed. The functions of the Mechanical and Engineering Departments regarding clearances are briefly described. The SCOPE car used to collect information for updating clearance records is shown and described. The flow chart of the digital computer program is illustrated.

Laden, HN (Chesapeake and Ohio Railway) *AREA Bulletin* Vol. 69 1968, pp 814-830, 1 Fig, 11 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1737)
DOTL RP

A2 040340
RAIL LAID WITHOUT EXPANSION ALLOWANCE VS. RAIL LAID WITH NORMAL EXPANSION ALLOWANCE
The purpose of this test is to determine by service test the practicability and advantages of laying end hardened rail without expansion allowance and with joints "frozen", as a means of reducing rail end impact and noise, and rail end batter. The design and laying of the test track is described. Walking inspections and observations of the test during the recording of field data have indicated superior surface and rail end condition of the tight rail as compared with the standard. Riding the Aero Train, which was noticeably noisy, showed a lower level of joint noise on the tight rail. The joints in the tight rail have lost less camber than those in the standard rail. During nine year's service it has been determined that rail laid without expansion offers reduction in joint bar wear and reduction in loss of joint camber as well as a better maintained track for equal expenditure.

Code, CJ
Penn Central Transportation Company Prog Rpt Test No. 510, June 1958, 9 pp, 1 Fig, 4 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1744)
DOTL RP

A2 040341
R.M.C. PLASTIC RAIL JOINT PACKING WITH VERMICULITE BASE
R.M.C. Plastic Rail Joints Packing is a cake composed of vermiculite impregnated with an asphalt oil and rust inhibitors. It is placed at the end rail behind the joint bar for the purpose of lubricating and protecting the joint. No-Ox-Id "A" is a rust inhibiting grease used for the same purpose. Comparison was made of these two substances by applying them to alternate 10 joint stretches. While the damage to rail ends by corrosion fatigue, which was found in so many cases with the original R.M.C. packing, does not seem

to be repeated with the Vermiculite packing, there is no evidence that the overall protection is superior to that given with No-Ox-Id "A". The protection to the rail end in most cases appears to be inferior. Since rail web failures have been reduced in new rail designs, and since there was a lack of apparent benefit from the use of packing, the use of packing was abandoned.

Code, CJ
Penn Central Transportation Company Test Rpt Sept. 1957, 3 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1745)
DOTL RP

A2 040342
78-FOOT RAIL VS 39-FOOT RAIL

The economies resulting from the use of 78-foot rail as compared with conventional 39-foot rail was studied. Test stretches were installed at three locations. Each location included one mile of track laid with 78-foot rail and one mile of track laid with 39-foot rail. Test results indicate that there has been a saving by the use of 78-foot rail. There should be an increase in savings credited to 78-foot rail when the need for reformed bars develops. Relatively larger joint gaps on the 78-foot rail as compared to the 39-foot rail have not as yet shown an appreciable effect on rail end batter or surfacing costs. End hardening of rail has apparently prevented excessive batter. The additional rail anchors applied to the test stretches in 1954, have been successful in preventing further accumulation of wide joint gaps in the 78-foot rail, and have also prevented welds from moving into tie plate areas.

Code, CJ
Penn Central Transportation Company Prog Rpt Test No. 552, Oct. 1961, 16 pp, 7 Fig, 2 Tab, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1746)
DOTL RP

A2 040343
REPAIR OF CAST MANGANESE GUARD RAILS BY ELECTRIC ARC PROCESS

The purpose of the test was to determine the economy and practicability of repairing worn or cracked cast manganese guard rails by building them up with electric arc welding. The 130-lb. P.S. guard rails were placed in "South Interlocking" at Altoona, Pa., in very severe service locations. The 131 R.E. guard rails were placed in a ladder track at the west end of Antis Yard, Altoona, Pa. After 2.5 years service, all guard rails have given satisfactory service at the locations they were applied. The 130 P.S. guard rails at "South Interlocking" are showing heavy wear, while the 131 R.E. at the west end at Antis Yard are showing relatively light wear and are in good condition. From the results of this test, it is concluded that the building up to worn cast manganese guard rails, by use of electric arc welding, is practical and economical.

Penn Central Transportation Company Test No. 556, Apr. 1954, 8 pp, 6 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1747)
DOTL RP

A2 040354
SUPER-ELEVATION OF CURVES

The purpose of this operation table is to provide a general practice reference to the speed for various degrees of curvature and superelevation.

Seaboard Coast Line Railway May 1971, 1 p, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1795)
DOTL RP

A2 040375
A COMPUTER STUDY OF DYNAMIC LOADS CAUSED BY VEHICLE-TRACK INTERACTION

Computer analyses of vehicle and track are producing enlightening results regarding actual dynamic loads and the manner in which various parameters of vehicle and track structure affect these loads. Using this information, it is possible to decide more intelligently how to alleviate the high wheel-rail stresses caused by today's unique traffic and track conditions. Possible solutions range from better track maintenance to different wheel rail geometries to changes in stiffness and damping of trucks and the track structure itself.

Meacham, HC Ahlbeck, DR (Battelle Memorial Institute) *ASME Journal of Engineering for Industry* Aug. 1969, pp 808-816, 12 Fig, 3 Tab, 3 Phot, 11 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1825)
DOTL RP

A2 040378
DYNAMIC MEASUREMENT OF RAIL PROFILE AND RELATED LOCOMOTIVE TRUCK MOTIONS

The profile of the railroad track on which a railway vehicle operates represents an input into the vehicle. This input is due to vertical and lateral rail irregularities and can cause dynamic loads that result in excessive damage or wear and tear on vehicle components and on the track itself. In order to study the dynamic operation of rail vehicles, it is necessary to know the profile of the track on which they operate. Since the unloaded profile of the rail can vary significantly from the loaded condition, it is the loaded-rail profile that must be known. This paper presents a method developed by the authors' company for the rapid measurement of the loaded-rail profile and includes some typical rail profiles and related truck motions resulting from these profiles. The instrumentation resulting from this work appears to have immediate application in day-to-day railroad operation and in high-speed rail transportation studies.

Contributed by the Railroad Division of the ASME for presentation at the 9th Joint ASME-IEEE Railroad Conference, San Francisco, California, May 4-6, 1966.

Spangler, EB Marta, HA (General Motors Corporation)
American Society of Mechanical Engineers Paper 66-RR-1, May 1966, 9 pp, 12 Fig, 3 Phot, 18 Ref, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1828)
DOTL RP

A2 040394
THE EFFECTS OF JUMBO (HEAVY AND HIGH CUBE) CARS ON THE M OF W EXPENSES

Studies research and field observations show that the heavier wheel loads imposed on the rail today cause higher rates of rail failures, severe flaking, spalling, pitting and shelling. Track geometry also deteriorates faster. The two remedies are stronger rail material and stiffer track. But these are quite costly and economically not always possible. Instead, it is more likely that the movement of heavy loads will be continued on the present track at the expense of higher maintenance costs. This paper presents estimates and approximations with regard to the magnitude of the penalty M of W departments must pay in the area of track maintenance as a result of operating jumbo cars.

Prepared for the AAR Accounting Division's 1970 Annual Meeting held in New Orleans, Louisiana, May 25-27.

Reiner, IA
Chesapeake and Ohio Railway, Baltimore and Ohio Railroad Conf Paper 70-105, May 1970, 18 pp, 3 Tab, 4 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1857)
DOTL RP

A2 040413
QUALITY OF RAILS AND MEANS OF GUARANTEEING IT--FALLING WEIGHT TESTS AND DEFINITION TESTS (1ST AND 2ND SERIES OF TESTS)

The main object of these tests--was to define and to standardize the conditions of use of the falling weight tests laid-down in UIC Leaflets 860-1-0 and 860-2-0, for the acceptance of rails of current quality and rails of nontreated steel of a quality resistant to wear. It was concluded that a falling weight test, irrespective of its type, is not representative of the fatigue behavior of rails in the track, but it was considered advisable to retain for the time being, such a test on complete pieces of rail, to make it possible to detect and eliminate brittle rails with a large degree of probable success and to maintain each rail production within a truly characteristic and correct scatter range.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Intrm Rpt. D45/RP 5/E, Apr. 1963, 35 pp, Figs., Apps.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1876)
PURCHASE FROM: UIC Repr. PC

DOTL RP

A2 040414
QUALITY OF RAILS AND MEANS OF GUARANTEEING IT--CONDITIONS OF USE FOR TECHNICAL SPECIFICATION UIC 860-1 CONCERNING: DIMENSIONAL TOLERANCES, FALLING WEIGHT TEST, TENSILS TEST-PIECE, DETECTION OF PIPING

The conditions of application of UIC Specification No. 860-1 were investigated relative to dimensional tolerance, falling weight test, tensile test piece, and detection of piping. Initially, rail tolerance measurements indicated that the majority of mill-produced rails were not acceptable, but if specified tolerances were strictly adhered to, it was felt the price of rail would increase greatly. Since users were reasonably satisfied with currently produced rail, the tolerance applicable to web thickness, inclination, and openings of the fishing angles were relaxed. When UIC Specification No 860-1 was initiated in 1954, it constituted the first step towards the standardization of the falling weight test. The Committee now offers a choice between two methods of carrying out the falling weight test; one method involves two successive blows applied to the test pieces rolled from a certain number of ingots, the other involves one blow and is applied to test pieces rolled from every ingot. Because of the nature of the steel used for wear-resisting rails, the corresponding UIC Specification 860-2 has been drafted to include a tensile test piece of 10 mm diameter. The Committee to propose the standardization of the 10 mm diameter test piece. One result of this decision is that the minimum elongation will have to be raised from 12 to 14% in the case of ordinary rails. This test has been found to be not very accurate and of limited interest, since in reality it only permitted the revelation of piping in the rail without offering the possibility of its true appreciation. The Committee therefore sought another test for inspection purposes which would reveal piping in an indisputable manner. After considerable research, they have decided on a test which consists of the examination of the polished slice of rail intended for the macrographic (sulpher print) test.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways D45/RP 2/E, Mar. 1962, 37 pp, Figs., Tabs., 34 App.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1877)
PURCHASE FROM: UIC Repr. PC

A2 040415
TECHNICAL AND ECONOMICAL STUDY OF TESTED TYPES OF CONCRETE SLEEPERS. BEHAVIOUR OF ORE TEST SECTIONS. (2ND OBSERVATION PERIOD 1965-1966). EFFECTS AND DERAILMENTS ON CONCRETE SLEEPERS

This report examines train derailments on concrete sleepered track. It is based on 40 derailment reports furnished by 8 European Administrations. It was that reinforced concrete sleepers have a certain degree of fragility and the damage observed in case of derailments, caused by the impact of derailed wheels, is generally considerable. It has, however, become apparent that the presence of concrete sleepers has never led to the derailment of axles, which would not have been derailed in the case of wooden sleepers. The repair involves more work than that in wooden-sleepered tracks and the resumption of the traffic at reduced speed often takes more time.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways D22/RP 4/E, Apr. 1968, 25 pp, 6 App.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1878)
PURCHASE FROM: UIC Repr. PC

DOTL RP

A2 040416
BEHAVIOUR OF THE METAL OF RAILS AND WHEELS IN THE CONTACT ZONE-RESIDUAL STRESSES IN THE RAIL (CONTINUED) STUDY OF THE WORK-HARDENED ZONE

This report contains the results of measurements taken to study the work-hardening caused by traffic, and more especially the changes in the residual stresses in the rails near the running tread which constitute an important factor in the study of rail fatigue phenomena. About 5 mm below the surface the work-hardening is very large, and the rail is the center of a hydrostatic pressure zone extending down to a depth of approximately 10 mm, this then changing into a tensile one with a maximum at about 15 mm. This may explain why the fatigue cracks (of the kidney-shaped flaw type) tend to originate at a depth of 10 to 20 mm but do not develop in the upper highly compressed zone. Furthermore, the residual-stress fields vary from one section of the rail to another, probably as a result of the oscillations of the wheel-loads due to short-wave rail corrugations.

Question C53 Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Report No. 6, Oct. 1970, 58 pp, 36 Fig

DOTL RP

A2 040417
BEHAVIOUR OF THE STEEL AT THE POINT OF RAIL-WHEEL CONTACT- INTRODUCTORY STUDY ON THE CAUSES OF SHELLING CRACKS IN RAILS

This report reviews pertinent literature on the subject of shelling cracks in rail head. From the research conducted at the University of Illinois it is concluded that shelling cracks in rail heads are primarily due to fatigue under repeated rolling action. Obvious methods of reducing the development of shelling cracks would be to reduce wheel loads on the rails, to use larger diameter wheels or to use stronger rail steels. Future research should be directed towards the closing of the gap between standard fatigue data and the fatigue phenomenon as it occurs under contact stresses due to rolling action. At the moment, the prime difficulty in correlating tensile or torsion and rolling contact fatigue data stems from insufficient knowledge of stress distributions modified with respect to elastic theory by plastic deformation.

Question C53. Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Document No. 1, Oct. 1961, 10 pp, 9 Ref

DOTL RP

A2 040418
PROBLEMS OF INTERACTION OF VEHICLES AND TRACK--WORN PROFILES OF RAIL HEADS AND WHEEL TYRES

As a result of a large number of tests it has been proved that service wear on wheel tires and rail heads leads to definite profiles. These worn profiles are to a large degree independent of the initial profiles of tires and rail heads. In the worn condition the profiles maintain their form and are not subject to any further change. The worn profiles are characterized by good mutual conformity and thus by little increase in wear. The worn profile of tires results in a shortening of the wave length of the periodical wheel set motions (hunting) in the track clearance. It was concluded that to wear new profiles of rail heads and tires should be adapted as much as possible to the worn profile. The use of special wheel tire profiles promise no lasting influence on the riding quality of vehicles. Therefore other design measures on the vehicles should be preferred to control the hunting motion.

Question C9 Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Interim Report No. 6, Oct. 1962, 2 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1881)

DOTL RP

A2 040422
SERVICE AND DETECTED FAILURES OF BUTT-WELDED RAIL JOINTS

During the period 14 service and detected failures of butt-welded rail joints were submitted for examination to the AAR Research Center. Macrographic and Microscopic examinations of the welds and of both rails adjacent to the joint were made. Since the majority of the butt welding rail in the United States is done by means of the electric flash process, the failures reported in Table 1 are predominantly in the welds produced by this process. Because of the thermal shock produced by this process in the relatively short heated portions at the ends of the rail, failures occur in rails with heavy segregation or fish tail which, before welding were in a homogeneous state, but opened into a discontinuity during the welding.

American Railway Engineering Association Vol. 66 Bulletin 591, Feb. 1965, pp 509-513, 3 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1887)
DOTL RP

A2 040425
INVESTIGATION OF SERVICE AND DETECTED BUTT-WELDED RAIL JOINT FAILURES
In the period between October 1, 1965, and October 1, 1966, sixteen failures, service and detected, in butt-welded rail joints were submitted to the Association of American Railroads Research Center for a metallurgical examination. To date, the investigation has been completed on 9 of these 16 failures, in two oxyacetylene pressure butt weld: It is believed that a result of improper welding practice. Failure in an electric-flash butt weld was attributed to the presence of an electrode burn introduced during the welding process. In other electric-flash butt welds it was disclosed that the rail ends were cropped with a petrogen torch and that the time between cutting and welding ranged from a few days to several weeks. This time lapse is of concern because of the incipient cracks that may form and further develop on subsequent heating operations. A second possible cause for these failures is that the amount of rail cropped from the ends of these secondhand rails was insufficient to remove existing bolt-hole cracks that extend back into the web. In still other electric-flash butt welds, heavy segregation patterns were found.

AREA Bulletin Vol. 68 Bulletin 605, Feb. 1967, pp 372-383, 18 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1890)
DOTL RP

A2 040426
ROLLING-LOAD AND SLOW-BEND TEST RESULTS OF BUTT-WELDED RAIL JOINTS
In the period from October 1, 1965, to October 1,1966, sixteen rolling load tests and six slow bend tests were conducted on butt-welded rail joints at the Association of American Railroads Research Center. The joints were made by the thermite (Thermex Metallurgical, Exomet and Orgotherm), submerged-arc and oxyacetylene pressure-butt-welding process. The rolling-load tests were made on a 12-in-stroke rolling-load machine. Welded specimens were tested for various reasons including: (1) to determine the quality of the submerged-arc-welded rail joints, (2) to evaluate 115-lb thermite welded rail joints made by the Exomet process, (3) to determine the seriousness of making butt welds from rails with hairline cracks of (pipe) in the web. (4) to investigate the possible detrimental effects of a collar that was not removed from an Orgotherm thermite welded rail joint. The slow bend tests were made with the rail resting on supports 4 ft. apart and loaded at 2 points, one on each side of and 6 in. from the weld. These tests were made with the rail base down, thereby subjecting the head to a compressive stress and the base to a tension stress. For satisfactory service performance a minimum of 1.5 in. of deflection and 140,000 psi modulus of rupture are being used as tentative criteria for oxyacetylene and electric-flash pressure butt welds. A summary of the slow bend test results is provided.

AREA Bulletin Vol. 68 Bulletin 605, Feb. 1967, pp 383-396, 16 Fig, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1891)
DOTL RP

A2 040427
BUTT WELD FAILURES
A record of failures in various types of butt-welded rail is presented and briefly analyzed. On the basis of failures per 100 weld years, the failure rates for the oxyacetylene pressure butt welds and electric flash pressure butt welds are low, and about the same, for new rail. It should be noted, however, that the average service period of the oxyacetylene pressure butt welds is 68 percent longer than that of the electric-flash pressure butt welds. For relay rail, the performance of the oxyacetylene pressure weld is somewhat better than that of the electric-flash pressure weld. The failure rate in thermite welds is substantially higher than that for either of the two pressure processes.

AREA Bulletin Vol. 68 Bulletin 605, Feb. 1967, p 397, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1892)
DOTL RP

A2 040429
EVALUATION OF LINDE'S EXPERIMENTAL 936-89 WIRE FOR BATTERED RAIL END BUILD UP USE
An investigation to evaluate Linde's experimental 936-89 cored wire for rail end build up was conducted based on rolling-load test results, hardness survey results and a metallurgical examination to determine the quality of the weld. Information supplied by Linde relating to the welding procedure indicates that prior to welding, all joints were preheated to 700 F. A Tempil stick was used to determine the preheat temperature. Immediately following the preheat the joints were welded using 425 amperes, 27 volts. Sample rail joint were resurfaced at the butt edge to bring the deposit closer to the edge. These welded, battered rail end sample joints were subjected to rolling-load testing in the 12-in-stroke rolling-load machine. Testing of one sample was discontinued after the joint had been subjected to 4,002,200 cycles in the rolling-load machine because of excessive batter. Testing specimen 154 C was subjected to 2,000,000 cycles in the rolling-load machine. This test was discontinued because of a failure, originally starting as a progressive-type failure from a bolt hole, and later resulting in a head and web separation when the bolts were tightened to a desired tension. Speciments cut from joint 154 A show a normal heat pattern and good weld-metal deposit penetration. A good weld-metal deposit penetration was noted.

AREA Bulletin Vol. 68 Bulletin 605, Feb. 1967, pp 437-452, 16 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1894)
DOTL RP

A2 040430
INVESTIGATION OF INSULATED RAIL JOINTS
A comprehensive investigation was undertaken to determine the most appropriate and significant laboratory testing procedure for evaluating the merits of insulated rail joints. The investigation decided upon consisted of three phases. First, a new 3M plastic insulated joint for 136 RE rail was instrumented with strain gages to measure the flexural strains developed in the top and bottom of the two bars at midlength and 6 in each way from midlength. Since the strain would be zero at the bar ends, this gave five points along the length of the bar to establish the shape of the bending moment curve. These bars were then placed in main-line track on the Santa Fe. and measurements were taken of joint bar flexural strains developed under a number of passing trains, including passenger and freight. In the second phase of the investigation, another pair of the same type of 3M plastic joint was similarly instrumented with strain gages and placed in a rolling-load machine in the laboratory. Increments of loading were applied, and it was found that a wheel load of 15,000 lb. gave the same range of flexural strain in the bars at midlength as the maximum range measured in the track installation. The third phase of the investigation is a laboratory study with the objective of determining the effectiveness of different designs of insulated joint to support the rail ends and minimize joint tie tamping requirements. It would be expected that the more flexible the insulated joint, the more load would be thrown on to the supporting ties and more frequent tamping would be required. Accordingly, two lengths of 132 RE rail, each 10 ft long were supported in a special laboratory setup under a hydraulic loading machine on 11 ties plates spaced 20 apart. Two load cells were placed between the rail base and each tie plate to measure each tie reaction. Results were not avilable at the time of this publications.

AREA Bulletin Vol. 68 Bulletin 605, Feb. 1967, pp 458-460

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1895)
DOTL RP

A2 040434
RAILROAD VEGETATION CONTROL A. TERMINOLOGY
This article covers reasons for controlling vegetation, methods employed, uncontrollable factors which affect results and railroad related factors in vegetation control. Methods are described for controlling weeds, grasses and brush. Some of the uncontrollable factors that affect the results of vegetation-control programs include: soil type, species of vegetation, rainfall, temperature, and sunlight. Railroad related factors include the kind and condition of track, financial commitment, degree of control desired, and company policies.

AREA Bulletin Vol. 68 Bulletin 605, Feb. 1967, pp 514-521

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1899)
DOTL RP

A2 040435
BEHAVIOR OF THE METALS OF RAILS AND WHEELS IN THE CONTACT ZONE--THREE-DIMENSIONAL PHOTO-ELASTIC STUDY OF A LOADED BUT NON-BENT RAIL
The mathematical and modeling studies are being conducted to determine the stresses produced by the strains applied to rails and wheels. The early results of these simulation tests are presented.

Partial Copy-summary only. Question C53 Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Interim Report No. 2, Oct. 1965, 2 pp, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1901)
DOTL RP

A2 040436
BEHAVIOUR OF THE METAL OF THE RAILS AND WHEELS IN THE CONTACT ZONE--ENQUIRY INTO THE PROBLEM OF SMALL DIAMETER WHEELS APPENDIX 3
The observations made at the Mairy mine concerning the wheel-rail dynamics are discussed. The width of the rolling band is wider than on the SNCF and can be explained by wear of the wheel and rail. It could also be due to transverse elastic deformation of the wheel. The calculations and measurements are summarized which were carried out in the laboratory of the SNCF to investigate the influence of the load, the curvature of the rail and the tire, and more particularly of wheel diameter on the stresses to which these components are subjected.

Partial Copy--Appendix Only-Summary of Report Abstracted Separately, Question C53. Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Interim Report No. 3, Oct. 1966, 11 pp, 5 Fig
RESPONSIBLE INDIVIDUAL:

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1902)
DOTL RP

A2 040437
BEHAVIOUR OF THE METAL OF THE RAILS AND WHEELS IN THE CONTACT ZONE--ENQUIRY INTO THE PROBLEM OF SMALL DIAMETER WHEELS
This report summarizes the responses to an enquiry into the effect that a reduction in the diameter of wheels would have on the behavior in service of the rails and wheels. Information was collected on the subject of P/D ratios (P = load per wheel in tons, D = diameter in meters) and includes an analysis of tests carried out by the U.S., Russia, Germany, the British and the French. Very different values of P/D were found, depending on the railway and especially on the type of steel in the rails.

Partial Copy--Appendix 3 Abstracted Separately, Question C53. Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Interim Report No. 3, Oct. 1966, 6 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1903)
DOTL RP

A2 040438
BEHAVIOUR OF THE METAL OF THE RAILS UNDER THE REPEATED ACTION OF THE WHEELS--RESIDUAL LONGITUDINAL STRESSES IN THE RAIL (PART 1)
The residual stresses result: from heat effects during the cooling of the rail after it leaves the rolling mill; from trimming, after rolling in the vertical and horizontal directions; and, from the cold rolling of the top surface of the rail by the passage of loads. The object of this report is: to lay down a method for the determination of residual stresses, and to supply the results obtained by applying such a method in some special cases.

Partial Copy, Question C53. Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Interim Report No. 4, Oct. 1966, 11 pp, 6 Fig, 8 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1904)
DOTL RP

A2 040456
INVESTIGATION OF SERVICE AND DETECTED BUTT WELDED RAIL JOINT FAILURES
Eight service failures and three detected failures in butt welded rail joints were investigated by the AAR between October 1967 and September 1968. A summary is given of the causes of failure, type of weld, size of rail, date of rolling, and the fabricator. Photographs of the rails at the point of failure are shown.

AREA Bulletin Vol. 70 No. 619, Feb. 1969, pp 681-698, 1 Tab, 25 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1922)
DOTL RP

A2 040457
RESULTS OF ROLLING-LOAD TESTS OF BUTT WELDED RAIL JOINTS
Between October 1, 1967 and September 30, 1968 fifteen butt welded rail joints were tested on the rolling-load machines at the AAR. The rails were tested to a maximum of 2,000,000 cycles, or to failure, of repeated loading. The rolling-load tests are tabulated. For the failed rails the damage points are shown.

AREA Bulletin Vol. 70 No. 619, Feb. 1969, pp 699-711, 1 Fig, 1 Tab, 10 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1923)
DOTL RP

A2 040458
BUTT WELD FAILURES
A summary of the butt weld failures accumulated up to December 1967 is tabulated. On the basis of failures per 100 weld years, the failure rate for the oxyacetylene pressure butt welds is slightly higher than for the electric flash pressure butt welds for new rail (0.0072 to 0.0046). The average service period of the oxyacetylene pressure butt welds is 48 percent longer than that of the electric flash pressure butt weld. For relay rail, the performance of the electric flash pressure weld is somewhat better than that of the oxyacetylene pressure weld.

AREA Bulletin Vol. 70 No. 619, Feb. 1969, p 712, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1924)
DOTL RP

A2 040462
INVESTIGATION OF SERVICE AND DETECTED BUTT-WELDED RAIL JOINT FAILURES
The results of the investigation of five butt-welded rail joints of the seven failures reported from October 1964 to October 1965 are discussed. Three of the five failures were service failures and the other two were detected failures. Photographs of the damaged rails are shown.

AREA Bulletin Vol. 67 No. 598, Feb. 1966, pp 423-428, 1 Tab, 6 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1928)
DOTL RP

A2 040463
BUTT-WELD-FAILURE STATISTICS
Failure statistics are shown from 1962 to December 1963 and to December 1964. The failure rate in thermit welds is substantially higher than for either oxyacetylene or flash-pressure butt welded rail.

AREA Bulletin Vol. 67 No. 598, Feb. 1966, pp 436-437, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1929)
DOTL RP

A2 040466
INSULATED RAIL JOINT DEVELOPMENT AND RESEARCH--THIRD PROGRESS REPORT
The results of rolling-load tests on 15 AAR-Veelcaboned joints are given. Two 132-lb joints completed the 2,000,000 cycles without failure. One permali insulated joint was tested, but failed after only 600 cycles. Results are tabulated.

AREA Bulletin Vol. 67 No. 598, Feb. 1966, pp 478-482, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1932)
DOTL RP

A2 040467
RAIL CROPPING USING THE OXYGEN-GASOLINE (PETROGEN) CUTTING TORCH

Hardness checks of the cropped area revealed excess cementite and a hardened heat-affected zone. This method of cropping rail for oxyacetylene pressure butt welding is not recommended unless the cementite and heat-affected area is removed by other means. Because of the large quantity of metal removed (washed-out) during the electric-flash butt-welding process, cropping by an oxygen-gaoline torch may be acceptable, but if cementite becomes entrapped in the weld interface during the welding process, a weld failure may result. If cementite becomes entrapped in a weld produced by a thermite welding process, it will act as a stress raiser which promotes fatigue failure. In rail torch-cut for application of joint bars, the presence of cementite on the rail faces may promote head and web separations.

AREA Bulletin Vol. 67 No. 598, Feb. 1966, pp 483-489, 2 Tab, 9 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1933)
DOTL RP

A2 040468
RAIL CROPPING BY THE WET ABRASIVE CUTTING METHOD USING A 26-IN. N.C.G. NO. 310 CUT-OFF WHEEL

Photomicrographs reveal the depths of transformed (untempered martensite) metal to vary from 0.017 to 0.024 inches for the three rails which were cropped by the wet abrasive cutting method. This layer would wash out during electric-flash butt welding. Tests will need to be performed to determine the effect of this layer on rails welded by oxyacetylene welding.

AREA Bulletin Vol. 67 No. 598, Feb. 1966, pp 489-492, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1934)
DOTL RP

A2 040470
SLOPE PROTECTION

Slope protection by diverting or controlling surface drainage, by vegetation, surface blanketing and slide detector fences is discussed. Various suitable seeds and rates of application are tabulated for ground covers. Detector fences are particularly valuable where falling rocks, snow and ice hazards are present.

AREA Bulletin Vol. 67 No. 598, Feb. 1966, pp 529-532, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1936)
DOTL RP

A2 040471
INVESTIGATION OF SERVICE AND DETECTED BUTT WELDED RAIL JOINT FAILURES

In the period between October 1, 1966, and October 1, 1967, there were seven service and no detected failures in butt welded rail joints investigated by the metallurgical laboratory of the AAR. A summary of these service failures is tabulated. Investigation 136-22 involved an electric flash butt welded joint that failed in service. The rails used in the fabrication of this joint were 112-lb RE sections rolled July 1942. This failure could be attributed to an entrapment introduced during the welding process. Investigation 136-25 involved a rail, part of a continuous welded string, that failed in service. This rail was identified as a 140-lb PS section rolled in 1959. This failure can be attributed to these electrode burns which were introduced during the welding process. Investigation 136-27A, B, and C involved three electric flash butt welded joints that failed in service. The rails used in the fabrication of these joints were 132-lb RE sections rolled in August 1965. These electric flash butt weld failures can be attributed to pipe and heavy segregration. Investigation 136-31 involved an Orgotherm thermite welded rail joint that failed in service. The rails used in the fabrication of this joint were 115-lb RE sections rolled in June 1966. This failure could be attributed to the presence of a martensite formation that resulted from a heavy grinding of the thermite weld collar after the weld metal had cooled. Investigation 136-34 involved an electric flash butt welded joint that failed in service. The rails used in the fabrication of this joint were 136-lb RE sections rolled in 1967. This failure could be attributed to the presence of this cementite.

AREA Bulletin Vol. 69 Bulletin 612, Feb. 1968, pp 574-588, 23 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1937)
DOTL RP

A2 040472
RESULTS OF ROLLING-LOAD AND SLOW-BEND TESTS OF BUTT WELDED RAIL JOINTS

In the period between October 1, 1966 and October 1, 1967, 22 rolling-load tests were conducted on butt welded rail joints but no slow-bend tests were conducted. These butt welded rail joints were made by the oxyacetylene and electric flash butt welding process. The rolling-load tests were made on a 12-in-stroke rolling-load machine. Investigation 214 (samples A through F) was conducted to determine the seriousness of hairline cracks (segregation and pipe) on oxyacetylene pressure butt weld quality. Five of the six joints with stood 2,000,000 cycles of repeated loadings without failure, which is considered a run-out, and one joint (214E) failed after 897,100 cycles. A macroscopic examination made on transverse sections cut from the end of each rail prior to welding indicates that this failure originated from a fishtail. Investigation 220 (samples A through F) is a continuation of the problem presented in investigation 214 but was conducted to determine the effects of hairline cracks on joints from rails of heavier sections. It was found that fatigue of the failed specimens originated in the fillet between the head and web and can be attributed to a shear drag introduced while removing the weld upset. Investigation 226 (samples A and B) was conducted to evaluate two electric flash butt welded joints from which the upset metal had been ground from the top and sides of the head and bottom and sides of the base but not removed from the web. An examination of the fracture surface to determine the fracture mechanics indicates that this failure originated in the fillets between the web and upset metal. Investigation 230 (samples A and B) was conduced to evaluate oxyacetylene pressure butt welded joints made with a new type of welding head. Joint 230A failed after 33,500 cycles of repeated loading and joint 230B withstood the 2,000,000 cycle minimum requirement without failure. This failure can be attributed to the lack of fusion at the weld interface.

AREA Bulletin Vol. 69 Bulletin 612, Feb. 1968, pp 589-597, 11 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1938)
DOTL RP

A2 040473
PROGRESS REPORT ON ANCHORAGE OF CONTINUOUS WELDED RAIL

Measurements were made on a test installation for the study of rail anchorage for continuous welded rail. The purpose was to obtain data on (1) the effect of train movements on rail anchorage forces (static before and after) and (2) the relation between rail anchorage force and tie movement. This installation was on tangent track with 115 RE continuous welded rail. All weight bars were loosened for the first train to obtain zero readings and a 100-lb force was applied to eastbound anchors (anchors to restrain easterly rail movement). All westbound anchors had the bolts adjusted to just be in contact. The joint gap and rail temperature were measured periodically. Also, the rail position lengthwise of the track was measured at each of 7 test locations. These measurements were then repeated after each of four trains had passed to show the change that had been effected by the train passage. Tests were also made to determine the resistance or force required to move the ties in the ballast. Specific results from the various tests are presented in several tables. Truck housing dynamic recording equipment was driven to the test site and information was recorded under all trains during a two-day period. The recording equipment consisted of 12-carrier amplifiers and a direct writing oscillograph. Ten channels recorded the longitudinal rail forces exerted through rail anchors to the weigh bars on the ties. The remaining two channels, connected to extensometers, were used to measure the longitudinal movement of the rail and tie with respect to the reference pipe.

AREA Bulletin Vol. 69 Bulletin 612, Feb. 1968, pp 600-617, 16 Fig, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1939)
DOTL RP

A2 040479
RAILWAY SNOWFIGHTING

Pushplows used in England, the United States, Canada and Sweden are described and illustrated. Rotary plows are described, such as the Les-

lie-type used in the U.S. and Europe, and types using other principles including the Bros Sno-Flyr (American), the Sicard Blower (Canadian), the Rolba Rotary Plough (Swiss), the Schmidt-Wyhlen Plough (German) and the Kisha Seizo Kaisha Plough (Japanese). Miscellaneous types of equipment include jet-engined blowers, snow melters, gas, infrared and electric point and switch heaters, and snow fences.

Parkes, GR *Institution of Locomotive Engineers Journal* Vol. 55 No. 307, Part 5, pp 415-478, 1 Fig, 27 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1953)

A2 040511
REPEATED SHOCK TEST OF RAILWAY TRACK
By means of a repeated shock tester for track, the dynamic properties are studied of the test track. Test tracks were selected one on a wooden tie section and the other on a concrete tie section. There were laid 50 kg PS rails, wooden ties without tie-plates or pre-stressed concrete ties with a spacing of 60 cm. Ballast was crushed stone with a depth of 25 cm and a shoulder width of 35 cm. Before every test the ballast was tamped. To know the pressure on rails, bending stress was measured. Displacement of rail depression was calculated on the data of measurements by the velocity vibrometer. Dynamic force upon rails was calculated on the data of rail bending stress. This force exceeds the centrifugal force under 1400 to 1900 rpm and this is considered to be caused through resonance.

Satoh, Y Hirata, G *Railway Technical Research Institute* Vol. 4 No. 2, June 1963, pp 42-45, 6 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2017)
DOTL RP

A2 040519
TRACK TOOLS
This committee is making a study of the following subjects: Snap-on Ratchet Track Wrench. The committee suggested that it be designed as a double-end socket wrench having a thin-wall socket with a single-action ratchet in one direction. The ratchet should be fitted around the center of the double-end socket where the handle will engage it. There have been a number of failures of aluminum track jacks. Therefore, a canvass is being conducted. From the data received, a study will be made to determine necessary changes in design, metallurgy, specifications, etc., to correct the situation. An investigation will be made on the use of lightweight metals for the AREA track level and gauge. Wear limit of striking and cutting tools. A study will be made on the economy of reclaiming tools that have worn down to the specified wear limit.

Peterson, CE *AREA Bulletin* Vol. 64 No. 577, Feb. 1963, p 432

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1946)
DOTL RP

A2 040520
STANDARDIZATION OF TRACKWORK PLANS
This committee submits the following report of progress in connection with the standardization of trackwork plans. Plans for five new standard turnouts were submitted and approved for recommended practice. Also published and issued for inclusion in the Manual were the various other AREA plans incorporating revisions in switch details. A study was made of the method used in calculating the recommended maximum speeds of trains through level turnouts. The AAR research staff made a study as a result of this investigation on standardization of turnouts. The formula developed by them used the angle of impingement at the point of switch, and an experimentally determined maximum lateral acceleration for comfortable riding, to develop the permissible speed through the switch. Speeds calculated by this method were compared to the recommended speeds now in the Manual and were found to be similar. Revision of a plan covering swtich stands was recommended.

McCowauthy, CJ *AREA Bulletin* Vol. 64 No. 577, Feb. 1963, pp 433-434, 2 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1947)
DOTL RP

A2 040521
DESIGN OF TIE PLATES
This is a final report, on the service test in which seven designs of tie plates for the rail base of 6 in. were subjected to 379 million gross tons of traffic. The test results indicate good uniformity in plate cutting under the 14-in. and 14 3/4-in. plates on the inner rail of the 6-deg curve, but that the 14 3/4-in. plates with 1/2-in. eccentricity had the best performance on the outer rail. The 13-in. plates have performed reasonably well and should be adequate, particularly under medium traffic or with 5 1/2-in. base rail. The 12-in. plate is indicated to be inferior for heavy traffic, particularly on the curve and tangent with softwood ties.

Pelton, LA *AREA Bulletin* Vol. 64 No. 577, Feb. 1963, pp 434-440, 2 Fig, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1948)
DOTL RP

A2 040522
INVESTIGATION OF FAILURES OF WELDED RAILS
Six failed welds were sent to this laboratory for evaluation. One electric-flash butt weld failed after about two years in service because of a fatigue fracture starting at near midheight of the rail web at a small ball of the molted sparks which ordinarily fly away as the rails are being heated but which in this case became trapped in the weld. Another electric-flash butt weld had also been in service about two years when it failed because of a fatigue fracture starting in the rail web about 3/4 in above the rail base. These two failures can be attributed to a combination of three circumstances: High tensile stresses due to cold weather. Stress concentration at the small imperfections in the welds. Stress concentration due to the flash under the rail bases. Four additional failures are described. Eleven bend test results are reported.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 64 No. 577, Feb. 1963, pp 451-459, 2 Tab, 8 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1949)
DOTL RP

A2 040542
THE PROBLEMS OF HIGH SPEED TRANSPORT ON FRENCH RAILROADS
Speed increases to 125 miles/hour has had hardly any influence on the cost price per kilometre of the locomotive-coach-track ensemble. Design features for trucks to permit the speed increase are discussed. High-speed adhesion test results are shown, indicating where slipping begins. High speed requires great power The amount of this power varies, for a given speed with the geometrical dimesnions of the train. As the length of the train plays an important part, it is preferable that the whole length should be available to passengers. Current collection test results are shown as a function of speed.

Nuvion, F (French National Railways) *Railway Division Journal* Vol. 1 Part 5, 1970, pp 595-615, 17 Fig, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2002)
DOTL RP

A2 040544
IMPRESSIONS ON THE NEW TOKAIKO LINE, JAPANESE NATIONAL RAILWAYS, BASED ON A RECENT VISIT TO JAPAN
The trains are made up of 12 coaches, but can be expanded to 15 to 16 as demand increases. The track is designed for high speed running. Track centers are widened to lessen the air impact effects as trains pass. Gradients are limited to 1.5 percent, minimum radius of curved track is 220 years, and maximum cant is 7.08 inches. Welded rail is padded by rubber and fastened to concrete cross ties with spring clips. Signals controlling train speed and operation are transmitted from a Central Train Control Office to the cab. Train brakes and speed are automatically controlled to eliminate collisions. The driver can assume control to counteract adverse environmental conditions. Revenues are described.

Burley, W *Institution of Locomotive Engineers Journal* Vol. 54 No. 302, Part 6, pp 585-595, 1 Fig, 7 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2004)
DOTL RP

A2 040556
EXPERIMENTS ON THE SETTING OF RAILWAY BALLAST UNDER REPETITION OF LOAD
Four types of ballast were laid a top 30 cm layer entirely composed of standard crushed stone; upper 20 cm composed of crushed stone and lower

10 cm of standard screened gravel; upper 10 cm of crushed stone and lower 20 cm of screened gravel; and 30 cm entirely composed of screened gravel. Comparison between the Grade 1 crushed stone with size distribution as produced and the one with size distribution modified by screening to 30 to 50 mm indicated that the setting rate of the ballast composed of the latter was 21% slower than that of the one of the former. Comparison between the wooden and the concrete ties used in the experiment with reference to both types of ballast revealed that the ballast setting under concrete ties was 50% less than under wooden ones. A ballast of screened gravel with coarse sand fillings was compared with the one of the same material minus sand. It was found that the setting rate of the former was very much slower than that of the latter; it means that good stability will be gained if the cavities are well filled.

Sato, Y *Railway Technical Research Institute* Vol. 1 No. 3, Sept. 1960, p 75

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2019)
DOTL RP

A2 040557
LATERAL BALLAST RESISTANCE AND STABILITY OF TRACK IN EARTHQUAKE
The behavior of the railway track in earthquake was studied through experiment and theoretical analysis. The experiment was performed with real tracks in the RC-box placed on the vibrational table of 5 times 5 sq m in dimensions. The conclusions are as follows: against the earthquake acceleration with which railway structures are designed, 83% of the static lateral ballast resistance of track is maintained in the track on the Shin Kansen and 78% in the track with PC-ties and crushed stone ballast on the narrow gauge lines. The long weld rail track holds the safety factor at least 1.15 for the buckling due to temperature rise in the earthquake with the same acceleration mentioned above.

Sato, Y *Railway Technical Research Institute* Vol. 11 No. 1, Mar. 1970, pp 3-6, 3 Fig, 4 Tab, 1 Phot, 3 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2020)
DOTL RP

A2 040559
TRACK STRUCTURE FOR HIGH SPEED RUNNING
Numerous experiments on gradual growth of track irregularities show that the vibration with very large acceleration of the track, which occurs by the shock of running wheels, brings an extreme reduction of load bearing power of the ballast, and that the ballast surface suffers settlement under train loads. The amount of ballast settlement is proportional to the load, the number of repetition and the acceleration of ballast vibration, and the acceleration increases proportionally to the train speed. By using 70 kg rails, with sleepers wider by 20% than the present ones and rubber pads having one half of the present coefficient of spring; the track destruction caused by the same train load becomes 35% of that of the present standard track. By decreasing spring coefficient of one. The method of fastening a rail elastically to a vibration becomes as small as 40% of that of the present one. The method of fastening a real elastically to a sleeper using rubber pads and metallic springs has already been standard for a concrete sleeper, but as the action of load at the portion of fastening was not hitherto known well, the design should be regarded as rather empirical.

Hoshino, Y *Railway Technical Research Institute* Apr. 1960, pp 37-46, 6 Fig, 1 Tab, 6 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2022)
DOTL RP

A2 040567
PHYSICAL TESTS OF NORMALIZED AND NOT-NORMALIZED OXYACETYLENE PRESSURE-BUTT-WELDED 115 RE RAIL
The welds were made using three 39-ft rails, according to the normal procedure with the exception of not normalizing eight of the welds. The rolling-load tests were made using 48,000-lb and 60,000-lb wheel loads. The data indicate that all the failures produced in the rolling-load tests were from causes other than the effects of normalizing or not normalizing. The slow bend test of two normalized and two not-normalized oxyacetylene pressure butt-welded rails made. The results indicate a trend toward greater load, energy absorption and deflection in favor of the not-normalized tests. The drop tests of two normalized and two not-normalized oxyacetylene pressure but-welded rails were conducted. Again no significant difference can be found in the data for the normalized compared with the not-normalized welds.

AREA Bulletin Vol. 61 No. 556, Feb. 1960, pp 905-914, 2 Fig, 4 Tab, 13 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2046)
DOTL RP

A2 040568
BONDING OF RAILS
The strength in static bending of rails bonded by conventional brazing or by a unique brazing technique involving the use of fiber metal shims ranges up to a maximum tensile fiber stress at failure of 71,800 psi. Work to date has been done using mild steel fiber metal shims, with and without copper foil on either side of the shim to supply molten filler metal. Since this technique yielded a joint strength as high as 63,900 psi, the superior technique of employing rail steel fiber metal shims preimpregnated with copper could yield strengths comparable to those of pressure-welded rail.

AREA Bulletin Vol. 61 No. 556, Feb. 1960, pp 915-925, 1 Fig, 1 Tab, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2047)
DOTL RP

A2 040570
SERVICE TESTS OF HEAT-TREATED AND ALLOY-STEEL RAIL
The results of service tests conducted by five railroads are reported. The rail types included in the tests were: 115-RE columbium-treated, chrome-vanadium alloy rail, 132 RE heat-treated rail, 140 RE high-silicon rail, 155 PS high-silicon rail, and 115 RE head-treated rail. Areas of heavy shelling and continuous flaking are illustrated.

AREA Bulletin Vol. 63 No. 570, Part 1, Feb. 1962, pp 533-545, 1 Fig, 7 Tab, 8 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2049)
DOTL RP

A2 040577
ROLLING-LOAD-TEST RESULTS OF WELDED ENGINE-WHEEL BURNS ON RAIL SUPPLIED BY THE SEABOARD AIR LINE RAILROAD
The oxyacetylene-welding method is the standard procedure for repairing wheel burns. Two welds of this type were prepared as controls. Eight engine-wheel burns were then welded by means of the electric-arc method. The first six welds were made on 115-lb RE rail and the last four welds were made on 132-lb RE rail. In this type of test 2,000,000 cycles without failure are considered a run-out. All of the welds were checked ultrasonically for defects. The oxyacetylene welds had the best results, in that one ran to 2,000,000 cycles without a failure and the other ran to 589,000 cycles, failing from a detected inclusion. The electric-arc welds failed prematurely at 49,000 to 159,000 cycles. The microscipic examination of fractures revealed taht a sharp line of demarcation between the weld metal and rail metal existed as well as very fine porosity on the interface. This porosity in all of the electric-arc welds was the cause of the failure. The microsocpic porosity in the interface could not be detected ultrasonically whereas the indication of the inclusion was very definite.

AREA Bulletin Vol. 61 No. 556, 1960, pp 891-896, 2 Tab, 8 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2056)
DOTL RP

A2 040622
THE KANSAS TEST TRACK. NON-CONVENTIONAL TRACK STRUCTURES. DESIGN REPORT
The report discusses the design of three non-conventional railroad track support structures. These non-conventional structures, which include a continuously reinforced concrete slab, twin cast-in-place concrete beams and twin precast concrete beams, are part of a research program to develop practical, low maintenance, high quality track structures for conventional and advanced rail vehicles. Included in this report are discussions of basic structural concepts, design methods and models, and recommended construction, inspection and maintenance techniques. (Author)

McLean, FG Williams, RD Turnbell, RC
Westenhoff and Novick, Incorporated Sept. 1972, 214p

ACKNOWLEDGMENT: NTIS (PB-212358)
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PB-212358, DOTL NTIS

A2 040781
TESTS OF ELECTRIC FLASH BUTT-WELDED RAILS
This paper describes rolling-load tests and physical tests of specimens of 131 and 130-lb electric flash butt-welded rails which were undertaken to determine if stress relief treatment would be necessary. The 131-lb. rail was set up for rolling-load tests of weld 73 in. in a 33-in. stroke rolling-load machine. The second rolling-load test was made on weld 52 in the 131-lb. rail, which was supplied with all the flash metal ground off except under the rail base. 1. The first two-rolling load tests that failed at a bolt hole and stress raiser on the rail webs emphasize the damaging effects of such conditions. 2. The rolling-load tests which ran over 2,000,000 cycles with 60,000-lb. wheel load without failure, are considered very satisfactory for welded rails. 3. The bend tests of 132-lb rails gave higher tests than unwelded 131-lb. rails, and as high as any previously tested rail welds. 4. Some of the physical tests indicate that the welds which were not stress relieved were slightly stronger than the stress relieved welds. However, the difference is negligible and no conclusions on this subject should be based on tests of only two welds.

Cramer, RE Jensen, RS (Illinois University) *AREA Bulletin* Vol. 55 1954, pp 684-694, 2 Tab, 12 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2077)
DOTL RP

A2 040788
GROOVED BENT STOCK RAILS FOR SWTICHES
This report provides a brief description of the design and results of Union Pacific tests of grooved bent stock rails for switches. The conclusion of the Union Pacific at this time is that grooved bent stock rails for 16-ft. 6-in. switches (No. 10 turnout) in locations of normal traffic on the turnout side are of undoubted advantage and will far outlast ungrooved stock rails. Further observation will be required before arriving at a definite conclusion on grooved bent stock rails for 24-ft. switches.

AREA Bulletin Vol. 54 Bulletin 507, Feb. 1953, pp 1034-36, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2082)
DOTL RP

A2 040789
DESIGN OF TIE PLATES
This report consists of (1) a progress report on the service tests of seven designs of tie plates for the rail base width of 5-1/2 in. and (2) the results of a field test in which the magnitude and eccentricity of tie plate loads in tangent track under diesel and steam power were measured with calibrated dynamometer tie plates. In the service tests, it was found that the 13-in. length plates as compared with the 11-in. designs on the 4-deg. curve effected a greater reduction in plate cutting than would be expected from the inverse ratio of the plate lengths. Excluding the 3170 plate with the pressed circular rail seat, and bottom, the shape of the rail seat of the other 11-in. designs had no important influence as to the amount of plate cutting. So far, the 3170 designs of tie plate, which has approximately 10 percent more area than the 7-3/4 in. by 11 in plates, has shown no superiority for reducing plate cutting. The tie plate load tests showed that swinging ties resulted in an average increase in tie plate loads of 4000 lb. for the steam locomotives, as compared with approximately 5000 lb. for the diesel locomotives. The individual tie plate loads measured under the diesels were more uniform in magnitude than for the medium weight Mikado locomotives. The steam locomotives produced higher individual tie plate loads than those of the diesels.

AREA Bulletin Vol. 54 Bulletin 507, Feb. 1953, pp 1037-46, 3 Fig, 2 Tab, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2083)
DOTL RP

A2 040792
RESISTANCE TO WARPING OF CONTINUOUSLY WELDED OLD AND NEW RAILS
This paper uses computational methods for calculation of track stability to examine the feasibility of welding the rails of older types of permanent way. It also examines the problem of warping of new, continuously welded rail, and the problem of whether very heavy rails (S64, S55) can be subjected to continuous welding in view of the fact that they employ light fastenings. The general results of these investigations can be summed up as follows: 1. Because of their particularly great moment of inertia, heavy rails can be continuously welded even when laid with simple, non-rigid fastenings. 2. With medium-heavy and light type of rails, the type of sleepering and the ballast cross-section have an important bearing on the resistance to warping. In such cases, it is advisable to examine, before the welding takes place, the safety against warping in accordance with local conditions, and to determine the minimum temperature at which the rails may be laid. 3. Because of the rail wear, the safety against warping increases to some extent with the age of the continuously welded track. It is therefore possible to accept a certain amount of slackness in the rail fastenings and a consequent reduction in the frame rigidity of the track.

Translated from Eisenbahntechnische Rundschau, No. 9, Sept. 1955.

Rubin, H *Rail International* Mar. 1957, pp 199-203, 4 Fig, 2 Tab, 2 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2034)
DOTL RP

A2 040793
TRACK ANALYSIS
In the present paper an attempt has been made to create the physical based for an objective assessment of the quality of railway track. For this purpose, the damage occasioned by faults in the geometric position of the track has been reduced to the universally applicable notion of 'detrimental energy' which is, in its turn, based on the detrimental integral exclusively derived from the geometry of the track. The definition of these novel notions is made possible by classifying the faults as subcritical, critical or super-critical depending on the period length of the oscillations caused by them. This leads to a coherent evaluation system which is largely founded on physical facts, lends itself to automation by means of modern computers, and furnishes directly applicable data not only for short-term maintenance programmes (marking of danger spots) but also for long-term renewal programmes (quality assessment of entire sections of track). The necessary computing techniques are outlined in their logical set-up.

Translated from Glasers Annalen, Zeitschrift fur Eisenbahnwesen und Verkehrstecknik, Feb. 1967.

Erismann, T (Amsler (Alfred J) and Company) *Rail International* pp 571-592, 8 Fig, 18 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2036)
DOTL RP

A2 040794
FIELD EVALUATION OF 130 LB PS 39 FT. ROLLED RAIL
It was the purpose of the test to determine by service if Briquetted Sponge Iron Scrap used in the manufacture of steel rail instead of the usual steel scrap would develop any advantage or superiority from the standpoint of wear or other service conditions. The rails were laid alternating five special and five ordinary rails on the outer and inner sides of curve. After a service of 13 months and immediately before removal from track measurements of head wear were taken on 12 special and 12 comparative rails (6 high and 6 low) around the curve. This test has shown considerable increased wear on an 8 deg. 00' curve in heavy traffic territory for 130 lb. PS open-hearth rail manufactured with Briquetted Sponge Iron Scrap compared with same weight and process rail manufactured by regular products which include Scrap Steel.

Boyd, JK
Penn Central Transportation Company Final Rpt Test No. 102, Jan. 1949, 3 pp, 4 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2037)
DOTL RP

A2 040796
PROGRESS TOWARD SCIENTIFIC DESIGN AND ANALYSIS OF TRACK
This paper surveys the DOT research and development program aimed at better track structures. This program includes the following: (1) improved ability to measure track geometry at speeds under load; (2) developing methods to analyze the measurements, and ways to make better use of the information; (3) looking at the possibility of designing track of greater stability; (4) experimental research on the dynamics of wheel-rail interaction.

Ward, EJ (Department of Transportation) *AREA Bulletin* Vol. 70 70-621-13, 1969, pp 946-954, 3 Fig, 1 Tab, 2 Phot, 4 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2038)
DOTL RP

A2 040798
ROADBED STABILIZATION SOIL PROBLEMS IN RAILWAY TRANSPORTATION ENGINEERING
In this paper soil problems are examined in terms of the cut and fill of line changes, in the daylighting of tunnels and in the performance of track. Included are planning remedial construction to preclude landslides, geometry studies for daylighting tunnels, design of new cut slopes including those in the proximity of abandoned coal workings, fill design in new construction effects of water content of borrow materials on compaction, and planning and control of waste areas.

Ireland, HD (Illinois University) *AREA Bulletin* Vol. 67 1965, pp 7-19, 6 Fig, 3 Phot, 5 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2040)
DOTL RP

A2 040802
EIGHTH PROGRESS REPORT OF THE ROLLING LOAD TESTS OF JOINT BARS
Twelve tests of 133 RE head contact 36-in. bars averaged 509,200 cycles. Twelve tests of 115 RE head free 36-in. bars averaged 1,462,450 cycles. Five of the joints ran to 2,000,000 cycles with no failure. Micrographs, taken on all failed bars, revealed decarburized bar surfaces to varying depths up to 0.024 in. No clearly defined correlation between cycles for failure and depth of decarburization was apparent. Brinell and tensile tests on 12 of 100 failed bars from service indicated higher hardness reading near the surface of the bars than at the center of the head. Ten of the 12 bars tested failed to meet the specifications of 100,000 psi, minimum tensile strength and 11 fell short of the 70,000 psi minimum yield point.

Jensen, RS (Illinois University) *AREA Bulletin* Vol. 51 No. 486, Feb. 1950, pp 585-593, 1 Fig, 4 Tab, 7 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2101)
DOTL RP

A2 040803
RAIL FRACTURES RESULTING FROM ENGINE WHEEL BURNS, INCLUDING EFFECT OF REPAIRING SUCH BURNS BY OXYACETYLENE OR ELECTRIC WELDING
Twenty-one specimens were artificially burned with the wheel rotating at a speed of 15 mph, the rails being applied to the moving surface of the wheel for 3-sec. intervals. The burns produced by this method were approximately 1-1/2 in. wide by 2-1/2 in. long and appeared to be quite uniform in nature. A tabulation of the rolling-load tests completed on these specimens up to the present time is shown. Up to the present time no explanation can be offered for the difference in fatigue life due to the location of the built-up metal on the engine burn. Tests have not progressed far enough to lead to any conclusions.

Akers, JB *AREA Bulletin* Vol. 51 No. 486, Feb. 1950, pp 594-595

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2102)
DOTL RP

A2 040808
SERVICE TESTS OF MANGANESE CROSSINGS
The report covers the comparative tests of designs of solid manganese steel crossing frogs at McCook, Illinois, the tests of manganese insert and solid manganese crossings on structural steel and longitudinal timber supports, and tests of crossing frog bolt tension. Some of the designs included in the tests are more resistant to the development of fatigue cracks than others, but in none were the developed stresses low enough relative to the fatigue strength of the manganese steel to give the service life under heavy traffic that should be expected. Four railroad crossings were installed in the double-track main lines of the Indiana Harbor Belt Railroad and the Chicago and Western Indiana Railroad. The structural steel T-beam support was placed under one each of the solid manganese and insert crossings and the other two crossings are carried on longitudinal bolted crossing timbers. The inspection made in 1947, after approximately one year's service, showed all castings in the four crossings to be in good condition with no-flangeway cracks. A plan of the flangeways of the four crossings showing the flangeway cracks as found on May 7, 1948 is presented. The extent of the cracks was about the same, regardless of kind of support, for the two types of crossings.

AREA Bulletin Vol. 50 No. 479, Feb. 1949, pp 572-579, 3 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2109)
DOTL RP

A2 040815
RAIL FAILURES RESULTING FROM ENGINE WHEEL BURNS, INCLUDING EFFECT OF REPAIRING SUCH BURNS BY OXYACETYLENE OR ELECTRIC WELDING
Service failures of repaired burns have been negligible. One railroad reports that of 500,000 burns repaired in the last 8 years only 6 service or detected failures of welded engine burns have occurred. Benefits derived from welding repair are: elimination of undesirable microstructure and quench cracks; which serve as potential stress raisers or reduce the fatigue strength of the rail steel elimination of low spots on the rail surface; and building up of engine burns permits recovery of much rail for main line use which would otherwise be scrapped or consigned to secondary service.

Akers, JB *AREA Bulletin* Vol. 53 No. 500, Feb. 1952, pp 894-898, 3 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2086)
DOTL RP

A2 040822
CROSSING FROG BOLT TENSION TESTS
To determine the characteristics required of spring washers for use with turnout and crossing frogs, field observations have included measurements on a bolted heat-treated rail crossing in high-speed territory, and on this type of crossing together with a manganese insert, and a solid manganese type in slow-speed territory. For each service period, the bolts were initially set to a tension of approximately 40,000 lb. Loss in bolt tension was not due to the nuts backing off. Loss of tension is evidently due to wear. The rate of bolt tension loss was found to be considerably more on the bolted rail type of construction than on either the manganese insert or solid manganese types of crossing. The high reaction types of spring washers have shown better ability to maintain bolt tension over the test period than the low reaction types. The shock load or dynamic variation in the bolt tension under traffic was measured. Two series of tests were conducted; one with 40,000 lb initial tension, the other with 25,000 lb tension. The bolt tension tests are continuing.

AREA Bulletin Vol. 52 No. 493, Feb. 1951, pp 532-553, 11 Fig, 7 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2093)
DOTL RP

A2 040829
DISCUSSION ON "THE ENGINEERING ASPECTS OF HIGH-SPEED TRAINS" (1) MOTIVE POWER: (2) PASSENGER ROLLING STOCK; (3) BRAKING AND SIGNALLING; (4) PERMANENT WAY
This paper surveys the engineering aspects of high-speed trains in terms of motive power, passenger rolling stock, braking and signaling, and permanent way. In developing high-speed trains there is clearly a need to examine all aspects of vehicle performance on the track, and also a need to subject every item of traction equipment to the closest secrutiny to ensure that it is suitable for onerous high-speed duties. The car of the future will probably be lower and smoother, and with smaller windows than present-day cars. It will be pressurized and adjacent body ends will be closer to incorporate peripheral coupling and improve passenger access. It will also cost more. A basic consideration in obtaining the best brake performance of high-speed

trains is the maximum braking retardation. When high retardations are used and as the maximum speed of trains increases from about 100 mph to 120 mph (or even 150 mph) two problems of braking which become increasingly important are adhesion and heat dissipation. Both necessitate modifications to present braking practice when higher speed stops are to be made. It is generally agreed that at high speeds some form of cab signaling is essential, and systems in use vary from the relatively simple A.W.S. as used in this country to apparatus which starts, controls, and stops the train automatically. There is every justification to believe that, from the point of construction, modern track would be quite suitable for speeds up to 160 mph--possibly more--where it is straight or flat-curved.

Sharp, E Thring, JF Peacock, DW Loach, JC *Institution of Locomotive Engineers Journal* Vol. 56 No. t 2, pp 196-219, 9 Fig, 1 Tab, 1 Phot, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1963)

A2 040870
RAIL DESIGN AND SERVICE MEASUREMENT OF RAIL WEB STRESSES OUTSIDE OF JOINT

The report on rail design deals primarily with the revisions of design to improve the strength in the upper web fillet of the rail to better resist the high range of stress that occurs on curved track on the gauge side at this location. The work described on rail design in the report was occasioned by the occurrence of web failures in the 131 lb. RE rail section on the low rail of curves after considerable traffic had been carried and there had been a reduction in height of section because of rail wear. The cause of split web failures (head and web separations) in 131 RE rail has been found to be corrosion fatigue. Laboratory and service stress measurements have demonstrated that this section develops high stresses in the upper web fillet gauge side, on the low rail of sharp curves. Based on practical experience, mathematical theory, and laboratory and service tests using modern strain measuring equipment, the 140 PS rail section has been developed to retain all the desirable characteristics of the 131 RE section and eliminate its weaknesses. The report contains a detailed drawing of the 140 PS rail section developed from this research and which is now known as the 140 RE rail section, having been adopted by the American Railway Engineering Association as a standard standard section. A detailed drawing of the 133 PS section and of the 155 PS section which were developed from this research are also included in the report.

Code, CJ (Pennsylvania Railroad)
Penn Central Transportation Company Test 405, 416, 8 pp, 3 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1732)

A2 040871
THERMIT WELDED RAILS, FULL FUSION PROCESS

The purpose of the test was to determine the strength and safety of Thermit welded rails (Full Fusion Process). Eight specimens of 131 lb. RE rail 8 ft. long, including a Thermit weld at the center, were provided for laboratory tests. For comparative purposes, eight similar specimens, including an Oxweld pressure weld, were furnished for test. All specimens were 131 lb. RE rail. Three specimens of each kind of weld were tested head down, and three specimens, head up, under the drop test machine. One specimen of each type of weld was tested head up and one head down, under static load, under the million pound testing machine. Results of the drop tests and static tests and of the hardness survey are shown on attached tabulated statements. Every Thermit welded rail broke with the first drop under the drop test machine, even though in one case with the rail tested head up the drop was reduced from 59" to 6" and the energy from 44,000 ft. pounds to 4500 ft. pounds. The Oxweld specimens each withstood the first and second blows with the full 44,000 ft. pounds energy. On the static test the Thermit rail tested head up broke at 262,000 pounds load on a 48" span, and the Thermit rail tested head down broke at 251,000 pounds load. The Oxweld specimen tested head down broke at 375,000 pounds with a square break directly through the weld. The Oxweld specimen tested head up did not break with a load of 375,000 pounds. The strength of the Thermit full fusion weld as determined by these tests does not approach the strength of a full section rail or that of a bolted joint. The grain structure is coarse, the fractures are brittle, indicating the probability that failures in service might be sudden and without warning.

Code, CJ (Pennsylvania Railroad)
Penn Central Transportation Company Test 407, Aug. 1945, 9 pp, 4 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1733)

A2 041097
ON THE PERFORMANCE OF THE RAIL FASTENING DEVICE FOR THE SHARP-CURVED, STEEP-GRADED TRACK

In order to examine the performance of rail fastening device Type 6 designed for PC sleepers used in the sharp-curved, steep-graded section where a severe load condition is assumed, and to make clear the distribution of train load on sharp curve, the lateral wheel force and wheel load, stress of spring clip and rail inclination angle were measured in the field test. These measured results were used for the examination of the fatigue limit of spring clip, the relationship between the lateral wheel force and stress of string clip and the distribution of lateral wheel force.

Umeda, S Aihara, K Kumazaki, H *Railway Technical Research Institute* Vol. 13 No. 1, Mar. 1972, pp 8-10, 5 Fig

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Japanese National Railways Kunitachi, Box 9, Tokyo, Japan Repr PC
DOTL JC

A2 041107
NUMERICAL CALCULATION AND APPROXIMATE FORMULA OF BUCKLING STRENGTH OF TRACK

In 1967, the adoption of 60 kg rail in the track of the Sanyo Shin Kansen was determined. For this determination, it was considered that the temperature difference corresponding to the buckling strength of the track with this rail would not be different so far from that of the track with 50 T rail. To confirm this, the authors made the calculation program of the buckling strength of track and computed this for every rail in Japan including the new 60 kg rail. Through the investigation of calculated results, it was found that there would be simple approximate formula to calculate the buckling strength of track. This paper contains the calculating method of the buckling strength, calculated results, the composition of the approximate formula and its application.

Sato, Y Kobayashi, S *Railway Technical Research Institute* Vol. 13 No. 1, Mar. 1972, pp 35-39, 4 Fig, 1 Tab

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Japanese National Railways Kunitachi, Box 9, Tokyo, Japan Repr PC
DOTL JC

A2 041108
THEORETICAL ANALYSIS OF VARIATION OF WHEEL LOAD

A three mass model was developed for theoretical analysis of the variation of the wheel load for a high speed railway like the Shin Kansen. The calculation of the frequency response function and transient response are demonstrated, with particular emphasis on passage through very small low spots of track.

Hirano, M *Railway Technical Research Institute* Vol. 13 No. 1, Mar. 1972, pp 42-44, 4 Fig

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Japanese National Railways Kunitachi, Box 9, Tokyo, Japan Repr PC
DOTL JC

A2 041116
RESILIENT RAIL

Design and experimental results of a Resilient Rail developed for the mitigation of vibration and noise under train operation are summarized. The paper is divided into three parts, Part 1 treating the design, performance, durability test and field test of the Resilient Rail on revenue lines; Part 2 the noise-abating effect of this rail; and Part 3 the qualitative examination of anti-vibration rubber employed in 9 revenue line test. It is concluded that the Resilient Rail has been adequately designed; the metallic parts and anti-vibration rubber possess ample strength; the Resilient Rail can reduce the noise by about 4 phons (A) on elevated tracks or bridges; and also a vibration-abating effect can be counted on.

Satoh, Y Umekubo, S Hirata, G Arai, M Chino, T Tsukamoto, K Sawada, T *Railway Technical Research Institute* Vol. 13 No. 2, June 1972, pp 76-84, 7 Fig, 6 Tab

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Railway Technical Research Institute Kunitachi, Box 9, Tokyo, Japan Repr PC

DOTL JC

A2 041221
SP WORKS INSULATED JOINTS INTO RAIL WELDING
Southern Pacific has adopted an approach to insulated joints in welded rail that involves the prefabrication of a bonded insulated joint between two 39 foot rails and the subsequent welding of the resulting 78 foot rail into welded strings at the welding plant. The insulated joints are assembled using an epoxy resin and Huck fasteners, and the epoxy is allowed to set for about 12 hours, after which the insulating value is tested with an Ohmmeter. The 78 foot rail must be backed into the welding machine. Such incorporation of the insulated joint into the welded rail string requires pre-planning the location of the insulated joints in the welded rail strings, and careful attention to the loading diagram when loading and unloading the welded rail train. The loading diagram is placed in a container at the loading end of the welded rail train.

Dove, RE (Railway Track and Structures) *Railway System Controls* Vol. 3 No. 11, Nov. 1972, pp 24-25, 6 Phot

ACKNOWLEDGMENT: Railway System Controls
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New Yok, 10013 Repr PC

DOTL JC

A2 041321
RETAINING GAUGE ON CURVES: THE L&N APPROACH
Louisville and Nashville has found that powerful diesel units with three axle trucks cause problems with holding gauge on curves. L&N launched three point plan: a laboratory study, use of gauge-measuring devices, and new standards for tie-plate sizes and spiking patterns for curves. Use of a common tie-plate for 100 lb and 132 lb rail meant that the 132 lb rail base covered one of the spike holes on the gauge side. To help prevent rail overturning under those conditions, a compression clip anchor was used in place of the spike on curves. L&N has adopted a new 18 inch tie-plate for problem curves. Diesel locomotive truck side thrust was suspected as a source of wide gauge on curves, so a gauge sensing device was mounted on a locomotive truck. Tests confirmed the rail moved outward under dynamic loading. Measuring devices attached to the rails also confirmed movement. A pickup truck equipped for rail/highway operation was also equipped with gauge recording instruments. On heavy-tonnage routes, curves of 5 degrees or more or troublesome curves get the new 18 inch tie-plate. Three line spikes are now used on the outer rail of the curve, with one screw spike in the hold down holes on either side of the rail. Still another technique being tried is the use of washer head screw spikes which are driven as line spikes.

A similar article on the L&N approach to curve problems appeared in Railway Track and Structures, V69, N1, January 1973.

Dove, RE *Railway Age* Vol. 174 No. 1, Jan. 1973, pp 28-30, 1 Fig, 4 Phot

ACKNOWLEDGMENT: Railway Age
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

A2 043365
STUDY OF ACTIVE VIBRATION ISOLATION SYSTEMS FOR SEVERE GROUND TRANSPORTATION ENVIRONMENTS
An investigation is conducted to evaluate the application of active mechanisms for the protection of equipment and/or personnel from the severe dynamic inputs characteristic of ground transportation vehicles. For the purposes of the study, dynamic loads and isolation system performance are defined in terms of the maximum expected vertical excitations associated with the suspension system of high speed ground transportation vehicles, and conservative levels of allowable passenger acceleration. Selected configurations employ available hardware, and consist of a static load support fluidic spring in parallel with a 0.2 Hz resonant frequency electrohydraulic isolator, which: a) provides the desired degree of isolation from both discrete frequency and broad-band vibration excitations; and b) limits the payload deflections to within plus or minus 6 inches under conditions of combined vibratory and transient dynamic loads. Rigid and flexible payloads of 1,000 3,000 and 10,000 pounds per isolator are considered. The response of the selected isolation systems is presented in terms of absolute and relative transmissibility; payload acceleration; and relative displacement between the payload and the source of excitation for the vibratory, transient, and combined excitations. In all cases the effect of increasing the payload weight by twenty percent is shown. The results indicate that the selected active isolation systems are capable of protecting a range of payloads from severe vibratory and transient dynamic loads. Systems stability, estimates of flow and power requirements, system weight, reliability, and failsafe criteria considerations are shown. Recommendations are made regarding extension of the techniques to provide isolation in the combined vertical and lateral directions. (Author)

Prepared for National Aeronautics and Space Administration.

Calcaterra, PC Cavanaugh, RD Schubert, DW
Wright (Barry) Corporation Contr Rpt NASA CR-1454, 155 pp, 20 Tab, 11 Ref, 2 App

ACKNOWLEDGMENT: National Aeronautics and Space Administration
PURCHASE FROM: NTIS Repr PC

DOTL NTIS

A2 043520
AUTOMATIC SUBMERGED-SLAG WELDING OF RAIL
The procedure of submerged-slag welding--a new automatic fusion welding of rails in the field--is described in this paper. The optimum wire compositions and welding conditions are determined in relation to micro hot cracking in HAZ, and the mechanical properties of welded rails are examined. Finally, the results of investigations of rails welded by a trial "welding car" are discussed. Based on the favourable results obtained of using this welding machine, it is expected to realize the full automatic welding of rails in the field in the near future.

Oishibashi, H Hakamata, S Ohara, M Oi, I Muramoto, T *Railway Technical Research Institute* Vol. 13 No. 4, Dec. 1972, pp 235-240, 9 Fig, 5 Tab, 4 Phot

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Japanese National Railways Kunitachi, Box 9, Tokyo, Japan Repr PC

DOTL JC

A2 043615
TIE REPLACEMENT PROGRAM
The demand for track materials varies directly with the financial state of the railroads. The demand for wood ties has recently slackened off so that tie producers have no incentive for R&D, lessening production efficiency and putting a squeeze on profits. The market for other lumber products and the availability of a concrete tie substitute have also considerably weakened the wood tie market. Concrete ties are more stable and lower in price due to steadier cost trends of sand, gravel, and cement, and also a lower labor to material cost ratio. Performance studies comparing concrete and wood ties have favored the former. In an economic evaluation of discounted cash flow equations and cost drains, concrete ties are favored again.

Keiner (Chesapeake and Ohio Railway)
Railway Systems and Management Association Feb. 1969, pp 63-74

ACKNOWLEDGMENT: Railway Systems Management Association
PURCHASE FROM: Railway Systems Management Association 163 East Walton Street, Chicago, Illinois, 60611 Repr PC

A2 043902
FATIGUE BEHAVIOR OF WELDED BEAMS
The fatigue behavior of welded steel beams is evaluated by using the fracture-mechanics concepts of stable crack growth. A fracture-mechanics model for cracks originating from the pores in the web-to-flange fillet weld is developed. Estimates of the stress-intensity factor are made that numerically describe the initial flaw condition. With the final crack size known, a theoretical crack-growth equation was derived from the fatigue test data of the welded beams. The derived relationship compares well with actual crack-growth measurements on a welded beam and available data from crack-growth specimens. The regime of crack growth, where most of the time is spent growing a fatigue crack in a structural element, is shown

to correspond to growth rates below 10 to the minus 6 power in. per cycle. Few experimental crack-growth data are available at this level. It is concluded that the fracture-mechanics concepts can be used to analyze fatigue behavior and to rationally evaluate the major variables that influence the fatigue life of welded beams.

Sponsored by Committee on Steel Superstructures.

Hirt, MA (Howard, Needles, Tammen and Bergendoff); Fisher, JW (Lehigh University) *Highway Research Record* No. 400, ISBN 0-309-02072-7, 1972, pp 4-15, 11 Fig, 16 Ref

PURCHASE FROM: Highway Research Board 2101 Constitution Avenue, NW, Washington, D.C., 20418 Repr PC

DOTL JC

A2 044005
MAINTENANCE OF WAY AND THE INFORMATION EXPLOSION

Maintenance of way activities have traditionally been subjected to budget restrictions, in part because it has been difficult to document and quantify the real cost of deferred track maintenance. Southern is using the computer to produce studies and reports on maintenance of way programs. The key elements are a group of data bases or master files containing essential information. Probably the most important is the Track Characteristic Master. Southern's Research C r R-1 provides key information on track conditions. A second file contains all pertinent details on derailments. Correlation of the derailment file with the track characteristic master produced a sensitivity index of defect types as a predictor of derailments. Southern is completing a System-wide anchor and double spiking program with standards based on traffic density, degree of curvature, and grade. The best way to determine when rail should be relaid and when track should be retied and surfaced is by measuring rail and track condition. R-1 car findings cause adjustment in maintenance schedules. Southern is pursuing an equally aggressive role with respect to rail defects and rail failures. The most recent addition to the data bases is the bridge file. Track programs have been correlated for efficiency.

Cary, AM (Southern Railway) *Progressive Railroading* Vol. 16 No. 2, Mar. 1973, pp 31-36, 2 Fig, 3 Phot

ACKNOWLEDGMENT: Progressive Railroading
PURCHASE FROM: Murphy-Richter Publishing Company 9 South Clinton Street, Chicago, Illinois, 60606 Repr PC

DOTL JC

A2 044010
CN SEEKS MORE STABLE TRACK

With the increase in traffic and the advent of six-axle diesel locomotives and 100-ton cars, CN has been experiencing some difficulty with conventional track...in maintaining line and gage, in accelerated rail wear, and in corrugation. The new 'track structure test' encompasses the overall function of the structure rather than specific components. It involves continuous welded RE high silicon rail, fastened accurately to prestressed monolithic concrete ties that are restrained by well tamped and drained crushed rock ballast. The test site was selected to include heavy trains, six-axle locomotives, and downgrades and sharp curvature. The results are intended to provide guidance in writing an improved track specification. Total tonnage moved in 1971 amounted to 31 million gross tons. The ties were made in England. The fastening used is the Pandrol 601 A clip. Details of the installation process under traffic are given. Three different tie spacings were used.

Progressive Railroading Vol. 16 No. 2, Mar. 1973, pp 62-66, 1 Fig, 7 Phot

ACKNOWLEDGMENT: Progressive Railroading
PURCHASE FROM: Murphy-Richter Publishing Company 9 South Clinton Street, Chicago, Illinois, 60606 Repr PC

DOTL JC

A2 044030
MATCHING THE TRACK TO THE LOAD

Inevitably, freight trains are going to get heavier and passenger trains faster as the commercial goals of increased payload and higher speed are pursued. In specifying track standards, the engineer must steer a delicate middle course between pessimism that impedes progress and optimism which later rebounds in the form of excessive maintenance costs.

Paterson, A *Railway Gazette International* Vol. 128 No. 2, Feb. 1972, pp 53-56

ACKNOWLEDGMENT: British Railways Board
PURCHASE FROM: IPC Transport Press Repr PC

DOTL JC

A2 044061
BR DEVELOPS LAYING-IN A CONTINUOUSLY REINFORCED CONCRETE PERMANENT WAY BASE UNDER SERVICE CONDITIONS ON HIGH-SPEED RUNNING LINES

Experience with a number of concrete track sections constructed three years ago on a secondary line has enabled BR to go ahead with laying a 1.8 km section under full service conditions suitable for Inter-City expresses and heavy freight services using a purpose-built slip-paver manufactured and operated by Robert McGregor, civil engineering contractors.

Rail Engineering International Vol. 2 No. 8, Oct. 1972, pp 385-388

ACKNOWLEDGMENT: British Railways Board
PURCHASE FROM: Broadfields (Technical Publishers) Limited Little Leighs, Chelmsford, Essex CM3 1PF, England Repr PC

DOTL JC

A2 044062
SOME CONSIDERATIONS CONCERNING PERMANENT WAY FOR HIGH SPEEDS

Speeds above 220 km/h call for new design of track maintenance machines and assessment of available rail fastenings whilst improved stability and track geometry realise a long lasting infrastructure which is furthered by non-destructive testing and rail grinding of rails. Relative train speeds evaluation on pre-set parameters in relation to cant can regularise an approach to riding and track forces.

Diaz Del Rio Y Juodenes, M *Rail Engineering International* Vol. 2 No. 8, Oct. 1972, 7 pp

ACKNOWLEDGMENT: British Railways Board
PURCHASE FROM: Broadfields (Technical Publishers) Limited Little Leighs, Chelmsford, Essex CM3 1PF, England Repr PC

DOTL JC

A2 044432
MAJOR M/W ACTIVITIES TO STAY AT HIGH LEVEL IN 1973

The Class 1 railroads laid 685,000 tons of new rail in renewal in 1972, which is 6.5% higher than the 643,321 tons laid in 1971. Although renewal of ties represented a decline of 4.8% compared to 1971, tie renewal for 1972 exceeded 20 million for only the second time in 15 years. Looking ahead to the next 12 months, it is estimated that the Class 1 railroads will install 730,000 short tons of new rails in existing track in 1973, which will be an increase of 45,000 tons, or 6.6% compared to 1972. The estimate of tie renewal in the Class 1 railroads is that 19,500,000 new crossties will be installed in existing tracks in 1973, which is a reduction of 900,000 ties, or 4.4% compared with 1972. The question of whether, and to what extent, M/W activities are being influenced today by the FRA Track Safety Standards, is answered by "not much". The fact is that railroad management has become convinced of the need to spend more on the tracks and structures.

Railway Track and Structures Vol. 69 No. 1, Jan. 1973, pp 22-23, 2 Fig

ACKNOWLEDGMENT: Railway Track and Structures
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

A2 044435
RESEARCH: THE ANSWER TO TRACK PROBLEMS

The FRA Track Safety Standards have now been established and the railroads must bring all their tracks into compliance and continue to maintain them to these standards, or reduce operating speeds to the lower track classification levels. The Research and Test Department of the AAR, under Dr. Bill Harris' administration and in cooperation with member railroads, the RPI, individual manufacturers and other agencies, has many major research projects under way, studying the adequacy of design and material specifications for tank cars, equipment components, as well as a

special committee assigned to study rail specifications and chemistry. The most promising of these projects, from a track standpoint, however, is the track-train dynamic study. The results to be derived from these research programs will not only make it possible for the railroads to meet the transportation demands of the future, but will make it possible for them to do so at a lower cost, not the least of it is the cost of maintaining the track and roadbed.

Brown, RM (American Railway Engineering Association) *Railway Track and Structures* Vol. 69 No. 3, Mar. 1973, p 19, 1 Phot

ACKNOWLEDGMENT: Railway Track and Structures
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

A2 044436
MANUFACTURERS HAVE THEIR SAY ON GETTING THE MOST OUT OF M/W MACHINES
When manufacturers of M/W equipment get together to talk about how to get the most out of their machines, the conversation keeps coming back to the role of the machine operator. Apparently he presents the biggest obstacle to the efficient use of their equipment. Other aspects of the subject are also discussed in this article, such as the need for supervisors to exercise a more positive role in training and supervising operators and in familiarizing themselves with the capabilities of the machines, the problem of safety and of getting more on-track time.

Railway Track and Structures Vol. 69 No. 3, Mar. 1973, pp 20-25, 5 Fig, 2 Phot

ACKNOWLEDGMENT: Railway Track and Structures
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

A2 044437
HOW I'D MECHANIZE A 5000-MILE RAILROAD--FROM SCRATCH
The assignment is to come up with a blueprint for mechanizing the maintenance-of-way operations of a 5,000-mile railroad, the hypothetical Ft. Knox & Denver Mint R.R. Three assumptions are made: the railroad runs through a thousand miles of changing climate and terrain with 3,000 mile of light-traffic branch lines and 2,000 miles of medium to heavy mainlines, all in good condition, and there are three major yards and many lesser ones--the railroad has money--and, fantastically enough, it has no maintenance machinery. There are at least two ways to attempt a national solution of the problem: one is to find one or more railways with similar conditions and use their machine fleets as models, the other is to develop a fleet consist by independent means. This is the method selected by the author. Details are given of the equipment fleet he would assemble, including three tables: (1) Rail gang equipment; (2) Tie gang equipment, and (3) Equipment for bridge gangs, switch gangs and special purposes.

Smith, FH (American Railway Engineering Association) *Railway Track and Structures* Vol. 69 No. 3, Mar. 1973, 4 pp, 3 Tab, 1 Phot

ACKNOWLEDGMENT: Railway Track and Structures
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

A2 044490
MODERN PERMANENT WAY
Heavier loads, higher speeds, and a greater concern for safety are creating a greater emphasis on railroad track structure. Yet the number of current books on railroad track is indeed small. This book is an attempt to present a modern treatment of track and its components in the English language. Although the author it associated with the Indian Railways, the book is pertinent to American practice, and contains many references to specific American practices. The book covers rails, ties, fasteners, ballast, soils, track assembly, track maintenance and track modernization. It also covers concrete ties, welded rail, and high speed track.

Srinivasan, M (Indian Railway Service of Engineers)
Somaiya Publications PVT Limited 1969, 555 pp, 275 Fig

PURCHASE FROM: Somaiya Publications PVT Limited Bombay-14, India Repr PC

A2 044524
EFFECT OF FLAT WHEELS ON TRACK AND EQUIPMENT
Under present AAR rules governing removal of flat wheels, flat spots are limited to 2-1/2 in. length for one slid flat and 2 in. each for adjoining spots on freight car wheels and 1 in. on passenger car wheels. These limitations have been established from the experience and judgment of those concerned with the operation and maintenance of equipment and track. To date mathematical solutions to evaluate the impact effects from flat spots have not been adequate. Until recent years, instruments of sufficiently high frequency response to accurately measure the rapid stress changes have not been available. Tests made on the New York, New Haven, and Hartford RR. in 1942 established the characteristics required for reliable instrumentation. Suitable stress measuring instruments were obtained and a comprehensive test program to determine the effects of flat spots on both the track and equipment was conducted on the Chicago & North Western Railway during the summer of 1947. A special test train was used consisting of a locomotive, a passenger car carrying the measuring and recording instruments for the measurements on the test car, and a flat test car having a flat wheel and loaded with rails.

This report was prepared by the Joint Committee on Relation Between Track and Equipment.

Association of American Railroads Technical Center MR-113, May 1951

ACKNOWLEDGMENT: Association of Americans Railroads
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr PC

A2 044561
FOR M/W, A BIGGER SHARE OF THE DOLLAR
For more than ten years both rail and tie renewals have traced a generally upward curve and for the next twelve months the rail-renewal curve is expected to continue upward. Tie renewals are projected to decline slightly but tie insertions in 1973 will be at a higher level than in 1972. In spite of the increases of recent years, tie renewals are running short of actual needs and insertion of new rails are running far below requirements. Apparently the FRA Track Safety Standards have had little effect so far on M/W programs. There seems to be a trend towards performing more spot work on track as opposed to out-of-face work and towards the use of insulated rail joints and new and improved M/W machines; and an effort is being made to determine the cause of cracks in concrete ties shortly after they are inserted.

Dick, MH *Railway Age* Vol. 174 No. 2, Jan. 1973, 3 pp, 2 Fig, 2 Phot

ACKNOWLEDGMENT: Railway Age
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

A2 044810
AERIAL STRUCTURE AND RAIL SUPPORT METHODS REPORT NO 11
A series of tests was run for BART to evaluate the ability of rail fasteners to maintain electrical isolation, reduce noise levels, and provide safety and economy; and to determine their suitability for use on advanced design concrete aerial structures. The evaluation of several types of concrete ties and the results of tests on a new concept in the installation of rail fasteners and associated hardware on concrete aerial structures are included. Investigation showed that a new concept of track support was required for aerial structures and subways; further, it was realized that the fastener chosen for use on the aerial structures can also be used on the underground portions of the rapid transit system, a fact which will limit the types of rail fasteners needed for the system. Subsequent studies, therefore, are geared to the choice of a fastener suitable for use on aerial structures. On aerial structures rail fasteners must be simple enough for one man to assemble with hand-carried tools. The fastener must remain stable under the application of a 15,000-pound wheel load and must be capable of holding a longitudinal force of approximately 2,000 pounds of 3,000,000 cycles of loading in a test machine. Other criteria for fasteners of rail and aerial structures are listed. The "second pour" technique, which still requires further development, is to be used in installing track fasteners on concrete surfaces in order to

guarantee that the anchor bolts will not come in direct contact with reinforcing steel. Indications from test results indicate that concrete ties are safe and economical and perform well under the type of transit loadings expected in the BARTD system.

Parsons, Brinckerhoff-Tudor-Bechtel CAL-mtd-2

ACKNOWLEDGMENT: NTIS (PB-177496)
PURCHASE FROM: NTIS Repr PC

PB-177496, DOTL NTIS

A2 046320
MAINTENANCE OF TRACK ON SHINKANSEN
This article discusses the train operation, track construction, quality standards, and maintenance program of the high speed railway in Japan. Train vibrations are related to track conditions. Use of Track Inspection Car to measure track quality is discussed. Maintenance operations are carried out at night when no trains are running.

Fukusawa, Y *Japanese Railway Engineering* Vol. 14 No. 1, 1973, pp 3-7

PURCHASE FROM: Japan Railway Engineers' Association 2-5-18 Otemachi, Chiyoda-ku, Tokyo, Japan Repr PC

DOTL JC

A2 046422
HOW TRACKMEN COMBAT UNIT TRAIN DAMAGE
Unit trains may have cheered up the job of top management by boosting freight revenues. But they have brought little sunshine into the lives of track engineers who are having to cope with a whole new set of track problems created by day-to-day running of high-axle-load unit trains. British Railways, for instance, says that substantially higher track maintenance costs are a direct result of today's higher speeds and heavier axles which demand better track and more repair time. Deutsche Bundesbahn makes virtually the same comment. But both DB and BR, operating almost entirely over continuous welded rail (cwr) and concrete sleepers on main lines, have a relatively easy time of it compared with a number of US railroads which are operating regular 100-ton wagon unit train consists over jointed track laid on timber sleepers.

International Railway Journal 5 pp, 3 Phot

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

A2 046444
PERFORMANCE OF FOUR PLASTICS IN RELATION TO BOLT RELAXATION IN A NON-CONDUCTING RAIL JOINT
Experiments have been conducted to observe the relaxation behavior of fishplate-bolted rail joints in which four different polymeric materials were used for electrical insulation. Static tests were conducted to study the effect of temperature and of different locking sequences for the bolts on a rig which simulated service conditions at a joint. The effect of cyclic loading was considered.

Mitchell, AS (Manchester University) *Journal of Strain Analysis* Vol. 7 No. 3, July 1972, pp 194-204, 15 Ref

ACKNOWLEDGMENT: EI (EI 73 009598)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

A2 046693
NEW PLANT FABRICATES BONDED INSULATED JOINTS
A new plant for fabricating I-Bond insulated joints in rail plugs of various lengths was opened at York, Pa. Production-line techniques are used to produce the assemblies in various lengths. The minimum overall rail length of the insulated joint assemblies fabricated at the plant is 11 feet.

Railway Track and Structures Vol. 68 No. 12, Dec. 1972, pp 26,37

ACKNOWLEDGMENT: EI (EI 73 009615)
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

A2 046765
TANDEM RAIL LAYING ON THE SOO LINE-AND WHY
Two gangs, which formerly worked at separate locations on the system, now operate one behind the other--with resulting benefits to both the engineering and transportation departments.

Railway Track and Structures Vol. 69 No. 7, July 1973, 2 pp, 3 Phot

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

A2 046820
RAIL STEELS APPRAISED INTERNATIONALLY
Iron & Steel Institute's full-day conference 'Rail Steels' in London discusses 13 papers and establishes a two-fold concept, the Continental focus on combatting wear and British preventive measures to eliminate rail breakage. An international gathering of some 150 attend from railways and industry with senior BR civil engineers in the chair.

Jones, EG *Rail Engineering International* Vol. 3 No. 4, Apr. 1973, 12 pp, 6 Fig, 4 Tab

PURCHASE FROM: Broadfields (Technical Publishers) Limited Little Leighs, Chelmsford, Essex CM3 1PF, England Repr PC

DOTL JC

A2 046837
CONTINUOUSLY SUPPORTED RAIL SUBJECTED TO AN AXIAL FORCE AND A MOVING LOAD
The recent practice of welding railroad rails to each other suggests that considerable axial compression forces may be induced in the rails because of a rise in temperature. This in turn may reduce the critical velocity for the track to the range of operational velocities of modern high-speed trains. The purpose of the paper is to demonstrate that this is indeed a possibility.

Kerr, AD (New York University, New York) *International Journal of Mechanical Sciences* Vol. 14 No. 1, Jan. 1972, pp 71-78, 8 Ref

ACKNOWLEDGMENT: EI (EI 73 029643)
PURCHASE FROM: ESL Repr PC, Microfilm

A2 046843
RAILWAY CURVES: THEIR ALIGNMENT AND REALIGNMENT
Installation, maintenance and rectification of railway curves are dealt with. Comprehensive tables in metric units are developed for computing cants on curves for various speeds and degrees of curvature to solve curve problems directly without calculations. The method of reconditioning curves by string-lining is fully explained and illustrated by working out a complete example.

Thadani, M (Indian Railways) *Institution of Eng (India) Journal, Civil Eng Div* Vol. 52 No. 9, May 1972, pp 227-239

ACKNOWLEDGMENT: EI (EI 73 020542)
PURCHASE FROM: ESL Repr PC, Microfilm

A2 046854
A NEW GENERATION OF SWITCH AND TAMPING MACHINES
Need to maintain points and crossings at a standard of that being achieved plain line is being high-lighted by increased speeds and axle-loading. Plasser & Theurer has introduced an improved machine which permits confirmed trackwork to be tamped with verticle tamping tools to ensure constant depth pressure during tamping operations.

Haferkorn, F *Rail Engineering International* Vol. 3 No. 5, June 1973, 3 pp, 4 Fig

PURCHASE FROM: Broadfields (Technical Publishers) Limited Little Leighs, Chelmsford, Essex CM3 1PF, England Repr PC

DOTL JC

A2 046855
A PLASSERS 07-SERIES TAMPER MARKS THIS MANUFACTURER'S 300TH TRACK MACHINE BR
The Chief Civil Engineer of BRB reports on worthwhile progress brought about by co-operation in the development of track maintenance machines

evolved by Plassers & Theurer as he formally accepts a 07-16 tamper & liner on behalf of BR the West Ealing works depot of Plasser Railway Machinery (GB).

McMurdo, AW *Rail Engineering International* Vol. 3 No. 5, June 1973, 2 pp, 3 Phot

PURCHASE FROM: Broadfields (Technical Publishers) Limited Little Leighs, Chelmsford, Essex CM3 1PF, England Repr PC

DOTL JC

A2 046870
PRESTRESSED CONCRETE MONOBLOCK SLEEPERS
Outline of the experimental investigations carried out at the Structural Engineering Research (Regional) Centre in Madras, India during an extensive research program on behalf of the Indian Railways for the development of prestressed concrete track ties.

Madhava Rao, AG (Structural Engineering Research Centre); Parameswaran, VS Abdul Karim, E *Indian Concrete Journal* Vol. 46 No. 8, Aug. 1972, 6 pp

ACKNOWLEDGMENT: EI (EI 73 046870)
PURCHASE FROM: ESL Repr PC, Microfilm

A2 046876
NEW BALLASTLESS TRACK STRUCTURES IN JAPAN
Detailed discussion of the development of a concrete tie and the adoption of a ballastless track structure for Japanese railroads. Test methods and results of tests of new type of track.

Satoh, Y (Japan Mechanized Works and Maintenance of Way Co) *Permanent Way* Vol. 13 No. 4, July 1972, pp 1-22

ACKNOWLEDGMENT: EI (EI 73 027095)
PURCHASE FROM: ESL Repr PC, 3DOL5,/fr

DOTL JC

A2 046877
SLIPFORM PAVER PLACES HIGH-SPEED RAILBED
A specially designed paving train developed by the British Rail Research Dept substitutes a method for laying continuously reinforced concrete as a stable foundation for tracks carrying high-speed trains. A specially adapted CPP-60 slipform paver has five sensors to operate microswitches that control the complex cross-sectional shape of the track. A feeler arm graveling along the guide wire controls line and grade to within/-1/8 in. Paver can handle extra-stiff mix.

Nelson, B (McGraw-Hill World News) *Congressional Record Daily Edition* Vol. 55 No. 3, Mar. 1973, pp 104-105

ACKNOWLEDGMENT: EI (EI 73 021714)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

A2 046881
NEW TAMPER EMPHASIZES VERSATILITY
It is reported that the machine described raises, lines and tamps track out of face, performs spotting work and tamps through switches. The special feature of the Model 2600 is the tamping tools which are mounted on two work heads, eight tools to each head. The eight tools comprising each workhead are mounted in pairs and each pair has a motor for imparting vibration to the ballast at high frequency.

Railway Track and Structures Vol. 68 No. 12, Dec. 1972, pp 20-21

ACKNOWLEDGMENT: EI (EI 73 009614)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

A2 046883
RAILWAY TRACK DESIGN, CONSTRUCTION, MAINTENANCE AND RENEWAL OF PERMANENT WAY
The multiplicity of operations involved in the construction and maintenance of Railway Track or Permanent Way, requires from those entrusted with these works, a thorough knowledge not only of the most efficient methods for modern loads and speeds, but also of the underlying principles of design. The methods of construction, of renewal, and of improvement of track have been described in detail, and the measures to be adopted in emergencies have been explained. The theory and practice of the intricate subject of Points and Crossings has been dealt with concisely in two chapters, and complete proofs have been given for all formulae. The manufacture, tests and treatment of materials used, and their capabilities and limitations, have been explained. Subjects such as Signalling and Interlocking, and Bridge Maintenance, with which a trackman is intimately connected, have also been dealt with briefly. Modern tendencies have been indicated in the discussion of every aspect of track work, and frequent comparisons have been made with track practice abroad, particularly in the United States of America, as the type there is similar to the Indian track.

Antia, KF
New Book Company Private Limited Book 1960, 478 pp

ACKNOWLEDGMENT: New Book Company Private Limited
PURCHASE FROM: New Book Company Private Limited 188-190, Dadabhoy Naoroji Road, Bombay, India Repr PC

DOTL TF240.A6 1949

A2 046914
COMPUTERIZED TRACK MAINTENANCE. OUTLINE OF A PLAN THAT GOES ALL THE WAY
The possibility of raising track-work planning and execution to a highly proficient level by combining mechanical track measurement and electronic data processing in such a way as to exercise total control over mechanized field operations is suggested.

Railway Track and Structures Vol. 67 No. 3, Mar. 1971, pp 22-24

ACKNOWLEDGMENT: EI (EI73 79927)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

A2 046917
HOW IC INCREASES THE LIFE OF CURVE RAILS
After experimenting with two heats of rail steel in which the percentage of manganese was increased, the Illinois Central was able to obtain the prolonged service life of a rail on curves at a reasonable cost. By adding to the manganese content of the rail steel, a life expectancy four times greater than conventional rail on curves is expected.

Railway Track and Structures Vol. 66 No. 9, Sept. 1970, p 23

ACKNOWLEDGMENT: EI (EI 73 46972)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

A2 046918
NEW IDEAS WHEN LAYING WELDED STRINGS ON MOPAC
Two unusual features in operation of a rail-laying crew on the Missouri Pacific Main track near Berger, Mo are described. One was a spiking machine specially developed by Nordberg Manufacturing Co, for use when laying rail. The other was the practice of making provision for stress control in the long welded strings by stretching them mechanically when the temperature is below 75 degrees.

Railway Age Vol. 66 No. 6, June 1970, pp 20-22

ACKNOWLEDGMENT: EI (EI 73 08347)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

A2 046934
EFFECT OF BALLAST CONDITIONS ON TRACK STABILITY
It is shown how installation of long-welded rail on Europe's principal trunk routes has created problems of track stability caused by the presence of thermal stresses in the track, affected by local climatic conditions. The measurements obtained by the tests conducted at the Technical University in Munich, West Germany showed that the lateral resistance is greatest when the track has settled under traffic. After tamping combined with a rise of 2 to 3 cm, the lateral resistance decreases by approximately 70%.

Eisenmann, J (Munich Technical University); Gnad, H *Railway Gazette* Vol. 126 No. 9, May 1970, p 349

ACKNOWLEDGMENT: EI (EI 72 27294)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

A2 046935
CONCRETE TIES CAN BE INTERSPERSED
Kansas City Southern has in service about 78,000 prestressed concrete ties that have been interspersed with wood ties. Old wood ties are pushed out of track by Fairmont Tie Remover. Installation practice is based on a spacing for the concrete ties of 29-1/4 in. center to center. The concrete tie Model 4 GH used by the Kansas City Southern-Louisiana & Arkansas is 8 ft 6 in. long and is trapezoidal in cross section, with a top width at the rail seat of 9 in. and a base width of 12 in. It has a flat base for its full length. The depth at the rail seat is 7 in.

Railway Age Vol. 169 No. 3, Aug. 1970, pp 36-37

ACKNOWLEDGMENT: EI (EI 72 43778)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

A2 046943
NOTCH TOUGHNESS AND CRACK PROPAGATION RATE OF LOW CARBON STEEL ALLOY RAIL
A new movable nose crossing for Shinkansen is made of low carbon alloy steel. In order to test the mechanical properties of this steel, the falling weight test and the bending fatigue test have been done. These tests indicate that this steel has the sufficient mechanical properties.

Kurihara, T Sugiyma, T *Railway Technical Research Institute* Quart Rpt. Vol. 14 No. 2, 148, 1972, June 1973, pp 116-117, 4 Fig., 2 Tab.

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Ken-yusha #1-45-6, Hikari-cho, Kokubunji, Tokyo, Japan Repr PC

DOTL JC

A2 046945
EPOXY RESIN MORTAR IN RAILWAY TRACK
Formulation of epoxy resin mortar has been investigated widely to obtain a good gap-filling material for construction of ballastless track. The results of a series of laboratory experiments designed to determine the effect of type and quantity of fillers, curing agent systems and diluents on mechanical strength and curing rate are summarized.

Usami, T Kobayashi, T *Railway Technical Research Institute* Quart Rpt Vol. 14 No. 2, #165-1972, June 1973, pp 108-109, 4 Fig

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Japanese National Railways Kunitachi, Box 9, Tokyo, Japan Repr PC

DOTL JC

A2 046947
REMOVAL OF PRESSED AND FROZEN SNOW AT THE FLANGE WAY OF THE TRACK
For the project of the nation-wide SHIN KANSEN network, the counter-measure against snow along deep snowy lines is important. For example, it arouses anxiety that the pressed and frozen snow formed on the flange way of the track may influence the running stability of the high speed vehicles. The report is concerned with the fundamental tests which were carried out in order to develop the way and apparatus for removing it efficiently.

Ohyama, T Sekiguchi, H *Railway Technical Research Institute* Quart Rpt Vol. 14 No. 2, 217, 1972, June 1973, pp 104-105, 3 Fig

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Japanese National Railways Kunitachi, Box 9, Tokyo, Japan Repr PC, Microfilm

DOTL JC

A2 046953
DYNAMIC BEHAVIOR OF SHIN-KANSEN SLAB TRACK--TESTING RESULTS OF 951 MODEL TEST CAR
Slab track has been carried on research since 1965 by the Railway Technical Research Institute, JNR. This slab track is laid for test in many places and to be fully used for the future Shinkansen, Okayama-Hakata, Tokyo-Morioka and other railway tracks. This present report shows test results of dynamic behavior of Shinkansen slab track under high speed, max. 260 km/h. The test results confirmed that slab track has sufficient efficiency and is also safe.

Ikemori, M Higuchi, Y Sakamoto, S *Railway Technical Research Institute* Quart Rpt Vol. 14 No. 2, 131, 1972, June 1973, pp 85-87, 7 Fig, 1 Tab, 2 Ref

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: IPC (America), Incorporated 205 East 42nd Street, New York, New York, 10017 Repr PC

DOTL JC

A2 046957
DESIGN AND EARTHWORK OF CUTS AND FILLS FOR CONCRETE SLAB TRACK UPON SUBGRADE
A concrete slab track upon subgrade has been studied principally by the Ballastless Track Group of R.T.R.I., JNR. Fills for concrete slab track must be made carefully and a nature ground is limited on the good place on laying slab tracks. On cuts for slab track, a displace layer is important factor. The thickness of a displace layer is designed by the liquid limit of the cut ground. The subgrade for concrete slab track is used a better material than the fill and it is necessary that it is compacted by the enough energy for earth work.

Iwasaki, K Ito, T *Railway Technical Research Institute* Quart Rpt Vol. 14 No. 2, 814, 1972, June 1973, pp 67-71, 6 Fig, 2 Tab, 3 Ref

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Japanese National Railways Kunitachi, Box 9, Tokyo, Japan Repr PC

DOTL JC

A2 047374
USE OF AUTOMATIC WELDING ON FRENCH NATIONAL RAILWAYS FOR REPAIRING RAILS ON THE TRACK [LA REPARATION DES RAILS EN VOIE PAR SOUDAGE AUTOMATIQUE]
The authors describe how mechanization of manual electric arc-welding for repairs makes it possible to speed up the deposit of the metal and enable large defects to be rectified. The electrodes have had to be replaced by a welding wire consisting of a metallic ribbon enclosing a powdered substance. The design and operation of the equipment is discussed. [French]

Gence, P Hannebicque, L *Revue Generale des Chemins de Fer* Vol. 92 Feb. 1973, pp 114-119

ACKNOWLEDGMENT: EI (EI 73 028961)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

A2 047840
INSTRUCTIONS FOR THE CARE AND SAFE OPERATION OF WELDING AND GRINDING EQUIPMENT
There is in service on the railroads today a large amount of both oxacetylene and electric welding equipment, and grinding equipment used in connection with welding. Rules and regulations are essential for the safe efficient and economical operation and care of this equipment. These instructions cover all welding equipment, and grinding equipment used in connection with welding, used by the maintenance-of-way departments of the railroads, both in the field and in shops. They may be used as presented or modified to suit the conditions on a particular railroad.

Association of American Railroads 1960, 23 pp, 2 Tab

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AAR Repr PC

DOTL RP

A2 047908
MAINTENANCE OF RAILROAD TRACKS WITH CONSTRUCTION AND MAINTENANCE MACHINERY [MOEGLICHKEITEN DER MASCHINELLEN GLEISUNTERHALTUNG]
Modern track maintenance includes mechanical measuring and testing of the track, leveling, lateral alignment, tamping and consolidating the track, and ballast cleaning. The author describes the most important machines for track

maintenance and gives operating principles for track construction and maintenance machinery currently offered on the market. [German]

Schmidtalbers, K *Foerdern und Heben* Vol. 23 No. 2, Feb. 1973, pp 93-95, 7 Ref

ACKNOWLEDGMENT: EI (EI 73 038889)
PURCHASE FROM: ESL Repr PC, Microfilm

A2 047963
WMATA BUILDS 98-MILE SUBWAY, 86 STATIONS, OPEN IN 1974
This article describes the Washington Metro new under construction, and expected to cost $3 billion. A referendum resulted in a large favorable vote for the system. The article discusses station design, advanced car design, and track designs contributing to quiet operation.

Myers, ET *Modern Railroads* Vol. 28 No. 9, Sept. 1973, pp 105-108

PURCHASE FROM: Cahners Publishing Company, Incorporated 5 South Wabash Avenue, Chicago, Illinois, 60603 Repr PC
DOTL JC

A2 047994
DEVELOPMENT OF THE CONCRETE SLAB TRACK ON FLEXIBLE PAVEMENT
A concrete slab track of RA type to be laid on an earth layer which had been stabilized by asphalt treatment and supported on a firm roadbed and embankment, has been developed. The results of static and dynamic tests performed on an experimental track section constructed with RA type structure revealed its effectiveness in fulfilling the requirements. The strength of mortar filling between the slab and the pavement intended for resisting the track lateral force has also been confirmed by the tests. At present, such track sections are being used in revenue service lines with excellent performance.

Satoh, Y Higuchi, Y Saito, T *Railway Technical Research Institute* Quart Rpt Vol. 14 No. 1, Mar. 1973, pp 25-28, 8 Fig, 1 Tab

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Japanese National Railways Kunitachi, Box 9, Tokyo, Japan Repr PC
DOTL JC

A2 048002
NEW RAIL STEELS FOR HEAD-HARDENED CROSSINGS OF WELDED CONSTRUCTION
The progress of a research on the composition of low alloy rail steels used in the fabrication of head-hardened crossings of welded construction in the technical research project of JNR "Research and Development of Turnouts for high train speed in narrow-gauge tracks" during 1968-1971 was reported.

Ito, A *Railway Technical Research Institute* Quart Rpt Vol. 14 No. 1, Mar. 1973, pp 58-59, 3 Tab

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Japanese National Railways Kunitachi, Box 9, Tokyo, Japan Repr PC
DOTL JC

A2 048075
THE EFFECT OF SURFACE FILMS ON FATIGUE CRACK INITIATION
The suppression of fatigue crack initiation by surface films can be viewed in terms of two mechanisms: (1) protection against environmental attack, and (2) suppression of surface plasticity. These two mechanisms are described in detail. Environmental protection requires a flawless coating which is impermeable to the active component of the environment and resistant to fracture under repeated cyclic strain. Suppression of plasticity requires a film with an elastic modulus greater than the substrate metal. The stiffer coating repels dislocations from the surface and suppresses the development of slip bands and crack initiation. (Author)
Availability: Pub. in Corrosion Fatigue, p201-210 1972.

Crosskeutz, JC
Midwest Research Institute Tech Rpt TR-12, 1972, 14 pp

Contract N00014-71-C-0020

ACKNOWLEDGMENT: NTIS (AD-760072)
PURCHASE FROM: NTIS Repr PC, Microfiche
AD-760072, DOTL NTIS

A2 048160
SLAB TRACK FOR RAPID TRANSIT
To avoid the costly and time-consuming task of preparing holes for fixings in a concrete slab, the Koln transport undertaking has developed a method of tracklaying in which a concrete beam is poured beneath rails and fixings already positioned on temporary supports.

Railway Gazette International Vol. 129 No. 7, July 1973, 2 pp, 2 Fig

PURCHASE FROM: IPC Transport Press Repr PC
DOTL JC

A2 048276
SOME ASPECTS OF DESIGN OF MONOBLOCK PRESTRESSED CONCRETE SLEEPERS
The author discusses the formulae adopted by different railways (the German Federal Railway, the American railways, the Japanese railways, the railways in the Soviet Union, British Raiwlays, the French Railways, and the Italian Railways) in regard to design, dimensions, loading estimates, the reaction of the ballast, flexion, the quality of the concrete, the reinforcement, the rate of compression of the concrete, and the acceptable prestressing tolerances.

Sikka, NK Singh, SP *Indian Railway Technical Bulletin* No. 185, May 1972, 12 pp, 14 Fig, 7 Tab, 17 Ref

ACKNOWLEDGMENT: International Railway Documentation (322)
PURCHASE FROM: International Union of Railways, BDC 14 rue Jean Rey, 75015 Paris, France Repr PC
DOTL JC

A2 048277
EVALUATION OF THE BRITTLE FRACTURE OF RAILS [SPRODBRUCHABSCHATZUNG AN SCHIENEN]
The testing of rails provided for in the technical specifications of the railways (and particularly the UIC) gives incomplete information concerning the behaviour of rails subjected to certain frequent stresses in service, such as the effect of impacts caused by flats on the wheel treads. The author's purpose is to establish more satisfactory criteria for evaluation purposes, taking into account the triaxial character of the pressure in the rails by making use of the Schnadt diagram covering the index of the capacity of plastic deformation of the steel in relation to the pressures to which it is subjected. The above article contains an account of the work carried out by the author in order to establish characteristic parameters of the risk of brittle fractures of the rails in relation to a coefficient covering eventual cracks, or grooves, in the rail surface, as well as the temperature, the load, and the speed, and numerical formulae are provided covering the German State Railway's S 49 rails. [German]

Tutzchky, G *Deutsche Eisenbahntechnik* No. 9, 1972, 4 pp, 7 Fig, 16 Ref

ACKNOWLEDGMENT: International Railway Documentation (326)
PURCHASE FROM: International Union of Railways, BDC 14 rue Jean Rey, 75015 Paris, France Repr PC

A2 048285
M/W PRODUCTIVITY: "GOOD MACHINES ARE NO GOOD STANDING IDLE"
Machines that will perform work better, faster and with fewer men are one way to greater productivity in the maintenance-of-way department--but not the only one. Maybe it's not even the most important means of making the most effective use of the M/W dollar. Certainly, it's important for a railroad to have the latest machines for maintaining track. But the interests of productivity are not being served if this equipment speeds a good part of the working hours sitting idle because trained personnel is lacking for making repairs when breakdowns occur. Neither are the interests of optimum productivity being served if price or cost is put ahead of durability in the purchase of materials or in the conduct of work.

Railway Age Vol. 174 No. 17, Sept. 1973, 5 pp, 9 Phot

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

A2 050028
MILE-LONG TRACK BUILT ON CONTINUOUS CONCRETE SLAB
Reinforced concrete roadbed, produced with close surface tolerances, is constructed by off-track, crawler-mounted 'paving' train. Paving train includes a unit for receiving concrete from ready-mix trucks and feeding it to an overhead conveyor system, traveling gantries that carry welded grids of steel reinforcement, and a slip-form paver.

Railway Track and Structures Vol. 69 No. 4, Apr. 1973, pp 28-29

ACKNOWLEDGMENT: EI (EI 73 030502)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

A2 050035
SPECIAL TECHNIQUES DEVELOPED FOR BUILDING ARIZONA LINE
Coal-haul railroad has concrete ties, butt-welded rail, 'glued' closure joints. Construction procedure involves novel system and equipment for distributing ties on subgrade to proper spacing and alignment. The electrified line, 78 miles long, is being built to carry coal from the Black Mesa coal fields in Arizona to an electric generating station near Page, Ariz. The concrete tie used is the Gerwick RT-7 tie.

Railway Track and Structures Vol. 68 No. 9, Sept. 1972, pp 24-28

ACKNOWLEDGMENT: EI (EI 73 001210)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

A2 050072
EFFECT OF FLAT WHEELS ON TRACK AND EQUIPMENT
Although old, this work is generally considered to be an excellent reference on this subject. The report describes the Test Apparatus and the Tests, presents the results of the tests, and presents some conclusions from the tests. The conclusions cover the effect of train speed, the effect of flat spot length, the effect of wheel load, and the impact force of a flat spot; and recommend guidelines for removing wheels from service and for running cars with flat wheels to terminals for service.

Association of American Railroads Technical Center May 1951, 81 pp, 27 Fig, 3 Tab, 9 Ref

ACKNOWLEDGMENT: Association of American Railroads Research Center (f4196)
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr PC

DOTL RP

A2 050083
RAIL STEELS: STRONGER, HARDER OR TOUGHER?
A conflict emerged at an Iron and Steel Institute Conference, held in London recently, between the commercial demand for steels that resist wear and the requirements to reduce the number of brittle fractures likely to occur which might lead to derailment.

Railway Gazette International Vol. 128 No. 12, Dec. 1972, pp 471-472

ACKNOWLEDGMENT: British Railways (29078)
PURCHASE FROM: IPC Transport Press Repr PC

DOTL JC

A2 050361
MECHANISED MAINTENANCE MACHINE DEVELOPMENT
In the early 1960's a series of machines were introduced which not only consolidated the track but corrected errors in varying degrees depending on how they were used. The Plasser-04, the Plasser-05, the Plasser-AL203, the Plasser 06-32, the Matisa, the Universal C.T.M. and others are described. One aspect of tamping calibration is studied in detail.

Pearson, DC Fawcett, BC *Permanent Way Institution, Journ & Rpt of Proceed* Proceeding Vol. 91 No. t1, 1973, pp 44-50, 4 Fig

PURCHASE FROM: Derry and Sons, Limited Canal Street, Nottingham, England Repr PC

DOTL JC

A2 050368
EFFECT OF TRACK GEOMETRY ON RIDE QUALITY
Track measuring cars provide an indication of what is off-standard in a section of track but give little indication of which variables are the most crucial to the production of a good ride. An approach which is being employed in an attemtp to bridge the gap between the track geometry and the quality of ride obtained on a given track section is described. Some preliminary results and conclusions are presented.

Ullman, KB (Department of Transportation); O'Sullivan, WB *IEEE Transactions on Industry & Genrl Applications* Vol. IGA-7, No. 6, pp 755-759

ACKNOWLEDGMENT: EI (EI 72 33184)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

A2 050369
TRACK FOR HIGHER SPEEDS
The paper reviews the studies conducted and practices adopted on various railroads in the world for attaining higher speeds, and experiments that are conducted in developing a continuous concrete bed with elastic pads between rail and the bed to meet needs of future higher speeds.

Ponnuswamy, S *Institution of Eng (India) Journal, Civil Eng Div* Vol. 52 No. 3, Part CI2, Nov. 1971, pp 86-93, 10 Ref

ACKNOWLEDGMENT: EI (EI 72 54802)
PURCHASE FROM: ESL Repr PC, Microfilm

A2 050375
VIBRATOR ASSURES LENGTH ADJUSTMENTS IN LONG RAILS
Machine developed by Union Pacific is designed to vibrate rail strings while they are being laid to facilitate changes in length in response to being heated or cooled. The vibrator is a track-mounted machine which has two rail vibrators, one for each rail, which are independent of each other. In each case the vibration is created by an eccentrically counterbalanced shaft in a hydraulic motor.

Railway Track and Structures Vol. 67 No. 6, June 1971, pp 26-27

ACKNOWLEDGMENT: EI (EI 73 57386)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

A2 050381
WHAT PRECAUTIONS WHEN WORKING CWR TRAFFIC
Report on the subject of when and how to timber and surface locations having continuous welded rail to avoid or minimize expansion or contraction. Prepatory measures taken to tie the renewals under continuous welded rail.

Sorrels, BD *Railway Track and Structures* Vol. 67 No. 11, Nov. 1971, pp 26-27

ACKNOWLEDGMENT: EI (EI 72 39995)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

A2 050383
SANTA FE-DOT TEST TRACK: 'SUBSTANTIAL STEP IN LONG JOURNEY'
The test track nearing completion is located in heavy freight-traffic territory, include concrete ties, beams and slabs. Sophisticated instrumentation, including a load-cell" tie specially designed for this project, will be used to monitor the performance of the test components.

Railway Track and Structures Vol. 68 No. 7, July 1972, pp 14-19

ACKNOWLEDGMENT: EI (EI 72 072048)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

A2 050388
EXPERIMENTS WITH SOLID CONCRETE TRACK-BEDS
Study of the possibility of replacing conventional tie track in stone ballast by a solid concrete track-bed, either laid in-situ as a continuous slab or in the form of precast beams or panels. Experiments in Japan, West Germany and Italy are described.

Railway Gazette International Vol. 127 No. 8, Aug. 1971, pp 316-318

ACKNOWLEDGMENT: EI (EI 72 26035)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

A2 050408
SPECIAL FEATURES UNDERSCORE CHANGING TIMES FOR ENGINEERS
Speakers at the American Railway Engineering Association convention at Chicago examine broad range of subjects including research, new challenges to engineers, the Track Safety Standard and engineering education.

Railway Track and Structures Vol. 69 No. 4, Apr. 1973, pp 18-21

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

A2 050412
SLEEPERS--A WIDE-AWAKE APPROACH TO TRACK PROBLEMS
In the early days of railroad development, few problems were encountered in the provision of cross ties; mainly they were extracted from nearby forests. As railroad development in South Africa picked up after World War I, indigenous sources of timber became inadequate and recourse was had to the import of hardwood cross ties from Australia, Rhodesia and the Far East. The development locally of concrete cross tie manufactere was a logical development after the Second World War and now home-made cross ties dominate the railroad scene pretty well throughout Southern Africa. Steel cross ties, concrete cross ties, and cross ties and rail failures are discussed.

Railway Engineering Vol. 17 No. 1, Jan. 1973, 4 pp

PURCHASE FROM: Thomson Publications SA (Pty) Limited P.O. Box 8308, Johannesburg, South Africa Repr PC
DOTL JC

A2 050444
THE REPAIR OF RAILS ON THE TRACK BY MEANS OF AUTOMATIC WELDING [LA REPARATION DES RAILS EN VOIE PAR SOUDAGE AUTOMATIQUE]
The introduction, by the SNCF, of automatic welding for the repair, on the track, of traces of slipping, and rail ends, has enabled considerable savings to be effected. [French]

Gence, P Hannebicque, L *Revue Generale des Chemins de Fer* Feb. 1973, 6 pp, 14 Fig, 3 Ref

ACKNOWLEDGMENT: International Railway Documentation
PURCHASE FROM: International Union of Railways, BDC 14 rue Jean Rey, 75015 Paris, France Repr PC
710, DOTL JC

A2 050446
PERMANENT WAY. HOW TRACKMEN COMBAT UNIT TRAIN DAMAGE
Reviews some of the problems caused to permanent way engineers and maintenance men by day-to-day running of high-axle-load unit trains, often at higher speeds, particularly in those countries where timber sleepers are still widely used.

International Railway Journal Vol. 13 No. 3, Mar. 1973, 5 pp, 3 Phot

ACKNOWLEDGMENT: International Railway Documentation
PURCHASE FROM: International Union of Railways, BDC 14 rue Jean Rey, 75015 Paris, France Repr PC
723, DOTL JC

A2 050453
RAIL RESEARCH–PROBLEM DEFINITION
This report presents a background study of rail design, the chemical composition and heat treatment of rail steel, the manufacturing and rolling of rail steel and the use of continuous welded rail. Problem areas of each are reviewed. A discussion of the defects associated with rail, and the background and techniques of rail defect (flaw) detection is also presented.

AREA Bulletin Vol. 75 No. t1, Sept. 1973, p 1

ACKNOWLEDGMENT: AREA
PURCHASE FROM: AREA Repr PC

A2 050455
CONCRETE TIES
This specification is intended to provide necessary guidance in the design, manufacture and use of concrete ties and their components for main line standard gage railway track systems. The specification contains minimum performance requirements of components for concrete tie railway track based on a variety of permissible tie spacings and ballast depths. Track constructed of tie and fastener components meeting the specifications applicable to the anticipated usage should be expected to give satisfactory performance under current AAR-approved maximum axle loads. The specification covers materials, physical dimensions, and structural strength of prestressed monoblock and prestressed and conventionally reinforced two-block concrete ties. In addition, longitudinal and lateral load restraint requirements as well as the electrical performance requirements of rail fastener and tie combinations are given. Laboratory tests for the determination of the suitability of new designs are specified, as are necessary quality-control procedure during manufacture. The specification does not cover techniques nor equipment for the manufacture of concrete ties or fastenings. Where current specifications or recommended practices of other technical societies, such as the American Society for Testing and Materials or the American Concrete Institute, are appropriate, they are made part of this specification by reference.

AREA Bulletin Vol. 75 Sept. 1973, p 85

ACKNOWLEDGMENT: AREA
PURCHASE FROM: AREA Repr PC

A2 050456
TIE RENEWALS AND COSTS
Statistics providing information on cross tie renewals and average tie costs for the year 1972, as compiled by the Economics and Finance Department, Association of American Railroads, are presented on the following pages in Tables A and B. Table C shows the number of other than wooden cross ties (concrete ties) laid in replacement and in new construction. Table D shows typical prices paid for wooden cross ties in the East, South and West. By geographical districts, the Eastern Roads inserted in replacement 55 ties per mile, the Southern Roads 115 ties per mile and the Western Roads 64 ties per mile.

AREA Bulletin Vol. 175 Sept. 1973, p 133

ACKNOWLEDGMENT: AREA
PURCHASE FROM: AREA Repr PC

A2 050461
TIMBER DOMINATES SYDNEY SLEEPER CONFERENCE
Developments in preservative techniques now make it possible to use a wider range of timbers for sleeper manufacture, but the economic balance may well have swung in favour of concrete before 2000.

Railway Gazette International Vol. 129 No. 10, Oct. 1973, 2 pp

PURCHASE FROM: IPC Transport Press Repr PC
DOTL JC

A2 050467
FIRST TUNNEL SECTION OF SLAB TRACK ON BR
Britain's first section of concrete slab track in tunnel is being laid in Glasgow as part of preparatory work for the extension of main line electrification next May. Two tunnels carrying sharply-curved fast and slow lines beneath Eglinton Street and Pollokshaws Road are being equipped with 463-m lengths of slab track to give adequate clearance for catenary in a situation

where the use of conventional ballasted track would have been extremely costly.

Railway Gazette International Vol. 129 No. 10, Oct. 1973, 1 pp

PURCHASE FROM: IPC Transport Press Repr PC

DOTL JC

A2 050478
PROBLEMS OF TRACK MAINTENANCE FOR HIGH SPEED
The replacement of steam by diesel and electric traction, high speeds, axles carrying a weight of 25 t on rail and very heavy merry-go-round trains, place more severe strain on the permanent way. This position is made manifest, inter alia, by the duplication of rail cracks and ruptures since 1960, and necessitates the revision of the track building and maintenance standards. The author reviews the research and activities carried out, with this object, through modification of the track and vehicles. The article contains a review of a number of special problems--pollution of the ballast by mud seeping through, the frittering away of the ballast, the poor holding qualities of the rail fastenings, joints, and the organization of the maintenance sites.

See also "Forward Thoughts on Permanent Way" by A.W. McMurdo in the same issue.

Rees, P *Permanent Way Institution, Journ & Rpt of Proceed* Vol. 90 No. tIII, 1972, 15 pp, 7 Fig, 6 Tab

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Derry and Sons, Limited Canal Street, Nottingham, England Repr PC

DOTL JC

A2 050483
CONCRETE SLAB TRACKS
A 16-km stretch of concrete slab track upon which trains have run at 210 km/h has proved to be better than ballast tracks with respect to riding quality and manpower savings in track maintenance. Concrete slab track has been chosen as the standard structure of tracks on the nationwide Shinkansen network.

Watanabe, Y *Japanese Railway Engineering* Vol. 13 No. 4, 1972, pp 21-22

ACKNOWLEDGMENT: British Railways (29634)
PURCHASE FROM: Japan Railway Engineers' Association P.O. Box 605, Tokyo Central, Tokyo, Japan Repr PC

DOTL JC

A2 050488
DYNAMIC RESPONSE OF RC SLAB BRIDGE TO PASSAGE OF VEHICLES
The dynamic response of simple beams in railway bridge is shown. The analysis takes into account the dynamics of bridge and four moving vehicles. Applying to the slender reinforced concrete slab bridge of Shinkansen, the dynamic bending moment and deflection are calculated, and they are compared with the results of the measurement of a Shinkansen bridge.

Okada, K *Railway Technical Research Institute* Quart Rpt Vol. 14 No. 1, Mar. 1973, pp 14-15, 5 Fig

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Japanese National Railways Kunitachi, Box 9, Tokyo, Japan Repr PC

A2 050537
COMPUTERS AND MECHANISED TRACK MAINTENANCE
An initial breakdown of track maintenance work reveals four major functions: track measuring and recording, classification and evaluation, actual performance of the work and checking and inspection. The Nepture System, which is a complete system of track fault analysis and correction comprised of four major parts (the track recording vehicle, Neptune computer analyser, maintenance planning and direction of mobile gangs to trouble spots) is presented.

Eden, GA *Railway Engineering Journal* Vol. 2 No. 1, Jan. 1973, 13 pp

PURCHASE FROM: ESL Repr PC, Microfilm

DOTL RP

A2 050563
WHY RAILROADS ARE BEEFING UP THEIR FIXED-PLANT EXPENDITURES
This report looks at four aspects of productivity-boosting plant spending: improved tools and methods for maintenance, terminal improvements, upgrading of line, and the redistribution of plant assets.

Railway Age Vol. 174 No. 10, May 1973, 7 pp, 2 Fig, 1 Phot

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

A2 050598
TECHNICAL ASPECT OF HIGH-SPEED TRAIN OPERATION: TRACK AND ELECTRIC INSTALLATIONS ON HIGH-SPEED LINES [L'ASPECT TECHNIQUE DES GRANDES VITESSES: LA VOIE ET LES INSTALLATIONS ELECTRIQUES DES LIGNES A GRANDE VITESSE]
The problems raised by trains travelling at 260-300 km/h are related essentially to vehicle operating stability and track stability, and have been substantially solved at the present time. Without going into the details of calculations, these problems are discussed along with the results of theoretical studies and tests. The techniques and approaches used can, for the most part, be regarded as operational today. The speed of the wheel-rail system is certainly not limited to 300 km/h: faster trains would raise economic as well as technical problems. In spite of the efforts made to raise speeds on existing lines, it is not possible to exceed 200 km/h on these lines, owing to the infrastructure which dates back to the last century, except on short stretches where high-speed tests have been conducted. The design of the infrastructure and superstructure (track, signalling and catenaries) of new allowing train speeds of 300 km/h is described in the article along with the engineering studies which have been making increasingly greater use of data processing techniques. [French]

Prud'homme, A Weber, O *Travaux* No. 460-462, Aug. 1973, pp 26-46

ACKNOWLEDGMENT: Federation Nationale des Trav Publ & des Synd Aff
PURCHASE FROM: ESL Repr PC, Microfilm

A2 050609
UNCONVENTIONAL TRACKS
Initial interest of ORE Specialists Committee D 87 in slab tracks was in relation to lines through tunnels under cities. Increasing interest in unconventional tracks for wider application persuaded the Control Committee to extend the terms of reference and a second enquiry was seen as a preliminary step in revising the working programme. The questionnaire sent to Administrations is appended to this ((Enquiry Report)) which summarises response from twenty-four Administrations.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways D87/RP 5/E, Oct. 1971, 21 pp, 1 Fig., Refs., Apps.

ACKNOWLEDGMENT: International Railway Congress Association
PURCHASE FROM: UIC Repr PC

DOTL RP

A2 050612
PROBLEMS OF CONSTRUCTION OF PERMANENT WAY OUTLAYS FOR INTRODUCTION OF HIGH-SPEED PASSENGER TRAINS
The main requirements for the reconstruction of permanent way outlays of existing railways when high-speed passenger trains are introduced, depend on the following factors: 1. Level of maximum speeds of passenger trains; 2. Level of maximum speeds of freight trains; 3. Number of passenger and freight trains and their weights; 4. Parameters of existing permanent way outlays; 5. Economical expediency of expenditure for the reconstruction of the outlay for the given railway section to ensure the required speed as compared with reduced speed as a variant.

Ioanisyan, AI (Institute of Railway Engineers, Moscow) *Rail International* No. 5, May 1973, pp 615-624, 8 Fig, 4 Tab, 7 Ref

PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

A2 050631
INFRASTRUCTURE IMPROVEMENT AND EXTENSION [RENOVATION ET EXTENSION DE L'INFRASTRUCTURE]
The author explains the whole range of measures intended to modernize and extend the infrastructure which have become necessary because of the age of a large proportion of the installations, generally largely dimensioned when they were built, and because of the enormous and constant development of passenger traffic. He provides details of the steps taken to improve technically the infrastructure (new and Modernized electrification, trebling or quadrupling of lines, signalling, traffic control, intermediate termini, etc.); the improvement of installations, especially stations, in respect of safety, capacity, convenience and comfort. He then deals with new infrastructure planned in Paris (interconnections, underground stations, Orsay-Invalides junction line, etc.) and the suburbs (services to new towns, airports, etc.). [French]

Legrand, M *Revue Generale des Chemins de Fer* Apr. 1973, pp 218-221, 2 Fig

ACKNOWLEDGMENT: French National Railways
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

A2 050727
ON THE STABILITY OF THE RAILROAD TRACK IN THE VERTICAL PLANE
The report reviews and discusses various aspects of railroad track buckling in the vertical plane. Buckling tests of straight tracks are reviewed first. A review of the published analyses on vertical track buckling reveals that they may be grouped into two main categories. In one category, the authors assume that the track is an elastic beam which is continuously supported by a Winkler base, before as well as during buckling. In the other group, the authors assume that the track is a beam of uniform weight, which rests on a 'rigid' base and that the buckling load is reached when part of the track lifts itself off the base. To clarify the validity of some of the assumptions made, two simple models which represent the assumptions made are studied first. This is followed by a review of the literature. (Modified author abstract)

Kerr, AD
New York University, Bronx NYU-AA-72-35, Nov. 1972, 39 pp

Contract DOT-FR-20064

ACKNOWLEDGMENT: NTIS (PB-222362/6)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-222362/6

A2 050868
DYNAMIC VARIATION OF WHEEL LOAD ATTRIBUTED TO VERTICAL DEFORMATION OF RAIL END
Vertical deformation of rail end within the allowable tolerance when supplied from manufacturer often causes unevenness of running surface of rail at welded rail. The transient vibration caused by this local unevenness at welded part was theoretically discussed for the vehicle-track vibration system. The relationships among train speed, length of unevenness, spring coefficient of rail support, damping coefficient of rail support and dynamic variation of wheel load were discussed.

Kuroda, S *Railway Technical Research Institute* Quart Rpt Vol. 14 No. 3, Sept. 1973, pp 143-144, 5 Fig

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

A2 051346
M/W PROBE NUMBER 1--THE UNION PACIFIC
Six related articles, all dealing with the Maintenance of Way Practices on the Union Pacific Railroad, are presented. Subjects covered included track standards, welded rail, organization of M/W gangs, the Track Recorder Car, and bridges.

Railway Track and Structures Vol. 69 No. 6, June 1973, 18 pp

PURCHASE FROM: XUM Repr PC
DOTL JC

A2 051367
SURFACE FINISHING ON RAIL HEADS ON THE GERMAN FEDERAL RAILWAY
The Author deals with the need for regular grinding of rail heads on railway tracks, for which purpose the German Federal Railway has employed the "Speno" rail-grinding train since 1968. Its design, use and results obtained are described here. [German]

Deckart, H *Eisenbahntechnische Rundschau* Vol. 22 No. 7/8, July 1973, 8 pp

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: Hestra-Verlag Hernichel und Dr. Strasse, Darmstadt, West Germany Repr PC
DOTL JC

A2 051370
NEW ALLOY FIGHTS CORROSION AND WEAR
Some metal alloys are wear resistant, some are corrosion resistant, and some are relatively easy to fabricate. But try to find an alloy that rates high in all three areas. After a long development program, metallurgists have come up with a series of alloys that combines these three unusual characteristics. These proprietary, intermetallic alloys are based on cobalt or nickel, and they're called Tribaloy.

Cameron, CB Ferriss, DP *Machine Design* Vol. 45 No. 19, Aug. 1973, 5 pp

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

A2 051388
DB TESTS SLAB TRACK IN A 250 KM/H LINE
Concrete slab track was laid by DB in its first 200 km/h section in 1967. Settlement averaged 6 mm, and after six years it has ceased. Prof. Dr.-Ing. F Birmann describes further tests with two types of slab track now being subjected to 250 km/h running.

Birmann, F *Railway Gazette International* Vol. 129 No. 12, Dec. 1973, pp 474-475, 3 Fig

ACKNOWLEDGMENT: Railway Gazette International
PURCHASE FROM: IPC Transport Press Repr PC
DOTL JC

A2 051452
FIFTEEN YEARS OF OPERATION OF A NEW TYPE OF STRUCTURE FOR TRACK AND POINTS OF THE ITALIAN NATIONAL RAILROAD AND TRAMWAY ASSOCIATION [QUINDICI ANNI DI ESERCIZIO DI UN NUOVO DI STRUTTURA PER BINARI E SCAMBI DELLA SOCIETA NAZIONALE DI FERROVIE E TRANVIE]
With the aim of reducing maintenance costs of track and points of traditional structure, and, in particular, abolishing expenditure connected with the renewal and maintenance of the ballast, since 1956 experiments have been made by the "Societa di Tranvie e Ferrovie" with a new type of track and points on certain bridges and approaches, on certain stations, yards, and siding tracks and points, on a gage line with 36 UNI 3141 rail. In summarizing the elements emerging from experience obtained, the first conclusions are given with regard to plant and maintenance costs. [Italian]

Zaquini, G *Ingegneria Ferroviaria* No. 3, Mar. 1973, pp 249-258

ACKNOWLEDGMENT: EI (EI 74 057048)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

A2 051462
CN TESTS CONCRETE TIES FOR MORE DURABLE TRACK
Canadian National completed construction of a concrete-tie test track to test the over-all function of its components under heavy-train operation, rather than testing specific components. Some results are discussed.

Railway Age Vol. 174 No. 5, Mar. 1973, pp 22-24

ACKNOWLEDGMENT: EI (EI 74 025367)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

A2 051535
A TRACK CURVATURE MEASURING SYSTEM AND ITS APPLICATION

A track curvature measuring system has been designed and installed in the Department of Transportation's rail test car by ENSCO, Inc. The system employs an inertial rate-of-turn gyroscope to measure the yaw rate of the car, an axle-driven tachometer to measure speed, and velocity transducers to measure the relative motions between the car and the trucks. An analog circuit receives these inputs and performs the curvature computation. The system is capable of making continuous curvature measurement at any speed greater than 3 mph at either direction of travel. The system performance and various applications of the data are demonstrated. Schemes for detecting undesirable superelevation and curvature mismatches are discussed.

Contributed by the Intersociety Committee on Transportation for presentation at the Intersociety Conference on Transportation, Denver, Colo., Sept. 23-27, 1973.

MacIntyre, SA May, JT (ENSCO, Incorporated)
American Society of Mechanical Engineers Paper 73-ICT-110, Sept. 1973, 8 pp, 11 Fig

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL RP

A2 051536
APPLICATION OF GUIDEWAY ROUGHNESS POWER SPECTRAL DENSITY AS A MANAGEMENT TOOL

Ground surface vehicles such as trucks or railway cars can be considered as mechanical systems suspended on vibrating wheels. The source of vibrational energy is the roughness in the roadway or the guideway. A portion of the vibrational energy is transmitted through the vehicle suspension system and to the passengers or lading inside the vehicle. The magnitude of the transmitted energy and its frequency content depend on the roughness of the surface, the speed of the vehicle, and the mechanical characteristics of the suspension system. If the roads and guideways are categorized by the Power Spectral Density (PSD) of their surface roughness, the amount of vibrational energy can be predicted if the speed and the characteristics of the vehicle suspension system are known. Conversely, if a safe limit of the vibration has been established for a particular lading, management can render a cost effective decision on guideway maintenance, speed practices, and vehicle design from knowledge of the PSD characteristics of a proposed route.

Contributed by the Intersociety Committee on Transportation for presentation at the Intersociety Conference on Transportation, Denver, Colo., Sept. 23-27, 1973.

Corbin, JC Yang, TL (ENSCO, Incorporated)
American Society of Mechanical Engineers Paper 73-ICT-114, Sept. 1973, 8 pp, 3 Fig, 11 Ref

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL RP

A2 051915
FRACTURE MECHANICS--ONLY A THEORY?

Fracture Mechanics, a new branch of the fields "Material Research" and "Theory of Strength of Materials" has during the last 5 years been introduced into the European Technical Literature. This branch deals with research on non-deformed brittle fractures in high tensile materials. Suitable functions have been established for different shapes of cracks but these functions include only the tension in the undisturbed zone and the shape of cracks, and it is thus possible to detect the stress intensity at the tip of the crack. The critical stress intensity during spontaneous crack widening (i.e. at failure of the test specimen or the structural member) is concurrently the material characteristic. This offers the possibility to calculate the allowable crack dimensions in structural members. So far the method is still limited to materials of ideal elasticity, i.e. to brittle materials, but there is reason to hope that it can be expanded to more common tough materials. [German]

Kalkbrenner, E *Glasers Annalen ZEV* Vol. 97 No. 9, Sept. 1973, 4 pp

ACKNOWLEDGMENT: British Railways (29822)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

A2 051964
STRESSES TO WHICH THE TRACK, THE BALLAST, AND THE SUBGRADE ARE SUBJECT, UNDER THE ACTION OF MOVING LOADS [SOLLICITATIONS DE LA VOIE, DU BALLAST ET DE LA PLATE-FORME SOUS L'ACTION DES CHARGES ROULANTES.]

The above article contains a synthesis of the research carried out by ORE D 71 Committee. Details are shown, in a condensed form, of the partial results set out in the 12 reports prepared by that Committee. So far as concerns research into the stresses to which the fastenings and sleepers are subjected, additional information is provided, showing the present concerning the studies carried out by the SNCF, after the general report had been drawn up. Progress effected in the field of the extensometric technique enables certain pressures to be more clearly established, and the use to be avoided of corrective coefficients, or empirical formulae, for the study of the rheological characteristics of the ballast and the subgrade. These investigations are carried out within the framework of research into the interaction between the track and the vehicle, and the optimum equipment of the conventional track. [French]

Revue Generale des Chemins de Fer May 1973, 11 pp, 5 Fig

ACKNOWLEDGMENT: UIC (1017)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

A2 051965
TRACK WITHOUT BALLAST [LA VOIE FERREE SANS BALLAST]

Non-ballasted track is a necessity from the point of view of a reduction in the cost of maintenance on main lines, and particularly in tunnels, and on underground railways. The constitution of non-ballasted track, i.e. continuously welded rails on RS concrete sleepers on continuous reinforced concrete slabs, with resilient sleeper pads placed between, resolves the problems of the transmission of the pressures to the track formation, the damping of the vibrations, the permanency of the track geometry, and, therefore maintenance. It is of advantage to make use of lightweight aggregates for the continuous reinforced slab, principally because of the small modulus of elasticity of the lightweight concrete. [French]

Ronsse, A Swartele, L *Revue Belge du Transport* No. 3, 1972, 5 pp, 1 Fig

ACKNOWLEDGMENT: UIC (1015)
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr PC
1015, DOTL JC

A2 051968
TECHNICAL PROBLEMS CONCERNING HIGH-SPEED TRANSPORT [TECHNISCHE PROBLEME DES SCHNELLVERKEHRS]

Based on the operating programme, and the problems of high-speed rail transport, details are shown of high-speed passenger coaches, and goods wagons. Solutions to tractive and braking problems are then discussed. Details are also shown of the effects of high-speeds on the layout, and deformation, of the track. Based on the terms "dependability" and "security", a description is given of a data-processing system. Finally, the authors deal with the necessity of research and development. [German]

Rahn, T Althammer, K Bischofberger, G Zeilhofer, M *Glasers Annalen ZEV* No. 2/3, 1973, 9 pp, 15 Fig, 3 Ref

ACKNOWLEDGMENT: UIC (996)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

A2 052090
WHAT BENEFITS FROM BALLAST COMPACTION?

An answer is sought through a research program undertaken jointly by the Federal Railroad Administration and five large railroads. A factor behind the undertaking is the reasoning that the disturbance of the ballast that takes

place during a track-surfacing operation has the effect of diminishing the restraint offered by the ballast to lateral and longitudinal movement of the track.

Railway Track and Structures Vol. 70 No. 2, Feb. 1974, 5 pp, Figs, Phots

ACKNOWLEDGMENT: Railway Track and Structures
PURCHASE FROM: XUM Repr PC

DOTL JC

A2 052100
AUSTRALIA HOLDS AN INTERNATIONAL CONGRESS ON SLEEPERS
Thirty papers presented in Sydney in August cover fully technical matters relating to timber sleepers against an Australian background but concrete and steel tend to figure in the presentation as equipments still in the development stage and are little discussed. Nevertheless, if the balance between prime and labour costs changes and the long-life of concrete outweighs its cost disadvantage, timber will take second place in Australia and New Zealand.

Rail Engineering International Vol. 4 No. 1, Jan. 1974, 10 pp, 8 Fig, 5 Phot

ACKNOWLEDGMENT: Rail Engineering International
PURCHASE FROM: Broadfields (Technical Publishers) Limited Little Leighs, Chelmsford, Essex CM3 1PF, England Repr PC

DOTL JC

A2 052120
NEW YARD CLEANER TACKLES MISSISSIPPI MUCK
Features of machine described include rubber-tired mounting, the use of electric motors for powering rotative operations and a drag chain for distributing material in car in which it is loaded.

Railway Track and Structures Vol. 69 No. 9, Sept. 1973

ACKNOWLEDGMENT: EI (EIX731203569)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

A2 052253
JOINT BARS-DESIGN SPECIFICATIONS AND SERVICE TESTS INCLUDING INSULATED JOINTS AND COMPROMISE JOINTS
Various tests and application procedures of joints are discussed. Insulated joints, glued joints, web-contact joint bars, Huck fasteners, and joints with structural adhesives are studied in service tests, both in the laboratory and in field installations. The field installations are varied in location. Static stresses in rail and dynamic stresses in rail joint are studied in connection with field installations Huck fasteners. Among the conclusions are: 1)service tests of redesigned vulcabond insulated joints showed much chipping and flaking off; 2) Huck fasteners on polyurethane insulated joints were in satisfactory condition after two to twelve months installation; 3) Huck fasteners in standard head-free toeless angle bars would not satisfactorily restrain rail movement.

AREA Bulletin Proceeding Vol. 73 N No. 36, Feb. 1972, pp 312-337, 2 Fig, 7 Tab, 22 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052254
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
Part one of this report discusses a laboratory investigation of 132-pound rail made from vacuum degassed steel. The purpose of this investigation is to determine whether rails made from vacuum degassed steel and air cooled are comparable in properties with rail steel produced by currently common practices. The manufacturing process and test specimens are described. Rolling load tests, drop tests, slow bend tests, Charpy impact tests, hardness tests, and chemical analysis are performed. Macroscopic and microscopic examinations and physical property determinations are examined. The properties of vacuum degassed steel rails without controlled cooling were comparable to those manufactured by conventional techniques. Part two is a report on a field inspection of vacuum degassed steel rail on the Norfolk & Western Railway. Slight curve wear was noted in the high side rails, and slight rail wear was noted on the low side rails. No shelling or head checking was noted.

AREA Bulletin Proceeding Vol. 73 N No. 36, Feb. 1972, pp 338-394, 16 Fig, 16 Tab, 31 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052256
RAIL FAILURE STATISTICS COVERING (A) ALL FAILURES (B) TRANSVERSE FISSURES (C) PERFORMANCE OF CONTROL-COOLED RAIL
This report of rail failure statistics covers all failures, transverse fissures, and performance of control-cooled rail. Mill performance with regard to service failures is discussed. Statistics for both accumulated service failures and detected number of defects are given. No additional transverse fissure failures in control-cooled rail were reported in 1971 indicating that good quality control and mill practices have been followed in the manufacture of this rail to avoid shatter cracks. The low incidence of rail failure from welded engine burns indicates that practice of welding these burns is showing good service performance. Butt weld failures are tabulated.

AREA Bulletin Proceeding Vol. 73 N No. 38, July 1972, pp 723-740, 4 Fig, 15 Tab

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052257
TIE RENEWALS AND COSTS
Statistics providing information on cross tie renewals and average tie costs for the year 1971 are presented. The number of concrete ties laid in replacement and in new construction are shown. Typical prices paid for wooden cross ties in the East, South, and West are given.

AREA Bulletin Proceeding Vol. 73 N No. 38, July 1972, pp 741 -75, 9 Tab

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052262
SOME ASPECTS OF SERVICE DEVELOPMENTS IN RAIL-HEAD METAL
Service developments in rail-head metal characterized by the presence of white etching regions have been studied. After the development of microstructural white-etching regions resulting from traction and adhesion conditions, spalling begins as a result of trains passing repeatedly over these hard and increasingly brittle areas. White-etching regions on a car-dumper hoop rail resulted from impact during loading and unloading of the dumper, because these areas were in contact with mating guide wheels in the normal load and unload positions of the car dumper. White-etching also results from the effects of repeated loads on the vertical face of non-end-hardened bolted rail. A rolling-contact fatigue test concludes that rail steels have longer life at lower maximum static contact stress levels than at higher stress levels.

Henry, RJ (Bethlehem Steel Company) *AREA Bulletin* Proceeding Vol. 72 N No. 33, 72-733-13, July 1971, pp 586-599, 1 Fig, 1 Tab, 10 Phot, 4 Ref

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052263
STRESS DISTRIBUTION IN THE PERMANENT WAY DUE TO HEAVY AXLE LOADS AND HIGH SPEEDS
The stress distribution in the rail head near the contact surface between rail and wheel with heavy axle loads at high speeds is discussed. An experimental investigation of the stress distribution was performed. Tensile bending stresses in the rail head and rail foot, and lateral forces are discussed. In Germany a test track of prefabricated concrete slab was constructed, and the measurements taken showed that scattering of stresses in the rail foot were small and did not vary with the driving speed.

Eisenmann, J (Munich Technical University) *AREA Bulletin* Proceeding Vol. 71 N No. 22, 71-622-3, Oct. 1969, pp 24-59, 15 Fig, 13 Tab, 1 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052265
THE THERMAL ELONGATION OF RAILS ON ELASTIC MOUNTINGS
Elongation and contraction of rails due to temperature changes is a primary factor affecting the variation in length of rails and their associated strains and stresses. This report considers thermal elongation in conjunction with the longitudinal elasticity of rail fastenings. The sequence of longitudinal loads on elastic rail mountings and the thermal elongation involving rail creep are mathematically presented. Numerical values worked out on a study of the Delft Viaduct show that the assumption of continuous distribution of rail mounting resistance provides a workable theory by which thermal elongation of rail systems can be effectively analyzed.

Verge, OH (Seetru Limited) *AREA Bulletin* Proceeding Vol. 71 N No. 26, 71-626-1, Feb. 1970, pp 621-643, 2 Fig, 2 Tab

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052266
AAR STUDIES OF BUTT WELDED RAIL JOINTS
The purpose of this study was to obtain a correlation between defects shown by radiographs of thermit butt welds in track and results obtained in rolling-load tests in the laboratory. Thermit welds in the Canadian National Railway and the Denver & Rio Grande Western Railroad were evaluated. The Research Center's repeated load tests did not correspond exactly to service conditions. More study is needed on the effectiveness of the radiographic examination technique in determining if thermit welds contain defects that would seriously impair their serviceability in track.

AREA Bulletin Proceeding Vol. 71 N No. 26, Feb. 1970, pp 646-651, 1 Fig, 1 Tab, 2 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052267
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL METHODS FOR THEIR PREVENTION
This report is in two parts. Part one presents the causes of shelly spots and head checks in rail. Samples of these service defects were analyzed and then duplicated at the Association of American Railroads Research Center. Results showed that they were stress induced microstructural changes, not foreign material attributable to manufacturing practice. Part two presents a summary of the test using fully heat-treated rails and alloy rails installed on curves with shelly histories. Changes in rail design were included in this test. For fully heat-treated rails wear on the low side rails was relatively less than on the high side rails. Use of high silicon rails was also tested. Chipping was noted in both the high-silicon and regular rails where bond wires had been attached by welding.

Henry, RJ (Bethlehem Steel Company) *AREA Bulletin* Proceeding Vol. 71 N No. 26, Feb. 1970, pp 682-709, 16 Fig, 3 Phot, 20 Ref

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052274
MODERN METHODS OF HEAT TREATING CARBON STEEL TRACKWORK AND REPAIRING SUCH TRACKWORK BY WELDING
A program was developed to investigate heat-treated and flame-hardened carbon steel track work, and the repair of this type of track work by welding. The tests extended over nine years on three different sets of track. They were repaired by five different welding techniques. It was concluded that fully heat-treated materials wore better than rolled steel and flame-hardened steel, and that repair by welding extended the service of this type of track material.

AREA Bulletin Proceeding Vol. 69 N No. 12, Feb. 1968, pp 564-571, 1 Fig, 2 Tab, 10 Ref

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052284
EFFECT OF LUBRICATION IN PREVENTING FROZEN RAIL JOINTS AND RETARDING CORROSION OF RAIL AND FASTENINGS
The effect of lubrication is investigated in preventing frozen rail joints and retarding corrosion of rail and fastenings on a five-mile service test of North Western's eastward main track, relaid with 78-ft butt-welded 115 RE rail in 1957. Four of the five miles were sprayed out-of-face; the other mile, the control, had no protection until July, 1962, when special compounds or paints were applied to some of the welds after flame cleaning and wire brushing. Applications of metal preservatives are described for each mile of test track, indicating where corrosion was minimized. It is concluded that the spray and brush coats of Texaco 55 and NO-OX-ID provide the best protection against corrosion of rail and fastenings.

AREA Bulletin Proceeding Vol. 67 N No. 98, Feb. 1966, pp 414-415, 1 Tab

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052295
RESULTS OF ROLLING-LOAD AND SLOW-BEND TEST OF BUTT-WELDED RAIL JOINTS
Results of rolling-load and slow-bend tests of butt-welded rail joints are reported. Welding methods include submerged arc, thermit process, and oxyacetylene pressure process with abrasive-wheel-cut weld faces and with variations in upset pressure and Btu input. Welds with magnaflux and ultrasonic indications of defects are also included in tests. It is noted that results, particularly results of submerged arc process, represent initial work on developments needing considerable further refinement. Results on thermit welds are representative of the results obtained in previous test of such welds, except those made by the Southern Railway, which show results meeting the standards established by tests of oxyacetylene pressure butt welds and flash butt welds for the first time. Investigations of welds with magnaflux and ultrasonic indications indicate a lack of uniformity existing in judging these indications at the inspection stations.

AREA Bulletin Proceeding Vol. 66 No. 591, Feb. 1965, pp 514-516, 1 Fig, 2 Tab

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052298
DESCRIPTION OF FLAME-HARDENING OF RAIL BY THE UNION PACIFIC RAILROAD, AND PHYSICAL AND METALLURGICAL TEST RESULTS
The process of flame-hardening of rail is described, and physical and metallurgical test results are presented. Rolling-load, drop, and slow-bend tests are performed on the treated rail. After an 8-hour flame-hardening process, no detrimental effects occur under the rolling-load tests for shelling; rail also conforms to accepted straightness with relatively inexpensive equipment. Since a superior fully heat-treated rail is unavailable economically to the railroads, the data described indicate a usable product for a relatively low cost.
This article is an abstract of report no. ER-34

AREA Bulletin Proceeding Vol. 65 N No. 80, Oct. 1963, pp 88-89

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052299
DESCRIPTION OF FLAME-HARDENING OF RAILS BY THE SANTA FE RAILWAY, AND PHYSICAL AND METALLURGICAL TEST RESULTS OF FLAME-HARDENED FLASH BUTT-WELDED RAIL JOINTS
Flame hardening of rails by the Santa Fe Railway is described, and physical and metallurgical test results of flame-hardened flash butt-welded rail joints are presented. Procedures and advantages of the flame-hardening process are cited, and rolling-load, drop, and slow-bend tests are performed. It is noted that the flame-hardening process is developed using relatively simple equipment producing a surface-hardened rail, giving satisfactory service for the cost involved, and performing well on the tests given.

AREA Bulletin Proceeding Vol. 65 N No. 80, Oct. 1963, pp 89-90, 1 Ref

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052300
LENGTH OF RAILWAY TRANSITION SPIRAL-ANALYSIS AND RUNNING TESTS
Report and analysis is made of length of railway transition spiral, to provide more information on fundamental factors related to the design of the spiral easement curves and the levels of acceleration suitable for the requisite comfort on diesel locomotive and modern passenger rail cars. Previous work and history are reviewed, and the problem is analyzed. Other topics considered include test procedures and instrumentation, passenger ride comfort, lateral forces on leading locomotive trucks, and effects of track variations. It is noted that reported results confirm British ride comfort results, despite more scatter in the plots of the current study here.

AREA Bulletin Proceeding Vol. 65 N No. 80, Oct. 1963, pp 91-129, 13 Fig, 8 Tab, 8 Phot, 20 Ref

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052301
INSPECTION OF CONCRETE TIES, ST. LOUIS-SAN FRANCISCO RAILWAY, NEAR CABAOL, MO., JULY 9 AND 10, 1963
Inspection of concrete ties is reported on the St. Louis-San Francisco Railway, near Cabaol, Missouri, July 9 and 10, 1963. Factors analyzed include number of ties, transverse cracks between rails, transverse cracks from bolt holes, transverse cracks from grooves, longitudinal cracks, and torque of bolts. It is noted that there is less change in the concrete tie section than with the wood tie section in the 6-month inspection period involved.

AREA Bulletin Proceeding Vol. 65 N No. 82, Dec. 1963, pp 266-268, 3 Tab

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052304
RAIL END BATTER; CAUSES AND REMEDIES
Causes and remedies of rail end batter are discussed. Four rail joints of 131 RE section with a 0.040-in. batter are welded, using the semi-automatic wire feed method with a modified 4560 wire electrode and gas shielding eliminated. A 700 F preheat and 1100 F post heat are produced with a propane heater. Rail joints are subjected to rolling-load tests. Results are presented of rolling-load tests of four rail joint assemblies, built up with Haynes Stellite modified 4560 wire electrode. It is noted that batter ranges from 0.006 in. to 0.016 in. on joints 69 A and 69 C that ran to 5,000,000 cycles. Hardness obtained on a standard BHN tester on the parent rail metal that was work hardened and on the weld metal before and after work hardening is reported. It is noted that the trend of spalled rail ends with a BHN range of 481-564 before work hardening and 512-600 after work hardening occurs, and that the spalling occurs about 1-1/2 in. away from the rail ends where the porosity is the heaviest.

AREA Bulletin Proceeding Vol. 65 N No. 84, Feb. 1964, pp 552-556, 2 Tab, 4 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052306
INSULATED RAIL JOINT DEVELOPMENT AND RESEARCH. SECOND PROGRESS REPORT
A second progress report on insulated rail joint development and research is presented. Objectives of the work and principles of the problem are discussed, and laboratory tests citing the experience of eight service test joints are reviewed. Characteristics of a rail joint are enumerated, and reasons for development of better insulated joints are presented. It is noted that the AAR design includes joint bar, insulation, armor and thimbles all molded and bonded into an integral unit, and the design has other advantages also. Exposure of the joint to a rolling load machine is also discussed.

AREA Bulletin Proceeding Vol. 65 N No. 84, Feb. 1964, pp 560-572, 2 Tab, 7 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052313
LENGTH OF TRANSITION SPIRALS-A REVIEW OF RESEARCH REPORT ER-37
A review of research report ER-37 is made to discuss length of transition spirals on curves. It is noted that existing methods and formulas provide spirals of adequate length when the work is carefully done, although situations still exist where a road has neglected to reline curves to provide spirals of desirable length and where the elevation runs out on the tangent, producing an undesirable sensation on the curve. A different principle is introduced into the calculation of spiral length, the principle that lateral acceleration should vary uniformly from zero on the tangent to a maximum on the full curve, and that the rate of change of lateral acceleration should be limited rather than limiting the rate of change of elevation. Formulas are elaborated, and their use results in new line construction, reconstruction of existing line, or setting up higher speed passenger service.

Code, CJ (Pennsylvania Railroad) *AREA Bulletin* Proceeding Vol. 65 N No. 86, July 1964, pp 881-884

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052316
RAIL SLIPPAGE TESTS-CONCRETE TIES
Tests are conducted to determine rail slippage for concrete ties, using the fastenings to check the slippage resistance anticipated in the design calculations. Test procedure is described and results are presented. It is noted that the values of rail slippage resistance for the AAR design clips for the Type E tie are generally more than the 2000 lb minimum for 5000 lb bolt tension, except those with vibration, which are only about 1000 lb. It is concluded that the measurements of rail slippage resistance obtained agrees reasonably well with those anticipated in the design of the fastening for the AAR Type E prestressed concrete tie. It is believed that a range of bolt tension between 10,000 and 5000 lb should be maintained with AAR clips until such time as service experience indicates that a change in these limits is warranted.
This article is an abstract of report no. ER-22.

AREA Bulletin Proceeding Vol. 64 N No. 73, Oct. 1962, pp 39-45, 2 Tab, 6 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052317
INSULATED RAIL JOINT DEVELOPMENT AND RESEARCH
An effort to design rail joint insulation capable of resisting high compressive and abrasive forces that develop between rails and joint bars was presented. A protective steel armor bonded to the insulation in the joint bars was selected as the best method to protect the insulation. Rolling-load tests were run on seven types of insulated joint bars, including the VulcaBond joint designed by the AAR. The rolling-load tests gave good comparative data on the action of the joints in flexure and the fatigue life in flexure. The VulcaBond joint had the smallest deflection. A standard armoured continuous type was next lowest, and the plastic joint had the greatest. The fiber-glass joints were the best of the plastic type tested, but had considerably greater deflections than the VulcaBond or continuous type and a lesser life in fatigue. The VulcaBond joints were installed on track in several railroads. Several weaknesses were found and remedied or eliminated. However, the bushings need further strengthening.
This article is an abstract of Report No. ER-9.

Cruse, WJ *AREA Bulletin* Proceeding Vol. 63 N No. 66, Oct. 1961, pp 1-12, 1 Fig, 1 Tab, 7 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052319
RAIL WEAR TESTS ON THE ST. LOUIS-SAN FRANCISCO RAILWAY
Two curves on the St. Louis-San Francisco Railway were selected for rail wear tests. The section having a slightly lower rate of wear in past service

was not lubricated. The other curve had a "Meco" single rail lubrication using graphite grease at the far end of its two curves. The effectiveness of the lubrication was gaged by taking rail profiles at various intervals of time. These profiles show the amount of steel worn from the heads of the rail gage. Elevation and curvature of the high rail were measured at each point where a profile was taken. Seven sets of profiles were taken of the rails undergoing the tests. The profiles show significantly less wear on the curve with the track lubricator than on the curve with no lubrication. The effectiveness of molybdenum-disulphide was tested as a rail lubricant. Its application showed less wear rate. These service tests definitely show that track lubricators are effective and can double the life of the outer rail in the presence of heavy sanding.

AREA Bulletin Proceeding Vol. 63 N No. 66, Oct. 1961, pp 17-25, 4 Fig, 1 Tab

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052324
SERVICE TEST OF SOLID MANGANESE STEEL CROSSING FROGS WITH PRESTRESSED CONCRETE SUPPORT VERSUS TIMBERS
An inspection of a service installation of a prestressed concrete crossing support is presented. The crossing had been given normal maintenance during the service period. At the end of the first winter the concrete was performing much better than the timbers, with very little vertical movement during traffic. After heavy rainfall the wet subgrade condition resulted in vertical moving of timbers double that of the concrete. A concrete corner was broken off at the point of failure in one of the post-tensioning rods, but there was no evidence of further distress due to reduction of effective rods from six to five. No cause for the break was found. A record of maintenance costs was not kept.

AREA Bulletin Proceeding Vol. 63 N No. 70, Feb. 1962, pp 493-494

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052327
ENGINEERING ASPECTS OF CURRENT RAIL SECTIONS
This investigation of the engineering aspects of current rail sections falls into four phases. 1) Flexural Stiffness and Strength--The additional stiffness as indicated by the moment of inertia and strength as indicated by the section modulus of the 106 CF&I, 119 CF&I and 136 CF&I sections are increased approximately in proportion to the additional amount of metal provided in these sections. 2) Shape of Head Contour--Measurements indicate the rolled contour of the 115 RE and 132 RE sections fit the worn wheel contour better than the 119 CR&I and 136 CF&I sections. Better service performance as to the development of shelling is concerned can be expected from them. Narrowing of the rail head decreases the radius of hollowing of worn car wheels with resultant increase in wheel contact pressures and internal direct stresses and shearing stresses within the rail head. 3) Depth of Rail Head--Increased depth of rail head in the CF&I sections provides additional metal for vertical head wear. Measurements of actual vertical head wear as related to traffic and traffic densities indicate the present RE sections have adequate depth of head to provide a full usable life of the rail. 4) Localized Web and Fillet Stresses--Measurements indicate that upper fillet stresses in the web are reduced with the CF&I sections as compared to corresponding RE sections.

This article is an abstract of Report No. ER-15.

AREA Bulletin Proceeding Vol. 63 N No. 70, Feb. 1962, pp 553-569, 10 Fig, 1 Tab

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052334
SERVICE PERFORMANCE AND ECONOMICS OF 78-FT RAIL; SPECIFICATIONS FOR 78-FT RAIL
The service test of rail laid in 78-ft lengths on the Illinois Central Railroad was covered in this progress report. The prime purpose of the test was the determination of adequate arrangement of rail anchors to control rail creepage better, and to obtain an improved rail gap uniformity. Winter gaps were measured before adjustment of the gaps was made. The average of summer gaps in the two test sections was not materially changed by the adjustment of gaps in the winter, except for one rail. The joints in this rail that would not close at high temperatures, before adjustment, now have summer gaps comparable to other joints measured. The anchorage, alternate ties boxed, in the test mile will give satisfactory results with 78-ft rail provided it is laid with expansion required to have it tight at 85 deg. Because joint slippage resistance is required to keep the joints from opening too much in the winter, especially in 78-ft rail, it is important that the track bolts be retightened frequently. In proposing expansion of the use of 78-ft rail a table is provided.

AREA Bulletin Proceeding Vol. 62 N No. 63, Feb. 1961, pp 635-638, 2 Fig

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052345
SUBSTITUTES FOR WOOD TIES
This progress report on substitutes for wood ties includes information on ties used in European countries, progress in prestressed concrete railroad ties, and work done in the AAR Research Laboratory. Metal and reinforced concrete sleepers (ties) have been used in France. The metal sleepers gave good results with light traffic, but could not be used on high-speed and circuited tracks. Concrete ties supplementing wooden ones were advantageous because their reported service life was from 30 to 40 years. The AAR Research Laboratory used three different rail designs on standard and lightweight aggregates. Lime-rock aggregate ties could not sustain loads imposed in heavy-duty travel. Bolts extending completely through concrete ties with rail clips were the most satisfactory rail fastenings.

AREA Bulletin Proceeding Vol. 61 1960, pp 408-412, 1 Fig, 2 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052353
SERVICE TESTS OF DESIGNS OF MANGANESE-STEEL CASTINGS IN CROSSINGS AT MC COOK, ILL
This report covers the service test of the last remaining test casting in the double-track lines of the Baltimore & Ohio Chicago Terminal Railroad and the Atchison, Topeka & Santa Fe Railway at Mc Cook, Ill. The two U. S. Steel solid pedestal castings showed that the depth-hardened frog was in service 0.8 year longer and carried 56 million more gross tons of traffic than the unhardened casting. Both depth-hardened castings were in service 26 months before the first welding of the battered tread corners a compared to the 18 months for the USS unhardened casting. The greater service life of the Rampo deepened-flangeway design than that of the USS solid pedestal type castings indicates some advantages for the more flexible casting. The USS casting with rigid support of tread corners also developed the higher receiving flangeway fillet stresses. All of the test castings were those used in the end position with a height of 6 1/4 inches to match 110 RE rail and an intersection angle of 75 degrees 48 minutes.

AREA Bulletin Proceeding Vol. 61 1960, pp 934-940

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052359
PRESTRESSED CONCRETE TIES
A new design of prestressed concrete ties by the AAR is the subject of this discussion. Two different types of fastenings were used with this tie to determine the type of fastening to be ultimately used. The design calls for clip bolts to be tightened to 10,000 lb. tension, which will give a good grip on the rail and prevent rail creep. Two types of tests to determine the flexural strength of the ties were performed; repeated load and static tests. The concrete tie was more securely held in the tests. In a test installation clips were used to hold the rail down. It concludes that a potential of 50-year track could be realized through the utilization of this type of prestressed concrete tie.

Magee, GM (Association of American Railroads Research Center) *AREA Bulletin* Proceeding Vol. 61 1960, 13 pp, 2 Fig, 15 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052361
WHEEL LOAD, WHEEL DIAMETER AND RAIL DAMAGE
The dual study of wheel load, wheel diameter and rail damage is presented. It is concluded that formulas derived from earlier studies should be applied to today's situations for worn wheel on worn rail. A report on shelly rail reviews previously gathered information before discussing a recommendation that a limitation be placed on wheel loads for diesel and turbine locomotives. The recommended limit for wheel loads is 800-lb per inch of diameter. The study concludes that shelly rail stress increases in proportion to the cube root of the load; the life of the rail up until the time failure occurs decreases very sharply for any small increase in stress.

Code, CJ (Pennsylvania Railroad) *AREA Bulletin* Proceeding Vol. 61 1960, 8 pp, 2 Fig, 1 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052362
STATIC AND FATIGUE TESTS ON PRESTRESSED CONCRETE RAILWAY SLABS
The fatigue properties of prestressed pretensioned concrete railway slabs are discussed. A theoretical study of the fatigue resistance of such members is first presented, followed by a description of laboratory tests on six beams. Test results are discussed and interpreted. The theory of fatigue failure is based on three diagrams including a failure envelope based on a limited amount of fatigue test data on prestressing strands and a diagram of the fatigue characteristics of plain concrete. The two failure envelopes are combined with curves expressing the moment-stress relationship for a given beam. The investigator is able to predict the critical loading. It is concluded that the test results check reasonably well with the critical fatigue loads predicted on the basis of the stated theory of fatigue failure.

AREA Bulletin Proceeding Vol. 60 1959, pp 3-50, 15 Fig, 11 Tab, 11 Phot, 6 Ref

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052369
PREVENTION OF DAMAGE RESULTING FROM BRINE DRIPPINGS ON TRACK AND STRUCTURES
Prevention of damage resulting from brine drippings on track and structures is discussed in an attempt to find non-toxic brine corrosion inhibitors for use in refrigerator car bunkers. Features of inhibitors for brine corrosion are cited, and tie plate corrosion resistance is also discussed. Copper bearing steel is evaluated, and rail corrosion in tunnels is investigated. It is noted that variation in concentrations of elements such as copper, nickel, and chromium contribute nothing toward increasing the resistance of the steel against liquid brine drippings.

AREA Bulletin Proceeding Vol. 60 1959, pp 793-799, 2 Tab, 11 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052370
HOLD-DOWN FASTENINGS FOR TIE PLATES, INCLUDING PADS UNDER PLATES-THEIR EFFECT ON TIE WEAR
Study is made of hold-down fastenings for tie plates, including pads under plates, and their effect on tie wear is investigated, related to tie life, regaging and readzing curves. Economic factors of hold-down fastenings are also considered. Tests are conducted, and progress of test, including additions and revisions, is reported. It is noted that a number of tie pads still in use are no longer considered satisfactory for use. Topics discussed include maintenance of hold-down fastenings, gage of test curves, general inspection, tie coatings, repeated load tests of tie pads, and economic studies.

AREA Bulletin Proceeding Vol. 60 1959, pp 800-827, 4 Fig, 4 Tab, 24 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052371
METHODS OF HEAT TREATMENT INCLUDING FLAME HARDENING OF BOLTED RAIL FROGS AND SPLIT SWITCHES TOGETHER WITH METHODS OF REPAIR BY WELDING
Study is made of methods of heat treatment and welding repair of bolted rail frogs and split switches. The flame hardening method is included. Service tests of simulated crossing units in the Milwaukee Railroad at Mannheim, Illinois, are reported, and unit maintenance, welding, rail wear, batter, and Brinell hardness are considered. Pending future appraisal, it is concluded that good results are obtained from a majority of welds.

AREA Bulletin Proceeding Vol. 60 1959, pp 862-869, 1 Fig, 2 Tab

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052373
SERVICE TESTS OF VARIOUS TYPES OF JOINT BARS
Report is made of two service tests of joint bars for 115 RE and 132 RE rail. Service test installations are described, and test data is presented. It is concluded after 10 years of service that the test sections show good performance with little difference except that the 4-hole bars show slightly more difference in the level at the 1/4-inch points of the rail ends. The long-toe bars on the Santa Fe continue to show a slight tendency toward developing cracks in the spike slits, although the progression is slow.

AREA Bulletin Proceeding Vol. 60 1959, pp 905-915, 6 Fig, 4 Tab, 2 Phot, 10 Ref

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052375
RECENT DEVELOPMENTS AFFECTING RAIL SECTION
Report is made of measurements of the actual loss in height due to wear of rail being removed from main line tangent track during 1957. Data is furnished for rail section, year rolled, approximate annual traffic density in gross tons, measured height of rail to the nearest 1/32-inch at the mid-width of the rail and away from rail end batter or wheel burns, and the loss in height of rail. Twenty railroads with annual traffic of 20 MGT or more furnish data from a measured location. It is noted that if rail head wear on main line tangent track follows the mean curve for traffic densities, then for varying traffic densities and a total rail life in its original tangent position varying from 150 to 500 MGT of traffic, the total head wear is expected to vary from 0.100 to 0.140-inch for the conditions tabulated.

AREA Bulletin Proceeding Vol. 60 1959, pp 970-972, 1 Fig

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052389
SERVICE PERFORMANCE AND ECONOMICS OF 78-FT RAIL, SPECIFICATIONS FOR 78-FT RAIL
Tests and measurements made on two service installations of 78-ft rail were presented. The purpose of the tests on the Chicago & North-Western and the Pennsylvania Railroad was to determine if the presence of greater joint gaps on the 78-ft rail would create an increase in cost of maintaining the remaining joints, thereby reducing benefits due to the elimination of one half of the joints. Measurements show no outstanding difference between the 78-ft rail and the 39-ft rail at the Chicago and Northwestern site. At the Pennsylvania Railroad site measurements show pull-in of 78-ft rail to be almost identical to that of 39-ft rail. Joint gap measurements on the Illinois Central reveal that rail anchorage of 22 alternate ties boxed per 78-ft rail has given a more satisfactory rail gap uniformity than in earlier tests.

AREA Bulletin Proceeding Vol. 59 1958, 18 pp, 9 Fig

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052391
DESIGN OF TIE PLATES
This report on the design of tie plates is presented in two parts. Part one presented the evaluation of seven designs of tie plates. Tie abrasion, tie plate bending, and gage of track were the factors used to evaluate the service wear

of the tie plates. The evaluation period of 13 years was not long enough to develop the advantage of longer plates. No permanent bending developed in the thinner plates. The plates with ribbed bottoms act as a retardant to gage widening, but show an increase in cutting the tie. The outer rail on the 6-degree curve is the chief maintenance problem as to wear of rail, ties and gage widening. Part two presents a final report on tie plate bending on a curve of the Illinois Central Railroad. It is concluded that the AREA plan thicknesses for plates for the 5 1/2 inch rail base is sufficient for a satisfactory service life, except where there is severe brine corrosion and heavy traffic density amounting to more than 18 million tons per year.

AREA Bulletin Proceeding Vol. 59 1958, 7 pp, 2 Fig, 1 Tab

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052394
LIFE OF RAIL
Recommendations on rail life and other revisions are adopted to amend the manual regarding operating data required for a study of the economic justification of line and grade revisions. Regarding rail and fastenings, charge should be made only for that portion in excess of that used in the present operation on the basis of experience; in the absence of actual experience, anticipated rail life on a new location under similar operating conditions may be determined with a recommended formula. Recommendations are also made for additional bridging steel, additional creosote trestles, enginehouse additions, additional or other buildings, and additional signals.

AREA Bulletin Proceeding Vol. 58 1957, pp 359-360

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052397
METHODS OF HEAT TREATMENT, INCLUDING FLAME HARDENING OF BOLTED RAIL FROGS AND SPLIT SWITCHES, TOGETHER WITH METHODS OF REPAIR BY WELDING
Methods of heat treatment are discussed, including flame hardening of bolted rail frogs and split switches, together with methods of repair by welding. Report includes welding techniques and metallurgical examination of experimental laboratory welds, and a description of service tests of simulated crossing units at Mannheim, Illinois. Recommended welding procedures for the service test units are made. Maintenance of tread corners is investigated, and measurements of rail wear and batter, and Brinell hardness are conducted during the entire service period. It is concluded that in the flame-hardened group, the Ramapo units had the lowest average number, receiving corner batter of 57 percent of the control units. The Cleveland units of the heat-treated group had the lowest average value of receiving corner batter of 37 percent of the control units. Average increases in Brinell hardness readings due to cold rolling and work hardening of the normal rail and the tread corners are tabulated.

AREA Bulletin Proceeding Vol. 58 1957, pp 903-955, 2 Fig, 4 Tab, 32 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052404
RECENT DEVELOPMENTS AFFECTING RAIL SECTIONS
Recent developments affecting rail sections were discussed. Tests made at the Area Research Center of a 115-lb rail in which holes had been punched with a velocity power punch showed that the fatigue strength of the specimen was higher than that of a specimen in which the holes had been drilled. However, cracks developed in service rail on which this tool had been used. Further testing was done, and it was concluded that an improved velocity power punch must be manufactured.

AREA Bulletin Proceeding Vol. 57 1956, pp 858-859

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052406
CURVE WEAR WITH DIESEL LOCOMOTIVES ON THE BESSEMER AND LAKE ERIE RAILROAD
A series of test runs were made to obtain definite information on the amount of rail curve wear produced by diesel locomotives relative to that produced by the remainder of the train. A second series of tests was made for the purpose of relating the effectiveness of flange oilers on the locomotive and rail lubricators in the track in controlling the amount of curve wear. Instrumentation consisted of a box to catch metal abraided by diesel units from the track and a motion picture camera to photograph the passing wheel flange on the high rail. The tests show that although the rate of rail and wheel wear with a diesel unit is greater than for a heavily loaded freight car, the greater amount of rail wear is due to the train rather than the diesel units. Rail and wheel flange wear on curved track can be practically eliminated by lubrication with either flange oilers on the diesel units or rail lubricators in track, or a combination of the two.

AREA Bulletin Proceeding Vol. 56 1955, pp 269-281, 1 Fig, 2 Tab, 9 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052427
STRESS CONCENTRATION IN BUILT-UP STRUCTURAL MEMBERS
This report covers a description and analysis of tests made to determine stress concentrations in plates in the vicinity of rivet or bolt holes under varying conditions of pitch, gage, edge distance, bearing and clamping force. Measurements of strains with SR-4 strain gages and the methods of photoelasicity were the two test procedures employed in the investigation. The items investigated by each of these methods and the results are as follows. Stress concentrations at the sides of open holes in plates will vary within relatively small limits if the conventional spacing of 3 hole diameters and edge distances of 1 1/2 diameters is maintained. Stress concentrations at the sides of holes with pins in bearing in double shear will be higher than for open holes. Plates connected by pins bearing in double shear will be higher than for open holes. Plates connected by pins bearing in single shear have stresses at the sides of the holes 20 to 40 or more times the average stress on the gross section of the plate when load is applied centrally with respect to width of plate. In joints connected by high clamping bolts, the stresses inside the hole produced by clamping applied through washer only are compressive. In correlating the magnitudes of stress concentrations with the results of fatigue tests on typical specimens it can be concluded that elastic stress concentration is a valid criterion for establishing the fatigue strength of fabricated structural members. Appendix I presents a qualitative explanation of stress concentration and change of direction of stress path or trajectory.

Carter, JW (Purdue University) *AREA Bulletin* Proceeding Vol. 53 1952, pp 1-34, 20 Fig, 1 Tab, 9 Phot, 10 Ref, 1 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052433
EFFECT OF LUBRICATION IN PREVENTING FROZEN RAIL JOINTS
Rail joint lubrication service tests on the Illinois Central Railroad and the Chicago, Burlington and Quincy Railroad were covered. Various types of lubricants or rust preventatives and methods of application were tested to determine more satisfactory and lasting treatment of rail joints and to prevent stripped joints and damaging corrosion during the life of the joint bars. A description of the test installations was given. Test measurements and data were described for the Illinois Central installation. No important conclusions as to the relative effectiveness of the rust preventatives were justified for this service test of one year. It was evident that the heat in the joint left from the rail end-hardening was detrimental to most of the sections greased with a brush coat. In tests on the Burlington rail joint gap and joint bar pull-in measurements were taken. Inspection of dismantled joints was performed. It was concluded that in general the several kinds of lubricants were not effective in reducing joint wear or pull-in to a significant amount. The greatest benefit derived from these was in the arresting of corrosion and the prevention of hard rust slabs forming in the lower rail fillets at the ends of the joint bars.

AREA Bulletin Proceeding Vol. 53 1952, pp 800-837, 10 Fig, 1 Tab, 23 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052439
RAIL END BATTER; CAUSES AND REMEDIES
Testing of various methods of building up rail ends by welding was explored. Nine railroads and one contract welder were invited to weld 50 joints each, using the procedures in use on their own railroads. Seven of the panels were welded by the oxyacetylene process, three panels by the d.c. electric arc process, and one panel by the a.c. electric arc process. A record was made of the net time required by the welder and helper to do the welding, and the amount of welding rod, oxygen and acetylene or gasoline used. The procedure on each panel was presented. The following conclusions were reached. 1) Satisfactory welding can be done by either the oxyacetylene or electric arc process. 2) The cost of labor and fuel is higher for the oxyacetylene process than for the electric arc. 3) The investment in equipment for the oxyacetylene process is less than that for the electric arc process. 4) The cost of reconditioning rail ends by heating and forging is nearly the same as that for building up by welding by the oxyacetylene process. 5) There is no advantage of multiflame oxyacetylene tips. 6) The rail should be preheated before electric welding. 7) Grinding produces a better surface than finishing by forging. 8) The skill of the welder is a very important factor.

AREA Bulletin Proceeding Vol. 52 1951, pp 629-633, 1 Fig, 1 Tab

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052448
RECENT DEVELOPMENTS AFFECTING RAIL SECTION
This report presented two studies in corrosion fatigue of rail web steel. Two fatigue tests with corrosion using tap water as the corrosion medium were performed. Tests from the University of Illinois showed very little reduction in the endurance limit as obtained without corrosion. Duplicate tests performed at the Pennsylvania Railroad Laboratory at Altoona, Pa. resulted in a greater reduction in the endurance limit than that of the original at the University of Illinois. It was concluded that the Altoona tap water was more corrosive than the Urbana tap water which accounted for the difference of results, and therefore,, no further modification of the corrosion procedure was done. Results of the Altoona test could readily be interpreted as corrosion fatigue due to the severity of the corrosion present during the tests. A curve concluded fatigue with and without corrosion was present. It showed that where corrosion is present it becomes a practical impossibility to so design a rail and the rail joint as to prevent failure from corrosion fatigue. In summary it was felt that sufficient proof had been offered that rail web failures in the joint do occur from corrosion fatigue, and that the fatigue life of rail web steel can be sufficiently reduced by corrosion fatigue to account for these failures.

AREA Bulletin Proceeding Vol. 51 1950, pp 620-625, 1 Fig, 1 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052450
DESIGN OF TIE PLATES
Investigation of specially designed tie plates for use on curved track to reduce the maintenance costs of periodically re-adzing ties to restore gage and cant of rail was discussed. Results of the investigation and suggested designs of tie plates for use on curves of three degrees and over were presented. Service tests of the performance of seven tie plate designs in 131RE rail in tangent track and a six degree curve were discussed. It concluded that several more years of traffic will b required before enough tie wear has developed to justify conclusions regarding the tie plate designs studied in these tests.

AREA Bulletin Proceeding Vol. 51 1950, pp 664-674, 7 Fig, 2 Tab

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052457
TEST RESULTS ON RELATION OF IMPACT TO SPEED
Test results on relation of impact to speed are reported to support the proposed Article 107 of the Rules for Rating Existing Iron and Steel Bridges. It is noted that a study of short span steel bridges 20 to 40 ft. long and deck plate girder spans 40 to 130 ft. long subjected to live loads with or without hammer blow indicates that the reduction of impact as a result of speed should occur at 40 mph or less, rather than synchronous speed or less as was proposed in 1947 for spans longer than 50 ft. The value of 40 mph was selected as the maximum practical speed where allowable reduction in impact might be permitted since rolling equipment without hammer blow has no synchronous speed. It is noted that some values of total impact on truss spans approximately 120-150 ft. long, subjected to equipment with hammer blow, receive more impact than is provided by Article 206 of the Specifications for Steel Railway Bridges. The character of the reduction equation for truss spans subjected to rolling equipment with hammer blow is consistent with the data.

AREA Bulletin Proceeding Vol. 50 1949, pp 432-443, 9 Fig, 1 Tab

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052462
REPORT ON SERVICE TEST OF SOLID MANGANESE CROSSINGS FROGS AT MCCOOK, ILLINOIS
Service tests of solid manganese crossing frogs at McCook, Illinois, are reported. Stress measurements are covered in the flangeways and at other significant stress areas of five different designs of manganese castings placed in the crossings of the Baltimore & Ohio Chicago Terminal Railroad and the Atchinson, Topeka & Santa Fe Railway. Service tests include tests of the original design of casting by Taylor-Wharton and the Carnegie-Illinois casting. It is concluded that some of the designs included in the tests are more resistant to the development of fatigue cracks than others, but in none were the developed stresses low enough relative to the fatigue strength of the manganese steel to give the service life under heavy traffic that should be expected, and efforts to further reduce these stresses are recommended.

AREA Bulletin Proceeding Vol. 50 1949, pp 572-576, 1 Fig, 2 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052463
HOLD-DOWN FASTENINGS FOR TIE PLATES, INCLUDING ELASTIC PADS UNDER PLATES; THEIR EFFECT ON TIE WEAR
Study is made of hold-down fastenings for tie plates, including elastic pads under plates, and their effect on tie wear, in an effort to extend the service life of ties and save cost. Service tests are reported to determine, from periodical measurement of tie plate penetration, track gage, curvature, cross levels and other observations, the relative effectiveness and economy of the several types of hold-down fastenings and tie pads, as to reduction in mechanical wear of ties and the maintaining of good track gage on curves. Initial gage measurements for original construction were taken in November 1974 and checked in August 1948; readings for the 1948 construction were taken on October, 1948. It is noted that when gage widening occurred, its cause was undetermined, but forthcoming tests will determine if the pads were a major contributing factor to the gage widening. Generally the gage in most test sections on the long curve held well. Tie plate penetration measurements are taken, but in many instances a tie plate does not become finally seated in one year.

AREA Bulletin Proceeding Vol. 50 1949, pp 595-625, 8 Fig, 3 Tab, 18 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052466
CROSS TIE RESEARCH IN COOPERATION BETWEEN THE ASSOCIATION OF AMERICAN RAILROADS AND THE NATIONAL LUMBER MANUFACTURERS ASSOCIATION
Cooperative cross tie research between the Association of American Railroads and the National Lumber Manufacturers Association is reported. Objective includes the development of methods whereby the service life of ties may be increased through the reduction or prevention of mechanical wear and preventing or minimizing tie deterioration due to end splitting or checking. Economical and practical means of effectively decreasing the shrinking and swelling of wood used for construction lumber, railroad cross ties, and other wood products is sought. Causes of tie deterioration are

determined, and modification and design of wood cross ties is presented. It is recommended that the method of fastening tie plate to the tie be improved.

Belcher, RS (Atchison, Topeka and Santa Fe Railway) *AREA Bulletin* Proceeding Vol. 50 1949, pp 734-738

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052476
FIRST PROGRESS REPORT-JOINT INVESTIGATION OF CONTINUOUS WELDED RAIL
Progress on the investigation of continuous welded rail was reported. Data and preliminary results of 1) metallographic studies of welded joints, 2) mechanical tests of specimens cut from rail metal, weld metal and metal in the junction zone between weld and rail, 3) tests of full-size welded-joint specimens under repeated wheel load, and 4) drop tests and bend tests of full-sized specimens of welded joints. The rolling-load testing machine for subjecting rail-joint specimens to repeated wheel load was described, as the testing rig for making bend tests of full-size rail joints. Attention was directed to the fact that all results obtained were preliminary and tentative.

Moore, HF Thomas, HR Cramer, RE (Illinois University, Urbana) *AREA Bulletin* Proceeding Vol. 40 1939, pp 687-613, 8 Fig, 6 Tab, 6 Phot, 1 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

A2 052511
ORE COLLOQUIA. REPORT ON THE THIRD COLLOQUIUM "TECHNICAL COMPUTER PROGRAMS" AMSTERDAM, 8TH TO 10TH MAY 1973.
This report contains the summaries of fifteen individual contributions on catenary and pantograph systems, track design, train performance, car design, suspension systems, locomotive design and utilization, braking systems, yard simulation, and road operations.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways AZ40/RP5/E, June 1973

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC
DOTL RP

A2 052518
UNCONVENTIONAL TRACKS. NOISE AND VIBRATION FROM UNCONVENTIONAL TRACKS (EXPERIMENTS AT RADCLIFF-ON-TRENT 1969 AND 1970)
Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways D87/RP6/E, Apr. 1973

A2 052519
OPTIMUM ADAPTION OF THE CONVENTIONAL TRACK TO FUTURE TRAFFIC. THE BEHAVIOUR OF RAILS IN RELATION TO THEIR CONDITIONS OF USE
Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways D117/RP3/E, Apr. 1973

A2 052525
QUALITY OF RAILS AND MEANS OF GUARANTEEING IT. PROPOSALS CONCERNING THE 6TH EDITION OF TECHNICAL SPECIFICATION 860-0 GOVERNING THE SUPPLY OF VIGNOLE (FLAT-BOTTOM) RAILS OF NON-TREATED STEEL
At the request of the 7th UIC Commission, the D 45 Specialist Committee has been charged with studying the dimensional tolerances of rails with a metric weight greater than 60 kg. As the administrations made increasing use of heavy rails it become necessary to include in Technical Specification 860-0 for the supply of Vignole (flat-bottom) rails of non-treated steel, the maximum permissible dimensional tolerances for these heavy rails. Having regard to the results of the tests already carried out within the scope of its programme of work and the experience gained by its members, the D 45 Specialist Committee deemed it advisable not to limit its investigations merely to the problem of dimensional tolerances, but to examine the whole specification at the same time, and to group into one report all the amendments and additions which it intended making to the existing text. The most important amendments concern marking, freedom from defects, dimensional tolerances, and certain acceptance and guarantee conditions. The wording of the texts at present in force and of the texts proposed to the 7th UIC Commission have been completed by remarks explaining or justifying the decisions of the D 45 Specialist Committee.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways D45/RP 11/E, Apr. 1969, 29 pp, 3 App.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC
DOTL RP

A2 052533
BEHAVIOR OF THE METAL OF RAILS AND WHEELS IN THE CONTACT ZONE. EXPERIMENTAL STUDIES: 1) WORK-HARDENING SPEED WITH THE EMS 60 MACHINE (ADDITIONAL MEASUREMENTS), 2) RESIDUAL STRESSES IN HARD-GRADE STEEL RAILS (ADDITIONAL MEASUREMENTS) 3) CHECKING OF FATIGUE CRITERION PROPOSED BY MR. DANG VAN
This report is in three parts: 1) Work-hardening speed examined with the EMS 60 machine: The development of the two principal residual stresses produced on the running surface of rails made of different grades of steel has been studied as a function of the repeated passages of a loaded wheel. It has been shown that this development ceases at about approximately 1 million cycles. 2) Residual stresses in hard-grade steel: These stresses have been measured inside 2 rails of hard-grade steel, one new and the other work-hardened in service. The use of the rail in the track produces severe longitudinal and transverse compressive stresses at the surface. The stress field is affected strongly throughout the height of the rail-head. 3) Checking of fatigue criterion proposed by Mr. Dang Van: The fatigue limits of a rail steel have been determined for different cases of stressing. The results have enabled the validity of the fatigue criterion proposed by Mr. Dang Van (see Report C 53/RP 7) to be confirmed.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways C53/RP 8/E, Oct. 1973, 31 pp, Figs., 2 Tab.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC
DOTL RP

A2 052534
UNCONVENTIONAL TRACKS. LABORATORY AND SITE MEASUREMENTS OF STIFFNESS AND DAMPING OF SELECTIVE TYPES OF DIRECT FIXING FOR TRACKS WITHOUT BALLAST
Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways D87/RP 8/E, Apr. 1973

A2 052547
INTERACTION BETWEEN VEHICLES AND TRACK. GEOMETRY OF THE CONTACT BETWEEN WHEELSET AND TRACK. PART I: METHODS OF MEASUREMENT AND ANALYSIS
The geometry of the contact between wheelset and track introduces the equivalent conicity concept, which is one of the important parameters intervening in the study of the riding stability of railway vehicles. After having outlined a concise theory and after having described some devices permitting the recording of wheel and rail profiles, the calculation methods and the results obtained are described.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways C116/RP 3/E, Oct. 1973, Figs., 4 Ref., 14 App.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

A2 052548
OPTIMUM ADAPTATION OF THE CONVENTIONAL TRACK TO FUTURE TRAFFIC. STUDY OF THE CHANGE IN THE TRACK LEVEL AS A FUNCTION OF THE TRAFFIC AND OF THE TRACK COMPONENTS (FIRST RESULTS OF LABORATORY AND SITE TESTS)

The report deals with the change in the longitudinal level of conventional tracks under the effect of operating loads. Tests have been carried out in the laboratory and on actual sites on differently equipped tracks, with a view to defining the influence of the various track component parameters. The discovered evolution law of defects has shown that the reduction in sleeper spacing and of crib and shoulder consolidation exert a rather clear influence. It has also become apparent that the quality of the maintenance operations exerts a very large influence. These findings should however be treated with caution. The influence of the inertia of the rail, the thickness of the rail pads, the types of sleepers and the conditions of the formation and of the ballast, will be accurately defined later.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B117/RP 2/E, Apr. 1973, 54 pp, Figs., Tabs.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

A2 052564
TEST TRACK AT RADCLIFFE-ON-TRENT. CONSTRUCTION AND RUNNING EXPERIENCE

This description of experience with various types of ballastless track using in situ concrete slab indicates some of the practical aspects of installation and the standards of accuracy obtained. Most of the test lengths have shown no significant deterioration in four years of service carrying normal traffic.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways D87/RP 7/E, Oct. 1973, 18 pp, 7 Fig., 12 Tab.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

A2 052572
AN ANALOG-DIGITAL METHOD OF DETERMINING VERTICAL TRACK IRREGULARITIES AS THE EXCITATION OF A RAIL VEHICLE'S VERTICAL OSCILLATIONS

Unknown dynamic parameters of the track have been obtained by statistical calculations. The parameters are used to design an analog-system to determinate a "substitute vertical track irregularity" as an excitation of vertical vehicle oscillations for the accepted model of the track. The signal recorded on the magnetic tape may also be used for an analog study of the vertical vibrations of other vehicles. The computations have been based on the correlation function method.

This paper was presented at the Third ORE Colloquium held in Amsterdam, May 8th to 10th 1973, and its Summary is contained in the Colloquium report #AZ40/RP 5/E; See RRIS #052511. Restrictions on the use of this document are contained in the explanatory material.

Kosieradski, W
International Union of Railways June 1973

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

A2 052582
OPTIMIZATION OF THE LAYOUT AND OF THE RE-ALIGNMENT OF THE LAYOUT OF CURVED TRACK

This study is devoted to problems in connection with the layout of railway tracks in curves, the "versine method" currently employed on the SNCF being the sole method considered. These problems involved are of two types and concern: (1) the re-alignment of the layout during track maintenance operations: it is a case here of the correction of layout defects due to the passage of trains and not involving important track shifting; (2) detailed modification of the layout: it is a case here of the modification of the layout of a curve carried out in particular with a view to an increase in the running speed, combined, possibly, with a fault-correction. The solution of these two problems is obtained with the help of linear programming: it gives the track-shifts and the future versines and superelevations at each reference point on the site in taking into account one or more optimization criteria. The results are presented in the form of a list accompanied by a diagram supplied by a curve-plotter and giving versines and superelevations as a function of the curvilinear abscissa. The first type of problem has now been solved, both for simple curves and for curves with successive arcs. The calculation program concerning the second type of problem is in the course of being perfected and finalized.

This paper was presented at the Third ORE Colloquium held in Amsterdam, May 8th to 10th 1973, and its Summary is contained in the Colloquium report #AZ40/RP 5/E; See RRIS #052511. Restrictions on the use of this document are contained in the explanatory material.

Blanc, P
International Union of Railways June 1973

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

A2 052592
AUTOMATIC WARNING OF TRACK MAINTENANCE GANGS. THEORETICAL STUDY TO ASCERTAIN THE OPTIMUM ACOUSTIC WARNING SIGNALS IN THE PRESENCE OF SEVERE BACKGROUND NOISE

The report contains a description of a theoretical study concerning the complex psycho-acoustic and psychological aspects of signal perception when the signals are masked by interfering noise. The report also suggests what features appear to be the most favourable for acoustic warning signals, and makes proposals for the continuation of the study.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B124/RP 4/E, Apr. 1974, 30 pp, 2 Fig., 1 Tab.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

A2 052597
STANDARDIZATION OF POINTS AND CROSSINGS. DIVERGING TURNOUTS FOR SPEEDS OF 100 TO 200 KM/H AND ABOVE--GENERAL DESIGN--EXPERIENCE ACQUIRED BY CERTAIN ADMINISTRATIONS

This report gives a summary of the experiences already gained by the Railway Administrations in the matter of switches and crossings for speeds between 100 and 160 km/h on the diverging route. To begin with are discussed the general characteristics of the guide lines within which the figures indicated are based essentially on the conclusions of Committee D 72. The trials already carried out and those yet to be undertaken should permit the establishment of the essential parameters; acceptable cant deficiency, form of transition, design of switch toe, slope of entry for check rails ets. Bordering on these trials of turnouts of standard design, which embrace the range of speed up to 220 km/h on the divergind route, the trials with movable nose crossings intended to eliminate gaps in the running lines, are equally provided for.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways D121/RP 1/E, Apr. 1974, 16 pp, 20 Fig., 3 Tab., 9 Ref., 1 App.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

A2 052608
OPTIMUM ADAPTION OF THE CONVENTIONAL TRACK TO FUTURE TRAFFIC. RHEOLOGICAL PROPERTIES OF THE TRACK
The laboratory tests carried out with a view to determining the dynamic modulus of elasticity of the ballast and described in the present report show that, from the point of view of vibratory phenomena, the real behaviour of the track can be simulated on the small test rig. The vibrations of the track have been analysed in the frequency range comprised between 20 and 90 Hz and it has been established that the use of sleepers of different types affects the modulus of elasticity and the position of the resonance peaks. It has thus been possible to show that heavy sleepers are better suited for high speeds.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways D117/RP 4/E, Apr. 1974, 41 pp, Figs., 10 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

A2 052653
UNCONVENTIONAL TRACKS. BRITISH RAILWAYS PROTOTYPES MAIN LINE PAVED CONCRETE TRACK AT DUFFIELD. CONSTRUCTION AND RUNNING EXPERIENCE
This report briefly describes the construction and running experience of the prototype main line paved concrete track at Duffield. The slab design and construction is described and measurements of the behaviour under traffic are summarised. A number of minor maintenance works have been necessary but overall the behaviour of the paved concrete track during the first year of service can be considered satisfactory.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways D87/RP 9/E, Apr. 1975, 25 pp, Figs., Tabs.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

A2 052654
UNCONVENTIONAL TRACKS. BRITISH RAILWAYS PROTOTYPE PAVED CONCRETE TRACK AT RADCLIFF-ON-TRENT (PHASE II) 1971-2
The report briefly describes the second concrete-based test track constructed at Radcliffe-on-Trent and put into service in June 1972. Construction accuracy and behaviour in service are discussed.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways D87/RP 10/E, Apr. 1975, 19 pp, Figs., Phots.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

A2 052661
CONSTRUCTIONAL ARRANGEMENTS FOR IMPROVING THE RIDING STABILITY AND GUIDING QUALITY OF ELECTRIC AND DIESEL LOCOMOTIVES AND VEHICLES. SUMMARY OF TEST RESULTS AND VEHICLE DESIGN RECOMMENDATIONS
During the investigations and studies relating to the riding stability and guiding quality of tractive units, various data have been collected which have enabled constructional recommendations to be elaborated. These have been grouped together in such a way that it will be possible to choose, from among these recommendations, those which are apt to reduce the forces between wheel and rail to the greatest possible extent, while a good riding stability of the tractive unit is still ensured.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B10/RP 15/E, Oct. 1974, 59 pp, Figs., 25 Ref., 2 App.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

A2 052666
ADHESION OF LOCOMOTIVES FROM THE POINT OF VIEW OF THEIR CONSTRUCTION AND OPERATION. ADHESION TESTS OF AUTUMN 1972
The report describes the adhesion tests carried out during Autumn 1972 using the B 44 Test Machine 18 000 equipped for operation with a 25 kV, 50 Hz feeding locomotive. The tests were a continuation of those already described in RP 9 and RP 10 but 1400 mm driving wheels were fitted. New data was obtained using the measuring axle-boxes, and the traction forces transmitted by each of the two driving wheels were measured. As before, both manual and statistical evaluations have been made to obtain the greatest information from the recorded results.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B44/RP 11/E, Apr. 1975, 25 pp, Figs., Tabs., Phots., 3 App.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

A2 052674
LAYING OF TRACK ON CROSS TIMBERS
Two methods of laying track, both appropriate when there is a shallow depth of construction, are outlined. In addition, the second method is used particularly in the case of lines containing long welded rails. The advantages and inconveniences inherent to both methods are discussed.

International Union of Railways DOC 16, Jan. 1967, 6 pp, 2 Fig., 3 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr. PC

DOTL RP

A2 053845
SANTA FE MECHANIZES SWITCH TRACK RENEWAL FOR BETTER RIDING TRACK
Often, an otherwise fine stretch of running track has contaminated ballast at the switches, turnouts and crossings. Santa Fe has developed and is now well into a program of ballast renewal by a production technique of mechanized undercutting. The Santa Fe's technique is geared to the performance of the Kershaw "bent-spoon" switch undercutter.

Progressive Railroading Vol. 16 No. 6, Nov. 1973, 2 pp, 3 Phot

PURCHASE FROM: Murphy-Richter Publishing Company 9 South Clinton Street, Chicago, Illinois, 60606 Repr PC

DOTL JC

A2 053858
THE CONCRETE TIE: WHAT CAN BE EXPECTED FROM IT?
Recent investigations aimed at determining the causes of service cracks in concrete ties, along with the results, are described in this article. Modifications in a proposed specification for concrete ties resulting from these and other problems are noted. Problems involved in expanding concrete-tie production capacity are explored.

Weber, JW (Portland Cement Association) *Railway Track and Structures* Vol. 69 No. 12, Dec. 1973, 2 pp, 1 Phot

ACKNOWLEDGMENT: Railway Track and Structures
PURCHASE FROM: XUM Repr PC

DOTL JC

A2 053860
CALCULATING MAINTENANCE PERFORMANCE--A STATISTICAL APPROACH
Figures on derailments, maintenance work performed and ton-miles are combined to produce index numbers that may be used for comparative purposes.

Grogan, GE *Railway Track and Structures* Vol. 69 No. 11, Nov. 1973, 4 pp, Tabs

ACKNOWLEDGMENT: Railway Track and Structures
PURCHASE FROM: XUM Repr PC

DOTL JC

A2 053861
A BONDED CONTINUOUS TURNOUT FOR CWR TERRITORY
Design developed for use on Washington's rapid transit system involves a "glued" switch insert and a standard frog modified so as to provide a greater bonding area.

Mester, GE Robey, RH (De Leuw, Cather and Company) *Railway Track and Structures* Vol. 69 No. 11, Nov. 1973, 2 pp, Fig

ACKNOWLEDGMENT: Railway Track and Structures
PURCHASE FROM: XUM Repr PC

DOTL JC

A2 053863
PLASTIC INSULATION FOR RAIL JOINTS
Extended service life is claimed for new material, resulting in reduced costs for track maintenance.

Railway Track and Structures Vol. 69 No. 9, Sept. 1973, 1 p, 4 Phot

ACKNOWLEDGMENT: Railway Track and Structures
PURCHASE FROM: XUM Repr PC

DOTL JC

A2 053884
RAISING STANDARDS TO COPE WITH HEAVY MINERAL GROWTH
Since completion of the Mount Isa project, 1975 will see a total of 30 million tonnes hauled. Much new construction and upgrading of existing lines has been necessary to cope with this burgeoning traffic, and track standards have been raised to match increased payloads.

Nutt, WS (Queensland Railways) *Railway Gazette International* Vol. 130 No. 2, Feb. 1974, 4 pp, 4 Phot

ACKNOWLEDGMENT: Railway Gazette International
PURCHASE FROM: IPC Transport Press Repr PC

DOTL JC

A2 053885
BRAZIL COMPLETES UPGRADING OF FIRST EXPORT FREIGHT ROUTE
New government policy favours movement of all heavy freight by rail, and RFFSA is making plans for upgrading several main lines to high standards to form export corridors.

Railway Gazette International Vol. 130 No. 2, Feb. 1974, 2 pp

ACKNOWLEDGMENT: Railway Gazette International
PURCHASE FROM: IPC Transport Press Repr PC

DOTL JC

A2 053978
ROLLING RESISTANCE AND TRACK
This short paper raises the question of the effect of the track structure on rolling resistance. The author points out the reduced rolling resistance of similar cars on different track structures, and suggests the heavier track structures used in America and Russia are of advantage.

Scales, BT *Railway Engineering Journal* Vol. 2 No. 3, May 1973, 1 pp, 1 Fig, 2 Ref

PURCHASE FROM: Institution of Mechanical Engineers 1 Birdcage Walk, Westminster, London SW1, England Repr PC

DOTL JC

A2 053990
SAND LAYER FOR TRACK STABILITY
A number of European railroads have had encouraging results with a layer of sand just below the ballast as a means of separating the ballast and also sealing it from the subgrade, thus improving track stability. This article describes the why and how of such sand layers. It also explains a unique system developed by Plasser for applying such a layer of sand on a production basis, and without removing the track.

Progressive Railroading Vol. 16 No. 5, Sept. 1973, 2 pp

PURCHASE FROM: Murphy-Richter Publishing Company 9 South Clinton Street, Chicago, Illinois, 60606 Repr PC

DOTL JC

A2 054011
STATISTICAL CHARACTERIZATIONS OF RAILWAY TRACK BEHAVIOR
Absolute space curve data of railway track, representing the vertical and lateral perturbations of both running rails, was collected and analyzed. A variety of track is studied, including high speed versus yard, bolted versus continuous welded rail (CWR), and old versus new construction. Analytical techniques include Signal Averaging, Analysis of Variances, and Correlation analysis. As a result, it is concluded that railway track is characterized by a pure Markovian process, a periodic process, and a periodically modulated random process.

A paper recommended by the IEEE Land Transportation Committee of the IEEE Industry Applications Society for presentation at the 1974 Joint ASME/IEEE Railroad Conference, Pittsburgh, Pa., April 2-4, 1974.

Corbin, JC (ENSCO, Incorporated)
Institute of Electrical and Electronics Engineers Dec. 1973, 15 pp, 18 Fig, 13 Ref

ACKNOWLEDGMENT: IEEE
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL RP

A2 054305
THE IN-TRACK TREATMENT OF THE RAIL RUNNING SURFACE ON THE NETWORK OF THE GERMAN FEDERAL RAILWAYS (DB)
The running speeds of passenger trains and express goods trains have constantly increased over the last few years. Particularly on main lines, electrification has led to the use of heavy electric locomotives with high axle loads and starting accelerations. For safety, economy and riding comfort in these conditions, a good track seating is essential. The Author deals with the need for regular grinding of rail heads on railway tracks, for which purpose the German Federal Railways have employed the "Speno" rail-grinding train since 1968. Its design, use and results obtained are described here.

Deckart, H (German Federal Railway) *Eisenbahntechnische Rundschau* Reprint No. 7/8, 1973, 7 pp, Figs

ACKNOWLEDGMENT: Eisenbahntechnische Rundschau
PURCHASE FROM: Hestra-Verlag Hernichel und Dr. Strasse, Darmstadt, West Germany Repr PC

DOTL RP

A2 054629
CONSOLIDATION OF THE PERMANENT WAY
Consolidation as an associated-essential of tamping is now widely accepted and extensive tests by Plasser & Theurer investigate the effectiveness of rotating an off-centre mass to impart vibration in the statically-loaded consolidating feet compared with the practice of applying constant-amplitude oscillations directly to them under similar loading conditions.

Rail Engineering International Vol. 4 No. 3, Apr. 1974, pp 133-136, 5 Fig, 2 Phot

ACKNOWLEDGMENT: Rail Engineering International
PURCHASE FROM: Broadfields (Technical Publishers) Limited Little Leighs, Chelmsford, Essex CM3 1PF, England Repr PC

DOTL JC

A2 054631
HIGH-FREQUENCY VIBRATION AND STATIC-LOADING COMBINED TO TAMP AND CONSOLIDATE TRACK
Oscilating 'tamping-forks' straddling the sleepers are forced into the cribs to achieve a uniform ballast-bed consolidation. Tamping groups are freely-suspended to ensure consolidation build-up.

Rail Engineering International Vol. 4 No. 3, Apr. 1974, pp 146-148, 3 Fig, 3 Phot

ACKNOWLEDGMENT: Rail Engineering International
PURCHASE FROM: Broadfields (Technical Publishers) Limited Little Leighs, Chelmsford, Essex CM3 1PF, England Repr PC

DOTL JC

A2 054658
CRISIS IN CROSSTIES: SUPPLY SQUEEZE AND NEED FOR HIGHER TRACK STANDARDS STEPS UP CONCERN ABOUT THE CROSSTIE ITSELF
A crisis in crossties that occurred in 1973 gives all indication of carrying over into 1974. Shortages of wood ties in 1973 was the cause of valuable time being lost in either track maintenance or catching up on deferred maintenance. Supply squeeze and need for higher track standards steps up concern about the crosstie itself. Alternatives are considered such as concrete ties, laminated particle board ties and steel ties.

Progressive Railroading Vol. 17 No. 1, Jan. 1974, pp 61-62,, 64

ACKNOWLEDGMENT: CNR
PURCHASE FROM: Murphy-Richter Publishing Company 9 South Clinton Street, Chicago, Illinois, 60606 Repr PC

DOTL JC

A2 054666
THE CANCER OF MAINTENANCE DEFERRAL
During the past 20 years there has been a marked decline in the quality of tracks expecially among the bankrupt railways. On the basis of a 37-year tie life, a railroad should install 80-90 ties per mile per year. Yet in 1972 PC installed 61. The Southern Railway presently has one of the best track maintenance programs in the U.S. and one of the highest maintenance-of-way ratios (percentage of operating revenue devoted to M/W. work) at 16.9. Continuous welded rail is also an important M/W project on the Southern. These programs typify the Southern as the prosperous railway of the South, Southwest and West.

Myers, ET *Modern Railroads* Vol. 29 No. 3, Mar. 1974, 3 pp

ACKNOWLEDGMENT: CNR
PURCHASE FROM: Cahners Publishing Company, Incorporated 5 South Wabash Avenue, Chicago, Illinois, 60603 Repr PC

DOTL JC

A2 054681
SANTA FE'S WELDED RAIL PLANT AIMS AT LOW COST PRODUCTION
The use of continuous welded rail is producing big savings for railroads. If those savings are to be maximized, large investments are required, at least on the major roads, to provide installations and equipment that will make it possible to produce CWR from both new and secondhand rail at minimum cost. Santa Fe's new centralized rail welding plant at Amarillo, Tex., to be dedicated on May 14, provides an example of how this line of reasoning works out in practice. On about 30 acres of land alongside its main line, Santa Fe has created a double-line rail butt-welding complex designed to produce approximately five miles of butt-welded rail daily in two eight-hour shifts the year around.

Railway Age Vol. 175 No. 9, May 1974, pp 36-39, 1 Fig, 4 Phot

ACKNOWLEDGMENT: Railway Age
PURCHASE FROM: XUM Repr PC

DOTL JC

A2 054687
ON TRACK SIGNALLING PROBLEMS RELATIVE TO MODERN PERMANENT WAY PRACTICE
In recent years a considerable change has taken place in the formation and construction of permanent way and in its maintenance by on track mechanised methods. Much of this development and application has occurred without the Signal and Telegraph Engineer having the opportunity to apply concurrent development of the signalling equipment associated with track work. In this paper the Author highlights some of the difficulties experienced with the continued use of old established methods for Signal and Telegraph equipment on track and suggests some alternative arrangements for development.

Whitehouse, WH *Permanent Way Institution, Journ & Rpt of Proceed* Vol. 91 No. tIII, 1973, pp 133-144, 6 Fig

PURCHASE FROM: Derry and Sons, Limited Canal Street, Nottingham, England Repr PC

DOTL JC

A2 054688
MODERN TRACK RENEWALS
This paper deals with modern mechanised railway track renewals, and why such renewals are necessary. It also describes briefly the rapid development during recent years in modern railway track, mentioning the materials and techniques involved.

Pitkin, KJ *Permanent Way Institution, Journ & Rpt of Proceed* Vol. 91 No. tIII, 1973, pp 152-158

PURCHASE FROM: Derry and Sons, Limited Canal Street, Nottingham, England Repr PC

DOTL JC

A2 054692
THE EFFECT OF TRACK AND VEHICLE PARAMETERS ON WHEEL/RAIL VERTICAL DYNAMIC FORCES
The railway track and vehicle combination comprises heavy rigid wheels running on heavy rails. Imperfections in either will give rise to dynamic effects which increase with speed. These will supplement the contact forces which, on perfect track with perfect wheels, are basically the static wheel loads. The commercial necessity for higher speeds and greater axle loads has been established and this historical trend will probably continue. Forces and stresses will therefore become more severe unless technical progress is made in track and vehicle design. In this context, close co-operation between the Civil and the Mechanical Engineer is essential. Track must have a high standard of alignment and level and maintenance quality must be improved as far as practicable. The forces that the rails and track structure will withstand must also be specified. New vehicles, particularly those for high speed operation or with heavy axle loads, must not generate excessive track forces.

Jenkins, HH Stephenson, JE Clayton, GA Morland, GW Lyon, D *Railway Engineering Journal* Vol. 3 No. 1, Jan. 1974, pp 2-16, 22 Fig, 4 Tab

ACKNOWLEDGMENT: Railway Engineering Journal
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

A2 054752
SANTA FE CENTRALIZED RAIL WELDING PLANT
Four short articles describe the various features of the Santa Fe's new rail welding plant at Amarillo, Texas.

Railway Track and Structures Vol. 70 No. 5, May 1974, 13 pp, Figs, Phots

PURCHASE FROM: XUM Repr PC

DOTL JC

A2 054779
TESTS ON A NEW TYPE OF CONCRETE SLEEPER [VERSUCHE MIT NEUARTIGEN BETONSCHWELLEN]
The sleeper in question is 2.4 m long with short crosswise projections on either side below the rail. The problem was to find a solution to track side-slip, especially in small radius curves, when the rails are welded in long sections. The OBB have carried out comparative tests in the laboratory and on the track with the new sleeper and with the standard concrete sleeper (BE 14) in extended 2.6 m form. Although the experiments have still to be completed, it is already clear that the stability of the new sleeper is greater. However a cost benefit analysis still has to be drawn up before the OBB can come to a decision over this sleeper.

Czuba, W *Die OBB in Wort und Bild* No. 9, 1973, 4 pp, 7 Fig

ACKNOWLEDGMENT: UIC (59)
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr PC

59

A2 054782
THE BEHAVIOUR OF RAILS IN RELATION TO THEIR CONDITIONS OF USE
The principal rail failure statistics of 5 Administrations have been analysed with a view to determining the respective influence of the different features involved in the behaviour of rails in service. Some recommendations are proposed concerning the choice of rail-section as a function of the traffic, the grade and quality of the rail steel and the construction of rail joints. The problems raised by welds in continuously welded rails, by the substructure and by the environment are also mentioned. It seems that the rail withdrawals for fatigue defects increase proportionally with the total traffic load on the one hand with the cube of the average axle-load on the other.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways D 117/RP 3, Apr. 1973, 34 pp, 27 Fig, 8 Tab

ACKNOWLEDGMENT: UIC (33)
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr PC

33

A2 054786
ELASTIC DEFORMATIONS IN TRACKS WITH S 60 RAILS [Zroznicowanie Odksztatcen Sprezystych Nawierzchni S 60]
The author looks back over studies carried out by the PKP over a four-year period into the behavioural pattern of tracks with S 60 rails on wooden or concrete sleepers, on main intercity routes. The article gives the results obtained for elastic depression of rails, their side-slip and stress, for rail deflection (including its height) or the coefficient of rigidity of track formation and rail, the effect of ballast grain size on depression, etc. He also gives forecasts for increases in track irregularities in relation to the loads carried in practice according to mathematical models and analysis of the measurements. The conclusions drawn underline the considerable advantages provided by the S 60 rail tracks which could be increased still more by perfecting the technology and quality of laying and maintenance work. [Polish]

Baluch, H *Przeglad Kolejowy Drogowy* No. 9, 1973, 11 pp, 14 Fig, 15 Ref

ACKNOWLEDGMENT: UIC (52)
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr PC

52

A2 056842
PERFORMANCE OF WELDED JOINTS IN RAILS
It is shown that high-carbon and chromium alloy steel joints, produced by butt welding, possess reduced resistance to impact loading in comparison with the base metal although they have otherwise excellent mechanical properties. Gas-pressure welding insures greater resistance of the joints to impact loading in comparison with resistance flash welding.

Mel'ko, YG *Welding Production* Vol. 20 No. 2, Feb. 1973, pp 53-55, 2 Ref

ACKNOWLEDGMENT: EI (EIX740301796)
PURCHASE FROM: ESL Repr PC, Microfilm

A2 056860
MODEL STUDY FOR VERTICAL TRACK BUCKLING
A study is presented of two models which represent the mechanism of vertical buckling of a track when subjected to a mechanical or to a thermal compression force, respectively. The postbuckling equilibrium curves and their stability are discussed and a stability criterion is defined. The effect of various track model parameters, upon the buckling load or buckling temperature, is shown. Graphs reveal that the range of safe compression forces for the mechanically compressed structure is much smaller than the range of the safe forces due to constrained thermal expansions; indicating a possible explanation why in the tests in which the compression forces are induced by jacks the track buckles predominantly in the vertical plane, whereas when the track is compressed by constrained thermal expansions it exhibits mainly horizontal buckling modes. It was found that the buckling loads, or temperatures, obtained from a linearized analysis have no relevance to the actual values obtained from a nonlinear analysis; the difference in results being substantial for buckling temperatures.

Kerr, AD (Princeton University) *High Speed Ground Transportation Journal* Vol. 7 No. 3, 1973, pp 351-368, 1 Ref

ACKNOWLEDGMENT: EI (EIX740304468)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

A2 057177
WARNING STAFF AT WORK ON THE TRACK BY RADIO-TELEMETRY LINK
The Alexander Early Warning System comprising a rail-affixed detector which transmits its warning by radio link up to three miles distant to the "lookout" man is described. A device which overcomes problems of impaired visibility and obstructed vision.

Rail Engineering International Vol. 4 No. 4, May 1974, pp 189-190, 3 Phot.

ACKNOWLEDGMENT: Rail Engineering International
PURCHASE FROM: Broadfields (Technical Publishers) Limited Little Leighs, Chelmsford, Essex CM3 1PF, England Repr. PC

DOTL JC

A2 057178
CHANGING CANT OF SLAB TRACK
Laying slab track introduces a permanence which poses problems when speeds are increased and cant deficiencies arise. The author examines the track geometry putting forward two approaches embodying shims and fastenings which can be changed mutually from inside to outside rails.

Bramall, B *Rail Engineering International* Vol. 4 No. 4, May 1974, 3 pp, 4 Fig

ACKNOWLEDGMENT: Rail Engineering International
PURCHASE FROM: Broadfields (Technical Publishers) Limited Little Leighs, Chelmsford, Essex CM3 1PF, England Repr. PC

DOTL JC

A2 057406
MAINTENANCE COSTS FOR INTERNAL TRANSPORTATION BY RAIL, AND METHODS FOR INSURING MINIMUM MAINTENANCE COSTS [Les frais d'entretien relatifs aux transports interieurs par voie ferree. Mesures qui permettent d'obtenir un cout d'entretien minimum]
This Benelux report of maintenance costs for the engines, rolling stock, rails, signal systems, etc, of internal railway systems of steel plants arrives at a figure of 40% of the total cost of operating this means of transportation. The figures used are those for 1968 to 1971. [French]

Revue de Metallurgie Vol. 71 No. 2, Feb. 1974

ACKNOWLEDGMENT: EI (EIX740606542)
PURCHASE FROM: ESL Repr PC, Microfilm

A2 057441
IMPROVEMENT OF THE TECHNOLOGY AND MECHANIZATION OF TRACK-LAYING WORKS AT OPEN PIT MINES [Sovershenstvovanie tekhnologii i mekhanizatsii putevykh rabot na rar'erakh]
Results of industrial tests of new track-laying machines are presented and the savings due to their use at the Sokolovsko-Sarbayskiy iron ore mining and dressing combine in Kazakhstan are described. These machines include some that are based on caterpillar and wheel tractors as well as a tie-placing machine based on combined automobile and rail drive. [Russian]

Putyatin, BK Podsosov, AL Yakimov, IT Tleugabylov, ZK Kim, VS *Gornyi Zhurnal* No. 1, Jan. 1974

ACKNOWLEDGMENT: EI (EIX740600137)
PURCHASE FROM: ESL Repr PC, Microfilm

A2 057454
ON THE STABILIZATION OF THE BALLAST BED [Ein Beitrag zur Stabilisierung des Schotterbettes]
An investigation was made, as part of a dissertation, into whether the addition of smaller-size ballast increases the deformation resistance of the ballast bed. Greatest success and reduced maintenance costs appear to be promised by adding 15 percent smaller ballast to the grade 1 size. [German]

Profanter, HH *Eisenbahntechnische Rundschau* Vol. 23 No. 1/2, Jan. 1974, pp 52-54, Figs., 4 Ref.

ACKNOWLEDGMENT: Eisenbahntechnische Rundschau
PURCHASE FROM: Hestra-Verlag Hernichel und Dr. Strauss, Darmstadt, West Germany Repr. PC

DOTL JC

A2 057456
THE TECHNICAL PLANNING FOR NEW LINES OF THE GERMAN FEDERAL RAILWAY [Die Technische Planung der Neubaustrecken der Deutschen Bundesbahn]
The Author describes the present stage of the German Federal Railway's planning for new lines in the near and distant future, also the elements of track layout, structure gauge, track spacing and the standard cross-section considerations. Reference is also made to the awaited results of the various studies and the decisions which will follow. [German]

Wolf, W (German Federal Railway) *Eisenbahntechnische Rundschau* Vol. 23 No. 1/2, Jan. 1974, pp 14-21, Figs., 1 Ref.

ACKNOWLEDGMENT: Eisenbahntechnische Rundschau
PURCHASE FROM: Hestra-Verlag Hernichel und Dr. Strauss, Darmstadt, West Germany Repr. PC

DOTL JC

A2 057462
INVESTIGATIONS ON THE FORM STABILITY OF RAILS AND CONCLUSIONS FOR THE PRACTICE [Untersuchung zur Gestaltfestigkeit der Schienen und Folgerungen fur die Praxis]
Investigations were made into the effects of tensile strength and steel qualities on the form stability of rails when subjected to flexural or bending stress, also the part played by the condition of the rail surface. The results showed that there was a danger of fatigue with the S 49 rail on main lines, with the result that the UIC 60 was recommended. [German]

Eisenmann, J Oberweiler, G (Munich Technical University); Schweitzer, R Heller, H (Krupp Huttenwerke AG) *Eisenbahntechnische Rundschau* Vol. 23 No. 3, Mar. 1974, pp 122-126, Figs., 6 Ref.

ACKNOWLEDGMENT: Eisenbahntechnische Rundschau
PURCHASE FROM: Hestra-Verlag Hernichel und Dr. Strauss, Darmstadt, West Germany Repr. PC

DOTL JC

A2 057500
THE USE OF HEAVY MACHINERY FOR TRACK MAINTENANCE
Mechanisation of track maintenance with heavy machinery enables the following operations to be carried out mechanically: longitudinal and transverse levelling of the track; realignment of the track; levelling of the ballast. To these operations we must now add the tamping of the spaces between sleepers, in the case of long welded track. This mechanisation, which began with track levelling followed by realignment, has now reached a level of quality superior to the similar operation carried out manually. In addition, particularly in countries where labour is expensive, this mechanisation enables track maintenance costs to be reduced.

Gunst, G *Rail International* No. 2, Feb. 1974, pp 177-187, Tabs.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr. PC

DOTL JC

A2 057514
OBB TRIES OUT LUGGED SLEEPERS ON SMALL RADIUS CURVES
Because of problems of transverse displacement and buckling, Austrian Federal Railways (OBB), like most other European railways, limits the installation of continuously-welded rail on concrete sleepers to curved track with a radius of not less than 450 m. In Austria, however, this limitation affects between 30 and 40 per cent of OBB's mileage and there is economic pressure to solve these problems so that the advantages of long-welded rail can be extended to routes with curves of smaller radius. OBB has therefore developed two new monobloc concrete sleepers with this in mind.

Railway Gazette International Vol. 130 No. 6, June 1974, pp 239-241

ACKNOWLEDGMENT: Railway Gazette International
PURCHASE FROM: XUM Repr. PC

DOTL JC

A2 057515
CLOSING THE GAP AT THE FROG
Swing-nose or swing-wing turnouts, designed to provide an uninterrupted path for wheel treads, have been installed experimentally by a number of European administrations, and their advantages in cutting down both horizontal and vertical impacts are likely to be more widely appreciated as speeds rise.

Railway Gazette International Vol. 130 No. 6, June 1974, p 239

ACKNOWLEDGMENT: Railway Gazette International
PURCHASE FROM: XUM Repr. PC

DOTL JC

A2 057558
C&NW'S 4 POINT RAIL-MAINTENANCE PROGRAM IN JOINTED TERRITORY
To counter effects of heavy traffic C&NW has stepped up its efforts to improve conditions at rail joints. Maintenance operations include surface grinding, bolt tightening, joint-straightening and building up battered joints.

Railway Track and Structures Vol. 70 N July 1974, pp 14-16, 1 Fig., 5 Phot.

ACKNOWLEDGMENT: Railway Track and Structures
PURCHASE FROM: XUM Repr. PC

DOTL JC

A2 057559
KANSAS CITY SOUTHERN MAKES TIE RENEWALS WITH SMALL MACHINE
To an increasing extent, tie renewals are being made on the Kansas City Southern with a relatively small machine, known as the Section Gang Machine, which can be moved to and from the track by a few men. The number of attachments designed to increase the versatility now include the tie renewer, spike hammer, spike puller, lag screw bolter, tie drill and concrete breaker. Ease of handling, versatility of attachments and convenience of transporting it give the Section Gang Machine a good performance rating by KCS.

Railway Track and Structures Vol. 70 N July 1974, pp 22-24, 4 Phot.

ACKNOWLEDGMENT: Railway Track and Structures
PURCHASE FROM: XUM Repr. PC

DOTL JC

A2 057716
RECIPE FOR REHABILITATION
Two articles discuss the problems of bad track and deferred maintenance and some possible solutions. Because of the bad track some people are suggesting that the government take over the track to maintain it and let the companies pay a user fee to operate over the rails. The Transportation Act of 1974 would provide loans that could be used for track maintenance. CONRAIL is another proposed solution to the problems. New equipment is making maintenance-of-way work faster and cheaper but problems are developing with material shortages, especially ties.

Myers, ET *Modern Railroads* Vol. 29 No. 7, July 1974, pp 40-44

ACKNOWLEDGMENT: CNR
PURCHASE FROM: Cahners Publishing Company, Incorporated 5 South Wabash Avenue, Chicago, Illinois, 60603 Repr. PC

DOTL JC

A2 057745
18,000 TONNE ORE TRAINS IN AUSTRALIA
Over its seven-year existence, northwestern Australia's Hamersley Iron Railway has handled steadily increasing iron ore traffic until its gross tonnage reached an estimated 57.6 million during 1974. This 388-km high-capacity railroad is confronted with special problems of geographical isolation, harsh climate and high-growth rate. While in original design all equipment and track were based on US standards, as time passes, more European practices are introduced. The railroad is already studying new car designs and ultimately may consider doubletracking and other means of increasing capacity.

Curlewis, WPC *Railway Engineering Journal* Vol. 3 No. 3, May 1974, pp 4-23, 20 Fig., 3 App.

PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

A2 057819
TRACK GEOMETRY DEVELOPMENT UMTA URBAN RAIL SUPPORTING TECHNOLOGY PROGRAM
Measurement of transit system track geometry parameters, under normal operating conditions, is essential for planning and conducting an effective maintenance program. The pertinent parameters are profile, gage, alignment, and cross level. Present methods of determining track conditions are inefficient and highly subjective. Several track geometry measurement methods have been investigated.

Rutyna, FJ
Transportation Systems Center Final Rpt. DOT-TSC-UMTA-73-14, Apr. 1974, 41 pp

Contract UM404/R4731

ACKNOWLEDGMENT: NTIS (PB-233394/6)
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-233394/6, DOTL NTIS

A2 057858
STUDY OF PREVENTIVE MEASURES FROM THE ACCUMULATION OF SNOW ON THE RAILWAY TRACK
In order to prevent possible snow damage on the railway lines in cold regions, a snow-free track structure has been devised and tested with an experimental structure constructed near Ohmagari on the Ohu Line. The report describes the tests conducted to evaluate the possibility of using a river stream as the snow removing media under various conditions of the air and water temperatures, the snowstorm, the depth of water, etc. and also the adverse effects on the flow of streams by gusts caused by high-speed trains.

Hikita, S *Railway Technical Research Institute* Quart. Rpt Vol. 15 No. 2, 1974, pp 76-78

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Ken-yusha 1-45-6, Hikari-cho, Kokubunji, Tokyo, Japan Repr. PC
DOTL JC

A2 057862
RAIL WELDING METHODS
This paper is a review of various kinds of rail welding methods used in Japan. It describes special merits, the present state of utilization and the trend in future of those methods, and it shows various experimental values about the strength of welded rails. Further, it describes a few special rail welding methods other than those for making continuous welded rail such as welding of austenitic manganese steel crossing to carbon steel rail.

Oishibashi, H *Railway Technical Research Institute* Quart. Rpt Vol. 15 No. 2, 1974, pp 69-75, Figs.

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Ken-yusha 1-45-6, Hikari-cho, Kokubunji, Tokyo, Japan Repr. PC
DOTL JC

A2 057871
DEVELOPMENT OF TRACK BALLAST MAT
As a result of tests on the New Tokaido Line, aimed at developing speeds to 250 km/h, the laying of rubber mats under the ballast was conceived. Used automobile tires, ground and heat moulded into mats, have proven effective in preventing the pulverization of the NT Line ballast. The cost of track maintenance was reduced and noise and vibration suppressed. It has been decided to totally adopt the ballast mat in the tracks of the nationwide Shin Kansen network and it is possible also on the narrow-gauge lines.
Also available through Japan Railway Civil Engineering Association.

Sato, Y Usami, T (Japanese National Railways) *Permanent Way* Vol. 15 No. 3, No. 56, 10 pp

ACKNOWLEDGMENT: Permanent Way
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

A2 057873
EXPERIMENTAL TESTS ON VIBRATION-PROOF TRACKS AND THEIR EFFECTS
To minimize vibrations and noise from subway operation under a primarily residential area, a new line incorporated test sections of rubber mats under crushed-stone ballast, neoprene strips in a cast concrete roadbed, and vibration-proof asphalt concrete under crushed stone. The mats proved most effective but would invite greater settling of the track, complicating maintenance. The concrete slab, while more expensive, would minimize maintenance but would be costly to restore once performance had deteriorated. The vibration-proof asphalt concrete was not effective.
Also available through Japan Railway Civil Engineering Association.

Fujiwara, T Nakamura, S (Teito Rapid Transit Authority, Japan) *Permanent Way* Vol. 15 No. 3, No. 56, pp 20-28

ACKNOWLEDGMENT: Permanent Way
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

A2 057874
LAYING OF TRACK BALLAST MATS IN SHINKANSEN
By laying mats of heat-moulded ground automobile tires beneath the ballast as rail is renewed, the Japanese National Railways is reducing maintenance costs sufficiently to justify the mat installation. Noise and vibration are also reduced. It is intended that this system will be standard as the Skin Kansen is extended throughout Japan. Further studies are planned on the durability of the ballast mat, its effects on preventing ballast pulverisation and the maintenance cost reduction.
Also available through Japan Railway Civil Engineering Association.

Tajima, H Kiura, K (Japanese National Railways) *Permanent Way* Vol. 15 No. 3, No. 56, pp 11-20

ACKNOWLEDGMENT: Permanent Way
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

A2 057884
ASSESSMENT OF DESIGN TOOLS AND CRITERIA FOR URBAN RAIL TRACK STRUCTURES. VOLUME I. AT-GRADE TIE-BALLAST TRACK
The report presents the results of a critical review of the technical factors which govern the design and performance of at-grade tie-ballast track for urban rail systems. The assessment of current design practice is based on a review of the literature and discussions with experienced track design personnel. The evaluation includes design loads and the criteria for selecting rail size, tie size and spacing, ballast depth, and subgrade parameters. The major track problems identified were rail joints, rail wear and noise on curves, rail fasteners, and rail corrugation. Detailed technical evaluations were made to determine those areas where the track design procedures are inadequate. The report includes detailed information for the engineering design of track and recommendations for both short and long-range program plans for future research pertaining to the improvement of track performance.
See also Volume 2, PB-233017. RRIS #012656.

Prause, RH Meacham, HC
Battelle Columbus Laboratories Final Rpt. Apr. 1974, 247 pp

Contract DOT-TSC-563

ACKNOWLEDGMENT: NTIS (PB-233016/5)
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-233016/5, DOTL NTIS

A2 057885
ASSESSMENT OF DESIGN TOOLS AND CRITERIA FOR URBAN RAIL TRACK STRUCTURES. VOLUME II. AT-GRADE SLAB TRACK
This report presents the results of a critical review of the technical factors which govern the design and performance of at-grade slab track for urban rail systems. The assessment of current design practices is based on a review of the literature and discussions with experienced track design personnel. The evaluation includes descriptions of slab structures now in use in four countries, followed by review of design and analysis procedures used to characterize the subgrade and its support characteristics; the reinforced concrete slab itself, and the subgrade-support system. With a few exceptions, most of the work reported in the literature is based on highway or runway applications, where the mechanism of load transfer into the slab is completely different than in a rail support slab. Further research on the mechanisms of load transfer from rail fasteners into a reinforced concrete slab is needed, and the newly developed finite element approach appears well-suited.
See also Volume 1, PB-233 016.

Meacham, HC Prause, RH Waddell, J
Battelle Columbus Laboratories Final Rpt. Apr. 1974, 101p

Contract DOT-TSC-563

ACKNOWLEDGMENT: NTIS (PB-233017/3)
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-233017/3, DOTL NTIS

A2 071747
RAILROAD ACCIDENT REPORT: CHICAGO, BURLINGTON AND QUINCY RAILROAD COMPANY TRAIN 64 AND TRAIN 824 DERAILMENT AND COLLISION WITH TANK CAR EXPLOSION CRETE, NEBRASKA, FEBRUARY 18, 1969
At about 6:30 a.m., on February 18, 1969, Chicago, Burlington, and Quincy Train No. 64 derailed the 72nd to the 90th cars, inclusive, at a turnout located on the spiral of a 2 degree curve as the train was entering Crete, Nebraska, at a speed of about 52 miles per hour. The derailed cars struck standing cars on a siding south of the main track and the cars of train 824 standing on a track north of the main track. A tank car in train 824 was completely fractured on impact with the derailed cars which released the lading of 29,200 gallons of anhydrous ammonia into the atmosphere. A gas cloud was formed which blanketed the surrounding area for a considerable time due to the weather conditions. Three trespassers riding on train 64 were killed as a result of the derailment and six people were killed and 53 were injured as a result of exposure to the cloud of ammonia. The Safety Board determined that the derailment was caused by the movement of a rail of the turnout due to lateral forces produced by the locomotive as it moved over track alignment and surface deficiencies of the track. The complete fracture of the tank car on impact was contributed to by the brittleness of the steel of the car caused by the low ambient temperature.

National Transportation Safety Board NTIS-RAR-71-2, Feb. 1971, 79 pp, Figs., Tabs.

ACKNOWLEDGMENT: National Transportation Safety Board
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-198790, DOTL NTIS

A2 071782
MEAN STRESS EFFECTS ON FATIGUE CRACK GROWTH AND FAILURE IN A RAIL STEEL
Over a limited range, the effect of mean stress has been studied on fatigue crack propagation and on the critical fatigue crack size associated with sudden fast fracture in center-notched plate specimens of a rail steel under pulsating loading. The results have been presented in terms of the stress intensity factor range K and the ratio R of the minimum to maximum stress. Increasing R was found to both accelerate cracking and reduce the critical crack size at instability. The data have been correlated with three crack growth equations currently used in the literature and it was found that the equation of Forman et al. relating crack growth rate to K and R gave the best fit. This equation was used to predict life in the finite range of the S-N curve. Fractographic examination revealed that the fracture surfaces were complex and a number of fracture modes contributed to cracking.

Evans, PR (National Physical Laboratory); Owen, NB McCartney, LN *Engineering Fracture Mechanics* Vol. 6 No. 1, Mar. 1974, pp 183-193, 8 Ref.

ACKNOWLEDGMENT: EI (EI 74 0801972)
PURCHASE FROM: ESL Repr. PC, Microfilm

A2 071793
CROSSTIE SUPPLY: LIGHT AT THE END OF THE TUNNEL
It is reported that as a result of price increases, plus better weather in producing areas and reduced demand from other users of hardwood, tie production is showing a sharp improvement from recent low levels.

Railway Track and Structures Vol. 70 No. 6, June 1974

ACKNOWLEDGMENT: EI (EIX740803406)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

A2 071810
RAILS FOR HIGHLY STRESSED TRACKS [Schienen fuer Hochbeanspruchte Geleise]
The increasing tonnage and speeds in grade operation, such as on the Gotthard line of the Swiss National Railways impose exacting demands on the quality of the rails. Qualification of Krupp's nominally 0.7C-0.7Si-1Mn-1Cr steel for such service is indicated by its tensile strength of 110 to 125 kp/sq mm, wear and shelling resistance, strain hardening, impact resistance, and weldability. [German]

Heller, W Schumacher, G *Technische Mitteilungen Krupp, Werksberichte* Vol. 32 No. 1, Mar. 1974, pp 21-27, 19 Ref.

ACKNOWLEDGMENT: EI (EIX740701609)
PURCHASE FROM: ESL Repr PC, Microfilm

A2 071817
IT'S 'BIG' IN MANY DIFFERENT WAYS
Double-line facility at Amarillo, Tex, described is reported to produce welded strings for the entire system, including secondhand rail which is brought to the plant in quarter-mile jointed strings. Operationally, the system for handling secondhand rails is divided into four zones: dismantling, inspection, cropping, and marshalling.

Railway Track and Structures Vol. 70 No. 5, May 1974

ACKNOWLEDGMENT: EI (EIX740704631)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

A2 071837
A UNITED STATES RAIL TRUST FUND; PRESCRIPTION FOR MODERN RAIL TRANSPORTATION
The Governor of Pennsylvania, aided by the Office of State Planning and Development and funded by two Federal agencies, has proposed a Rail Trust Fund of $12 to $13 billion for grants to all U.S. railroads for improvements in track, yards and other facilities over a six-year period. Like the Highway Trust Fund, users would pay the costs. Every railroad would collect and pay into the fund a 5% surcharge on freight revenues. These funds would pay off government-backed obligations financed over 30 years. Rehabilitation of road and track would require almost $7 billion; electrification, $3.2 billion; modernization and expansion of fixed facilities, $1.9 billion; modernization of yards, $900 million. Lower operating costs would result.
Prepared with Federal Financial assistance provided by the Department of Housing and Urban Affairs, Appalachian Regional Commission and Department of Commerce.

Shapp, MJ
Pennsylvania Department of Transportation 62 PP, Figs., Tabs., Phots.

PURCHASE FROM: Pennsylvania Department of Transportation Bureau of Planning Statistics, Harrisburg, Pennsylvania, 17120 Repr. PC
DOTL RP

A2 071979
MAIN METHODS OF INCREASING EFFICIENCY OF UTILIZATION OF RAILS ON THE SOVIET RAILROADS
Properties of rails and types used in the Soviet Union are presented. While Soviet railroad network represents 10% of the world network, the freight utilization is some 2. 4 times more than in the USA. Heavy axle loads and high speeds characterize Soviet railroads.

Albreht, VG Melentiev, LP *Rail International* No. 5, May 1974

ACKNOWLEDGMENT: EI (EIX740903047)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

A2 071981
C&NW INCREASES ITS RAIL-END WELDING, ADOPTS FOUR-PART MAINTENANCE PLAN
Rail welding and rail maintenance programs and practices at the Chicago & North Western Railroads are discussed. Innovations made in rail welding processes are outlined.

Dove, RE *Railway Age* Vol. 175 No. 13, 07

ACKNOWLEDGMENT: EI (EIX740902621)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

A2 072471
TRACK PRACTICES IN THE USSR
A six-man tour sponsored by the Department of Transportation made an 11-day tour of Soviet railroads to give them a look at track problems and practices in the USSR. In this first of two installments, the team of engineers and researchers reports on use of concrete ties and continuous welded rail. Track practices are largely determined by the heavy traffic densities of major routes. The goal is to do as much maintenance work in the shortest possible time, achieved by going to massive, high-production machines wherever possible. Much use is made of prefabricated track panels to speed this process. Various specialized machines are described.
See also RRIS #072568.

Railway Track and Structures Vol. 70 No. 9, Sept. 1974, pp 20-25

PURCHASE FROM: XUM Repr. PC
DOTL JC

A2 072474
JOINING AND HARDFACING OF RAILS, POINTS AND CROSSINGS USING MANUAL METAL-ARC WELDING ON THE SWEDISH RAILWAYS
Since 1967, the Swedish State Railways track office and the ESAB Central Research Laboratories has been developing a suitable technique and filler materials for rail welding. The first task was to reduce maintenance costs for track material by hard surfacing and joining of rail ends and crossings and later also points. The second phase was to further develop a technique and a backing material for the joining of rails by means of manual mold welding. The aim was to obtain such high quality in welds that the technique would be approved without any limitations.

Ljunggren, J (Swedish State Railways) *Svetsaren-English Edition* No. 2, 1974, 6 pp, 10 Fig.

ACKNOWLEDGMENT: Svetsaren-English Edition
PURCHASE FROM: Elektriska Svetsning Aktiebolaget Box 8850, S-402 71, Goteborg 8, Sweden Repr. PC
DOTL RP

A2 072552
PLASTIC MOULDED-SLEEPERS APPLIED TO AN UNDERGROUND RAILWAY TO SURPRESS NOISE.
The Vienna U-bahn system is laid with Voest plastic sleepers embedded in a solid concrete formation incorporating a glass-fibre mat to minimize vibration and noise transmission. Anticombustion and inherent electrical insulation properties are advantageous to Metro lines.

Rail Engineering International Vol. 4 No. 7, Sept. 1974, pp 340-342, 3 Fig., 4 Phot.

PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

A2 072553
TRACK FOR TODAY
Improved track formation with deeper ballast of better quality, continuous welded rail, pre-stressed concrete sleepers, simplified track fastenings and highly-developed mechanisation of maintenance was a first overall policy change on BR under the author's leadership. Need of worldwide knowledge is essential in bringing about such improvements.

Butland, AN (British Railways Board) *Rail Engineering International* Vol. 4 No. 7, Sept. 1974, pp 329-331, 5 Phot.

PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

A2 072556
ATTAINING THE DURABILITY OF THE TRACK LEVEL
Non-synchronous constant-tamping techniques to attain the required density of compaction now incorporating sleeper-end tamping to obtain 15-cm penetration laterally towards the zone compacted from the sleeper sides combined with automatic adjustment which sees the last 2-mm of lift pressed up and held despite pressure from below by Plasser & Theurer 07-RS system.

Rail Engineering International Vol. 4 No. 7, Sept. 1974, pp 332-333, 2 Fig., 3 Phot.

PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

A2 072565
DESIGN, LAYING, MAINTENANCE AND REPAIR OF CONTINUOUS WELDED RAILS ON THE USSR RAILWAYS
Use of continuous welded rails is winning increased acceptance all over the world. This paper sketches the history of the welded rails on USSR Railways and describes the design, laying, maintenance and repair, along with the machines and methods used for laying and welding of continuous strings.

Tzepushelov, AL Toyitzky, LF (Ministry of Railways, USSR) *Rail International* No. 9, Sept. 1974, pp 589-614, 47 Fig.

PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

A2 072566
SANTA FE SETS SERIVCE TEST OF RECONSTITUTED TIE
Santa Fe is investigating a process for reconstituting ties, utilizing pieces of and entire ties which have been removed from track and can no longer be burned or left along the right-of-way. Ties are processed through chipping machines in the field and are delivered to the plant for reconstitution. Inorganic materials are removed, the chips are washed and dried if necessary, and the material is reduced to fibers for reconstitution. The fibers are mixed with resins and molded into a conventional ties configuration but supplemented with a steel reinforcement. Santa Fe plans to install the ties in track where traffic amounts of up to 10 million tons annually.

Railway Track and Structures Vol. 70 No. 10, Oct. 1974, pp 18-19, 4 Phot.

PURCHASE FROM: XUM Repr. PC
DOTL JC

A2 072567
UNIT TRAINS AND THE TRACK; THE PROBLEMS AND THE ANSWERS
This report by the Roadmasters' Association pinpoints the track problems which are produced by unit-train equipment that is characterized by being heavier and having a higher center of gravity. Suggestions are made for assuring suitable life from turnouts and curve rail and the importance of subgrade stability. The problems of rail corrugation are also discussed.

Railway Track and Structures Vol. 70 No. 10, Oct. 1974, 3 pp, 1 Phot.

PURCHASE FROM: XUM Repr. PC
DOTL JC

A2 072568
TRACK PRACTICES IN THE USSR
This second installment of a report by U.S. engineers and researchers on Soviet railroads was prepared after a trip to Russia. Soviet track maintenance is of four classifications and there is substantial mechanization of these operations, generally with large, expensive machinery. The major effort being devoted to track research in Russia dwarfs similar activity being carried on in the U.S. Details on experimental track-supporting construction are illustrated.
See also RRIS #072471.

Railway Track and Structures Vol. 70 No. 10, Oct. 1974, pp 28-30, 4 Phot.

PURCHASE FROM: XUM Repr. PC
DOTL JC

A2 072585
TIE RENEWALS AND COSTS
The new tie renewals on U.S. railroads, as compiled by the Economics and Finance Department of the AAR show that new tie renewals dropped from 20.6 million in 1972 to 17.9 million in 1973. While total replacements dropped by 13%, the average cost of ties increased about 10% in 1973. Only in the Eastern District did replacements equal the 1972 figure.
Also available through ESL.

AREA Bulletin Proceeding Vol. 76 Bulletin 649, Sept. 1974, pp 55-63, 2 Tab.

ACKNOWLEDGMENT: AREA Bulletin
PURCHASE FROM: AREA Repr. PC

A2 072655
DIRECTIONS IN TRACK STRUCTURE RESEARCH
This paper presents a survey of contemporary problems in track structure technology and the programs of research and development addressing these problems. It reports current and anticipated investigations into aspects of the service environment of railroad track structures, the mechanics of track structure degradation, the fatigue and fracture of rails, the development of rational design and maintenance techniques, the improvement of track components, and the development of non-conventional, low maintenance track structures for application to high speed high density service. Efforts involved with both the fundamentals of track mechanics, and the design of improved structures for urban rapid transit applications, as well as mainline railroad use are included.
Contributed by the Applied Mechanics Division of the American Society of Mechanical Engineers for presentation at the winter Annual Meeting, 17-22 November 1974, New York, New York.

McConnell, DP (Transportation Systems Center)
American Society of Mechanical Engineers 74-WA/APM-24, July 1974, 9 pp, 1 Tab., 47 Ref.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ASME Repr. PC
DOTL RP

A2 072656
THE STRESS AND STABILITY ANALYSES OF RAILROAD TRACKS
The paper presents a survey of the state of knowledge in the fields of stress and stability determination of a railroad track. At first, the evolution of the railroad track structure is briefly summarized. This is followed by sections which discuss the development of the methods for the determination of stresses in the rails and ties, and the stability of the railroad track due to constrained thermal expansions.
This paper was contributed by the ASME Applied Mechanics Division for presentation at the Winter Annual Meeting, 17-21 November 1974. The research was sponsored by the Department of Transportation, Federal Railroad Administration, Rails Systems Division, Washington, D.C.

Kerr, AD (Princeton University)
American Society of Mechanical Engineers No. 74-WA/APM-23, June 1974, 7 pp, 3 Fig., 41 Ref.

Contract DOT-FR-40017

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ASME Repr. PC
DOTL RP

A2 072657
AUTOMATIC PARAMETER IDENTIFICATION APPLIED TO A RAILROAD CAR DYNAMIC DRAFT GEAR MODEL
One of the most important components in simulating track-train dynamics is the mathematical model of the connection between two cars, the draft gear-coupler combination. In this paper an automatic parameter identification technique is presented which can be used to generate a nonlinear functional relationship of dynamic draft gear characteristics using experimental data.
This paper was contributed by the Automatic Control Division of ASME for presentation at the Annual Winter Meeting, 17-22 November 1974, New York, New York.

Ward, ED Leonard, RG (Purdue University)
American Society of Mechanical Engineers No. 74-WA/AUT-1, Jan. 1974, 6 pp, 8 Fig., 11 Ref., 1 App.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ASME Repr. PC
DOTL RP

A2 072706
LATERAL BUCKLING OF TRACK
The stability of this track against lateral buckling is afforded by flexural resistance of the track frame consisting of rails and sleepers and the ballast resistance. An attempt has been made to analyse the resistance offered by sleeper fastenings and represent the same in terms of virtual forces acting on the rails. The energy method has been used for calculating the buckling force, the shape of buckled track has been assumed as a triangle with elastic hinges at the ends. The lateral ballast resistance has been assumed to be constant irrespective of the deflection of buckled track. The present method is simple in calculation and can easily take into account the change in buckling load due to partial or complete loss of lateral ballast resistance of a few sleepers. The effect of various maintenance practices as per Indian Railways Long welded Rails Manual on the safety margin against lateral buckling has also been calculated.

Vaish, VK (Indian Railways) *Rail International* No. N6, June 1974, pp 437-450, 7 Ref.

ACKNOWLEDGMENT: EI (EI 74 065251)
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

A2 072773
FOR THE CONCRETE TIE: NEW ROUND OF SERVICE TESTS
More recent developments in concrete ties, especially with reference to new test sections, are dealt with in the article. The four new tests installations described use threadless, elastic-type rail-fastening systems which have been upgraded for North American conditions.

Weber, JW (Portland Cement Association) *Railway Track and Structures* Vol. 70 No. 8, Aug. 1974, pp 17-19

ACKNOWLEDGMENT: EI (EI 74 072832)
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

A2 072794
A BIBLIOGRAPHY ON THE DESIGN AND PERFORMANCE OF RAIL TRACK STRUCTURES
This bibliography was prepared as part of the Rail Supporting Technology Program being sponsored by the Rail Programs Branch of the Urban Mass Transportation Administration. It is based on the reference material that was used to evaluate the technical factors which govern the design and performance of at-grade track structures for urban rail systems. While most of the reference material that has been included is directly related to track used for railroad, rail rapid transit and light rail transportation, there are some additional references on related topics such as rail vehicle dynamics, soil mechanics, stress analysis, etc. However, this bibliography does not include a comprehensive review of these related topics. This survey includes much of the published literature on track design, track loading, ballast,

wood and concrete cross ties, rail and rail fasteners. It also includes considerable material on track problems such as rail wear corrugation, rail defects, rail joints and track degradation. The formal literature search for this bibliography covered the time period from about 1963 to 1973. The principal sources were the National Technical Information Service (NTIS) file of government reports, Engineering Index, and the Applied Science and Technology Index. Earlier references were identified from the Railroad Research Information Service (RRIS) computerized data base and bibliographies prepared by the RRIS and the Association of American Railroads.

Individual abstracts from this bibliography have been selected under RRIS numbers 072794-072851.

Prause, RH Pestel, HC Melvin, RH
Battelle Columbus Laboratories, (DOT-TSC-UMTA-74-11) Final Rpt. UMTA-MA-06-0025-74-7, Sept. 1974, 142 pp

DOT-TSC-563

ACKNOWLEDGMENT: UMTA
PURCHASE FROM: NTIS Repr. PC
PB 238127/5SL, DOTL NTIS, DOTL RP

A2 072795
SANTA FE INSTALLS CONCRETE TIE TESTS
Four out-of-face service installations at widely scattered points on system include various types of prestressed mono-block ties as well as different types of fastenings. The fifth installation tests concrete ties on a one-for-one basis. Details of the several test installations, each identified by its location, are described.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Railway Track and Structures Vol. 68 No. 1, Jan. 1972, pp 30-32

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: XUM Repr. PC

A2 072796
ANALYSIS OF COEFFICIENTS FOR THE CALCULATION OF REINFORCED CONCRETE TIES [Betrachtungen ueber Beiwerte zur Berechnung von Spannbetonschwellen]
From static and dynamic stress measurements on rails and ties, coefficients were derived which are required for calculating the strength properties of concrete ties. [German]

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Talposi, A *Glasers Annalen ZEV* Vol. 95 No. 4, Apr. 1971, pp 89-90

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: ESL Repr. PC, Microfilm

A2 072800
INVESTIGATION OF THE FORMATION OF CORRUGATIONS IN RAILS ON SELECTED TEST TRACKS UNDER CONDITIONS OF ORDINARY TRAFFIC
This is an evaluation of a large amount of data collected on two tracks since 1951 and 1958, respectively. Emphasis was on determining the behavior of different steels as a function of composition, melting practice, and treatment after rolling. Examples of findings are that increasing tensile strength and nitrogen content increase corrugations, increasing Mn and Si decrease the defect. [German]

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Spieker, W Koehler, H Kuehlmeyer, M *Stahl und Eisen* Vol. 91 No. 26, Dec. 1971, pp 1470-87

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: ESL Repr. PC, Microfilm

A2 072802
VERY HIGH RAILWAY SPEEDS ON THE NEW SUBSTRUCTURES
Spectrum of the geometrical defects in the permanent way are given. Vertical movements and lateral movements are described. The permanent way structure characteristics of the layout of a new line for speeds of 250 to 300 km an hour are discussed. [French]

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Prud'Homme, A *Revue Generale des Chemins de Fer* Jan. 1970, pp 56-72

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: ESL Repr. PC, Microfilm

A2 072814
NOW, STEEL-TIE TRACK PANELS, MACHINE PRODUCED
The system is described that uses special wedge-type fastening and mechanized production line for making sections of track.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Railway Track and Structures Vol. 66 No. 5, May 1970, pp 14-17

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: XUM Repr. PC

A2 072816
COMPUTER SPOTS RAIL DEFECTS FAST
Survey of applications of computer complex in the computerizing of rail-defect information developed by a fleet of rail detector cars and a variety of portable ultrasonic testing instruments. A monthly printout from Penn Central computer shows rail defects found by special cars and ultrasonic devices. Computer data is also shown to be useful in programming rail renewals.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Railway Age Vol. 169 No. 1, July 1970, pp 32-33

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: XUM Repr. PC

A2 072817
SIGNIFICANCE OF A DETECTION OF DEFECTS IN RAILS
The articles describe the principal types of defects which may be found in rails, and indicates those which are inherent in the manufacturing processes and those which arise as a result of service loads. The principles of resonance and pulse-echo ultrasonic flaw detection as applied to rails are given, and the current ultrasonic testing practice at the British Railway is described.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Johnson, PC Wise, S *Non-Destructive Testing* Vol. 3 N Apr. 1970, pp 111-116

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: ESL Repr. PC, Microfilm

A2 072818
DETECTION OF BASE SEAMS IN INLAID RAILS
A description of a test apparatus that has made possible the detection of rolling mill defects in the seams, located at the base of new rails, installed less than 2 yrs is presented. A semi-automated ultrasonic rail test car, operated at 5 km/hr, is demonstrated.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Veniza, GE *Intl Conf on Nondestructive Testing, 6th Proc* Vol. 3 Session H, Rept. 4, 1970, pp 37-46

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: Society for Nondestructive Testing 704 47th Street, Los Alamos, New Mexico, 87544 Repr. PC

A2 072822
DESIGN OF CONVENTIONAL RAIL TRACK FOUNDATIONS
Measurements of the distribution of vertical stress in the subgrade for given depths of ballast, track structural configurations and loading conditions are described. The mean maximum vertical stress in the subgrade can be predicted with reasonable accuracy by simple elastic theory. The results of laboratory work in which samples of soil were subjected to repeated triaxial loading are presented. For the cohesive soils tested a level of stress was found above which repeated applications of load caused large permanent deformations and below which permanent deformations were small and terminating. Based on these findings a method of track foundation design is developed in which the depth of ballast required to prevent excessive deformation of the subgrade can be predicted from the results of a simple laboratory repeated load test and a knowledge of the traffic loading to be carried. Small decreases in construction depth from the design depth produce large increases in deformation rate while large increases in construction depth over the design depth produce little return in terms of reduced rates of deformation. The proposed design procedure produces construction depths that are apparently close to the optimum for the fine grained soils so far investigated.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Heath, DL Shenton, MJ Sparrow, RW Waters, JM *Institution of Civil Engineers, Proceedings* 1972, pp 251-267

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: ESL Repr. PC, Microfilm

A2 072823
M/W EFFICIENCY ON UNION PACIFIC
The best yardstick in measuring the success of a maintenance policy is to compare the quality of the track and roadbed structure, with the maintenance cost, based upon the tonnage of traffic and the speed. Charts are updated each year to compare UP maintenance-of-way operating expenses with those of six other major railroads which have comparable traffic volumes, operating conditions, and so forth. Equipment is updated each year with the latest generation of equipment available, without over- mechanizing. The quality of day-to-day track-maintenance work that is done between the periods of out-of-face heavy program work has more to do to insure the best track conditions at the lowest over-all cost than any other single factor. Section gangs are assigned over the entire railroad to do the day-to-day maintenance work. The section forces mark the bad ties. The number of ties marked in each area is tabulated before the annual tie-gang program is established. UP M/W department is having a problem getting adequate on-track time for its mechanized track gangs engaged in out-of-face work. The only solution to the problem is to maintain close communication with operating department people to get just as much time on the track as possible. UP is a relative newcomer in the use of continuous welded rail. The road has firm rules governing the heating or cooling of the long strings. By vibrating the rail at the same time that it was being heated or cooled, frictional resistance is overcome and the rail is permitted to expand or contract the desired amount at the end of the string. Another area of pioneering for UP is in the use of glued or bonded insulated and closure joints between CWR strings. UP hopes to purchase a self-propelled car capable of testing track at 35 to 45 mph.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Railway Age June 1973, pp 38-41

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: XUM Repr. PC

A2 072824
CONTACT VIBRATIONS
When a wheel rolls on a rail with a randomly wavy surface, the random waviness gives rise to a displacement input to the wheel and rail with a significant high-frequency (f greater than 100 HZ) spectral content. This displacement input excites the contact resonance of the system, wherein the mass of the wheel and an "equivalent mass" of the rail vibrate on the nonlinear contact spring. The purpose of the paper is to develop an analytical model for these high-frequency contact vibrations. The wheel is assumed to undergo only rigid-body motions, apart from the localized elastic deformation near the contact region. The rail is modeled as an infinite beam on a continuous, point-reacting foundation. With the rail roughness being assumed to be a locally stationary, Gaussian random process, a complete solution is presented to the linearized problem. Three phenomena of interest are investigated in detail: plastic deformation, loss of contact, and the formation of corrugations on the rail. The effects of various wheel and rail parameters on these phenomena are explored.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Nayak, PR *Journal of Sound and Vibration* Vol. 28 No. 2, 1973, pp 277-293

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: ESL Repr. PC, Microfilm

A2 072825
DYNAMIC TRACK COMPLIANCE
Analytical expressions for vertical and lateral track compliance are obtained from the solution of a beam on a visco-elastic foundation model. The equivalent foundation parameters were derived from the theory for a mass on a viscoelastic halfspace. The dependence of the overall track stiffness, damping, and natural frequency on the rail, tie, and roadbed parameters are evaluated. Upper and lower bounds for the overall track properties are obtained for existing types of at-grade track structures. A distinct advantage of the approach described is that it results in estimates for the effective damping due to both radiation of energy into the roadbed and energy loss due to internal soil friction. The damping due to internal friction can generally be neglected compared with the radiation damping.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Kurzweil, L
Transportation Systems Center, (TSC-GSP-067) May 1972, pp 13-14

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: TSC Repr. PC

A2 072826
PRELIMINARY SPECIFICATION FOR CONCRETE CROSS TIES (AND FASTENINGS)
This specification is intended to provide necessary guidance in the design, manufacture and use of concrete tie railroad track systems and their components. The specification contains minimum performance requirements of components of concrete tie railway track based on a variety of permissible tie spacings and ballast depths. Track constructed of tie and fastener components meeting the specifications applicable to the anticipated usage should be expected to give satisfactory performance under current AAR-approved maximum axle loads. The specification covers materials, physical dimensions, and structural strength of prestressed monoblock and prestressed and conventionally reinforced two-block concrete ties. In addition, longitudinal and lateral load restraint requirements as well as the electrical performance of rail fastener and tie combinations are given. Laboratory tests for the determination of the suitability of new designs are specified, as are necessary quality-control procedures during manufacture. The specification does not cover techniques nor equipment for the manufacture of concrete ties or fastenings. Where current specifications or recommended practices of other technical societies, such as the American Society for Testing and Materials or the American Concrete Institute, are appropriate, they are made part of this specification.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

AREA Bulletin No. 634, Oct. 1971, pp 99-140

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: ESL Repr. PC, Microfilm

A2 072828
ELECTRICAL HEATING OF RAILWAY POINTS
The heaters are attached by strips held in position by the existing permanent-way coach screws and small bolts through the rails. This form of heating can be readily fixed in position with considerable ease and the only precaution to observe is that the matting surfaces are thoroughly cleaned and the element attached as closely as possible to the rail.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Mawet, MJ *Copper* No. 5, 1971, pp 24-25

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: Copper Development Association London 1, England Repr. PC

A2 072829
DEVELOPMENT OF A RAILROAD ROUGHNESS INDEXING AND SIMULATION PROCEDURE
To simulate rail vehicle performance on an analog computer to study shock and vibration characteristics of various rail and cargo configurations, input must be provided representing the roughness characteristic of the rail surface. Methods for measuring and simulating rail surface roughness are described which resulted in a recommendation to use a white noise generator to provide the required inputs. Measured accelerations on cargo were found to approximate the characteristics of white noise.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Pursifull, LJ Prothro, BE *Shock and Vibration Bulletin* No. 39, Pt. 6, Mar. 1969, pp 47-55

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: Shock and Vibration Information Center Naval Research Laboratory, Washington, D.C., Repr. PC

A2 072830
REINFORCED CONCRETE PREFABRICATED PARTS FOR ALL KINDS OF TRACK INSTALLATIONS
Reinforced concrete blocks of various types are made for holding railway tracks. An account is made of the design of these blocks and laying them.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Hagedorn, HP *Eisenbahningenieur* July 1971, pp 171-174

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: Dr Arthur Tetzlaff-Verlag Niddastrasse 64, Frankfurt am Main, West Germany Repr. PC

A2 072831
SCANNING ELECTRON MICROSCOPY OF EARTHQUAKE--INDUCED RAIL FRACTURES
This investigation has as its purpose a somewhat systematic scanning electron fractography study of railroad-rail fracture resulting from stresses induced by earth movements associated with an earthquake measuring 6.6 on the Richter scale which struck the Los Angeles, California area on February 9, 1971, having a primary shock duration ranging from 1 to 2 min.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Murr, LE Hodgkin, NM Lowe, BV (University of Southern California) *Metallography* Vol. 4 No. 6, Dec. 1971, pp 477-486

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: ESL Repr. PC, Microfilm

A2 072832
LABORATORY METHODS OF INVESTIGATION OF PRE-STRESSED CONCRETE SLEEPERS
Describes test laboratory measurements to be made of the deformation of sleepers under varying loads and on layers of ballast. Results of these measurements are shown and several conclusions are drawn.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Mazur, S *Deutsche Eisenbahntechnik* No. 12, 1971, p 578

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: VEB Verlag Technik Oranienburgerstrasse 13-14, 102 Berlin, East Germany Repr. PC

A2 072833
EXPERIMENTS ON ARITA RIVER RAILWAY BRIDGE WITH CONCRETE BED
Experiments using four kinds of track structures are described. Two of them use concrete short sleepers or wooden short sleepers on a PC bridge and the other two use steel plates with holes or slabs for fastening rails without sleepers on a RC rigid frame.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Warizawa, Y
Battelle Columbus Laboratories Railway Res. Rpt. #3, Sept. 1970, pp 146-148

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: Battelle Columbus Laboratories 505 King Avenue, Columbus, Ohio, 43201 Repr. PC

A2 072834
FRENCH RAILWAYS' TRACK. (VI) LAYING RAILS DIRECTLY ON CONCRETE BLOCKS
Two types of permanent way have been developed: (1) a heavy type for the heaviest traffic stressing when taking curves with small radii has given excellent service, requiring no maintenance whatever, and (2) lighter permanent way for straight tracks and curves of large radius. Illustrations show a track laid on concrete blocks, and the rail fastenings in tunnels.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Prud'Homme, A *Eisenbahningenieur* May 1969, pp 144-145

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: Dr Arthur Tetzlaff-Verlag Niddastrasse 64, Frankfurt am Main, West Germany Repr. PC

A2 072835
DEVELOPMENTS IN TRACKS WITH CONCRETE FOUNDATIONS
Ninety nine percent of the track in the streets of Zurich are laid on concrete slabs. There are 3 rather serious defects in this method, the track is now laid only on an asphalt course. The method using concrete slabs and the asphalt course method are described.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration. No. 9 of Wirschaftl. & Techn. Schriftener, pp 47-50, 1969.

Sulger-Buel, A
Battelle Columbus Laboratories

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: Battelle Columbus Laboratories 505 King Avenue, Columbus, Ohio, 43201 Repr. PC

A2 072836
FRENCH RAILWAYS' TRACK. (V) THE CONCRETE SLEEPER AND ITS RAIL FASTENING
Describes the VW, RS and Vagneux types of track. The VW type is a monobloc stressed concrete sleeper. In the RS and Vagneux types there are two mixed sleepers of concrete and steel with two reinforced concrete blocks joined together by a rail steel stay. The spring fastenings are the same for all three kinds of sleepers. [German]

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Prud'Homme, A *Eisenbahningenieur* May 1969, pp 143-144
ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: Dr Arthur Tetzlaff-Verlag Niddastrasse 64, Frankfurt am Main, West Germany Repr. PC

A2 072837
ADJUSTMENTS MADE EASY WITH NEW CONCRETE ROADBED
A major characteristic of the Fist-T system is that each rail is supported on a concrete block using a Fist clip in conjunction with a supporting assembly that has features that are designed to facilitate the making of vertical and lateral adjustments in the rails. This assembly is placed on the block in a recess, located diagonally with the rail.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Railway Track and Structures Mar. 1968, pp 30-31

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: XUM Repr. PC

A2 072838
STUDY OF NEW TRACK STRUCTURE DESIGNS
The effect of an abrupt change in the elastic foundation properties upon the motion of a high speed vehicle is investigated in detail in this study. Limiting allowable accelerations are chosen as the criteria for riding quality. The study indicates that there is a likelihood of encountering a variety of elastic soil combinations which can seriously deteriorate the riding qualities of a rail vehicle on conventional track. As remedial measures, two alternatives are considered to improve the quality of ride; one by improving the rigidity of the track structure by means of providing a track structure utilizing narrow vertical walls embedded in the subsoil, and the other by carefully compacting the foundation soil to minimize local variations. A study is also made to evaluate the relative economics of the alternatives.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Bhatia, GS Romualdi, JP Thiers, GR
Carnegie-Mellon University Mar. 1968, 103 pp

Contract C-222-66

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-179401, DOTL NTIS

A2 072840
FASTENING THE RAILS ON TRACKS FOR VERY HEAVY LOADS [Schienenbefestigung fuer Schwerstbelastete Gleise]
On a special testing machine, which is described and illustrated, rail assemblies were fatigue tested under pulsating loads. The assemblies consisted of the rail, fastened by double shank spring spikes to a steel base plate separated from the tar-oil saturated beechwood tie by a layer of plastic material. The results, which are given in great detail, lead to the conclusion that such an assembly can be expected to have a long service life even in 300 to 500 m long curves, when the mean axle loads are 360 kN and loads occasionally increase to 450 kN. [German]

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Eisenmann, J *Stahl und Eisen* Vol. 91 No. 22, Nov. 1971, 3 pp

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: ESL Repr. PC, Microfilm

A2 072842
SOME ASPECTS OF THE INTERACTION BETWEEN RAILWAY VEHICLE AND TRACK
This paper describes aspects of experimental research on the South African Railways into the conditions affecting the riding quality of railroad vehicles. Parameters which influence the vertical riding quality of railway vehicles are given against the theory of forced vibrations. Results recorded during riding quality tests were found to be in good agreement with the theory. A method of simulating vertical oscillations of railway vehicles on a digital computer is outlined.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Labuschagne, TJ Scheffel, H (South African Railways) *Civil Engineer in South Africa* Vol. 11 No. 10, Oct. 1969, pp 247-252

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: ESL Repr. PC, Microfilm

A2 072844
WELDED RAIL ON BRIDGES
In a quarter-mile length of welded rail movement due to changes in temperature is confined to the 8 rail lengths at each end, with no movement taking place in the 21 rails in the center section. The action of welded rail on bridges is probably not too much different than that of jointed rail because of the resistance to slippage of rail ends in the joint bars. Consequently, the anchorage being used for jointed rail may be useful as a guide. On ballasted deck bridges, welded rail could be used and anchored in the manner used for open track and no consideration need be given to locating the rail joints off the bridge. On open-deck vaiduct spans, anchor every tie for 200 ft each side of any rail joint that falls on the span with two rail spring clips and elsewhere anchor alternate ties with two clips. On open-deck truss spans, box-anchor each tie in the open track for 200 ft at each end of the span. For spans up to 250 ft it would probably be satisfactory to use no anchors on the bridge except for perhaps two rail lengths at the fixed end and leave the span free to expand and contract at the expansion end. On Open-deck bridges, the welded rail could be used on timber, concrete or steel-beam trestles for any length of bridge with the same anchor pattern as used on open track if the rail joints fall 200 ft off of the bridge.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Magee, GM (Association of American Railroads Research Center) *Railway Track and Structures* Nov. 1965, pp 24-26

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: ESL Repr. PC, Microfilm

A2 072846
THE EFFECT OF FORCES ON THE RAIL JOINTS, AND THE NOSE-SUSPENDED MOTOR DRIVES OF LOCOMOTIVES
With the help of an analogue computer, the author analyses the reciprocal effects in relation to the speed, the uneveness, and the resilience of the joints. It is concluded that there is close interdependence between the quality of the motor suspension and the reaction on the motor axle. [German]

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Handel, H *Deutsche Eisenbahntechnik* Jan. 1972, pp 31

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: VEB Verlag Technik Oranienburgerstrasse 13-14, 102 Berlin, East Germany Repr. PC

A2 072847
DEVELOPMENT TRENDS IN TRACK CONSTRUCTION
Conventional to continuous welded track, normal-resistant steel for fish-plate jointing to advantageously weldable profiled heaviest rails, wooden and steel sleepers to concrete, resilient fastenings, and concrete deck are discussed.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Munch, W *Eisenbahntechnische Rundschau* No. 12, Dec. 1970, 4 pp

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: Hestra[Verlag Holzhofallee 33, 61 Darmstadt, West Germany Repr. PC

A2 072850
QUANTIFIED GEOMETRIC STATE OF RAILROAD TRACKS
[L'Etat geometrique quantifie]
General principles and methods of statistical analysis of railway track displacements adopted by the Swiss railways are given. The tracks are automatically tested by means of a track inspection car equipped with an analyzer. Statistical properties of discrete data distribution, and the algorithm of the analysis are discussed. Graphs are presented illustrating the analytical results of the track inspection. [French]

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Juillerat, T Rivier, R *Bulletin Technique de la Suisse Romande* Vol. 97 No. 5, Mar. 1971, pp 55-63

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: ESL Repr. PC, Microfilm

A2 072851
ROADBED/BALLAST
Exploration, testing, and design are discussed, including stability of rock slopes; cuts in soil, sand, and clay; non-uniform soils; loess; foundation of fills; and selection of soils for fills.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

AREA Bulletin No. 631, Jan. 1971, pp 257-290

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: ESL Repr. PC, Microfilm

A2 072939
CONSTRUCTING WASHINGTON, D.C.'S, METRO SUBWAY
This massive subway project with an eventual $3.9 billion price tag involves extensive tunneling and construction of stations under Washington, D.C., in difficult soil and rock conditions. Many different contractors are at work and there are diverse approaches to construction problems. Underpinning many of Washington's official buildings is a crucial aspect of the project. Nearly 1,000 civil engineers are on the job: Bechtel is overseeing the immense undertaking.

Wilhoyt, EE, Jr *ASCE Civil Engineering* Vol. 44 No. 11, Nov. 1974, pp 74-77, 2 Fig., 3 Phot.

ACKNOWLEDGMENT: ASCE Civil Engineering
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

A2 072949
COMPUTERIZED PLANNING OF ANNUAL RAIL PROGRAMS
The Chessie System's computer guides the Engineering Department in preparing annual rail replacement programs. The system: (1) Determines the priority of replacement for each unbroken length of track having essentially uniform terrain and operating conditions with age and remaining life calculated; (2) Selects the most economical rail type at a given location applying the discounted cashflow method utilizing a mathematical model which incorporates effects of tax regulations, and interest rates; (3) Provides a long range monitoring of rail condition by computing the annual amount of new rail necessary for a desired level of operating condition.

Reiner, IA (Chessie System) *Railway Management Review* Vol. 74 No. 2, 1974, pp 30-47, 9 Fig., 18 Ref.

PURCHASE FROM: Railway Systems and Management Association 181 East Lake Shore Drive, Chicago, Illinois, 60611 Repr. PC
DOTL JC

A2 072950
RAILWAYS OF SOUTHERN AFRICA--TRACK PROBLEMS AND SOME SOLUTIONS
In track, South African Railways has followed closely the western European concept--concrete sleepers, good elastic fastenings, with a high ballast standard using continuously welded rail. All aspects of track design, particularly rail and sleeper fastenings, must be designed to reduce maintenance. The author notes that what might appear to be a costly initial design often turns out to be a cost saver in the long run. It is concluded that track design validates the fundamental axiom of engineering: that the closer the design approaches the limit of the strength of the material, the shorter the life of the product.

Pitkin, KJ *Railway Management Review* Vol. 74 No. 2, 1974, pp 9-29, 5 Fig.

PURCHASE FROM: Railway Systems and Management Association 181 East Lake Shore Drive, Chicago, Illinois, 60611 Repr. PC
DOTL JC

A2 080087
WELDING OF AUSTENITIC MANAGANESE STEEL--SOME EXPERIMENTS INCLUDING A WELDING OF CROSSINGS
This report, a supplement to previous papers, includes three sections on the welding of austenitic manganese steel. First the effects of silicon and phosphorus in the base metal on cracking suceptibility of welds are compared and discussed, based on slit-type and angle-expanding-type (modified Murex-type) cracking tests. Then the manual and automatic gas shielded arc welding of manganese steel to carbon steel is described. Finally the properties of a sort of delayed cracking observed in a 16 Mn, 16 Cr type weld metal and its prevention, which are applicable to the welding of manganese steel crossing frogs to carbon steel rails are investigated. The welds have shown good performance in a field test.

Kimata, N *Railway Technical Research Institute* Quart Rpt. Vol. 15 No. 3, Sept. 1974, pp 162-167, 6 Fig., 1 Tab., 5 Ref.

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Ken-yusha 1-45-6, Hikari-cho, Kokubunji, Tokyo, Japan Repr. PC
DOTL JC

A2 080092
DEVELOPMENT OF "BALLAST-MAT"
To realize the commercial operation of 250 km/h on the Shin-Kansen network, the "Ballast-mat" which gives more elasticity to the track on elevated structures or tunnels was developed. The process of the development is here introduced through the construction of the ballast-mat, a field test, vibrogir tests, a follow-up examination and material tests in a laboratory. During the process, it became clear that the ballast-mat greatly contributes to the reduction of the cost for track maintenance, the prevention of the pulverization of ballast and the suppression of noise and vibration.

Satoh, Y Usami, T Satoh, Y *Railway Technical Research Institute* Quart Rpt. Vol. 15 No. 3, Sept. 1974, pp 125-130, 8 Fig., 4 Tab., 2 Ref.

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Ken-yusha 1-45-6, Hikari-cho, Kokubunji, Tokyo, Japan Repr. PC
DOTL JC

A2 080093
STUDY ON EMBANKMENT FOR CONCRETE SLAB TRACK UPON FLEXIBLE PAVEMENT--REINFORCED EMBANKMENT WITH NET
To construct concrete slab track and assure minimum maintenance, it is necessary to have a densely compacted embankment, taking into account the specific nature of the fill material and the structure. An embankment reinforced with nets of polyethylene has been developed to achieve this. The nets are laid horizontally at 20-cm intervals throughout the fill slope shoulders. The tensile strength of the net allows the heavy compacting vehicle to transverse the shoulder of each layer of the fill safely. Tests showed the embankment was compacted densely throughout--even at the slope surface.

Uezawa, H Nasu, M Komine, T Yasuda, Y *Railway Technical Research Institute* Quart Rpt. Vol. 15 No. 3, Sept. 1974, pp 121-124, 6 Fig., 2 Tab.

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Ken-yusha 1-45-6, Hikari-cho, Kokubunji, Tokyo, Japan Repr. PC
DOTL JC

A2 080104
DRILL-LIME TREATMENT OF SHALLOW RAILWAY SUBGRADE FAILURES IN EXPANSIVE CLAYS
This report deals with a method of stabilizing roadbed by applying hydrated lime to holes drilled in the subgrade which Southern Railway has been utilizing. With some 80 locations treated, the results after a few months were encouraging. While it is too soon to evaluate permanent results, it appears that the drill-lime application may offer relief to areas having the following combination of features: 1) Expansive clays responding to lime treatment; 2) Track areas having shallow ballast sections; and 3) Shallow subgrade failures.

This article is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", Sept. 1974, #072794.

Farris, JB (Southern Railway System) *AREA Bulletin* No. 626, Feb. 1970, pp 574-579, 5 Fig.

ACKNOWLEDGMENT: UMTA
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

A2 080105
MANY NEW APPLICATIONS FOR 'NON-CLOGGING' SNOW SWITCH
A special switch based on the stub principle, which was originally developed for use as a snow-free switch in yards, is now being offered for use wherever conditions are such as to cause split switches to become clogged and rendered inoperable unless cleaned out. An application on the Lake Terminal Railway on a track at the coke-oven quench track has proved to be resistant to clogging by materials other than snow and ice, and has eliminated a problem with derailed cars at that point.

Railway Track and Structures Vol. 70 No. 12, Dec. 1974, pp 22-23, 1 Fig., 2 Phot.

PURCHASE FROM: XUM Repr. PC
DOTL JC

A2 080114
INVESTIGATION OF 132 LB/YD RAIL MADE FROM VACUUM DEGASSED STEEL
Presently rails are manufactured in 39 ft. lengths. The desire to obtain longer lengths of rail has been expressed by many railroads because of savings anticipated from a reduction in the number of welded joints required in continuous welded rail strings. One factor inhibiting the production of rails longer than 39 ft. is the practice of control cooling in covered containers. Control cooling is employed to prevent the development of internal flakes or shatter cracks that have been causally related to the level of hydrogen absorbed in the steel. With the use of vacuum degassing hydrogen content is controlled by a different technique; therefore, it is believed that rails made of vacuum degassed steel can be air cooled without shatter cracks developing. The purpose of this investigation is to determine whether rails made from vacuum degassed steel and air cooled are comparable in properties with rail steel produced by currently common practices. This laboratory evaluation of 132 lb. RE rail made from vacuum degassed steel was made for the Norfolk and Western Railway. As measured in the laboratory, the properties of these vacuum degassed heats, without controlled cooling, were comparable to those measured previously for steels made by more conventional techniques and subjected to controlled cooling.

Research sponsored by the Norfolk and Western Railway Company.

Association of American Railroads Technical Center, (70-R-42) Res. Rpt. R-110, Oct. 1971, 57 pp, 42 Fig., 10 Tab., 31 Phot.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

A2 080120
SIXTH PROGRESS REPORT OF COOPERATIVE RESEARCH ON WOOD TIES BY THE RAILWAY TIE ASSOCIATION AND THE ASSOCIATION OF AMERICAN RAILROADS RESEARCH AND TEST DEPARTMENT
The Railway Tie Association and the Association of American Railroads entered into a cooperative agreement on March 18, 1965 for the AAR Research Center to "conduct an investigation, both analytical and in the laboratory, for the purpose of ascertaining criteria for the most effective system for supporting rail of various sections on wood railway ties, taking into acount tie spacing, length, and size of cross section." This report presents the progress in the study of the effects of tie size and spacing on the development of an effective supporting rail system.

Association of American Railroads Technical Center R-111, Dec. 1971, 6 pp, 6 Fig., 2 Tab., 1 App.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

A2 080124
INVESTIGATION OF RAILS MADE FROM CONTINUOUSLY CAST BLOOMS BY ALGOMA STEEL CORPORATION
This evaluation of rails made from continuously cast blooms by the Algoma Steel Corporation and submitted to the AAR Research Department by the Algoma Central Railway, resulted in the conclusion that physical properties of rail rolled from continuously cast blooms compared with rail rolled from ingots shows that the rails rolled from continuously cast blooms have a slightly higher ultimate tensile strength, yield strength, reduction of area and elongation.

Sponsored by Algoma Central Railway.

Association of American Railroads Technical Center, (69-T-26) R-104, Oct. 1970, 51 pp, 35 Fig., 8 Tab.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

A2 080126
INVESTIGATION OF 140 LB/YD RAIL MADE FROM VACUUM DEGASSED STEEL
Presently rails are manufactured in 39 ft. lengths. The desire to obtain longer lengths of rail has been expressed by many railroads because of savings anticipated from a reduction in the number of welded joints required in continuous welded rail strings. One factor inhibiting the production of rails longer than 39 ft. is the practice of control cooling in covered containers. Control cooling is employed to prevent the development of internal flakes or shatter cracks that have been causally related to the level of hydrogen absorbed in the steel. With the use of vacuum degassing, hydrogen content is controlled by a different technique; therefore, it is believed that rails made of vacuum degassed steel can be air cooled without shatter cracks developing. The purpose of this investigation is to determine whether rails made from vacuum degassed steel and air cooled are comparable in properties with rail steel produced by currently common practices. As measured in the laboratory, the properties of this vacuum degassed heat, without controlled cooling were comparable to those measured previously for steels made by more conventional techniques and subjected to controlled cooling.

Sponsored by the Pennsylvania Railroad.

Association of American Railroads Technical Center, (70-R-58) R-101, June 1970, 43 pp, 29 Fig., 8 Tab.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

A2 080284
SUMMARY OF HEAT-TREATED AND ALLOY RAIL SERVICE TEST INSTALLATIONS ON CURVES WITH SHELLY HISTORIES--1972
The AAR, in its program of Rail Research, has a project of field inspection and analysis of those rails that continue in service which show some potential for improvement in performance. The field inspections are carried out as a cooperative effort of the American Railway Engineering Association (AREA) Rail Committee, the American Iron and Steel Institute (AISI), and the AAR Research and Test Department. This report is a summary of results of the August and September 1972 inspections of seven field test

installations of High-Silicon, Curvemaster, Fully Heat-Treated and Columbium Treated Rails.
An RPI-AAR Cooperative Project.

Schoeneberg, KW
Association of American Railroads Technical Center, (R009) Res. Rpt. R-121, Apr. 1973, 59 pp, 28 Fig.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

A2 080285
RAIL RESEARCH-PROBLEM DEFINITION
A program was initiated to determine and define the problems associated with rail. The purpose was to collect and analyze facts regarding national and international experience on rail behavior, in order to focus attention on the major unresolved problems in rail. These are (1) Joint area problems, both bolted and welded, (2) Plastic deformation of rail head causing shelling, (3) Rail defects and premature removal of rail from track, and (4) Appropriate selection of rail based upon service requirements-use criterion. This report presents a background study of rail design, chemical composition and heat treatment of rail, manufacturing and rolling of rail-reviewing problem areas of each. A discussion of rail defects and the background and techniques of rail defect (flaw) detection is also presented. Recommendations are made for further research and study on bolt hole drilling, rail straightness, new rail steel process and manufacturing techniques, wheel/rail interaction, fracture properties and defect propagation of present and proposed rail steels, rail flaw detection technology, and economic use criterion of rail.

Schoeneberg, KW
Association of American Railroads Technical Center, (70-R-66) Res. Rpt. R-120, Mar. 1973, 81 pp, 45 Ref.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

A2 080348
CTA REBUILDS TRACK UNDER TRAFFIC
The author reports how short sections on track of the Chicago Transit Authority are removed and a front-end loader is used to push the roadbed material toward a locomotive crane. Track is rebuilt with new material, including continuous welded rail. While the area is still excavated, the top bridge surfaces over streets and business establishments are waterproofed.

Dove, RE *Railway Age* Vol. 175 No. 19, Oct. 1974, 2 pp

ACKNOWLEDGMENT: EI (EI 74 080395)
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

A2 080357
INVESTIGATION FOR INCREASING THE STABILITY OF RAILROAD TRACK [Forschungen zur Erhoehung der Lagebestaendigkeit des Eisenbahngleises ein Wichtiger Beitrag fuer Fahrweg und Fahrzeug]
The article reports on possible improvements of the track for increasing its life in respect of the track position to meet the present and future requirements at higher speeds. Track and switch construction including the associated changerover methods are optimized to obtain the best possible track for the vehicle, under due consideration of the cost of furnishing machinery and equipment and the cost of vehicle and track maintenance. [German]

Birmann, F *Glasers Annalen ZEV* Vol. 98 No. 7-8, July 1974, pp 266-276, 18 Ref.

ACKNOWLEDGMENT: EI (EI 74 080394)
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

A2 080413
ANALYSIS OF NAD CRANE MAINTENANCE OF WAY
The report represents an in-depth comprehensive analysis of NAD Crane's railroad maintenance of way (M/W) program. Quantitative tools have been developed to provide a rational framework for decision making for M/W. This analysis was prompted by the occurrence of numerous derailments attributed to poor track conditions. The safety aspects of derailments of hazardous material including high explosives required a thorough analysis of causes related to operations of the Ordnance Department and the Public Works Transportation, Maintenance, and Maintenance Control Division. The report presents several recommendations for the establishment of annual levels of maintenance, recommendations on the equipment required, and recommendations on the priority use of maintenance resources. (Author)

Lueking, JR Hinkle, GJJ
Naval Ammunition Depot NAD-CR-RDTR-285, Sept. 1974, 133p

ACKNOWLEDGMENT: NTIS (AD/A-000066/1SL)
PURCHASE FROM: NTIS Repr. PC, Microfiche
AD/A-000066/1SL, DOTL NTIS

A2 080417
PAPERS PRESENTED AT THE WAYS AND STRUCTURES AND GENERAL SESSIONS OF THE ATA RAIL TRANSIT CONFERENCE HELD IN SAN FRANCISCO, CALIFORNIA ON APRIL 16 AND 18, 1974
Four of these papers concern problems facing the Bay Area Rapid Transit District and the way they are being resolved. Mr. McCutcheon discusses tunnel ventilation, Mr. Mahon deals with track maintenance as well as building and grounds and fire prevention. Mr. Storey deals with measuring vehicle noise and Mr. Todd discusses means of minimizing electrical leakage from running rails. Mr. Lawrence discusses recently completed tunnel construction in Toronto as well as the current construction of the Spadina subway and the unique geology water and vibration problems encountered. The paper by Mr. Reed and Mr. Harris deals with the National Transportation Safety Board and its work with rail rapid transit systems. Mr Aboudara describes the Transit Development Corporation and three of its on-going projects.

Todd, P Storey, HE Lawrence, ST McCutchen, WR Mahon, VP
American Public Transit Association, National Transportation Safety Board, Transit Development Corporation, Incorporated, Bay Area Rapid Transit District ATA-RT-74-4, Sept. 1974, 140p

ACKNOWLEDGMENT: NTIS (PB-236563/3SL)
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-236563/3SL, DOTL NTIS

A2 080789
NW EMPHASIZES STRONG TRACK, WELL MAINTAINED
Norfolk & Western is committed to a policy of having strong track handled by a well-equipped maintenance organization which is adequately supplied with replacement materials. This article discusses various facets of the road's track programs and the maintenance groups which do the work. There has been great emphasis on mechanization. One result is a maintenance expense per thousand gross ton miles which is among the lowest in the U.S.

Dick, MH *Railway Age* Vol. 175 No. 21, Nov. 1974, pp 24-26, 3 Phot.

PURCHASE FROM: XUM Repr. PC
DOTL JC

A2 080973
MEANS AND METHODS TO INCREASE TRACK STABILITY
The stability of track is a serious problem for every railroad, especially since the introduction of welded rail. The primary concern of this paper is the behavior of track after trackwork has been carried out with particular regard to its geometry. Such work affects the resistance of track to all types of movement, both under traffic and induced by climatic conditions. The attention is directed at conventional track structures because too little is so far known about other types. It is concluded that a high standard of track geometry can only be maintained by lining machines; modern equipment can efficiently increase the lateral resistance of the ballast bed; and track stiffness can be increased with appropriate fasteners and new types of ties.

Riessberger, KH *AREA Bulletin* Vol. 75 Bulletin No. 648, June 1974, pp 797-811, 15 Fig.

PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

A2 081260
METHOD OF ASSESSING THE ENDURANCE OF SLEEPERS ON A TRACK USED FOR FREIGHT TRAFFIC [Metodika ocenki vynoslivosti zelezobetonnyk spal e ucetom gruzonaprjazennosti linu]
The article describes a method and results of comparative assessment of the endurance of reinforced concrete sleepers under various operating conditions. The main parameter defining the work capacity of reinforced concrete sleepers in various operating conditions is the endurance threshold of the sleeper in certain transversal cross-sections. The "typical load", a value which determines the endurance of the sleepers for a specific type of freight traffic, is essentially a function of the type of rail and number of fully-loaded heavy wagons; it is calculated on the basis of: (1) the number of loading cycles borne by the sleeper; (2) the maximum load applied during these cycles; and (3) the frequency of the repetition of these cycles, according to the traffic. This method may be applied, for instance, when assessing the endurance of reinforced concrete sleepers in the case of an increase in the axle load. [Russian]

Malysev, VG *Vestnik Vniizt* No. 3, 1974, pp 38-43, 4 Ref.

ACKNOWLEDGMENT: International Railway Documentation, Selection of (UIC Serial No. 1136)
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr. PC

DOTL JC

A2 081267
PARTICULAR CHARACTERISTICS OF TRACK MAINTENANCE ON HIGH SPEED LINES [Osobennosti soderzanija puti na ucastkah vysokoskorostnogo dvizenija poezdov]
Based on experience from the introduction of high-speed traffic on the "October" network (Moscow-Leningrad), the article considers the particular characteristics of routine track maintenance on high-speed lines, and gives recommendations for this maintenance for speeds of up to 200 km/h. According to the article, the specific requirements of routine track maintenance, when traffic speeds rise to 200 km/h confirm that man-power demands do not increase beyond 12-15%. This increase is determined in advance by the higher standard of inspection and protection of the track. The increase in speeds up to 200 km/h in passenger transport will not therefore lead to any appreciable increase in expenditure for routine track maintenance, but will require a reduction in the intervals between the periodical engineering work on the line. [Russian]

Andreev, GE *Zeleznodoroznyj Transport* No. 1, 1974, pp 63-67, 3 Tab.

ACKNOWLEDGMENT: International Railway Documentation, Selection of (UIC Serial No. 866)
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr. PC

DOTL JC

A2 081268
TESTING LATERAL SLIPPING OF THE TRACK WITH A NEW DESIGN OF SLEEPER IN THE AUSTRIAN FEDERAL RAILWAYS [Gleisverwerfungsversuche der Oesterreichischen Bundesbahnen mit neuen Schwellenformen]
Tests on the lateral slipping of the track on a curve with a radius of 189 m have shown that the track's resistance to lateral displacement was considerably improved by modifying the shape of the sleepers, and that the welding of the rails was also possible with smaller radii. The resistance to lateral displacement of the Be 14 d sleeper with lugs is twice that of the B 14 sleeper without lugs, and 50% higher than the resistance of the Be 17 sleeper, which has about the same basic surface as the Be 14 d sleeper. [German]

Klugar, K *Eisenbahningenieur* Vol. 25 No. 3, Mar. 1974, pp 70-75, 12 Fig., 3 Ref.

ACKNOWLEDGMENT: International Railway Documentation, Selection of (UIC Serial No. 876)
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr. PC

DOTL JC

A2 081269
MANUFACTURE OF MONOBLOC CONCRETE SLEEPERS IN INDIA
A short but full article on the problem of concrete sleepers as dealt with by the Indian Railways. The author gives details of: (1) the production technique adopted: site and production capacity of manufacturing factories; (2) the basic specifications finally chosen for the sleepers; (3) the manufacturing technology and its development; and (4) future projects.

Parthasarathy, R *Indian Railway Technical Bulletin* Vol. 30 No. 189, May 1973, pp 47-57, 4 Tab.

ACKNOWLEDGMENT: International Railway Documentation, Selection of (UIC Serial No. 880)
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr. PC

DOTL JC

A2 081382
COMPUTERIZED SUPERVISION OF TRACK MAINTENANCE
Japanese National Railways has computerized the planning of the maintenance of its 26,000 km of main lines, 13,000 km of sidings, and 70,000 switches. JNR has programmed the replacement of 2,000 km of rail yearly. For each individual turnout, data is stored on the parts involved, on the results of annual inspections, and on the speed and volume of movements. Initially tie condition has involved the almost 38 million wood ties on JNR but the growing number of prestressed concrete ties are to be included in the future. Seven high-speed track inspection cars are being fitted to provide input for a maintenance planning system. While problems remain, computerization of maintenance equipment control, track improvement planning and track work estimates are being made.

Inoue, T (Japanese National Railways) *Japanese Railway Engineering* Vol. 15 No. 1, 1974, pp 9-13, 5 Fig.

PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

A2 081388
CHOOSING THE RIGHT TRACK FOR URBAN CONDITIONS
Several conurbations in South America, India and the Far East are building or planning metros to cope with a huge rise in population. The author draws on five year's experience as Deconsult's chief consulting engineer to the Sao Paulo metro--which opened last September--to present and discuss technical and economic criteria for the choice of track design and components, and for the design and installation of concrete slab track with vibration suppression.

Hehenberger, W *Developing Railways* 1975, 7 pp, 6 Ref.

ACKNOWLEDGMENT: Developing Railways
PURCHASE FROM: XUM Repr. PC

DOTL JC

A2 081784
TRACK TRAIN DYNAMICS. HARMONIC ROLL SERIES-VOLUME II
This is the second of two installments of the report marking completion of Task 13 of Phase I of the International Government-Industry Research Program on Track Train Dynamics. This reference manual has data on truck components and on truck characteristics and is based on work performed by American Steel Foundries. Included are reports on frictional damping forces at the side frame/truck bolster interface; vertical, lateral, torsional and pitch spring rates of standard truck coil springs; deflection characteristics of truck bolsters and side frames; torsional resistance at the truck bolster/carbody centerplate interface; theoretical clearances throughout the truck; and mass moment of intertia of the side frame and truck bolster.

This project was sponsored by the Association of American Railroads, the Federal Railroad Administration, the Railway Progress Institute and the Transportation Development Agency of Canada

Association of American Railroads Technical Center 1974, 92 pp, 61 Fig.

PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

A2 082174
TRACK TRAIN DYNAMICS, ACCIDENT INVESTIGATION
This manual, a report marking the completion of one assignment of the International Government-Industry Research Program on Track-Train Dynamics, is a guide to systematic investigation of any derailment in order to establish a cause, or combination of causes. It presents information stressing the close relationships between track, train and vehicle characteristics, train handling, and track-train dynamics. Stressed is the need to recognize that a derailment may be combination-caused, rather than mandating the investigators to report a single cause. This is necessary if information from the accident investigation is to accurately reflect the true situation. The manual concludes with six recommendations for individual railroad users.

This project was sponsored by the Association of American Railroads, the Federal Railroad Administration, the Railway Progress Institute and the Transportation Development Agency of Canada.

Association of American Railroads Technical Center 1974, 77 pp, Figs.

PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

A2 083057
NEW CONCRETE-TIE SERVICE TEST FOR THE SANTA FE
Since late in 1974, Santa Fe trains have been operating over a concrete-tie test section which is reported to represent the latest in concrete-tie technology as learned from previous test sections on this road and from other sources. Two types of ties and several types of fastenings were used in a segment of the mainline in Illinois. Special attention was given to providing a subgrade and ballast bed which would give maximum support to the ties which will be subjected to 20 million gross tons annually with trains operating at up to 79 mph.

Weber, JW *Railway Track and Structures* Vol. 71 No. 1, Jan. 1975, pp 32-34

PURCHASE FROM: XUM Repr. PC
DOTL JC

A2 083058
NEW EQUIPMENT SPEEDS CHANGE-OUT OF DEFECTIVE RAILS
Outfit developed on Santa Fe includes special prime-mover truck plus an abrasive saw and a multiple-spindle drill, both operated hydraulically from power unit activated from a power take-off on the truck.

Railway Track and Structures Vol. 71 No. 1, Jan. 1975, p 26-28

PURCHASE FROM: XUM Repr. PC
DOTL JC

A2 083065
FLASH-BUTT WELDING OF NATURAL HARDENING RAILS OF SPECIAL QUALITY CHROME-MANGENESE STEEL
The conditions for obtaining good and fully reliable rail welds were derived from many tests as described in this article. Progressive flashing is important to insure a clean weld seam with good static bending characteristics and hardening at the rail running surface.

This publication is available in German, English, French and Spanish editions.

Schweitzer, R Heller, W *Eisenbahntechnische Rundschau* Vol. 23 No. 12, Dec. 1974, pp 506-515

PURCHASE FROM: Hestra[Verlag Holzhofallee 33, 61 Darmstadt, West Germany Repr. PC
DOTL JC

A2 083066
STRENGTHENING THE RAILWAY TRACK WITH THIN PRESTRESSED CONCRETE SLABS
For some years the Czechoslovak State Railway (CSD) has been seeking to increase the load-bearing capacity of their tracks on heavily-worked routes in poor ground by inserting thin prestressed concrete slabs between the formation and the ballast bed. The design of the slabs, laboratory testing thereof, and some test track sections are described.

This publication is available in German, English, French and Spanish Editions.

Tyc, P *Eisenbahntechnische Rundschau* Vol. 23 No. 12, Dec. 1974, pp 516-521

PURCHASE FROM: Hestra[Verlag Holzhofallee 33, 61 Darmstadt, West Germany Repr. PC
DOTL JC

A2 083067
HIGH SPEED TRACK AND ITS MAINTENANCE
The author discusses the conditions necessary for technically and economically acceptable track construction on high-speed routes with mixed-traffic working, taking into consideration the track alignment and the construction elements. Already at the planning and design stage, the track-building conditions and economical maintenance of heavily-worked routes must be given full consideration, and also adhered to later during regular operation. Proper staff training is also important. But further tests, for example with concrete-slab track structure under heavy working loads, are necessary before final decisions are made.

This publication is available in German, English, French and Spanish editions.

Fastenrath, F *Eisenbahntechnische Rundschau* Vol. 23 No. 12, Dec. 1974, pp 491-498

PURCHASE FROM: Hestra[Verlag Holzhofallee 33, 61 Darmstadt, West Germany Repr. PC
DOTL JC

A2 083073
JOINING AND HARDFACING OF RAILS, POINTS AND CROSSINGS USING MANUAL METAL-ARC WELDING ON THE SWEDISH RAILWAYS
A detailed account is given of work done in developing a suitable technique and filler materials to meet two main objectives. The first main task was to reduce maintenance costs for rail material by the hard surfacing and joining of rail ends and crossings and later also points (switches). The second main task was to further develop a technique and backing material for the joining of rails by means of manual mold welding. The aim was to obtain such a high quality in the form welds that the technique would be approved without any limitations for the joining of rails with a nominal minimum U.T.S. (ultimate tensile strength) of 800 and 900 N/mm2. The following requirements were to be fulfilled: Specifications of the various electrode materials are given, listing weld-metal composition, welding data, and applications.

Ljunggren, J *Svetsaren-English Edition* No. 2, 1974, 7 pp

ACKNOWLEDGMENT: EI (EI 75 005215)
PURCHASE FROM: ESL Repr. PC, Microfilm

A2 083911
SPECIFICATION OF RIDE QUALITY CRITERIA FOR TRANSPORTATION SYSTEMS: THE STATE OF THE ART AND A NEW APPROACH
The current state-of-the-art of ride quality criteria is reviewed. In particular the existing technique of describing the guideway in terms of its spectral density and of defining the ride quality standard as the acceleration spectral density is outlined. By utilizing linear system theory an alternative deterministic approach is presented. A deterministic ride quality standard is proposed and an analytical technique to design vehicle-suspension systems to meet this standard is presented.

Fearnsides, JJ (Department of Transportation); Hendrick, JK Firouztash, H *High Speed Ground Transportation Journal* Vol. 8 No. 2, June 1974, pp 125-132, 17 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

A2 083920
THE TRIBOLOGY OF WHEEL ON RAIL
The functioning of wheels and rails as a supporting and guiding system depends on a Hertzian contact of 1.2 x 10 to minus 4th power sq m (0.2 in sq) area. In addition to its supporting function, this area must withstand tangential forces to enable the functions of traction, braking and guidance to be fulfilled. Such traction forces are accompanied by a deflection known as 'creep' and classical estimates of this quantity are compared with measurements made on the track. Modes of wear of wheel and rail are described and alternative systems which avoid contact are discussed.

Barwell, FT *Tribology* Vol. 7 No. 4, Aug. 1974, pp 146-150

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: ESL Repr. PC, Microfilm

A2 084917
CHIEF ENGINEERS APPRAISE PENN CENTRAL
A "Chief Engineers' Report" compiled by the chief engineers of six major railways has indicated that it will cost $4.6 billion to rehabilitate the Penn Central. The report comments on yard and mainline track conditions, including ballast, rail wear, etc. Because of the extremely poor condition of the railway, the report stresses that rebuilding the railway should begin now and not wait for Conrail.

Progressive Railroading Vol. 18 No. 2, Feb. 1975, pp 55-56

ACKNOWLEDGMENT: CNR
PURCHASE FROM: Murphy-Richter Publishing Company 9 South Clinton Street, Chicago, Illinois, 60606 Repr. PC
DOTL JC

A2 084924
UNSTABLE TRACK: CAUSES AND CURES
The effectiveness of ballast is of prime importance to the stability of track. Burlington Northern has found there are four main factors affecting the durability of ballast. Continuous welded rail is the most significant development. In addition, the quality of the ballast, the condition of the sub-grade and the compactions of the ballast all affect the condition of the track.

Progressive Railroading Vol. 17 No. 11, Nov. 1974, pp 61-64

ACKNOWLEDGMENT: CNR
PURCHASE FROM: Murphy-Richter Publishing Company 9 South Clinton Street, Chicago, Illinois, 60606 Repr. PC
DOTL JC

A2 084927
WELDED RAIL ALL THE WAY ON THE SANTA FE
The Santa Fe has laid over 5,000 miles of welded rail on its system. A new rail welding plant has been constructed at Amarillo, Texas. The plant also reclaims rail that has been removed when welded rail is installed. The old rail is shipped to the Amarillo plant in 1,440 sections where it is disassembled and reclaimed.

Progressive Railroading Vol. 17 No. 9, Sept. 1974, pp 82-88

ACKNOWLEDGMENT: CNR
PURCHASE FROM: Murphy-Richter Publishing Company 9 South Clinton Street, Chicago, Illinois, 60606 Repr. PC
DOTL JC

A2 084937
STRESS ANALYSIS OF CONCRETE TRACK SLABS ON AN ELASTIC FOUNDATION BY THE FINITE ELEMENT METHOD
In analyzing the track slab stress, it has been revealed that the beam theory has led to certain discrepancies and left unexplicable parts of the actual phenomena. But it is found that these drawbacks can be eliminated by assuming that the rail supporting elasticity is concentrated at fastening devices and considering the track slab as a plate, with the aid of a mechanical model analysis. For the analysis of the plate the finite element method is employed for its flexibility in applying the boundary conditions. The slab track is divided into many triangular elements and analyzed by using the hybrid type potential energy principle. The theoretical results thus obtained are in good agreement with those observed and they are practically employed in the slab track designing.
Aslo available from ESL.

Saito, T *Railway Technical Research Institute* Quart Rpt. Vol. 15 No. 4, Dec. 1974, pp 186-190, 4 Fig., 2 Tab.

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Ken-yusha 1-45-6, Hikari-cho, Kokubunji, Tokyo, Japan Repr. PC
DOTL JC

A2 090658
URBAN RAIL SUPPORTING TECHNOLOGY PROGRAM FISCAL YEAR 1974, YEAR END SUMMARY
Major areas include program management, technical support and application engineering, facilities development, test and evaluation, and technology development. Specific technical discussion includes track measurement systems; UMTA facilities development at the DOT High Speed Ground Test Center, Pueblo, Colorado; rail car test and evaluation; instrumentation for data acquisition and processing; noise abatement technology; tunneling; and car crashworthiness studies.
See also PB-238 602.

Madigan, RJ
Transportation Systems Center, Urban Mass Transportation Administration Final Rpt. DOT-TSC-UMTA-75-7, Mar. 1975, 94 pp

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-241239/3ST, DOTL/NTIS

A2 093294
NORTHEAST CORRIDOR HIGH SPEED RAIL PASSENGER SERVICE IMPROVEMENT PROJECT. TASK 9: TECHNICAL AND ECONOMIC ANALYSIS OF VEHICLE/RIGHT OF WAY SYSTEMS. VOLUME I
This report presents the results of a study performed to define the combination of vehicle and right-of-way characteristics which best meets objectives for upgrading passenger service on the Northeast Corridor. The specific goals of this rail system are 2-1/2 hours travel time between Washington, D.C. and New York City with five stops, and 3 hours travel time between New York City and Boston with five stops. Consideration of technical, economic and intangible factors leads to the conclusions that certain right-of-way improvements should be implemented and that multiple unit electric (MU) cars should be used. Volume One discusses high speed technology, power concepts, vehicle design, kinematics, safety, comfort, train performance, and some mathematical formulations.
See also PB-242 445 and Volume 2, PB-245 222.

Lawson, KL Prause, RH Gillespie, CW Wujek, JH Arnlund, R Bechtel Incorporated, Federal Railroad Administration Final Rpt. FRA/ONECD-75/9-Vol-1, Aug. 1975, 225 pp

Contract DOT-FR-40027

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-245221/7ST, DOTL NTIS

A2 093295
NORTHEAST CORRIDOR HIGH SPEED RAIL PASSENGER SERVICE IMPROVEMENT PROJECT. TASK 9: TECHNICAL AND ECONOMIC ANALYSIS OF VEHICLE/RIGHT OF WAY SYSTEMS. VOLUME II
This document contains the results of a study performed to define the combination of vehicle characteristics and right-of-way improvements which best meets the Corridor Rail objectives for upgrading passenger service on the Northeast Corridor. Volume Two of a two-part report deals with economic inputs of rolling stock, electrification, shop construction, track maintenance, and service demand. Costs, planning, and systems engineering are discussed, along with tradeoffs, environmental considerations, and vehicles, with particular attention to tilt body design.
See also PB-242 445 and Volume 1, PB-245 221.

Lawson, KL Prause, RH Gillespie, CW Wujek, JH Arnlund, R
Bechtel Incorporated, Federal Railroad Administration Final Rpt. FRA/ONECD-75/9-Vol-2, Aug. 1975, 245 pp

Contract DOT-FR-40027

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-245222/5ST, DOTL NTIS

A2 093350
NORTHEAST CORRIDOR HIGH SPEED RAIL PASSENGER SERVICE IMPROVEMENT PROJECT. TASK 11S. IMPROVEMENT PLAN FOR PHYSICAL PLANTS WITH ESTIMATED COSTS. VOLUME II
The two-volume report describes the physical plant necessary to meet trip time goals and permit high speed train operations in the section of the Northeast Corridor between Washington, D. C. and New Haven, Connecticut. The cost of the physical improvements are estimated and an implementation schedule is presented in Volume I. Facilities include track, bridges, tunnels, signals, communications, electrification and other items. Volume 2 includes track charts and aerial photographs of major curve realignments and interline connections on the Northeast Corridor, and a graphical representation of simulated train performance.
See also PB-244 873.

Sutcliff, H Bailey, W Biss, DJ Irvin, LA Livingston, FM
Bechtel Corporation, Federal Railroad Administration Final Rpt. FRA-ONECD-75-11S, July 1975, 135 pp

Contract DOT-FR-40027

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-245414/8ST, DOTL NTIS

A2 093374
NORTHEAST CORRIDOR HIGH-SPEED RAIL PASSENGER SERVICE IMPROVEMENT PROJECT. TASK 3. TRACK AND STRUCTURES STANDARDS DEVELOPMENT
Track and structure characteristics and problem areas to be encountered in upgrading the Corridor are discussed. Standards considerations and applicability are outlined along with the maintenance history of the Corridor. Track system options for application to 150 MPH High Speed Rail (HSR) service are discussed and performance records examined. Concrete ties, fastener systems and ballastless track (concrete slab) are considered with wood tie track in a structural and cost effective investigation. Factors of type and frequency level of HSR train service and potential joint usage with freight movements are projected for these analyses. With this information, design parameters such as lateral and vertical track stability are investigated and established. On basis of structural integrity, selected track system candidates are costed over a 50 year life cycle of construction and maintenance. All projected maintenance items are described in detail with cycle rationale delineated.
See also PB-243 419.

Howell, RP Kendall, RA Magee, GM Holowaty, MC Holness, KJ
De Leuw, Cather/STV, Federal Railroad Administration Final Rpt. FRA/ONECD-75/3, Sept. 1975, 355 pp

Contract DOT-FR-40026

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-245774/5ST, DOTL NTIS

A2 093378
NORTHEAST CORRIDOR HIGH SPEED RAIL PASSENGER SERVICE IMPROVEMENT PROJECT. TASK 4A. SIGNALING AND COMMUNICATIONS
The report includes description of the present signal systems, recommendations and description of the changes required to support high-speed passenger service, and corresponding cost estimates for the Northeast Corridor (Washington, D.C. to Boston, Massachusetts). Recommendations and descriptions cover the areas of proposed signal systems, track circuit requirements, impedance bonds, hazard protection devices, control systems, communications systems, training devices, installation schedule, and estimates of costs to procure and install such systems. Typical construction and installation specifications are included as an appendix.
See also report dated Apr 75, PB-243 419.

Williams, J Pipas, G
Bechtel Corporation, Federal Railroad Administration Final Rpt. FRA/ONECD-75/4A, Sept. 1975, 110 pp

Contract DOT-FR-40027

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Micfofiche
PB-245956/8ST, DOTL NTIS

A2 094187
DEVELOPMENT OF STANDARD SPECIFICATIONS FOR CONCRETE TIES FOR RAPID TRANSIT. PHASE I. TASKS 1 TO 5
This report presents the results of the first part of a project to develop specifications for standard concrete ties for rapid transit use. The report is presented in five sections: Section 1 estimates the market potential of concrete ties for the transit industry. Section 2 presents a technical and economic evaluation of concrete ties based on international experience. Section 3 presents parameters necessary for the design of standard concrete ties for rapid transit use. Section 4 covers the preliminary specifications for the materials, fabrication and handling of the standard concrete ties.

Hanna, AN Weber, JW
Construction Technology Laboratories, Transit Development Corporation, Incorporated Final Rpt. TDC-CT-75-1, Oct. 1975, 117 pp

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-247676/0ST, DOTL NTIS

A2 095211
MEASUREMENT AND CALCULATION OF TRACK CURVES FROM ANGULAR CO-ORDINATES [Die Vermessung und Berechnung von Gleisboegen aus Winkelkoordinaten]
Track-geometry determination in conjunction with open track alignment using normal trigonometrical methods requires considerable quantities of instruments and major calculations. The author describes a method based on angular coordinates which achieves the desired objective without special instruments. [German]

Bose, E *Eisenbahningenieur* Vol. 25 No. 6, 1974, pp 200-209, 5 Fig., 6 Ref.

ACKNOWLEDGMENT: International Railway Documentation, Selection of
PURCHASE FROM: Dr. Arthur Tetzlaff-Verlag Niddastrasse 64, Frankfurt am Main, West Germany Repr. PC

A2 095214
MEANS AND METHODS TO INCREASE TRACK STABILITY
The author deals with the means and methods of preventing the decreases in track stability following maintenance operations. Above all, he refers to the so-called Plasser-all-side-system RS-System and gives an account of some tests to determine the best conditions for its use. He goes on to provide graphs showing: the results of a large number of measurements of track resistance to lateral deformation; the conditions of buckling stability deduced from theoretical and relative formulae either in the case of simple buckling of a perfectly straight track or that of deformation of a track with a slight flaw at the outset. He comes to the familiar conclusions as far as conditions for good stability are concerned: high standard of track geometry; increased lateral resistance of the ballast bed by use of modern equipment; increased track stiffness with wing-ties, used so successfully by the Austrian Federal Railways.

Riessberger, KH *AREA Bulletin* No. 648, June 1974, pp 797-811, 3 Fig., 6 Ref.

ACKNOWLEDGMENT: International Railway Documentation, Selection of
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

A2 095225
STEADY-STATE VIBRATIONS OF RAIL ON AN ELASTIC DAMPED FOUNDATION SUBJECTED TO AN AXIAL FORCE AND A MOVING LOAD
The recent practice of continuously welded railroad rails suggests that considerable axial forces may be induced in the rails due to a change in temperature. This paper presents an analytical solution for the effect of an axial force on the steady-state vibrations of a rail continuously supported on an elastic damped (viscoelastic of the Kelvin type) foundation and subjected to a moving load. The presence of damping is shown to result in an unsymmetric dynamic deflection of the rail. Due to phase shift the largest deflection occurs slightly behind the point of application of the moving load, and the deflection ahead is always larger than the deflection behind the point of maximum deflection. The results are relevant to present studies of the temperature buckling of continuously welded railway rails. If the rail is near to the point of buckling due to thermal strains, additional longitudinal strain in the rail due to a moving load may result in buckling of the rail ahead of the moving load.

Contributed by the Rail Transportation Division of The American Society of Mechanical Engineers for presentation at the IEEE-ASME Joint Railroad Conference, San Francisco, California, April 15-17, 1975.

Dokainish, MA Elmaraghy, W (McMaster University)
American Society of Mechanical Engineers 75-RT-3, Apr. 1975, 8 pp, 6 Fig., 10 Ref.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL RP

A2 095235
THE CONCRETE TIE AND OPTIMUM TRACK
The Santa Fe Railway has installed a concrete tie test section near Streator, Illinois. The company is testing two types of ties and three types of rail clips. The track has continuous welded rail. It carries about 20 million gross tons of traffic annually, with train speeds up to 79 mph. Certain ties have 18 strain gauges permanently installed to record tie and track performance.

Progressive Railroading Vol. 18 No. 3, Mar. 1975, pp 61-64

ACKNOWLEDGMENT: CNR
PURCHASE FROM: Murphy-Richter Publishing Company 9 South Clinton Street, Chicago, Illinois, 60606 Repr. PC

DOTL JC

A2 095237
IS IT GOOD ENOUGH?
Many track engineers believe that present conventional track is inadequate for today's heavy fast trains, a new track research laboratory is being built in Chicago to test such track components as ballast, subgrade and fittings and to investigate maintenance practices, wheel loading and track stability. In addition, the Sante Fe has built a test section into its main line to study eight different types of track structures. The following article describes the development of the concrete tie and discusses its success in several sites in North America.

Modern Railroads Vol. 30 No. 3, Mar. 1975, pp 47-51

ACKNOWLEDGMENT: CNR
PURCHASE FROM: Cahners Publishing Company, Incorporated 5 South Wabash Avenue, Chicago, Illinois, 60603 Repr. PC

DOTL JC

A2 095377
THE DR'S POINTS WITH PARABOLIC TONGUES [Weichen mit Parabelzungen bei der Deutschen Reichsbahn]
Following details of the importance of the geometrical shape of the tongues of points on the standard of the working of the points, the author explains the principle of the parabolic tongue while pointing out that the length of the point structure remains unchanged. The advantage of parabolic tongues for points is the reduced level of wear and extended useful life. The DR will be using the new system for the points to be fitted with R 65 section rails. [German]

Kohler, J *Signal und Schiene* Vol. 18 No. 7, 1974, pp 226-228, 4 Ref.

ACKNOWLEDGMENT: International Railway Documentation, Selection of
PURCHASE FROM: Transpress VEB Verlag fuer Verkehrswesen Franzoesische Strasse 13-14, 108 Berlin, East Germany Repr. PC

A2 095379
TRACK SUPERSTRUCTURE-CONDITION SINE QUA NON [Der Oberbau-conditio sine qua nonÖ]
Superstructure is subjected to static and dynamic stresses. In the interests of safety and productivity, wear in equipment must be foreseen in time. To avoid disturbing traffic as far as possible because of work on superstructures, the use of S 60 type rails has been introduced. First class track on main and secondary lines with traffic volumes of more than 25,000 tonnes/day should be composed of S 60 type rails. By 1985, the DB plans to lay 16,000 km of track and fit 15,000 points with heavy rails (S 60 and S 54). Lastly, the author deals with the problem of collaboration with rail manufacturing works and the organization of the superstructure section. [German]

Fastenrath, F *Die Bundesbahn* Vol. 50 No. 9, Sept. 1974, pp 557-564, 7 Fig.

ACKNOWLEDGMENT: International Railway Documentation, Selection of
PURCHASE FROM: Hestra[Verlag Holzhofallee 33, 61 Darmstadt, West Germany Repr. PC

A2 095380
TESTING OF NON-BALLASTED TRACK IN FRANCE AND OTHER COUNTRIES [Essais de voie sans ballast en France et a l'etranger]
This brief summary of the latest experiments with track on slabs in France and other countries stresses, for each type of track-laying, the original character of the tests. An examination of the advantages and drawbacks of the various laying methods reveals the value there would be in carrying out fresh research aimed at reducing the maintenance costs for conventional track, since the laying of track on concrete slabs does not appear to be indicated, even for speeds in the region of 300 km/h. [French]

Erieau, J *Informations Techn SNCF-Direction de l'Equipement* No. 13, June 1974, pp 63-72, 14 Fig., 2 Tab.

ACKNOWLEDGMENT: International Railway Documentation, Selection of
PURCHASE FROM: Societe Nationale des Chemins de Fer Francais Paris, France Repr. PC

A2 095414
ANALYSIS OF TRACK PARAMETER HETEROGENEITY AS A COMPLEMENT TO GEOMETRICAL METHODS OF TRACK CONDITION RATING
The condition of a track may be defined by track rating indices (W indices at the PKP) taken from recordings by a track inspection car, or obtained by geometrical measurements (longitudinal dip and cross-sectional irregularities, without load or with a moving load, lateral displacement, etc.). By track heterogeneity, the writer means the differences that such indices reveal on lengths of line with identical make-up, similar age, and used by the same traffic. These heterogeneities, which may be caused by the laying or maintenance of the track, or by constructional features with different characteristics, are also likely to result in great differences in the rapidity with which these lengths of line deteriorate, necessitating earlier continuous track renewal. The article proposes methods of assessing these heterogeneities by tests based on classic statistics laws. Numerical examples thus deal with: heterogeneities in the W index, by the X to the 2nd power test; heterogeneities in the track gauge by a method called the "ZM test" taken from an American book referred to in the bibliography; correlations between rail dip and lateral displacement under a moving load, by an analysis of sequential correlation. These complex analyses are not used as a basis of routine maintenance decisions, but in investigations for the purpose of explaining abnormal phenomena.

Baluch, H *Rail International* Vol. 5 No. 7-8, Aug. 1974, pp 537-546, 6 Fig., 4 Tab., 6 Ref.

ACKNOWLEDGMENT: International Railway Documentation, Selection of
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

A2 095440
FOUR TRACKS FROM TIBER TO ARNO: THE NEW DIRECT LINK ROME-FLORENCE [Vier Gleise vom Tiber zum Arno Die neue Direttissima Roma-Firenze]
In tracing the historical development of the railway network and the excessive operating load on the Rome-Florence route, the Author shows the need for the conversion of the latter to a four-track link. The new tracks will be independent of the existing, but will have several connections with these, and will be built for a top speed of 250 km/h. The technical data for the track alignment and the fixed installations for electric traction and train working are discussed, and the article concludes with a report on the present stage of the construction work and details of bridges viaducts and tunnels. [German]

Misiti, L *Eisenbahntechnische Rundschau* Jan. 1975, pp 2-10, 15 Fig.

ACKNOWLEDGMENT: Eisenbahntechnische Rundschau
PURCHASE FROM: Hestra[Verlag Holzhofallee 33, 61 Darmstadt, West Germany Repr. PC

DOTL JC

A2 095673
M/W COSTS: HOW THEY ARE AFFECTED BY CAR WEIGHTS AND THE TRACK STRUCTURE
Using a combination of theory and actual field measurements, the author develops the relative maintenance costs associated with axle loads and the type and condition of the track. The article attaches definite values to variables such as total tonnage carried, track condition and car size. The Illinois Central Gulf considers that 53% of total track expense and capital investment is incremental--varying with the tonnage moving over the railroad. This incremental cost is then broken into its own increments based on rail deflection, rail bending stress, rail life and miscellaneous costs.

Ahlf, RE (Illinois Central Gulf Railroad) *Railway Track and Structures* Vol. 71 No. 3, Mar. 1975, 7 pp, 6 Fig.

PURCHASE FROM: XUM Repr. PC

DOTL JC

A2 095674
SANTA FE LOOKS FAR AHEAD IN M/W PROGRAMMING
Maintenance of way requirements on this road are projected as far as 20 years into the future. To bring out the thinking behind this practice, including the expected benefits, the Santa Fe's chief executive officer, vice president operations and chief engineer participated in a roundtable which is reported in this article. The long-term planning is aimed at overcoming peaks and valleys in earnings by avoiding peaks and valleys in maintenance operations.

Railway Track and Structures Vol. 71 No. 3, Mar. 1975, pp 20-24

PURCHASE FROM: XUM Repr. PC

DOTL JC

A2 095677
SOLID TRACKBED CROSSOVERS IN HEITERSBERG TUNNEL
Anticipating the construction of a new Gotthard tunnel, Swiss Federal Railways has completed a dummy run for laying concrete slab track, considered essential for a long tunnel with a high traffic density because a conventional ballasted trackbed would require undue time for maintenance. The tunnel on the new cutoff between Zurich and Berne was laid entirely with 9.5 km of solid trackbed, including four crossovers. The Heitsberg tunnel trackbed was laid with virtually the same construction methods used in a test section in the Bozberg tunnel in 1966 which has since required no maintenance and has been entirely satisfactory.

Railway Gazette International Vol. 131 No. 2, Feb. 1975, p 73, 2 Phot.

PURCHASE FROM: XUM Repr. PC

DOTL JC

A2 095679
EXPERIMENTAL ASPHALT-BASED TRACK BUILT IN ENGLAND
Contruction at British Rail's research center consists of 9-in. asphalt base on which rails are supported by prestressed concrete beams and transverse bearing members. The work is a cooperative effort of British Rail's Research & Development Division and Esso Petroleum's Research Center. Asphalt can be subjected to traffic loading within a few hours of laying, unlike concrete slabs which require much longer curing before they can be used in service. Asphalt-based track might prove suitable for track replacement where services can only be interrupted for a short time. The site has been exhaustively instrumented to determine stresses and deflection.

Railway Track and Structures Vol. 71 No. 4, Apr. 1975, pp 26-27, 2 Phot.

PURCHASE FROM: XUM Repr. PC

DOTL JC

A2 095680
PANELIZED STEEL-TIE TRACK FILLS A NEED ON THIS PROJECT
The construction of a six-mile in-plant railroad serving the Tilden iron-ore mine and pelletizing plant near Ishpeming, Mich., was accomplished with all-steel panelized track. A total of 845 pre-assembled steel-tie track panels and 16 all-steel turnouts were used. The panelized track concept was credited with not only maintaining the original construction schedule, but also staying within budget estimates. While the original cost was in excess of that for the same amount of trackage on wood ties, savings in construction labor and time were achieved. It is expected that maintainance will also be lower.

Railway Track and Structures Vol. 71 No. 4, Apr. 1975, pp 28-29, 3 Phot.

PURCHASE FROM: XUM Repr. PC

DOTL JC

A2 095682
FLAME HARDENING OF RAIL BY THE HAMMON CONTINUOUS PROCESS AND PHYSICAL AND ROLLING LOAD TEST RESULTS
Since the standard carbon rail is removed from track due to abrasion, head flow on the low rail of the curves and shelling on the high rail, it is of interest to the industry to investigate any process that alleviates this problem. Failures due to shelling alone amount to 40 percent of all types of failures. Alloy rail steel chemistries and heat treatment have been found helpful in extending rail life where the above conditions existed. In the area of heat treatment, various types of flame hardening of the rail head have been found applicable economically and available in all parts of the United States. Summarizing, features of this process that may be of interest to railroads are: 1. Evaluation of rail flame hardened by this process at the Research Center and the University of Illinois indicates that it should give good service performance. 2. It is claimed that it will be economical because of its ability to use propane or natural gas for heating the rail. 3. Rail of any length can be continuously flame hardened, before or after welding. 4. The equipment can be mounted on railroad cars to be used either at the welding or cropping site.

Association of American Railroads Technical Center No. ER-44, Apr. 1964, 3 pp, 10 Fig., 4 Tab.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC

DOTL RP

A2 095683
FATIGUE RESISTANCE OF QUARTER-SCALE BRIDGE STRINGERS IN FLEXURE AND SHEAR
Scaled specimens of Douglas-fir and southern pine were evaluated under several combinations of variables to obtain information on the behavior in flexure and shear under repeated loading. Fatigue strengths are summarized.

Lewis, WC
Association of American Railroads Technical Center No. ER-39, Dec. 1963, 28 pp, 33 Fig., 2 Ref.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC

DOTL RP

A2 095691
SURVEYING AND CALCULATION OF CURVED TRACK, USING ANGLE CONFIGURATION CO-ORDINATES
The method described for surveying and calculation of curved track with the aid of angle configuration coordinates is not inferior to values calculated on the strength of normal coordinates and has the following advantages: Less mathematical effort compared with polar marking and surveyings; work can be carried out with instruments currently available (measuring tapes and theodolites); application of calculators with the well known angle- Configuration :method. The formulas which apparently are complicated can be derived without major effort from the calculation sketch for each individual case.

Bose, E *Rail International* Vol. 6 No. 1, Jan. 1975, pp 55-61, 5 Fig., 6 Ref.

ACKNOWLEDGMENT: Rail International
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

A2 095698
VERTICAL ACTION OF FORCES BETWEEN WHEEL AND RAIL WHEN CROSSING A RAIL JOINT
An example serves to determine the maximum dynamic vertical wheel force when a modern coach crosses a rail joint. The problem is described mathematically by a system of ordinary differential equations and is solved by means of an analog computer. The high dynamic vertical wheel forces obtained linearly increase with the travelling speed. As a result, the demand of more elastic wheels is made for railway vehicles travelling at high speed, besides that of a high quality of the permanent way. [German]

Beer, R Gudacker, E Ebert, J *DET Eisenbahntechnik* Vol. 22 No. 11, Nov. 1974, pp 509-511

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: VEB Verlag Technik Oranienburgerstrasse 13-14, 102 Berlin, East Germany Repr. PC

A2 095873
PRESTRESSED CONCRETE TIE INVESTIGATION-2ND REPORT
This is a summary of some five years experience and field tests with strain gages and measurements of electrical resistance.
Conducted under sponsorship of AREA Committee 3-Ties and Wood Preservation and AREA Committee 5-Track.

Association of American Railroads Technical Center ER-58, Apr. 1965, 65 pp, 21 Fig., 1 Tab., 1 Phot., 1 App.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

A2 095874
RAIL STUDY BESSEMER AND LAKE ERIE RAILROAD
Because of the ever increasing concern with shelling of rail and its possible connection with wheel loads and the present day trend to still heavier wheel loads, a study was conducted on the Bessemer and Lake Erie Railroad to analyze their rail conditions in conjunction with their use of 90-ton cars for transporting of ore. This railroad has been using these 90-ton capacity hopper cars since 1931, with practice being to load ore for southbound movement to capacity, thus creating loads averaging 32,300 lbs. per wheel. It has been noted over the years that even with these wheel loads and rather high annual tonnages, the Bessemer has had little or not shelling of their rail. This study was prompted to see if an answer could be derived as to why no shelling problem exists here. In particular, two locations on the railroad were checked where the present rail in track is 131 lb., laid in 1938, and has had over 400,000,000 gross tons of traffic, most of which consisted of are carried in these 90-ton hopper cars. The northmost location is at Springboro, Pennsylvania, where there is a length of one mile of the 131 lb. rail in track (north and south of Mile Post 116). The other location is through and to the south of Grove City, Pennsylvania, Mile Post 60-63, where there is a 3-mile section of 131 lb. rail in track. Both of these sections of 131 lb. rail now carry both northbound and southbound tonnage, but prior to single tracking and installation of C.T.C. in 1957, this trackage was the southbound main track in both instances and carried the predominant southbound ore traffic. At both locations of 131 lb. rail, rail profiles were taken, degree and superelevation of curves were noted, predominant speeds of tonnage trains in both directions were noted, condition of the entire track structure and, in particular, condition of the rail both on tangent and curves were noted. Photographs were taken to show the rail condition. Because of curvature in the locations not exceeding 3 degrees, other locations on the railroad were chosen to make like studies, these locations having the same or less annual tonnages, and having different weights of rail of shorter service life, but having greater degree of curvature. Rail profiles and photographs were taken at these locations also. Along with the study of the rail and track conditions, a study of the 90-ton B & LE hopper cars was conducted, obtaining all pertinent data, prints, and photographs having to do with their construction and maintenance. The Bessemer's rail replacement policy is guided by the formula--T = .703xWxD.565 where T = Life of rail in million gross tons. W = Weight of rail in lbs. per yard. D = Traffic density in million gross tons per year.
Conducted under sponsorship of AAR Joint Committee on Relation Between Track and Equipment.

Association of American Railroads Technical Center ER-55, Mar. 1965, 3 pp, 4 Fig., 3 Phot.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

A2 095876
INVESTIGATION FOR REPAIRS BY WELDING OF HEAT TREATED AND FLAME HARDENED RAIL IN BOLTED RAIL CROSSINGS
In 1952 a program was developed to provide for investigation of heat treated rail and flame hardened rail in crossing frogs by means of service installations followed by laboratory studies of welding techniques to be used in field repairs to worn and battered units. A contract was made with the Chicago, Milwaukee, St. Paul and Pacific Railroad for installation of three test panels of crossing intersections at Manheim, Illinois, each of the three test panels to consist of eight simulated crossing intersections three of carbon-steel rail, heat treated by various methods; three of flame hardened carbon-steel rail; one carbon-steel panel of control cooled rail (as rolled) and one panel of chrome-vanadium rail. The studies of welding techniques were carried out at the AAR Research Center and the University of Illinois. 1. The flame hardened units held up generally well following welding with electric procedures used as indicated in Table 5. 2. The gas welds on the flame hardened units were less effective than the electric techniques and must be considered to be inferior. 3. The three types of electric welds and two types of gas welds used on the heat treated units gave comparable results and may be considered as satisfactory. 4. The best performing weld on chrome-vanadium rail was the electric weld in the west panel probably due to the hardness obtained by the process used. 5. On the open hearth units the best performance was obtained with gas weld 1G on unit E8. It is difficult to appraise the poor performance of weld 2G on unit C8 as this weld procedure gave good results on the flame hardened and heat treated units.
Conducted under sponsorship of AREA Committee 5-Track.

Association of American Railroads Technical Center ER-51, Nov. 1964, 14 pp, 65 Fig, 5 Tab., Phots.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

A2 095877
SERVICE INVESTIGATION OF VARIOUS TYPES OF JOINT BARS ON SANTA FE AND NORTHWESTERN RAILWAYS
This report covers the service investigation of various types of joint bars and variations of bolt spacing on the Atchison, Topeka and Santa Fe Railway near Streator, Illinois and on the Chicago and Northwestern Railway at Sterling, Illinois. 1. All design of joint bars have been adequate throughout the service period of 16 years. 2. Four bolts in 36 in joints with 9-9 1/8-9 in spacing are adequate to hold the rail, but do not provide sufficient rail end support, hence, create additional batter and droop of the rail ends compared with 6-bolt bars. 3. There appears to be little difference in the performance of the current AREA bolt hole spacing of 6-6-7 1/8-6-6 in compared with the 6 1/2-6 1/2-5 1/8-6 1/2-6 1/2 in spacing where such a

comparison can be made in the Santa Fe test. Inasmuch as the current AREA spacing has been shown to produce less stress concentration at the bolt holes and this service test has shown no disadvantage in other respects, it has confirmed the desirability of continuing the current AREA bolt hole spacing.

Conducted under sponsorship of AREA Committee 4-Rail.

Lamport, LR
Association of American Railroads Technical Center 6 pp, 12 Fig., Phots., 10 Ref.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

A2 095879
METALLURIGICAL, PHYSICAL AND ROLLING LOAD TEST RESULTS OF RAIL ROLLED FROM CONTINUOUSLY CAST BLOOMS

The development of information relative to any new process applicable to producing rail more economically is of interest to the industry. The opportunity of investigating the application of continuous casting in rolling rail presented itself when the M.W. Kellog Company became interested in investigating this process on behalf of a Mexican client. The AAR Research Center cooperated in developing the metallurgical, physical and rolling load test results of rail rolled to the S49 section from continuously cast blooms. The results on the same type of of tests as described above tested in the 12 in stroke rolling load machine are shown on Table 4. The S49 rails and the oxyacetylene pressure butt welded rail joints did not fail. The flash butt welded rail joints failed prematurely due to grinding cracks away from the weld caused by heavy cold grinding as shown in Figs. 8 and 9. The drop test results of the rail as shown on Table 5 indicate that the rail met the AREA specification. Fig. 10 illustrates the effect of the drop test. As mentioned before, very few butt welded rail joints have withstood the standard drop test for rail. The structure of these fractures were noted to be fiberous. The results of the investigation of the S49 rail rolled from continuously cast blooms at the AAR Research Center and comparable results of the investigation by Dr. Janiche indicate that rail produced by this process is of equal quality to rail produced by the standard process. The results are surprising in this first attempt of producing rail in this manner. As the art of of continuous casting in reference to rail is advanced, all of the defects such as segregations will undoubtedly be eliminated. The economy of the process is predicated on the elimination of mold and teeming practices as well as soaking pits and primary mill installations. It is of interest to call attention to the last paragraph of the attached report which states that the UIC specification for rolling rail calling for a bloom cross section of at least 20 times larger than the rail cross section was not met in this case. In the above rolling, the ratio amounted to 15 to 1 in the case of the 30 d rail and 9 to 1 in the case of the S49 rail.

Association of American Railroads Technical Center ER-45, Aug. 1964, 6 pp, 13 Fig., 6 Tab.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

A2 096535
DEVELOPMENT OF UNCONVENTIONAL TRACK BY JNR

JNR has been developing an unconventional, maintenance-free track which may be applicable not only from technical aspects, but also from economical aspects, in comparison with the conventional track structure consisting of sleepers and ballast. This new track will be used on the New San-yo Line (NSL) between Okayama and Hakata which uses standard gauge track, taking into account a maximum speed of 250 km/h, and also on the Kosei Line, the Musashino Line, etc., which use narrow gauge track with a maximum speed of 120 km/h. This paper discusses the technical, economical and social backgrounds, and the history of technical development in changing from the conventional structure, together with relevant problems.

Miyamoto, T Watanabe, K Aoki, M *Rail International* Vol. 6 No. 3, Mar. 1975, pp 189-203, 14 Fig., 9 Tab.

ACKNOWLEDGMENT: Rail International
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

A2 096561
REPORT TO CONGRESS. THE RAIL PASSENGER SERVICE ACT OF 1970.

This report was submitted to Congress pursuant to the Rail Passenger Service Act of 1970 that requires the Secretary of Transportation report on and evaluate the effectiveness of the Act in achieving and promoting intercity rail passenger service and on the effectiveness of Amtrak. Part I summarizes the material in the Report. Part II discusses scheduling, on-time performance, equipment acquisition, and reservations and fares in the light of Amtrak's precedents. Part III considers the orderly assumption by Amtrak of all its operations and the control exercized by its management along with potential benefits from mail transport and problems of track improvements. Part IV evaluates routes and services, present and future. Part V has legislative recommendations.

Department of Transportation Mar. 1973, 110 pp, Figs., Tabs.

PURCHASE FROM: DOT Repr. PC
HE 2705.E153 1973

A2 096626
THE LANDS TEST SITE. POINTS AND CROSSINGS FOR SWITCHING TRAINS AT HIGH-SPEEDS [Le chantier d'essai des Landes. Appareils de voie franchissables en deviation a' grande vitesse]

Photographic report with brief technical particulars on the characteristics and layout of the points and crossings being tested by the SNCF on the Bordeaux-Dax line, which make it possible to switch trains onto turnout tracks at speeds of 220 km/h at least. The blade alone extends over 36 m, for a switch with a total length of 210 m; the radius of the curve is about 10,000 m (tg 0.0162). [French]

Chemins de fer No. 307, Apr. 1974, pp 207-210, 13 Fig.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

A2 096654
MINERAL WASTES AS RAILROAD BALLAST

Approximately half of the $100 million allocated annually by Canadian railways for track maintenance is for the purchase, haulage, installation and maintenance of ballast. With the growth of Canadian rail traffic, it has been estimated that the nation will have to undertake major new rail construction in the next few years. Good quality ballast is not available all across Canada, particularly in the prairies. There are sources for the material in several locations, some of which would be the wastes from mining and metallurgical operations. The report discusses the function, characteristics, appraisal and sources of ballast. It is noted that Canadian railways are placing increased emphasis on the materials to be utilized as subballast and ballast in their track.

For presentation at the Annual General Meeting, Canadian Institute of Mining and Metallurgy, Toronto, Canada, 5-7 May 1975.

Feasby, DG (Mineral Sciences Laboratories)
Canada Centre for Mineral and Energy Technology MRP/MSL 75-76(OP), Apr. 1975, 17 pp, 1 Tab., 7 Ref.

PURCHASE FROM: Canadian Institute of Mining and Metallurgy 906-1117 Ste Catherine Street, West, Montreal 110, Quebec, Canada Repr. PC
DOTL RP

A2 097253
AN INVESTIGATION OF VARIOUS WELDING TECHNIQUES FOR BUILDING UP BATTERED RAIL ENDS

The building up of battered rail ends by means of different welding procedures and the evaluation of welding rods and electrodes used in these procedures is of considerable importance to the railroads. An investigation on this subject using 12 in. stroke rolling load machines at the Technical Center of the Association of American Railroads has been carried on under the general direction of G.M. Magee, director of engineering research, by Kurt Kannowski, metallurgical engineer. A definite program was outlined and followed in this investigation. The data in this investigation indicate

that, in spite of variations in rods and welding procedures, the oxyacetylene welding method performs well in building up battered rail ends. The occurrence of the porosity near the interface of the weld and rail metal as well as the sharp demarcation line between the rail and weld metal have caused the failures of the electric arc welds rather than the practice of not pre or post heating. The failures of electric arc welds are often caused by a variable that was not given consideration in this investigation. These welds are subject to the human element variations that may be expected due to the welder depositing the metal. This effect on the quality of the weld is gradually being eliminated by improvements in the automatic feed and wire electrode welding process. Welds produced by this method are now under the rolling load test as well as in an extensive service test on the New York Central System. Results from both show considerable promise.

Kannowski, K
Association of American Railroads Technical Center ER-32, Mar. 1963, 3 pp, 25 Fig., Tabs., Phots.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

A2 097255
INVESTIGATION OF SPECIAL JOINT BARS AND RAIL PLUGS FOR USE IN JOINING LENGTHS OF CONTINUOUS WELDED RAIL

This report covers laboratory tests of two completely assembled special rail joints with rail plugs (Dutchmen) to determine if such joints will stand up under traffic. A member road developed the special joint for use in connection with laying continuous welded rail at low temperatures and requested that tests be made in the rolling load machines at the Technical Center. It was felt that this subject matter would be of interest to other member roads and arrangements were made for tests of two joints. The purpose of the rail plug with a special length joint is to provide means of adjusting expansion of continuous lengths of rail laid at low temperatures withoug creating an additional joint for a short length of rail used by some railroads when joining continuous lengths. The special joints are made of regular cross section design, metallurgy and heat treatment, but the bars are lengthened to provide for the length of the plug and the spacing between the center bolt holes increased a corresponding amount. In laying continuous welded rail at below mean temperatures, the special joints with plugs would be used, the length of joint and plug being selected according to the amount the rail temperature when laying was below the mean temperature. At some later and convenient date, when the rail temperature was near the mean temperature the special joints and plugs would be removed, rail anchors removed to allow the rail ends to close the gap, and regular joint bars applied. The special joints and plugs would then be held for use on the next rail laying job as needed.

Association of American Railroads Technical Center ER-7, Feb. 1961, 2 pp, 4 Fig., Phots.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

A2 097256
PHYSICAL TEST RESULTS OF OXY-ACETYLENE PRESSURE BUTT WELDS OF HEAT TREATED RAILS

In order to develop all pertinent data in regards to continuous welded rail rolling load, flexure, drop and slow bend tests were performed on oxy-acetylene pressure butt welded fully heat treated rails at the request of the Norfolk and Western Railway Company. The fully heat treated rails, 132 lb. RE section, were supplied by the Bethlehem Steel Corporation and the welds were made by the Norfolk and Western Railway Company at their Roadway Material Yard in Roanoke. Eight of these welds were made by the oxy-acetylene pressure butt welding process. They were also normalized. Each of the tests were 6 ft. long with the weld in the center. The rolling load, flexure and drop tests were made at the AAR Technical Center and the slow bend tests were made at the University of Illinois by Professor R.E. Cramer. Two of the weld specimens were subjected to the rolling load test in a 12 in. stroke rolling load machine using a wheel load of 60,000 lb. with the weld placed 2 in. from the support on the cantilever end of rail. Since the wheel path is 10 in. beyond the weld, the weld was subjected to a bending moment of 600,000 in. lb. Under this test procedure, 2,000,000 load applications or cycles without failure is considered a run out. Both of the test specimens ran out at 2,000,000 cycles without failure. The flexure test was performed on a multi-press using a 60,000 lb. repeated load applied on the center of the weld on the rail head with a wheel shaped contact. The rail was supported on its base to have a 48 in. span. Thus, for each cycle of loading the bending moment at the weld varied from 0 to 720,000 in. lb. with the base in tension, giving a calculated maximum stress at the extreme fiber of 26,000 psi tension. Two of the test specimens were subjected to 2,000,000 flexures each without a failure. The two flexure test specimens, as well as two other test specimens, were then subjected to the drop test on a standard rail drop test machine. A 2,000 lb. tup was dropped 22 ft. on the center of weld with the rail head up. The rail was supported on a 48 in. span. As shown on Table 2, the two flexure test specimens failed at the first blow. One test specimen broke through the weld and a welding defect from a pop out on the outer edge of the base was noted. The other flexure test specimen failed 6 in. away from the weld and a transverse progressive defect in the head originating from a grinding crack was noted. One of the two regular test specimens failed outside the weld area after two blows. The other test specimen failed at the first blow through the weld. It was noted that the lower part of the web and the base were partially fused. The slow bend test results were obtained at the University of Illinois by Professor Cramer. The tests were made with the head up on supports 48 in. apart. The load was applied at two points 6 in. on each side of the weld. Thus, the applied bending moment between these load points was nine times the applied load in in. lb. One of the tests failed prematurely through weld. It was noted that the lower web and the base were partially fused. The other test performed excellently and broke 5 in. from the weld at the edge of the beat affected zone. The data obtained under the testing procedure indicates that even though the benefit from the heat treatment has been eliminated in that part of the rail heated above the critical temperature during the welding process, that fully heat treated rail welded by this process will perform as well as standard control cooled rail in the weld zone. Oxy-acetylene pressure butt welds with control cooled rail are in use extensively without failures if properly welded. The failures noted in these tests are not different from those that have been experienced in laboratory tests and field service in welds made by this process with standard control cooled rail.

Association of American Railroads Technical Center ER-8, Feb. 1961, 3 pp

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

A2 097257
REPORT ON ASPHALT TREATMENT OF BALLAST AND BRIDGE DECKS

This report deals with the asphalt ballast treatments made during 1960 on five roads and the bridge deck treatments on two roads. In addition, a progress report is presented on the nine track sections and one bridge project treated in 1959. The general features of these latter projects were described last year and appear in the Proceedings, Vol. 61, 1960, page 715. These treatments are the result of the research project jointly sponsored by the Roadway and Ballast Committee of the American Railway Engineering Association, of the Asphalt Institute and the Research Department of the AAR. Special equipment for the process has been developed and used, the description of which appears in the Proceedings, Vol. 60, 1959, page 712. The applications were made possible by the complete and excellent cooperation of the participating railroads who bore the cost of the materials and application with such technical assistance as required from the staff of the Asphalt Institute and the AAR. The special equipment has been made available upon request to any railroad without charge. It is expected that after revisions and repairs indicated during service in 1960 they will also be available to Member Roads in 1961 upon request to the Research Department, AAR. Some difficulty was experienced with the equipment on this project and full coverage was not obtained under the rail, through the restricted station area. Also, the application of the cover coat was not fully uniform. The project appeared fairly satisfactory upon completion. The 1960 ballast treatments covered a wide range of conditions. They will be valuable in determining the effects of climate and track characteristics on such treatments. Work this year has further demonstrated that good coverage can

be obtained which should serve very effectively toward tie preservation and protection of track fittings against corrosion. With the use of extended spray nozzles directed under the rail, full coverage and a good seal of the full ballast section was obtained in most cases, particularly where there was an opening under the rail in the cribs. The equipment in transfer movements from project to project indicated several deficiencies in security fastenings and appreciable damage occurred. This damage at times interfered with full production on the treatments reducing efficiency and raising costs to some extent. Careful note has been made of all sub-standard conditions and plans have been made for their correction including a number of betterments. If programs during 1961 indicate the need for the cars these changes will be made prior to the season and the cars will be available without charge to the roads on request to the Research Department, AAR.

Conducted under sponsorship of AREA Committee 1-Roadway and Ballast.

Smith, R
Association of American Railroads Technical Center ER-10, Feb. 1961, 6 pp

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC

DOTL RP

A2 097261
TEST OF SUSTAMID JOINT BARS FOR 129 LB. TR RAIL

The joints were made of sustamid special type 0.4K 88/04K90. The joint was applied to 129 lb. TR rail ends furnished by the Burlington Railroad. The large deflection this joint takes under load will result in putting larger loads on the ties supporting the joint and increase the track maintenance required. It will also have poor strength to resist high loads that may be imposed under unusual conditions, such as excessive play in track and large lateral forces from poor alignment or equipment nosing action. Further tests were not deemed worthwhile.

Conducted under sponsorship of AREA Committee 4-Rail, New Methods of Insulating Rail Joints.

Association of American Railroads Technical Center ER-6, Jan. 1961, 4 pp, 1 Phot.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC

DOTL RP

A2 097265
THE EFFECT OF UNIT TRAINS ON STRESS OCCURRENCES IN A CHICAGO AND NORTH WESTERN RAILWAY BRIDGE

This report contains a description and analysis of data obtained on the stringers and floor beams of a Chicago and North Western railway bridge to determine the frequency of occurrence of maximum stresses in these short span bridge elements which carry unit trains as well as regular service freight trains. The results may be summarized as follows: Track without rail Joint: 1. The frequency of occurrence of maximum stress was in the range of 3.0 to 4.0 ksi in the stringers and the floor beam under the combined loading of unit trains and regular service freights and was on the order of 2 to 9 percent of the total occurrence respectively. 2. The loaded unit trains comprised 5 percent of the total cars recorded and produced 46 percent of the maximum stress occurrences greater than 3 ksi in the floor beam and 7 percent in the stringers respectively. Track with Rail Joint: 1. The frequency of occurrence of maximum stress under combined loading of unit trains and regular service freights was on the order of 4 percent for the floor beam and 1 to 3 percent for the stringers of the total occurrence.

Conducted under sponsorship of AREA Committee 30-Impact and Bridge Stresses.

Association of American Railroads Technical Center ER-87, June 1969, 12 pp, 7 Fig., 6 Tab.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC

DOTL RP

A2 097267
DEVELOPMENT OF AN INNER BRACING FOR SWITCH STOCK RAILS ON THE GERMAN FEDERAL RAILWAY [Entwicklung einer inneren Backenschienen-Verspannung fuer Weichen der Deustchen Bundesbahn]

The stock rails of switches have hitherto always had outside bracings of various designs, but with increasing speeds, shorter intervals between trains, higher axle loadings and hence greater stresses on the switches, these outside and indirect-acting supports are no longer adequate. The Author describes the development of an inner bracing which with the aid of a specially-designed tension piece provides a flexible and permanently force-locking connection. Details of its design, basis of calculation, and testing by the German Federal Railway are given. [German]

Heim, A *Eisenbahntechnische Rundschau* Vol. 24 Apr. 1975, pp 117-122, 6 Fig., 7 Ref.

ACKNOWLEDGMENT: Eisenbahntechnische Rundschau
PURCHASE FROM: Hestra[Verlag Holzhofallee 33, 61 Darmstadt, West Germany Repr. PC

DOTL JC

A2 097268
INVESTIGATION OF DIFFERENT FORMATION PROTECTIVE LAYERS [Untersuchung verschiedener Planumsschutzschichten fuer den Schotteroberbau]

The Authors calculate the stresses in relation to different deformation moduli for the formation in respect of a ballast bed without a formation protective layer, with a 30-cm gravel underlayer, and with a cement-consolidated layer of 20 or 25 cm thickness. The limits of their suitability are determined, and recommendations made for the practical application of the various layers. [German]

Eisenmann, J Schneider, E *Eisenbahntechnische Rundschau* Vol. 24 Apr. 1975, pp 111-116, Figs., 12 Ref.

ACKNOWLEDGMENT: Eisenbahntechnische Rundschau
PURCHASE FROM: Hestra[Verlag Holzhofallee 33, 61 Darmstadt, West Germany Repr. PC

DOTL JC

A2 097269
NEW MONITORING SYSTEM FOR USAGE OF PERMANENT-WAY MACHINERY [Neu Arbeitsorganisation zur Ueberwachung des Baumaschirneneinsatzes im Oberbau]

The useful employment of permanent-way machinery can be substantially improved by means of continuously analysing the productive and idle time components. Exact data on the actual attainable performance under different operational and site conditions with machinery of different makes and type is also necessary for realistic planning of the work at future sites. The Author describes how the data acquistion equipment fitted on all the large p.w. machines of the German Federal Railway is used to obtain this information. [German]

Sauerwein, H *Eisenbahntechnische Rundschau* Vol. 24 Apr. 1975, 4 pp, 2 Fig.

ACKNOWLEDGMENT: Eisenbahntechnische Rundschau
PURCHASE FROM: Hestra[Verlag Holzhofallee 33, 61 Darmstadt, West Germany Repr. PC

DOTL JC

A2 097270
DIRECT CONCRETE ENCASING OF NON-BALLASTED AND SLEEPER-LESS HIGH-SPEED TRACKS [Unmittelbares Einbetonieren bettungs-und Schwellenloser Schnellfahrgleise]

The Kolner Verkenrs-Betriebe AG has developed a track without ballast or sleepers which can be laid in tunnels, on bridges and on normal earth formations. The rails with their fastenings are mounted in their exact position on strong assembly equipment and then immediately encased in concrete. The track is built, so to say, from the top downwards. The system is cheaper than the experimental methods tried out by the German Federal Railway, and should also be capable of being developed for the latter's new routes. [German]

Braitsch, H *Eisenbahntechnische Rundschau* Vol. 24 Apr. 1975, pp 129-134, 6 Fig., Phots., 19 Ref.

ACKNOWLEDGMENT: Eisenbahntechnische Rundschau
PURCHASE FROM: Hestra[Verlag Holzhofallee 33, 61 Darmstadt, West Germany Repr. PC

DOTL JC

A2 097297
THE CONTINUOUSLY SUPPORTED RAIL SUBJECTED TO AN AXIAL FORCE AND A MOVING LOAD
The recent practice of welding railroad rails to each other suggests that considerable axial compression forces may be induced in the rails because of a rise in temperature. This in turn may reduce the critical velocity for the track to the range of operational velocities of modern high-speed trains. The purpose of the paper is to demonstrate that this is indeed a possibility.

Kerr, AD (New York University, New York) *International Journal of Mechanical Sciences* Vol. 14 1972, pp 71-78, 5 Fig., 8 Ref.

ACKNOWLEDGMENT: International Journal of Mechanical Sciences
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL RP

A2 098006
CORRUGATION AND PITTING OF ROLLING SURFACES-ARE THEY CONTINGENT UPON ULTRASONICS?
This article is an abridged version of essay number 28/1973 held in the Archiv fuer Eisenbahntechnik. Rail corrugations, which were a familiar phenomenon in the 1890's and similar periodic forms of wear occur in other rolling contact combinations. An attempt is made in this paper to explain these manifestations. It is suggested in conclusion that it would appear that troublesome corrugations and perhaps damaging pitting could be avoided if, besides the attenuation of low-frequency oscillations, a means could be found to prevent the agitation and propagation of intensive ultrasonic fields within the area of the running surfaces.

Werner, K *Wear* Vol. 32 No. 2, Apr. 1975, pp 233-248, 18 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

A2 098048
OPTIMUM TRACK: WHAT IS IS, WHAT IT COSTS, WHAT IT SAVES
There is general agreement savings in maintenance costs can be realized by converting poor track into what might be called 'optimum' track. While recognizing that many variables are involved, this article uses a hypothetical case in an attempt to calculate the economics possible through rehabilitation.

Railway Track and Structures Vol. 71 No. 6, June 1975, pp 14-16

ACKNOWLEDGMENT: Railway Track and Structures
PURCHASE FROM: XUM Repr. PC

DOTL JC

A2 098049
OPTIMUM TRACK: THE ELEMENTS AND THEIR ECONOMICS
Each of the elements of optimum track, whether a stable roadbed, clean ballast, sound rail, or some other feature, produces savings compared with a less desirable condition. Purpose of this article to examine the benefits of each of the elements and to state the savings in tangible terms wherever possible.

Railway Track and Structures Vol. 71 No. 6, June 1975, 4 pp

ACKNOWLEDGMENT: Railway Track and Structures
PURCHASE FROM: XUM Repr. PC

DOTL JC

A2 098059
ALLOWABLE LIMIT OF VERTICAL DEFLECTION FOR GIRDER OF SHIN KANSEN
The purpose of this report is to investigate the dynamic property of a car that is running through the deflected track on a bridge girder and to propose the allowable limit for the girder from the view point of riding comfort and running safety. By this invesitgation a tentative limit of deflections are proposed for SHIN KANSEN bridge girder.

Matsuura, A *Railway Technical Research Institute* Vol. 16 No. 1, Mar. 1975, pp 1-5, 13 Fig.

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Ken-yusha 1-45-6, Hikari-cho, Kokubunji, Tokyo, Japan Repr. PC

DOTL JC

A2 098074
EIGHTH REPORT ON THE RAILROAD TECHNOLOGY PROGRAM
This annual report by the Secretary of Transportation serves as an information source for those having a technological interest in FRA's research, development and demonstration activities. It covers not only programs funded by the High Speed Ground Transportation Act of 1965, but also related work performed under appropriations for advancing railroad technology and safety. Sections deal with improved freight service, safety, improved track structures, automated test inspection and test support services, passenger service, supporting technology and facilities, Railroad Research Information Service, advanced technology and High Speed Ground Test Center. The year covered is through September 30, 1974.

Federal Railroad Administration 1974, 87 pp, 66 Fig., 2 App.

PURCHASE FROM: NTIS Repr. PC, Microfiche

PB-247206/AS, DOTL NTIS

A2 098079
THE FRACTURE TOUGHNESS OF CARBON-STEEL, ALLOY-STEEL AND HEAT-TREATED RAILWAY RAILS
The static and dynamic fracture toughness of standard carbon steel rail was determined using precracked Charpy bars. The static, fracture toughness was found to be higher than the dynamic fracture toughness across the entire range of railway operating conditions. Since rails are subjected to dynamic loading conditions, dynamic fracture toughness tests were conducted on specimens from alloy-steel and heat-treated rails in order to compare fracture properties. In addition, the standard British rail steel and two heat-treated grades of British rail steel were evaluated. It was found that carbon levels above 0.55 w/o did not affect fracture toughness while increasing silicon decreased fracture toughness in both high and low carbon rails. In line with earlier work, it was found that decreasing pearlite spacing increased fracture toughness. In addition, the effects of manganese, chromium and molybdenum are discussed.

Stone, DH
Association of American Railroads Technical Center, (R-014) R-163, Sept. 1974, 23 pp, 7 Fig., 1 Ref.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC

DOTL RP

A2 098080
THE EFFECTS OF MICROSTRUCTURAL VARIATIONS ON THE STRENGTH AND TOUGHNESS OF RAIL STEELS
An experimental program was carried out on fully-pearlitic rail steel to determine the effects of microstructural variations on tensile and impact properties. A heat treating schedule was developed to isolate the effects of prior austenitic grain size, pearlite interlamellar spacing, and to a minor extent, pearlite colony size. Grain size was varied by a factor of ten, and pearlite spacing by a factor of two. Room temperature yield strength increased monotonically with decreasing interlameller spacing, with the latter controlled by the transformation temerature and prior austenitic grain size. Charpy impact tests were performed to obtain an evaluation of toughness, and showed that toughness increased with decreasing grain size, and was largely independent of an influence of pearlite spacing. Dynamic fracture toughness values, (KID), obtained from instrumented impact testing of precracked Charpy bars, were compared with the standard Charpy results, and yielded Similar findings. Thus, it was found that strength and toughness are controlled by different microstructural parameters, and can be varied independent of each other to optimize service performance.

Hyzak, JM Bernstein, IM (Carnegie-Mellon University); Stone, DH Association of American Railroads Technical Center, (R-021) R-168, Apr. 1974, 33 pp, Figs., 16 Ref.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

A2 098081
SUMMARY OF PERFORMANCE OF STANDARD-CARBON AND VARIOUS WEAR-RESISTANT RAILS IN TEST CURVES ON THE CHESSIE SYSTEM-SECOND REPORT
This report contains the summary of the second annual inspection of a service test installation of fully heat-treated, induction head-hardened, intermediate- manganese and standard control-cooled rail on the Chessie System. The field inspection is part of the cooperative effort on rail research of the American Railway Engineering Association, the American Iron and Steel Institute and the Association of American Railroads to observe and analyze those rails in curved track that display some potential for improvement in wear-resistance and retarding the onset of shelling. Measurements were made and recorded of curvature, superelevation and gage of four service test curves located near Oakland, Maryland, General track conditions were observed also. Rail head cross-section contours were taken and recorded of the 80 test rails contained in these curves. Rail wear has been calculated for the second year of service for the various types of rail in test.

Schoeneberg, KW
Association of American Railroads Technical Center, (R-057) R-171, Apr. 1975, 70 pp, 25 Fig., 1 Tab.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

A2 098685
ON THE TORSIONAL RIGIDITY OF RAIL FASTENERS IN THE LATERAL PLANE
This paper deals with the resistance of the rail fastener to torsion in the plane of the track, as a factor affecting the stability of the track structure. In addition to a review of the various mathematical models used to simulate the track, this paper also reports on the results of experimental measurements of the torsional rigidity of various types of rail fasteners in use in both the United States and Western Europe, including the type of rail fastener utilized in the construction of the high speed test track at the High Speed Ground Test Center of the Department of Transportation, Federal Railroad Administration, located at Pueblo, Colorado. The results of these tests indicate a scheme for increasing the torsional rigidity of track panels. In conclusion, important considerations for the design and selection of rail fasteners for use on continuously welded rail are described.

McConnell, DP
New York University, Bronx, Federal Railroad Administration Final Rpt. NYU-AM-72-35, Nov. 1972, 35 pp, 12 Fig., 1 Tab., 14 Ref.

ACKNOWLEDGMENT: FRA, NTIS
PURCHASE FROM: NTIS Repr. PC
PB-243624/4ST

A2 098689
SUBGRADE OR BASE OF RAIL ELEVATIONS
File name is ENGR. GRADE: This program is designed to calculate subgrade or base of rail elevations. Given the elevation and engineering station of the point of beginning; stations of the PI's and lengths of vertical curves; and the slopes of the courses, the program will calculate subgrade or base or rail elevations for full stations or full stations plus 50 feet if specified. In addition, output will include calculated stations to all control points along with all pertinent grade data.

Robinson, RE
Atchison, Topeka and Santa Fe Railway 1968

ACKNOWLEDGMENT: AREA (AREA 01-02-001)
PURCHASE FROM: Atchison, Topeka and Santa Fe Railway 9th and Jackson Streets, Information Systems Department, Topeka, Kansas, 66628

A2 098692
TRACK ALIGNMENT
File names are ENAL and ENBL. Program provides complete detail for simple or complex alignments including spiralized or simple curves. Input requirements are: Azimuth and distance between PI's or control points; degree or curve and spiral length when applicable. Output will include Engineering stations for all curves and control points; ordinates and coordinates of all PI's and control points, all curve data i.e., length, delta, semi-tangents, etc., and deflections for spirals and curves. In the event of long curves which must be traversed, the program will calculate direction and distance along the radial line between traverse points and the curve, as well as stationing and deflection angles and POC's as determined. This program was designed as a supplement to ENAL to convert random traverse data, which has control points along a predescribed alignment, into distances and azimuths along the alignment course. It will also provide ordinates and coordinates of all points. Calculating the relationship of triangulation control points to the "preliminary" line in new location work is an example of the function of this program.

Robinson, RE
Atchison, Topeka and Santa Fe Railway 1968

ACKNOWLEDGMENT: AREA (AREA 01-03-001)
PURCHASE FROM: Atchison, Topeka and Santa Fe Railway 9 th and Jackson Streets, Information Systems Department, Topeka, Kansas, 66628

A2 098693
TRACK CHARTS
This computer program plots the track charts. The track charts contain relevant information about track condition such as type and weight of rail, surfacing information, tie installation, ballast cleaning, etc. The various types of information are plotted on the plotter in a form of a bar chart which reflects the location of the bars within the railroad system. The data base is entered through card. It is hoped to file all this information on disk file for other useful purposes.

Glickstein, DL
Penn Central Transportation Company 1971

ACKNOWLEDGMENT: AREA (AREA 01-03-002)
PURCHASE FROM: Penn Central Transportation Company 6 Penn Central Plaza, Philadelphia, Pennsylvania, 19104

A2 098694
CURVE CALCULATOR-MASTER
Program calculates curve data and necessary geometry for staking turnout given the master angle between two diverging tracks, the turnout number, and the degree of curve desired.

Rankins, AD
St Louis - San Francisco Railway Company 1970

ACKNOWLEDGMENT: AREA (AREA 01-03-003)
PURCHASE FROM: St Louis - San Francisco Railway Company 3253 East Trafficway, Springfield, Missouri, 65802

A2 098695
REVERSE CURVE CALCULATOR-REVERS
Program calculates curve data and necessary geometry for staking turnout given the perpendicular distance between two parallel tracks, and the number of turnout and degree of turnout and degree of curve.

Rankins, AD
St Louis - San Francisco Railway Company 1970

ACKNOWLEDGMENT: AREA (AREA 01-03-004)
PURCHASE FROM: St Louis - San Francisco Railway Company 3253 East Trafficway, Springfield, Missouri, 65802

A2 098696
INDUSTRY TRACK ESTIMATING PROGRAM-INDTRK
Program calculates estimated unit costs of various weights of rail used as basis for estimating cost of construction of trackage for serving industries. Unit prices of component parts are stored in the program, and the output is in tabular form for ease of use by engineer making estimate.

Jaeger, BW
St Louis - San Francisco Railway Company Oct. 1971

ACKNOWLEDGMENT: AREA (AREA 01-03-005)
PURCHASE FROM: St Louis - San Francisco Railway Company 3253 East Trafficway, Springfield, Missouri, 65802

A2 098697
RAIL ESTIMATING PROGRAM-RAILES
Program calculates estimated total cost, additions and betterments, and equilization amounts of proposed New Rail and Relay Rail programs using tables of unit prices stored in the program. Input consists of number of miles of track, number of miles of curvemaster rail, weight of rail, number and size of turnouts involved, etc. Output if formatted to provide finished document suitable for attaching to form G-18.

Jaeger, BW
St Louis - San Francisco Railway Company Jan. 1972

ACKNOWLEDGMENT: AREA (AREA 01-03-006)
PURCHASE FROM: St Louis - San Francisco Railway Company 3253 East Trafficway, Springfield, Missouri, 65802

A2 098698
TRACK PROFILES
This program permits computer generation of track profiles using a Calcomp plotter. Accurate milepost location of each track element is required. Unless existing manual records are both accurate and current, new data from the field is necessary. This can be accomplished with a track geometry car or any test car where accurate distance measurement is an output. The program utilizes data in a three-step process. The first is to input the type and milepost location of each track element in the symbol master. The output from this step consists of two reports--a symbol listing in milepost order and the distance between each milepost. Elements include yard track locations, spring switches, railroad crossings, private crossings, three types of public crossings, railroad bridges, rivers, underpasses, overhead bridges, tunnels, hot box detectors, 13 types of train signals. The second step merges the symbol master data from step 1, grade and curve data from the track characteristics master, and milepost locations from the milepost master. Output from this step is a printed listing of each track element in milepost order and a plot tape. The third step uses the plot tape as input to drive a Calcomp plotter and produce the track profile (generally on a paper original). Plot scale is two inches to the mile (5280 feet). Height of the profile is 4 1/2 inches and can be of any length. Plot consists of a milepost line dividing distance between adjacent mileposts into ten equal parts regardless of actual distance, a grade line, a track line showing single track, double track, sidings, spurs, and all track elements and a curve line.

Brooks, BL
Southern Railway System 1973

ACKNOWLEDGMENT: AREA (AREA 01-03-007)
PURCHASE FROM: Southern Railway System 99 Spring Street, SW, Atlanta, Georgia, 30303

A2 098699
TRACK ECCENTRICITIES CALCULATION
The file name is CURVBR. Auxiliary program to compute track eccentricities for various elements of bridge on curve, needed as input data for CARES steel bridge analysis program. Input: Curve radius, span length, back-wall to back-wall distance, panel number and length. Output: Eccentricities of track at middspan and at support and eccentricities for each bridge element.

Granitow, WW
Southern Pacific Transportation Company Mar. 1968

ACKNOWLEDGMENT: AREA (AREA 01-03-008)
PURCHASE FROM: Southern Pacific Transportation Company 1 Market Street, San Francisco, California, 94105

A2 098700
CURVE STUDY
File name is ENCS. Program accepts specific curve characteristics, including curve number; degree; central angle, spiral lengths, boarded speeds and super elevation, which is used to prepare curve record denoting in addition to the input, analysis as to the comparison of boarded speeds against current standards and special message depicting the results of the analysis.

Robinson, RE
Atchison, Topeka and Santa Fe Railway 1968

ACKNOWLEDGMENT: AREA (AREA 01-03-009)
PURCHASE FROM: Atchison, Tokeka and Santa Fe Railway 9th and Jackson Streets, Information Systems Department, Topeka, Kansas, 66628

A2 098701
RAIL FAILURE SYSTEM
File name is ENRF. Computer program. The "Rail Failure" application is designed to compile statistics of all types of rail failures. The system employes two highly regimented input forms entitled "Rail Removal Order" and "Rail Insertion Report" which also serve to cause the appropriate physical action to take place. The system is modular and as such contains over twenty (20) separate programs re: data validity edits, maintenance and print routines which can provide monthly, year-to-date and yearly statistics, e.g.: (a) "Audigage and Reflectoscope; Detector Car; and Service Rail Failure Statement": a three part statement, i.e., a separate report for each potential input source, giving a complete description by Division and District of type of track, location of rail, position, grade, weight, mill, etc. of all failures reported. (b) "Rail Insertion Report Statement Covering Service and Detected Rail Removal Orders"; this statement lists all rail that has had a defect and that has been replaced by a new rail, angle bar repaired or taken out of service. (c) "Annual Report of Rail Failures, Service and Detected, in Rail of All Ages and Sections". (d) "Rail Removal Orders not Covered by Insertion Reports on the Eastern, Western and Coast Lines". Report will flag any removal order over 30 days old for which as insertion report has not been issued. (e) The "Transverse Fissure Rail Heat Statement": This statement provides listing of all transverse fissure heat failures over the system. The statement is written out in mill order and year rolled plus pertinent detail data. (f) The "Thermite and Butt Welded Joint Failure Statement"; This statement lists all thermite and butt welded rail failures by division, district, mile post, type track, weight or rail, mill and year rolled. Each report is year to date.

Robinson, RE
Atchison, Topeka and Santa Fe Railway 1972

ACKNOWLEDGMENT: AREA (AREA 02-01-001)
PURCHASE FROM: Atchison, Topeka and Santa Fe Railway 9th and Jackson Streets, Information Systems Department, Topeka, Kansas, 66628

A2 098702
RAIL STRESS CALCULATIONS-UNIT LOAD OF 1 KIP
For given rail sections, the program produces a table of rail stresses by inches from the load point up to 300 inches, for a unit load of 1 Kip. The stress values are shown for various values of the modulus of foundation, ranging from 400 to 3,000 lb/in.

Holt, RW
Canadian Pacific 1974

ACKNOWLEDGMENT: AREA (AREA 02-01-002)
PURCHASE FROM: Canadian Pacific Windsor Station, Montreal, Quebec H3C 3E4, Canada

A2 098703
RAIL STRESS CALCULATIONS FOR MULTIPLE LOADS
For a given set of rail sections, the program calculates stress values for given load configurations. For each loading, the rail stress is calculated under each axle and at the mid-point between axles. Also, for each rail section, the program calculates maximum equipment operating speeds within a stress safety limit of 35 Kips (30 Kips for C.W.R.) using maximum tension value found on the rail base.

Holt, RW
Canadian Pacific 1972

ACKNOWLEDGMENT: AREA (AREA 02-01-003)
PURCHASE FROM: Canadian Pacific Windsor Station, Montreal, Quebec H3C 3E4, Canada

A2 098704
ALLOWABLE GROSS LOADS ON VARIOUS RAIL SECTIONS
File name is RAILSTR. Computer Program. Application: Used as a one-time guide for determining the maximum allowable loading on various rail sections. Contains many assumptions and some "retrofit" based on actual loadings previously known to have been carried. This program computes the maximum allowable total gross weight for any type rail

equipment with identical axle loads on 15 different rail sections. The theory and formulas are based on the rail acting as a continuous beam on a continuous elastic base (AREA proceedings of 1918, Vol. 19, pages 875-1058). Two moduli of elasticity of rail support are assumed for each rail section, one for "good roadbed and one for "poor" roadbed. Input consists of all information required about the axle configuration of the equipment being considered. Output includes documentation of the input, a listing of each rail weight and the assumed impact for each, and the allowable gross weight for good and poor roadbed for each rail section. This program makes many assumptions having to do with roadbed, impact, and unit stresses which may or may not be justified.

Alford, HT
Southern Railway System Apr. 1970

ACKNOWLEDGMENT: AREA (AREA 02-01-004)
PURCHASE FROM: Southern Railway System 99 Spring Street, SW, Atlanta, Georgia, 30303

A2 098705
RAIL AND TRACK CHARACTERISTICS PICKER PROGRAM
File name is Track Characteristics Master, Rail Defect Master, Derailment Master. Computer Program. The purpose of the rail and track characteristics picker program is to provide the information with which to develop the relationships between various rail and track characteristics and their correlation with rail failures, rail defects, and derailment frequency. The Track Characteristics Master contains rail type (jointed versus welded, kind of steel) weight, rail rolled and laid dates, history of surfacing dates, rail and track inspection and test data, grades, curves, load limits, and traffic density (tons per year) for all system track. Locations of rail failures, rail defects, and exceptions to track geometry standards found by testing and inspection are contained in the rail defect master. The derailment master contains pertinent data on all derailments. The rail and track characteristics picker program selects and prints out track locations from the track characteristics master with user-defined selection criteria; these can be minimums and/or maximum for any combination of the characteristics listed above. Up to 50 different combinations, i.e., cells in a matrix can be requested at one time. For each cell or specific request, the number of miles of track and the number of ton-miles is printed out. In addition for each cell, the progrm gives the types and numbers of rail defects and derailments reported over a time period selected by the user. Once relationships have been established, the program can be used for developing rail laying and timbering and surfacing programs, anchor and double spiking programs, problem area identification, budgeting, and other applications.

Brooks, BL
Southern Railway System 1974

ACKNOWLEDGMENT: AREA (AREA 02-01-005)
PURCHASE FROM: Southern Railway System 99 Spring Street, SW, Atlanta, Georgia, 30303

A2 098706
RAIL CONSIST AND HISTORY
File name is EN980930. Computer reporting program of all pertinent information on main line and branch track of Union Pacific Railroad. This track information can be reported to one one-hundredth of a mile accuracy for main line and branch track. The output shows milepost from, milepost to, track miles involved, degrees of curve, weight of rail, what company rolled the steel and type of treatment of the steel, the length of the rail in either 39 feet, 78 feet, or CWR, the year laid, work order number, if the steel was transposed, cropped, welded, or ground the size of the plates and year installed, million gross tons, of traffic over given segments of rail, passenger and freight speed allowable, and failures reported for the last two years broken done into three classes fo failure, then combined to show defects per mile per month. This Consist and History program evolves from four other basic programs plus a failed rail master. The four programs used to generate Consist and History are a tonnage master (EN9601), the description table (EN9602), an initial track master file (EN9603), and a revolving track master file (EN9805). EN9601 is a program which generates a tonnage table and a tonnage code. The railroad is broken down into segments depending on the million gross ton miles per year run over those segments. This program is fed into the initial track master file, EN9805, for a basis to calculate the million gross ton miles in the Consist and History report. The tonnage table for a given section of track has been calculated from our Way Bills to insure accuracy. EN9602 is a program which generates heading information for given sections of track (e.g. direction, and milepost limits). Also, it generates a cost center description so that the final report can be produced either by cost center or divisions. This program also genrates an order number, which we have assigned to help us segregate different parts of track. EN9601 and EN9602 are combined into EN9603 which begins to set up the initial master file. EN9603 at this time inputs all of the curve information of the railroad. EN9805 then adds the actual track relay information into the program.

Zednik, EV Jenkins, JW
Union Pacific Railroad Mar. 1970

ACKNOWLEDGMENT: AREA (AREA 02-01-006)
PURCHASE FROM: Union Pacific Railroad 1416 Dodge Street, Omaha, Nebraska, 68102

A2 098707
FAILED RAIL REPORT
File name is EN470230. Computer program compiles all of statistics for failed rails and their locations. This program is used in conjunction with EN9809 to produce the defects per mile per month in the Consist and History report. There are also three programs assigned with this program, EN8801, EN8802, and EN8803, what mill and date rolled and date laid, and the third, what means the defect was found.

Zednik, EV Jenkins, JW
Union Pacific Railroad Mar. 1970

ACKNOWLEDGMENT: AREA (AREA 02-01-007)
PURCHASE FROM: Union Pacific Railroad 1416 Dodge Street, Omaha, Nebraska, 68102

A2 098710
COMPUTE RAIL STRESSES
File name is RAILST. Computer program. Computer Rail Stresses for non-standard and in various road bed conditions. Input: Rail Wt. moment of inertia, Section Modulus, Foundation Modulus, No. of Units (LOCO or CAR), Class of LOCO, Series number, Length, Axle Load, spacing. Output: Stress in base of rail, Section for various speeds.

Luttrell, NW
Southern Pacific Transportation Company 1969

ACKNOWLEDGMENT: AREA (AREA 02-01-010)
PURCHASE FROM: Southern Pacific Transportation Company 1 Market Street, San Francisco, California, 94105

A2 098730
CURVE OFFSETS FOR TIES ON BRIDGE DECKS
File name is OFFSET. Computer Program. Application: Used as required for detailing all bridge decks on sharp curves. This program computes offsets from a chord to a circular curve for every tie on a bridge on a curve. This has application on severe curves where it may be necessary for certain tie details to follow the centerline of the track and for other details to follow the centerline of the span or offset chord. Input includes bridge identification, degree of curve, superelevation, and spacing of each tie on the bridge. Output includes documentation of the input, computed span length from the tie spacings, maximum midordinate offset for the span length, cumulative distance to each tie, offsets from curve to long chord for each tie, offsets from curve to offset chord tangent to curve at centerline of span for each tie, and tie depth correction for each tie due to curve running up and down bevel of tie.

Alford, HT
Southern Railway System Nov. 1972

ACKNOWLEDGMENT: AREA (AREA 08-10-005)
PURCHASE FROM: Southern Railway System 99 Spring Street, SW, Atlanta, Georgia, 30303

A2 098731
CURVE SPIRAL ON A BRIDGE DECK
File name is SPIRAL. Computer Program. Application: Used during the detailing of all bridge decks on spirals. This program computes bevel dimensions for bridge ties on the spiral of a curve. Input includes bridge

identification, tie length, bevel length, spacing of each tie on the bridge, location of the beginning and ending of the spiral on the bridge, and amount of the superelevation at the beginning and ending of the bridge. Output includes documentation of the input, cumulative distance to each tie, superelevation of each tie, total bevel of each tie, and amount of bevel from low end of tie to low rail.

Alford, HT
Southern Railway System Apr. 1971

ACKNOWLEDGMENT: AREA (AREA 08-10-006)
PURCHASE FROM: Southern Railway System 99 Spring Street, SW, Atlanta, Georgia, 30303

A2 098766
GEOMETRIC PROGRAM SOLVER
The file name is CNTRL, REPLY. This Computer Program is composed of various geometric solving routines with particular emphasis on railroad applications. It consists of two parts. 1. CNTRL-which generates file points for surveying problems through the use of routines that solve basic functions such as intersection of lines, tangents, offsets, etc. 2. REPLY-is geared to solving special railroad applications such as, traverse, reverse curves, perimeters, alignment and other problems. The two parts were designed to complement each other and shear the same output file.

Eimer, N
Penn Central Transportation Company 1971

ACKNOWLEDGMENT: AREA (AREA 10-03-001)
PURCHASE FROM: Penn Central Transportation Company 6 Penn Central Plaza, Philadelphia, Pennsylvania, 19104

A2 098769
PRODUCTION GANG
The file name is MWI. This computer program monitors the gang production on a weelky basis. Information is gathered at the division level and includes locations of work, track, number, time worked delays, transportation, production weekly and accumulates relevant information. Accumulative report is generated for any given period and total production, delays, etc. is recorded. In addition the program projects future production by each gang based on its production case history.

Glickstein, DL
Penn Central Transportation Company 1968

ACKNOWLEDGMENT: AREA (AREA 10-05-001)
PURCHASE FROM: Penn Central Transportation Company 6 Penn Central Plaza, Philadelphia, Pennsylvania, 19104

A2 099180
TRACK TRAIN DYNAMICS INTERACTION. SECOND CONFERENCE, VOLUME 2
These proceedings record the accomplishments of Phase I of the International Government-Industry Research Program on Track Train Dynamics by December 1974. The papers in this volume; Locomotive Tests and Model; Locomotive Curving and Hunting Models; Truck Component Characterization; Roller Bearing Characterization; Freight Car System Tests; Introduction to Truck Hunting, Curving and Ride Quality Problems; Truck-Carbody Model; Rock and Roll Report; Methodology for Car Characterization Via Simplified Mathematic Models; Mathematical Model; Characterizing Alignment Control; Lateral Stability Tests; Quasi-Static Lateral Train Stability Model; Introduction to L/V; L/V Testing; L/V Model; Vertical Train Stability Efforts; An Investigation of Factors Contributing to Wide Gage on Tangent Railroad Track; Application of Models to Investigate Operating and Component Parameters; Canadian Research Activities in Connections with Track-Train Dynamics; Introduction to Phase II.

Proceedings of an International Government-Industry Research Program on Train-Track Dynamics conference held at Chicago, Illinois, 4-6 December 1974. The cost of the 2 volumes is $20.00.

Association of American Railroads Technical Center 1975, 450 pp

PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616

DOTL RP

A2 099201
"ENGINEERED" TRACK-PART TWO: BALLAST STABILITY AND PROLONGED RAIL LIFE
This is the second, and final article on the design of modern track. The article discusses the identification of qualities lending high stability to ballast, the role of ties in transmitting loads and holding gauge, and the factors tending to produce rail failure.

See also RRIS 01 095233, RRIS Bulletin 7502.

Progressive Railroading Vol. 18 No. 4, Apr. 1975, pp 49-52

ACKNOWLEDGMENT: CNR
PURCHASE FROM: Murphy-Richter Publishing Company 9 South Clinton Street, Chicago, Illinois, 60606 Repr. PC

DOTL JC

A2 099767
EXTENSIVE RESEARCH INTO THE NEW TRACK STRUCTURE WITH LS FASTENINGS [Der Grossversuch mit dem neuen Oberbau Ls]
On the DB network, extensive research with the new Ls fastening (set sole plates, sleeper screws and SKL1 tightening spike) has been carried out regularly as shown in Tables 1 and 2 during track laying in the second half of 1974. Experience has shown that it would be better to use nut-headed sleeper screws instead of normal screws. Despite the somewhat high cost involved, the overall result (assembly, laying, maintenance, annual costs) for the new rail fastening with nut headed sleeper screws could work out to be more economical. To reach a final conclusion on the use of the new sleeper screw, further extensive research should be carried out next year (1975). [German]

Kahn, F *Die Holzschwelle* Vol. 69 No. 78, Dec. 1974, pp 29-39, 4 Fig., 2 Tab., 5 Ref.

PURCHASE FROM: Studiengesellschaft fuer Holzschwellenoberbau e.V. Waldstrasse 11, 53 Bonn-Ippendorf, West Germany Repr. PC

A2 099789
A RAIL INVENTORY OF THE NORTHEAST AND MIDWEST UNITED STATES
Bechtel Incorporated's primary role in the survey of rail facilities under the Regional Rail Reorganization Act of 1973 was that of technical direction contractor. Using input from the United States Railroad Association and five other associate contractors, Bechtel established administrative and procedural guidelines to assure consistency in work performed and to rationalize the data gathered. The result was a quantitative and qualitative inventory and assessment of the rail facilities to determine condition, identify required rehabilitation work and materials and estimate the cost of rehabilitation. In the inventory was trackwork, yards, shops, bridges, tunnels, buildings, terminals, signals, communications, servicing facilities and motive power.

Bechtel Briefs Vol. 30 No. 6, July 1975, 2 pp, 2 Phot.

PURCHASE FROM: Bechtel Corporation P.O. Box 3965, San Francisco, California, 94119 Repr. PC

A2 099797
TIE DEMAND NOSEDIVES FOLLOWING LAST YEAR'S SURGE
This report on a meeting sponsored jointly by the Transportation Materials Management Forum and Railway Progress Institute described the upturn of the wooden cross tie market in 1974, then its collapse in 1975 as producers had succeeded in raising production. To assure that needed ties will be produced in coming years, it was agreed that it is necessary to have a stability in tie production. Railroad managements were said to overreact to fluctuations in business at both ends of the business cycle--first ordering more than can be produced or used, and then eliminating virtually all such purchases with a downturn of almost any magnitude.

Railway Age Vol. 176 No. 9, May 1975, pp 34-35

PURCHASE FROM: XUM Repr. PC

DOTL JC

A2 099799
P&LE UPGRADES CROSSING PROTECTION
In the course of installing welded rail, the Pittsburg & Lake Erie was confronted with eight grade crossings in a 1 1/2-mile stretch. The goal was to produce a safe system that would not unduely delay vehicular traffic. Audiofrequency overlays of the conventional type would have been extremely complicated. The solution was installation of electronic movement detection through measurement of rail impedance changes. Several frequencies are overlapped for some distance beyond the crossings.

Progressive Railroading Vol. 18 No. 8, Aug. 1975, pp 43-44, 3 Phot.

PURCHASE FROM: Murphy-Richter Publishing Company 9 South Clinton Street, Chicago, Illinois, 60606 Repr. PC
DOTL JC

A2 099802
CNR COURSE FOR ROADMASTERS INCLUDES "MODULE" ON MARKING TIES
Increased need for training track supervisors is met by establishing schools that are based on 23 instruction modules which include one on the identification of failed ties.

Railway Track and Structures Vol. 71 No. 7, July 1975, pp 14-15

PURCHASE FROM: XUM Repr. PC
DOTL JC

A2 099803
ICG FAVORS CORED-WIRE ELECTRODE FOR RAIL AND FROG MAINTENANCE
Small-diameter wire is said to avoid high heat input and subsequent underbead cracking. Automatic feeder is claimed to permit unskilled welder to weld continuously and to perform satisfactory work. The backlog of deferred frog maintenance was cleared up in three years because of the new equipment.

Railway Track and Structures Vol. 71 No. 7, July 1975, pp 18-19, 2 Phot.

PURCHASE FROM: XUM Repr. PC
DOTL JC

A2 099806
A RAILROADER'S BAD DAY AT BLACK MESA
The coal-hauling Black Mesa and Lake Powell Railroad has encountered numerous technical problems as it has attempted to move to the level of operations for which it was designed. Problems with the automatic control system, the concrete ties, the crushed river rock ballast, and with wheel and rail wear are all combining to force a complete redirection of the operation. It is estimated that up to $10 million could be required for the locomotives, cars and track changes to permit the level of train operations that will properly fuel the generating station for which the new electric railroad was built. The 78-mile railroad opened in 1974 is due for a major redesign.

Business Week Aug. 1975, pp 69-70

PURCHASE FROM: McGraw-Hill, Incorporated 1221 Avenue of the Americas, New York, New York, 10020 Repr. PC
DOTL JC

A2 099811
ECONOMIC IMPACT OF TRIBOLOGY
Friction and wear-caused mechanical failures and maintenance normally have their roots in phenomena based on tribology, the science and technology of interacting surfaces in relative motion. Developments in tribology since the publication of the "Jost Report" have utilized existing and new knowledge from physics, chemistry, mathematics, statistics, engineering, etc. As a result, advances in diverse fields, from metalworking to medicine or space technology, have been produced. The economic benefits that may accrue to industry can be substantial; in the case of the U.S. the savings obtainable through tribology could amount to as much as $16 billion per annum. Some of the means used in the United Kingdom in order to reap the benefits attainable by application of the principles of the multi-disciplinary subject of tribology, and some of the results obtained, are described.

Jost, HP (Angel Lodge Laboratories) *ASME Journal of Mechanical Engineering* Vol. 97 No. 8, Aug. 1975, pp 26-33

ACKNOWLEDGMENT: ASME Journal of Mechanical Engineering
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

A2 099817
DESIGN OF A HIGH QUALITY INFRASTRUCTURE SYSTEM REQUIRING MINIMUM MAINTENANCE, EVEN UNDER CONDITIONS OF HIGH SPEEDS AND HEAVY LOADS
The paper is intended to demonstrate the limits of certain basic criteria generally accepted for the design and construction of a railway network, and to indicate some of the aspects from which it is possible to envisage the development of research relating to the following factors: infrastructure, alignment, engineering structures, together with the economic aspects of these elements.

Oliveros, F *Rail International* No. 6, June 1975, pp 475-487, 4 Fig., 15 Ref.

ACKNOWLEDGMENT: Rail International
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

A2 099820
STRUCTURAL DESIGN CRITERIA FOR THE NEW LINES OF THE GERMAN FEDERAL RAILWAY CONFORMING TO THE OBJECTIVES OF THE EUROPEAN INFRASTRUCTURE MASTER PLAN
In 1971, the European railway administrations cooperating under the auspices of the UIC decided to initiate investigations into the possiblities of improving the European railway network on the basis of uniform standards on an international scale. The Planning Committee was asked to prepare a corresponding plan. The first result of this effort has been the draft of a "European Infrastructure Master Plan--First Preparatory Stage" which was submitted to the UIC Management Committee in the summer of 1973 and unanimously adopted by it. Meanwhile, in the autumn of 1973, this plan was published and submitted to the Governments in the East and West so that the political objectives may also be included. The Master Plan is based on the recognition on the part of the European railway administrations that they are confronted with broadly the same problems. The railway network must be adapted to the economic and technical development which has occurred during the 20th century. Although the present financial situation of the German Federal Railway cannot be regarded as rosy, the construction of the new lines is essential to its improvement and therefore also to the future of the German Federal Railway. This assessment is also reflected in the thirteen objectives indicated by the Federal Minister of Transport to the Board of Management of the German Federal Railway at the end of 1974.

Zeuge, H *Rail International* No. 5, May 1975, pp 371-396, 19 Fig., Refs.

ACKNOWLEDGMENT: Rail International
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

A2 099834
POLYETHYLENE TIE PLATES GAINING ACCEPTANCE
After six years of field testing, high density polyethylene tie plates are gaining acceptance from an increasing number of railroads for use on industrial and branchline track. Further evaluations are now being made of the plates possible use on heavy-load, high-speed mainlines. The tie plates were developed by Koppers Company, leading suppliers of creosoted ties, as part of a continuing program to extend tie life. The injection molded plate weighs up to 1 1/2 pounds.

Progressive Railroading Vol. 18 No. 7, July 1975, pp 39-40, 2 Phot.

PURCHASE FROM: Murphy-Richter Publishing Company 9 South Clinton Street, Chicago, Illinois, 60606 Repr. PC
DOTL JC

A2 125801
ANNUAL BOOK OF ASTM STANDARDS, 1975--PART 4, STRUCTURAL STEEL; CONCRETE REINFORCING STEEL; PRESSURE VESSEL PLATE AND FORGINGS; STEEL RAILS, WHEELS, AND TIRES
This volume contains the specifications for structural steel; steel for concrete reinforcement and prestressed concrete; steel plate, forgings and rivets for boilers and pressure vessels; steel rails and accessories, wheels, axles and tires. A metric practices guide is included.

American Society for Testing and Materials Apr. 1975, 720 pp
ACKNOWLEDGMENT: EI
PURCHASE FROM: American Society for Testing and Materials 1916 Race Street, Philadelphia, Pennsylvania, 19103 Repr. PC

01-004075-02

A2 125806
RAILROAD TRACKS FOR HIGH-SPEED TRAINS [Eisenbahnoberbau fuer Schnellverkehrsstrecken]
Design criteria for railroad beds and structures to support heavy loads and high-speed trains are discussed. Specially designed fish plates with bolts that employ springs for holding rails are described. [German]

Eisenmann, J (Technical University of Munich, West Germany) *Verein Deutscher Ingenieure Zeitschrift* Vol. 17 No. 17, Apr. 1975, pp 335-341, 20 Ref.

PURCHASE FROM: ESL Repr. PC, Microfilm

A2 125807
TECHNOLOGICAL RESEARCH AND DEVELOPMENT IN RAILROAD TRANSPORTATION [Technologische Forschung und Entwicklung-Transport und Verkehr]
The volume contains papers and discussions dealing with research results on railroad cars and trucks. Investigation results on test vehicles, interaction on wheel/rail system, suspension and other railroad car elements are reported and evaluated. [German]
This study appeared in report #T74-42, December 1974.

Ministry for the Advance of Material & Process Eng Dec. 1974, 271 pp, 18 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

A2 125854
A COMPUTER PROGRAM TO OPTIMISE CURVE ALIGNMENT
Where physical restraints are imposed by structures, manual calculation of optimum curve alignment can be a lengthy process; a newly-developed computer program introduced by British Rail does the job quickly and more effectively.

Ellis, JA *Railway Gazette International* Vol. 131 No. 3, Mar. 1975, pp 102-104

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

A2 125864
THE USE OF SIMULATION TO DETERMINE THE CAPACITY OF SINGLE-TRACK RAILWAY LINES
The assessment of various upgrading alternatives is presented here in terms of the capacity of the line. Several definitions of single-track line capacity are given; the capacity definition based on weighted delay computations and differentiated by train class is shown to be a promising approach. However, more research is needed into the ways of determining the weighting factors and delay costs of various classes of trains.

Walker, AEG Jones, JCM *Transport Economics and Operational Analysis* No. 1, Mar. 1975, pp 1-13

ACKNOWLEDGMENT: British Railways

A2 125869
PREVENTION AND CURE OF RAIL CORRUGATION
The author has discovered that corrugation is a function of track modulus and wheel loading. There is a critical range of shear and compressive stress within which rail corrugation takes places but below or above this range the phenomenon is absent, possibly because wear particles are either not generated or they are removed altogether. Not only will correct matching of track modulus, to axleloads carried avoid generation, but elimination of a mismatch will also cause existing corrugation to disappear without the need for grinding.

Srinivasan, M *Railway Gazette International* Vol. 131 No. 3, Mar. 1975, pp 97-101

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

A2 125870
FACTORS INFLUENCING THE STABILITY OF SOIL SLOPES
The knowledge of factors influencing the stability should be regarded as a prerequisite for expert estimate of stability of soil slopes and of causes of damages done to them. The ten most important influences are briefly discussed and their mode of operation and interdependencies are given in table form. [German]

Schmidt, M *DET Eisenbahntechnik* Vol. 23 No. 2, Feb. 1975, pp 80-84

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: VEB Verlag Technik Oranienburgerstrasse 13-14, 102 Berlin, East Germany Repr. PC

A2 125894
RAILWAY TRACK RESEARCH--THEORETICAL AND EXPERIMENTAL
Presents theoretical approach for determining stresses that result from vertical and lateral bending of track and stresses that act in the vicinity of the contact area between wheel and rail. The influence of thermal and residual stresses on track behavior is discussed and the dynamic deflections and stress resulting from the action of moving wheels and track irregularities are considered. The occurrence of track failure is analyzed on the basis of failure criteria and fatigue theories.

Hanna, AN
Portland Cement Association Bulletin RD030.01R, 1975, 15 pp, 30 Fig., 24 Ref.

ACKNOWLEDGMENT: Portland Cement Association
PURCHASE FROM: Portland Cement Association Old Orchard Road, Skokie, Illinois, 60076 Repr. PC

DOTL RP

A2 126400
DEMANDS ON RAIL TRAVELING ALUMINUM TRAINS FROM THE VIEWPOINT OF THE TRAFFIC DEPARTMENT [Forderungen an Aluminium-schienenfahrzeuge aus der Sicht des Verkehrsbetriebes]
Large scale use of aluminum trains contributes to a reduction of energy consumption and of wear of the track. Consideration of the economics of using aluminum trains leads to suggestions for reducing costs by changes in design and methods of production. Some of the cars of the German Federal Railway now in service are discussed. [German]

Rappenglueck, W *Aluminum* Vol. 51 No. 4, Apr. 1975, pp 277-280

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

A2 126443
ISOLATED MINING LINE HAS 'BIG' RAILROAD FEATURES
A molybdenum mining project in Colorado has involved building of a 14.4-mile double-track automated narrow gauge ore-hauling railroad which includes a 9.6-mile tunnel under the continental divide, third-longest railroad tunnel in the world. Six electrically operated unit trains will shuttle between mine and ore processing plant. Laser beam guidance controlled tunnel construction. The welded rails are laid on wood cross ties on the surface and on a concrete slab in the tunnel. Three piece rubber fasteners are used for securing the rails to the slab.

Railway Track and Structures Vol. 71 No. 9, Sept. 1975, pp 18-20, 5 Phot.

PURCHASE FROM: XUM Repr. PC

DOTL JC

A2 126444
CNR SETS POLICY ON USE OF CONCRETE TIES
Canadian National policy, at least for the next five years, calls for use of large numbers of concrete ties in curves, in existing main track in high-density, heavy- traffic territory. On curves of 4 degrees or more, these ties will permit rail to be transposed simply by removing and replacing the rail fastening clips. Wood tie life under heavy traffic has been shortened with gauge widening and rail overturning developing. Concrete tie used by CN

conforms to British design, Type 23, but has more prestressing wires than the type which is standard on British railways.

Railway Track and Structures Vol. 71 No. 9, Sept. 1975, pp 21-23, 7 Phot.

PURCHASE FROM: XUM Repr. PC

DOTL JC

A2 126445
BLUEPRINT FOR TRACK REHABILITATION?
The Iowa Department of Transportation has been authorized by the legislature, concerned about track conditions in the state, to take several steps. A program of rehabilitation of branch lines has seen work started on ten segments involving expenditure of $8.7 million. Condition of all trackage in the state is to be monitored annually by a new track-measuring car. Development of a numerical "sufficiency rating" for all trackage in the state will rate ability of the lines to perform in accordance with accepted standards. Steps will be taken to assure sufficient supplies of materials and machines and enough manpower to meet any crash program of railroad rehabilitation which might be initiated at the federal level. So far state, local and railroad funding is involved.

Railway Track and Structures Vol. 71 No. 9, Sept. 1975, pp 14-17, 1 Tab., 2 Phot.

PURCHASE FROM: XUM Repr. PC

DOTL JC

A2 126446
FOR THOSE BRANCH-LINE BLUES--HELPFUL IDEAS AND POINTERS FROM A 49-YEAR VETERAN
Feeder and branch line tracks with medium rail and poor ballast can be sustained in operating condition with a minimum expenditure of money and manpower. This article discusses the temporary tamping, use of wing ties, importance of hardpan under ties and proper drainage which can maintain marginal track in safe operating condition.

Blanchard, LC *Railway Track and Structures* Vol. 71 No. 9, Sept. 1975, pp 24-25, 1 Phot.

PURCHASE FROM: XUM Repr. PC

DOTL JC

A2 126447
NEW ENGINEERING SETUP EMPHASIZES DIVISIONAL AUTONOMY
Chessie System has reorganized its maintenance of way organization so that system officers coordinate major maintenance activities, construction projects and rail laying, but regional and division offices have primary responsibility for directing and coordinating field forces and for efficient utilization of available resources. Each division has a staff constituted to make it self-sufficient in initiating and carrying out all construction and maintenance work on the division. Major projects are handled either at system or regional level.

Railway Track and Structures Vol. 71 No. 9, Sept. 1975, pp 28-30

PURCHASE FROM: XUM Repr. PC

DOTL JC

A2 126450
CONTROLLING TRACK SETTLEMENT AS AN INTEGRATED OPERATION OF THE LINING AND TAMPING-CYCLE
Despite consolidation of track, an immediate gradual settlement takes place once the line is opened to traffic. To minimize this, Plasser & Theurer's dynamic stabilizing group can make a substantial contribution when operated in conjunction with the lining and tamping machine to which it is coupled.

Rail Engineering International Vol. 5 No. 4, June 1975, pp 165-166, 3 Fig., 2 Phot.

PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

A2 126451
SOME PROBLEMS OF RAILWAY OPERATION AT HIGH AXLELOADS
Long high-axle-load trains create cracking, shelling, crushing and corrugation of the rail head while weight transfer further accentuates the situation. "Worn" tire profiles can reduce contact pressure by 30 percent, but excess cant will increase crushing on the inner rail and axle-loading must be considered in relation to rail steel quality in the track. Three-axle locomotive power trucks set up higher lateral forces than two-axle types. Locomotive and car suspension characteristics must be considered in three planes.

Koffman, JL Fairweather, DMS *Rail Engineering International* Vol. 5 No. 4, June 1975, pp 156-161, 10 Fig., 18 Ref.

PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

A2 126970
STRESS OF THE SUBGRADE BY DIFFERENT TYPES OF SLEEPERS
The stress of the subgrade by prestressed-concrete sleepers BS 65 and BS 66 mainly used by the German Railways is different. Early measurements obtained with tests of the prestressed-concrete sleeper BS 72 showed that subgrade stresses are lower than for BS 62, BS 65 and for the timber sleeper, and are of the order of the values calculated. However, for a statistically safe statement the number of measurements is still insufficient. Therefore trials will be made in tests sections to obtain early results. [German]

Just, H Schmidt, E *DET Eisenbahntechnik* Vol. 23 No. 7, July 1975, pp 298-302

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: VEB Verlag Technik Oranienburgerstrasse 13-14, 102 Berlin, East Germany Repr. PC

A2 126996
CONSTRUCTION OF BALLASTLESS TRACK ON SLABS FOR HIGH SPEEDS ON THE CSD [Konstruckce zelezniciho svrsku s deskami pro vysoke rychlosti v podminkach CSSR]
This construction method is extremely important, given the geographical situation of the country and transport development prospects in Czechoslovakia. The CSD are working on a 300 km/h electric locomotive. The author discusses 5 versions of the superstructure involved. [Czech]

Petrtyl, M Balihar, J *Zeleznicni Technika* Vol. 4 No. 4, 1974, pp 235-238, 4 Fig.

ACKNOWLEDGMENT: International Railway Documentation, Selection of
PURCHASE FROM: Zeleznicni Technika Prague, Czechoslovakia Repr. PC

A2 126998
SUPERELEVATION RAMPS AND DESIGN CONSIDERATIONS [Gestaltung der Ueberhoehungsrampen]
The author describes and compares various types of superelevation ramp design from the point of view of vehicle running dynamics and track construction. He concludes that the optimal solution is the "S" shaped ramp formed by 2-second degree parabolas and in use for some 40 years now. [German]

Schramm, G *Eisenbahningenieur* Vol. 26 No. 3, Mar. 1975, pp 95-104, 5 Fig.

ACKNOWLEDGMENT: International Railway Documentation, Selection of
PURCHASE FROM: Dr Arthur Tetzlaff-Verlag Niddastrasse 64, Frankfurt am Main, West Germany Repr. PC

A2 127007
THE DB'S OPTICAL WARNING SYSTEM FOR PERMANENT WAY MAINTENANCE GANGS [Die optische Rottenwarnanlage der DB]
The use of audible warning signals to gangs working on the line causes much disturbance for people living near the railway, especially at night. The DB has tried to replace audible warnings by optical signals for work on the permanent way at night. The principle is that at the arrival of the train, the lighting intensity at the worksite is varied according to the two frequencies used by the DB to show the track on which the train is arriving. On engines

with autonomous lighting, electronic flash-devices are used to warn the gangs. Finally, the author stresses that the present warning system depending on a look-out man, as used by the DB, is unsatisfactory from the safety point of view. Only automatically operated equipment could meet safety requirements. Moreover, this optical warning device saves manpower, as the look-out man is not required. [German]

Koerber, H *Eisenbahningenieur* Vol. 26 No. 3, Mar. 1975, pp 89-90, 3 Fig.

ACKNOWLEDGMENT: International Railway Documentation, Selection of
PURCHASE FROM: Dr Arthur Tetzlaff-Verlag Niddastrasse 64, Frankfurt am Main, West Germany Repr. PC

A2 127349
BALLASTLESS TURNOUT TRACK WITH ELASTOMER
To develop maintenance-free turnouts, a study of fastening systems and materials was undertaken. With polyurethane elastomer vulcanized at room temperature, turnouts without ballast can be easily and firmly secured on a concrete base without embedding of ties. Such a track structure and the newly developed elastomeric packing methods have been utilized also for another track installation.

Shimizu, K Kakegawa, H *Railway Technical Research Institute* Vol. 16 No. 2, June 1975, pp 60-63, 5 Fig.

PURCHASE FROM: Ken-yusha 1-45-6, Hikari-cho, Kokubunji, Tokyo, Japan Repr. PC

A2 127389
THE QUADRUPLING OF THE ROME-FLORENCE LINE
In 1970 the FS undertook the construction of a new line about 260 km in length, for the quadrupling of the Rome-Florence link. After explaining the reasons and aims of this project, this paper will illustrate the criteria adopted for the infrastructure construction project, with a view to procuring the greatest capacity from the quadrupling, by mixed operation capable of development for specialization of the new track alignment for very high speeds. An outline is also given of the technical features and methodology adopted for the building of tunnels, viaducts and embankments, including details of the development of the work and the cost comparison factors.

Ruoppolo, G *Rail International* No. 7, July 1975, pp 565-580, 7 Fig., 5 Tab.

ACKNOWLEDGMENT: Rail International
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

A2 127620
COMPUTER APPLICATIONS IN CIVIL ENGINEERING DESIGN AND MAINTENANCE--WESTERN AUSTRALIAN GOVERNMENT RAILWAYS
The use of computers in the Western Australian Government Railways dates back to 1966 when an IBM 360/30 computer was installed. In the next five years the computer was used for nonscientific work including data processing. The Civil Engineering Branch made use of these techniques for financial control of large projects. Since early 1973 both scientific and nonscientific programs have been processed and some progress has been made toward the use of minicomputers for data capture and toward the use of terminals for on-line calculations. Programs to solve the following problems have now reached the production stage: realignment of compound curves; structural analysis; waterway design; earthworks & surveying; estimating; rail wear monitoring; and metrication records.

Presented at the Conference on Computers in Engineering, Sydney, May 16-17, 1974 and contained in Nal't Conference Publication No. 74/1.

Sutton-Mattlocks, KD (West Australian Government Railways)
Institute of Engineering Proc Paper 1974, pp 168-172

ACKNOWLEDGMENT: EI
PURCHASE FROM: Institute of Engineering Sydney, Australia Repr. PC

A2 127701
ALUMINO-THERMIC WELDING OF RAILS
Because of the improvements in alumino-thermic welding of rails in the past 15 years, it is important that a process be studied in relation to details such as economy, speed, ease of execution and assurance of the metallurgical quality of the assembly. Four processes are described, along with their advantages: Type C, Type C-2, Type C-A; and Type C-B.

Boutet, C *Rail International* No. 9-10, Sept. 1975, pp 801-804, 4 Fig.

ACKNOWLEDGMENT: Rail International
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

A2 127709
TRACK TESTING FOR VALIDATION OF COMPUTER MODELS
The purpose of the track stiffness test was to obtain data to assist in validation of the L/V and Lateral Train Stability models as an extension of earlier dynamic tests conducted at the Transportation Test Center. The first series of tests conducted was to obtain instrumented data on Vertical Track Modulus (VTM). The second series of tests were designed to collect data on rail to rail stiffness using various rail loads combined with and without static vertical loads. The third series of tests were conducted to measure lateral track stiffness with and without rail loads on a tangent segment of the track, on both left and right hand curves.

An International government-Industry Research Program on Train-Track Dynamics. Requests for this publication should be directed to J.G. Britton, Director of Operations, AAR.

Association of American Railroads AAR R-181, 1975, 20 pp, Phots.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

A2 127711
WIDE GAGE INVESTIGATION, VOLUME 1
One of the immediate problems in track maintenance and improvement is Gage Widening. Track lateral stability has been of great concern in recent years, both from the thermal load aspects involved in the use of continuous welded rail, and the train dynamics aspects of heavier equipment and rail, and the train dynamics aspects of heavier equipment and longer trains. Two particular problems attributed to track-train dynamics interactions are wide gage and rail rollover. For this investigation of wide gage in tangent track, an experiment was conducted on a stretch of track on the Union Pacific Railroad near Pocatello, Idaho. Eight sections of track with different combinations of tie plates and fasteners were installed by the Union Pacific at a site noted for recent wide gage problems. The purpose of the experiment was two-fold: first, as a track train dynamics study, to identify specific factors contributing to development of wide gage; second, as a fatigue test, to evaluate the ability of various test sections to maintain gage under heavy, high speed traffic conditions. Measurements of gage and observations of track conditions at the test site were periodically collected by Union Pacific personnel, so that long term trends could be established. In addition, field experiments measured the dynamic response of the track to traffic during both summer and winter ambient conditions. Volume 1 presents a description of the wide gage experiments and results from the summer field experiment, during which 315 trains were recorded over a 3-week period about 1.5 million gross tons of traffic.

An International Government-Industry Research Program on Track-Train Dynamics. Requests for the publication should be directed to J.G. Britton, Director of Operations, AAR.

Association of American Railroads AAR-R178, 1975, 120 pp, 34 Fig., 13 Tab., 6 App.

PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

A2 127712
WIDE GAGE INVESTIGATION, VOLUME 2
The wide gage investigation involved test measurements in the summer and winter months. The reasons for performing measurements by season was because experienced railroad engineers felt the phenomena of gage widening was accelerated during winter months. As reported in Volume I, permanent widening of gage occurs in the summer. Significantly, no appreciable permanent track deformation was found in periodic gage measurements at the test site between May (the installation of the test sections) and November of 1974. After a sufficient period of snow and subzero weather had passed,

to assure that the ballast section had deep frost, the track dynamics instrumentation as described in Volume I was again set up for measurements. This report presents the results of this winter series of experiments.

An International Government-Industry Research Program on Track-Train Dynamics. Requests for this publication should be directed to J.G. Britton, Director of Operations, AAR.

Association of American Railroads AAR-R179, 1975, 44 pp, 16 Fig., 5 Tab.

PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC

DOTL RP

A2 127715
TRACK TRAIN DYNAMICS. GUIDELINES FOR: TRAIN HANDLING, TRAIN MAKEUP, TRACK & STRUCTURES, ENGINEER EDUCATION

This manual was prepared as an immediate aid in improving freight train performance. It has five sections: Definitions and Functions of Equipment; Train Handling; Train Makeup; Track and Structure; Engineer Education. These results are based on parametric study using validated analytical models.

A Government-Industry Research Program on Track Train Dynamics. Requests for this publication should be directed to J.G. Britton, Director of Operations, AAR. This is a 2 volume set.

Association of American Railroads AAR-R153, 1973, 33 pp, Figs.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC

DOTL RP

A2 127836
RAILWAY DYNAMIC TESTS

The verification of running safety and the quantitative assessment of the comfort of railway vehicles involves the taking of many dynamic measurements. The author first lists the range of the main recordings required and explains how they are taken: fitting of gauges, isolation of the phenomenon to be studied and transformation of the results into readings that can be interpreted more easily (usually an electric process), amplification, filtering, remote transmission of this data, reception and recording. The complex behaviour of a moving vehicle means that numerous phenomena must be recorded simultaneously and continuously by a whole series of measuring instruments. The author describes and explains in three sections the techniques used for measuring stresses and wheel-rail interaction, the series of measuring instruments, and the interpretation of the many and varied experimental results obtained, particularly with the TGV 001 trainset and the Z 7001 railcar. These results are very close to those obtained by calculation; they show the high value of the method using an analogue computer. [French]

Joly, R *Revue Generale des Chemins de Fer* Vol. 94 July 1975, pp 417-452

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

A2 127851
150TH ANNIVERSARY ISSUE

The Institutions of Mechanical, Civil, Electrical and Railway Signal Engineers conducted an International Engineering Conference in September 1975 to commemorate the 150th anniversary of passenger railway. This issue has editorical comment designed to complement the papers presented at the Conference. The contents of this issue are as follows: Modern track fastenings; Developments in Welding techniques for rolling stock; Modern dc traction motor design practice; Non-ferrous brake materials; Bridge reconstruction for overhead electrification; Ferrous fittings for overhead equipment; Roller bearings for railway rolling stock; Thyristor control of traction motors; Appraisal of tank car valves and their application; Australia's railways invest in passengers; Electric cables for signalling and track to train communications; Brake blending and wheelslide protection; High speed track recording coach; Ultrasonic rail flaw detection; Flexicoil suspensions; Prestressed concrete beams for bridges; Recent developments in plain bearings; Asynchronous motor drive for locomotives; Gangway connections between long carriages; Point heaters--progress in design; Batteries for railway applications; TOPS equipment; electrical carbon and the challenge of railways; Design and cost of containers; Railway roller bearings; Computer aided design in railway signalling; Adoption of AWAC catenery on BR, Powered doors for rail vehicles; Signal control desks.

Railway Engineering Journal Vol. 4 No. 5, Sept. 1975, 160 pp, Figs., Tabs., Phots.

PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

A2 127856
TIE RENEWALS AND COSTS

This report of AREA Committee 3 involves statistics on tie renewals and average tie costs for 1974 as compiled by the Economics and Finance Department of AAR. The details are given in tabular form. Along with conclusions about the rates at which Eastern, Southern and Western railroads inserted ties, it is shown that the "indicated" wooden tie life for all U.S. Class I railroads is 47 years. The average cost of ties increased by 43% from 1973 to 1974. There was only an increase of 5% in tie renewals in 1974. The average number of concrete ties inserted was the same in both years but the tie cost went up 44%.

Advance Report of AREA Committee 3--Ties and Wood Preservation.

AREA Bulletin Bul 654 Proc V77, Sept. 1975, pp 13-23, 4 Tab.

ACKNOWLEDGMENT: AREA Bulletin
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

A2 127857
WORK EQUIPMENT REPAIR ORGANIZATIONS OF NORTH AMERICAN RAILROADS

This report is the result of a survey which brought responses from 63 railroads which were divided in four categories according to length. Examined are factors such as whether automotive and maintenance of way equipment are repaired in company shops, whether work on m/w equipment is done in a single shop or in dispersed facilities and how road repairs are made to the equipment. It is noted that in developing or altering a repair organization, shop and field work each have unique advantages which are detailed.

Advance report of AREA Committee 27--Maintenance of Way Work Equipment.

AREA Bulletin Bul 654 Proc V77, Sept. 1975, pp 9-12

ACKNOWLEDGMENT: AREA Bulletin
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

A2 127871
SOLID-BED TRACK LAID FOR TRAIL SERVICE ON NETHERLANDS RAILWAYS

Initial design on a viaduct in Delft has been followed by trials under ORE Committee D87 auspices of solid-bed track on British Rail, German Federal Railway and at the Czechoslovakian Velim Test Track. All employ prefabricated blocks to carry rail laid on a concrete underbed. All tracks, including the new installation in the Netherlands use the DE spring rail fastener. Importance of a solid-bed track is emphasized for use with welded rail.

Eisses, JA (Netherlands Railways) *Rail Engineering International* Vol. 5 No. 5, Aug. 1975, pp 187-194, 22 Fig

PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

A2 127872
BR GREAT NORTHERN SUBURBAN ELECTRIFICATION--TRACK REMODELING AND ASSOCIATED CIVIL ENGINEERING

Extensive track realignment and the rebuilding of stations and bridges are involved in electrification of 110 km of British Rail lines used for suburban service into Kings Cross and Moorgate stations. Multi-span brick arch road overpasses had to be replaced completely using explosive and hydraulic jacks for demolition. Details of track changes to permit express speeds of up

to 200 kph and local and branch line speeds of 120 kph are discussed. The lines' inner areas will have both 750-V third rail and 25-kV catenary for power distribution.

O'Loughlin, TB (British Railways Board) *Rail Engineering International* Vol. 5 No. 5, Aug. 1975, pp 201-206, 2 Fig., Phots.

PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

A2 127873
VELIM TEST CIRCUIT, RAILWAY RESEARCH INSTITUTE, PRAGUE
The Velim Railway Testing Circuit, located 50 km east of Prague is the test facility for the Institute which is engaged in technology relating to transport economics, track construction and maintenance, rolling stock and electric and diesel traction, communications and other areas. The 200-kph test loops are energized at 25 kV 50 Hz and they may be used for controlled service tests for ORE, OSShD and for European and Russian railways and suppliers. Slab and conventional track are being evaluated. Laboratories have computers which can be coordinated with dynamometer car activities.

Rail Engineering International Vol. 5 No. 5, Aug. 1975, pp 215-218, 1 Fig., Phots.

PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

A2 128187
LARGE SCALE CONSTRUCTION WORK OF CONCRETE SLAB TRACKS FOR THE SAN-YO SHINKANSEN
The concrete slab track utilized by JNR (16 km on the Shin Kansen and 84 km on the narrow gauge line) has proved satisfactory and has shown the need for little maintenance. Therefore concrete slab track is used for 70% of the line between Okayama and Hakata. This article describes design requirements, construction methods and track details. JNR has two types--one with minimum provision for adjustment used only on straight track in tunnels and the other with larger adjustment margin used on all elevated sections (straight or curved) and on curves in tunnels. For the 393 km line 12 concrete slab production facilities were set up, 60 slab distribution points, 58 mortar plants and 25 depots for rail and fastenings. JNR is researching additional problems associated with the slab track.

Hiroi, I (Japanese National Railways) *Japanese Railway Engineering* Vol. 15 No. 3/4, 1974, pp 6-9, 6 Fig., 3 Phot.

PURCHASE FROM: Japan Railway Engineers' Association 2-5-18 Otemachi, Chyoda-ku, Tokyo, Japan Repr. PC

DOTL JC

A2 128605
MECHANICS OF TRANSPORTATION SYSTEMS
This is a continuation of the work of the Applied Mechanics Division of the American Society of Mechanical Engineers on dissemination of information on application of mechanics in transportation. In no aspect of transportation technology does applied mechanics play a more decisive role than in suspension system design. The papers in this volume are: (1) Classifying Track by Power Spectral Density by Corbin and Kaufman, (2) Active Suspensions for Ground Transport Vehicles, A State of the Art Review by Hedrick and Wormley, (3) The Tire as a Vehicle Component by Segel, (4) Development of Advanced Suspension Systems for High Speed Railcars-The Metroliner, A Case Study. Part I-Dynamic Performance Requirements by Strong and Herring, Part II- Prototype Development and Testing by Dean.

The papers in this book were presented at the winter Annual Meeting of ASME, Houston, Texas, Nov 30-Dec 5, 1975. Individual papers are RRIS 03 128606, 03 128607, 01 128608 and 02 128609.

American Society of Mechanical Engineers AMD-Vol. 15, 1975, 110 pp

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ASME Repr. PC

DOTL RP

A2 128608
CLASSIFYING TRACK BY POWER SPECTRAL DENSITY
Historically, the Power Spectral Density (PSD) has been used as a diagnostic tool and as a classifier in many disciplines. This paper illustrates how this valuable tool can be applied to railway track geometry data to assist in the understanding and management of the permanent way. The PSD can be used to diagnose random and periodic behavior in the track surface (profile). Three parameters are developed that are capable of describing this behavior. Furthermore, the PSD can be used to classify the track. Two of these parameters have a strong impact on the deviations of a 19-m (62-ft) midchord offset. Within prescribed confidence limits, these can be tied to the Federal Railroad Administration's track safety standards. This permits the assignment of the speed class at which the track may be economically maintained without major overhauling.

This paper was presented at the Winter Annual Meeting of ASME, Houston, Texas, Nov 30-Dec 5, 1975 and is from ASME Mechanics of Transportation Systems, RRIS 02 128605.

Corbin, JC Kaufman, WM (ENSCO, Incorporated)
American Society of Mechanical Engineers AMD-Vol. 15, 1975, pp 1-20, 11 Fig., 1 Tab., 16 Ref.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ASME Repr. PC

DOTL RP

A2 128630
AN INVESTIGATION OF FACTORS CONTRIBUTING TO WIDE GAGE ON TANGENT RAILROAD TRACK
Wide gage--a fatigue failure of the track to maintain the nominal lateral distance between rail heads--is one of several modes of track failure on which the AAR-FRA-RPI-TDA Track Train Dynamics Program has focused attention. To investigate the generation of wide gage on tangent track, experiments were conducted to measure track dynamic response and long-term fatigue life of track sections on the Union Pacific Railroad in Idaho. Results of these experiments have defined the important factors in this mode of track fatigue.

This paper was contributed by the Rail Transportation Division of the ASME for presentation at the Winter Annual Meeting, Houston, Texas, November 30-December 5, 1975.

Ahlbeck, DR Harrison, HD Noble, SL (Battelle Columbus Laboratories)
American Society of Mechanical Engineers 75-WA/RT-1, July 1975, 9 pp, 9 Fig., 1 Tab., 5 Ref.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL RP

A2 128841
ICG RESTORES ELASTICITY TO ITS TRACK
Illinois Central Gulf is restoring elasticity and strength to sections of track damaged by the action of heavy high-speed traffic. Upward action of subgrade material reduces ability of ballast to distribute loads, causing deterioration of track quality. Problem is particularly severe on sections with poor drainage and abundance of mud. Three such sections are currently being rehabilitated. ICG is using new machines-Plasser combination undercutter and battast cleaner, and Tamper vibratory crib and shoulder compactor. Results have been good and an added feature is the relatively low cost.

Progressive Railroading Vol. 18 No. 9, Sept. 1975, 3 pp, 4 Phot.

ACKNOWLEDGMENT: CNR
PURCHASE FROM: Murphy-Richter Publishing Company 9 South Clinton Street, Chicago, Illinois, 60606 Repr. PC

DOTL JC

A2 128845
THE TIES THAT BIND
After years of deferred maintenance, Norfolk and Western Railway has embarked on "rebuilding" policy, emphasizing plant as opposed to equipment improvement. The policy is evidenced by the increase in capital expenditures and maintenance programs, including track ballasting and surfacing, ballast cleaning, vegetation control, replacement of ties and switches. Other aspects of the program include yard rehabilitation, installation of microwave network, and modernization of communications system.

Roberts, R *Modern Railroads* Vol. 30 No. 8, Aug. 1975, pp 76-77, 2 Fig., 1 Phot.

ACKNOWLEDGMENT: CNR
PURCHASE FROM: Cahners Publishing Company, Incorporated 5 South Wabash Avenue, Chicago, Illinois, 60603 Repr. PC

DOTL JC

A2 128850
CLOSE-UP OF SOUTHERN POLICIES AND PRACTICES
In a four-part feature, the Southern Railway policies in track maintenance are examined. Southern started early in mechanizing m/w operations and has achieved a high degree of efficiency in manpower use. It has always emphasized rail and tie renewals. In Part 1, The Strategy Behind the Progress, the development of a five-year plan, the acceptance of a high m/w ratio, and use of a track geometry car and rigid quality control are discussed. Part 2, Dual Method of Laying Highlights Rail Practices, tells how a 54-man gang lays eight welded rail strings in a day and discusses welding, heat-treated rail and hardening of frogs. Part 3, Top Efficiency Is Goal in T&S Operations, tells how highly mechanized system gangs are organized around machines, including those which remove ties for possible reuse. Part 4, Innovations Feature Prefabrication of Turnouts, Track Panels, tells how turnouts are produced for rail relay programs and new industrial tracks. Track panels are used in building sidings and industry tracks and for reconstructing tracks damaged during derailments.

Railway Track and Structures Vol. 71 No. 11, Nov. 1975, pp 16-20

PURCHASE FROM: XUM Repr. PC

DOTL JC

A2 128875
AXIALLY STRESSED RAILROAD TRACK ON AN ELASTIC CONTINUUM SUBJECTED TO A MOVING LOAD
The recent introduction of the welded railroad track raises the possibility that high axial compressive forces may occur in the rails due to constrained thermal expansions. This in turn may reduce the critical velocity of the track to within the operational velocities of present day trains. Recently the effect of axial forces upon the critical velocities of the track was analyzed by A.D. Kerr using the Winkler model for the base response. In this study, the effect of the axial compressive force on the critical velocity of the track is studied assuming for the base an elastic half space with inertia.

Labra, JJ (ENSCO, Incorporated) *Acta Technica* Vol. 22 No. 1-2, 1975, pp 113-129, 11 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

A2 128876
EFFECT OF A MOVING SYSTEM OF FORCES ON A BEAM LYING ON AN ELASTIC BASE [Deistvie dvizhushcheisya sistemy sil na balku, lezhashchuyu nauprugom osnovanii]
Steady-state vibrations of an infinite beam supported by a Winkler base are investigated for the case when an infinite system of identical forces moves along the beam at a constant velocity. In addition, a uniformly distributed load pressing the beam to the base acts on the beam. A computation algorithm is worked out taking into account the possibility of the appearance of a zone of separation of the beam from the base. The relationship between problem parameters accompanying the onset of such a zone is made clear. Results of numerical calculations for a wide range of parameters are presented. The possiblity of the loss of stability by the beam from the plane in which the moving load acts is investigated. An example close to railroad track parameters is given. [Russian]

Muravskii, GB *Mechanics of Solids* No. 3, May 1975, pp 190-195

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

A2 128885
PRINCIPAL CHARACTERISTICS OF RAIL STEEL PRODUCTION CONSIDERING THE DEMANDS OF THE RAILROAD NETWORKS [Principales caracteristiques de la fabrication de l'acier a rails face aux besoins des reseaux ferroviaires]
This review emphasizes the ever increasing demands on rails in connection with increasing speeds of traffic and increasing loads to be carried. The different types of rail steel are described. Quality control by continuous testing for inclusions, flakes, and microcracks and the rolling of rails are discussed. [French]

Vicens, P (Sacilor) *Revue de Metallurgie* Vol. 72 No. 5, May 1975, pp 387-402

PURCHASE FROM: ESL Repr. PC, Microfilm

A2 129081
TRENDS IN TURNOUT AND CROSSING MAINTENANCE
Nationwide survey reported shows that more railroads are now working through main-line switches in conjunction with out-of-face surfacing operations, but individual practices vary widely. Practices at grade crossings were included in the survey. The machines that have been developed for working through turnouts including switch tampers are featured.

Railway Track and Structures Vol. 71 No. 8, Aug. 1975, pp 18-21

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

A2 129094
ICG UNDERCUTS TRACK, CLEANS BALLAST WITH BIG MACHINES
The Plasser ballast undercutter-cleaner excavates the ballast section with an undercutting chain that cuts a swath which can be adjusted between 12 ft 4 in to a maximum of 14 ft 6 in width at a depth ranging from 10 in to 17 in below the bottoms of the ties. The chain, 80 ft long, has wear-resistant fingers and scoops. It operates at a speed of about 6 ft per second and conveys the excavated material up a chute to a receiving hopper, which distributes it onto vibrating screens.

Railway Track and Structures Vol. 71 No. 8, Aug. 1975, pp 24-25

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

A2 129095
BUILDING TRACKS IN THE WASHINGTON METRO
Problems created by special fastening assembly are solved by the use of movable templates to position anchor bolts and in pouring grout pads for the assemblies. Tractor compressors are factor in facilitating construction.

Railway Track and Structures Vol. 71 No. 7, July 1975, pp 54-55

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

A2 129096
MEASUREMENT AND ANALYSIS OF THE IMPACTS APPLIED TO THE RAILROAD TRACK UNDER THE RUNNING VEHICLES
No Abstract. [Japanese]

Ono, K Ito, Y *Japan Society of Civil Engineers, Proceedings* 240, Aug. 1975, pp 93-102, 11 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

A2 129170
LIMITED ANALYSIS OF THE SAFETY IMPLICATIONS OF THE PRELIMINARY SYSTEM PLAN FOR RAILROAD CONSOLIDATION
This Study looks at the safety impact of the system changes resulting from the reorganization of the railroads of the Northeast and Midwest due to the reduction of ton-miles of freight transported by rail, the increase by truck, the elimination of rail-highway crossings, and the upgrading and improved maintenance of the system. The subjects considered are the rail system itself, interaction with its surroundings, and interaction with other types of transportation. Only the change in transport mode of freight originating or terminating on the lines scheduled for abandonment is considered. Tables comparing safety performance for different transport modes are included.
Sponsored by USRA.

Allen, JD
Battelle Columbus Laboratories, United States Railway Association Final Rpt. USRA-R-129, June 1975, 51 pp, 12 Ref.

Contract USRA-C-50039

ACKNOWLEDGMENT: United States Railway Association, NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-247368/4ST, DOTL NTIS

A2 129186
THE TECHNICAL AND ECONOMIC ASPECTS OF CONCRETE SLEEPER RECONDITIONING [Techniczne i ekonomiczne zagadnienia zagadnienia regeneracji podkladow betonowych]
The author summarises the experience acquired in the reconditioning of concrete cross ties on the PKP and other railways. He then examines: 1) the actual renovation of the ties, its range, its efficacy, and its utility in relation to all types of defect likely to emerge in ties; 2) the methods of assessing the technical state of a tie and of determining the kind of renovation necessary, as well as of calculating the profitability of such an operation; 3) the technology of repairs to wooden peg fastenings, the organisation proposed for working sites and considerations on the introduction of an industrial orgainsation at the sites. [Polish]

Turyn, M *Przeglad Kolejowy Drogowy* No. 4, Apr. 1975, pp 14-19

ACKNOWLEDGMENT: International Union of Railways, BD
PURCHASE FROM: Wydawnictwa Komunikacji i Lacznosci Ul Kazimierzowska 52, Warsaw 12, Poland Repr. PC

A2 129200
A REVIEW OF MEASUREMENT TECHNIQUES, REQUIREMENTS, AND AVAILABLE DATA ON THE DYNAMIC COMPLIANCE OF RAILROAD TRACK
The need for increasing train speeds and operating safety while, reducing track maintenance is responsible for much of the current research on track structues, vehicle dynamics, and vehicle/track interaction. This report covers Phase I of a 3-phase program to design and fabricate equipment for measuring track dynamic characteristics. It is generally recognized that the available data and measurement techniques for obtaining this type of data for U.S. track and inadequate. This Phase I report includes a review of previous measurement techniques, a compilation of available data on track dynamic characteristics, an evaluation of data requirements, and the development of concepts for measuring track dynamic compolance.
This project was sponsored by the Federal Railroad Administration, DOT.

Kaiser, WD Nessler, GL Meacham, HC Prause, RH
Battelle Columbus Laboratories Intrm Rpt. FRA-OR&D-76-70, May 1975, 59 pp, 18 Fig., 4 Tab., 28 Ref., 2 App.

Contract DOT-FR-30051

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-250547/AS, DOTL NTIS

A2 129270
SKV 32 001 PRESS FOR WELDING RAIL ON THE TRACK [Schieneklemmvorrichtung SKV 32 001]
Welding of rails is only permitted within narrow temperature limits. The SKV 32 001 press is a device with a light, powerful, hydraulic pump (655 kg), which makes it possible, apartfrom the stipulated temperature limits, to draw or compress rails so as to make and keep the gap between the rails to be welded the exact optimal size.

Sperlich, W *Signal und Schiene* Vol. 19 No. 5, 1975, 3 pp, 3 Fig.

ACKNOWLEDGMENT: International Union of Railways, BD
PURCHASE FROM: Transpress VEB Verlag fuer Verkehrswesen Franzoesische Strasse 13-14, 108 Berlin, East Germany Repr. PC

A2 129271
TRACK ALIGNMENT ACCORDING TO FIXED POINTS WITH TRACK STRAIGHTENING OR TRACK STRAIGHTENING AND DAMPING MACHINES [Gleisrichten nach Festpunkten mit Richtbeziehungsweise kombinierten Richt-und Stopfmaschinen]
Following a reminder of how the old track straightening processes worked (using measurements from arrows, without, and then using reference point), the author states his ideas on future methods. This will involve straightening by machine according to very exact reference points with underpinning of the points of origin of the straightening damping cord as the machine makes its single run. The technique and cases of use of these processes are discussed in depth. [German]

Warnick, A *Eisenbahningenieur* Vol. 26 No. 7, 1975, pp 251-254, 2 Tab., 11 Ref.

ACKNOWLEDGMENT: International Union of Railways, BD
PURCHASE FROM: Dr Arthur Tetzlaff-Verlag Niddastrasse 64, Frankfurt am Main, West Germany Repr. PC

A2 129287
RECENT DEVELOPMENTS IN MEASURED SHOVEL PACKING
Detailed study of this track levelling method developed in collaboration between SNCF and Indian Railways.

Manglik, SK *Indian Railway Technical Bulletin* Vol. 31 No. 192, Feb. 1974, pp 5-15, 12 Fig., 2 Tab., 26 Ref.

ACKNOWLEDGMENT: International Union of Railways, BD
PURCHASE FROM: Research Design and Standards Organization Alambagh, Lucknow 5, India Repr. PC

A2 129306
RAIL FASTENING [Die Schienenbefestigung]
The author first gives a concrete description of the enormous stresses to which rails are subjected. From this observation, he then describes the various methods of fastening, from simple nailing to ballastless superstructure, including double-clamping elastic spikes, ribbed plates and concrete sleepers. [German]

Schultheiss, H *Europeaverkehr* No. 2, 1975, pp 63-67, 3 Fig.

ACKNOWLEDGMENT: International Union of Railways, BD
PURCHASE FROM: Europeaverkehr Darmstadt, West Germany Repr. PC

A2 129312
MAKING BAD TRACK GOOD: WHAT ARE THE ECONOMICS
Reduced maintenance costs are not the only economy to be expected from track repair. Other aspects must be taken into consideration: reduction in the number of accidents, in supervision and routine maintenance costs, higher train speeds, increase in car utilization and better quality of service. No exhaustive study on this subject has ever been carried out, but the article gives an outline of the degradation and repair process for a track over an eight-year period, with quantified assessments by heading of expenditure and foreseeable economics.

Merwin, HD *Railway Age* Vol. 176 No. 11, June 1975, pp 36-37, 2 Fig.

ACKNOWLEDGMENT: International Union of Railways, BD
PURCHASE FROM: XUM Repr. PC
DOTL JC

A2 129322
PROGRAMMED TRACK STABILIZATION-BY LIME INJECTION
Beginning in 1972, Southern Railway has been using lime injection to combat roadbed destabilization. Article reviews work of research program on lime stabilization at University of Arkansas Graduate Institute of Technology, the cost factor, and evaluation of results achieved to date.

Progressive Railroading Vol. 18 No. 11, Nov. 1975, pp 38-41, 5 Phot.

ACKNOWLEDGMENT: CNR
PURCHASE FROM: Murphy-Richter Publishing Company 9 South Clinton Street, Chicago, Illinois, 60606 Repr. PC
DOTL JC

A2 129323
"CUSHIONED" TRACK
The shock absorbing characteristics of track tie pads is gaining increasing acceptance as railroads witness the growing wear on tracks caused by higher speeds and heavier tonnages, the damage to ballast and ties caused by the pumping action of track. Improved materials are now available for tie pads and economically it is becoming advantageous to invest in this additional material when skyrocketing track maintenance costs are considered. Three cushioning systems are described: (1) a pair of pads between the tie plate and the rail and between the tie plate and the tie; (2) rail-base encasement in place of the tie plate; (3) concrete slab track. Initial installations over a sixteen year period has shown a 50% maintenance cost reduction.

Progressive Railroading Vol. 18 No. 12, Dec. 1975, pp 36-38, 1 Fig., 4 Phot.

ACKNOWLEDGMENT: CNR
PURCHASE FROM: Murphy-Richter Publishing Company 9 South Clinton Street, Chicago, Illinois, 60606 Repr. PC

DOTL JC

A2 129328
THE ROAD TO DISASTER
Most crucial problem faced by North American railroads today is the deplorable condition of the roadbeds, the result of years of deferred maintenance. Money cannot now be found within the industry to stop the deferrals, much less to eliminate previously accumulated deferrals. A conservative estimate of this M/W deficiency is $4,727 billion. Possible solutions to the problem are the nationalization of the railroads, so far rejected in the U.S.; a Congressional aid program that will not destroy the private enterprise rail system; government-guaranteed low-interest loans; or a self-liquidating rail trust fund, financed by highway excise and diesel fuel taxes and a special surtax on all surface freight transportation.

Myers, ET *Modern Railroads* Vol. 30 No. 10, Oct. 1975, pp 56-60, 3 Fig., 1 Phot.

ACKNOWLEDGMENT: CNR
PURCHASE FROM: Cahners Publishing Company, Incorporated 5 South Wabash Avenue, Chicago, Illinois, 60603 Repr. PC

DOTL JC

A2 129332
THE BAND-AID APPROACH
Part 2 (Part 1 appeared in Modern Railroads, October 1975) of special report on the crucial problem of railroad physical plant. The result of years of deferred maintenance. The problem today is staggering--material, labour costs required to restore the track to a level capable to meeting present needs is now beyond the industry's ability to pay. The article analyzes two elements of the situation-the availability of material (steel rails, ties, track maintenance equipment) and of trained labour.

Myers, ET *Modern Railroads* Vol. 30 No. 11, Nov. 1975, pp 61-65, 1 Fig., 6 Phot.

ACKNOWLEDGMENT: CNR
PURCHASE FROM: Cahners Publishing Company, Incorporated 5 South Wabash Avenue, Chicago, Illinois, 60603 Repr. PC

DOTL JC

A2 129411
ELASTICITY OF RAIL STRETCHES IN RELATION TO THE PARAMETERS OF THE FASTENINGS [Uprugost' rel'sovyh nitcj v zavisimosti ot parametrov promezutocnyh skreplenij]
The article examines the theoretical correlation between, on the one hand, the rigidity parameters of rail fastenings during the intermittent actions of loads on the bearings and, on the other, the elasticity of the track during wheel stresses on the rail segment. Results are given concerning the experimental research into these problems. On the basis of tests with the fastening devices both in laboratory and under operating conditions, the theoretical research explained in the article provides an overall insight of wheel action, which is vital when defining the optimum parameters of fastenings. [Russian]

Kupcov, VV *Vestnik Vniizt* Vol. 34 No. 3, 1975, pp 28-34, 5 Fig., 2 Tab., 7 Ref.

ACKNOWLEDGMENT: International Union of Railways, BD
PURCHASE FROM: Vestnik Vniizt Moscow, USSR Repr. PC

A2 129413
MODERN SYSTEMS FOR TRACK BUILDING
According to the authors, modern systems of track building and renewal can be classified into two large groups: systems using prefabricated track panels; systems with direct laying of sleepers on the ballast and fastening of the rails on the sleepers. For application of the first group of systems, two sites are necessary: one for assembly and the other for dismantling, which should be organized taking several factors into account: expenses, manpower, mechanization of the sites and frequency of train circulation. In this particular group, the authors mention the system used by SNCF which achieves the complete laying of track at a speed of 350 m/h. The integrated systems in the second group do not need the above indicated sites. However, special mention should be made of the system used by the "SECMAFER" gangs, presently adopted by the Mexican National Railways, the replace the track fastened with sleeper-screws by the track with an elastic pad. [Spanish]

Carrasco, M Palmer, M *Comunicaciones y Transportes* No. 15, Apr. 1975, pp 31-40

ACKNOWLEDGMENT: International Union of Railways, BD
PURCHASE FROM: Comunicaciones y Transportes Mexico Repr. PC

A2 129414
STUDY OF THE VARIOUS PROTECTIVE LAYERS OF THE TRACK FORMATION FOR BALLAST TRACK [Untersuchung verschiedener Planumschutzschichten fuer den Schotteroberbau]
The authors apply several sub-soil deformation modules to calculate stress for the following types of ballast track: without protective layer; with a 30 cm gravel layer; with a 20 cm or 25 cm cemented protective layer. Proposals are made for applications of the various types of protective layer. A cemented protective layer (with an elasticity module of 60,000 kp/sq cm) on ground of average hardness can account for a characteristic ballast coefficient of up to 30 kp/cu cm and a ballast pressure of 3.2 kp/sq cm which can be considered a maximum limit. Therefore, it is advisable to use cemented layers only when the elasticity module of the track formation is less than 500 kp/sq cm under 20 t axle loads. However, above 150 kp/sq cm, the ground must be stabilized and deep draining is necessary. [German]

Eisenmann, J Schneider, E *Eisenbahntechnische Rundschau* Vol. 24 No. 4, Apr. 1975, pp 111-116, 7 Fig., 12 Ref.

ACKNOWLEDGMENT: International Union of Railways, BD
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

A2 129415
TRACK BUILDING MACHINE USE PLANNING BY MEANS OF A SIMULATION MODEL [Maschineneinsatzplanung im Gleisbau unter Einbezizhung eines Simulations modells]
The authors describe a simulation model for planning the medium and short term use of track renewal equipment trains during breaks in the traffic flow. They deal with: the structure of data for planning use of machines; the output of track building and maintenance machines in relation to local conditions; the data acquisition method; the method of storing and updating data; the machine use planning model including remote data transmission. [German]

Bayer, W *Wissenschaftliche Zeitschrift* Vol. 21 No. 3, 1974, pp 357-554, 6 Tab., 6 Ref.

ACKNOWLEDGMENT: International Union of Railways, BD
PURCHASE FROM: Hochschule fuer Verkehrswesen —Friedrich List— Friedrich-List Platz 1, Dresden 801, East Germany Repr. PC

A2 129416
A NEW METHOD FOR CURRENT MAINTENANCE OF THE TRACK [Eine neue Methode zur laufenden Instandhaltung des Schienenwegs ausserhalb des Schutterbetts fuer Gleise mit hohen Geschwindigkeiten]
The authors describe maintenance methods, with their advantages and drawbacks, with reference to quality requirements for high-speed lines. They discuss a new method, and describe its operation, advantages, productivity and efficiency of the work. The new method is based on the use of a new rail fastening with a movable liner, which enables current maintenance of the track to be carried out without touching the ballast. [German]

Iwanow, G Mirtschew, M *DET Eisenbahntechnik* Vol. 23 No. 5, May 1975, pp 216-218, 1 Tab., 3 Ref.

ACKNOWLEDGMENT: International Union of Railways, BD
PURCHASE FROM: VEB Verlag Technik Oranienburgerstrasse 13-14, 102 Berlin, East Germany Repr. PC

A2 129422
TROUBLED TRACK
This article puts the industry in perspective, noting deferred maintenance is not confined to the publicized difficulties of the Northeast railroads. Over

the past two decades railroads have worked themselves into an overwhelming imbalance with equipment money being available and investments having been primarily above the rail. Money-starved track has then been punished by higher speeds and heavier axle loading. Government could decide it is time to equalize the "public cost" for transportation right-of-way betterment. Technology is of little use unless the railroad right-of-way is fit to serve contemporary needs and railroad personnel learn to use technology to best advantage.

Silcox, LK *Bent* Vol. 66 No. 3, June 1975, pp 10-16, 2 Phot.

PURCHASE FROM: Tau Beta Pi Association, Incorporated P.O. Box 8840, University Station, Knoxville, Tennessee, 37916 Repr. PC

A2 129424
WHAT MACHINES FOR BRANCH-LINE MAINTENANCE
Problems of branchline maintenance involve coping with unballasted track, poor drainage and light, badly worn rail. Available manpower is minimal. The author cites particular types of tools and machines which are seen as most effective in the hands of a few men. Design of track and choice of ballast are also discussed.

Blanchard, LC *Railway Track and Structures* Vol. 71 No. 12, Dec. 1975, pp 17-19

PURCHASE FROM: XUM Repr. PC

DOTL JC

A2 129787
EFFECT OF RESIDUAL STRESSES IN HARDENED RAILS ON THE FORMATION AND PROPAGATION OF STRESS FISSURES DUE TO CYCLIC STRAINS [Vlijanie ostatocnyh naprjazenij V Zakalennyh rel'sah Vozniknovenie i rasprostranenie ustalostnyh trescin pri Cikliceskom izgibe]
The authors have reached the following conclusions: The railhead, as a result of heat treatment or cold straightening, can develop a considerable drop in the stress limit, a drop in the number of cycles completed before stress fissures occur, a drop in the number of cycles completed during the stress fissure propagation period, a reduction in the critical size of each stress fissure, or a drop in the curability of hardened rail, 2) the residual compression stresses which occur in the rail head accentuate the above characteristics. [Russian]

Sur, EA Konjuhov, AD *Trudy CNII MPS: Ostat naprja i Proc Zelez relsov* Vol. 491 1973, pp 29-37, 1 Tab., 13 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Trudy CNII MPS: Ostat naprja i Proc Zelez relsov Moscow, USSR Repr. PC

A2 129795
DYNAMICS OF INTERNAL STRESSES IN RAILS AND BUCKLING DURING CORE HARDENING [Dinamika obrazovanija vnutrennih naprjazenij i iskrivlennost rel'sov pri obemnoj zakalke in v masle]
This article explains a method for studying stresses in a rail when it is core hardened. It is possible to: -monitor the dynamics of stresses in the rail section and -obtain a diagram of these residual and temporary stresses. By the analytic and experimental method, the rail section is divided into zones having equal cooling times, and the increase in stresses is noted at fixed moments after cooling has begun. The values in the diagram obtained by this method tally with those provided by extensometric methods as regards residual stresses in the surface layers of the rail. The article also gives an analysis of the buckling mechanism which may occur in rails during hardening. [Russian]

Murav'ev, EA Mihalev, MS *Trudy CNII MPS: Ostat naprja i proc Zelez relsov* Vol. 491 1973, pp 45-56, 1 Tab.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Trudy CNII MPS: Ostat naprja i proc Zelez relsov Moscow, USSR Repr. PC

A2 129796
RESIDUAL STRESSES IN SERIES P65 HARDENED RAILS [Ostotocnye naprjazenija v Zakalennyh relsah P65]
This article gives the results of a study on residual stresses in core hardened rail produced by the Nijni Taghil (Central Urals) steel combine. The authors discuss new rail, as well as rail over which trains of various tonnages have been hauled. A comparison of diagrams showing residual stresses in new rail and those in rail over which 152 and 235 million gross tonnes have been hauled show that, for the most part, there is no difference between the location of these stresses in the web and the rail flange of new rails, and those in rails which show wear. However, the study showed that the type and extent of residual stress on the contact area of the rail head is modified when trains run on these rails. Traction stresses of 8.1 kgf/mm2 were recorded on the rail head of new rails, whilst stresses of 4.5 and 3.1 kgf/mm2 were recorded on rail heads over which 152 and 235 million gross tonnes had been hauled. [Russian]

Sahunjanc, GM Nikonov, AM *Trudy CNII MPS: Ostat naprja i proc zelez relsov* Vol. 491 1973, pp 27-29

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Trudy CNII MPS: Ostat naprja i proc zelez relsov Moscow, USSR Repr. PC

A2 129802
WHAT REALLY HAPPENED ON THE BLACK MESA AND LAKE POWELL?
In the face of conflicting reports concerning the track problems of the Black Mesa & Lake Powell, this article reports the results of an on-site investigation. Management view is that the track bed is sound, rail was properly laid and has perfact alignment, but there have been problems with rail fastenings. This has led to problems with the concrete cross ties, which developed spalling under the rails. BM&LP is replacing about 75,000 of its original 196,000 concrete ties with 100,000 wood ties, leaving 121,000 concrete ties in service. All concrete ties on curves greater than 30 minutes are being replaced. The spalled areas of all remaining ties are being repaired with a sand/epoxy mix. Clip bolts on all remaining concrete ties are being replaced with high-tensile steel and the rubber pads under the rails are being replaced with hard polyethylene pads, retaining original clips.

Dick, MH *Railway Age* Vol. 177 No. 1, Jan. 1976, pp 26-29, 4 Phot.

PURCHASE FROM: XUM Repr. PC

DOTL JC

A2 129803
RAILROAD REHABILITATION PROGRAM, A PROGRAM TO UPGRADE SELECTED BRANCH LINES IN IOWA
This report describes how Iowa participates with railroads and shippers in upgrading track and roadbeds, through direct financial assistance. Major topics include a discussion of the selection, negotiation, implementation, follow-up and payback procedures; the factors related to transferring the program from Iowa to another state; the authorizing legislation with back-ground information; and comments about future directions for the program. The Iowa Railway Assistance Act establishes a fund to be expanded by the Iowa Department of Transportation for upgrading the branch lines, serving not as a substitute for abandonment but as a realistic approach for saving viable branch lines.

Direct requests to Dick Howard, Innovations Transfer Project.

Council on State Governments 22 pp

ACKNOWLEDGMENT: Council of State Governments
PURCHASE FROM: Council of State Governments P.O. Box 11910, Iron Works Pike, Lexington, Kentucky, 40511 Orig. PC

A2 129832
METHOD FOR CALCULATING THE TRANSITORY HEAT FIELD DURING RAIL SURFACE AND CORE HARDENING [Metodika rasceta nestacionarnogo temperaturnogo polja pri obemnoj i poverhnostnoj zakalke relsov]
The authors explain the main requirements for establishing a method for calculating the heat field during rail surface and core hardening. The results of these calculations are compared against experimental rail cooling graphs of core hardening at three characteristics points in the rail section. The comparison shows that the calculations and experimental results tally. This

calculation method can be used to determine the structure and hardness of rail sections which have been cooled by different methods and hardening mediums for which the heat transfer coefficient is known. [Russian]

Konjuhov, AD Potapcenko, SS *Trudy CNII MPS: Ostat naprja i proc zelez relsov* Vol. 491 1973, pp 42-49, 8 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Trudy CNII MPS: Ostat naprja i proc zelez relsov Moscow, USSR

A2 129834
RESIDUAL STRESSES IN RAILS [Ostatocyne naprjazenija v zeleznodoroznyh relsah]
The article examines the effect of residual stresses on rail breaks along the length of the web and on stability during rupture tests on core hardened rail: the aim of decreasing residual stresses in core hardened rails and the formation of residual stresses in the rail head can be achieved by making further improvements to the cold hardening process; residual stresses do not have any substantial effect on stability during rupture tests on rails when the break begins because of a drop hammer failure and, before the break occurs, the rail changes considerably; this is precisely what happens in tests on core hardened rails when the temperature changes from-60 degrees to 20 degrees C. [Russian]

Konjuhov, AD *Trudy CNII MPS: Ostat naprja i proc zelez relsov* Vol. 491 1973, pp 10-27, 3 Tab., 11 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Trudy CNII MPS: Ostat naprja i proc zelez relsov Moscow, USSR

A2 129835
THE EFFECT OF RESIDUAL STRESSES ON RAIL STRENGTH [Issledovanie vlijanija ostatocnyh naprjazenij na procnost relsov]
The article describes a method for determining residual stresses in rails which show wear due to rail-wheel contact fatigue and in rails which have been bent before being placed on track sections on curves. The authors mention how residual stresses can be the cause and propagator of rail fatigue defects due to rail-wheel contact. [Russian]

Kislik, VA Karmazin, AL *Trudy CNII MPS: Ostat naprja i proc zelez relsov* Vol. 491 1973, pp 37-42, 2 Tab.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Trudy CNII MPS: Ostat naprja i proc zelez relsov Moscow, USSR

A2 129849
INFLUENCE OF THE CONCRETE CONDITIONS OF CONTACT BETWEEN WHEEL AND RAIL ON THE RUNNING OF VEHICLES OVER RAILWAY LINES [Einfluss konkreter Rad-Schiene Beruhrungsverhaltnisse auf das Laufverhalten von Schienenfahrzeugen]
The authors speak of the effects of a number of different wheel, and rail profiles on the stability of rolling stock, and also of the influence on such stability of the wheel/rail friction coefficient. From the studies carried out, it transpires that a wheel profile close to the shapes created by natural wear between wheel and rail is more advantageous than conical profiles as regards maintenance and running stability. [German]

Hanneforth, W Fischer, W *DET Eisenbahntechnik* Vol. 23 No. 9, Sept. 1975, pp 409-412, 1 Tab., 11 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: VEB Verlag Technik Oranienburgerstrasse 13-14, 102 Berlin, East Germany Repr. PC

A2 129855
FATIGUE STRENGTH OF STEEL WIRE FOR PRESTRESSED CONCRETE SLEEPER
This paper describes calculation of the fatigue strength of steel wire used for prestressing concrete cross ties. From the results of rotating bending fatigue tests of deformed prestressing wires and plain wires pretreated in various ways, the following conclusions were obtained: (1) Suitable deformed prestressing wires are available for concrete cross ties; (2) Some surface damage may decrease the fatigue strength of the prestressing wire (corrosion, notching and sparks, for instance); (3) JNR's present prestressing loads are sufficient. The effects of spark damage to wires are particularly critical.

Watanabe, S *Railway Technical Research Institute* Quart Rpt. Vol. 16 No. 3, Sept. 1975, pp 131-134

ACKNOWLEDGMENT: Japanese National Railways
PURCHASE FROM: Ken-yusha 1-45-6, Hikari-cho, Kokubunji, Tokyo, Japan Repr. PC

DOTL JC

A2 129860
STUDY OF TRACK IRREGULARITY INSPECTION SYSTEM WITH ACCELEROMETER
Measurements of rail profile and alignment are done by the mid-chord offset system; this is suitable for ride quality determinations of conventional vehicles. Japanese National Railways has been experimenting with a track profile measuring instrument for use on the Shinkansen which consists of an accelerometer mounted on the journalbox of one wheelset with the signal double integrated to give an absolute profile.

Takeshita, K Kishimoto, S *Railway Technical Research Institute* Quart Rpt. Vol. 16 No. 3, Sept. 1975, p 136, 2 Fig.

ACKNOWLEDGMENT: Japanese National Railways
PURCHASE FROM: Ken-yusha 1-45-6, Hikari-cho, Kokubunji, Tokyo, Japan Repr. PC

DOTL JC

A2 130672
LI TRIES FOR MORE TIE LIFE BY REDUCING TIE-PLATE WEAR
To reduce the cutting of wooden cross ties by tie plates, the Long Island Rail Road has initiated tests of Pandrol rail fastenings with special plates having shoulders that accommodate the legs of the spring clips. The goal was to increase the 28-year tie life experienced on heavy-density routes. A 13-mile stretch of new continuous welded rail has been secured with the Pandrol fastenings; tie plates are secured with three Lock Spikes. Tie life is enhanced by eliminating movement of the plates on the ties and a stiffer track structure is thought to have been produced. In addition to the longer service from ties, the Pandrol assembly simplifies the changing of defective rails and avoids problems of spike killing of ties and the loss of plate gauge every time a rail is changed.

Railway Track and Structures Vol. 72 No. 1, Jan. 1976, pp 26-27, 5 Phot.

PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

A2 130800
IMPROVEMENT OF THE RESISTANCE OF HARDENED STEEL RAILS WITH FLAWS OF THERMOMECHANICAL ORIGIN [Povysenie procnost, zakalennyh relsov s termomehaniceskimi povrezdenijami]
The article describes the results of studies into the effect of flaws of thermomechanical origin in hardened rails on the resistance characteristics of these rails. It is seen that the reduction in static and wear resistance, plasticity, tensile strength of rails, as results from wheel slipping and skidding, can be lessened by heat hardening of the rails. [Russian]

Sur, EA Porosin, VL *Vestnik Vniizt* Vol. 34 No. 7, 1975, pp 48-51, 1 Tab., 4 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Vestnik Vniizt Moscow, USSR Repr. PC

A2 130801
BAM: A TRACK FORMATION OF HIGH DURABILITY [BAM-dologovecnoe zemljanoe polotno]
The article examines the geological and civil engineering conditions in the Eastern Siberian and Eastmost region to be crossed by the Baikal-Amour (BAM) main railway line, the special features of the project and the construction of the line's track formation. This line, which is now being built, goes through a whole series of mountain ranges and across large rivers, regions with different geological structures, and various Eastern Siberian and Eastmost climatic zones. The line's route is characterized by complex

geological and civil-engineering conditions due to: the presence of terrain hard frozen for many years, a sinuous profile, high seismicity as well as deep tactonic and exogeneous cracks in the mountain masses, and also to the active frost process affecting the ground surface. Added difficulties include: rock falls, ground subsidence and dejecta cones, ice layers and thermokarsts, underground ice layers. The ground surface is constantly strained by distension and subsidence phenomena brough about by the eroding effects of rivers and lakes during the seasonal freezing and thawing processes. [Russian]

Mocenov, GM Larionov, AD *Zeleznodoroznyj Transport* No. 10, Oct. 1975, pp 59-64

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Zeleznodoroznyj Transport Moscow, USSR Repr. PC

A2 130812
LONGITUDINAL FORCES IN A TRAIN WHEN TAKING A CONVEX CURVE CONNECTING WITH A LONGITUDINAL SECTION [Prodolnye sily v poezde na soprjazenii ogranicivajuscih uklonov vypuklyh ucastkov profilja puti]
The article studies the profiles to be given to these connecting curves, and their effects when they are taken by heavy trains under traction conditions. Recommendations are made for reducing the dynamic longitudinal forces of quasi-static nature appearing in the couplings of such trains. [Russian]

Versinskij, SV Sakovic, LA *Vestnik Vniizt* Vol. 34 No. 7, 1975, pp 34-38, 3 Tab., 4 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Vestnik Vniizt Moscow, USSR Repr. PC

A2 130813
ON THERMIT WELDING OF NATURALLY HARD KAILS OF SPECIAL STEEL CHROMIUM-MANGANESE [Zum aluminothermischen Schweissen von Naturharten Schienen aus Sonderguete Chrom-Manganstahl]
An intermediate casting is used for rail welding. The temperature levels must be adapted to the qualities of the alloys. Welding done respecting the manufacturers' advice have generally given good results on lines with very heavy traffic flows. [German]

Heller, W Schweitzer, R *Eisenbahntechnische Rundschau* Vol. 24 No. 10, Oct. 1975, pp 357-364, 9 Fig., 2 Tab., 10 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Hestra-Verlag Holzhofallee 33, 61 Darmstadt, West Germany Repr. PC

DOTL JC

A2 130817
DETERMINATION OF THE HEAT STRESSES IN THE RAILS OF A TRACK WITH LONG WELDED SECTIONS BY MEANS OF A PERMEABILITY CHANGE MEASURING DEVICE [Bestimmung der thermischen Kraftgroessen in den Schienen eines lueckenlosen Gleises mit Hilfe eines Permeabilitaetsaenderungs-Messkopfes]
To clarify various points over practical use of the effect of permeability to determine thermal stresses in tracks with long welded rails, the author shows a common characteristic of the causes behind mistakes in the results from the measuring device. He also defines the areas in which the method is applicable to obtain statistically accurate measurements and establish the temperature for laying long welded rails. [German]

Mazur, S *Eisenbahntechnische Rundschau* Vol. 24 No. 10, Oct. 1975, pp 378-381, 4 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Hestra-Verlag Holzhofallee 33, 61 Darmstadt, West Germany Repr. PC

DOTL JC

A2 130826
SYMPOSIUM ON RAILROAD TRACK MECHANICS PRINCETON UNIVERSITY, 1975
This report contains a description of the Symposium on Railroad Track Mechanics which took place at Princeton University on April 21, 22 and 23, 1975. It contains the program as well as extensive summaries of each technical paper. The papers: Development of Analytical Models for Railroad Track Dynamics; The Mechanics of Rail Fasteners for Concrete-Slab Tracks; Experimental Determination of the Axial and Lateral Track Ballast Resistance; Railroad Track Structure for High Speed Lines; Lateral Buckling of Tracks Due to Constrained Thermal Expansion; A Contribution to Ballast Mechanics; Review of Rail-Wheel Contact Stress Problems; Excitations and Behavior of Railroad Track During Train Passage at Very High Speeds; Selection and Performance of Railroad Ballast; Deformation of Railway Ballast Under Repeated Loading Conditions; Requirements for the Reliability Assessemnt of Railroad Rail in Service; The Current Status of Measurement and Evaluation Technique for Structure-Borne Sound Measurement of Track; Development of the Prestressed Concrete Tie in the USA.

Sponsorship was from the Federal Railroad Administration, DOT. See RRIS Nos. 01 130827 through 01 130839 and 10 130838, Publication 7602.

Kerr, AD
Princeton University Final Rpt. 76-TR-1, Oct. 1975, 41 pp

Contract DOT-FR-54175

PURCHASE FROM: NTIS Repr. PC, Microfiche

DOTL NTIS

A2 130827
THE DEVELOPMENT OF ANALYTICAL MODELS FOR RAILROAD TRACK DYNAMICS
A renewed interest during the past decade in high-speed rail transportation has underlined a need for better understanding of the dynamic interaction between vehicle and track. Speeds in excess of 160 km/h tax the presently used rail-tie-ballast track structure in terms of long-term stability and required track accuracy. Hence, the investigation of improved structures with better dynamic response characteristics and greater stability has followed in the wake of improved high-speed railcar design. This paper presented some recent developments in analytical modeling of railroad track structures for the study of vehicle-track dynamic interaction by computer simulation. Field measurements taken on main-line track of several North American railroads were used to evaluate the accuracy and define the necessary modifications of the computer model. Predictions of better overall system response and long-term stability from this computer model have aided in the preliminary design of several new track structures which are currently undergoing field evaluation.

This article is extracted from Symposium on Railroad Track Mechanics, RRIS 01 130826, Publication 7602. The complete volume is $3.75, Microfiche $2.25.

Ahlback, DR Meacham, HC Prause, RH (Battelle Columbus Laboratories)
Princeton University 76-TR-1, Oct. 1975, pp 21-22

Contract DOT-FR-54175

ACKNOWLEDGMENT: Princeton University
PURCHASE FROM: NTIS

DOTL RP

A2 130828
THE MECHANICS OF RAIL FASTENERS FOR CONCRETE-SLAB TRACKS
In the growing use and potential development of the concrete rail base in place of ballast, rail fasteners serve a vital function. To a large extent they substitute for the elasticity that is traditionally provided by ballast. In addition, they may aid in the possible suppression of noise. Since the first use of concrete slabs for railroad use, fastener problems have been persistent. In this paper, Bramall summarized basic design principles and practical applications that are being developed for rail fasteners for such installations. An analysis and comparison of experiments with various fasteners and analysis of their characteristics may serve as a design guide and a basis for further investigation.

This article is extracted from Symposium on Railroad Track Mechanics, RRIS 01 130826, Publication 7602. The complete volume is $3.75, Microfiche $2.25.

Bramall, B (International Union of Railways)
Princeton University 76-TR-1, Oct. 1975, pp 34-35

Contract DOT-FR-54175
ACKNOWLEDGMENT: Princeton University
PURCHASE FROM: NTIS

DOTL RP

A2 130829
EXPERIMENTAL DETERMINATION OF THE AXIAL AND LATERAL TRACK BALLAST RESISTANCE

This paper presented a state-of-the-art survey of the various techniques for determining axial and lateral track-ballast resistance and described the experimental methods used in these investigations. The survey included a comparison of the results produced by several investigators. The discussion included data on the effect of compaction of ballast and the effect of an increase in ballast. Various methods of static and dynamic measurements of lateral and axial resistance by rails, ties, and ballast were presented.

This article is extracted from Symposium on Railroad Track Mechanics, RRIS 01 130826, Publication 7602. The complete volume is $3.75, Microfiche $2.25.

Dogneton, P (International Union of Railways)
Princeton University 76-TR-1, Oct. 1975, pp 14-16

Contract DOT-FR-54175

ACKNOWLEDGMENT: Princeton University
PURCHASE FROM: NTIS

DOTL RP

A2 130830
RAILROAD TRACK STRUCTURE FOR HIGH SPEED LINES

Speeds in the 250-300 km/h range demand a track with precise alignment with elastically mounted rails, and low maintenance cost. Along with an improved ballasted track, a track structure mounted on a rigid pavement, distinguished by a precise mounting of the rails and the promise of low maintenance cost, was discussed. Prof. Eisenmann described a track structure using a concrete paving slab. The results presented were based on research carried out at the Institute for Construction of Land Transport Routes of the Technical University of Munich. On the basis of research work of the last two decades and current practical experience, it has been determined that a reinforced ballasted track may be used for speeds up to 250 km/h. For higher speeds an elastic rail mounting on a rigid pavement has been investigated. Experiments performed on the high-speed section of the Deutsche Bundesbahn between Bielefeld and Hamm using concrete ties demonstrated a noticable improvement with the insertion of a soft rubber pad in the area of the rail fastening. Experience in highway construction indicates the pavement should have a multi-layered structure, and the supporting system must be frostproof. With a correct calculation of dimensions and structural design, ideal conditions are created for trouble-free wheel motion with an almost complete elimination of maintenance work.

This article is extracted from Symposium on Railroad Track Mechanics, RRIS 01 130826, Publication 7602. The complete volume is $3.75, Microfiche $2.25.

Eisenmann, J (Munich Technical University)
Princeton University 76-TR-1, Oct. 1975, pp 6-7

Contract DOT-FR-54175

ACKNOWLEDGMENT: Princeton University
PURCHASE FROM: NTIS

DOTL RP

A2 130831
THE LATERAL BUCKLING OF RAILROAD TRACKS DUE TO CONSTRAINED THERMAL EXPANSIONS

Thermal buckling of jointed tracks has been a problem for quite some time. Its occurrence has greatly increased since the introduction of CWR. In spite of intensive research conducted in several countries over the past several decades, to date there are no reliable analyses to predict the buckling temperature of a railroad track. The purpose of this paper was to review the relevant test results and various analytical attempts to solve this problem. The discussion sought to review their deficiencies and thus pave the way towards a solution of the track- buckling problem.

This article is extracted from Symposium on Railroad Track Mechanics, RRIS 01 130826, Publication 7602. The complete volume is $3.75, Microfiche $2.25.

Kerr, AD
Princeton University 76-TR-1, Oct. 1975, pp 12-13

Contract DOT-FR-54175

ACKNOWLEDGMENT: Princeton University
PURCHASE FROM: NTIS

DOTL RP

A2 130832
A CONTRIBUTION TO BALLAST MECHANICS

Most railroaders are apparently convinced that conventional track, will not meet the performance requirements of future traffic. It is clear that immediate progress will stem from current research experiments. In this paper the author described tests he conducted in conjunction with the Austrian Federal Railways to improve conventional railroad track. First, the effect of grain size, grain shape, and quality of ballast upon stability of the road bed were considered. This was followed by a discussion of the plastic and elastic settlement of the ties and a comparison between the behavior of the ballast bed and that of a spring model. Prof. Klugar introduced a new type tie called the "wing tie" devised to increase lateral stability. The author then discussed the lateral displacement of the track in connection with buckling tests in sharp curves.

This article is extracted from Symposium on Railroad Track Mechanics, RRIS 01 130826, Publication 7602. The complete volume is $3.75, Microfiche $2.25.

Klugar, K (Graz Technical University)
Princeton University 76-TR-1, Oct. 1975, pp 38-39

Contract DOT-FR-54175

ACKNOWLEDGMENT: Princeton University
PURCHASE FROM: NTIS

DOTL RP

A2 130833
A REVIEW OF RAIL-WHEEL CONTACT STRESS PROBLEMS

Nearly 200,000 defective rails were located on U.S. railroads in 1972 Rail failures are one of the largest single causes of derailments, ranking somewhat ahead of the next most substantial contributor: wheels and axles (bearings). Furthermore, a high degree of correlation was observed between the rail-related accidents and the ton-miles carried, suggesting that a higher utilization of the rail system may lead to yet higher accident rates. The defective rails and rail-failure-related accidents occur in spite of a massive inspection effort and the installation of over 700,000 tons of new rail annually. Not all defects are equally likely to cause derailments. Rail-end failures (bolt-hole cracks and head/web separations) occur most frequently, but are not proportionately the largest cause of accidents. Transverse defects, which are less frequent, can account for a disproportionately high number of accidents.

This article is extracted from Symposium on Railroad Track Mechanics, RRIS 01 130826, Publication 7602. The complete volume is $3.75, Microfiche $2.25.

Paul, B
Princeton University 76-TR-1, Oct. 1975, pp 25-26

Contract DOT-FR-54175

ACKNOWLEDGMENT: Princeton University
PURCHASE FROM: NTIS

DOTL RP

A2 130834
STRESSES AND BEHAVIOR OF RAIL TRACKS DURING THE PASSAGE OF TRAINS TRAVELLING AT VERY HIGH SPEEDS; STANDARDS ADOPTED BY THE SNCF FOR ITS FUTURE VERY HIGH SPEEDS LINES (250/300 KM/H)

On the Paris-Madrid line in Southwest France, between Bordeaux and Dax, there is a section on which there are two straight stretches of 20 to 45 km, separated by a curve with a radius of 2850 meters. This SNCF line allows tests to be carried out at speeds of over 250 km/h. Since August 1972, two prototype trains, the TGV 001 turbotrain, and the Z 7001 electric motor train, have been traveling four times a day at speeds between 250 and 320 km/h. This paper summarized the knowledge acquired in France as the result of systematic tests carried out at those speeds in anticipation of the

new Paris-Sud-Est line on which trains will travel at speeds of over 250 km/h. Although the problems are not yet completely solved, they are at least now defined very clearly, and none of them is of a fundamental type. The doubts raised a few years ago now appear to be baseless, at least for speeds of up to 300 km/h.

This article is extracted from Symposium on Railroad Track Mechanics, RRIS 01 130826, Publication 7602. The complete volume is $3.75, Microfiche $2.25.

Prud'Homme, A (French National Railways)
Princeton University 76-TR-1, Oct. 1975, pp 29-31

Contract DOT-FR-54175

ACKNOWLEDGMENT: Princeton University
PURCHASE FROM: NTIS

DOTL RP

A2 130835
SELECTION AND PERFORMANCE OF RAILROAD BALLAST

This paper reported an investigation of ballast selection, using standard and modified standard classification tests. The results enable ballasts to be selected with better reliability. A large number of standard laboratory tests were performed on ten ballasts to determine correlation with field performance. The field performance in terms of stability and in terms of breakdown of the ten ballasts was obtained from a CNR field test. In addition, the behavior of a layer of ballast was investigated under ideal loading conditions. Vibration tests investigated how ballast compacts under vibration. Repeated loading tests investigated the fundamental stress-strain characteristics of the ballast. These were supplemented by a model full-scale test. The results of this additional work will improve the specifications for the initial compaction of a layer of ballast and tie configuration to give the best subsequent performance under load. In the future it should lead to the development of a theoretically valid design method for the complete roadbed.

This article is extracted from Symposium on Railroad Track Mechanics, RRIS 01 130826, Publication 7602. The complete volume is $3.75, Microfiche $2.25.

Raymond, GP Gaskin, PN (Queen's University, Canada)
Princeton University 76-TR-1, Oct. 1975, 41 pp

Contract DOT-FR-54175

ACKNOWLEDGMENT: Princeton University
PURCHASE FROM: NTIS

DOTL RP

A2 130836
DEFORMATION OF RAILWAY BALLAST UNDER REPEATED LOADING CONDITIONS

The work described in this paper was concerned with the action of repetitively applied stresses on the deformation of track ballast and was confined to the tri-axial testing of dry ballast where the stresses can be accurately controlled. A major departure between this work and the more normal testing in the field of soil mechanics is that it is more usual to concentrate on the determination of the ultimate strength of the material, while here the main purpose is to determine deformations in the material at stresses often well below those which cause failure. At the present moment the work is in mid-program and both interpretation of the existing test results and also the complete test series have not yet been concluded. Therefore, this paper is by way of an interim report suggesting some ideas which may immediately have direct relevance to today's railways and also to act as a spur for work to be done to bring the knowledge of the material properties of ballast up to that of other engineering materials.

This article is extracted from Symposium on Railroad Track Mechanics, RRIS 01 130826, Publication 7602. The complete volume is $3.75, Microfiche $2.25.

Shenton, MJ (British Railways Technical Centre)
Princeton University 76-TR-1, Oct. 1975, pp 40-41

Contract DOT-FR-54175

ACKNOWLEDGMENT: Princeton University
PURCHASE FROM: NTIS

DOTL RP

A2 130839
DEVELOPMENT OF THE PRESTRESSED CONCRETE TIE IN THE U.S.

Weber traced the history of concrete crossties in the United States, starting in 1893 when 200 were installed by the Reading in Germantown, Pa., through 1972, when several major railroads had installed concrete ties in main-line service for, in the most part, short test sections of one mile or less. Such installations were located on the Western Pacific, the Southern and the Santa Fe. Despite persistent problems (except for the period 1930-1957 when there was virtually no concrete-tie activity in this country because of adequate timber supply and preservation methods) development has continued with emphasis on the requirement for further research. By 1957 several European countries had already developed satisfactory concrete ties designed specifically for the loads and conditions prevailing in those coutries. Until new information becomes available, the new American Railway Engineering Association "Specifications for Concrete Ties (and Fastenings)" will set the standards for concrete-tie performance.

This article is extracted from Symposium on Railroad Track Mechanics, RRIS 01 130826, Publication 7602. The complete volume is $3.75, Microfiche $2.25.

Weber, JW (Rowland and Company)
Princeton University 76-TR-1, Oct. 1975, pp 32-33

Contract DOT-FR-54175

ACKNOWLEDGMENT: Princeton University
PURCHASE FROM: NTIS

DOTL RP

A2 130911
ESTIMATING THE DEGREE OF DEHYDROGENATION OF RAIL STEEL BY THE BATCH METHOD [Ocena stopnia odwodorowania stali na szyny metoda porcjowa]

A study was made of the effectiveness of dehydrogenation of open-hearth steel in a vacuum installation by the batch method. It is found that the optimal degree of dehydrogenation of molten rail steel by the batch method of degassing is attained when the steel circulation coefficient is greater than 3.0 and the pressure in the vacuum collector ranges from 0.5 to 1.0 torr. The hydrogen content in rail steel after degassing by the batch method ranges from 2.0 to 3.7 cu cm per 100 g. An electrode addition of about 1.5 kg per ton of steel increases the hydrogen content after degassing by about 0.5 cu cm per 100 g. [Polish]

Mazanek, T Klisiewicz, Z Sowa, L Kupka, H *Hutnik* Vol. 42 No. 8-9, Aug. 1975, pp 335-338

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

A2 131023
WORK ON THE TRACK BY THE ENGINEERING DEPARTMENTS. 1.2

The first paper outlines the activities associated with work on the track which brings the Signal Department and Civil Engineer's Department into close contact and sometimes, conflict. It discusses the Signal Engineer's track problems and raises a number of particular ones which need a mutual approach for solution. It shows how machines have been developed to save time and manpower and ends with a pleas for greater co-operation between the two departments so that each may acquire a greater understanding of the other's disciplines. In the second paper the author describes briefly the history of track arrangements for both plain track and point and crossings before outlining the process of present day track renewals and drawing attention to problems relating to the installation of continuous welded rails. It shows how, in an endeavour to save time and reduce manpower, machines have been developed to assist both renewal and maintenance of track. The problems of maintenance are discussed and reference is made to the need for additional safety requirements for both men and machines.

Papers presented to the Institution of Railway Signal Engineers, December 1, 1975.

Kerr, F Goldie, J
Institution of Railway Signal Engineers Dec. 1975, 16 pp

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: Institution of Railway Signal Engineers 1 Ashbourne Close, London W5, England Repr. PC

A2 131028
STATE-OF-THE-ART OF BALLASTLESS TRACK AT-GRADE
Ballastless track support structures are regarded as possible solutions to the problems of track maintenance and the research and development of these structures is reviewed. The new types of structures include ties embedded in concrete slabs and also beams. These structures are cast-in-place, precast, and slip formed. Several design problems are examined with consideration to the advantages of ballastless track over conventional track. Maintenance and cost advantages are considered. Current research and development is considered for seven countries; United States, United Kingdom, Germany, France, Soviet Union, Switzerland, Japan. This paper reviews the types of structures actually built and put in experimental or revenue service. The development of new types of rail fasteners is also considered with each type of new track structure.

Wheeler, WL (Parsons Brinckerhoff-Tudor-Bechtel) *ASCE Journal of Transportation Engineering* Vol. 102 No. TE1, Proc. Paper 11929, Feb. 1976, pp 131-145, 20 Ref.

ACKNOWLEDGMENT: ASCE
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

A2 131234
STUDY INTO DYNAMIC FORCES IN RAILWAY TRACK AND LAYOUT OF A TESTING DEVICE [Estudio sobre esfueros dinamicos en las vias ferreas y diseno de un aparato de pruebas, basaco en mediciones directas]
The Secretariat for Civil Engineering in Conjunction with Mexico University's Institute of Engineering, has proposed a series of studies into the stresses caused by dynamic forces acting on the track superstructure, and the determination of pressure distribution under the sleeper and ballast, aimed at designing and developing equipment adapted for laboratory tests. This paper, which won first prize in Section A of the Caracas Congress, contains a description of the initial steps of this plan, and comprises three parts: 1) Theoretical bases, hypotheses, and calculation methods for orienting the on-site experiments. 2) Actual on-site recordings. 3) layout of testing equipment, particularly for concrete sleepers and rail fastenings, aimed at reproducing the necessary load and speed characteristics. [Spanish]

Gardulo, AM
Panamerican Railway Congress Proc Paper Section A, Nov. 1975, 89 pp, Figs.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr. PC

A2 131241
DETERMINATION OF THE DENSITY OF THE BALLAST BED BY MEANS OF RADIOACTIVE ISOTOPES [Bestimmung der Bettungsdichte mittels radioaktiver Isotope]
The measuring principle is based on the absorption of the gamma rays by the ballast, situated between a radioactive preparation and ray detector. The author describes this measuring method, used by the DB Test Centres at Minden and Munich.

Schmidt, W *Eisenbahntechnische Rundschau* Vol. 24 No. 11, Nov. 1975, pp 426-427, 1 Fig.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Hestra-Verlag Holzhofallee 33, 61 Darmstadt, West Germany Repr. PC

DOTL JC

A2 131246
POSSIBILITIES FOR THE DEVELOPMENT OF RAILS FOR HIGH- CAPACITY, HIGH-SPEED TRANSPORT [Moeglichkeiten der Schienentwicklung fuer einen Hochleistungsschnellverkehr]
High-capacity, high-speed transport makes additional demands on the rails. The article discusses the possibility of developing materials for self-hardening rail steels. He presents the results of tests carried out on experimental rails produced industrially. These are mainly made of perlitic steels, steels with a bainitic structure, and low-carbon steels. [German]

Heller, W *Technische Mitteilungen Krupp* Vol. 33 No. 2, May 1975, pp 73-77, 2 Fig., 6 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: ESL Repr. PC, Microfilm

A2 131247
THEORETICAL STUDY ON THE DETERMINATION OF SECONDARY DEFLECTION IN RAILS [Theoretische Studie ueber die Ermittlung der Sekundaerdurchbiegung der Schiene]
The calculation of the deflection of a rail is based on the assumption of a continuous elastic support. It is in fact a support at separate spaced points, which causes an additional (secondary) deflection. The author calculates this secondary deflection, and concludes that it does not not have any significant effect on superstructure stress. [German]

Eisenman, J Reinfelder, R *Glasers Annalen ZEV* Vol. 99 No. 11, Nov. 1975, pp 301-303, 6 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

A2 131263
WEAR ON EXTERNAL SURFACES OF WHEELS AND RAIL DUE TO FRICTION [Verschleissvorgang im Grenzschichtbereich der Reibpaarung Rad/Schiene]
The stresses borne by rail and wheel elements are analysed on the basis of several fundamental definitions of wear by Fleischer. A number of studies were carried out on plastic deformation, running surfaces and wear characteristics. Partial oxidation can occur when the external surfaces of wheels or rails are deformed because the materials come into contact with the surrounding atmosphere. Oxidised metallic particles are then worn away. Wear is often affected by the characteristics of the process itself or by layers of martensite which are produced by shoe brakes. [German]

Pigors, O *DET Eisenbahntechnik* Vol. 23 No. 11, Nov. 1975, pp 495-498, 5 Fig., 12 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: VEB Verlag Technik Oranienburgerstrasse 13-14, 102 Berlin, East Germany Repr. PC

A2 131272
EFFECT ON TRACK OF HEAVY AXLE LOADS
The author recalls and makes reference to numerous studies on the problems of damage to rails caused by heavy axle loads. He quotes recommendations developed by AREA with regard to permissible axle loads in relation to wheel diameter and vehicle speed, and the ultimate tensile strength of rail steels. He mentions the experience of Australian Railways operating meneral lines with block- trains made up of very heavy wagons. He then gives formulae and tables in which the track maintenace cost, as per traffic unit, is expressed in relation to various variables and parameters: speed, axle weight on rail, age of ballast, linear weight of rail, curve radius, etc.
International Engineering Conference Paper. 150th Anniversary of passenger railways.

Gordon, ER Brew, JR
Institution of Mechanical Engineers Sept. 1975, pp 40-43, 3 Tab., 14 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: ESL Repr. PC, icrofilm 3

DOTL JC

A2 131280
THE EFFECT OF LATERAL RESISTANCE ON TRACK BUCKLING ANALYSIS
A model which exhibits the essential features of track buckling mechanisms is used. It is represented by four bars constrained at the interconnecting joints by spiral springs. The bars deform axially according to Hooke's law and the law of linear thermal expansion, but are "rigid" in bending. The author analyses the mathematical model according to three different assumptions. He compares the results obtained and draws conclusions as to the critical temperature at which buckling can occur and the assumption which is most representative of track buckling.

Kerr, AD *Rail International* Vol. 7 No. 1, Jan. 1976, pp 30-38, 1 Fig., 16 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

A2 131282
THE TRACK SUPERSTRUCTURE ON SOVIET UNION RAILWAYS [Der Oberbau bei den Eisenbahnen der USSR]
The SZD carry over half of the world's total volume of freight traffic. The average density of traffic on electrified lines is 76 million gross tonnes per year; locomotive axle loads reach 27 tonnes, and the length of freight trains may be up to 2000 m. The lines are classified as "very heavy traffic" (50 million tonnes of freight a year)", "heavy traffic" (over 25 million tonnes), and "normal" (up to 25 million tonnes). For these categories, standard rails (R.50, 65, 75) are shown in tables and figures, together with wear allowances, shaping, temperature, compensation, length and transport. 70% of the tracks are laid on wooden sleepers, but laying on concrete sleepers is on the increase. The measurements of concrete sleepers are given, also those for superstructure on concrete slabs, test results, construction and maintenance costs. The organisation and direction of superstructure work are described, and an organisation chart for an automated district is shown. [German]

Haferkorn, FG *Holzschwelle* Vol. 70 No. 81, Dec. 1975, pp 32-56, 1 Fig., 2 Tab., 35 Ref.

ACKNOWLEDGMENT: Messerschmitt-Boelkow-Blohm GmbH
PURCHASE FROM: Studiengesellschaft fuer Holzschwellenoberbau E.V. Waldstrasse 11, Bonn-Ippendorf, West Germany Repr. PC

A2 131283
OVERALL EVALUATION OF TRACK CONDITIONS FOR THE PURPOSE OF PLANNING SYSTEMATIC MAINTENANCE [Syntetyczna ocena nawierzchni dla planowania napraw biezacych ciagtych]
It is necessary to know what the actual condition of track is to draw up overall track maintenance plans. The author describes a "synthesis" method for evaluating track conditions using an Amsler dynamometer car with Matisa measuring equipment. An index which is a synthesis of track characteristics and condition (Ws) is established on the basis of a statistical analysis of 5 parameters (levelling, gauge, track distortion, superelevation, and alignment). The analysis contains variations of Ws in relation to acceptable train speeds and lineload. The author concludes with a recommendation concerning the use of the Ws index for planning track maintenance operations. [Polish]

Semrau, A *Przeglad Kolejowy Drogowy* Vol. 22 No. 7/8, July 1975, pp 1-11, 7 Tab., 10 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Wydawnictwa Komunikafji i Lacznosci Ul Kazimierzowska 52, Warsaw 12, Poland Repr. PC

A2 131290
IMPROVING TRACK INFRASTRUCTURE FOR HIGH SPEEDS [Tendenzen bei der Weiterentwicklung des Eisenbahnoberbaues fuer hohe Geschwindigkeiten]
It is essential to improve ballast track for operating at speeds of up to 200-250 km/h. But for speeds of up to 300 km/h ballastless track where rails are placed on concrete slabs is necessary. Some experience has already been acquired in this area but further tests are needed. [German]

Eisenmann, J *Eisenbahntechnische Rundschau* Vol. 24 No. 12, Dec. 1975, pp 456-458, 3 Fig., 12 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Hestra-Verlag Holzhofallee 33, 61 Darmstadt, West Germany Repr. PC
DOTL JC

A2 131298
ELASTICITY OF RAIL STRETCHES IN RELATION TO THE PARAMETERS OF THE FASTENINGS [Uprugost' rel'sovyh nitej v zavisimosti ot parametrov promezutocnyh skreplenij]
The article examines the theoretical correlation between, on the one hand, the rigidity parameters of rail fastenings during the intermittent actions of loads on the bearings and, on the other, the elasticity of the track during wheel stresses on the rail stretch. Results are given concerning the experimental research into these problems. On the basis of tests with the security devices both in laboratory and under operating conditions, the theoretical research explained in the article provides an overall insight of wheel action, which is vital when defining the optimum parameters of fastenings. [Russian]

Kupcov, VV *Vestnik Vniizt* Vol. 34 No. 3, 1975, pp 28-34, 5 Fig., 2 Tab., 7 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Vestnik Vniizt Moscow, USSR Repr. PC

A2 131301
DEVELOPMENT OF CORRUGATIONS ON SURFACES IN ROLLING CONTACT
The self-generation of corrugation on metal surfaces in rolling contact has been studied experimentally in a rolling contact disc machine and theoretically using a computer simulation. The system vibrates in the "contact resonance" mode excited by surface irregularities, and these vibrations may be severe enough to cause plastic indentation of the surface in one revolution which then amplifies the vibration in the next revolution.

Johnson, KL Gray, GG *Institution of Mechanical Engineers Proceedings* Vol. 189 No. 13, 1975, pp 45-58, 14 Fig.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

A2 131310
CALCULATION OF THE DIMENSIONS OF A PRESTRESSED REINFORCED CONCRETE SLEEPER ON THE BASIS OF A RIGID BEAM [A fesizitett betonalj meretezese merev tarto alapjan]
The author presents a very simple method of calculation, based on the uniform, or uniformly varied, distribution of the pressure of the rail base. This procedure is suitable for the preliminary project, for the comparison of sleepers, and it provides rapid results, although it does not take into account the elastic characteristics of the sleeper and the ballast. [Hungarian]

Kutasy, L *Kozlekedestudomanyi Szemle* Vol. 25 No. 1, Jan. 1975, pp 25-29, 3 Fig.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Lapkiado Vallat Lenin Korut 9-11, Budapest 7, Hungary Repr. PC

A2 131315
INVESTIGATION INTO CAUSES OF RAIL CORRUGATIONS
Heavy traffic density and high-capacity cars increased wear and abrasion or curves which CP Rail countered with lubricators that cut flange abrasion but produced rail corrugation with a wavelength of 8 to 28 inches on the low rail. Plastic flow or rail head metal combined with surface fatigue are predominately responsible for rail corrugation. Recommendations for overcoming the problem includes improved wheel rail contact geometry through elimination of wide gauge, elimination of false flanges on wheels, reduction of railhead curvature and modification of the AAR wheel profile; cutting of lateral frictional force by use of self-steering trucks; changes in rail metallurgy to increase resistance to surface fatigue and plastic flow, reduction of dynamic loadings and improved flange lubrication techniques.

Kalousek, J Klein, R *AREA Bulletin* Vol. 77 Bulletin, Jan. 1976, pp 429-48, 15 Fig., 2 Tab., 7 Ref.

ACKNOWLEDGMENT: AREA Bulletin
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

A2 131322
POLYETHYLENE TIE PLATES PASS LAB, SERVICE TESTS, REGULAR USE BEGINS
Specimens have survived rolling-load machine tests, extremes of heat and cold, exposure to water and sand, chemical agents and ultraviolet rays, and severe load conditions in actual service. The high-density polyethylene tie plate is injection molded from a formulation of Super-Dyland and weigh 1 1/2 lb each, as compared with 18 lb for the 13-inch steel tie plate. Field

testing includes a range from industrial tracks to heavy-traffic main lines. Now Koppers, the manufacturer, reports increasing interest in the tie plate for use in surface tracks of rapid transit lines.

Railway Track and Structures Vol. 72 No. 2, Feb. 1976, pp 28-29

PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

A2 131641
ANALYTICAL AND EXPERIMENTAL DETERMINATION OF NONLINEAR WHEEL/RAIL GEOMETRIC CONSTRAINTS
The wheel/rail geometric constraint relationship for actual wheel and rail profiles are generally nonlinear functions of wheelset lateral displacement. Two of these relationships which strongly influence the lateral dynamics of railway vehicles are the effective conicity and gravitational stiffness. An algorithm for the digital computer is presented that calculates these nonlinear relationships for arbitrary wheel and rail head profiles. An experimental apparatus was developed to determine the location of the wheel/rail contact points as a function of wheelset lateral displacement for arbitrary profiles. Experimental data obtained with this apparatus are presented for various cases which validate the results of the analytical procedure.

Presented at the 1976 Joint ASME/IEEE Railroad Technical Conference, Chicago, Illinois, April 6-8, 1976. For the complete volume see RRIS No. 02 131638, Publication 7602. Also available from NTIS, PB-252290/AS.

Cooperider, NK (Arizona State University); Law, EH (Clemson University); Hull, R (Arizona State University); Kadala, PS Tuten, JM (Clemson University)
American Society of Mechanical Engineers 1976, pp 41-69, 11 Fig., 9 Ref.

ACKNOWLEDGMENT: ASME, IEEE
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL RP

A2 132202
KANSAS TEST TRACK: WHAT WENT WRONG?
The FRA-sponsored Kansas Test Track, an 8000-ft field laboratory composed of eight segments utilizing concrete ties and continuous longitudinal concrete beams and slabs and ballast stabilized by an elastomeric polymer, has been retired. Early in 1977 FRA will present a final report telling how the stretch adjacent to Santa Fe's mainline at Eldorado, Ks., performed and failed to perform. The goal had been to understand the improvement in track stability, performance and maintenance requirements resulting from incremental increases in stiffness. When AT&SF revenue freight trains first traversed the track at low speed, track fasteners on the beams failed. After months of repairs, trouble developed again after the line was reopened. Beams again developed problems but mud pumping around them and under the stabilized ballast indicated that the entire subgrade was failing. Some of the track components will be reused at Pueblo, Colo.

Railway Age Vol. 177 No. 7, Apr. 1976, pp 34-40, 4 Phot.

PURCHASE FROM: XUM Repr. PC

DOTL JC

A2 132206
WIDE-GAUGE RESEARCH LEADS TO A NEW STANDARD ON UP
Following research on the causes of wide gauge, Union Pacific has adopted as standard a 16-inch tie plate with a 1:30 cant. Gauge widening is a problem common on high-speed,heavy-duty mainline track and this phenomenon was investigated on UP as part of the industry's Track Train Dynamics Research Program. Tie-plate cant varied from standard 1:40 down to 1:14. The 1:30 design finally chosen is to reduce the incidence of rail rollover and to reduce overloading on the gauge side so that the wear pattern was down the center of the rail.

Railway Track and Structures Vol. 72 No. 3, Mar. 1976, 5 pp

PURCHASE FROM: XUM Repr. PC

DOTL JC

A2 132955
EVOLUTION OF RAIL STEEL AND RAIL SECTIONS AND WHAT IS BEING DONE RELATIVE TO THIS MATERIAL TODAY
Account of the shapes and manufacturing processes for making steel rails over the years in the USA and brief details of the AAR's research into tests, specifications, chemical composition, treatment and rail microstructures as well as into fault detection.

Schoeneberg, KW *AREA Bulletin* Vol. 76 No. 653, June 1975, pp 653-664, 3 Fig., 3 Tab.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: AREA

DOTL JC

A2 132958
EFFECT OF HEAVY AXLE LOADS ON TRACK
Sessions included track developments, suspension developments and track/-train interaction. Eighteen papers were presented by authors from the United States, Canada, Mexico and Europe.

Proceedings of the 12th Annual Railroad Engineering Conference held at Pueblo, Colorado, October 23 and 24, 1975. Individual papers are RRIS Numbers 02 132959, 01 132960, 01 132961, 02 132962, 01 132963, 01 132964, 03 132965, 03 132966, 03 132967, 03 132968, 03 132969, 24 132970, 02 132971, 02 132972, 18 132973, 00 132974, 02 132975, and 00 132976.

Federal Railroad Administration FRA OR&D 76-243, Oct. 1975, 174 pp, Figs., Refs.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-252968/AS, DOTL NTIS, DOTL RP

A2 132959
DETERMINATION OF LOADS ON TRACK
In the past decade, advances in the technology of instrumentation and of computers have made possible the determination of wheel/rail loads so that proper design and maintenance procedures may be developed for vehicles and track so that the industry can live with today's axle loadings. Methods of determining such loads by measurements on the vehicle and the track are discussed. Mathematical modeling procedures may also be utilized to calculate such loads. Computer simulation which includes both vehicle and track in a dynamic interacting system permits specification of outputs in the form of vertical and lateral forces between wheel and rail. Some of the research programs in load determination are then described.

Proceedings of the 12th Annual Railroad Engineering Conference held at Pueblo, Colorado, October 23-24, 1975. The complete volume is RRIS 02 132958, Pricing is for the complete volume: Repr. PC $6.75, Microfiche$2.25, NTIS PB-252968/AS.

Meacham, HC
Federal Railroad Administration FRA OR&D 76-243, Oct. 1975, pp 8-16, 28 Fig.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS

DOTL NTIS, DOTL RP

A2 132961
TRACK STRUCTURES FOR HEAVY WHEEL LOADS
The load bearing capability of track depends on the combined characteristics of foundation, superstructure and loads to be carried. Evidence is that loads imposed by 100-ton cars exceed the load-bearing capacity of much of the track over which they operate. Track deterioration under heavy loads appears in the form of loss of surface and line; in conversion of subgrade and ballast sections into plastic masses that pump mud and water, in wide gauge, plate cutting, tie splitting and spike-killed ties; in rapid wear, battered rail ends and in formation of corrugated and shelly rail. After discussing facets of track design and track deflection, the problems of ballast and subgrade are examined and the effects of wheel loads are detailed. Ten recommendations for combatting effects of high wheel loads and two other lines of action for limiting or accounting in advance for track deterioration are suggested.

Proceedings of the 12th Annual Railroad Engineering Conference held at Pueblo, Colorado, October 23-24, 1975. The complete volume is RRIS 02 132958, Pricing is for the complete volume: Repr. PC $6.75, Microfiche$2.25, NTIS PB-252968/AS.

Hay, WW (Illinois University, Urbana)
Federal Railroad Administration FRA OR&D 76-243, Oct. 1975, pp 27-36, 10 Fig., 13 Ref.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS

DOTL NTIS, DOTL RP

A2 132962
OBSERVATIONS ON THE EFFECT OF HEAVY WHEEL LOADS ON RAIL LIFE
The Bessemer and Lake Erie Railroad has operated 90-59 open-top cars since 1931 and has some statistics on rail wear and rail life under the stresses imposed by such equipment. Rail life on tangent track has been around 440 million gross tons for jointed rail and beyond 650 million gross tons for continuous welded rail. Statistics are also available for Curvemaster and controlled cooled rail on curves. On newer ore carrying railways, rail life appears to be appreciably shorter. Among possible reasons are the bidirectional operation of loaded trains on B&LE, the mixing of various capacities of cars, and the predominance of traffic on solid, rather than roller-type, journal bearings.

Proceedings of the 12th Annual Railroad Engineering Conference held at Pueblo, Colorado, October 23-24, 1975. The complete volume is RRIS 02 132958, Pricing is for the complete volume: Repr. PC $6.75, Microfiche$2.25, NTIS PB-252968/AS.

Rougas, M (Bessemer and Lake Erie Railroad)
Federal Railroad Administration FRA OR&D 76-243, Oct. 1975, pp 41-44, 5 Fig.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS

DOTL NTIS, DOTL RP

A2 132963
EFFECT OF HEAVY AXLE LOADS ON RAIL AND TIES
The Quebec North Shore and Labrador Railway was built in 1953 to handle iron ore from mines 350 miles north of the St. Lawrence River. Trains of up to 280 cars with five locomotive units are operated. This presentation reports the maintenance experience on track which carries up to 50 million net tons annually, and has handled almost 700 million gross tons since opening. Among the findings: line, surface and gauge must be maintained even on tangent track; corrugated rail develops quickly on grades and curves and must be countered promptly; joint bars must be kept tight and rail ends restored; oilers are all-important on curves.

Proceedings of the 12th Annual Railroad Engineering Conference held at Pueblo, Colorado, October 23-24, 1975. The complete volume is RRIS 02 132958, Pricing is for the complete volume: Repr. PC $6.75, Microfiche$2.25, NTIS PB-252968/AS.

Monaghan, BM (Iron Ore Company of Canada)
Federal Railroad Administration FRA OR&D 76-243, Oct. 1975, pp 45-48, 9 Fig.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS

DOTL NTIS, DOTL RP

A2 132964
WELDING CONTINUOUS RAIL IN-TRACK
Continuous welded rail has usually been fabricated using the electric flash butt welding process to join 39-foot rails into 1440-foot lengths. These are then transported for installation in the field. This entails a major materials handling problem which could be reduced by making field welds. Such welds have not met the criteria of quality or cost. A solution developed in the USSR is a highly portable electric flash butt welder. It adds a new option for rail welding and is suitable not only for field work but also for in-plant welding.

Proceedings of the 12th Annual Railroad Engineering Conference held at Pueblo, Colorado, October 23-24, 1975. The complete volume is RRIS 02 132958, Pricing is for the complete volume: Repr. PC $6.75, Microfiche$2.25, NTIS PB-252968/AS.

Hunziker, RA (Holland Company)
Federal Railroad Administration FRA OR&D 76-243, Oct. 1975, pp 49-53, 7 Fig.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS

DOTL NTIS, DOTL RP

A2 132971
RAIL DYNAMICS SIMULATOR
The car testing facility at the Rail Dynamics Laboratory at the Transportation Test Center is described. The facility was designed and constructed to assist government and industry in evaluating and characterizing the dynamic behavior of cars equipped with two-axle trucks. The configuration of the Vertical Shaker System are described, along with its capabilities. Mathematical modeling of a piggyback car is discussed.

Proceedings of the 12th Annual Railroad Engineering Conference held at Pueblo, Colorado, October 23-24, 1975. The complete volume is RRIS 02 132958, Pricing is for the complete volume: Repr. PC $6.75, Microfiche$2.25, NTIS PB-252968/AS.

de Benedet, D (Wyle Laboratories)
Federal Railroad Administration FRA OR&D 76-243, Oct. 1975, pp 118-122, 12 Fig.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS

DOTL NTIS, DOTL RP

A2 132972
COMPARATIVE STUDY OF LOCOMOTIVE LATERAL STABILITY MODELS
In this paper a comparative study is made between present investigation of the 39 degree-of-freedom mathematical model and other simplified models. The results of the study of a typical six-axle locomotive obtained from the 39 DOF model are presented. The lateral stability is appraised, and the model includes the coupling between vertical and lateral motions. The merits and demerits of various models are discussed. A bibliography is included.

Proceedings of the 12th Annual Railroad Engineering Conference held at Pueblo, Colorado, October 23-24, 1975. The complete volume is RRIS 02 132958, Pricing is for the complete volume: Repr. PC $6.75, Microfiche$2.25, NTIS PB-252968/AS.

Garg, VK Mels, KD (General Motors Corporation)
Federal Railroad Administration FRA OR&D 76-243, Oct. 1975, pp 123-129, 5 Fig., 13 Ref.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS

DOTL NTIS, DOTL RP

A2 132974
EFFECT OF HEAVY AXLE LOADS ON BRIDGES
It is estimated there are 3500 miles of bridges on American railroads; replacement cost is estimated at $10 billion. The problem is not the spectacular, long-span steel bridges, but the many structures built many years ago for much lighter loading. As reconstruction is deferred, more speed and weight restrictions will have to be imposed; modern equipment may have to be prohibited from many lines. With scarce capital it will be many years before the frail steel spans of 1880-1900 are replaced. The Cooper E-60 rating permitted by the AAR Mechanical Division does not produce cars capable of unrestricted operation over the rail network. Timber trestles are particularly vulnerable to closely spaced axles.

Proceedings of the 12th Annual Railroad Engineering Conference held at Pueblo, Colorado, October 23-24, 1975. The complete volume is RRIS 02 132958, Pricing is for the complete volume: Repr. PC $6.75, Microfiche$2.25, NTIS PB-252968/AS.

Noyszewski, M (Illinois Central Gulf Railroad)
Federal Railroad Administration FRA OR&D 76-243, Oct. 1975, pp 133-138, 9 Fig.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS

DOTL NTIS, DOTL RP

A2 132976
HEAVY AXLE LOADS IN NATIONAL RAILWAYS OF MEXICO AND NEED FOR STRENGTHENING OF BRIDGES
National Railways of Mexico has been confronted with many low-capacity bridges on lines where heavy cars are being, or will be handled. While the

new bridge standard is Cooper E72 rating, those built prior to 1970 range downward from E60 to E35 on some former narrow-gauge routes. NdeM has raised the ratings on some bridges since diesel locomotives have replaced steam with resultant reduced impact loadings. Slow orders are imposed on certain structures to handle concentrated program of strengthening bridges where it is reduce impact on bridges and use of neoprene pads under the rail base for the same reason have been widely applied. A concentrated program of strenthening bridges where it is economical has been undertaken. Bridges of low capacity or in bad condition are replaced.

Proceedings of the 12th Annual Railroad Engineering Conference held at Pueblo, Colorado, October 23-24, 1975. The complete volume is RRIS 02 132958, Pricing is for the complete volume: Repr. PC $6.75, Microfiche$2.25, NTIS PB-252968/AS.

Diaz, GR (National Railways of Mexico)
Federal Railroad Administration FRA OR&D 76-243, Oct. 1975, pp 148-154, 29 Fig.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS

DOTL NTIS, DOTL RP

A2 133580
PRACTICAL PERFORMANCE OF THE TRACK SYSTEM WITH ASPHALT TREATING METHOD
Maintenance required on conventional track/ballast structures has caused Japanese National Railways to investigate ways to preserve track geometry and minimize ballast degradation. The Track System with Asphalt Treating Method was developed to be applied with a minimum of out-of-service time for the track and to prevent track subsidence while also stabilizing ballast. Asphalt is forced into the ballast beneath the ties and the ballast shoulders are paved. A slab tie must be used--these-called Large Prestressed Concrete (LPC) Slab Ties. Tests indicate stability does not decrease in the long term.

Inui, S Umeda, S Iwasaki, I *Railway Technical Research Institute* Quart. Rpt Vol. 16 No. 4, Dec. 1975, pp 154-155, 2 Fig., 1 Tab.

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Ken-yusha 1-45-6, Hikari-cho, Kokubunji, Tokyo, Japan
DOTL JC

A2 134535
NEW SNCF CONCRETE SLEEPERS [Les nouvelles traverses en beton de la SNCF]
After outlining the history of the use of concrete sleepers and describing their technical characteristics, the study on stresses in the track, caused by dynamic overloading, is based on the work of an ORE Specialists Committee (Question D 71) and the experience acquired by the SNCF in the calculation of the maximum stresses to be taken into consideration. So as to be able to compare the performance of the different sleepers and check the results obtained by experiment against behaviour in service, the SNCF decided to have the following types manufactured: composite reinforced concrete sleepers (VAX V30 and SL V 30); monobloc prestressed concrete sleepers; composite "PRETUBE" sleepers in which an extrusion tube serves as a tie-bar and a means of obtaining prestressing. [French]

Prud'homme, A Ericau, J *Revue Generale des Chemins de Fer* Vol. 95 Feb. 1976, pp 102-117, 13 Fig., 2 Tab., 1 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

A2 134567
THE METALLURGY OF RAIL STEEL WELDING [Die Metallurgie des Schweissens von Schienenstaehlen]
No Abstract. [German]

Guntermann, H *Braunkohle* Vol. 27 No. 7, July 1975, pp 221-226, 10 Fig.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Verlag Braunkohle Postfach 1122, 4 Duesseldorf, West Germany

A2 134576
THEORETICAL STUDY OF NATURAL FREQUENCIES AND OSCILLATION AMPLITUDES IN BALLASTLESS AND BALLASTED PERMANENT WAY [Theoretische Untersuchung der Eigenfrequenzen und Schwingungsamplituden bei schotterlosen Oberbau Konstruktionen und klassischem Schotteroberbau]
The study provides the basis for calculating the dimensions of the ballast layer and the intermediate elastic slabs. These elastic slabs replace the ballast bed for load distribution and absorbing shocks, while costing less for maintenance. The slabs can reduce the forces imposed on the track by oscillation, and thus have a favorable effect on noise, track bed stability, rail wear, and smooth running. [German]

Keim, D *Eisenbahntechnische Rundschau* Vol. 25 No. 1-2, Jan. 1976, pp 94-105, 3 Fig., 1 Tab., 1 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Hestra-Verlag Holzhofallee 33, 61 Darmstadt, West Germany

DOTL JC

A2 134579
TRIAL LENGTHS ON DB OF BALLASTLESS TRACK
First test lengths laid in 1967 embodied prefabricated slabs but these are technically inferior to site-cast continuous techniques as applied to the two trials reported here, implemented in 1972 at Rheda and Oelde.

Eisenmann, J *Railway Engineer* Vol. 1 No. 1, Jan. 1976, pp 18-20, 7 Fig.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Mechanical Engineering Publications Penthouse 1, 15 West 55th Street, New York, New York, 10019

DOTL JC

A2 135189
REASONS FOR THE OCCURRENCE OF INTERNAL STRESSES IN RAILS OF S60 TYPE AND QUANTITATIVE EVALUATION OF THESE STRESSES [Przyczyny powstawania naprezen wlasnych w szynach S60 i ich ilosciowe oznaczenie]
The effect of the cross-sectional configuration, structural changes, and the process technology on the occurrence of internal stresses in rails made of steel S60 during or immediately following straightening between rollers is discussed. A method of investigating these stresses and determining the resulting strains is described which assumes the existence of static stresses in the rails in the unloaded state and involves the use of electrical strain gages and photoelastic measurements of the strain distribution in the rails. [Polish]

Wosiek, E Morawiecki, M Schmidt, J Wojcicki, Z Jamroz, L *Hutnicke Listy* Vol. 42 No. 10, Oct. 1975, pp 381-388

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

A2 135210
PLASTIC FILTERS-A NEW CONSTRUCTION MATERIAL. TESTS ON DRAINAGE OF THE TRACK FORMATION [Kunstoffilter-ein neuer Baustoff, Versuche zur Sanierung des Untergrundes von Eisenbahngleisen]
Synthetic cloth and woven plastic are obtainable from industry firms, to be used for filtering and all problems to do with separating the upper layer of soil and drainage. Under certain conditions these materials can be used to retain the soil and allow water to drain away. The article describes tests at present in progress on track bed drainage using these plastic filters. [German]

Martinek, K *Eisenbahningenieur* Vol. 27 No. 2, Feb. 1976, pp 51-54, 1 Fig., 1 Tab.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Dr Arthur Tetzlaff-Verlag Niddastrasse 64, Frankfurt am Main, West Germany

RAIL VEHICLE SAFETY RESEARCH

Rail vehicle safety research is aimed at improving railroad safety by delineating problem areas and developing countermeasures to reduce accidents in four major areas: rolling stock, accident avoidance, human factors, and control systems.

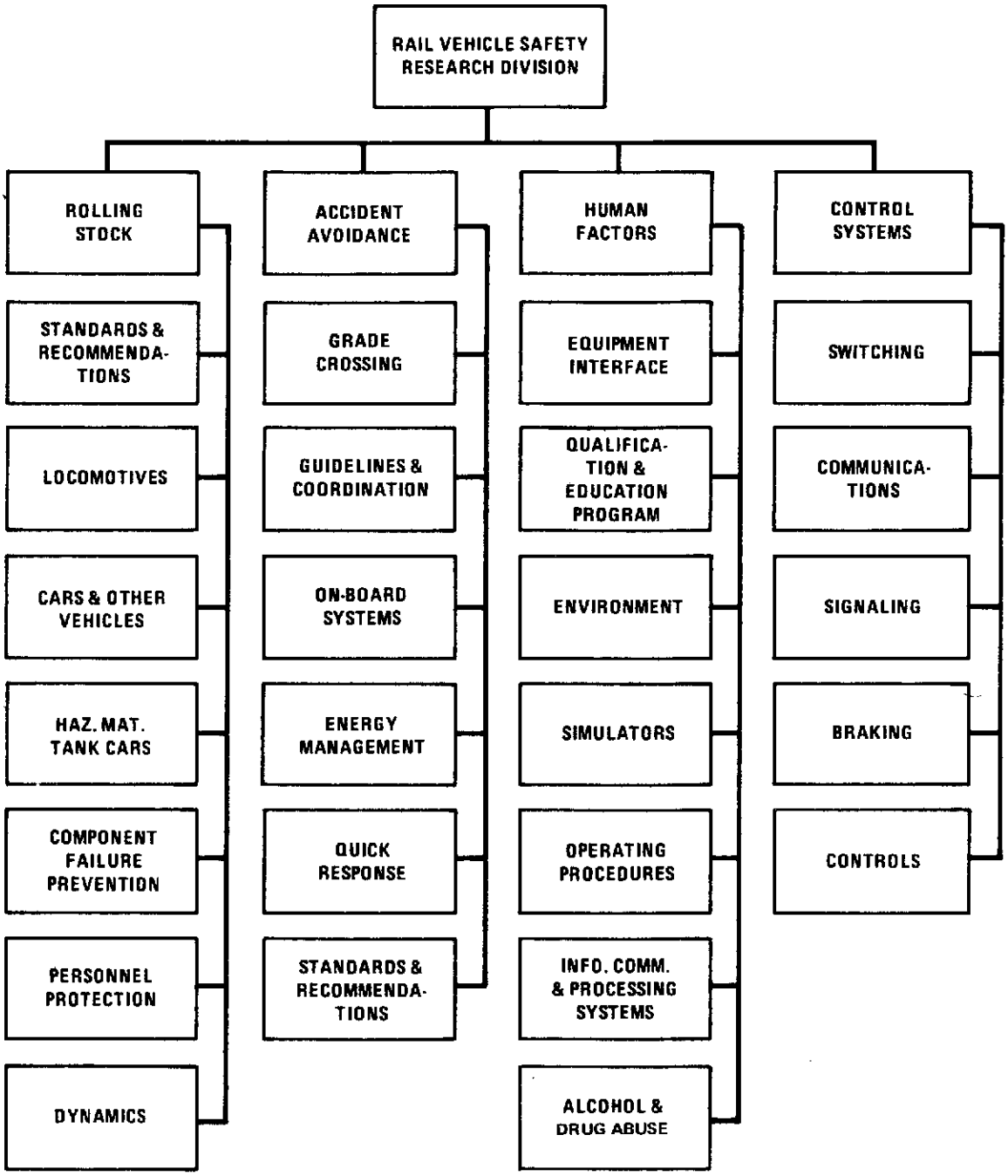
The goal of the rolling stock program is to improve railroad safety by research and development efforts to determine achievable performance specifications for (a) vehicles and vehicle components that are less prone to failure; (b) techniques and mechanisms for predicting, detecting and reacting to failures that do occur, and (c) increasing the accident survivability of vehicle occupants. The prevention of catastrophic consequences in the transport of hazardous materials has been a major undertaking in this program, and the full-scale fire test depicted above is one of the important past activities.

The human factors research program strives to improve the interaction between human and machine in order to reduce the number and severity of accidents resulting from so-called human "errors." FRA has sponsored research aimed at acquiring an understanding of the requirements of safety-critical activities and environments.

The objective of the accident avoidance program is reduction in derailments and collisions. This includes grade-crossing research and the development of practical on-board warning technology.

The control systems program is aimed at reducing the number and the severity of railroad accidents by improving control systems. Evaluations are made of both control systems equipment and control systems procedures.

Figure 5. Organization of the Rail Vehicle Safety Research Division.



B1 033100
SAFETY AND RIDE-COMFORT OF HIGH-SPEED RAILWAY CARS
Running safety is the essential requirement for the high-speed operation of rolling-stock. However, riding comfort is another important factor which should never be overlooked. Discussion is limited to the car-dynamical problems such as the over-turn or derailment of cars. The riding problem is concentrated to the vibrational riding quality.

Matsudaira, T (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. .I. Apr. 1960, pp13-19

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-037)
DOTL RP

B1 033314
STUDIES OF THE PRESSURE AS AFFECTED BY THE AREA OF CONTACT BETWEEN WHEEL AND RAIL. EFFECT OF WHEEL SIZE
The following is a progress report on one phase of this investigation, namely, rolling-load tests in which wheels of various diameters are rolled to and fro on a short length of rail for the purpose of determining the number of cycles of load application required to produce failure. The results of the rolling-load tests to fracture show considerable "scatter" and no very marked difference between the results of tests under a 50-in. wheel and those from tests under a 33-inch wheel. The vertical wear on rail 757C (33-in. wheel) was 0.046 in. at failure, whereas the wear on rail 757C1 (50-in. wheel) at 580,900 cycles was 0.041 in. At failure, 750,100 cycles, the wear on rail 757C1 was 0.0425 in. A second type of test being tried to ascertain the effect of wheel size on the rail is to measure the depth of work hardening in the rail head. The rail head appeared to have been work hardened down to a depth of about 0.45 in. by the 33-in. wheel with a maximum hardness of 296 at a depth of 0.15 in. A test on a section from the same rail rolled with the 50-in. wheel appears to have been work hardened down to a depth of 0.20 in. with a maximum hardness of 269 at a depth of 0.10 in.

Alleman, NJ (Illinois University) *AREA Bulletin* Vol. 45 1944, pp3-8

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-268)
DOTL RP

B1 037235
DERAILMENT OF ELECTRIC PASSENGER TRAIN
The derailment of the last coach of an electric multiple-unit down passenger train on December 13, 1963, which subsequently came into glancing contact with the side of another passenger train, was caused by axle fatigue. This fatigue would have been detected if the prescribed frequency for ultrasonic inspection had been observed. It was suggested that no axle be tested less frequently than every 18 months. One passenger was killed and 31 injured.

Robertson, JRH (Ministry of Railroads, England) *Railway Gazette* Vol. 120 Nov. 1964, pp 953

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-931)
DOTL RP

B1 037246
INQUIRY INTO DERAILMENTS ON THE VICTORIAN RAILWAYS
This summary of a committee of Public Accounts inquiring into derailments during the years 1954-1964 examines the incidence of hot boxes, fracture of axle-box guides, track defects, mileage and ballast with total derailments. The conclusions were that the recent increase in freight trains derailments was due to the use of four-wheel wagons and poor track conditions on low traffic country lines. Also, cross ties were in poor condition on some lines, and ballast was inadequate.

Railway Gazette Vol. 121 Sept. 1965, pp 688-690, 5 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-942)
DOTL RP

B1 037419
NEW BRAKE SHOE CUTS STOPPING TIME, REDUCES WEAR AND SPARKING
A new brake shoe completely interchangeable with the standard metal shoe promises better train control, increased life and almost total spark suppression. Key to the breakthrough is an alloy of iron which exhibits a vastly different metallurgical structure from that of a standard shoe. The Samson shoe reduced stopping distance 32 percent and confirmed the improvement in train handling. The Samson retained the favorable friction characteristics of the standard metal shoe at static breakaway and low speed. Comparative sparking under drag braking conditions tested with cheese cloth placed in the trajectory of sparks leaving the wheel. At 45 mph, sparks from the standard metal shoe ignited the cheesecloth in seven minutes; Samson caused no fire.

Modern Railroads May 1971, pp 49-52, 1 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-882)
DOTL RP

B1 037434
TRAILS WITH GLUED WHEELSETS
One of the most recent developments in the metal adhesives field is their use in the assembly of wheelsets. One reason for this is the increasing demand for lighness of unsprung parts. The normal method of assembly of wheelsets by interference press fit has reached the limits which the materials can withstand. A careful choice of the adhesive to be used is most important in all cases, but especially so for such highly stressed parts as wheels, axles and tyres. With these factors in mind, the German Federal Railway decided on an experimental application of the process. Four axles were assembled using adhesive methods in the repair works at Stuttgart-Bad Cannstatt. For the joints between the wheel hubs and axles a very strong adhesive of low viscosity was chosen, but it was decided to press on the axle in the usual manner. A first test on a wheelset testing machine at the Minden Research Institute took the form of running 10,000 km with a constant axleload of 17 tons. This produced no displacement of the glued components, and it was noted that the wheelset ran remarkably quietly.

Railway Gazette Vol. 125 Jan. 1969, pp 61, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-869)
DOTL RP

B1 037446
WHEELSET DEVELOPMENT REVIEWED BY ENGINEERS
Design and wearing qualities to accommodate increased speeds and axleloads predominate in the papers delivered at the Third Wheelset Conference. Spalling of wheels experienced on North American rapid transit systems had been brought about by wheel slip and it was recommended that a total adhesion system should be considered at the design stage of coaches.

In introducing synthetic brake blocks where wheel tyre cracking existed and it was considered that tyre steels which should be used were those which did not have a hardening tendency and soft steels of low carbon content which were immune from heat cracking. Resilient wheels for use under rail vehicles for suburban and main line railways, cast steel wheels, hollow-tread profiles, wrought-steel wheels, and non-alloy wheels are also briefly discussed as well as cast steel wheels.

Railway Gazette Vol. 124 July 1969, pp 550-553, 1 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-853)

DOTL RP

B1 037470
DERAILMENT AT TYSELEY

An express passenger train comprising 12 coaches hauled by a Type 4 diesel-electric locomotive was approaching Tyesley North signalbox on the down main line at 60 to 65 mile/h when the bracket on the locomotive supporting part of the a.w.s. equipment became loose. The wheels of the rear bogie of the locomotive and of all 12 coaches derailed. Examination of the fractured bracket bolts confirmed that high stress fatigue failures had occurred in the four bolts. Use of maximum tightening torque of 758 lb-ft is essential to achieve the longest life under fatigue loading conditions. It was also recommended that the bracket design should be re-examined to see if longer bolts could be used.

Railway Gazette Vol. 124 May 1968, p 397

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-848)

DOTL RP

B1 037624
ADVANTAGES OF HYDRAULIC BUFFERS

The hydraulic buffer automatically produces a steady retarding force of such a value that, whatever the speed of impact, the wagon is brought to rest as the buffer-stroke is completed. These buffers also produce a very low recoil. Hydraulic buffers make it possible for the safe speed of impact, to be raised from something over 4 mph to nearly 10 mph. Present-day marshalling yards already work with impact speeds of 10-12 mph and a survey carried out at one hump yard showed that 4 percent of impacts were at speeds of more than 10 mph. Hydraulic buffers also have a part to play in the reduction of shock in trains fitted with continuous brakes.

Railway Gazette Vol. 106 Feb. 1957, pp 180-181

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-526)

DOTL RP

B1 037626
BRITISH TIMKEN RAILWAY WAGON BEARING UNIT

A new railway wagon bearing unit is in use on railway freight vehicles. The new design constitutes a two-part assembly which completely replaces the conventional roller-bearing axlebox. Production of the new assembly is much simpler, and therefore much more economical, than that of a conventional axlebox. Normal service wear is confined to the axle guard grooves of the horsehoe adapter. These are linered, and the liners can be renewed without interfering with the wagon bearing unit.

Railway Gazette Vol. 106 Mar. 1957, pp 251-252, 1 Fig, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-528)

DOTL RP

B1 037637
LIGHTWEIGHT PASSENGER STOCK DEVELOPMENT IN U.S.A.

A prototype stainless-steel passenger car, the Pioneer III, which meets all the strength and safety requirements of the Association of American Railroads, with a net weight of 595 lb. per passenger, has been designed by the Budd Company, Philadelphia. A feature is the lightweight four-wheel bogie with single air spring on each side, with tubular axles, and outside-mounted disc brakes. The basic design is suitable for both suburban and main line stock. The principal parts of the bogie are the side frames, bolster, and two air springs; there are no equalizer beams, springs, swing hangers, spring plank, or transom. Interior partitions are of micarta-faced plywood which is resistant to wear. Use is also made of laminated plastics for doors, vestibule ceiling panels, exterior door inner panels, air ducts, enclosure aroung the air conditioning, and seating.

Railway Gazette Vol. 107 Aug. 1957, pp 135-136, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-539)

DOTL RP

B1 037640
AUTOMATIC ARC WELDING OF RAILWAY WHEEL TYRES

Worn wheel flanges are being repaired by the automatic arc welding process, which allows the wheels to undergo three times the number of machinings before reaching the scrapping stage. It is estimated that the net savings over previous methods used is 50 percent. The process is that of the Fusarc Welding Co., Ltd. of Letchworth, and is carried out with a standard Fusarc stationary type automatic arc welding head mounted on a specially designed jug to hold one pair of wheels. The details of the machine and process are illustrated.

Railway Gazette Vol. 74 Apr. 1941, pp 424-425, 1 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-542)

DOTL RP

B1 037653
DEVELOPMENTS IN SPHERICAL ROLLER BEARING AXLEBOXES--1

The design of the spherical roller bearing has been improved to give an increased fatigue life of some 200 per cent compared with that used in railway axleboxes for over 35 years. The principal feature of the spherical roller bearing, its self-aligning property, has not been affected by using only one spherical roller bearing per axlebox, but even in rigid boxes where two bearings are used side by side, the self-aligning property of this kind of bearing is still valuable. Test equipment for accelerated life tests is shown.

Railway Gazette Vol. 107 Dec. 1957, pp 655-656, 2 Fig, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-557)

DOTL RP

B1 037654
DEVELOPMENTS IN SPHERICAL ROLLER BEARING AXLEBOXES--2

The carrying capacity of a roller bearing is increased to a greater extent by using larger diameter rollers rather than by increasing the number of rollers. Except for the difference in the end faces of the rollers, the rollers in the new SKF Type C spherical roller bearings are symmetrical. The close conformity and the uniform distribution of the load over the roller length--give an increased carrying capacity of approximately 15 percent. This means approximately three times longer fatigue life, a factor of no little importance. The bearings are pictured in several railway applications.

Railway Gazette Vol. 107 Dec. 1957, pp 707-710, 5 Fig, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-558)

DOTL RP

B1 037658
JOURNAL STOPS FOR WAGON-TYPE PLAIN BEARINGS

In a new A.A.R. journal bearing assembly, with all dimensions nominal and journals central laterally, the maximum displacement from impact is 7/16 in. Bronze stops, cap screwed to the side wall of the journal box to prevent displacement of the journal out of its bearing were considered the most practicable means to achieve the desired stabilization. The increased bearing life obtained with the journal stops is principally because of reduced end wear and the elimination of spread linings.

Railway Gazette Vol. 109 Oct. 1958, pp 425-426, 2 Fig, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-565)

DOTL RP

B1 037671
DISC BRAKES IN THE U.S.A.

In 1948 the Union Pacific Railraod decided to use disc brakes in new stock. When the first disc-braked cars were put in service, they were mixed with cars equipped with clasp brakes. Trains composed exclusively of cars with disc brakes were assembled. The results have been a reduction in noise and in jolting when trains are being stopped. Thermal cracking of wheel tires has been virtually eliminated. Certain interesting cost figures have been got out comparing the use of clasp and disc brakes on one of the trains over a

12-month period. The cast-iron tread shoes of the clasp brakes required renewal after every round trip of 4,598 miles, 73 changes of shoes thus being made during the year; the disc brake shoes ran an average of 90,000 miles each, and so required an average of 3.73 changes only. Over a full year, the renewals of short clasp brakes cost a total of $48,865.60 and of the long type $65,045.26, whereas the corresponding expenditure for Budd disc brake renewals was $7,221.48.

Railway Gazette Vol. 108 June 1958, pp 677-678

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-584)
DOTL RP

B1 037676
FRICTION MATERIALS FOR RAILWAY BRAKING
The Ferodo composition brake block is compared to cast iron brake blocks. The braking characteristics are shown for the average of 20 stops using emergency brake applications of a train travelling 50 mph. The deceleration time for the Ferodo brake was greater than the cast iron brake, but the stopping distance was less. A composition brake block is less abrasive to the wheel than a cast iron block, and the product of wear less harmful. Although the Ferodo block still wears more rapidly than the wheel, its life has been found to be equal to as many as five cast iron blocks in some instances. Flange profiles are shown comparing the two types of brake blocks as to flange wear.

Pritchard, C (Ferodo Limited) *Railway Gazette* Vol. 108 Feb. 1958, pp 250-252, 3 Fig, 3 Phot, 3 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-589)
DOTL RP

B1 037760
MAINTENANCE CHECKS FOR ROLLER-BEARINGS
SKF has introduced an instrument for shock-pulse measurement of roller-bearings. The technique is based on spalling or flaking damage in roller-bearings producing mechanical shocks. Short-duration high-frequency oscillations produced by the shocks are transmitted to the bearing housing and by fitting measuring nipples to the housing at selected points, the shocks can be registered by an accelerometer. The magnitude of these is a measure of the degree of damage.

Railway Gazette Vol. 126 June 1970, pp 471, 1 Fig, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-770)
DOTL RP

B1 037787
CONFINES OF BRAKING--5
This article discusses the economics of brake systems, especially that extras costs in changes should bring about greater safety, train handling improvement and easier maintenance. Factors of higher speeds, increased loading as reflected in higher air pressure requirements, problems of brake block and wheel temperatures, as well as increased stresses in the components are considered. Increased wear in brake blocks and wheels can result either in higher costs or spatial limitations for the hardware necessary to perform the tasks.

Broadbent, HR *Railway Gazette* Vol. 97 Dec. 1952, p 627

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-802)
DOTL RP

B1 037841
SAFETY ON THE INDIAN RAILWAYS
This is primarily a review of the safety record of Indian Railways. This analysis, for 1962-63, 1963-64, and 1964-65, differentiates between significant and other accidents, such as collisions at level-crossings, fires in trains, and running into cattle and other obstructions. Accidents caused by train-wrecking are included under derailments. Partings of trains which have not resulted in collisions or derailments are excluded, as are other types of failure. In general, there was a substantial drop in accidents in recent years following a big rise in traffic over the last decade and a half. Detailed data are presented throughout the article.

Langley, CA (British Railways Board) *Railway Gazette* Vol. 122 June 1966, pp 473-475, 7 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-925)
DOTL RP

B1 037896
ELIMINATING THE HOT BOX
Elimination of freight car hot boxes is discussed as a result of experience on the New York Central during 1948-1949. The cars used has steel wheels, 5.5 times 10 in. journals, axleboxes fitted with tight lids, deflector strips, packing retainer springs, and drawgear protected by rubber pads. Maximum load on a bearing area in any axlebox could not exceed 199.2 lb. per sq. in. Based on the experience, the following was recommended: a packing retainer should be installed in every axlebox which would be capable of holding the packing in place under impact; journal box lids and dust guards should be kept as tight as possible, and suitable methods used to ensure that water and dirt are kept out of axleboxes; and defective wagon wheels should be replaced at the earliest possible moment. As longer-range measures, redesign of journals and bearings to reduce unit bearing pressures, of axles and axleboxes to eliminate collars on journals, and of frames and drought years of cars to minimize the effects on journal boxes of impacts between cars is suggested.

Railway Gazette Vol. 92 May 1950, p 533

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1087)
DOTL RP

B1 039410
ASSEMBLY AND MAINTENANCE OF TRAILERSTOCK WHEELSETS
The article discusses some problems in the assembly and maintenance of wheelsets. Included are relationships between press-fitting and shrink-fitting wheels and resulting distortions and effects upon wheel wear. The several ways of changing wheel profiles and their economics are also discussed. The effects of flange thickness related to wheel stability as well as problems in designing a standardized wheel profile for various applications are considered.

Question B79. Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways ORE Pub-25,26, 5 pp, 2 Fig, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-659)
DOTL RP

B1 039418
REUSE OF PARTIALLY LIFE-EXPIRED ROLLER BEARINGS
The life expectancy is discussed of freight car roller bearings which have seen extensive service. The meanings of the terms life expectancy and B-10 life as defined by the AAR are given. A typical bearing life expectancy curve is shown. A group of used bearings which are carefully inspected according to manufacturer's recommendtions should perform with reliability very nearly the same as new bearings. For maximum economy, such bearings should be reused based upon normal inspection and maintenance practices.

Timken Roller Bearing Company, Incorporated Aug. 1969, 3 pp, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-670)
DOTL RP

B1 039462
A GENERALIZED SPECIFICATION FOR COMPOSITION BRAKE BLOCKS FOR RAILWAY VEHICLES
The braking of railway vehicles may be improved technically and economically by a direct replacement of cast iron brake blocks by blocks of a composite material of the correct design and functional characteristic. Numerous available composite materials can introduce large savings due to their good wearing properties when compared to cast iron. As a result of excessive heat dissipation rates and thermal shock, rolling stock wheel treads can be seriously overstressed at the higher operating speeds by blocks of incorrect friction characteristic and physical design. This paper deals with the definition of the physical requirements related to the design of composition brake blocks for railway vehicles, and motivates a generalized specification for the performance characteristic.

Barnard, JH *Rail International* Oct. 1970, pp 694-703, 3 Fig, 2 Tab, 4 Phot, 6 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-757)
DOTL RP

B1 039466
CATALOGUE OF DEFECTS ON THE WHEELS OF RAILWAY TRAILER STOCK
The catalogue is solely concerned with the qualitative aspects of the defects without indicating their size. The catalogue is deliberately confined to defects of a mechanical or thermal origin without taking into account wear, or defects of a geometrical nature. For each type of defect the following are given: a brief description; one or more means of detection; recommendations relating to the measures to be taken for the wheel set to be returned to, or kept in, normal service; and, the probable cause of the defect.

Rail International June 1971, p 563, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-761)
DOTL RP

B1 039469
DESIGN OF SPRINGS
Due to high stresses and abrasive action between laminated spring plates causing a reduction in thickness, it is recommended that a service life be established for the springs and the springs then be replaced. Several other design weaknesses are described, including the center fastening.

Frost, WE (John Spencer & Sons, Ltd.) *Railway Gazette* Vol. 97 Dec. 1952, pp 705-706

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-785)
DOTL RP

B1 039505
PULLMAN'S APPROACH TO CENTER PLATE PROBLEMS
Tests were conducted on fabricated cushioned underframe center plates using a Hy-Cube car, using a car rocking device designed to excite a fully-loaded car at its natural roll frequency. Results were correlated with field service reports. Tests were in progress on the rocking device using a 100-ton covered hopper car. The conclusion of the two-year test program on cushioned underframe cars has indicated these results: rock and roll is instrumental in center plate wear and breakdown; breakdown originates in the transition radius and propagates into the transverse and longitudinal reinforcement; the 3/8" radius is not satisfactory for today's fatigue environment; longitudinal reinforcement on the center plate should be located over the outer circumference of the bowl; a flat center plate application significantly reduces the attachment pre-stress in the transition radius; both fabricated and cast center plates can develop cracking unless fatigue design is considered; the center plate application is related to car configuration; and supplemental snubbing devices that reduce car body roll would increase the fatigue life of center plates.

Technical Proceedings from 1969 Railroad Engineering Conference.

Rousseau, GL (Pullman-Standard Car Manufacturing Company)
Dresser Transportation Equipment Division Tech Proc Sept. 1969, pp 39-41

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1007)
DOTL RP

B1 039511
TOTAL CAR DESIGN FOR OPTIMUM CAR UTILIZATION
A new hopper car is described, which was to be tested by the Canadian National in late 1969. Truck and car design to minimize rail corrugation are described. Illustrations show rail corrugation being measured, track locations subject to corrugation, and bearing configurations.

Technical Proceedings from 1969 Railroad Engineering Conference.

Giesking, PF (National Steel Car Corporation)
Dresser Transportation Equipment Division Tech Proc Sept. 1969, pp 59-63, 12 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1013)
DOTL RP

B1 039563
WEARING PARTS OF ELECTRIC ROLLING STOCK
The subject of wear and tear on vehicles is considered. Focus is on two aspects; wear resulting from the work accomplished by the rolling stock and wear, particularly bogie frame wear, resulting from vibrations generated during operation. Tyre wear is also mentioned. This results in sharp flanges, deep flanges, thermal checking and flaking, and hollow treads. Each of these problems is briefly examined.

Railway Gazette Vol. 100 Jan. 1954, p 116

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1202)
DOTL RP

B1 039596
BALL AND ROLLER BEARINGS IN MODERN ROLLING STOCK
An increasing number of specifications calls for ball or roller bearings to be fitted at all vital points for locomotives and coaches. Advantages which have been realized include: (1) up to 85% lower starting and about 10% lower running resistance. (2) Reduced charges for inspection and maintenance. (3) Fewer hot boxes, resulting in an increased availability factor. (4) More economical use of lubricants. (5) Maintenance of axle and valve gear centres as designed, by virtue of the absence of wear. In the construction of locomotives and rolling stock generally, the following gives a fair idea of the extent to which this type of bearing has been used: locomotives: axleboxes, bogie driving, truck, and bogie pivots; spring compensation beams. Rolling stock: axleboxes bogie pivots. Diesel-engine vehicles; axleboxes; gearboxes; engine bearings; generator, armature bearings; motor armature bearings.

McArd, GW *Railway Gazette* Vol. 96 Jan. 1952, pp 39-43, 15 Fig, 1 Tab, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1248)
DOTL RP

B1 039621
APPARATUS FOR DETECTING WHEEL-SEAT FLAWS IN RAILWAY AXLES
The Research Department of the London Midland and Scottish Railway Company undertook the task of devising and developing a method of detecting wheel-seat flaws in railway axles without removing wheels from axles or even wheel and axle assemblies from the coach. The essential item consists of a rigid steel ring of square cross section, split diametrically to allow it to be clamped to the axle under test. Contact with the axle occurs at three spherical seatings, of which two are fixed to the inside of the ring and the third is adjustable and is screwed to grip the axle firmly after the two halves of the ring have been bolted together. The system described comprises essentially, two nominally rigid reference planes, fixed normal to the axle and set one on each side of a possible flaw situated near the inner end of the wheel seat. If such a flaw does exist the strength of the axle will be less in the direction passing through the center of the axle and the centroid of the flaw than in the direction at right angles to it. Details and case histories are given.

Johansen, FC *Railway Gazette* Vol. 78 1943, pp 190-192, 8 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1277)
DOTL RP

B1 039661
HEAVY-DUTY CAST-STEEL WHEELS FOR FREIGHT CARS
American Brake Shoe Company has developed a wheel now in volume production for hard service on freight vehicles for heavy commodity loads. During service testing on 23 U.S.A. railways in 1947-55 the wheels have run more than 5,600,000 miles on van, hopper, tank, flat, refrigerator, and other types of wagon of 40, 50, and 70 tons capacity. Five of the vehicles averaged 275,000 miles of operation and one totalled more than 350,000 miles. Measurements of rolling and braking wear on 1,000 of the new wheels showed only equal results to that of other steel wheels and was less in some service conditions. The Casting process is described and a cross section of the wheel, known as the Southern wheel, is shown.

Railway Gazette Vol. 103 Dec. 1955, pp 706-707, 1 Fig, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1359)
DOTL RP

B1 039680
TUBULAR CONSTRUCTION OF LIGHTWEIGHT STOCK
Experiments with tubular structure under impact conditions revealed that buckling in both circular-and square-section thin-wall tubes under dynamic

loading always started at an end, and at high speeds it was largely confined to that part of the specimen. As related to conventional railway-coach structure (where the longitudinal strength resides mainly in the heavy underframe) the tubular structure can absorb more collision energy for a given shortening. Some projections to coach construction are also given.

Railway Gazette Vol. 113 July 1960, pp 93-94

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1397)
DOTL RP

B1 039683
ACCIDENTS ON BRITISH RAILWAYS IN 1959
There were a total of 1154 accidents in 1959. Of these, 609 were attributed to the human element, 113 were caused by technical defects, and 432 resulted from other causes. Within the causes of the human element category there were 276 collision, 119 derailments, 174 running into obstructions, 7 fires, and 2 miscellaneous accidents. In the technical defects category there were 12 collisions, 69 derailments, 14 running into obstructions, 13 fires and 5 miscellaneous accidents. The other causes category accounted for 130 collisions, 27 derailments, 205 running into obstructions, 42 fires, and 28 miscellaneous accidents.

Langley, CA *Railway Gazette* Vol. 113 Oct. 1960, pp 418-420, 3 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1400)
DOTL RP

B1 039997
REPORT ON THE CHARACTERISTICS OF STEELS AT LOW TEMPERATURES--COUPLER INVESTIGATION
The report discusses problems in finding a basis for coupler failures between geographic areas. The parameter for comparison was the number of failures per freight car miles travelled. Conclusions are that more couplers fail during cold than hot months. The critical temperature for failure occurs a few degrees below freezing.

Association of American Railroads Tech Rpt AAR-M-190, Nov. 1945, 4 pp, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1464)
DOTL RP

B1 040003
ALUMINUM IN ROLLING STOCK: THE VALUE OF RESEARCH AND DEVELOPMENT
In Canada, aluminum is considered standard for box cars roofs, the inside lining of refrigerator cars, brine tanks, hopper cars for bauxite and alumina, hopper car hatch covers, piggy-back trailers and passenger car furnishings. The properties of aluminum which make it ideal for use in rolling stock are good strength and impact resistance, light weight, excellent corrosion resistance and good fabricating characteristics. Service experience and impact tests, which were more rigorous than conditions encountered normally, have shown that all-welded aluminum hopper cars are strong and rugged enough to withstand such severe treatment. Impact and fatigue test results are reported for several types of aluminum cars. The lightness of aluminum cars mean that fewer of these cars are required to transport a given cargo. The excellent resistance of aluminum to the weather and corrosive cargoes means that annual maintenance costs can be lowered appreciably. The life of the aluminum cars will be governed by failure due to mechanical causes rather than corrosion and even after their normal service life they will have a high scrap value.

Campbell, RA Whiting, JF Kemp, RA (Aluminum Laboratories, Limited)
Aluminum Company of Canada, Limited Tech Rpt Nov. 1957, 36 pp, 8 Fig, 1 Tab, 12 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1486)
DOTL RP

B1 040012
THE BEHAVIOUR OF THE MOTIVE POWER AXLES (WHEELS) ON THE S.N.C.F.
Wheel-set stresses are modified by the action of the strains inherent in service which may be categorized as follows: those affecting the shrinking-on; those which correspond either to vertical effort exerted by the wheel on the rail, essentially cylical, or to the lateral reactions of the rail on the wheel both cyclical and erratic (abnormal shocks); and those set up by a temperature rise, due to braking. The SNCF has tested, both in the laboratory and in service, the diverse stresses as they are linked up with strains. Common damages to wheelsets are described and are shown. Wheel manufacturers are using the test results to enhance wheel design criteria.

French Rail News Vol. 4 1969, pp 52-54, 9 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1495)
DOTL RP

B1 040013
SURFACE-TREATED MONOBLOCK WHEELS
Ten years of experience is reviewed with the use of carbon and manganese low-alloy steels for monoblock wheels. The service-life of these wheels is shown. Compared to tired-wheels for electric locomotives the surface-treated wheels can last twice the distance. Compared to chromium-molybdenum wheels, the surface-treated wheels had 20 percent lower cost, an increased service life of 30 percent, and a longer time-lapse between non-destructive test inspections.

French Rail News Vol. 4 1969, p 55, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1496)
DOTL RP

B1 040022
RESEARCHES ON INCREASING THE FATIGUE STRENGTH OF PRESS-FITTED AXLES
Fatigue tests with 50 mm dia. press-fitted specimens, heat-treated by Tufftride process or other processes, were made to determine the influence of those treatments upon fatigue strengths, sigma(sub omega 2) and sigma(sub omega 1). These are fatigue strengths based upon complete fracture of the shaft and initiation of minute fatigue cracks in fretted region. Main results obtained as are as follows: tufftriding is strongly effective to increase sigma(sub omega 1) as well as sigma(sub omega 2); if the superficial compound layer of iron and nitrogen is removed, sigma(sub omega 1) is lowered but sigma(sub omega 2) does not change; specimens, heated in Argon gas at the same temperature as Tufftride process followed by quenching in water, have the same sigma(sub omega 2) as that of Tufftrided ones. It is concluded that the increases of sigma(sub omega 1) and sigma(sub omega 2) by Tufftriding are due to the hard compound layer and the compressive residual stresses.

Nishioka, K Komatsu, H (Sumitomo Metal Industries, Limited) *JSME Bulletin* Vol. 14 N No. 3, July 1971, p 712

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1505)
DOTL RP

B1 040109
BRITISH RAILWAYS CARRIAGE AND WAGON AXLE DESIGN
Information is presented relating to the effect of shapes and stresses on the fatigue properties of components. The journal load, wheel load, and flange force are tabulated for a 74-ton car with 4.5-ton trucks. Fatigue strength of steel axles and bending moments for steel are shown. The ride quality and center of gravity for passenger trains are calculated.

Koffman, JL (British Railways Board) *Railway Gazette* Vol. 122 Apr. 1966, pp 281-283, 2 Fig, 5 Tab, 7 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1605)
DOTL RP

B1 040130
DERAILMENT DETECTION SYSTEM
The application of a Servo Rail Detector to cars which carry hazardous materials will cause the brakes to be applied immediately if any of the wheels of the car become derailed. This will bring the train to a stop and greatly reduce the possibility of a catastrophic accident. Each truck of a car has a sensor mounted near each wheel. The sensors are narrower than the width of the wheel. A nickel cadmium battery and wheel-driven alternator provide power for the system. The system will not interfere with or be interfered by signal or communications systems. It will operate over a temperature range of-40 degrees to 160 degrees F., and will operate for 7 days on battery power without car moving.
Company Report

Ray, RL Lockwood, RA
Servo Corporation of America SCA-P6411, 7 pp, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1630)
DOTL RP

B1 040131
SERVO RAIL DETECTIVE-DERAILMENT DETECTION SYSTEM
This proposal for the development of a derailment detection system was submitted to the Chicago Transit Authority. The planned system meets an urgent need for a reliable, low-cost derailment detection system for rapid transit service. The general operating characteristics of the proposed system are described.
Company Report

Weinstein, M Westover, T
Servo Corporation of America SCA-P-6249-1R, June 1969, 20 pp, 3 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1631)
DOTL RP

B1 040215
WHEEL, AXLE, AND RAIL STRESS PROBLEMS RELATED TO HIGHER CAPACITY CARS PART 1 AXLE PROBLEMS
This paper submits some fundamental considerations in the design of axles and propose two new axle designs of 72,000 and 80,000 pounds capacity. Larger axle design standardization must satisfy a wide range of car geometry factors such as (a) center of gravity height from 72 to 94 in and (b) wheel diameter ranging up through 40 in. The effect of these factors on axle capacity is shown by curves derived from the Reuleaux formula; serious deficiencies in this formula are also discussed. Other primary axle design factors presented are (c) wheel seat design (f) effect of switches, frogs, and crossings (e) effect of curved track (h) effect of flat spots and shellouts of wheel treads.

Horger, OJ (Timken Roller Bearing Company)
American Society of Mechanical Engineers Paper Nov. 1963, 16 pp, 7 Fig, 1 Tab, 24 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1678)
DOTL RP

B1 040216
BRITISH RAILWAYS INVESTIGATIONS INTO THE PROBLEM OF AXLE FATIGUE FAILURES UNDER THE WHEEL HUB
This paper discusses the problem of the fatigue failure of railway axles and points out the main factors contributing to failures of this type. The reasons behind the investigation currently in progress are described and the results obtained to date are given. Future work is detailed and it is shown how the results of these experiments should enable a more satisfactory axle service performance to be obtained. A certain amount of increase in axle fatigue strength has been obtained by the straightforward application of metallurgically better materials--as happened when wrought iron was replaced by steel. However, because of the overriding importance of shape in a component subjected to fatigue loading, as an axle is, it can be predicted that the use of even higher strength steels will not produce proportionate increases in axle fatigue strength unless allied to a shape of axle which excludes, as far as possible, all notch and stress concentration effects.

Burdon, ES
British Railways Conf Paper Apr. 1963, pp 27, 13 Fig, 12 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1679)
DOTL RP

B1 040220
RESEARCH ON THE OPERATING STRESSES IN PATH RAILCAR AXLES, DRIVE SYSTEMS, WHEELS, AND RAIL JOINTS
This paper identifies the cause of premature cracking of axles with inboard bearings as being the bending-mode oscillation of the axle. It points out the importance of gear-tooth separation produced by torsional oscillations in the drive motor system in both right angle and parallel drive gear failures. A unique technique of simultaneous measurement of impulse and thermal loads on the wheel tread is explained and the test data are presented. The relation between the wheel impact loads and the dynamic behavior of rail joints is shown.

Yontar, M (New York Port Authority :)
American Society of Mechanical Engineers Conf Paper 66-RR-6, May 1966, 21 pp, 33 Fig, 2 Phot, 36 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1683)
DOTL RP

B1 040222
WHEEL, AXLE, AND RAIL STRESS PROBLEMS RELATED TO HIGHER CAPACITY CARS--WHEEL PROBLEMS
Factors to consider in selecting a wheel for high capacity cars--aside from dimensional compatibility with the rail and truck, are wheel class, wheel diameter, and rim thickness. Rim thickness determines replacement period and is primarily a function of car utilization. Wheel diameter determines stress in the contact area of the wheel tread and rail. Wheel class determines relative resistance of wheels to wear and service damage, principally shelling and thermal cracking. Safety and economy of the operation depends largely on freedom from excessive shelling, thermal cracking, and rapid wear, all commensurate with the cost of new wheels, reconditioning, and maintenance.
Panel Symposium, the ASME Railroad Division November 21,1963

Johnsen, AM (Armco Steel Corporation)
American Society of Mechanical Engineers Conf Paper Nov. 1963, 5 pp, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1685)
DOTL RP

B1 040223
A THREE-DIMENSIONAL FINITE DIFFERENCE SOLUTION FOR THE THERMAL STRESSES IN RAILCAR WHEELS
A numerical solution is presented for both the transient temperature and three-dimensional stress distribution in a railcar wheel resulting from a simulated emergency brake application. A computer program has been written for generating thermoelastic solutions applicable to wheels of arbitrary contour with temperature variations in both axial and radial directions. The results include the effect of shear stresses caused by the axial-radial temperature gradients and the high degree of boundary irregularity associated with this type of problem. The program has been validated by computing thermoelastic solutions for thin disks and long cylinders; the computed values being in good agreement with the closed form solutions. Currently, the computer program is being extended to general stress solutions corresponding to the transient temperature distributions obtained by simulated drag brake applications. When this work is completed, it will be possible to synthesize the thermal history of a railcar wheel and investigate the effects of wheel geometry in relation to thermal fatigue.

Novak, GE (Materials Research Laboratory, Incorporated); Eck, BJ (Griffin Wheel Company) *ASME Journal of Engineering For Industry* 69-RR-4, Apr. 1969, pp 891-896, 13 Fig, 2 Phot, 12 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1686)
DOTL RP

B1 040224
ANALYSIS OF RESIDUAL, THERMAL, AND LOADING STRESSES IN A B33 WHEEL AND THEIR RELATIONSHIP TO FATIGUE DAMAGE
This investigation involves the problem of service loading conditions that produce the highest stresses and the possibility of fatigue damage. Static loading, rim heating, residual stress measurements, and fatigue tests were made in the laboratory on representative b33 wheels. A series of simulated loading conditions was studied and the resulting stresses combined by simple superposition principles. The resultant stress patterns were compared with fatigue test results using the modified Goodman relationship. In this way the service loading conditions that produce fatigue damage may be predicted.

Bruner, JP Benjamin, GN Bench, DM (Armco Steel Corporation) *ASME Journal of Engineering For Industry* RR-3 Paper No 66-WA/, Aug. 1966, pp 10, 14 Fig, 9 Tab, 5 Phot, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1687)
DOTL RP

B1 040226
EFFECT OF DESIGN VARIATION ON SERVICE STRESSES IN RAILROAD WHEELS
The continuing trend of present railroad operating practices toward higher wheel loads and speeds has created the need for better design criteria to insure that wheel configurations are the best attainable. Computer programs to simulate service braking and loading conditions have been applied to various wheel designs and the braking and loading stresses computed. The results indicate that cyclic stresses of significant magnitude may occur under different operating conditions, so fatigue concepts are important in wheel design considerations. There was no one optimum wheel design for all possible service conditions, although several configurations showed promise. A method was proposed for optimizing design for specific service conditions to safeguard against fatigue damage.

Contributed by Railroad Division of the ASME for presentation at the Winter Annual Meeting Energy Systems Exposition Pittsburgh Pennsylvania, November 12-17,1967

Bruner, JP (Armco Steel Corporation); Levy, S Jones, RD (Canadian Steel Wheel Limited); Wandrisco, JM (United States Steel Corporation)
American Society of Mechanical Engineers Paper 67-WA/RR-6, Nov. 1967, 16 pp, 12 Fig, 1 Tab, 10 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1690)
DOTL RP

B1 040301
ANALYSIS OF TAPERED ROLLER BEARING DAMAGE
Tapered roller bearings, damaged in field applications or laboratory tests have been subjected to a systematic analysis of such damage to prevent its recurrence in the field or to gain knowledge of its control in the laboratory. A method of analysis is described which has been developed for examining such bearing damage. The essential steps of the analysis are described with emphasis on the visual classification and metallographic examination of the damage. Bearing damage is classified in two major categories, that resulting from contact fatigue, and that due to other mechanisms. Damage which is related to material, surface finish, geometry, local asperities (grooves and bruises), the lubricant viscosity is usually due to contact fatigue. Damage due to other mechanisms is that which results from obvious mechanical, chemical, or electrical factors in the application which either change bearing geometry or eventually cause contact fatigue.

Widner, RL Wolfe, JO (Timken Roller Bearing Company, Incorporated)
American Society for Metals C 7-11.1, Oct. 1967, 32 pp, 1 Fig, 2 Tab, 37 Phot, 21 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1782)
DOTL RP

B1 040311
FATIGUE TESTS OF FREIGHT CAR AXLES 5 1/2 TIMES 10 INCH JOURNALS
The series of fatigue tests was concluded on a proposed design of raised wheel seat freight car axle with "as forged" (unmachined) body between wheel seats. The proposed design has a considerably greater fatigue strength in the wheel fit than the Standard Freight Car Axle (Black Collar Design). One group of Standard Freight Car Axles had an abnormally low fatigue resistance of 13,000 psi in the body portion between the wheel seats. This value was raised to the normal value of 17,500 psi by stress relieving at 1150 degrees F for six hours. One group of axles of the proposed freight car design had a similarly low body fatigue resistance of 13,000 psi. Machining the axle body was found to be beneficial in improving the fatigue resistance. This finding may mean that unfavorable residual stresses due to straightening were removed by machining.

Association of American Railroads Prog Rpt MR-242, June 1955, 59 pp, 23 Fig, 16 Tab, 6 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1792)
DOTL RP

B1 040317
STUDY OF FREIGHT CAR AXLE DESIGN TO WITHSTAND LOADINGS UP TO 10 RO 20 PERCENT IN EXCESS OF PRESENT AXLE LOAD LIMITS AND SUMMARY OF DATA ON AXLES FOUND DEFECTIVE BY MAGNETIC PARTICLE AND ULTRASONIC TESTING OVER A FIVE-YEAR PERIOD
This report covers the engineering study of recommeded axle dimensions for a load rating of 10 and 20 percent in excess of present axle load limits. This study covers the nominal 5-1/2" times 10", 6" times 11" and 6-1/2" times 12" axle sizes or respectively, 40,000, 50,000 and 60,000 pound per axle load ratings. This report also covers the results of a questionnaire sent to Member Roads to develop summary data on axles found defective when tested by magnetic particle and ultrasonic equipment with a projected estimate of the increase in expected failures when overloading beyond present axle rated capacities.

Association of American Railroads Res Rpt MR-404, 8 pp, 6 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1821)
DOTL RP

B1 040346
STRESSES IMPOSED BY PROCESSING
Types of residual stress, measurement and formation are discussed. Residual stresses were measured on two different sizes of truck axle shafts of 1 11/16-in. and 2 1/8-in. diameter. Two specimens were taken for residual stress investigation from each shaft, one toward the flange end and the other from the splined end. Metallurgical examination was made. Results of completely reversed torsional fatigue tests made on 1 11/16-in. diameter shafts are presented. Fatigue tests were made in rotating bending on full-size large-diameter shafts of two different designs. Fatigue results are summarized. Residual stresses were measured in these large shafts. Favorable surface compressive stresses were determined for these shafts water-quenched from the tempering temperature as compared with nil stresses in those aircooled. It was concluded that favorable thermal stresses were a very important consideration in improving fatigue strength.

Horger, OJ (Timken Roller Bearing Company, Incorporated) *SAE Quarterly Transactions* Vol. 5 No. 3, July 1951, pp 393-403, 19 Fig, 1 Tab, 1 Phot, 27 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1775)
DOTL RP

B1 040348
FATIGUE OF LARGE SHAFTS BY FRETTING CORROSION
Rotating bending fatigue tests were made for the AAR on sixty-six shafts of 9 1/2 inches diameter. A press-fitted member was mounted on each shaft. Fatigue failure initiated in the shaft under the fitted member. Six different engineering steels were used for the shaft forgings. Some steels were normalized and tempered while others were quenched and tempered. Two groups of specimens were quenched below the critical temperature to develop residual compressive stresses in the surface zone. All shafts were run 85 million stress reversals unless breakage developed earlier. The maximum allowable bending stress of endurance limit to prevent the shaft breaking off under the fitted member for all normalized and tempered or quenched and tempered shafts ranged from 9,500 to 12,500 lb. per sq. in. The two groups of shafts given a subcritical quench gave endurance values of 18,000 and 19,000 lb. per sq. in.

Horger, OJ (Timken Roller Bearing Company, Incorporated)
Institution of Mechanical Engineers Conf Paper Sept. 1956, 11 pp, 5 Fig, 6 Tab, 4 Phot, 9 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1777)
DOTL RP

B1 040349
FATIGUE STRENGTH OF NORMALIZED AND TEMPERED VERSUS AS-FORGED FULL SIZE RAILROAD CAR AXLES
Rotating cantilever fatigue tests were made on 48 full size railroad car axles to determine the fatigue strength of the axle wheel seat on which is pressed-on. Plain carbon steel of 0.39 to 0.53 per cent carbon content in both the as-forged and normalized and tempered condition was investigated. As-forged axles had 1/3 greater fatigue resistance in the wheel seat to the initiation of fatigue cracks than normalized and tempered axles of practically

same carbon content. Of two groups of as-forged axles the one having about 10 points higher carbon showed 1/3 greater fatigue resistance in the wheel seat to the initiation of fatigue cracks than the lower carbon content axles.

Horger, OJ Buckwalter, TV (Timken Roller Bearing Company, Incorporated)
American Society for Metals Sept. 1943, pp 559-581, 2 Fig, 5 Tab, 12 Phot, 9 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1778)
DOTL RP

B1 040350
STRESSING AXLES AND OTHER RAILROAD EQUIPMENT BY COLD ROLLING
The history associated with the development of surface pressing is discussed, followed by examples of tests and practical applications. A discussion of the reasons and theory for the improvement in fatigue resistance is presented.
Reprinted from "Surface Stressing of Metals"

Horger, OJ (Timken Roller Bearing Company, Incorporated)
American Society for Metals pp 85-142, 32 Fig, 8 Tab, 26 Phot, 63 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1779)
DOTL RP

B1 040359
EFFECT OF OVERHEATING ON THE FATIGUE RESISTANCE OF PLAIN BEARING AXLE JOURNALS
A laboratory test of axles was authorized in which axle journals would be overheated under load in the laboratory and subsequently fatigue tested to determine the effect of overheating. It was decided to carefully evaluate all axles which had failed in the test to determine whether or not copper penetration was present. Tentative conclusions based on the data obtained to date are: 1. Damage to the steel structure of axles due to severe journal overheating can occur without being caused by copper penetration. 2. No traces of copper penetration have been found in the overheated specimens.

Association of American Railroads Prog Rpt AAR MR-212, 1952, 1 p

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1803)
DOTL RP

B1 040362
EFFECT OF PERIODIC NORMALIZING OF TRUCK SIDE FRAMES
The two series of tests on eight side frames covered by this report are the basis for the following conclusions: 1. Heat treatment of second hand truck side frames did not increase their fatigue life expectancy. 2. The reconditioning of worn column areas by welding when subsequently heat treated does not impair fatigue life expectancy. 3. The normalizing heat treatment process (heating to 1550 degrees F and cooling in still air) did not result in improved fatigue test performance in comparison with the stress relieving heat treatment as given the first four frames.

Association of American Railroads Res Rpt AAR MR-219, May 1954, p 1

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1806)
DOTL RP

B1 040363
FATIGUE TESTS OF FREIGHT CAR AXLES 5 1/2 TIMES 10 INCH JOURNALS
This is the first Progress Report on a series of tests made at the Canton Laboratory on a proposed design of raised wheel seat freight car axle with "as forged" body between wheel seats. These tests are part of the program undertaken with the object of providing an improved freight car axle. The indications at this time are that: the proposed design "as forged" raised wheel seat axle appears to have a slightly greater fatigue life than the present standard AAR black collar design axle. Machining the axle body between wheel seats is beneficial to the fatigue life of the axle.

Association of American Railroads Prog Rpt AAR MR-221, Apr. 1954, 1 p

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1807)
DOTL RP

B1 040365
FATIGUE TESTS OF FREIGHT CAR AXLES 5 1/2 TIMES 10 INCH JOURNALS
This report concludes the series of fatigue tests made at the Canton Laboratory on a proposed design of raised wheel seat freight car axle with "as forged" (unmachined) body between wheel seats. These tests constitute a part of the program undertaken to develop an improved freight car axle. The conclusions drawn from this investigation are as follows: 1. The proposed design "as forged" raised wheel seat freight car axle has a considerably greater fatigue strength in the wheel fit than the Standard Freight Car Axle (Black Collar Design) due to two factors: (a) The removal of the black collar and use of the raised wheel seat design gives an improved shape, resulting in at least 13% greater fatigue resistance to breaking off in the wheel fit. (b) The increased diameter at the wheel seat decreases the stress at that location by 21%.

Association of American Railroads Prog Rpt AAR MR-242, June 1955, 1 p

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1809)
DOTL RP

B1 040370
IMPACT TESTS OF HOPPER CAR LOADED WITH FERROMANGANESE ORE
This report describes impact tests made on a four pocket hopper car loaded with ferromanganese ore in order to determine whether or not it is safe to ship such a product in hopper cars. Tests were made on both the A and B ends of the hopper car at speeds up to 11.3 miles per hour, and measurements and observations were made to check for any permanent deformation in major structural members of the car and for adequacy of the experimental wood bracing arrangement. It was included that hopper cars can be employed safely for the transportation of ferromanganese ore if adequate bracing is applied to the doors of the loaded hoppers. Only approved methods of bracing should be used and wood wedges should be used to secure the locking pawls of the door latches.

Association of American Railroads Res Rpt AAR MR-321, Aug. 1958, 1 p

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1815)
DOTL RP

B1 040371
INVESTIGATION OF AXLE JOURNAL FILLETS AND DUST GUARD SURFACES RESULTING FROM CONTACT WITH JOURNAL BOX DUST GUARD FLANGES
In order to determine the extent to which damage was occurring with the dust guard opening in its present configuration, the Research Department made a field survey of axles coming into the wheel shop for attention. A total of 126 dust guard seats and fillets of axles were examined. During this examination it was observed that the following damage was occurring: 1. Pounding at the fillet, 2. Wear at the juncture of the fillet and dust guard seat diameter, 3. Grooving at the fillet caused by pressure on the dust guard seat diameter cold working the metal. As a result of damage to axle fillets by contact with dust guard wall surfaces, the Car Construction Committee reviewed the matter and decided that the dust guard wall projection should be modified to prevent damage to journals and also to provide better retention of oil in the journal box.

Association of American Railroads Res Rpt AAR MR-324, Aug. 1958, 4 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1816)
DOTL RP

B1 040373
IMPACT TESTS OF BALTIMORE AND OHIO RAILROAD TWO-POCKET FIFTY-TON HOPPER CAR LOADED WITH FERROMANGANESE
This report covers the results of a series of impact tests with a two-pocket fifty-ton hopper car loaded with ferromanganese. The purpose of this series of impact tests was to determine the safety of shipping this dense commodity in a standard hopper car that has auxiliary bracing between the hopper doors and also to determine the extent of the damage that can normally be expected on the hopper pockets and door equipment when the car is

subjected to over-solid impacts. The following conclusions were made. The Baltimore and Ohio two-pocket hopper car, Class N-44, is representative of equipment that can be safely used to transport ferromanganese if the hopper doors are properly braced in the same manner used in this series of tests. The results of this test show that it is reasonable to expect a certain amount of bulging and distortion to the hopper doors, frames, and the hopper sheets adjacent to the door when ferromanganese is transported in this type car when the car is subjected to impacts at speeds of 6 mph or greater. The impacts in this series of tests were as high as 10.9 mph, which is higher than would be expected in normal service.

See also AAR MR-321 for similar studies.

Association of American Railroads Res Rpt AAR MR-350, Apr. 1959, 1 p

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1818)

DOTL RP

B1 040401

COMPOSITION BRAKE BLOCKS--INTERACTION BETWEEN COMPOSITION BRAKE BLOCKS AND WHEELS

The service tests with various makes of K-block on the Berliner S-Bahn are described. The object of the tests was to study the interaction of the two friction elements, block/wheel. Although a strong tendency for the formation of cracks in wheel tires had occasionally been observed with K-blocks, in the service tests such a tendency could not be detected. All the stages of grooving and follow-wear were present on the tires. Similar phenomena had been observed by the SNCF on suburban services. Experience gained by the DB showed that some difficulty arose due to metallic particles sometimes becoming embedded in the braking surface of the block. K-blocks were used extensively on the London Transport Underground lines. Thermal cracking, tire spalling and wear constituted a special problem on the frequently-stopping motor coaches with heavily-loaded small diameter wheels, running in tube tunnels. The performance of a K-block depended on various parameters: characteristics of the block and of the wheel steel, application conditions, service conditions, weather, and shape of block. The development of a universal K-block would be difficult.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Intrm Rpt. B64/RP 2/E, Mar. 1967, 62 pp, Figs., Phots., 8 App.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1864)
PURCHASE FROM: UIC Repr. PC

DOTL RP

B1 040403

COMPOSITION BRAKE-BLOCKS-EFFECTS OF HUMIDITY ON BRAKING

Tests carried out by the SNCF, to determine the effects of humidity on braking; were made with 20 different types of existing composition brake-block. On the test rig at Vitry, braking tests were made from speeds of up to 160 km/h to a stop, and continuous braking tests were made with single cars at about 60 km/h. In service, fly-shunting tests at speeds of up to 140 km/h were made. The brake-block wear was not measured during the tests on wet rails. The similarity of the curves obtained with the different makes of block on dry wheels was not repeated on wet wheels. It would seem that not all the blocks have been designed and manufactured with the same object of obtaining satisfactory performances under wet conditions.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B64/RP 4/E, Apr. 1968, 16 pp, Figs., Tabs., Phots.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1866)
PURCHASE FROM: UIC Repr. PC

DOTL RP

B1 040404

COMPOSITION BRAKE BLOCKS-METALLIC INCLUSIONS IN THE COMPOSITION BRAKE BLOCKS

Metallic inclusions is given types of composition brake blocks lead to excessively severe wear of the tires and of the blocks. Recent experience has shown that not all composition brake blocks are affected by metallic inclusions. A list indicates those composition brake blocks which, according to data collected up to mid-1969, are unaffected or are affected only in certain isolated instances by metallic inclusions, and which therefore behave favourably with respect to undue wear of the wheel-tire. The list also shows which organizations obtained these favorable results, with which type of vehicles and in which kind of service.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B64/RP 6/E, Oct. 1979, 9 pp, 21 Fig., 5 Tab., 3 App.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1867)
PURCHASE FROM: UIC Repr. PC

DOTL RP

B1 040406

COMPOSITION BRAKE-BLOCKS-TESTS WITH COMPOSITION BRAKE-BLOCKS OF VARIOUS DIMENSIONS AND SHAPE

The German State Railway conducted the necessary tests on the bench and on the Berlin S-Bahn. The tests were based on the assumption that the wheel wear might be diminished if the shape of the composition brake blocks was altered from the usual rectangular shape taken over from cast-iron blocks. A number of different geometrical shapes of the friction surface of composition brake blocks were considered. The coefficient of friction under various conditions was similar with all block shapes tested. None of the block shapes tested produced any bad side effects. It was not possible to find any significant differences between the different block shapes when braking with one block per wheel or with two blocks per wheel; though tire wear for braking with one block per wheel was slightly lower than that for braking with two blocks per wheel. The tests have not revealed any compelling reason for diverging from the customary simple rectangular shape brake blocks.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B64/RP 8/E, Oct. 1970, 9 pp, 35 Fig., 3 App.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1869)
PURCHASE FROM: UIC Repr. PC

DOTL RP

B1 040412

GENERAL PROBLEMS CONNECTED WITH WHEELS AND THEIR ASSEMBLY: SOLID CAST-STEEL WHEELS, WHEELS OF DIFFERENT DIAMETER AND SHAPE--THIRD CONTRIBUTION TO THE STUDY OF SOLID CAST-STEEL WHEELS

In this report an account is given of the running tests, the braking tests on the wheel testing machine and the test runs on steep falling gradients. The running tests employed wheels of 730 mm diameter with treated wheel-rim of non-alloyed steel with a carbon content of either 0.61% or lower than 0.5% with an ultimate tensile strength of 115 to 130 hbar and 84 to 101 hbar respectively. Other tests were made with solid wheels of 920 mm diameter made of Wt steel (carbon and manganese content lower than or equal to 0.52% and 0.80% respectively. These tests consisted of falling-gradient runs on the St. Gothard line and of runs on flat sections under loaded wagons. Some wheels were also submitted to tests on the test rigs at MINDEN, VITRE-sur-SEINE and DERBY, in order to determine their behavior under the effect of heat generated by braking (liability to thermal cracks and deformations of the wheel-rim). Finally, one wheel of 730 mm diameter and wheels of 920 mm diameter of Wt steel were submitted to investigations in the laboratory and the latter wheels were in addition, studied with a view to the stresses developed. The braking tests carried on the rig with 730 mm diameter ABEX wheels have given unfavorable results. The running tests in commercial service have also given unfavorable results (spalling of running-tread). Concerning the GRIFFIN wheels of the same diameter, the running tests have also supplied disappointing results, there wheels displaying spalling or even perhaps flaking. The ABEX and GRIFFIN wheels of 970 mm diameter with treated wheel-rim and somewhat high carbon content showed a good behavior in SWEDEN during tests under high load (25 t/axle) but very mild braking conditions, the climatic conditions however being very severe. The 920 mm ABEX wheels, ordered in Wt steel have shown a good behavior during the running tests and du-

the braking-tests on the MINDEN, VITRY and DERBY rigs (resistance to thermal cracks). However, during the falling-gradient runs on the St. Gothard line, they had given rise to deformations reducing the play of the axle.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B98/RP 8/E, Oct. 1970, 29 pp, Figs., Tabs., Phots., 8 App.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1875)
PURCHASE FROM: UIC Repr. PC

DOTL RP

B1 040437
BEHAVIOUR OF THE METAL OF THE RAILS AND WHEELS IN THE CONTACT ZONE--ENQUIRY INTO THE PROBLEM OF SMALL DIAMETER WHEELS

This report summarizes the responses to an enquiry into the effect that a reduction in the diameter of wheels would have on the behavior in service of the rails and wheels. Information was collected on the subject of P/D ratios (P = load per wheel in tons, D = diameter in meters) and includes an analysis of tests carried out by the U.S., Russia, Germany, the British and the French. Very different values of P/D were found, depending on the railway and especially on the type of steel in the rails.

Partial Copy--Appendix 3 Abstracted Separately, Question C53. Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Interim Report No. 3, Oct. 1966, 6 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1903)

DOTL RP

B1 040496
THE DUAL ROLES OF DESIGN AND SURFACE TREATMENT IN COMBATING FATIGUE FAILURES

The problem of producing components which will have satisfactory lives under repeated stress conditions requires a twofold approach. In the first instance the design must take account of any stress concentration effects in the component by geometrically distributing the material in the most efficient way so as to reduce such stress concentration effects to a minimum. The second approach is based on the fact that fatigue failures in the vast majority of cases are initiated on the surfaces of components. The designer must consider what deleterious surface effects occur on the component being designed, and counter these with the use of a surface treatment applicable to the particular case being studied. The present-day incidence of fatigue failures in all branches of engineering 90 percent of all service failures, is intolerably high. The importance of the twofold approach in designing for fatigue loading conditions is extremely important.

Wise, S Burdon, ES (British Railways Board) *Institution of Locomotive Engineers Journal* Vol. 54 No. 298, Part 2, pp 142-215, 23 Fig, 8 Tab, 1 Phot, 27 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1980)

DOTL RP

B1 040506
COMPOSITION BRAKE BLOCKS AND TYRES

This paper describes some of the problem which have arisen from the use of composition brake blocks in the past. For at least two of these, wet stopping performance and thermal cracking, there is now an understanding of the problem and possible solutions. Present-day production has also resulted in blocks free from the other difficulties. Other methods of avoiding the dangers associated with thermal cracking have been indicated: these involve moving away from the classic wheel and tire arrangement and the materials which have persisted for many years.

Wise, S Lewis, GR *Railway Division Journal* Vol. 1 Part 4, 1970, pp 386-443, 5 Fig, 4 Tab, 7 Phot, 13 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1993)

DOTL RP

B1 040529
TWENTY YEARS' EXPERIENCE WITH DIESEL RAILCARS

The following topics are discussed: Bodies--A short discussion on the relative merits of light alloy and steel construction together with some notes on our experience with various materials used in the passenger areas and finally a discussion on the problems of heating this type of vehicle. Bogies--Some notes on the problems which have been associated with the brake gear, followed by a discussion of the riding problems experienced with these vehicles and then some notes on the problems which were encountered with axle design. Power Equipment--A short discussion on the relative merits based on experience of gear boxes and torque converters. Some notes on the various problems which have been associated with the final drive units and lastly notes on the performance.

Wakefield, FHG *Railway Division Journal* Vol. 2 No. t 1, 1971, pp 45-83, 6 Fig, 1 Tab, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1969)

DOTL RP

B1 040534
MEASURES TO COUNTER FATIGUE FAILURE IN RAILWAY AXLES

This paper reviews the experience in London Transport of fatigue cracking in railway axles, and presents the results of laboratory fatigue tests on full-scale axle specimens under simulated rotating bending. The investigation was undertaken with the aim of entirely eliminating fatigue cracking and fretting under the press fits of wheel-axle sets. Cold rolling of wheel seats strongly inhibits the propagation of such fatigue cracks but it does not prevent their initiation. The introduction of a stress-relieving groove, such that the edge of the press fit overhangs the groove, leads to a marked reduction in fretting and increase in life of test specimens, and the results of a limited service test suggest that the presence of such a groove reduces the stresses under the wheel hubs to a level at which cracking is eliminated.

Maxwell, WW (London Transport Board); Dudley, BR (Nottingham University, England); Cleary, AB (Imperial Chemical Industries Limited); Richards, J Shaw, J (London Transport Board) *Institution of Locomotive Engineers Journal* Vol. 58 No. 322, Part 2, pp 136-171, 5 Fig, 2 Tab, 4 Phot, 27 Ref, 3 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1986)

DOTL RP

B1 040546
DEVELOPMENT OF RAILWAY TECHNIQUE AND OPERATION

Recent operational statistics for the Dutch Railways are discussed. An extensive program to reduce operating costs is described. Technical improvements in testing equipment, automatic coupling, traffic control systems, and directions of future research are outlined.

Koster, JP (Netherlands Railways) *Institution of Locomotive Engineers Journal* Vol. 54 No. 301, Part 5, pp 379-404, 1 Fig, 14 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2006)

DOTL RP

B1 040551
DESIGN CONSIDERATIONS FOR NEW ROLLING STOCK FOR THE VICTORIA LINE, LONDON TRANSPORT RAILWAYS

The 1967 Tube Stock incorporates many new features, some arising directly from the fact that the trains will only carry a single operator. The background to the development of many of the new items is traced and reference made to prototype testing which was carried out on a very extensive scale. The rolling stock, which is suitable for operation in 12 ft. diameter tunnels, is made up into 4-car units each consisting of two driving motor cars and two trailer cars. Two units will normally be coupled together to form an 8-car train. The trains are arranged for automatic operation and are controlled by a single operator, situated in the front cab, who controls the door operation and the starting of the train. The station to station run is normally performed entirely automatically, but manual control can be substituted in the event of failure of the automatic equipment.

Webster, E (London Transport Board) *Institution of Locomotive Engineers Journal* Vol. 58 No. 326, Part 6, pp 516-563, 9 Fig, 8 Phot, 7 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2011)

DOTL RP

B1 040778
SUMMARY OF FATIGUE TESTS OF FREIGHT CAR AXLES AND ESTIMATED EFFECT OF OVERLOADING
This report was prepared to accumulate and consolidate all data now available for consideration on the problem of overloading of cars in order to resolve the question as to whether the strength of axles and other car conditions justify changes in the present rules which would permit or restrict heavier loading. With a 10 percent overload, the estimated number of axles which will fail before running their full life expectancy is 72 percent. With a 20 percent overload, the estimated number of axles which will fail before running their full life expectancy is 100 percent.

Association of American Railroads MR-390 Res Rpt, July 1960, 18 pp, 2 Fig, 6 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1820)
DOTL RP

B1 040783
FATIGUE COMPARISON OF 7-IN. DIAMETER SOLID AND TUBULAR AXLES
The object of this experimental investigation was to determine the fatigue resistance of solid versus tubular type axles for railroad car service. Solid axles tested represented conditions consistent with existing railroad specifications. The tubular axles investigated were of two types; one of which was tested with permission of A.A.R. and the results reported by the manufacturer, the other was tested as a separate project in order to contribute information on certain questions pertaining to the fatigue strength of axles. Rotating cantilever beam fatigue tests were made on axles about 7 in. in diameter using steel of about S.A.E. 1045 analysis. Comparison of axle fatigue resistance due to a press-fitted wheel was made between "as-forged" solid members and seamless tubes in "hot-rolled" and several conditions of heat treatment. Results showed that tubular axles having high tensile strength values may or may not exhibit greater fatigue strength than those having lower physical properties. Observations on the effect of residual stresses are given. Some tubular axles showed greater fatigue strength than the solid ones.

Horger, OJ Buckwalter, TV (Timken Roller Bearing Company, Incorporated)
American Society for Testing and Materials Proceeding Vol. 41 1941, 12 pp, 6 Fig, 3 Tab, 6 Phot, 9 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2033)
DOTL RP

B1 040797
PANEL DISCUSSION--C&NW WAGES WAR AGAINST TRAIN ACCIDENTS
This paper surveys the creation and current operation of the C&NW, Accident and Loss Prevention Department. Topics include procedures for analysis of derailments, review of hot box and dragging equipment detector systems and implementation and rules education. The first year after creation of this department, the costs of our train accidents were down over 30% from the previous year of 1966. Even more encouraging was the fact that losses resulting from human failures decreased over 90%.

Waugh, TL Hoffman, RP McKerr, JD Ingram, CW (Chicago and North Western Railway) *AREA Bulletin* Vol. 70 70-621-12, 1969, pp 936-945

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2039)
DOTL RP

B1 040800
WHAT CAUSES WHEEL TREAD DEFECTS? PART 1: SHELLING
Studies were made of wheels that shelled in service after being subjected to the usual on-tread braking as well as a wheel equipped with disc-type brakes. These studies have indicated that shelling is essentially a fatigue failure that is caused by rolling loads. The formation of structurally weakened metal as the result of the heat of braking friction is believed to accelerate the formation of shelling cracks. Macroscopic examinations of radial-tangential sections from shelled areas have indicated that shelling is caused by cracks that form at angles of 30 to 50 deg to the tread surface. Because shelling cracks are oriented at 30 to 50 deg to the tread surface they are assumed to be caused by high shear stresses developed by rolling loads.

Wandrisco, JM Dewez, FJ, Jr (United States Steel Corporation) *Railway Locomotives and Cars* July 1960, pp 30-32, 10 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2030)
DOTL RP

B1 040812
WHAT CAUSES WHEEL TREAD DEFECTS? PART 2: THERMAL CRACKING
United States Steel undertook an investigation of wheel-tread defects. Shelling was shown to be the result of repeated stress application to the rolling wheel, which apparently caused the tread metal to fail in shear. Cracks propagate from below to the tread surface. When two of these cracks of opposed orientation meet beneath the tread, metal between them is loosened and finally expelled. This is the typical shelling type of failure. While shelling apparently is not caused by braking, there are wheel defects which can be caused by stresses that develop in the wheel rim as a result of thermal gradients generated by friction between the tread and brake shoe during braking. Shelling and thermal cracking of railroad wheels shorten wheel life, and checking brought on by severe braking may occasionally result in a complete wheel failure.

Wandrisco, JM Dewez, FJ, Jr (United States Steel Corporation) *Railway Locomotives and Cars* Aug. 1960, 4 pp, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1463)
DOTL RP

B1 041227
PRICE LIST OF PUBLICATIONS ISSUED BY TIME ASSOCIATION OF AMERICAN RAILROADS
The main headings are: Operations and Maintenance Department; Research and Test Department; Management Systems Department; Economics and Finance Department.

Association of American Railroads Jan. 1972, 61 pp

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AAR Repr PC

B1 043654
ELECTRONIC CRASH RECORDER. VOLUME I. DESIGN AND PRELIMINARY DEVELOPMENT
The requirements for a sensing and recording device for use in passenger vehicles are listed with a discussion of how the requirements are met with a prototype unit which was fabricated and assembled. A complete description of the electronic circuits for conditioning signals from remote transducers is included with a signal processing technique for recording data on a magnetic tape system. Laboratory tests on critical elements of the recording devices are discussed and the results of the tests are noted to show feasibility of the design. (Author)

Conlon, CMJ
Avco Systems Division Final Rpt Feb. 1972, 164 pp

Contract DOT-FH-11-7603

ACKNOWLEDGMENT: NTIS (PB-213449)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-213449, DOTL NTIS

B1 044275
STANDARDIZED FORMAT FOR RAILROAD ENVIRONMENT WITH APPLICATION TO FATIGUE DESIGN AND TESTING
This paper outlines a format for recording railroad environmental spectrum data that utilizes the standard arrangement of the modified Goodman diagram. In this form the environmental data is applicable to theoretical finite life fatigue design and to variable-cycle spectrum-type fatigue testing. Maximum loadings for operational guidance, equivalent static design analysis, lading damage studies, and proof testing are also accurately portrayed. The extensive environmental data requirements for modern design dictate the need for standardization of data format and content to provide compatibility of data from various sources and facilitate formation of the national data bank required by the railroad industry.

Contributed by the Rail Transportation Division of ASME for presentation at the IEEE-ASME Joint Railroad Conference, St. Louis, Mo., April 11-12, 1973.

Cook, RM (Association of American Railroads)
American Society of Mechanical Engineers Paper 73-RT-2, Apr. 1973, 8 pp

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL RP

B1 046408
STUDY OF RIM STRESSES RESULTING FROM STATIC LOADS ON DIFFERENT 36-INCH RAILROAD WHEEL DESIGNS
This report is the result of a series of experimental tests made at the Southern Railway Research & Tests Laboratory in Alexandria, Va., on 36-in.-dia., one-wear railroad wheels. The purpose of this investigation was to evaluate the stress levels developed in the rim section of different wheel designs, and to determine if there exists a relationship between high stress levels in the wheel rim and a history of fatigue failures of the wheel tread.

Lovelace, WS
American Society of Mechanical Engineers Paper 71-RR-4, Apr. 1971, 12 pp

ACKNOWLEDGMENT: British Railways (29015)
PURCHASE FROM: ASME Repr PC
DOTL TF5.A72 1971

B1 047555
THE REQUIREMENTS FOR A BALANCED DRAFT SYSTEM COUPLERS, RAILWAY FREIGHT CARS TO PRESERVE INTEGRITY OF OPERATIONS, MAXIMUM AVAILIBILITY AND LOW MAINTENANCE COSTS. PANEL DISCUSSION
Train Partings are a problem, but railroads do not have unlimited funds. So a balanced draft system is required, in which each component is engineered with regard for the other components. Specifications are presented for Grade C and Grade Couplers. The knuckle is designed as the weakest line, but with new knuckles, many old couplers fail first. Standardization of couplers and components of the draft system is discussed. Statistics are given on components in service and on failures. The comments of delegates and the responses of the panel are presented.

Proceedings of the 1972 Railroad Engineering Conference, Advancing Freight Car Design the Meet the Changing Environment of Modern Train Operations, Sponsored by Dresser Industries, Incorporated, 6-8 September 1972.

Hinson, AE (Southern Railway Company); Terlecky, B (Trailor Train Company)
Dresser Transportation Equipment Division Proceeding 1972, pp 50-57

PURCHASE FROM: ESL Repr PC, Microfilm
DOTL RP

B1 047557
THE FEDERAL RAILROAD ADMINISTRATION
In an effort to implement the Railroad Safety Act of 1970, the FRA is approaching three problem areas: defective track, defective equipment, and unqualified people. Track standards are in effect. Employee qualification standards are in the works, and equipment standards are about to be published. This presentation and discussion is directed toward equipment standards. Equipment standards concern (1) inspection requirements, (2) design, and (3) maintenance.

Proceedings of the 1972 Railroad Engineering Conference, Advancing Freight Car Design to Meet the Changing Environment of Modern Train Operations, Sponsored by Dresser Industries, Incorporated, 6-8 September 1972.

Rourke, JE (Federal Railroad Administration)
Dresser Transportation Equipment Division Proceeding 1972, pp 67-71

PURCHASE FROM: ESL Repr PC, Microfilm
DOTL RP

B1 047558
CHIEF OPERATING OFFICERS' VIEW OF MODERN FREIGHT CARS AS THEY AFFECT TRAIN OPERATIONS
The success of a company depends on the judgement used in making capital expenditures. The single most important area for capital investment is the freight car fleet. The freight cars are the key to quality service, new business and future profitability. Engineering of freight cars is a must. Component reliability and ride quality are critical. Investment price and maintenance cost are problems. The dynamic characteristics of cars and the reliability of their components have major influences on freight train safety. 'Scaled up' car fleets have had an impact on track. There must be a total systems approach to freight trains and their operation. On the B&LE, two industrial engineers have been appointed to investigate each derailment, to pinpoint responsibility, and to identify a solution. A summary of their investigations is given. Delegate comments and the panels responses are included.

Proceedings of the 1972 Railroad Engineering Conference, Advancing Freight Car Design to Meet the Changing Environment of Modern Train Operations, Sponsored by Dresser Industries, Incorporated, 6-8 September 1972.

Cena, L (Atchison, Topeka and Santa Fe Railway); Hunt, KE (Canadian National Railways); Read, JW (Bessemer and Lake Erie Railroad)
Dresser Transportation Equipment Division Proceeding 1972, pp 72-82

PURCHASE FROM: ESL Repr PC, Microfilm
DOTL RP

B1 047821
BRAKE SHOE PERFORMANCE ON 100 TON FREIGHT CARS
The braking performance of 100-ton cars should be viewed from the ability to provide a braking level or stopping capability no less favorable than lighter weight cars. Such a performance level can not be matched by 100-ton cars with cast metal shoes at a reasonable braking ratio. However the performance criteria for COBRA shoes on 100-ton cars is to provide a stopping ability, at minimum, on less favorable than a 50-ton car with cast metal shoes. This has obvious benefits in the areas of signal spacing, high speed consideration, etc. With this stopping ability however the most advantageous maintenance and economic relationships available should be realized. With the number of existing 100-ton cars with metal shoes presently in service, together with the majority of new 100-ton cars having COBRA shoes, it has been possible to accurately measure the economic and braking performance relationships between the two brake shoe concepts. The information contained in this presentation provides a summary of data in both of these areas.

Railroad Friction Products Corporation RFP-111, Feb. 1969, 14 pp, 4 Fig, 2 Tab

ACKNOWLEDGMENT: Railroad Friction Products Corporation
PURCHASE FROM: Railroad Friction Products Corporation Wilmerding, Pennsylvania, Repr PC
DOTL RP

B1 050072
EFFECT OF FLAT WHEELS ON TRACK AND EQUIPMENT
Although old, this work is generally considered to be an excellent reference on this subject. The report describes the Test Apparatus and the Tests, presents the results of the tests, and presents some conclusions from the tests. The conclusions cover the effect of train speed, the effect of flat spot length, the effect of wheel load, and the impact force of a flat spot; and recommend guidelines for removing wheels from service and for running cars with flat wheels to terminals for service.

Association of American Railroads Technical Center May 1951, 81 pp, 27 Fig, 3 Tab, 9 Ref

ACKNOWLEDGMENT: Association of American Railroads Research Center (f4196)
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr PC
DOTL RP

B1 050543
HIGH-CUBE CARS HAVE CREATED A MARKET FOR COUPLER POSITIONING DEVICES
Since coming on the railroad scene less than ten year ago, the high-cube auto parts car has shown as alarming affinity for passed coupler damage. The coupler centering and positioning devices can, in the majority of instances, prevent the passing of couplers. Several devices on the market are presented.

Railway Locomotives and Cars Vol. 147 No. 1, Jan. 1973, 4 pp

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

B1 051924
COUPLER AND KNUCKLE SERVICE PERFORMANCE
Combines failure data from two sources with fleet population data to obtain a relative failure index which is a measure of the relative failure rates among the coupler and knuckle components currently in freight service on american railroads. Also, includes statistics from the AAR mechanized car repair billing exchange system for couplers and knuckle components currently in freight service on American Railroads. Also, includes statistics from the AAR mechanized car repair billing exchange system for couplers and knuckles removed from service during an eighteen month period. A relative wear index has been calculated. Includes recommendations for removal from service of highest failure rate coupler and knuckle components.

Sponsored by RPI/AAR Railroad Coupler Safety Research and Test Project.

Morella, N Cook, RM
Association of American Railroads Technical Center Tech Rpt No. 5, #R-149, June 1973, 67 pp, 3 Ref

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr PC

DOTL RP

B1 051925
YOKE SERVICE PERFORMANCE, AAR MECHANIZED CAR REPAIR BILLING EXCHANGE SYSTEM DATA
Presents the initial 18 months of yoke removal data (for foreign cars only) reported to the newly established AAR Mechanized Car Repair Billing Exchange System in Washington, D. C. This computerized system lists the reason the yoke was removed under eight code numbers which interpreted mean, worn out, broken, missing, bent, bent beyond repair, obsolete, account other repairs, and removed in good condition. There were a total of 19,647 yoke removals reported in the initial 18 months. The number of reporting railroads (11 total) participating in the system at the end of the first 18 months accounted for a little over half of the freight car ownership in 1972 and therefore perhaps about half of the yokes removed from foreign cars by railroads (foreign cars are cars not owned by the reporting railroad). Considering this condition combined with other factors it seems reasonable to multiply the total removals reported to the AAR Billing Exchange by about 6 to obtain the total removals by the industry for the entire current service fleet of freight cars.

Sponsored by RPI-AAR Railroad Coupler Safety Research and Test Project.

Morella, N Cook, RM
Association of American Railroads Technical Center Tech Rpt No. 6, # R-150, July 1973, 24 pp, 4 Ref

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr PC

DOTL RP

B1 052108
HOW SAFE WERE THE MOTOR TRAINS?
This article is a facet of a comprehensive study on the rise and fall of motor trains in the United States. The term "motor train" is used in this article because "motor car" has been used loosely in the railroad literature to designate "motor trains," maintenance-of-way cars, and automobiles and buses. For the purposes of this article, a "motor train" is a passenger train of one, two, or three cars, which is not pulled by a locomotive, but has a self-contained power plant in a vehicle partially devoted to revenue space.

Prosser, RS *Traffic Quarterly* Vol. 27 No. 4, Oct. 1973, pp 601-618, 1 Tab

ACKNOWLEDGMENT: Traffic Quarterly
PURCHASE FROM: Eno Foundation for Transportation, Incorporated Westport, Connecticut, 06880 Repr PC

DOTL JC

B1 052361
WHEEL LOAD, WHEEL DIAMETER AND RAIL DAMAGE
The dual study of wheel load, wheel diameter and rail damage is presented. It is concluded that formulas derived from earlier studies should be applied to today's situations for worn wheel on worn rail. A report on shelly rail reviews previously gathered information before discussing a recommendation that a limitation be placed on wheel loads for diesel and turbine locomotives. The recommended limit for wheel loads is 800-lb per inch of diameter. The study concludes that shelly rail stress increases in proportion to the cube root of the load; the life of the rail up until the time failure occurs decreases very sharply for any small increase in stress.

Code, CJ (Pennsylvania Railroad) *AREA Bulletin* Proceeding Vol. 61 1960, 8 pp, 2 Fig, 1 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

B1 052553
STANDARDISATION OF WAGONS. PROGRAMME OF TESTS TO BE CARRIED OUT ON WAGONS WITH STEEL UNDERFRAME AND BODY AND SUITABLE FOR BEING FITTED WITH THE AUTOMATIC BUFFING AND DRAW COUPLER
This report replaces the previous B 12/RP 17 report, 1st edition. It surveys all the tests which are at present considered as representing the complete series of tests to which a new type of wagon can be exposed. The conditions under which these tests should be made and the results to be obtained (maximum or minimum values) are laid down for each test. On account of the detailed information, it contains taking into consideration the developments which have taken place the last few years in the construction of goods wagons, this report constitutes a valuable basis for the design of new types of wagons.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B12/RP 20/E, Oct. 1973, 11 pp, Figs., Tabs., 6 App.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B1 052602
STANDARDIZATION OF LARGE CONTAINERS AND LARGE CONTAINER WAGONS. 60' BOGIE WAGON, WITH SHOCK-ABSORBING SYSTEM, FOR THE CONVEYANCE OF LARGE CONTAINERS IN ORDINARY TRAINS
This report contains a technical specification for the development of a standard 60' bogie wagon, with shock-absorbing system, for the conveyance of large containers in ordinary trains.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B112/RP 12/E, Apr. 1974, 12 pp, Figs., 1 App.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B1 052607
TEST ON AUTOMATIC COUPLERS. WORK OF COMMITTEE B51 FROM JANUARY 1972 TO DECEMBER 1973 AND THE CURRENT STATE OF THE STUDIES AND TESTS RELATING TO THE INTRODUCTION OF THE AUTOMATIC COUPLER
The report gives an account of the current state of the work carried out in connection with the introduction of the automatic coupler and the studies and tests made for this purpose from January 1972 to December 1973. Special attention was given to the following questions: Studies and tests relating to the design of the basic type of the automatic coupler and completion of this work; Studies and tests relating to the riding stability of wagons with automatic centre buffer couplers with the object of a) limiting the longitudinal compressive forces in the train by a suitable choice of elastic systems and variation of the brake characteristics b) controlling the longitudinal compressive forces in the train by the use of a stabilising

articulation with vertical and horizontal alignment control, in short, a universal articulation;-studies and tests with passenger coaches equipped with automatic couplers, mixed air couplings, intermediate parts for train ferry services and different types of electric plug contacts, relating to the question of coupler wear in service, to the need for protection covers and to shunting procedures to be used for wagons equipped with automatic couplers;-current state of the work on the compilation and revision of several UIC and Joint UIC/OSJD Specification Leaflets.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B51/RP 15/E, Apr. 1974, 64 pp, Figs., Apps.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B1 052637
PERMISSIBLE MASSES PER AXLE FOR TRAILER VEHICLES AS A FUNCTION OF THE WHEEL DIAMETER AND SPEED. INVESTIGATION OF THE PERMISSIBLE AXLE-LOADS FOR WAGONS WITH Y25 BOGIES (920 MM WHEELS) AT HIGH SPEED (BEYOND 120 KM/H)

This report contains a description of the line tests, carried out on a bogie wagon of the SNCF with Y 25 bogies. It concerns measurements on the wagon at speeds to 160 km/h and masses per axle to 20 t. The report also contains some recommendations for the maximum masses per axle depending on the speed from the points of view of the harmful effects exerted by the vehicle on the track and the riding stability.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways C113/RP 3/E, Oct. 1974, 45 pp, 21 Fig., Tabs.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B1 053837
STANDARDIZED FORMAT FOR RAILROAD ENVIRONMENT

This paper outlines a format for recording railroad environmental spectrum data that utilizes the standard arrangement of the modified Goodman diagram. In this form the environmental data is applicable to theoretical finite life fatigue design and to variable-cycle spectrum-type fatigue testing. Maximum loadings for operational guidance, equivalent static design analysis, lading damage studies, and proof testing are also accurately portrayed. The extensive environmental data requirements for modern design dictate the need for standardization of data format and content to provide compatibility of data from various sources and facilitate formation of the national data bank required by the railroad industry.

Cook, RM (Association of American Railroads)
American Society of Mechanical Engineers 73-RT-2, Jan. 1973, 8 pp, 4 Fig

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL RP

B1 054000
COMPONENTIZATION FOR FATIGUE DESIGN AND TESTING

This paper briefly reviews the most common cause for fatigue initiation in freight cars, the specialized data required for theoretical fatigue design, fatigue design criteria, appropriate modern fatigue testing equipment, and the types of full-scale component tests believed most applicable to the car building and railroad industry. The concept of componentization is introduced as a means for expediting both the fatigue design and testing phases of a freight car development program. An objective has been to present the overall aspects of the subject in terms understandable to the person who is not an expert in the fatigue area by presenting only the fundamentals most directly applicable to freight cars.

Contributed by the Rail Transportation Division of The American Society of Mechanical Engineers for presentation at the IEEE-ASME Joint Railroad Conference, New York, N.Y., April 19-21, 1971.

Cook, RM (ACF Industries, Incorporated)
American Society of Mechanical Engineers ASME #71-RR-2, Jan. 1971, 8 pp, 5 Fig, 7 Ref

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL TF5.A721971

B1 054005
ENVIRONMENTAL FINITE LIFE FATIGUE TESTING. UTILIZING MINER'S HYPOTHESIS

This paper outlines one method suitable for cost effective computerized theoretical finite life structural fatigue design and determination of means for conducting laboratory fatigue tests that can predict or confirm finite service life of a component or product. Basic modified Goodman type fatigue test data is utilized with the actual environmental loading spectrum and Miner's hypothesis to determine the damaging cycles experienced in service. The total damaging portion of the environmental loading incurred during the long life of railroad equipment can then be applied in laboratory tests of practical duration. Hence, this is truly an environmental test and not what is often termed an accelerated fatigue test. The technical opinions expressed herein are those of the author and do not necessarily represent the policy of the Association of American Railroads.

Contributed by the Rail Transportation Division of The American Society of Mechanical Engineers for presentation at the ASME-IEEE Joint Railroad Conference, Pittsburgh, Pa., April 3-4, 1974

Cook, RM (Association of American Railroads)
American Society of Mechanical Engineers ASME #74-RT-7, Jan. 1974, 8 pp, 3 Fig, 13 Ref

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL RP

B1 054006
DEVELOPMENT OF FATIGUE STANDARDS FOR FREIGHT CAR TRUCK COMPONENTS AND WHEELS

Factors which should be considered in the development of fatigue standards for freight car truck components and wheels are discussed. These standards would be formulated to provide a desired level of operational reliability, and they would be based on the fluctuating loads acting on the components in service. Typical data describing this environmental are presented. Statistical considerations in establishing the margin between the environmental loads and component fatigue strength are also described.

Contributed by the Rail Transportation Division of The American Society of Mechanical Engineers for presentation at the ASME-IEEE Joint Railroad Conference, Pittsburgh, Pa., April 3-4, 1974

Johnson, MR (IIT Research Institute)
American Society of Mechanical Engineers ASME #74-RT-4, Dec. 1973, 11 pp, 17 Fig, 8 Ref

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL RP

B1 054007
DETERMINATION OF CAR BODY CENTER PLATE FATIGUE DESIGN CRITERIA BY FULL-SCALE CAR TESTING

Fatigue design criteria are established based on full-scale car tests conducted on a 100-ton Southern Railway Hopper car. Stress levels on body center plate and its attachments to the car were determined for static car loading by means of jacking, for standing car dynamic loading under a full roll mode received on AAR rock and roll environmental prepared track testing. Correlation of determined stress loadings leads to three proposed axioms for design criteria.

Contributed by the Rail Transportation Division of The American Society of Mechanical Engineers for presentation at the ASME-IEEE Joint Railroad Conference, Pittsburgh, Pa., April 3-4, 1974

Martin, AE Smith, LW (Dresser Transportation Equipment Division)
American Society of Mechanical Engineers ASME-#74-RT-8, Jan. 1974, 9 pp, 16 Fig, 3 App

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL RP

B1 054718
THE DEPARTMENT FOR RIDING QUALITIES AND VIBRATION ENGINEERING OF THE FEDERAL RAILWAY RESEARCH INSTITUTE IN MINDEN (WESTPHALIA). 1. HISTORICAL DEVELOPMENT, FIELDS OF ACTIVITY, AND ORGANIZATION STRUCTURE [DIE ABTEILUNG FUER LAUF-UND SCHWINGUNGSTECHNIK IN DER BUNDESBAHN-VERSUCHSANSTALT MINDEN (WESTF.). 1. GESCHICHTLICHER WERDEGANG, ARBEITSGEBIETE UND GLIEDERUNG]
After some general remarks on the problems in connection with the riding qualities and vibration properties of railway vehicles, the present state of research in this field is outlined briefly. The department for riding qualities and vibration engineering of the research institute, which is engaged in research work in this field at Deutsche Bundesbahn, has originated from the research centres for locomotives and wagons of the former RAW in Berlin-Grunewald. As compared to the original tasks of these research centres, the present fields of activities of the department are considerably more diversified and mainly focussed on the solution of the problems arising in connection with the proposed higher train speeds. In conclusion, the setup of the department is described, referring also to the special requirements regarding the technical qualifications and character of the employees. [German]

Zottmann, W *Glasers Annalen ZEV* Vol. 98 No. 3, Mar. 1974, p 69

ACKNOWLEDGMENT: Glasers Annalen ZEV
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B1 056883
PROGRESS IN RAILROAD RESEARCH
This report describes the AAR research work now underway or planned for the near future. It also describes the facilities available at the Chicago Railroad Technical Center. It describes the AAR programs involving university research. The research projects described deal with train track dynamics, track stresses, track structure, computer models, freight car information systems, and with safety and hazardous materials.

Harris, WJ, Jr
Association of American Railroads 1973, 241 pp, Figs, Refs

PURCHASE FROM: AAR Repr PC

DOTL RP

B1 057162
STRUCTURAL PROBLEMS ASSOCIATED WITH THE PREDICTION OF VEHICLE CRASHWORTHINESS
The magnitude of problems associated with employing destructive testing as a means to determine vehicle structure crashworthiness in the early design stages, coupled with the availability of modern computing systems and a host of promising numerical methods, has resulted in the development of a number of vehicle structure crash simulation computer programs. This paper delineates the problems associated with the theoretical prediction of large deformation dynamics of crash impacted vehicular structures, assesses the prediction capabilities and technical approaches of the recently developed vehicle crash simulation programs, and identifies areas of research needed to improve current crash simulation capabilities.

Presented at the Winter Annual Meeting of the American Society of Mechanical Engineers, Nov. 11-15, 1973, sponsored by the Applied Mechanics Division and the Automatic Controls Division. Papers presented at this meeting are compiled in "Surveys of Research in Transportation Technology", AMD-Vol. 5.

Saczalski, KJ (Office of Naval Research)
American Society of Mechanical Engineers 1973, pp 87-108, 13 Fig, 2 Tab, 66 Ref

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL RP

B1 057171
AMERICAN STEEL FOUNDARIES DYNAMIC TEST FACILITY FOR RAILWAY TRUCK COMPONENTS
This article describes the ASF test facility for truck components. The facility permits dynamic testing of the various components. The article describes the test equipment and the test procedures, and several conclusions that have been reached are discussed.

Tennikait, HG (American Steel Foundries) *Closed Loop* Vol. 4 No. 2, Apr. 1974, pp 10-16, 6 Fig., Phots.

ACKNOWLEDGMENT: Closed Loop
PURCHASE FROM: MTS Systems Corporation P.O. Box 24012, Minneapolis, Minnesota, 55424 Repr. PC

DOTL JC

B1 072791
METALLURGICAL FACTORS CONTROLLING THE FRACTURE TOUGHNESS OF WELD MICROSTRUCTURES, WITH PARTICULAR REFERENCE TO THE MICROMECHANISM OF FRACTURE INITIATION
To link fracture toughness measurements specifically to particular micromechanisms, correlations between toughness, microstructure and composition must be related directly to the mechanism of initiation by inspection of the fracture surface in the region of the specimen notch after testing. Some factors which are beneficial to resistance to cleavage may be deleterious as regards resistance to microvoid coalescence and that, for optimum toughness over a wide range of temperature, applied strain rate and stress state, compromises in composition are required. However where, in a given application, only one micromechanism of fracture is of concern, efforts can be more simply concentrated on optimizing composition and welding procedure to produce HAZ and weld metal microstructures having the maximum resistance to fracture by this particular mechanism, subject, of course, to any other requirements, such as retaining adequate tensile properties and resistance to weld cracking problems.

Presented at Practical Implications of Fracture Mechanics, Spring Meeting, University of Newcastle Upon Tyne, England, March 27-29, 1973.

Dolby, RE (Welding Institute); Saunders, GG Widgery, DJ
Institute of Metallurgy Conf Paper Ser2,No.10,604-73-Y, 1973, 10 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

B1 072792
APPLICATION OF FRACTURE MECHANICS TO RAILWAY FAILURES
The authors have attempted to demonstrate both the potential and the current limitations of fracture mechanics in the context of railroad engineering. The principal limitations are the need for detailed service stress data and the establishment of appropriate K-calibrations. The benefits of applying a fracture mechanics approach to railway failures are discussed. In failure investigations, fracture mechanics enables the failure stress to be estimated.

Cannon, DF Allen, RJ *Railway Engineering Journal* Vol. 3 No. 4, July 1974, pp 6-23, 41 Ref.

ACKNOWLEDGMENT: EI (EI 74 072829)
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

B1 072793
SOME QUESTIONS OF THE METHOD OF INVESTIGATING THE SERVICE RELIABILITY OF WELDED STRUCTURES
The method of investigating the service reliability of materials and welded structures should include the determination of their resistance to fatigue and brittle fracture, which is usually determined experimentally. In this investigation of welded locomotive truck frames, it is necessary to reproduce, to the greatest extent possible, the type of service failure and conditions determining the efficiency of structures.

Kraichik, MM Ratner, RS *Welding Production* Vol. 21 No. 2, Feb. 1974, pp 86-90, 6 Fig., 16 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

B1 080078
DESIGN AIMS AND SCOPE FOR RAPID-TRANSIT SYSTEMS [Aufgaben und Moglichkeiten des Designs fur S-Bahnen]
Among the manifold tasks of the DB's Design Centre is the furnishing of ideas for the best passenger-oriented equipment of rapid-transit rail vehicles, and also proposals concerning the construction of the transit system as a whole. The work of the Design Centre is described. [German]

Radlbeck, K *Eisenbahntechnische Rundschau* Vol. 23 No. 7/8, July 1974, pp 313-317, 7 Fig., 2 Ref.

ACKNOWLEDGMENT: Eisenbahntechnische Rundschau
PURCHASE FROM: Hestra-Verlag Hernichel undDr. Strauss, Darmstadt, West Germany Repr. PC
DOTL JC

B1 080091
FIRE EXPERIMENTS OF COACH
As part of the equipment development program of the Japanese National Railways, steps are being taken to step up the fire prevention and protection qualities of passenger cars. Because of the high speeds, long tunnels and subways in which trains operate, and the large amount of new rolling stock which is planned, preventing train fires is given high priority. The resistance of various seat upholstery materials to ignition from a burning newspaper were checked initially. Subsequently the same second class coach was ignited and the fire allowed to burn fiercely with smoke concentrations, gasses and temperatures monitored as the conflagration continued inside the standing car. Further work on fire suppression is planned.

Oikawa, I *Railway Technical Research Institute* Quart Rpt. Vol. 15 No. 3, Sept. 1974, pp 131-132, 3 Fig.

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Ken-yusha 1-45-6, Hikari-cho, Kokubunji, Tokyo, Japan Repr. PC
DOTL JC

B1 080102
RAILROAD ACCIDENT REPORT: SOUTHERN RAILWAY COMPANY TRAIN 154 DERAILMENT WITH FIRE AND EXPLOSION LAUREL, MISSISSIPPI JANUARY 25, 1969
Southern Railway train 154 was wrecked at Laurel, Mississippi on January 25, 1969 at about 4:15 a.m., when 15 tank cars of liquefied petroleum gas derailed. The train, with four diesel-electric locomotive units, 139 cars and caboose was moving northward at about 30 mph when the west wheel on the lead truck of the 62nd car in the train broke. The wheel which broke as it was passing over the crossing of the Gulf, Mobile, and Ohio Railroad, derailed about 256 feet north of the crossing, and the train continued northward for about 2,146 feet before the 62nd car and 14 loaded tank cars behind it were derailed. Most of the tanks were mechanically damaged by the derailment resulting in an immediate violent eruption of fire and explosion. Two fatalities resulted from injuries caused by the fires and explosions after the wreck, 33 persons were hospitalized. Property damage in the town was extensive and total damage to Southern Railway track, equipment and lading was estimated at about $3,000,000.

National Transportation Safety Board 1969, 74 pp, Figs., Phots., 4 App.

ACKNOWLEDGMENT: National Transportation Safety Board
PURCHASE FROM: NTIS Repr. PC
PB-190208, DOTL NTIS

B1 080118
THE FRACTURE PROPERTIES OF TWO FAILED CAST STEEL WHEELS FROM THE UNION PACIFIC RAILROAD
During the late autumn of 1972 the Union Pacific Railroad had what appeared to be an unusually high number of wheel failures associated with low ambient temperatures. This behavior suggested to the Union Pacific that the temperature may have dropped below the materials transition temperature. In this connection the AAR was requested to determine the fracture properties of two cast steel wheels which failed during low temperature conditions (less than 35 F). On the basis of both the Charpy and critical stress intensity factor tests both wheels did not significantly change their fracture characteristics over the entire range of operating temperatures.

Stone, DH
Association of American Railroads Technical Center, (R027) R-123, May 1973, 10 pp, 3 Ref.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B1 080128
STATISTICAL SUMMARY OF JOINT AAR-RAILROAD SURVEY OF CRACKED OR BROKEN COUPLERS, KNUCKLES AND YOKES IN FREIGHT SERVICE ON FIVE RAILROADS
To determine the approximate number of cracked or broken couplers, knuckles and yokes being regularly removed from freight service and to note the general relation of design, service life, location of failure and ambient temperature, the AAR and five railroads initiated a joint program. The investigation took the form of a field survey. This is a summary report and includes all the statistical data that has been computer sorted into tabular form for both the summer and winter periods of the program.
An RPI-AAR Cooperative Project.

Morella, NA Cook, R
Association of American Railroads Technical Center, (C-65-7) R-118, Sept. 1972, 176 pp, Figs., 114 Tab., 6 App.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B1 080129
SUMMARY OF VISUAL INSPECTION RESULTS CRACKED OR BROKEN FREIGHT CAR COUPLERS, KNUCKLES AND YOKES
This report contains the results from a visual inspection of 1097 broken freight car couplers, knuckle and yoke components collected by five railroads during a thirty day period. The sample was collected as part of a joint AAR-Railroad program, just prior to the start of this joint RPI-AAR Railroad Coupler Safety Research and Test Project, to initially determine the approximate extent and character of current failures in couplers, knuckles and yokes. The result of this inspection, when combined with current population data, do not permit the determination of failure rate for the various components because the proportion of the total industry failures represented by the sample is indeterminate and the sample is, for most components, too small to provide the desired reliability. The results from this inspection will, however, supply valuable insight required to determine the necessary procedures, data and sample size to achieve the project objective.

Morella, NA Cook, R
Association of American Railroads Technical Center, (C-65-7) R-117, Aug. 1972, 122 pp, 3 Fig., 104 Tab.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B1 080281
CURRENT POPULATIONS OF COUPLERS AND KNUCKLES IN FREIGHT SERVICE INCLUDING IDENTIFICATION OF RECLAIMED COUPLERS
A field population study was made by looking at couplers and knuckles on one end of 5053 active freight cars in the U.S. fleet at eleven classification yards operated by nine major railroads at five different cities; namely, Chicago, Illinois, Washington, D.C., Atlanta, Ga., Houston, Texas, and Los Angeles, Calif. The specific coupler data included coupler catalog number date of original manufacture, name of manufacturer and date most recently reclaimed. The specific knuckle data included knuckle catalog number in all cases but date of original manufacture and name of manufacturer only if the car was not coupled. Car data included age of car (new or rebuilt), type of car, capacity of car and car number.
An RPI-AAR Cooperative Project.

Morella, NA Cook, R
Association of American Railroads Technical Center Res. Rpt. R-119, Feb. 1973, 85 pp, 1 Ref.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B1 080287
YOKE SERVICE PERFORMANCE
Presents the initial 18 months of yoke removal data (for foreign cars only) reported to the newly established AAR Mechanized Car Repair Billing Exchange System in Washington, D.C. This computerized system lists the reason the yoke was removed under eight code numbers which interpreted mean: worn out, broken, missing, bent, bent beyond repair, obsolete, account other repairs, and removed in good condition. There were a total of 19,647 yoke removals reported in the initial 18 months. The number of reporting railroads (11 total) participating in the system at the end of the first 18 months accounted for a little over half of the freight car ownership in 1972 and therefore perhaps about half of the yokes removed from foreign cars by railroads (foreign cars are cars not owned by the reporting railroad). Considering this condition combined with other factors it seems reasonable to multiply the total removals reported to the AAR Billing Exchange by about 6 to obtain the total removals by the industry for the entire current service fleet of freight cars.
An RPI-AAR Cooperative Project.

Morella, NA Cook, R
Association of American Railroads Technical Center Res. Rpt. R-150, July 1973, 24 pp, 4 Ref.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B1 080367
RESIDUAL STRESSES IN THE PLATE FILLETS OF TWENTY-EIGHT-INCH DIAMETER WROUGHT STEEL WHEELS
Past experience with the B-28 wheel has shown that this design is susceptible to plate cracking. This reports the results of a program to determine the state of residual stress in class U untreated and class B heat-treated wheels. Measurements were made according to the procedure outlined in the AISI Steel Products Manual for Wrought Steel Wheels and Forged Railway Axles. Measurements were taken at the front hub-plate fillet and the back rim-plate fillet on each wheel. While the maximum principal residual stresses developed in the class B wheels were two to four times higher than those developed in the class U wheels, analysis by Goodman diagram shows similar fatigue properties in both wheels.
Direct requests to the Director's Office, AAR Technical Center, Chicago, Illinois.

Stone, DH
Association of American Railroads Technical Center, (R-026) R-158, May 1974, 11 pp, 7 Ref.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B1 080374
METALLURGICAL ANALYSIS OF FAILED RIMS ON FIVE BURLINGTON NORTHERN UNIT TRAIN TRUCK BOLSTERS
Results of fracture analysis, dimensional study, chemical analysis, Brinell hardness tests, and examination of the microstructures of five failed unit train truck bolster castings are reported. It was concluded that the failures were all triggered at the rim-bowl base fillet by various stress risers created by impacts of the horizontal liner plates against the rims. The failures propagated suddenly or in fatigue under impact of the rims with the body center plates. It was also found that the vertical liner rings had broken away from the rims of two bolsters before they were removed from service.
Direct requests to Directors Office, AAR Research Center.

Fleming, L
Association of American Railroads, (R015) R-152, Sept. 1973, 56 pp

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B1 081265
STABILITY OF RIBBED PLATES IN THE CONSTRUCTION OF RAILWAY VEHICLES [Zur Stabilitat gesickter Bleche im Schienenfahrzeugbau]
In the case of plates with tailed-in ends, compressed along the ribbing, coupled elongations are produced as a result of bending deformation. These additional compression stresses are superposed upon the primary buckling constraints. For this reason, the elastic limit can be exceeded locally in ribbed walls, more especially in the intervention zone of the transversal forces. Other origins of this phenomenon can be: lack of precision in assembling, pre-existent deformations in the ribbed plates, residual welding tensions and the very asymmetrical form of the ribbing. Tests have been carried out in order to determine the bending stress. [German]

Haug, A *Leichtbau der Verkehrsfahrzeuge* Vol. 18 No. 3, May 1974, pp 58-63, 2 Tab., 6 Ref.

ACKNOWLEDGMENT: International Railway Documentation, Selection of (UIC Serial No. 1188)
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr. PC
DOTL JC

B1 090658
URBAN RAIL SUPPORTING TECHNOLOGY PROGRAM FISCAL YEAR 1974, YEAR END SUMMARY
Major areas include program management, technical support and application engineering, facilities development, test and evaluation, and technology development. Specific technical discussion includes track measurement systems; UMTA facilities development at the DOT High Speed Ground Test Center, Pueblo, Colorado; rail car test and evaluation; instrumentation for data acquisition and processing; noise abatement technology; tunneling; and car crashworthiness studies.
See also PB-238 602.

Madigan, RJ
Transportation Systems Center, Urban Mass Transportation Administration Final Rpt. DOT-TSC-UMTA-75-7, Mar. 1975, 94 pp

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-241239/3ST, DOTL/NTIS

B1 091264
ATMX-600 RAILCAR SAFETY ANALYSIS REPORT FOR PACKAGING (SARP)
No Abstract.

Adcock, FE
Dow Chemical Company Oct. 1974, 37 pp

Contract AT(29-1)-1106

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
RFP-2244, DOTL NTIS

B1 091886
PHYSICS OF COLLISIONS
Paper clears up some misconceptions on rail car structure and sets down the physical basis of collision analysis and car structure design.

Raskin, D
Transit Development Corporation, Incorporated Final Rpt. TDC/500-74/6, Oct. 1974, 13 pp

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-241852/3ST, DOTL NTIS

B1 091887
TRANSIT FLAMMABILITY REQUIREMENTS
Control of the flammability characteristics of furnishings within a structure will reduce the fire hazard to the structure and enhance the life safety of its occupants. Flammability of materials should be considered along with comfort, cost and wear. Quantifying flammability, setting acceptable standards, identifying appropriate test procedures, and locating the material to satisfy the standards are steps taken by the Port Authority of New York and New Jersey.

Schafran, E
Transit Development Corporation, Incorporated Final Rpt. TDC/500-74/3, June 1974, 11 pp

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-241851/5ST, DOTL NTIS

B1 092216
STATE-OF-THE-ART CAR DEVELOPMENT PROGRAM FINAL TEST REPORT. VOLUME I. COMPONENT TESTING
The Urban Rapid Rail Vehicle and Systems Program is an integrated development program directed toward improving high speed, frequent-stop urban rail systems. The overall objective is to enhance the attractiveness of rail transportation to the urban traveler by providing service that is as comfortable, reliable, safe and economical as possible. The objective of the State-of-the-Art Car (SOAC) is to demonstrate the best state-of-the-art in rapid rail car design, with two improved cars using existing proven technology. Primary goals for the cars are passenger convenience and operating efficiency. This document, Volume I of the SOAC Final Test Report, presents the test results of the component testing of the State-of-the-Art car. The purpose of these tests was to show compliance with the SOAC Detail Specification (NTIS PB-225 934). All component tests were conducted by the supplier of the applicable subsystems. An introduction, test procedures and results, and conclusions are presented. Appendices are titled: Propulsion, Dynamic Braking and Auxiliary Power Equipment; Truck Frame; Truck Bolster; Windshield; Seat Strength; and Materials-Fire Resistance.
See also Volume 2, PB-244 048. Paper copy also available in set of 5 report as PB-244 047-SET, PC$26.00.

Boeing Vertol Company, Urban Mass Transportation Administration D174-10024-1, UMTA-IT-06-0026-74-1, Aug. 1974, 291 pp

Contract DOT-UT-10007

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-244048/5ST, DOTL NTIS

B1 092220
STATE-OF-THE-ART CAR DEVELOPMENT PROGRAM FINAL TEST REPORT. VOLUME 5. POST REPAIR TESTING
The Urban Rapid Rail Vehicle and Systems Program is an integrated development program directed toward improving high speed, frequent-stop urban rail systems. The objective of the State-of-the-Art car (SOAC) is to demonstrate the best state-of-the-art in rapid rail car design, with two improved cars using existing proven technology. Primary goals for the cars are passenger convenience and operating efficiency. This document presents the test results for the Post-Repair Testing of the SOAC. The purpose of these tests was to show: (1) compliance with the SOAC Detail Specification (NTIS no. PB-222 147) following repairs to the Number 2 car damaged in an accident on August 11, 1973 at the DOT High Speed Ground Test Center, Pueblo, Colorado; and (2) to complete the Simulated Demonstration Testing (Volume 4) which had been interrupted by the accident. Chapters present configuration, instrumentation, test procedures, test results and conclusions.
See also Volume 4, PB-244 051. Paper copy also available in set of 5 reports as PB-244 047-SET, PC$26.00.

Christiansen, G
Boeing Vertol Company, Urban Mass Transportation Administration Final Rpt. D174-10024-5, UMTA-IT-06-0026-74-6, Dec. 1974, 65 pp

Contract DOT-UT-10007

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-244052/7ST, DOTL NTIS

B1 092463
SOAC: STATE-OF-THE-ART CAR ENGINEERING TESTS AT DEPARTMENT OF TRANSPORTATION HIGH SPEED GROUND TEST CENTER. FINAL TEST REPORTS
No Abstract.
Set includes PB-244 747 thru PB-244 752.

Boeing Company, Urban Mass Transportation Administration, Transportation Systems Center Jan. 1975, 824p-in 6V

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC
PB-244746-SET/ST, DOTL NTIS

B1 092464
SOAC: STATE-OF-THE-ART CAR ENGINEERING TESTS AT DEPARTMENT OF TRANSPORTATION HIGH SPEED GROUND TEST CENTER. FINAL TEST REPORT. VOLUME I. PROGRAM DESCRIPTION AND TEST SUMMARY
The six-volume report presents the technical methodology, data samples, and results of tests conducted on the SOAC on the Rail Transit Test Track at the High Speed Ground Test Center in Pueblo, Colorado during the period April to July 1973. The Test program comprises three areas: Vehicle testing, ways and structures testing and track geometry measurement. The objective of the SOAC program is to demonstrate the current state-of-the-art in rail rapid transit vehicle technology, with passenger convenience and operating efficiency as primary goals. In this series, Vol. I contains a description of the SOAC test program and vehicle, and a summary of the test results; Vol. II, Performance Test data; Vol. III, Ride Quality Test data; Vol. IV, Noise Test data; Vol. V, Structural, Voltage, and Radio Frequency Interference Test data; and Vol. VI a description of the Instrumentation system used for performance, ride quality and structural testing.
Paper copy also available in set of 6 reports as PB-244 746-SET, PC$28.00.

Boeing Company, Urban Mass Transportation Administration, Transportation Systems Center, (UMTA-MA-06-0025) Final Rpt. UMTA-MA-06-0025-75-1, Jan. 1975, 88 pp

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-244747/2ST, DOTL NTIS

B1 092465
SOAC: STATE-OF-THE-ART CAR ENGINEERING TESTS AT DEPARTMENT OF TRANSPORTATION HIGH SPEED GROUND TEST CENTER. FINAL TEST REPORT. VOLUME II. PERFORMANCE TESTS
No Abstract.
See also RRIS 03-092464. Paper copy also available in set of 6 reports as PB-244 746-SET, PC$28.00.

Boeing Company, Urban Mass Transportation Administration, Transportation Systems Center, (UMTA-MA-06-0025) Final Rpt. UMTA-MA-06-0025-72-2, Jan. 1975, 160 pp

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-244748/0ST, DOTL NTIS

B1 092466
SOAC: STATE-OF-THE-ART CAR ENGINEERING TESTS AT DEPARTMENT OF TRANSPORTATION HIGH SPEED GROUND TEST CENTER. FINAL TEST REPORT. VOLUME III. RIDE QUALITY TESTS
No Abstract.
See also RRIS 03-092464. Paper copy also available in set of 6 reports as PB-244 746-SET, PC$28.00.

Boeing Company, Urban Mass Transportation Administration, Transportation Systems Center, (UMTA-MA-06-0025) Final Rpt. UMTA-MA-06-0025-75-3, Jan. 1975, 250 pp

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-244749/8ST, DOTL NTIS

B1 092467
SOAC: STATE-OF-THE-ART CAR ENGINEERING TESTS AT DEPARTMENT OF TRANSPORTATION HIGH SPEED GROUND TEST CENTER. FINAL TEST REPORT. VOLUME IV. NOISE TESTS
No Abstract.
See also RRIS 03-092464. Paper copy also available in set of 6 reports as PB-244 746-SET, PC$28.00.

Boeing Company, Urban Mass Transportation Administration, Transportation Systems Center, (UMTA-MA-06-0025) Final Rpt. UMTA-MA-06-0025-75-4, Jan. 1975, 125 pp

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-244750/6ST, DOTL NTIS

B1 092468
SOAC: STATE-OF-THE-ART CAR ENGINEERING TESTS AT DEPARTMENT OF TRANSPORTATION HIGH SPEED GROUND TESTS CENTER. FINAL TEST REPORT. VOLUME V. STRUCTURAL, VOLTAGE, AND RADIO FREQUENCY INTERFERENCE TESTS
No Abstract.
See also RRIS 03-095464. Paper copy also available in set of 6 reports as PB-244 746-SET, PC$28.00.

Boeing Company, Urban Mass Transportation Administration, Transportation Systems Center, (UMTA-MA-06-0025) Final Rpt. UMTA-MA-06-0025-75-5, Jan. 1975, 84 pp

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-244751/4ST, DOTL NTIS

B1 092469
SOAC: STATE-OF-THE-ART CAR ENGINEERING TESTS AT DEPARTMENT OF TRANSPORTATION HIGH SPEED GROUND TEST CENTER. FINAL TEST REPORT. VOLUME VI. SOAC INSTRUMENTATION SYSTEM
No Abstract.
See also RRIS 03-092464. Paper copy also available in set of 6 reports as PB-244 746-SET, PC$28.00.

Boeing Company, Urban Mass Transportation Administration, Transportation Systems Center, (UMTA-MA-06-0025) Final Rpt. UMTA-MA-06-0025-75-6, Jan. 1975, 117 pp

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-244752/2ST, DOTL NTIS

B1 092835
TRANSPORTATION FOR THE ELDERLY OR PHYSICALLY HANDICAPPED (A BIBLIOGRAPHY WITH ABSTRACTS)
Reports on planning for public transportation for older persons or those persons who are physically disabled are abstracted in the bibliography. Included are studies of difficulties encountered, special design, and real and potential use of facilities. (Contains 41 abstracts).
Supersedes COM-74-10887.

Young, ME
National Technical Information Service Report July 1975, 46p

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
NTIS/PS-75/575/1ST, DOTL NTIS

B1 093610
CRASHWORTHINESS ANALYSIS OF THE UMTA STATE-OF-THE-ART CARS
An engineering assessment of the crashworthiness of the UMTA State-of-the-Art Car (SOAC) has been conducted as part of a program to provide safer transportation to urban rail vehicles. Crash dynamics and crashworthiness methodology based on post-yield energy absorption characteristics and a 'weighted acceleration' severity index has been applied. Sensitivity studies have been conducted to show the effect of car buff strength, passenger relative velocity, passenger spacing, and cushioning on casualties as defined by the severity index. Major gains in injury reduction through improved internal cushioning are indicated. The prevention of car penetration by override is treated. The SOAC collision dynamics model is validated by comparison to the SOAC-gondola accident of August 11, 1973, and by comparison to a nonlinear finite element mathematical simulation of the SOAC in crash conditions.

Widmayer, E Tanner, AE Klump, R
Boeing Vertol Company, Urban Mass Transportation Administration, Transportation Systems Center Final Rpt. UMTA-MA-06-0025-7515, Oct. 1975, 193 pp

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-247230/6ST, DOTL NTIS

B1 093772
OVERHEATED JOURNAL BEARING DERAILMENT PREVENTION SYSTEM
An anti-derailment system is disclosed in the patent application to prevent train derailment due to axle failure resulting from journal bearing overheating. The system includes a thermal sensor to continuously monitor the temperature of the bearing and to activate the brake system when the temperature exceeds a predetermined level. A thermally-responsive element located in the journal bearing adapter physically deforms to activate a power source. The resulting signal initiates an electro-explosive brake line venting mechanism, puncturing and venting the brake line to stop the train. Several configurations of the thermal sensor and the power source are possible.
Government-owned invention available for licensing. Copy of application available NTIS.

Armstrong, JH Kluge, FC
Department of the Navy Patent App PAT-APPL-495 478, Filed 7 Au, 17 pp

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
AD-D001260/9ST, DOTL NTIS

B1 094135
AN ASSESSMENT OF THE CRASHWORTHINESS OF EXISTING URBAN RAIL VEHICLES
No abstract available.
Set includes PB-249 142 thru PB-249 143.

Calspan Corporation, Department of Transportation Nov. 1975, 370p-in 2v

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC
PB-249141/SET-ST, DOTL NTIS

B1 094136
AN ASSESSMENT OF THE CRASHWORTHINESS OF EXISTING URBAN RAIL VEHICLES. VOLUME I: ANALYSES AND ASSESSMENTS OF VEHICLES, CHAPTERS 1 THROUGH 7
The crashworthiness of existing urban rail vehicles (passenger cars) and the feasibility of improvements in this area were investigated. Both rail-car structural configurations and impact absorption devices were studied. Recommendations for engineering standards for urban rail vehicles were developed. The report covers: (1) The development of analytical tools to predict passenger threat -environment during collision; (2) criteria for predicting passenger injury due to train collisions; (3) an application of injury criteria and analytic models to predict passenger injuries resulting from collisions of trains that represent existing construction types; (4) a preliminary investigation of applying impact absorption devices to transit vehicles; (5) a design study of car structural configurations for improved impact energy management; (6) a review of engineering standards for Urban Rail Car Crashworthiness.
Paper copy also available in set of 2 reports as PB-249 141-SET, PC$13.00.

Cassidy, RJ Romeo, DJ
Calspan Corporation, Department of Transportation Final Rpt., 6-Vol-1, UMTAMA06-0025-7516V1, UMTA-MA-06-0025-75-1, Nov. 1975, 199 pp

Contract DOT-TSC-681

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-249142/1ST, DOTL NTIS

B1 094137
AN ASSESSMENT OF THE CRASHWORTHINESS OF EXISTING URBAN RAIL VEHICLES. VOLUME II: ANALYSES AND ASSESSMENTS OF VEHICLES, CHAPTERS 8 THROUGH 12 AND APPENDIXES AND REFERENCES
This publication presents information related to the following: Railcar override; Priority areas for the development of cost effective improved car structures; Preliminary design study of impact energy absorbing device; Cost effectiveness of structural improvements; Development of uniform standards.

Paper copy also available in set of 2 reports as PB-249 141-SET, PC$13.00.

Cassidy, RJ Romeo, DJ
Calspan Corporation, Department of Transportation Final Rpt. UMTAMA06-0025-7516V2, Nov. 1975, 171 pp

Contract DOT-TSC-681

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-249143/9ST, DOTL NTIS

B1 094690
A FIRE HAZARD EVALUATION OF THE INTERIOR OF WMATA METRORAIL CARS
A series of fire tests was conducted for the Washington Metropolitan Area Transit Authority to assist them in assessing the potential for fire hazard in the new Metrorail subway cars. Results of small-scale laboratory tests were found inadequate for this assessment. Results of full-scale tests on mock-ups of the interior (and on a real car for a smoke penetration test) show that the potential for hazard arises primarily from the seat padding and covering and from the plastic wall lining. The hazard arises both from smoke development and from spread of flame and heat. The times to reach unacceptable conditions has been determined for several test conditions. It is recommended that the authorities review these times in the context of what they consider to be appropriate times for safe escape. Recommendations are made for increasing the amount of time available for escape. These would require changes in the seating and wall lining materials.

Braun, E
National Bureau of Standards, Washington Metropolitan Area Transit Authority, (NBS-4927371) Final Rpt. NBSIR-75-971, Dec. 1975, 35 pp

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS
PB-249776/6ST, DOTL NTIS

B1 095221
LIFE CYCLE COSTING: A KEY TO FREIGHT CAR COMPONENT EVALUATION
The cost of repairing and replacing freight car components represents a very sizeable expenditure for the railroad industry. Of major concern to the railroad industry are the "costs" associated with various components. These costs include not only the direct costs of procuring and servicing such components but also related costs such as occur in derailments, train delays, and train handling mishaps. Phase II of the International Government-Industry Research Program on Track Train Dynamics is concerned with improving freight train performance and operating safety through the development of performance specifications and design guidelines for car components. If this activity is to be effective, it is essential that present and potential costs of component ownership be thoroughly evaluated. The authors have pursued this end through the development of a life Cycle Cost Model. Once necessary data sources are developed, this model will be used to evaluate research and implementation strategies for the program.

Contributed by the Rail Transportation Division of the American Society of Mechanical Engineers for presentation at the IEEE-ASME Joint Railroad Conference, San Francisco, California, April 15-17, 1975.

Byers, RH (Battelle Columbus Laboratories); Hawthorne, KL (Association of American Railroads Technical Center)
American Society of Mechanical Engineers 75-RT-9, Apr. 1975, 9 pp, 3 Fig., 1 App.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL RP

B1 095245
CAUSE FOR THE FORMATION OF GROOVES ON THE WHEELS OF BLOCK-BRAKED RAILROAD ROLLING STOCK AND THEIR PREVENTION [Ursache der Rillenbildung und Deren Vermeidung bei Raedern Klotzgebremster Schienefahrzuege]
Grooves on the friction surface of block-braked car and locomotive wheels are not formed as a result of hard structural consitituents in the cast-iron brake blocks, but rather as a result of partial melting and displacement of the wheel steel softened by heating in excess of the solids temperature during the friction process. The displaced steel collects for the most part on the braking surface of the block in the form of foil laminations. The cause for this phenomenon lies in an excessively high softening temperature of the brake block material. To prevent the occurrence of this defect, it is suggested to use cast iron containing low-melting structural constituents in adequate quantity and distribution. [German]

Pahl, E (Bundesbahn-Versuchsanst, Germany) *Maschinenschaden* Vol. 47 No. 3, 1974, pp 107-114, 30 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

B1 095247
HUMAN FACTOR AND HARDWARE DESIGN CONSIDERATIONS FOR PASSENGER PROTECTION IN HIGH SPEED CRASHES
Included in the objective of the paper are the identification and summary of significant human factor considerations for restraint and protection of passengers involved in barrier-type collisions at speeds up to 300 miles per hour. These considerations result in computed values of minimum stopping distance as a function of initial velocity. The bases of the calculations are upper limits of tolerable deceleration which are a function of impact duration. Two types of lap and shoulder restraint schemes for achieving optimal restraint conditions are described. The advantages and disadvantages of each are discussed. A totally passive hydraulic/pneumatic shock isolation system for constraining the deceleration levels to acceptable and approximately constant values is described. Typical results of digital computer simulation studies demonstrate the significance of energy dissipation by means of structural deformation of the vehicle. Also, the simulation results demonstrate that the passive shock isolation system can be utilized to achieve an approximately constant and safe deceleration.

Wilkins, LO (Texas University, Arlington); Hullender, DA *High Speed Ground Transportation Journal* Vol. 9 No. 1, 1975, pp 425-433, 16 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B1 096593
SAFETY CONSIDERATIONS IN DESIGN OF NEW TRANSIT BUS SEATS
This paper describes the results of a program to develop advanced cantilevered transit bus seats. The Department of Transportation's Urban Mass Transportation Administration funded the $26 million Transbus Program. The paper is divided into two parts. The first part describes the results of a detailed analysis of passenger accidents on-board current transit buses. The second part describes the results of sled tests that evaluated the safety of three new cantilevered seat-sidewall section designs proposed for Transbus relative to the safety of current transit buses. The testing facilities and procedures are described, along with a summary of the results of 16 sled test runs that employed four different sizes of anthropometric dummies. The results clearly indicate that the new seats have safety characteristics superior to current transit bus seats, especially in severe crash situations.

Proceedings of 18th Stapp Car Crash Conference, University of Michigan,

Ann Arbor, Dec 4-5 1974.
Mateyka, JA (Booz-Allen Applied Research, Incorporated)
Society of Automotive Engineers Pap 741178, 1974, pp 71-87, 5 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: SAE Repr. PC

B1 096620
AN EXAMINATION OF FATIGUE STRENGTH IN THE CONSTRUCTION OF RAILWAY VEHICLES [Berucksichtigung der Betriebsfestigkeit bei der Konstruktion von Schienen]
The author discusses the importance of fatigue strength in the construction of railway vehicles and problems connected with designing construction components which will withstand stress, taking into account their service life. Moreover, construction elements which undergo great stress must often weigh as little as possible and therefore careful attention must be given to the properties of specific materials and to the field of force.

Umback, R *Glasers Annalen ZEV* Vol. 98 No. 10, Oct. 1974, pp 253-359, 15 Fig., 2 Tab., 10 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

B1 097262
BEHAVIOR OF FREIGHT CAR CONSTRUCTION MATERIALS AT CRYOGENIC TEMPERATURES
The purpose of this study was to explore the action of wood and steel construction materials when impacted at low temperatures. Cooling and heating rates were also determined since these properties affect the quantity of coolant used to produce croygenic temperatures and the time available for demolition after the material has been cooled. Liquid nitrogen (B.P. 77.4 degrees K or-320.4 degrees F) was used in the study since this chemical is readily available in laboratory quantities and is less susceptible to explosion hazards than hydrogen or oxygen. The laboratory tests of thermal properties of wood and steel at cryogenic temperatures showed that both materials cool rapidly when immersed in liquid nitrogen with steel cooling about five times more rapidly than wood. These materials also heat rapidly when removed from the liquid nitrogen environment with steel having about five times the heating rate of wood. In the tests conducted, wood exhibited little change in fracture characteristics when the temperature was lowered to that of liquid nitrogen. Conversely, steel, at this temperature, shows brittle fracture properties as compared to ductile properties of steel at room temperature. Based on the tests conducted, scrapping wood freight cars by lowering the temperature to cryogenic levels would be impractical. Large quantities of relatively expensive coolant would be required to lower the car temperature which would heat rapidly as soon as the collant was removed. In this scheme of scrapping freight cars, it was thought that wood shattering would take place with heavy impact blows. The laboratory tests did not show any shattering effect of the wood at cyrogenic temperatures but it is possible that some steel shattering might occur if the impact blows were struck quickly after the car was cooled.

Association of American Railroads Technical Center MR-444, Jan. 1967, 11 pp, 4 Fig.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC

DOTL RP

B1 097312
INNOVATIVE CONCEPTS IN UNIT TRAIN OPERATION
The transition to haulage of taconite pellets on the Duluth, Missabe & Iron Range Railway found unit train services attractive. To achieve optimum train operation, DM&IR coupled its short ore cars in four-car sets with drawbars, introduced the Wabco straight-air retainer system, and eliminated angle-cocks and air-hose connectors where the drawbars are installed. The road uses a planned 1,188 cars assembled in "miniquads" in 124-car unit trains. With this operation so successful, attention has now turned to on-train monitoring of derailed equipment and plans for a more comprehensive real-time measurement of condition throughout any unit train. It is concluded that more can be done to improve the operational control, efficiency and safety of unit trains.

This is a paper from the proceedings of the 11th Annual Railroad Engineering Conference held at Southern Colorado State College, Pueblo, Colorado, October 23-24, 1974. Other individual papers from this conference have been accessioned separately for RRIS. The following is a list of the RRIS numbers of these papers preceded by its section number as it is contained in the bulletin: 03 097308, 03 097309; 13 097310, 04 097311, 03 097313, 04 097314, 03 097315, 03 097316, 03 097317, 03 097318, 03 097319. The entire proceedings 03 097307 has also been accessioned. All of these are contained in Bulletin 7502.

Abramson, JE Ojard, DR (Duluth, Missabe & Iron Range Railway Company)
Federal Railroad Administration 1974, pp 78-84, 6 Fig.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC

PB-241730/1ST, DOTL NTIS

B1 098058
SOME OBSERVATION ON FATIGUE PHENOMENA IN A LARGE PLATE SPECIMEN OF SPRING STEEL AFTER SHOT-PEENING TREATMENT
To obtain the fundamental data for the nondestructive finding of fatigue damage in vehicle parts, the fatigue due to pulsating repeated bending in a large plate of spring steel which had been shot-peened to increase its fatigue strength as a vehicle part, was investigated. It was clarified that there were two ways to find the fatigue damage: to observe the changing state of the surface residual stress and to detect the internal cracks non-destructively.

Murayama, S Kohara, M Iwamoto, M *Railway Technical Research Institute* Vol. 16 No. 1, Mar. 1975, pp 35-39, 6 Fig., 4 Tab.

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Ken-yusha 1-45-6, Hikari-cho, Kokubunji, Tokyo, Japan Repr. PC

DOTL JC

B1 098759
ACTIVE CAR SAMPLE
Computer program: ACTIVE CAR SAMPLE MASTER FILE. The objective of this program is to provide estimates of car mileage on Southern Railway System for selected groups of cars. The mileage estimates may be any of the following characteristics or combination of characteristics which are obtained from the Umler File and added to the Active Car Master File (age range, AAR car type, truck tonnage capacity, SRS marketing code, cubic foot capacity, nominal capacity, tare weight, lining, outside length, side door width, clearance, bearing type, draft gear travel, truck center length, fittings, compartments, floor type). These mileage estimates are used in calculating failure rates for groups of cars. Examples include studies of (1) derailments by AAR car type and age range, (2) uncouplings by cut-lever type and car cushioning, and (3) broken knuckles and couplers by AAR car type and age range. The input data (consisting of car number and supplemental information obtained by inspection of the car such as air hose arrangements and/or cut-lever type) is collected at selected hump yards for a sample of cars going over the hump. The file is of unlimited length. This method of estimating car population approximates mileage more closely than would ownership figures since cars will be included in the sample in proportion to their movement. The program produces a microfiche listing of all data in the file by car initial and number. Other reports are generated by a general purpose picker program (RSVP) which has the capability to select certain records, to sort them in any order, and to print the selected records with summaries on any field.

Tharpe, MK, III
Southern Railway System Aug. 1974

ACKNOWLEDGMENT: AREA (AREA 09-02-004)
PURCHASE FROM: Southern Railway System 99 Spring Street, SW, Atlanta, Georgia, 30303

B1 098760
EMERGENCY BRAKE APPLICATION
The file name is REEBA. A computer program which models an emergency brake application of railroad trains. The input consists of: the locomotive and train consist, grade or location of train, the initial speed and train handling information. The output provides: the stopping distance and time, if an intratrain collision would take place, if the train would separate, and the approximate coupler forces developed during the application.

Tallen, SM
Atchison, Topeka and Santa Fe Railway No Date

ACKNOWLEDGMENT: AREA (AREA 09-02-005)
PURCHASE FROM: Atchison, Topeka and Santa Fe Railway 9th and Jackson Streets, Information Systems Department, Topeka, Kansas, 66628

B1 098772
UNIVERSAL MACHINE LANGUAGE EQUIPMENT REGISTER PICKER PROGRAM
File name is UMLER FILE. Program allows selection of cars in the Umler file on the basis of ownership code, AAR car type, individual car numbers (maximum of 500 cars), a car series, or car initials. Output consists of the selected Umler file data with sorting options of car age, AAR car type, capacity, bearing type, draft gear, outside length, tare weight, truck center length, and car identification. Objective of the program is to classify cars in failure groups or in population samples by the various characteristics described in the Umler file for failure analysis.

McNeil, RG
Southern Railway System 1973

ACKNOWLEDGMENT: AREA (AREA 12-01-001)
PURCHASE FROM: Southern Railway System 99 Spring Street, SW, Atlanta, Georgia, 30303

B1 099175
ADVANCED DESIGN TECHNOLOGY FOR RAIL TRANSPORTATION VEHICLES
This is an interim report on a cooperative research project between Washington University and AMCAR Division of ACF Industries Inc. The purpose of the project is development of a new finite element stress analysis capability which is more cost effective and better suited for fatigue life evaluation than existing finite element computer programs. The report contains a general outline of the method, description of the algorithm structure and methods by which the computational efficiency can be further increased. A benchmark problem established by experimentation and by computation using an existing finite element computer program (STARDYNE) is presented.

The Association of American Railroads and AMCAR Division of ACF Industries, Inc. provided for partial funding of this project.

Szabo, BA Katz, IN Rossow, MP Rodin, EY Peano, A Lee, JC
Washington University, St Louis, (64262) Intrm Rpt. DOT-OS-30108-2, June 1974, 153 pp, Figs.

Contract DOT-OS-30108

ACKNOWLEDGMENT: DOT
PURCHASE FROM: NTIS Repr. PC, Microfiche
DOTL NTIS

B1 099186
SAFETY PRIORITIES IN RAIL RAPID TRANSIT. VOLUME 1-REPORT
Rail Rapid transit presently produces the lowest number of fatalities of any of the major passenger transportation modes. This report develops a program to identify what should be done to aid in assuring that rail rapid transit safety continues. All aspects of rail rapid transit safety are reviewed, hazards are identified, priorities established, and remedial actions recommended. Recommendations include: (1) an evaluation program for materials which utilizes new methods of computing and assessing risk in the areas of flammability, smoke and toxicity; (2) compilation and dissemination of procedures, techniques, and equipment used in the safe evacuation of rail rapid transit patrons; (3) an improvement study of fixed stairs in rail rapid transit facilities to determine whether significant reduction can be achieved in the number of patron falls; (4) a safety education plan to produce films for public education and use in primary schools; (5) work efforts in the development of fire detection and transit vehicle fire extinguishing equipment; (6) establishment of criteria for transparencies used for transit vehicles; (7) determination of hazards of power regeneration and the evolution of procedures to eliminate them; and (8) continuation and support of the Safety Advisory Board techniques for analyzing and assessing safety in rail rapid transit to help assure coordinated technical information input to transit safety development. A bibliography is furnished.

Sponsorship was by the Urban Mass Transportation Administration, DOT. See also Safety Priorities in Rail Rapied Transit. Volume 2-Exhibits. Paper copy also available in set of 2 reports as PB-242 952-SET, PC $11.00.

Connell, WM
Transit Development Corporation, Incorporated, Urban Mass Transportation Administration, (UMTA-DC-06-0091) Final Rpt. UMTA-DC-06-0091-75-1, Mar. 1975, 45 pp

ACKNOWLEDGMENT: UMTA, NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-242953, DOTL NTIS

B1 126433
ROTARY CAR DUMPER SYSTEMS
The important technical points in total system planning of car retarders, electronic scale platen, the many varieties of single and tandem dumpers, car ejectors, and train positioners are discussed. Pollution control and OSHA safety provisions also analyzed.

Presented at the Joint Materials Handling Conference, Sheraton-Cleveland Hotel, Cleveland, Ohio, 23-25 September 1975.

Sabina, WE (Stearns-Roger, Incorporated)
Society of Manufacturing Engineers MS75-641, Sept. 1975

ACKNOWLEDGMENT: Society of Manufacturing Engineers
PURCHASE FROM: Society of Manufacturing Engineers 20501 Ford Road, Dearborn, Michigan, 48128 Repr. PC

B1 126978
FRACTURE RESISTANCE OF RAILROAD WHEELS
The effects of manufacturing method, chemical composition, heat treatment, temperature, and loading rate on the plane strain fracture toughness KIC of railroad wheels have been determined. Carbon content of the wheels is shown to be the principal factor which controls their toughness. One hundred wheels which fractured in service are analyzed by means of fracture mechanics procedures. The locations, configurations, and size of thermal and plate cracks which initiated brittle fracture are reviewed, and estimates made of the stress levels which resulted in failure. Estimates have been made of the minimum size of crack which could result in the failure of wheels under adverse service conditions. These are discussed with respect to the minimum size of defect which can be reliably detected by NDT. Included in the report are state-of-the-art reviews on thermal and plate cracking and on the stresses developed in railroad wheels.

Sponsored by FRA.

Carter, CS Caton, RG
Boeing Company, (DOT-TSC-FRA-74-10) Intrm Rpt. FRA-ORD&D-75-12, Sept. 1974, 216 pp, Figs., Tabs., Phots., 45 Ref., 3 App.

Contract DOT-TSC-617

ACKNOWLEDGMENT: FRA, NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB243638/AS, DOTL NTIS

B1 126988
AUTOMATIC CONTROL OF WHEELTREAD WEAR [Avtomaticeskij kontroliznosa katanija koles]
The article presents: the structure, working principles and results of tests on a prototype electronic image-convertor for measuring the type profile on a moving train; the structural diagram of the test model of a system for controlling wear on the running surface of the rail; the algorithm of the solution to the problem of automation, control of the maximum value and the irregularity of the wheel profile. [Russian]

Sapovalov, VM *Zeleznodoroznij Transport* Vol. 57 No. 2, Feb. 1975, pp 58-60, 3 Fig.

ACKNOWLEDGMENT: International Railway Documentation, Selection of
PURCHASE FROM: Zeleznodoroznij Transport Moscow, USSR Repr. PC

B1 127353
P-S-N CURVE FOR WHEEL-SEAT OF CAR-AXLE
This paper presents a fatigue life for the wheelseat of car axles. The results were obtained from fatigue test results for test axles using a full-scale fatigue testing machine. Statistical data are presented on fatigue crack initiation of actual axles and the reliability and usefulness of the P-S-N curve are discussed.

Tanaka, S Hatsuno, K Yaguchi, S *Railway Technical Research Institute* Vol. 16 No. 2, June 1975, pp 75-76, 2 Fig., 2 Tab.

PURCHASE FROM: Ken-yusha 1-45-6, Hikari-cho, Kokubunji, Tokyo, Japan Repr. PC

B1 127619
TESTING OF BOGIE FRAMES FOR RAILWAY CARS [Pruefung von Drehgestellrahmen fuer Eisenbahnfahrzeuge]
A new method of testing by the German Federal Railways laboratories is described. Only arc-shaped road travel is simulated. The deviations from the mean stress observed in these tests are treated as the basic stress amplitude. The forces are applied by servohydraulic equipment. A nomogram for determination of permissible lateral fatigue stresses is given. [German]

Schenk, H Lange, H *Materialpruefung* Vol. 17 No. 6, June 1975, pp 178-180

ACKNOWLEDGMENT: EI
PURCHASE FROM: VDI-Verlag GmbH Postfach 1139, 4 Duesselforf, West Germany Repr. PC

B1 127715
TRACK TRAIN DYNAMICS, GUIDELINES FOR: TRAIN HANDLING, TRAIN MAKEUP, TRACK & STRUCTURES, ENGINEER EDUCATION
This manual was prepared as an immediate aid in improving freight train performance. It has five sections: Definitions and Functions of Equipment; Train Handling; Train Makeup; Track and Structure; Engineer Education. These results are based on parametric study using validated analytical models.

A Government-Industry Research Program on Track Train Dynamics. Requests for this publication should be directed to J.G. Britton, Director of Operations, AAR. This is a 2 volume set.

Association of American Railroads AAR-R153, 1973, 33 pp, Figs.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B1 127835
MOORGATE TUBE TRAIN DISASTER
This two-part article describes the medical aspects of the crash of a London Underground transit train in a dead end tunnel which resulted in 43 deaths and 72 injuries requiring hospital treatment. Part 1 describes the experience of the medical staff and reports a substantial advantage in using on-site medical teams that could offer anaesthetic facilities. Adequate communication between the accident site and hospital is important. Part 2 reviews injuries sustained by 113 causalities, showing the need for rapid evacuation. Recognition of the "crush syndrome" is important and a radical surgical approach is suggested. Chest injuries were common and contributed to many of the deaths.

Direct requests to J.O. Robinson.

British Medical Journal Vol. 3 No. 5986, Sept. 1975, pp 727-730

ACKNOWLEDGMENT: British Medical Journal
PURCHASE FROM: St Bartholomew's Hospital Department of Surgery, London EC1A 7BE, England Repr. PC

B1 128186
SHINKANSEN ELECTRIC POWER FACILITIES BETWEEN SHIN-OSAKA AND HAKATA
Shin Kansen electric power facilities have been constructed taking advantage of new technologies which have been developed in the ten years since the opening of the Tokyo-Shin Osaka segment. Problems of environmental protection have been taken into consideration and measures have been taken to prevent fires on board the trains. This article describes the heavy compound catenary system, the feeders and power transforming facilities and the overhead contact facilities in the Shin Kansen tunnels. Disaster prevention measures in tunnels are also described.

Terachi, K Takeishi, M (Japanese National Railways) *Japanese Railway Engineering* Vol. 15 No. 3/4, 1974, pp 20-22, 6 Fig.

PURCHASE FROM: Japan Railway Engineers' Association 2-5-18 Otemachi, Chyoda-ku, Tokyo, Japan Repr. PC
DOTL JC

B1 128855
DYNAMIC STRESSES ACTING ON THE WINDOW PANES IN PASSENGER CARS OF THE TRAINS MEETING IN TUNNEL [Dynamische Druckbeanspruchungen von Fensterscheiben in Reisezugwagen Bei Zugegegnungen und Tunneldurchfahrten]
An attempt is made to obtain a theoretical estimate of the stresses acting on window panes in passenger trains at high speeds. Pressure and expansion readings were taken on window panes while the train was passing through a tunnel, the results being evaluated during comparative tests under the influence of explosible pressures. The procedure is illustrated for the example of the nose wave. [German]

Voss, G (Hannover Technical University) *Glasers Annalen ZEV* Vol. 99 No. 6, June 1975, pp 161-165, 14 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B1 129164
URBAN RAPID RAIL VEHICLE AND SYSTEMS PROGRAM ANNUAL REPORT, JULY 1974
This report reviews the third year's efforts of the Urban Mass Transportation Administration's Urban Rapid Rail Vehicle and Ssytems Program. The objective of the Program is to enhance the attractiveness of rail rapid transit to the urban traveler by providing him with transit vehicles that are as comfortable, reliable, safe and economical as possible. Accomplishments for the year ending June 1974 included the following: completion of the review of BART data; completion of the SOAC test and simulated demonstration programs at the High Speed Ground Test Center, Pueblo, Colorado after repairing the damage to the SOAC cars resulting from a collision with a standing car on August 11, 1973; completion of SOAC demonstration runs on the NYCTA lines. The ACT-1 program progressed to the award of a contract for the design and construction of ACT-1 train. A list of candidate subsystems has been proposed for test and development under the Advanced Subsystem Development Program (ASDP).

Boeing Vertol Company, (D174-10033-1) Ann. Rpt. UMTA-IT-06-0026, July 1974, 116 pp

Contract DOT-UT-10007

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC
DOTL NTIS

B1 129825
METHODS OF REDUCING WEAR ON THE ROLLER BEARINGS OF WAGON AXLE BOXES AS CAUSED BY TRACTION CURRENT [Sposoby umensenija povrezdenija tjagovym tokom buksovyh rolikovyh podsipnikov vagonov]
The article examines the causes of wear by electric erosion occurring in the roller bearings of axle-boxes, and provides recommendations framed for the protection of bearings against damage caused by traction current. By equipping the electric locomotives with contact devices for evacuating the traction current in the rails, through the axle-boxes, the number of roller-bearings damaged through electric erosion is reduced by some 15%. This damage can be reduced by introducing, in the earthing circuit, an additional resistance between bogie-underframe and axles-boxes, themselves isolated from the underframe. The total resistance of the earthing circuit of a wagon must be roughly 0.0625 ohms. [Russian]

Orlov, MV *Vestnik Vniizt* Vol. 34 No. 6, 1975, pp 35-40, 5 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Vestnik Vniizt Moscow, USSR

B1 129826
MODERN CALCULATION PROCEDURES FOR DETERMINING THE STRESSES AND DEFORMATIONS SUFFERED BY WHEEL SETS [Einsatz moderner Rechenverfahren zur Ermittlung der Spannungen und Verformungen bei Radsatzen]
On the basis of a number of examples, the author presents a whole range of possibilities that can be utilized in the preparation of a calculation programme for a precise analysis of the stresses and deformations suffered by wheel sets in accordance with the method of finite elements. A complete article, in which the illustrations provide as much information as the text. [German]

Raquet, E *Glasers Annalen ZEV* Vol. 99 No. 9, Sept. 1975, pp 249-255, 7 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B1 130825
CALCULATION OF BOGIES
Follow-up to an article published by the same author in the July 1973 issue of Rail International. This article gives an explanation, by means of some 40 formulae and equations, of stress calculations in bogie side frames for horizontal and braking loads.

Shadur, L *Rail International* Vol. 6 No. 11, Nov. 1975, pp 831-851, 9 Fig., 4 Tab., 11 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B1 130999
REGIONAL MACROECONOMIC MODEL
This paper is a description and explanation of the model described in "Transport Research Program: An Analysis of Investment Alternatives in the Colombian Transport System, Harvard University, Cambridge, Massachusetts, 1968, Chapter 3". This macroeconomic model was developed to simulate the regional consumption and production patterns of a country, and to evaluate the effects and interactions on the economy from alternative transport policies and development plans.

Holland, EP Isaac, I
International Bank for Reconstruction & Developmnt Paper No. 60, June 1970, 25 pp, 2 Fig., 4 App.

ACKNOWLEDGMENT: International Bank for Reconstruction & Developmnt
PURCHASE FROM: International Bank for Reconstruction & Developmnt 1818 H Street, NW, Washington, D.C., 20016 Repr. PC
Catalog No. 176, DOTL RP

B1 131020
ULTRASONIC INSPECTION OF GRAIN SIZE IN THE MATERIALS FOR RAILWAY WHEEL SETS
This work outlines the present theory of attenuation of the ultrasonic waves, particularly the theory of scattering, and describes the measurement of attenuation in metals. Experiments were carried out to measure the attenuation of samples with different grain size taken from materials for railway wheel sets; in these experiments the pulse echo method, with elimination of the effect of the reflexion factor, was applied. The article presents the relation between the overall attenuation coefficient and its scattering component, the grain size and frequency. On the basis of our measurements and an analysis of the obtained results, two methods of evaluation of the structure of railway materials by ultrasonic inspection were derived.

Kopec, B *Ultrasonics* Vol. 13 No. 6, Nov. 1975, pp 267-274

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B1 131027
USE OF FINITE ELEMENT ANALYSES FOR RAILCAR DESIGN
The analysis of railcar structures is improved by the use of electronic computers. Outlined are specific applications of finite element analyses to total car systems, and stress concentration. Data are presented on modeling, dynamic characteristics, and correlation of results.

Dennis, MJ (Boeing Vertol Company) *ASCE Journal of Transportation Engineering* Vol. 102 No. TE1, Proc. Paper 11921, Feb. 1976, pp 105-116, 5 Fig., 4 Tab.

ACKNOWLEDGMENT: ASCE
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B1 131258
METHOD FOR THE RAPID MEASUREMENT OF WHEEL AND RAIL WEAR BY MEANS OF RADIOACTIVE ISOTOPES [Kurzzeitverschleiss-Messverfahren an Rad und Schiene mit Hilfe radioaktiver Isotope]
No Abstract. [German]

Grohmann, HD *DET Eisenbahntechnik* Vol. 23 No. 12, Dec. 1975, pp 560-62, 1 Fig., 8 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: VEB Verlag Technik Oranienburgerstrasse 13-14, 102 Berlin, East Germany Repr. PC

B1 131259
THE ELASTIC FACTOR OF RAIL VEHICLE WHEELS [Die radiale Radfederkonstante von Eisenbahnraedern]
There have been constant efforts to increase the elasticity of rail vehicle wheels, in other words the elastic factor to be applied. This is determined by calculating the maximum dynamic vertical stress borne by the wheel when passing over a rail joint in relation to the radial elastic factor. The authors, who use a system of ordinary differential equations to solve this problem, with the help of an analog computer, obtain a radial elastic factor for impact reduction. [German]

Beer, R *DET Eisenbahntechnik* Vol. 23 No. 12, Dec. 1975, pp 563-565, 9 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: VEB Verlag Technik Oranienburgerstrasse 13-14, 102 Berlin, East Germany Repr. PC

B1 131263
WEAR ON EXTERNAL SURFACES OF WHEELS AND RAIL DUE TO FRICTION [Verschleissvorgang im Grenzschichtbereich der Reibpaarung Rad/Schiene]
The stresses borne by rail and wheel elements are analysed on the basis of several fundamental definitions of wear by Fleischer. A number of studies were carried out on plastic deformation, running surfaces and wear characteristics. Partial oxidation can occur when the external surfaces of wheels or rails are deformed because the materials come into contact with the surrounding atmosphere. Oxidised metallic particles are then worn away. Wear is often affected by the characteristics of the process itself or by layers of martensite which are produced by shoe brakes. [German]

Pigors, O *DET Eisenbahntechnik* Vol. 23 No. 11, Nov. 1975, pp 495-498, 5 Fig., 12 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: VEB Verlag Technik Oranienburgerstrasse 13-14, 102 Berlin, East Germany Repr. PC

B1 131274
RESEARCH ON THE STABILITY OF THE GAUGE MEASUREMENT OF WHEELSETS WITH SOLID WHEELS AND BRAKE SHOES
The purpose of this research was to determine the effect of the shape of solid wheel centres on their permanent heat- induced axial deformation, when brake shoes were used for braking. First, mathematical analyses based on the finite element method were used to find wheel centre shapes with a minimum tendency to deformation under the effect of heat. Then braking tests with prototype wheels on a test bench were performed to confirm the mathematical analyses. Certain types of corrugated wheel centre show minimum deformation. [German]

Raquet, E Tacke, G *Glasers Annalen ZEV* Vol. 98 No. 11, Nov. 1975, pp 311-316, 8 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B1 131645
BEARING BRINELLING FROM COUPLING IMPACTS OF UNIT TRAIN CARS
Problems of "excessive" wear and failure have arisen in new cars in unit train service. Some were due to over-the- road running, others to rough handling of empty cars. Early and high incidence of failure of all roller bearings on a fleet of year-old unit train cars was the pessimistic prediction made for a western railroad. This paper describes their determining the cause and their solutions to this problem.

Presented at the 1976 Joint ASME/IEEE Railroad Technical Conference, Chicago, Illinois, April 6-8, 1976. For the complete volume see RRIS No. 02 131638, Publication 7602.

Williams, AD Rhine, PE (Union Pacific Railroad); Driver, JB (Association of American Railroads)
American Society of Mechanical Engineers 1976, pp 123-163, 20 Fig., 12 Tab.

ACKNOWLEDGMENT: ASME, IEEE
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL RP

B1 132922
NEW MOUNTING TECHNIQUES OF WHEELS AND AXLE (OIL INJECTION METHOD)
This report describes some new mounting techniques for railroad wheels and axles, called the Oil Injection Method, described to be applied to New Tokaido Lines. Authors and JNR staffs have found the most effective method for the application of these techniques and also investigated their merits, for example the improvement of grip-force and removal of scratch marks that sometimes appear in the case of Force-Fit. [Japanese]

Matsushita, K Mizushima, A Morita, K *Sumitomo Metals* Vol. 26 No. 3, July 1974, pp 86-97

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

B1 132949
EFFECT OF THE DEVELOPMENT OF RESIDUAL STRESSES IN SOLID WHEELS ON WEAR [Evolution des contraintes residuelles dans les roues monoblocs. Influence sur les degradations]
After describing the special procedures employed to determine the residual stresses by destructive methods and X-ray diffraction, an assessment is made of the results obtained witn new solid wheels, to which different braking powers had been applied, over varied distances. The effect of these stresses is studied on the following mechanisms of wear: thermal flaws, fatigue cracks in the rim or the center and buckling. [French]

Revillon, A Leluan, A *Revue Generale des Chemins de Fer* Vol. 94 Nov. 1975, pp 647-662

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B1 132951
INVESTIGATIONS OF THE TRACK GAGE STABILITY OF WHEEL SETS WITH BLOCK-BRAKED SOLID WHEELS [Untersuchungen zur spurmasstabilitaet bei Radsaetzen mit klotzgebremsten vollraedern]
The investigations described were carried out to determine the influence of the shape of the wheel centers of solid wheels on their thermal distortion and permanent set in axial direction during or after heating of the wheel tire by the brake blocks. Analyses by computation using the method of finite elements served the purpose of finding wheel center shapes featuring a minimum thermal distortion. Subsequent braking tests on prototype wheels on the test stand proved that a small thermal distortion results also in small permanent set. [German]

Raquet, E Tacke, G *Glasers Annalen ZEV* Vol. 99 No. 11, Nov. 1975, pp 311-316, 8 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B1 132971
RAIL DYNAMICS SIMULATOR
The car testing facility at the Rail Dynamics Laboratory at the Transportation Test Center is described. The facility was designed and constructed to assist government and industry in evaluating and characterizing the dynamic behavior of cars equipped with two-axle trucks. The configuration of the Vertical Shaker System are described, along with its capabilities. Mathematical modeling of a piggyback car is discussed.

Proceedings of the 12th Annual Railroad Engineering Conference held at Pueblo, Colorado, October 23-24, 1975. The complete volume is RRIS 02 132958, Pricing is for the complete volume: Repr. PC $6.75, Microfiche$2.25, NTIS PB-252968/AS.

de Benedet, D (Wyle Laboratories)
Federal Railroad Administration FRA OR&D 76-243, Oct. 1975, pp 118-122, 12 Fig.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS
DOTL NTIS, DOTL RP

B1 134552
USE OF IMPACT-ABSORBING DAMPERS IN ELECTRIC TRAINS [Primenenie antiavarijnyh amortizirujuscih ustrojstv v elektropoezdah]
It is known that in about 92% of cases, collisions between electric train coaches occur at running speeds of 15 to 20 km/h. For this reason, when designing the mechanical parts of suburban electric train coaches, it must be borne in mind that, to comply with strength calculation standards, the body bearing sections should not be liable to deformation which would be dangerous for passengers in a collision at 20 km/h. The article contains regulations for the construction of electric train bodies to protect passengers in the event of a collision, examines the problem of using dampers to absorb a considerable part of impact energy, and, finally, gives the results of tests on a prototype of a device of this kind. [Russian]

Ivanov, AV Solodkov, SP *Vestnik Vniizt* No. 1, 1976, pp 31-35, 1 Fig., 1 Tab., 4 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Vestnik Vniizt Moscow, USSR

B1 134559
DEVELOPMENT AND STRUCTURAL TESTING OF THE CLASS 87 LOCOMOTIVE BOGIE FRAME
The article first describes the basic requirements of this bogie design, and some of the constructional problems (particularly welding). It then describes: the study of stress levels in the various components by finite element stress analysis; the static and dynamic tests to which the prototype was subjected; use of a Perspex scale model to measure strains in the prototype; the method of computer calculation of the fatigue life of components under random cyclic loading. Similar methods of investigation have been applied successfully to a wide range of other structures, such as coach bodies, and tank wagon bodies.

Lowe, CB *Railway Engineer* Vol. 4 No. 6, Nov. 1975, pp 54-62, 1 Tab., 10 Phot., 7 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Mechanical Engineering Publications Penthouse 1, 15 West 55th Street, New York, New York, 10019
DOTL JC

B1 134589
ULTRASONIC METHOD OF MONITORING THE SECURING OF WAGON WHEEL HUBS ON THE AXLE [Ul'trazvukovok sposob knontrolja plotnosti posadki stupic vagonnyh koles na os']
The article presents the results of experimental studies into the monitoring of wheel securing by ultrasound vibration method, and goes on to assess the effect of the metal's structure on the speed of travel of ultrasonic waves. [Russian]

Lihacev, JV *Vestnik Vniizt* Vol. 34 No. 8, 1975, pp 29-31, 3 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Vestnik Vniizt Moscow, USSR

B1 135182
COATING FOR THE PRESERVATION OF FRACTURE SURFACES

In order to perform a meaningful examination of a fracture surface in the scanning electron microscope it is necessary for the examined surface to be in a condition as close to the fractured condition as possible. Laboratory preservation techniques are not available to the engineer in the field so that fracture surfaces are best preserved by coating them with a material that can be easily removed later without damage to the fractures. In this paper, a preservative is described that is suitable for the protection of fracture surfaces both in the field and in the laboratory. The restrictions and limitations of the preservative are discussed and examples of fracture surfaces before coating and after coating and exposure to a humidity cabinet are shown.

Broadman, BE Zipp, R Goering, WA
Society of Automotive Engineers Preprint No. 750967, 1975, 10 pp

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

B2 033083
WHEEL-RAIL ADHESION
The subject of adhesion between locomotive wheels and rails has been an area of vital interest to locomotive manufactures and to the railroads. Horsepower of internally powered locomotives has continued to increase significantly, thereby providing more power for traction. The trend of increasing horsepower has been the product of progress in technology and engineering development. Wheel-to-rail adhesion within the lower speed range has been a limiting factor in tonnage ratings for locomotives in drag service on U.S. railroads. Factors Affecting Adhesion are: (1) Vehicle Factors, (2) Track Factors, and (3) Contact-Area Common Factors. Additional discussion of the conclusions follows.

Marta, HA Mels, KD (General Motors Corporation) *ASME Journal of Engineering for Industry* 68-WA/RR-1, Aug. 1969, pp839-854, 69 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-019)
DOTL RP

B2 033084
FRICTION CREEP PHENOMENON OF ADHESION BETWEEN STEEL WHEELS AND RAILS
The purpose of this article is to present a summary of the laboratory and field tests which have been conducted by EMD to evaluate the friction and creep phenomenon of adhesion between steel wheels and rails. The available adhesion coefficient between the driven wheels and rail is a primary factor in determining the amount of power that can be converted to tractive force by the locomotive. For this reason, experimental investigations into rolling contact friction-creep phenomenon were conducted on model equipment in 1968 along with full scale field tests on an SD-45 model locomotive.
Conference sponsored by the American Society of Mechanical Engineers and the Institute of Electrical and Electronics Engineers.

Marta, HA Mels, KD Itami, GS (General Motors Corporation) *ASME/IEEE Railroad Conference* 1971, 35pp, 31 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-020)
DOTL RP

B2 033094
RUNNING SAFETY OF RUSSEL SNOW PLOW FOR DOUBLE TRACK
Running safety from derailment of the Russel snow plow for double track was studied by test and analysis. Shape is useful to push snow away to one side only, but it increases the amount of side pressure of the front wheel on the rail and may endanger the car for possible derailment. In the course of the test and analysis (a) the snow-plowing resistance, (b) the equilibrium of forces applied to the car during the operation, (c) the amount of the lateral and vertical thrust of the front wheel on the rail, (d) the derailment quotient--the ratio of lateral thrust to vertical load at the wheel tread--and its critical value, and (e) the recommendable speeds for safety under various operational conditions.

Matsui, S (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 1 No. 3, May 1959, p79

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-031)
DOTL RP

B2 033099
ROLLING STOCK FOR HIGH-SPEED OPERATION
Discussion of factors to be considered in the design of rolling stock for high speed operation. Factors in the design to rolling stock includes: gauge, outside forms as related to streamlining, carriage structure, locomotion systems, braking systems.

Miki, T (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. .I. Apr. 1960, pp7-12

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-036)
DOTL RP

B2 033100
SAFETY AND RIDE-COMFORT OF HIGH-SPEED RAILWAY CARS
Running safety is the essential requirement for the high-speed operation of rolling-stock. However, riding comfort is another important factor which should never be overlooked. Discussion is limited to the car-dynamical problems such as the over-turn or derailment of cars. The riding problem is concentrated to the vibrational riding quality.

Matsudaira, T (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. .I. Apr. 1960, pp13-19

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-037)
DOTL RP

B2 033104
ON THE TYRE PROFILE OF FREIGHTCAR WHEELS
Adoption of the N-profile tyre wheels for double-link suspension freight cars has been decided upon. Fundamental considerations in determination of wheel tyre and flange profile are as follows: (1) high stability to hunting, (2) little wear due to running, (3) great safety against derailment. The N-profile tyre proposed to meet this demand has been confirmed to be effective both theoretically and experimentally; it is going to be adopted in all two-axle freight cars of double-link suspension. It is expected to make drastic cutdown of derailment cases of two-axle freight cars.

Matsui, N (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 11 No. 2, June 1970, pp61-65, 7 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-042)
DOTL RP

B2 033105
CALCULATION ON HUNTING OF HIGH SPEED RAILWAY TRUCK--PROBLEMS OF TRUCK DESIGN FOR SANYO SHIN KANSEN
This report treats of an outline with the fundamental characteristic of the hunting of car, and of the theoretical foundation on the basic design of the test truck for the SYNYO SHIN KANSEN with an example of numerical calculation. Discusses the various factors which affect to the hunting speed of the truck, for instance, the supporting stiffness of the wheelset, the spring constant between the side frame and the truck one, and the frictional moment and the elastic one against to the truck turning etc. As a result the basic data for the car design are proposed.

Yokose, K (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 11 No. 2, June 1970, pp108-112, 5 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-044)
DOTL RP

B2 033130
DYNAMICS OF HIGH SPEED ROLLING STOCK
Article deals with the relationship of passenger comfort to braking of the train, research on running safety with measurements of side thrust and verticle forces in the axle wheel. Additionally, results of testing related to minimizing truck hunting are discussed.

Matsudaira, T (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. .I. Nov. 1961, pp20-26

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-070)
DOTL RP

B2 033132
TECHNICAL PROCEEDINGS OF THE ENGINEERING EXCHANGE FORUM
Papers from a railroad forum which discuss car design trends, high speed track design, roll and wheel lift tests, coupling requirements. Also included with the papers are comments and questions concerning the papers presented at the forum.

Engineering Exchange Forum Sept. 1966, 53pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-072)
DOTL RP

B2 033135
ON THE EFFECTIVENESS OF CAR BODY STRUCTURAL MEMBERS (PART 2)
The experimental results and some considerations on a large car body structural model in bending which were carried out utilizing repeated strain

method are presented. Detailed stress distributions on the structure are obtained conveniently by this method, and the accuracy of measurements is satisfactory enough in view of practice. Some data on the effectiveness of members are derived from these experiments.

Ito, H Kawamura, T Kezuka, E (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 10 No. 1, Mar. 1969, pp31-33

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-075)
DOTL RP

B2 033152
HIGH-SPEED ROLLING STOCK. I. AERODYNAMICAL PROBLEMS
The main purpose of the tests on the test track section is to examine various problems which may occur when a high speed train is running in the tunnels and when two high speed trains are passing each other in the tunnels. At first, tests were made to clarify phenomena which actually occur, and then experiments were made to study the countermeasures for the results if necessary.
Special Issue

Hara, T (Japanese National Railways) *Railway Technical Research Institute* Oct. 1963, pp7-11

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-106)
DOTL RP

B2 033158
TOLERANCE CRITERIA OF RIDING COMFORT FOR LATERAL VIBRATION (REPORT 1)
This report refers to preliminary experiments studying the effect of low-frequency lateral vibrations on the psychological quantities of human subject on a vibration table.

Miyoshi, K Sakamoto, M (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 8 No. 2, June 1967

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-112)
DOTL RP

B2 033171
STABILITY REGION OF THE NONLINEAR HUNTING VIBRATION OF RAILWAY VEHICLE TRUCK
Applying the describing function method to the estimation of the nonlinear hunting vibration of a railway truck, the stability region of that truck can be estimated easily by the computer. The result obtained by this method coincides well with the one obtained by an analytical method.

Mano, K Arai, S Yokose, K (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 9 No. 2, June 1968, pp109-110

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-125)
DOTL RP

B2 033177
CALCULATION ON DYNAMIC PERFORMANCE OF HYDRAULIC CUSHION UNDERFRAME (REPORT 1)
The car structure with a movable through-member which connects the draft gears at the car ends-the cushion underframe--is considered for the case when a hydraulic shock absorber acts against the relative motion between the through-member and the car body. The impact motion between a conventional car and the car with a cushion underframe is solved in order to give a practical method to determine suitable dimensions of elements and also to predict the motion under any initial conditions. For the calculation, use of electronic computer is considered. Numerical examples show the favourable performance of the system, giving the coupler forces within the limit of car-end strength even for a very high impact speed, say 20 km/h, of the cars. The method described in this article has been successfully applied for the designing marine-container cars. The test results are quite favourable.

Matsui, S Suzuki, S (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 9 No. 1, Mar. 1968, pp25-32

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-131)
DOTL RP

B2 033186
CALCULATION ON DYNAMIC PERFORMANCE OF HYDRAULIC CUSHION UNDERFRAME (REPORT 2)
Car end-to-end impact of the hydraulic cushion underframe car was analyzed numerically, not only for one-to-one but also for one-to-two car impact. The result shows a good agreement with the data of the actual car test. Besides, effects of masses of coupler and sliding sill, coupler rigidity and draft gear damping were clarified.

Matsui, S Suzuki, S (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 9 No. 4, Dec. 1968, pp216-219, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-142)
DOTL RP

B2 033195
EVALUATIONS OF TRAIN RIDING COMFORT UNDER VARIOUS DECELERATIONS
When a train runs on the track at high speed, passengers are subjected to various forces which are produced by the change of its speed. In general, the riding comfort felt by them is evaluated in terms of this change. Determine the allowable limits of the train riding comfort for passengers, obtain the data on their feelings and evaluate them quantitatively under various conditions. Also intended to calculate significant differences between individual passengers.

Urabe, S Nomura, Y (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 5 No. 2, June 1964, pp28-34

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-152)
DOTL RP

B2 033197
BRAKING SHOCK TEST OF PASSENGER-AND FREIGHT-CARS MIXED TRAIN
According to the existing regulation on train operation of the Japanese National Railways, cut-off of the supplementary auxiliary air reservoirs of passenger cars is required in a mixed composition of train, when six or more freight cars are included in the train, in order to alleviate the difference of brake effects. The present test was planned for examining the effect on train impact of application of emergency brake under the condition of the supplementary reservoir included or excluded in the operation, and for exploring the possibility of modernizing the regulations.

Nomura, Y Kikuchi, K Matsui, S (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 5 No. 2, June 1964, pp43-44

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-154)
DOTL RP

B2 033201
TESTS ON THE TRACK ON THE RIDING STABILITY AND THE GUIDING QUALITY OF VEHICLES BY MEANS OF A SPECIAL VEHICLE. CHARACTERISTICS OF THE EXPERIMENTAL VEHICLE
In order to study experimentally the riding stability and the hunting movements of vehicles, it was decided to consider a vehicle of the simplest possible design i.e. a two-axled isolated bogie. Each of the factors entering into the dynamic phenomena connected with its running can be separately varied. This experimental bogie is placed under the middle section of the body of an ordinary bogie coach. The bogie and the experimental coach are described in detail and also the methods adopted for measuring the interesting magnitudes.
Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B52/RP 1/E, June 1963, 28 pp, 31 Fig.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-158)
PURCHASE FROM: UIC Repr. PC
DOTL RP

B2 033202
PREVENTION OF DERAILMENT OF GOODS WAGONS ON DISTORTED TRACKS. STATISTICAL ENQUIRY RELATING TO THE PERMISSIBLE TRACK TWIST

The study of the permissible wheel load deviations and of the resultant characteristics for the goods wagons requires an exact knowledge of the existing track "twists". A statistical inquiry was made on the lines of the DB, the SNCF and the PKP. The inquiry has principally dealt with continuous measurements of existing track twists, related to a basis of 5.00 m (wheelbase of the recording coach), and a length of 1,820 km of track on the DB, 1,805 km on the SNCF and 1,955 km on the PKP has been examined. In each case, the measurements were made on tracks of all categories. The present report gives an account of the results of these measurements-each classified in "ranges of twist" of 1 degree/00-for twists exceeding 4 degrees/00. A statistical analysis, which is based on the assumption of a critical value of twist of 7 degrees/00, related to a base of 5.00 m, has been appended to the present report. This statistical analysis indicates, for the actual state of maintenance of the tracks and for a wagon running an average distance of 1,000 km, the probability of encountering at least "a" twists greater than the above mentioned limit. It also shows the possible reduction in risk to be expected through the application of special measures with regard to track maintenance and vehicle design. The following possibilities have been studied: a) stricter control of accident twists of dangerous magnitude; b) extention of the maintenance regulations for track category 2 to the lower categories of track; c) improving the adaption possibilities of the vehicles to track twists.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B55/RP 2/E, June 1965, 19 pp, 20 Fig., 11 Tab.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-160)
PURCHASE FROM: UIC Repr. PC
DOTL RP

B2 033203
STUDY OF THE OPTIMUM DAMPING REQUIRED BY THE SUSPENSION SYSTEMS OF WAGONS SO AS TO ENABLE THEIR RUNNING, UNDER ANY LOADING CONDITIONS, AT A SPEED OF 80 KM/H ON TRACKS IN AN AVERAGE STATE OF REPAIR

The running of trains in ordinary service at a speed of 80 km/h as of 1970 entails problems especially as regards certain series of existing wagons, which will not have been redeemed in the forthcoming years and which may give rise to difficulties when being run at higher speeds. In the present report of enquiry the measures to be taken in order to improve the riding stability of these latter vehicles are examined. These arrangements concern both the constructional modifications to be made and the adaptation of the damping systems. They should, however, be economic in order that they can rapidly be redeemed. The study shows as regards the two-axled wagons the importance of the ratio between wheelbase and length of the wagon body and, more exactly, between the wheelbase and the radius of gyration in relation to the vertical axis of the centre of gravity. The increase of the wheelbase has shown to be one of the most efficacious measures in order to improve the stability of the wagons having insufficient riding qualities. In the case of bogie wagons, the study gives an account of the damping systems based on friction aiming at an improvement in the behaviour of the vehicles fitted with helical spring suspension systems. Such systems also enable bogies to be visualised capable of being used at speeds up to 120 km/h. The report finally supplies some general indications on the choice of the lines where the tests on vehicles could be undertaken within the frame of studies of a Specialists Committee. These tests should make it possible to guarantee the safety of the running of the modified wagons on all the lines where a speed of 80 km/h is authorized.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B56/RE /E, July 1962, 49 pp, 4 Fig., 2 Tab., 4 App.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-161)
PURCHASE FROM: UIC
DOTL RP

B2 033204
MAINTENANCE OF THE WHEELSETS OF TRAILER STOCK. TESTS ON PASSENGER COACHES TO ASCERTAIN THE PERMISSIBLE OUT-OF-ROUNDNESS AND OUT-OF-BALANCE OF THE WHEELS OF THESE FOR SPEEDS OF BETWEEN 0 AND 250 KM/H

Previous reports contain the results of the tests carried out with a view to determining the permissible out-of-roundness and out-of-balance values for the wheel-set of trailer-stock, for running speeds comprised between 0 and 150 km/h. New tests have been carried out for speeds comprised between 0 and 250 km/h. These have consisted of bench-tests, carried out on the SNCF dynamic test-rig for vehicle suspensions at Vitry-sur-Seine, and have concerned 3 coaches (SNCF, DB and FS). In addition, line tests have been carried out with the SNCF coach; in a first series of tests a speed of 250 km/h was reached, while, in a second series of tests the running-speed was only 160 km/h. The results obtained have permitted the following limit values of plus minus 0.15 mm for the out-of-roundness and 0.125 kg.m for the out-of-balance per wheel (static balancing would seem to suffice in most cases) to be fixed, such that the comfort obtained with the three coaches is still acceptable. This is valid up to the speed of 250 km/h in the case of the DB and SNCF coaches and up to 220 km/h for the FS coach. It has also been found: a) that the test-bench used constituted a perfect reference basis and that it seem desirable to devise a better correlation between the excitation obtained on the track and that produced on the rig; b) that, for the purpose of determining the comfort, the whole of the floor of the coach should be covered by the examination, since, for speeds beyond 150 km/h, the body can present a complex vibratory system with several nodes; c) that, if it is whished to use a coach for high running speeds, it must be checked to see that, beyond a certain speed, there is no very sharp increase in all the recorded accelerations.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Rpt 9, Question B79, Oct. 1970, 39pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-162)
DOTL RP

B2 033206
PROBLEMS OF INTERACTION OF VEHICLES AND TRACK

A committee report considers that the railway vehicle is made up of units which are united by elastic elements. The movements of the various units are considered, and formulae to represent such phenomenon as single mass oscillation, nonlinear vibrations, self-sustained movement, are included. The problem of "hunting" is defined, factors discussed, and the part that the track plays in the phenomenon is discussed.

Restrictions on the use of this document are contained in the explanatory material.

Van Bommel, I (International Union of Railways)
International Union of Railways Annual Rpt Question C9, Jan. 1961, 14pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-164)
DOTL RP

B2 033221
1956 FREIGHT TRUCK TESTS ON NORTHERN REGION AUTHORITY

Data and analysis of test of freight car ride on a group of freight trucks after 8 years of service, a series snubbed spring packages used to replace AAR 15/8 springs on a 70 ton Hopper car. Results of test data comparing used truck with new trucks previously tested. Also includes attempts to use vertical impact counts to determine critical speed. Results indicate that after 8 years of service, the ride of the trucks was not adversely affected. This study was to lead to the establishment of maintenance cycle for freight truck suspension.

Guins, SG Roman, JB (Chesapeake and Ohio Railway)
Chesapeake and Ohio Railway Res Rpt 37, July 1956, 41pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-088)
DOTL RP

B2 033225
CARRIAGE AND RAILCAR BOGIES: THEIR DESIGN AND DEVELOPMENT--VI
Article discusses the interrelationship between design of a bogie and the coach under which it will be installed. Differences in coach length, width, centers of gravity, wheel diameters and rail condition are considered. The factors of sound intensity, bouncing and pitching of the coach are related to ride and comfort index.

Conclusion of a six-part article deals with the effects of track and sound intensity.

Koffman, JL (British Railways) *Railway Gazette* Oct. 1961, pp 446-449

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-092)

B2 033229
HIGH SPEED ROLLING STOCK. I. AERODYNAMIC PROBLEMS
Articles discusses unique problems of high speed trains. Aerodynamic problems such as testing of sealed-nonsealed train units, means to measure aerodynamic drag are discussed. Structural analyses of side frames, load tests, strength of bodies and components are also included. Testing of power transmission, effects of wheel flat, bearings and life guard are further investigated.

Hara, T (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. .I. Aug. 1964, pp9-19

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-096)
DOTL RP

B2 033237
A NEW TRANSIT PROPULSION UNIT SUSPENSION-PROVED ON NORTHEAST CORRIDOR HIGH SPEED TEST CARS
The old generation propulsion units for lightweight, inboard journal trucks had the motor and gear unit bolted solidly together, driving the axle through, and supported on, rubber around the axle. By correcting deficiencies in this design, yet retaining the principle of floating the motor in rubber to isolate it from rail shocks, this new propulsion unit arrangement for lightweight, inboard journal trucks has successfully permitted the car operating speeds to double, from 75 to 150 mph in one jump. Paper has been written to emphasize the growing importance of dynamic vibration analysis in the design of rail vehicle trucks and truck and axle-mounted propulsion equipment. Detailed analytical studies of the wheel and axle, truck, and propulsion equipment suspension dynamics has generally been deferred in the past. The car body dynamics have been studied closely to ensure that the passengers receive a smooth ride, but the ride of the trucks and their equipment has been of little concern to most. We will point out why the suspension dynamics of the truck must be studied, how they can be analyzed, and the consequences of failure to do so.

Conference Paper.

Nelson, JA Hapeman, MJ (General Electric Company)
American Society of Mechanical Engineers 69-RR-3, 12pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-183)
DOTL RP

B2 033243
NEW PRINCIPLES IN BOGIE-BODY CONNECTIONS. TWO PROTOTYPE BOGIES DESIGNED BY THE S.N.C.F.
Until recently the problem of the comfort of railway coaches was settled empirically. It was not till 1952 that a start was made with experimental research into the conditions determining comfort in a railway vehicle. There was a problem in connection with the link between bogie and body as far as railway vehicle comfort was concerned. It appeared that the choice of the solutions made by trial and error was not the best. The problem of comfort has two aspects: transversal comfort; and vertical comfort. Two bogies have been designed on the same theoretical bases: Suspension rods of the body in relation to the bogie 0.500 m long, inclined 1/10 towards the interior. Transversal play of the body in relation to the bogie plus or minus 65 mm. Complete freedom of rotation of the bogie in relation to the body.

Mauzin, M (French National Railways) *Rail International* Nov. 1965, pp751-767

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-189)
DOTL RP

B2 033244
FREIGHT CAR TRUCK PROGRESS
The modern High Speed Freight Car Truck of the present-day 50-ton freight car has a weight complete of about 14,000 lbs. in Grade "B" steel, and is capable of transporting 110,000 lbs. of material safely and without damage at speeds up to 100 mph. The trucks also support the car body, which in some cases weighs 40,000 to 45,000 lbs., making 150,000 to 155,000 lbs. in all. This is 11 lbs of load carried per pound of weight. The cast steel truck bolster supports about 90 lbs. per pound of its own weight, and the cast steel side frame about 65 lbs. per pound of weight. The cast steel bolster is capable of carrying 65 lbs. and the cast steel side frame 46 lbs. of revenue freight per pound of their own weight. Analysis shows that the forged steel axles carry 34 lbs. of revenue freight per pound of weight and the one-wear steel wheels 24-1/2 lbs., indicating the excellent efficiency and weight economy of the cast steel side frame and bolster.

Cottrell, RB (American Steel Foundries)
American Steel Foundries 13pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-191)
DOTL RP

B2 033246
WESTINGHOUSE MARK H-100
A description and plans of the Mark H-100 Draft gear as manufactured by Cardwell Westinghouse. A friction gear which uses hydraulic unit to supplement spring pressure on the friction clutch. The unit fits the standard 36 inches pocket with standard attachments. Features include variable orifice which adjusts to changes in velocity and pressure. Unit does not have moving seals which frequently leak, seals used are low pressure and proved successful. Assembly has been hammer tested to more than 30,000,000 ft. pounds of work.

Unpublished data.

Cardwell, L (Cardwell Westinghouse Company)
Cardwell Westinghouse Company 14pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-193)
DOTL RP

B2 033247
WESTINGHOUSE HYDRAULIC-FRICTION DRAFT GEAR MARK H-60
The Mark H-60 combines an hydraulic unit with the serviceproven Westinghouse principle of a spring-actuated friction clutch mechanism. The hydraulic unit adds to the spring resistance, which when multiplied by the friction clutch more than doubles the ultimate capacity of the gear. The hydraulic unit has been designed to be as trouble-free as possible. All of the hydraulic fluid seals are static instead of moving, and all are located on the low pressure side. Hydraulic unit has been endurance-tested to over one million cycles, and has been service-tested for over two years. The Mark H-60 is for all cars having the new standard 17-3/4 inches striker and 24-5/8 inches pocket. Travel is 3-1/4 inches. One follower is required per gear. No special attachments are needed.

Unpublished data.

Cardwell Westinghouse Company July 1978, 22pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-194)
DOTL RP

B2 033249
DRAFT GEAR RESEARCH IMPACT TESTS OF AAR APPROVED STANDARD POCKET DRAFT GEARS
This report describes an investigation conducted by the utilization of impacts made on eleven AAR approved (24-5/8 in.) standard pocket draft gears. During the study two gears of the same manufacturer were installed in two identical 50-ton box cars and impacted under test conditions of: (a) empty cars (no load), (b) half or medium load, and (c) full load. The draft gears investigated included six friction, three rubber, and two friction-rubber types. This investigation resulted in the development of a large volume of data related to such variables as force input, gear closure, stress distribution in the car underframe and car body, and load accelerations. Only a part of the data has been reduced and analyzed for this report. No attempt has been made to present any conclusions.

Association of American Railroads MR-348, May 1961, 25pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-196)
DOTL RP

B2 033250
AN ANALYSIS OF THE RAIL CLIMBING TENDENCY OF A WHEEL AXLE SET AT VARIOUS ANGLES OF ATTACK
This analysis examines the rail climbing tendency of a wheel at various angles of attack. Static conditions (incipient motion or constant speed motion with no lateral acceleration or track irregularities) are assumed. The analysis shows no tendency for the wheel to climb the rail at any normal angle of attack.

Johnson, MR Oct. 1956, 4pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-198)
DOTL RP

B2 033255
HIGH-SPEED ROLL ING STOCK. I. AERODYNAMICAL PROBLEMS
Considering the various problems of high speed train operation, pressure variations of trains in tunnels and the relationship to internal pressure changes is discussed. Structural problems of rolling stock including deformation, stress and window design, wheel axle and axle box are also considered. Finally, traction motor design and power transmissions are considered.

Hara, T (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. .I. Oct. 1963, pp7-20

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-203)
DOTL RP

B2 033258
RELATION BETWEEN SUPERELEVATION AND CAR ROLLING
Springs and links between car body and axles can be thought as a mechanical filter to isolate the car body from axle motion (except axle revolution). Then the problem to know the relation between track irregularity and car vibration is the problem to know the characteristics of this filter. there are three methods to study the characteristics. The first method is to calculate the characteristics theoretically from the parts constants. The second method is to know the characteristics by measuring the output of filter for special input. The third method is to determine the characteristics by analyzing the input-output relations for normal operation. No special equipment except measuring instruments is needed. Second, the effect of random noise can be cancelled out by statistical treatment of data. An application of this method is described.

Nakamura, I (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 3 No. 1, Mar. 1962, pp17-20

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-207)
DOTL RP

B2 033264
RUNNING SAFETY OF RUSSEL SNOWPLOW FOR DOUBLE TRACK (REPORT 2)
The Russel snowplow used for clearance of double track in JNR has a single edged front to push the snow toward one side; consequently, wheel lateral thrust on rail may become considerably high under some conditions. Actually derailment has been of frequent occurrence during operation. In order to secure efficient operation of the snowplow without loss of running safely, a study has been made of the relation between wheel reaction and plowing conditions.

Matsui, S Koyama, M (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 3 No. 1, Mar. 1962, pp32-39

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-214)
DOTL RP

B2 033266
ALUMINUM IN ROLLING STOCK IMPACT TESTS AT COLLISION SPEEDS
The paper records the results of 75 impact tests, 47 of which occurred between the speeds of 5 to 15.4 mph on an all-aluminum 70 ton capacity covered hopper car. Coupler forces ranged between 500,000 and 947,000 lbs. The hopper car was equipped with aluminum centersill and bolsters. Summary values of strain gauge reading are presented. Considerable space is devoted to describing the damage to various parts of the "hammer" and "anvil" cars as a result of the highest speed collision. One of the unique results of the test explained in the paper is a schedule showing coupler force distribution from the centersill to the carbody, along the length of the car from the collision point. The discussion on location of strain gauge is very adequate, but little specific information is given on stress levels recorded. There is a graph showing average longitudinal compressive stresses recorded in the aluminum centersill along with a design specification for the centersill.

Campbell, RA Sutherland, JG Whiting, JF (Aluminum Company of Canada, Limited)
American Society of Mechanical Engineers Paper 58-RR-1, Apr. 1958

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-216)
DOTL RP

B2 033269
STUDY OF THE VERTICAL SUSPENSION OF A RAILWAY VEHICLE
In the following pages, we propose to study the vertical suspension of a railway vehicle considered as a rigid body resting on elastic supports. This study will make it possible to determine the numerical values of the suspension components to obtain the best possible comfort in the body, i.e., (1) the rigidity of the springs making up the 2 stages of the suspension; (2) the positioning and rate of amortization. In addition, a study of the transitory regime will make it possible to describe the behaviour of the suspension when the vehicle passes over an isolated defect in the track (low joint, faulty frog, etc.) and to see whether the stipulated rate of amortization is sufficient to damp out the oscillations rapidly.

Mauzin, A Joly, RE (French National Railways) *Rail International* Oct. 1968, pp948-1006, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-219)
DOTL RP

B2 033274
TRAIN RESISTANCE, POWER AND ENERGY REQUIREMENT OF M-U CARS
Equations to be used in determination of multiple-unit train resistance, power and energy requirement are developed. Curves are presented for air resistance in tunnels. For open air the effect of wind speed and direction is also analyzed. Methods are presented for energy requirement optimization. Considerable energy savings can be realized by using these methods as guide lines for operational criteria. This study extends the work of W.J. Davis, Jr., for all kinds of M-U cars. The Davis equations were prepared and still are successfully used for conventional rapid transit train speeds and shapes, but not for high speeds and streamlining.

de Koranyi, L (General Electric Company)
Institute of Electrical and Electronics Engineers Conf Paper 34CP 66-201, Mar. 1966, 13pp, 14 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-225)
DOTL RP

B2 033286
TANK CARS IN THE NEWS
Report on a speech concerning effective rail car utilization and applications to the 4 wheel, 125 ton car. Lists the objectives to the same car which are; light rail, rail wear, and bridges and trestles. Proposes several alternatives to the problem of meeting the railroad costs by increasing the payload of each car.

Traffic World

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-238)
DOTL RP

B2 033287
PROCEEDINGS OF SEMINAR ON RAIL CAR UTILIZATION
It was the purpose of this seminar to explore the newest techniques in rail car and systems design along with railroad programs which provide the greatest degree of rapid recovery of use of rail cars. The effective adaptation of almost instantaneous data retrieval is one method explored as a means of

more fully utilizing available rail car capacities. Other means included more efficient use of railcars while in the hands of shippers, reduced warehousing use of existing cars and better designed cars and systems. All of these methods were discussed in this seminar with the hope that it would provide all interested in reduced distribution costs with a greater knowledge of the latest tools available to move the goods of commerce faster and more efficiently. Specific presentations included: Planning for Improved Rail Fleet Utilization; Designing for Improved Car Utilization; Inventory Control of Rail Equipment; and use of a Computer Based Information System to Reduce Total Distribution Costs.

Seminar Proceedings.

Bonham, FS (Monsanto Company); Phillips, EA (Union Tank Car Company); Sulik, LR (Dow Chemical Company)
Manufacturing Chemists Association Nov. 1967, 66pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-239)
DOTL RP

B2 033293
IMPACT TESTS OF N & W RR 70-TON HOPPER CARS, NO. 34000 AND NO. 31162

The Norfolk and Western Railway Company had impact tests made on two 70-ton hopper cars. These cars were loaded to a weight on rail of 176,000 lbs. For test purposes, the original draft gear was replaced with National M-400 rubber draft gears and then with National M-17A friction draft gears, which had been calibrated to their travel limits. It appears from the results of thest tests that satisfactory performance and life may be expected from the new class H-10 car providing impacts do not exceed 9.5 mph with rubber draft gears and 5.5 mph with the cars equipped with friction draft gears.

National Malleable and Steel Castings Company Rpt 3556, 37pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-246)
DOTL RP

B2 033294
IMPACT TESTS OF VIRGINIAN RAILWAY 70-TON HOPPER CAR NO. 5000

The Virginian Railway had impact tests made on a newly built 70-ton hopper car, class H-14, No. 5000, to determine the location of the highest stress points in the car, whether any weakness existed in its design or construction and to compare force and stress levels obtained with friction and rubber draft gears. A similar class car was used as the impacting car. Comparison of the test results revealed that the force and stress levels at 7.7 mph impacts for the rubber draft gear were approximately equivalent to those at 6 mph impacts for the friction draft gear. These tests indicated that satisfactory performance and service life could be expected from the 70-ton hopper cars of the design tested. Cars of this design and construction can be expected to receive impacts up to 6 mph without sustaining permanent damage when equipped with friction draft gears, and up to 7-1/2 mph when equipped with rubber draft gears. Under special impact conditions such that the force of impact is divided between the striking casting and the rear draft stops, the maximum safe impact speed with friction draft gears was found to be approximately 6 mph. When the entire impact force was directed against the striking casting and the draft gear restricted from functioning, the maximum safe impact speed with friction draft gears was approximately 5 mph.

Company report.

National Malleable and Steel Castings Company Rept 3956, Oct. 1956, 42pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-247)
DOTL RP

B2 033297
TRACK-TRAIN DYNAMICS STUDY PROJECT TR-14 RAIL-VEHICLE INTERACTION STUDY REPORT NO. 1 (PRELIMINARY ANALYSIS OF SAMPLE DATA)

As a result of various derailments, a task force was formed to investigate the dynamic forces exerted by locomotive and freight car wheels against the rail. Critical study was directed at the 3 and 2 axle trucks of high horsepower locomotives, 85 feet TFC cars, and 50 feet box cars. The objective of this investigation was to determine if dynamic forces of sufficient magnitude to cause derailment were being generated by equipment, track structure and operating practice, and to recommend whatever corrective action might be indicated. Extensive field tests of wheel-rail interaction were conducted in various territories between Los Angeles and Pine Bluff, Arkansas. An analysis of these test results led to the following general conclusions: 1. Dynamic forces of sufficient magnitude to cause derailments are being generated in every day operation of revenue trains. 2. The forces are also sufficient to cause greatly accelerated wheel and rail wear. 3. Forces of sufficient magnitude to exceed the ability of the track structure to resist permanent deformation in alignment are also being generated.

Lynch, JP TenBroeck, HR Wagner, TB (Southern Pacific Company)
Southern Pacific Company Report No.1, June 1970, 126pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-250)
DOTL RP

B2 033314
STUDIES OF THE PRESSURE AS AFFECTED BY THE AREA OF CONTACT BETWEEN WHEEL AND RAIL. EFFECT OF WHEEL SIZE

The following is a progress report on one phase of this investigation, namely, rolling-load tests in which wheels of various diameters are rolled to and fro on a short length of rail for the purpose of determining the number of cycles of load application required to produce failure. The results of the rolling-load tests to fracture show considerable "scatter" and no very marked difference between the results of tests under a 50-in. wheel and those from tests under a 33-inch wheel. The vertical wear on rail 757C (33-in. wheel) was 0.046 in. at failure, whereas the wear on rail 757C1 (50-in. wheel) at 580,900 cycles was 0.041 in. At failure, 750,100 cycles, the wear on rail 757C1 was 0.0425 in. A second type of test being tried to ascertain the effect of wheel size on the rail is to measure the depth of work hardening in the rail head. The rail head appeared to have been work hardened down to a depth of about 0.45 in. by the 33-in. wheel with a maximum hardness of 296 at a depth of 0.15 in. A test on a section from the same rail rolled with the 50-in. wheel appears to have been work hardened down to a depth of 0.20 in. with a maximum hardness of 269 at a depth of 0.10 in.

Alleman, NJ (Illinois University) *AREA Bulletin* Vol. 45 1944, pp3-8

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-268)
DOTL RP

B2 033323
A THEORY OF THE DERAILMENT OF WHEELSET

In this study, in order to find out an allowable limit of derailment, the author made four assumptions and analyzed the simplest case where a wheelset derails. In order to prove the theory, the author made experiments by 1/10 and 1/5 scale model wheelset. The results of either case of 1/10 or 1/5 models coincide with theoretical values, and no difference was observed on the limit value of derailment by stationary side thrust having various kinds of radii of wheels.

Yokose, K (Japanese National Railways) *Railway Technical Research Institute* Vol. 7 No. 3, Sept. 1966, pp30-34, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-002)
DOTL RP

B2 033354
ON THE RELATION BETWEEN SUPERELEVATION AND CAR ROLLING

Springs and links between the car body and axles can be thought as a mechanical filter to isolate the car body from axle motion (except axle revolution). To know the relation between track irregularity and car vibration is the problem to know the characteristics of this filter. Method is to know the characteristics by analysing the input-output relations for normal operation. Application of this method is introduced in the following section.

Nakamura, I (Japanese National Railways) *Permanent Way* Vol. 5 No. 1, No. 14, Mar. 1962, pp10-16, 5 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-308)
DOTL RP

B2 033365
IMPROVING THE RUNNING QUALITIES OF THE COACHES TO BE INCLUDED IN HIGH SPEED LUXURY TRAINS--MODERN BOGIES--POSSIBLE TECHNICAL EVOLUTION
Discusses the needs of bogie design when rolling stock speeds reach 200 km/h. Suggested areas include relationship of connections between axles, bogie frames and coach bodies; tire profile for stability of 250 km/h speeds; vertical suspension systems for light weight coaches, reduction of unsprung weight, use of rubber in suspension systems. Finally, the problems of running coaches on lines with superelevated curves where problems exist in retaining a level coach interior.

Robert, J (French National Railways) *French Railway Techniques* No. 2, 1968, pp97-122

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-319)
DOTL RP

B2 033366
ROLLING LABORATORIES OF S.N.C.F. THE NEW CATENARIES INSPECTION COACH OPERATED BY THE FIXED INSTALLATIONS DEPARTMENT, S.N.C.F. TESTS COACH S. 445, S. 510, S. 512, S. 513--DYNAMOMETRIC RECORDING COACH
Discusses a number of mobile units used by the S.N.C.F. for such purposes as inspection of power lines and relationship to pantographs, pressure, movement and acceleration, tests of air and electro-braking systems. Measurements of noise levels as related to passenger comfort and a dynamometer coach. The details of each type of test unit are discussed and described individually.

French Railway Techniques No. 1, 1964, pp 39-59

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-320)
DOTL RP

B2 033367
DETAILS OF SOME RECENT TEST WORK ON THE S.N.C.F. 1. RAILWAY DYNAMICS SECTION (R.D.S.) 2. BRAKE TEST SECTION (B.T.S.) 3. ROLLING STOCK SOUND AND HEAT PROOFING SECTION. 4. VITRY TESTS STATION
Report of test work by the various sections of the S.N.C.F. including tests of stability of gas turbine unit at high speeds, and study of unit on straight and curved track. Tests of braking systems-The Capitale, test vehicles with anti-locking systems, disc and shoe brakes and electro-magnetic brake. Finally, tests of noise levels in coaches with different bogies, and spring test bed for determining vehicle spring rate.

French Railway Techniques No. 1, 1969, pp 60-70

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-321)
DOTL RP

B2 033370
PROGRAMME FOR TECHNICAL RESEARCH INTO VERY HIGH SPEEDS
A study of the areas which need to be researched for very high speed (up to 300 km/h) operation. The S.N.C.F. program of research for such operation is listed, stability, aerodynamics and train resistance, braking, adhesion, running gear, safety equipment, infra-structure, traction systems and collection are each discussed in detail. The problems, and possible solutions are also considered individually.

Tessier, M Mignot, C (French National Railways) *French Railway Techniques* No. 1, No. 1, 1970, pp1-13, 2 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-324)
DOTL RP

B2 033374
REPORT ON SOME RECENT TESTS BY THE "DIVISION DES ESSAIS DE MATERIEL OF THE S.N.C.F. 1. RAILWAY DYNAMICS SECTION (S.D.F.) 2. BRAKE TESTING SECTION (S.E.F.) 3. VITRY-SUR-SEINE TESTING STATION (S.E.V.)
Report of French rail technology including tests of braking and effects on vehicle stability, stability of an experimental gas turbine, locomotives with rubber block suspension. The second section deals with testing of braking systems of passenger and freight units. The last section reports testing of a modified suspension system, air suspension and an Eddy Current Brake.

French Railway Techniques No. 3, 1970, pp105-115

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-329)
DOTL RP

B2 033375
BASIC PRINCIPLES FOR THE DESIGN OF BOGIES FOR PASSENGER ROLLING STOCK
Discusses the parameters to be used in the design of the bogie unit. The principles which are established concern good lateral control of car body, critical speed of bogie and tread profile. New devices and materials may be necessary for the design of units for speeds in excess of 200 km/h. Good matching between the characteristics of bogie and attached body. Design of each unit alone is not satisfactory but matching of the components is necessary.

Moron, P (French National Railways) *French Railway Techniques* No. 4, 1970, pp117-139, 5 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-331)
DOTL RP

B2 033382
TRIAL RUNS AT SPEEDS EXCEEDING 200 KM/H OF NEW ROLLING STOCK DESIGNED FOR THE ITALIAN STATE RAILWAYS
Report on the performance and capabilities of an Italian high speed rail car. Designed for speeds of 160 km/h, though tests included speeds of 200 km/h. Discussion of pantograph used for current collection is included. A detailed report on the bogie design and structural considerations is also included. The test results of the components of the pantograph and bogie assembly suggest that the units are capable of exceeding maximum speed of 225 km/h.

Manzo, M (Italian State Railways) *Rail International* May 1965, pp323-345

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-341)
DOTL RP

B2 033387
THE PROBLEMS ARISING WHEN BRAKING AT PRESENT DAY SPEEDS
Discusses the basic law of braking and the ways in which it is accomplished. Further the Bozic, Knorr, Oerlikon and F.S. brake regulators, Type "M" Anti-Slip systems are discussed. The modes of operation, advantages and disadvantages are discussed also. Finally, the problems of braking systems and some of the forms suggested for high speed operation are compared.

Svagel, J (Yugoslavian Railways) *Rail International* Vol. 37 No. 7, July 1960, p569

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-347)
DOTL RP

B2 033390
THE EFFECT OF SUSPENSION DESIGN ON RAIL STRESSES. THE MATCHING OF SPRING STIFFNESS AND DAMPER CHARACTERISTICS AS AN AID TO IMPROVING RIDING AND REDUCING RAIL STRESSES
Article considers the relationship between spring stiffness, damper characteristics of rolling stock as a way to improve comfort and to reduce stress at the rail and also considers factors of vehicle mass, spring stiffness, damping factors of vehicles and track irregularity, sprang-unspramg weight mass, stiffness of track, and the softness of the ballast.

Koffman, JL (British Railways) *Rail International* Sept. 1960, pp756-766, 15 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-351)
DOTL RP

B2 033400
A CONTRIBUTION TO THE STUDY OF TRANSVERSAL COMFORT OF CARRIAGES
To improve test techniques and to provide for advances, investigations have been implemented by the use of a motorized rail car, on which factors relating to bogie/body suspension could be varied as desired. Significance of studies is that much of the consideration of the vehicle dynamics design problems does not have to be left to trial and error methods on line, thus avoiding the possible setting up of hazardous resonance phenomena.

Mauzin, A (French National Railways) *French Railway Techniques* No. 1, 1966, pp24-38

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-361)
DOTL RP

B2 033402
HIGH SPEED RUNNING AND RELATED TRACK PROBLEMS
High-speed running does not set any track-make-up problems. The conventional type is quite suitable. Strengthening the track is not a must, neither from the angle of safety nor that of fatigue. Strengthening, which could be useful on the lines carrying both dense fast traffic and numerous slow heavy trains, could be carried out simply at the time of the scheduled renewals. The layout problem is more difficult. On certain important lines on the S.N.C.F. there are sufficiently long sections where the radii are over the minima indicated above. Consequently, scheduled service traffic at 200 km/h could be envisaged on these sections in a not too far distant future.

Prud'Homme, A (French National Railways) *French Railway Techniques* No. 2, 1966, pp83-92, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-363)
DOTL RP

B2 033407
RESULTS OF TRIALS WITH A NEW TYPE OF BOGIE DESIGNED BY THE SNCF
These tests dealt with the truck Y 207 and considered particularly the transverse stability of this truck at speeds of from 140 to 245 km/h, with wheel tires in tread worn condition, corresponding to 350,000 km of operation, and with tires worn to profiles to generate "shaking". After the wheels on this truck had actually made 350,000 km (217,000 mi.) without requiring turning for sharp flanges or instability on the track, and having an average depth of tread wear of 2 mm, this vehicle was tested at 140 km/h. These tests were the first ever run at speeds over 200 km/h with wheel treads in such worn conditions, and have significant results.

Mauzin, A (French National Railways) *French Railway Techniques* No. 3, 1966, pp145-148

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-369)
DOTL RP

B2 033408
RESEARCH ON PNEUMATIC SUSPENSION SYSTEMS
The efforts made to improve the service and to raise the speed of traffic impose technical advance on the S.N.C.F. concerning, notably, riding stability and the dynamic comfort offered by vehicles in general, and more particularly passenger coaches. Systematic theoretical and experimental research work is being effected on this subject, and diverse solutions differing with the bogie design or the characteristics of the suspension components are being tried out. One of these consists in fitting, to the secondary suspension, pneumatic springs, identical with those employed successfully by the Japanese Railways.

French Railway Techniques No. 3, 1966, pp149-153

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-370)
DOTL RP

B2 033412
NEW TYPE RUNNING PERFORMANCE TESTING CAR
New type testing car, SUYA 11, has been built incorporating the latest developments in both measuring and rolling stock building techniques. Items measured by the testing car are as follows: forces acting between wheel and rail; relative movements of wheels against rails; rolling stock vibration; stresses exerted on running gear parts; temperature rise in running gear parts.

Miyoshi, K (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 11 No. 2, 1970, pp28-30

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-374)
DOTL RP

B2 033422
CAR DYNAMICS STUDY
In the calculation of car vibration, for instance, especially that of hunting motions, the electronic computer is almost indispensable. Manual computation is quite inadequate for a problem such as this, involving a large number of degrees of freedom of motion. Calculations of the hunting characteristics of electric cars for the New Tokaido Line is now under construction by using a digital computer to find out the roots of the characteristic equation of such a high order as stated above. In this way, we have played since last year a leading part in developing measures to reduce hunting motion in the design of the bogie truck.

Matsudaira, T (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 4 No. 3, Sept. 1963, pp39

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-386)
DOTL RP

B2 033435
EFFECT OF WHEEL FLAT ON THE CAR VIBRATION
A series of running tests was performed with the prototype "B" train for the new Tokaido line. The object is to investigate the effect of the wheel flat on the car body and truck vibration. The data were expected to give a reference for design and maintenance of car, and to give a base for determining the allowable limit of the flat length in practical operation. The running speed was 200 km/h for the flat up to 90 mm, and 50 km/h for 110 mm. So far as the truck and car body vibration is concerned, flat caused more vibration at a low speed than at a high speed. So car vibration is not considered the most decisive factor limiting the allowable length of flat.

Matsui, N Miyoshi, K (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 6 No. 3, Sept. 1965, pp51

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-399)
DOTL RP

B2 033440
THE RESISTANCE OF THE PERMANENT WAY TO THE TRANSVERSAL STRESSES EXERTED BY THE ROLLING STOCK
The improvement of the stability of running of the rolling stock is certainly important. Is desired to increase the speeds of both the passenger and the freight trains. In the case of the latter, in which the general public is interested, the problems raised by increasing the maximum speeds from 120 to 140 km/h and even 160 km/h have been solved satisfactorily, and it is now question of going a stage further by reaching speeds of 200 km/h in current service.

Prud'Homme, A (French National Railways) *Rail International* Nov. 1967, pp731-766, 2 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-406)
DOTL RP

B2 033442
AXLE LOAD AND WHEEL DIAMETER CONSIDERED FROM THE ASPECT OF THE STRESSES ACTING ON THE MATERIAL OF WHEEL AND RAIL
This discussion is on the mechanical stresses of each wheel and each rail as part of the normal and tangential forces acting at the contact surface. Wheels wear and form "worn profiles" resulting in flatter curvature and lower stresses than in new profiles. As wheel diameters decrease, the load cycle or incidence of contact increases.

Kilb, E (German Federal Railways) *Rail International* Oct. 1967, pp663-668, 5 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-408)
DOTL RP

B2 033448
WHY METALS BREAK
To list some of the principal modes of failure at present known: 1 Collapse due to buckling or general yielding, 2. fatigue, 3. brittle fracture, 4. creep, 5. stress corrosion, 6. corrosion fatigue, 7. tearing or shear failure. This paper has endeavoured to list some of the failure mechanisms which can lead to fracture in metals, and to show that the tensile strength of the metal has virtually no significance in any of the important failure modes, although it may be useful as a simple basis for comparison between different steels or non-ferrous alloys. Photographs show failures of rail, axles, wheels and bogies.

Wise, S *Railway Division Journal* Vol. 2 No. 2, Mar. 1971, pp162-188, 7 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-418)
DOTL RP

B2 033724
DYNAMICS OF HIGH-SPEED ROLLING STOCK
Article discusses the results of running tests conducted with defective tracks, a rescue diesel locomotive and repeated speed up and operation tests at frequent intervals. In addition, the hunting of rolling stock, vibration of a vehicle with a defective track is detailed. Finally, the performance test of production vehicles is discussed on the whole line.

Matsui, N (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 7 No. 1, Mar. 1966, pp45-97

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-008)
DOTL RP

B2 033726
DYNAMICS OF HIGH SPEED ROLLING STOCK
The main object of this research group is to solve the problems concerning the safety of rolling stock and the passenger ride comfort. The researches for the determination of allowable limit with respect to safety and the researches for the prevention of derailment as well as destruction of track, the running stability of truck, and the elimination of rolling stock vibration and shock are dealt with here.

Matsudaira, T (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. .I. Apr. 1960, pp57-65

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-039)
DOTL RP

B2 033731
DYNAMICS OF HIGH SPEED ROLLING STOCK
Basic researches on running safety and riding quality were required for the design of vehicles for the new Tokaido line, and high speed tests of the prototype vehicles on the test track section have been almost finished in the fiscal year 1962. In the fiscal year 1963 researches on some remaining problems for the final design of production type vehicles, especially, minute researches on the hunting prevention and on the lateral load-deflection characteristics of air springs, have been made continuously. In March 1964 the running performance test of the first built six production type vehicles was performed. The main results of these researches and test are described.

Matsudaira, T (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. .I. Sept. 1964, pp21-25

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-149)
DOTL RP

B2 033732
TESTS ON THE TRACK ON THE RIDING STABILITY AND THE GUIDING QUALITY OF VEHICLES BY MEANS OF A SPECIAL VEHICLE-RESULTS OF THE FIRST TRACK TESTS
The report gives an account of the results of the tests made with the experimental bogie described in a previous report. The first part of the report supplies data relating to four series of tests during which the various parameters of the bogie (lateral play between axle-box and axle, axle load) and also the riding speed were successively varied. These tests have made it possible to establish conclusions relating to the wave-length of the hunting movement, the amplitude of the transverse movements of the bogie and the maximum transverse forces occurring between bogie and axles. The second part of the report supplies data relating to the tests during which the wheelbase of the test bogie was varied. The data obtained have permitted the establishment of some conclusions relating to the wave-length of the hunting movement, the transverse displacement of the bogie frame, the maximum angle of rotation of the bogie and the transverse forces. The third part of the report contains an account of the results obtained during the tests, the object of which was to study the same magntiudes as those prevailing during the previous tests, the wheel tyres of the test bogie having however been machined in accordance with the wear profile "Muller No. 2". All the tests were made on one and the same section, this being in an excellent state of repair and having a relatively constant gauge and chiefly consisting of straight track.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B52/RP 2/E, June 1963, 36 pp, 35 Fig., 2 Tab.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-159)
PURCHASE FROM: UIC Repr. PC
DOTL RP

B2 033734
VERTICAL FORCED VIBRATION OF VEHICLE BODY AND VERTICAL WHEEL LOAD DIMINUATION DUE TO TRACK IRREGULARITY
A high speed passenger railway vehicle is designed to offer an agreeable riding comfort as well as to assure the safety running. Possibility of a high speed of 500 km/h, from these viewpoints, is examined by calculating the vertical acceleration and the change of wheel load. The results suggest promising possibilities of realization.

Matsui, N Arai, S (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 9 No. 3, Sept. 1968, pp169-170

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-178)
DOTL RP

B2 033736
FIRST PROGRESS REPORT LATERAL ACTION OF COMMON DESIGNS OF FREIGHT CAR TRUCKS HAVING AXLES WITH AND WITHOUT END COLLARS
The objective of certain instrumentation in the tests was to obtain fundamental information on the lateral action of different common designs of freight car trucks having standard and modified parts in the journal box assemblies, and having axles with and without end collars. It was desired to determine the motions of truck parts, and relation between these motions and lateral car body accelerations, and the origins of lateral disturbances to the car body, relative importance of these origins, and manner of transmission of these disturbances from the rail through the truck to the car body. A mechanical recorder was attached to one truck to obtain records of the relative lateral movements of truck parts (axle, bearing, wedge, frame) at both ends of one axle, and records of the vertical and lateral displacements of both side frames relative to the bolster. The conclusions are as follows: The most important origin of lateral disturbance to the car body is the nosing of the wheel-axle assemblies and truck, due to coning of the wheel treads. The effects of axle end collars on truck action are to increase the activity of truck parts but to limit the forces transmitted through the truck. Increase of lateral clearance, which does not reduce the beneficial effects of axle end collars, should improve the lateral riding quality of conventional trucks with snubbers. Curved track produces a quieting influence on truck action and improves lateral riding quality. Definite improvement in lateral riding quality should result from the use of a device which would cause the car body to seek a centered position between lateral clearances.

Progress Report.

Association of American Railroads F4000, Dec. 1950, 51pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-197)
DOTL RP

B2 033737
DYNAMICS OF HIGH SPEED ROLLING STOCK
Test on passenger ride comfort on curved track and also under braking were carried out in March 1962 to supplement the data obtained by the previous tests. Tests were planned minutely with the theory of sensory inspection and

experimental design, and the analysis of the subjects' evaluation of ride comfort was made with a statistical technique. Main difference of these tests from the previous ones lies in the method of evaluation of ride comfort. The evaluation was marked separately for degree of sensation against acceleration, for degree of mood or comfortableness, and for judging whether the ride is permissible or not in terms of sensation or mood.

Matsudaira, T (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. .I. Oct. 1963, pp21-27

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-204)
DOTL RP

B2 033738
DYNAMICS OF HIGH SPEED ROLLING STOCK
Article devoted to dynamics of high speed rolling stock. Areas of discussion include test of allowable acceleration in a curved track, limit of wheel side thrust, effect of load upon wheel side thrust, track hunting and reports of bogie assemblies especially designed for high speed operation in conjunction with air springs and rubber draft gear.

Matsudaira, T (Japanese National Railways) *Railway Technical Research Institute* Vol. .I. Nov. 1962, pp13-22

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-212)
DOTL RP

B2 033741
THE ANALYSIS OF TRUCK FORCES ON CURVED TRACK
This report contains an analysis of the static, steady state forces on a four-wheel truck moving on curved track. The truck is used in the general sense to describe any four-wheel rigid wheel base of conventional truck size or as large as experimental four-wheel cars. This work should represent one phase of a program to attempt a rationalization of various truck phenomena. Appended to this report is an 8-part series of published articles: "The Mechanics of a Locomotive on Curved Track". These articles appeared in The Railway Engineer, 1934-1935.
Unpublished Data.

Johnson, MR Apr. 1957, 40pp, 8 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-240)
DOTL RP

B2 033742
TRACK-TRAIN DYNAMICS STUDY PROJECT TR-14 RAIL-VEHICLE INTERACTION STUDY--REPORT NO. 2 (COMPLETE ANALYSIS OF DATA USING COMPUTER TECHNOLOGY)
Following a description of the problem involved in preparing a hybrid computer program for the analysis and reduction of transient data taken in the actual field tests of the TRACK-TRAIN DYNAMICS STUDY PROJECT and an explanation of the computational approach, there is a description of the method of interfacing the digitized data with the digital computers used to obtain an in-depth engineering analysis of the results of the tests. The evaluation of the numerical data indicated that under controlled operating conditions, the L/V ratios were significantly repetitive, which fact can be helpful in future studies. However, the inability to measure the track lateral deflections simultaneously to obtain the combined effect of vertical and lateral displacements in the rail was a severe limitation, and it was not possible to derive any information concerning track stresses and probable damage due to high dynamic loads. Graphs and bar charts were developed from the computational results to show the relationship between speed, drawbar load and L/V ratios for locomotives and cars, and graphs were used to illustrate the accumulative distribution of dynamic rail deflections on various segments of the railroad where the tests were run. Parameters that were not included in the field measurements which could have possibly contributed to the establishment of a more definite pattern include: the relative velocity between instrumented cars, track curvature and truck hunting action and the cross-level of track.
Company Report.

Lind, EF Nuttrell, NW (Southern Pacific Company)
Southern Pacific Company Report 2, Apr. 1971, 104pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-251)
DOTL RP

B2 033847
THE RIDING QUALITY OF A TRAIN PASSING A CURVE AS DETERMINED BY SUPERELEVATION AND CENTRIFUGAL FORCE
The purpose of this report is to clarify the relationship between the riding quality and a lateral acceleration on a curved track. The author has polled the opinions of 50 persons who took part in the test by riding a test train and correlated the findings of such polling with different degrees of lateral acceleration. Thus, the limit of excessive acceleration on curved tracks was examined from the standpoint of riding quality.

Koyama, M (Japanese National Railways) *Permanent Way* Vol. 6 No. 2, June 1963, pp19-25

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-302)
DOTL RP

B2 033849
RUNNING OF TILTING RAILWAY VEHICLES OVER CURVED TRACK--GENERAL ASPECTS RECENT TESTS WITH THE S.N.C.F. TILTING COACH
Article discusses the problems of passenger comfort as related to high speed trains on a canted curved track. The French experiments using a test vehicle to determine means to correct for this cant is detailed including the specifications of the vehicle, the ways in which solutions to the problem of cant were tested. Recommendations in the types of equipment to solve the problem are also discussed.

Terrase, R Joly, R (French National Railways) *French Railway Techniques* No. 3, 1970, pp89-103

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-330)
DOTL RP

B2 033850
RAILWAY TRACK STABILITY IN RELATION TO TRANSVERSE STRESSES EXERTED BY ROLLING STOCK. A THEORETICAL STUDY OF TRACK BEHAVIOUR. A PRACTICAL METHOD FOR DETERMINING THE RESISTANCE OF THE TRACK TO TRANSVERSE STRESSES EXERTED BY ROLLING STOCK
Part one studies the behaviour of railway track subjected to the stress of rolling stock and the experimental results on a test track with formulae for the pressures on the track through ballast or by rails through sleepers. Part two contains a computer solution to a fourth degree equation representing equilibrium equation of a track segment. Last, the interrelationship between rails, ballast, temperature and stress upon track behaviour are discussed.

Amans, F Sauvage, R (French National Railways) *Rail International* Nov. 1969, pp685-716, 2 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-334)
DOTL RP

B2 033855
THE BEHAVIOUR OF THE SNCF STOCK AT HIGH SPEEDS
The behaviour of the rolling stock during the high speeds of 200 to 250 km/h, using three different types of equipment, all designed for 150 km/h, showed no abnormal findings as to transverse efforts exerted on the tracks by the equipment or transverse accelerations in the body of the last coach. The transverse acceleration in the last coach always remained under 0.08 g, which corresponded to the best obtainable in comfort with existing equipment.

Mauzin, A (French National Railways) *French Railway Techniques* No. 2, 1966, pp93-96

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-364)
DOTL RP

B2 033856
INCREASE OF TRAIN SPEED ON CURVES
For a train to reach the destination in shorter time is to increase speed on curves and gradients. It would involve enormous investment to eliminate curves and gradients through re-routing the track in a mountainous country like Japan. Thus, the alternative would be to achieve an effect of speed by selectively investing in certain high-speed trains. Introduced a bogie truck TR96 which is an experimental one built for the purpose of exploring the

possibilities of increase speed on curves. The data collected using this truck will offer the basis upon which a new high-speed train will be developed for actual service in a few years.

Sakai, S (Japanese National Railways) *Railway Technical Research Institute*

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-376)
DOTL RP

B2 033857
HOW HIGH CAN TRAIN SPEED BE INCREASED?--A REVIEW OF PRESENT AND FUTURE
Discusses the factors which are the practical limits of trains speeds. These include obstacle by wave formation, adhesion limits, vibrational disturbance, problems of curved track, and the speed limits of existing trains. The summary discusses probable limits of present and future trains with differences in power-adhesion systems.

Matsudaira, T (Japanese National Railways) *Railway Technical Research Institute* Vol. 7 No. 2, June 1966, pp4-7

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-381)
DOTL RP

B2 033862
HOW HIGH CAN TRAIN SPEED BE INCREASED?
Discusses the factors which influence the maximum speed for railroad operations. Factors of wave formation, adhesion, vibrational disturbance, track curvature, are among those discussed. The limits of present track wheel system, linear motor-wheel system, linear-motor and air cushion and gas turbine air cushion are discussed and compared as to their limits within the speed spectrum.

Matsudaira, T (Japanese National Railways) *Rail International* Jan. 1967, pp93-99

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-415)
DOTL RP

B2 033863
WORK SESSION
Discussion of rolling stock for high speed operation. Includes discussion of bogie-suspension systems, comparison of 4 2h33l vs. bogie systems, locomotive design and relationship to track for determining speed limits. Part II which concerns fixed installations, discusses the theoretical and experimental solutions to the problems of track design for high speed operation. Note as these are records of working sessions, the papers are abstracted, and there are questions and discussion of many points raised in the meetings.

Rail International June 1968, pp1018-98

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-417)
DOTL RP

B2 033864
DESIGN AND MAINTENANCE ASPECTS OF FREIGHT ROLLING STOCK RELATIVE TO THE EFFECTS ON THE TRACK
A modern Railway has grown up in this country with new and more powerful forms of traction and improved signaling and track, but the majority of wagons in use still consist of small four-wheelers, the basic design of which has not changed for over 50 years. These wagons incorporate a 'Box-on-Wheels' design which was robust and cheap, suitable for the low axle weight, low speeds, and low utilization of their day. They are, however, incapable of meeting today's conditions of high utilization and speeds without an unacceptable degree of maintenance and inspection. Until recently very little was known of the behaviour and design parameters necessary for high-speed wagons, and because of this, in 1963 when it became obvious that improved wagon suspension was required B.R. adopted the U.I.C. Double Link Suspension. This was a proven design which was, and still is, in wide use on the Continent, but here again problems arose when operating at higher speeds and axle loads permitted in this country. These problems concerned the rapid wear of the links and saddles due to the friction necessary for lateral damping and spring failures caused by the torsion induced in the spring superimposed on the normal vertical loading.

Love, A Sugden, EA *Railway Division Journal* Vol. 2 No. 4, 1971, pp467-482

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-423)
DOTL RP

B2 037209
HUNTING PROBLEM OF HIGH-SPEED RAILWAY VEHICLES WITH SPECIAL REFERENCE TO BOGIE DESIGN FOR THE NEW TOKAIDO LINE
This paper describes the preliminary experiment on hunting by means of a model vehicle; the hunting tests of an experimental bogie and the prototype bogie at the rolling stock testing plant; a considerable amount of various hunting calculations carried out in the design stage; running test, with casual hunting observed, of the prototype bogies on the test track section of the new Tokaido line; and the construction of a bogie finally designed--and gives a number of major results with some discussion on the points to be considered. Elaborate running tests of six prototype cars were carried out on the test track section of the new Tokaido line. In designing this bogie, special attention was paid to the following two points to prevent hunting: (1) Mode of axle-box support and its stiffness: (2) Combination of frictional and elastic restoring force against bogie rotation. According to the running test at 246 km/h this bogie exhibited a very high running stability.

Matsudaira, T (Japanese National Railways) *Institution of Mechanical Engineers, Proceedings* Vol. 180 No. t 3F, 1965, pp 58-66, 6 Fig, 1 Tab, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-629)
DOTL RP

B2 037211
SOME ASPECTS OF THE HUNTING OF A RAILWAY AXLE
Equations of motion are derived to describe the hunting mode of a railway axle running at constant velocity along straight track. It is assumed that the wheel and rail-head profiles take some arbitrary shape. This shape gives rise to non-linearities in the equations. The equations are first linearized, and approximate expressions derived for the frequency of the oscillation and conditions of stability. Asymptotic stability for all initial conditions of the non-linear system is then considered in the manner of Aiserman, and the equations are examined for stable limit-cycle by applying the first approximations of Kryloff and Bogoliuboff. It is shown that, when running at low velocities, the axle will execute limit-cycle oscillations even though the wheel's flanges do not contact the rails. Small increases in velocity, however, quickly result in flange contact.

Brann, RP (London University College) *Journal of Sound and Vibration* Vol. 4 No. 1, 1966, pp 18-32, 6 Fig, 8 Ref, 2 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-631)
DOTL RP

B2 037213
LATERAL DYNAMICS OF RAILWAY VEHICLES
The fundamentals of lateral dynamics theory of railway vehicles is reviewed. Numerous topics are presented, including: stable running theory, longitudinal creep, forward speeds, sinusoidal path, forces acting, hunting, conditons for stability, critical speeds, profiled wheels, suspension, coned and profiled wheels, wear of trends, vehicle design, and track geometry.

Wickens, AH (British Railways Research Department) *Railway Gazette* Vol. 121 Dec. 1965, pp 987-990, 4 Fig, 2 Phos, 14 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-633)
DOTL RP

B2 037214
THE TOLERANCE OF TRACK LONGITUDINAL LEVEL IRREGULARITY DETERMINED BY RIDING QUALITY
This investigation was concerned with the vertical vibration of bogie car which was caused by track longitudinal level irregularity. It delineated the characteristics of the longitudinal level irregularity which can occur on track and proposed a method to determine the tolerance of longitudinal level irregularity from the view point of riding quality. In addition, the study examined the relation between the riding quality, the car structure and condition, the running speed and the measuring method of track longitudinal level irregularity.

Sato, Y (Japanese National Railways) *Railway Technical Research Institute* Vol. 8 No. 1, Mar. 1967, pp 43-48, 13 Fig, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-634)
DOTL RP

B2 037224
THE RIDING PROPERTIES OF BOGIE VEHICLES--1
This article discusses the problems of values assigned to ride quality as an indicator of the effectiveness of a suspension system of a rail vehicle. In order to find an index of such performance, a mechanical device such as the Askania Universal Vibrograph is recommended. The charts which are produced by the Vibrograph are evaluated and the application of the results to vehicle design is discussed. The instrument may be used to measure vehicle body oscillations. Vertical acceleration and resonance is included in the measurements. The article concludes with the reminder that the factors recorded by the vibrograph should not be used alone as parameters of vehicle design but should be used with the factors of noise and vibration also.

Koffman, JL *Railway Gazette* Vol. 111 Nov. 1959, pp 483-487, 8 Fig, 10 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-644)
DOTL RP

B2 037225
THE RIDING PROPERTIES OF BOGIE VEHICLES--2
The author explores various theoretical aspects of railway vehicle riding performance as an aid to the rationalization of bogie design. It was shown that low ride index values can be retained by minimizing the natural frequency and/or the amplitude of the oscillation. The importance of damping with respect to amplitude ratio is shown and it is pointed out that dampers are actually undesirable at speeds in excess of 1.41 of the resonance speed. It is also pointed out that damping is of relatively little importance with short swing links. In order to determine the ride index of a rail vehicle, the magnitude of excitation amplitudes, the natural frequency and the damping factor of the system must be known.

Dilg, WC *Engineering Interchange for Railroad Advancement* Vol. 111 Dec. 1959, pp 538-540, 6 Fig, 3 Tab, 7 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-645)
DOTL RP

B2 037275
THE DESIGN OF RAILWAY BOGIES
In connection with bogie design research and development has led to the establishment of ten particular design features which cover primary and secondary spring deflection; primary damping; secondary spring disposition and damping; swing-link design and suspension; bolster anchorage by traction bars; bogie frame stiffness; rotational damping; secondary spring anchorage, and check stop clearances. It has been clearly established by investigation and testing that the inclusion of the recommendations on these ten points into a new bogie design will give a consistently good ride, which is relatively insensitive to tyre wear and to normal track irregularities.

Railway Gazette Vol. 115 Nov. 1961, pp 588-589

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-982)
DOTL RP

B2 037277
HIGHER SPEEDS THROUGH CURVES
Investigation of rail friction (mu (sub y)), made on both wet and sanded rock, at speeds between 6 and 72 km/h, showed values ranging between 0.4 mu (sub y) and 0.5 mu (sub y) with banding leading to higher values. Values of mu (sub y) for lateral slip versus wheel-load are given as are values of mu (sub y) for a range of R(m) from 300 to 890 at speeds from 80 to 110 km/h. It was noted that the use of bogie intercouplers reduce rail friction (mu (sub y)) and flange wear.

Letter to the editor of the Railway Gazette.

Koffman, JL *Railway Gazette* Vol. 126 May 1970, p 367, 2 Fig, 3 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-984)
DOTL RP

B2 037286
BOGIE DESIGN FOR HIGH SPEED
Opinion holds that the line of demarkation between low speed and high speed operation, from the coach design point of view, is in the region of 80 to 85 mph. Bogies that have been tested in freight wagons have exhibited good riding qualities at 80 mph, or lower, but have shown themselves entirely unsuited to speeds above 85 mph, in some of the tests the shocks recorded were doubled in intensity as speed increased from 80 to 90 mph. Up to 80 mph the amplitudes of body swing were within reasonable limits, but at 90 mph the body of the box wagon under test was becoming unstable. Experiments proved that, given equal conditions of springing and of maintenance, a six-wheel bogie gives slightly better riding in both vertical and horizontal planes than a four-wheel bogie, and has better braking qualities also; but the gain is not considered to be worth the increase in weight, first cost, and cost of maintenance. In the design of passenger-car bogies, coil bolster springs perform the same duty as the swing hangers in the elliptic spring bogie. Another important requirement is that in wheels for high speed equipment the treads shall be concentric within 0-10 in. Experiment showed that one of the principal factors in causing bogies to "hunt" at speed, is a short and sharp taper close to the throat of the main flange of the wheels, even if the extent of the taper be no more than 1/10 in. No bogie design tried by the Milwaukee has given good riding at high speed if the wheels have been in this condition, and the only way to restore such wheels to good riding qualities is by re-turning or griding them.

Railway Gazette Vol. 82 Apr. 1945, p 337

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1137)
DOTL RP

B2 037309
THE RIDING PROPERTIES OF BOGIE VEHICLES--3
Recent vehicle development has led to the introduction of railcars and locomotives with unsymmetrical body-weight distribution resulting in the use of bogies of differing design at each end. The author explores theoretical predictions of railcar and locomotive riding performance as an aid to the rationalization of bogie design.

Koffman, JL *Railway Gazette* Vol. 111 No. 20, Dec. 1959, pp 398-601, 4 Fig, 2 Phot, 18 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-646)
DOTL RP

B2 037417
"LRC" PROTOTYPE DEMONSTRATED--POWERED BANKING ON CURVES IS KEY FEATURE ON NEW CANADIAN FAST-TRAIN CAR
The prototype coach of Canada's high-speed "LRC" train has successfully undergone running tests at speeds in excess of 90 mph. When completed, the "Lightweight Rapid Comfortable" train would operate in pushpull service, with a locomotive at each end and up to 12 coaches, at speeds up to 120 mph on existing North American Tracks. LRC's most significant engineering feature is its "powered banking" system, built into the car suspension. The two-axle trucks, are basically of conventional design, but they have an additional bolster that can tilt the car body to compensate for up to 10 deg of unbalanced superelevation. Each truck has a sensor, which responds to centrifugal force and seeks a bank angle that will reduce this force on the passengers to near-equilibrium. The sensor activates a servo mechanism that causes the banking bolster to be rotated hydraulically until the car body meets the desired bank angle.

Shedd, T *Modern Railroads* Dec. 1971, p 60, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-490)
DOTL RP

B2 037418
EVALUATION OF THE STABILITY OF THE M130 AND D1G CONTAINER CARS
The railroads have been experiencing difficulties with 100-ton cars having a high center of gravity. The results of the tests showed that the M130 Container Car and the simulated D1G container car were both sensitive in roll to track-induced inputs in the as received condition with standard D-3 springs. At 22 mph, the car roll amplitude reached 7.5 degrees and wheel lifts of e inches were retested. The rocking action was reduced substantially

but 2-in wheel lifts occurred within 1 mph of the critical speed of 22 mph. The addition of 8 Stucki HS-6 snubbers to the D-4 spring group eliminated wheel lifts up to 22.5 mph. The dynamic roll action of this 350,000 lb. car produced excessive track degradation in the as received condition. The hydraulic snubbers and D-4 spring modification reduced this track degradation by a factor of 4 to 1.

*Test Report*Test Rpt 71-11, May 1971, 32 pp, 7 Fig, 4 Tab, 10 Phot, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-577)
DOTL RP

B2 037421
EAR BUILDS A MANAGEMENT INFORMATION SYSTEM
East African Railways Implemented an integrated computer-based management information system because there was an urgent need to exercise greater control over wagons, coaches and locomotives to insure their maximum utilization. In addition to this, computer application to rail wear analysis, including rail wear in curves was initiated. Developments and accomplishments are enumerated.

Railway Gazette International Nov. 1970, pp 772-773, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-868)
DOTL RP

B2 037425
TILTING COACHES TO RAISE SPEEDS ON CURVES
Of all the ways in which overall passenger train speeds can be raised, titlting the coach body inwards on curves is probably one of the easiest and cheapest. As a result, there are now three countries with tilting coaches in service, and a further six with experimental or prototype stock at an advanced stage of development. The design of these trains and their limitations are discussed.

Railway Gazette Vol. 126 Sept. 1970, pp 655-659, 4 Fig, 1 Tab, 7 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-615)
DOTL RP

B2 037429
ON THE USE OF INDIVIDUALLY SUPPORTED FREE ROLLING WHEELS ON RAILWAY VEHICLES [ZUR FRAGE DER VERWENDUNG VON LOSRADERN IM SCHIENENFAHRZEUGBAU]
The kinematics of wheel-sets on railway vehicles is discussed in theory. The tests are reviewed which were made of individually supported, free rolling wheels in frames under vehicles without a rigid connecting axle from wheel to wheel. The conclusions of this study point out the following: free rolling wheels have no guidance capabilities along the rail; wear on the curves is not avoided by free wheels. Safety factor against derailments is less than with conventional wheel sets, since the free wheel cannot develop sine waves in its running, it runs free of such lateral vibrations and is therefore quieter. [German]

Becker, P *Eisenbahntechnische Rundschau* Vol. 19 No. 11, Nov. 1970, pp 457-463, 8 Fig, 3 Phot, 12 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-575)
DOTL RP

B2 037430
METHOD OF DETERMINING THE RUNNING SMOOTHNESS FROM THE FREQUENCY CHARACTERISTICS OF ROLLING STOCK [VERFAHREN ZUR ERMITTLUNG DER WAGENLAUFGUTE AUS DEM FREQUENZGANG DES FAHRZEUGES]
From various tests made to evaluate the smoothness of running of a railway vehicle, a smoothness coefficient, W (sub z), was derived. This article describes in detail mathematically how this coefficient, W (sub z) can be calculated in advance for any given vehicle from a knowledge of the track and vehicle characteristics. These calculations can only be accomplished by a digital computer. This process can be used to calculate coefficients during the engineering stages of new equipment. [German]

Krettek, O *Eisenbahntechnische Rundschau* Vol. 19 No. 4, Apr. 1970, pp 151-155, 3 Fig, 1 Tab, 7 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-574)
DOTL RP

B2 037435
DB EXPERIMENTS WITH POWERED TILTING OF COACH BODIES
A three-car diesel train with air suspension has undergone field testing to develop an electro-pneumatic servo which tilts the body inward on curves. The three-car diesel train has been run experimentally at 130 km/h over a route that is largely limited to 105 km/h. If the train itself was capable of higher speeds it is claimed that 135 km/h could have been attained safely. Air springing provides the tilting mechanism, the servo system being arranged so that the air bellows on the outside of the curve are inflated and those on the inside deflated, thus tilting the body relative to the bogie towards the inside of the curve. The centrifugal force that can be tolerated without discomfort is taken as 0.067 g, which is equivalent to a cant deficiency of 100 mm.

Railway Gazette Vol. 125 Jan. 1969, pp 57-58, 2 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-870)
DOTL RP

B2 037463
PHYSICAL HAZARDS OF TRANSPORTATION
The interaction of shipping containers in the presence of shock and vibration during railway transportation is discussed. Vibration frequency measurements are reported for empty, half-loaded, and fully loaded cars travelling at speeds from 10 to 90 mph. The impact of containers on end walls is suggested as a more important source of merchandise damage than coupler forces or acceleration. Compartmentalization and load dividers are suggested to decrease damage. Variable rate springs for freight cars are being studied to narrow the frequency band of vertical vibration of the car. Test programs are being developed to further study impact in loaded cars.

Guins, SG (Chesapeake and Ohio Railway)
Chesapeake and Ohio Railway Tech Rpt 68-113, 1968, 20 pp, 11 Fig, 2 Tab, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-482)
DOTL RP

B2 037464
STEERING CHARACTERISTICS OF BOGIES
This article, which is a description and analysis of the fundamental steering properties of four-wheel bogies, considers the limitations of bogie vehicles for high speed operation and compares their performance with estimates for the APT, the 250 Km/h advanced passenger train. Because bogies act to attenuate the effect of road bed irregularities, there are strong reasons to favor bogie vehicles whenever passenger comfort is a major consideration. A possible disadvantage is that bodies designed to be dynamically stable at high speeds may need a primary suspension which is too stiff for good steering properties. It is concluded from mathematical studies that a dynamically optimized bogie still provides satisfactory guidance, comparable with a four wheel vehicle with a very soft suspension, and bogies should not, therefore, be regarded as unsuitable for high speeds.

Newland, DE (Sheffield University) *Railway Gazette* Vol. 124 Oct. 1968, pp 745-750, 12 Fig, 3 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-622)
DOTL RP

B2 037591
INTERACTION OF WHEEL AND RAIL WITH RESPECT TO TRACKING, WEAR, FREE ROLLING AND STRESS IN WHEEL SETS
The author examines the interaction of wheel to rail with respect to tracking qualities, wear of wheel tread and rail, free rolling and stress in the power wheel sets under power or braking. A picture is shown comparing the stress lines in the rail under a wheel with the flange away from the rail with that where the wheel tread and flange both exert pressure on the rail. The verification of the theoretical considerations of these conditions by actual measurements has been made by modern techniques, which are closing the gap between theory and practice.

Kurek, EG *Eisenbahntechnische Rundschau* Vol. 15 No. 9, Sept. 1966, pp 338-346, 9 Fig, 2 Phot, 12 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-475)
DOTL RP

B2 037593
TRACK STRESSES AND VEHICLE MOTION AT HIGH SPEEDS
The high speed test runs made with the locomotives E 10 299 and E 10 300 and 8 wheeled track recording cars and passenger cars are described. Extensive measurements were made of the stresses to which the track is subjected at train speeds of 140 to 200 km/h, and of the dynamic wheel loads and lateral pressures against the rail, as well as the effect of these forces on the roadbed. The results of these tests on curved and straight track are given and illustrated by charts. The present usual track structure will suffice for the high speed operation. The minimum radius of curvature should not be under 1890 meters. Continuous welded rail improves the riding qualities in high speed operation. A desirable riding comfort level is attained in the passenger cars at 200 km/h speeds.

Birmann, F *Eisenbahntechnische Rundschau* Vol. 14 No. 8, Aug. 1965, pp 335-351, 49 Fig, 2 Tab, 9 Phot, 15 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-478)
DOTL RP

B2 037595
ASSURING THE STABILITY OF THE BARTD LIGHTWEIGHT RAPID TRANSIT VEHICLE
The BARTD System will utilize lightweight cars about 800 lbs. per linear foot operating at higher average speeds than any other transit system in the world. These vehicles will be subjected occasionally, on 31 miles of aerial structures and 24 miles of at-grade construction, to high winds. Mathematical formulas were developed to determine the reliability of vehicle-track systems constructed to a range of gauges under various combinations of adverse conditions. As a result of these investigations, it is recommended that the BARTD System vehicle and track system be designed to a guage of 5'-6". Findings clearly indicate that this approach would assure the lateral stability and safety of the desired lightweight vehicle more effectively and economically than any other design approach.

Bugge, WA
Parsons, Brinckerhoff-Tudor-Bechtel Res Rpt Apr. 1964, 14 pp, 12 Fig, 2 Phot, 9 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-480)
DOTL RP

B2 037598
LATERAL RAIL FORCES DUE TO VARIOUS LOCOMOTIVE AND TRAIN CONSISTS
A series of tests was performed to determine the lateral forces developed by various types of locomotives and train consists. Analysis of the data indicates that no excessive lateral forces were developed by any of the test consists. The maximum average force, 7,400 pounds was developed by the T.P.F.C. freight. The effect of roadway irregularities on lateral forces generated by normal consists remains largely unknown. Based on the results of this test series, it is concluded that light locomotive, passenger and freght consists generate relatively low lateral force on good roadway. There is a slight reduction in maximum lateral forces as training tonnage is increased. A study of the available research literature on the forces required to overturn rail shows that the maximum pressures measured were about 30% of the forces theoretically needed.

Luebke, RW
Chesapeake and Ohio Railway, Baltimore and Ohio Railroad Test Rpt Apr. 1967, 14 pp, 8 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-484)
DOTL RP

B2 037609
ROLL ACTION TESTS OF 100-TON HOPPER CARS ON THE GULF, MOBILE AND OHIO RAILWAY
The GM and O conducted extensive induced roll action tests on Commonwealth Edison 100-ton hopper cars being used in unit coal train service. The tests were conducted on tangent track, laid with 112-lb. rail. A target was placed on top of the car at its center and a transit was set up on an overhead bridge to measure the amount of lateral movement of the top of the car in inches. It was found to be possible to measure the car roll accurately in this manner. The amount of wheel lift was estimated. These cars are equipped with rotary couplers for unloading. A friction type gage was used to measure the maximum spring deflection. Variations were made in the type and number of springs, with and without various types of snubbing devices, bolster gib clearance, and side bearing spacing. The data sheets give a description of the truck arrangement and the results obtained. It was decided after these tests that the standard equipment provided initially on these cars was satisfactory for their operations.

Gulf Mobile and Ohio Railroad Aug. 1964

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-509)
DOTL RP

B2 037621
RUBBER IN RAILWAY ENGINEERING
Design of bogies employing rubber to avoid wear on metal surfaces, thus increasing service lift of rolling stock, is discussed. The Silentbloc suspension system is illustrated. The rubber suspension system designs attempt to eliminate bogie hunting by eliminating all wearing parts, providing spring action in three degrees of freedom, and giving a suspension system with constant periodicity.

Railway Gazette Vol. 106 Jan. 1957, pp 71-72, 3 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-523)
DOTL RP

B2 037666
ANALYSIS OF COVERED HOPPER CAR DERAILMENTS ON THE BALTIMORE AND OHIO RAILROAD
The derailment history of high-cube, covered hopper cars on the B&O Railroad was analyzed. The analysis showed that the in-service life of this type of equipment has a very noticeable effect on its derailment rate. About 80% of the derailments occurred during the first year of service. The statistics also show that rock-offs of foreign cars of the same type are also a serious and growing problem. The analysis shows that the operating restrictions on the PS-2-CD domestic and foreign cars are effectively reducing derailments of these high-cube, covered hopper cars. An extension of the PS-2-CD operating restrictions to all covered hopper cars with a capacity of 3000 or more cubic feet and less than one year old could provide an interim solution that could be quickly implemented.

Luebke, RW
Chesapeake and Ohio Railway, Baltimore and Ohio Railroad Co Report 67-115, July 1967, 16 pp, 9 Fig, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-579)
DOTL RP

B2 037667
A WHEEL PROFILE: FOR BETTER RIDING AND LONGER WHEEL LIFE
Riding qualities can be improved and wheel life can be extended by making rather modest modifications to conventional profiles. The present AAR profile has one major shortcoming in common with the conventional British profile, and one additional problem that is unique to railroading in North America. The common problem is that there are two points of contact between the wheel and the rail when flange guiding is required. The uniquely American problem is associated with the inward cant at a 1:40 angle whereas the angle of the tread face is 1:20. Because of the angle between the rail and the tread face, there is rapid tread wear immediately after wheels are turned and an attendant loss in lateral riding qualities. The proposed profile uses a basic taper of 1:40. A flange throat contour which at all points has a slightly larger radius than the head of the rail, and a short section of flange face at a 70-degree angle. The region of the tread face which gets the least use is relieved at a 1:10 tamper. Using a modified flange throat contour will improve the steering action of a wheel set lateral movement of the wheel will be opposed by a smoothly increasing lateral restraining force and on a curve the rolling radius of the outside wheel can increase much more than is possible with a conventional wheel set.

List, HA *Modern Railroads* May 1970, pp 61-62, 4 Fig, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-580)
DOTL RP

B2 037680
ROLLABILITY OF CARS
Potomac Yard tests were conducted with cars obtained from the yard which were hard rollers. The rolling resistance of the car as received in the yard was compared with that after certain changes were made for improvement. A total of 408 test runs were made, utilizing 7 freight cars. Observations made during the testing were skewed trucks on tangent track; dragging brakes; wind up to 12 mph; poor center plates; comby wheels; hollow wheel treads; wheel diameter difference of 3/8 in.; and side bearing clearance from tight to 1/2 in. Changes made intended to improve rolling resistance were: grease outer rail on curves; apply regular grease on center plate; moly grease on center plate; add liners for side bearing clearance; grease side bearings; add nylon moly content liners in center plate; add brass liners in center plate; and tighten brake rods for rod eccentricity. Significant differences in the average rolling resistance were reported following the changes.

AREA Bulletin Vol. 62 1961, pp 799-802, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-594)
DOTL RP

B2 037684
CLEARANCE ALLOWANCES TO PROVIDE FOR VERTICAL AND HORIZTONTAL MOVEMENTS OF EQUIPMENT DUE TO LATERAL PLAY, WEAR AND SPRING DEFLECTION
A method for calculating lateral clearance requirements for passenger cars on curved track is presented considering the following factors: roll of car body, due to unequal spring deflections and play in side bearings; displacement due to swing-hanger movements and lateral play and wear in truck parts, and allowances for the effect of track irregularities and dynamic behavior of equipment. The results obtained are only as good as the basic information, such as degree of curvature and elevation. For best results, it is recommended that actual field conditions be determined by actual field measurement, determining curvature by string lining and elevation by cross levels. Variation of a few minutes in curvature should not be ignored.

Mills, EE *AREA Bulletin* Vol. 61 1960, pp 549-554, 4 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-598)
DOTL RP

B2 037688
THE TRANSVERSAL STABILITY WHEN IN MOTION OF RAILWAY VEHICLES ON THE STRAIGHT
The theory of car rocking was investigated by means of an analog computer. Wheel-rail dynamics are first established for an isolated axle with differential equations. The theory is then expanded to a two axle locomotive bogie with the axles having transversal play, and an ordinary bogie vehicle with sliding surface between the body and the bogies. Yet to be established is the relationship of actual performance with the theoretical predictions.

Rail International Nov. 1959, pp 1058-73, 16 Fig, 1 Phot, 9 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-602)
DOTL RP

B2 037691
VEHICLE DESIGN RELATED TO TRACK CONDITIONS
Recommendations which may influence improvements in the safety and comfort of passenger-train rolling stock are made in a paper, Vehicle Suspension and Bogie Design in Relation to Track Conditions, by Mr. R.M. Hancock of British Railways. The paper deals with the necessity of relating vehicle suspension and bogie design to the track conditions likely to be encountered in practice, particularly where lateral and crosslevel wave shape are concerned, as these are most likely to produce discomfort. The vehicle-response basis of systematic testing main routes as carried out with the Western Region track-testing car has provided much of the experience from which the illustrations in the paper are drawn. The effects of coning and track shape, in relation to the riding of four-wheel vehicles, are considered with reference to an investigation of their derailment in fast trains.

Hancock, RM (British Railways) *Railway Gazette* Vol. 110 Apr. 1959, pp 445-446

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-605)
DOTL RP

B2 037693
THE EFFECT OF TRACK GEOMETRY ON RIDE QUALITY
In this test, acceleration measurements were taken with one lateral and one vertical accelerometer attached to the floor of the test car. The sensitivity of ride roughness to changes in crosslevel during the negotiation of a curve is shown. Also shown is the change in ride response due to bolted to welded rail transition. The track geometry measurements used in this investigation were: centerline profile, the average profile of both rails; alignment; gauge; rate of change of gauge; and warp. The track and ride data were then sorted according to speed. The data for the 100-110 mph tests are plotted on scatter diagrams. Correlation coefficients were then computed for each of the six track exception densitites and the density of the sum of all exceptions with vertical, lateral, and mean lateral/vertical ride. The results are shown. Though sample populations are small, data correlation is sufficiently reasonable to lend support to the approach.

Paper recommended by IEEE Land Transport Committee of the IEEE Industry and General Applications Group for presentation at the joint IEEE/ASME Railroad Conference, Montreal, Quebec, Canada.

Ullman, KB O'Sullivan, WB (Department of Transportation) Institute of Electrical and Electronics Engineers Paper 69CP355-IEA, Apr. 1969, 8 pp, 3 Fig, 1 Tab, 4 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-607)
DOTL RP

B2 037696
BODY ROLLING AS INFLUENCED BY BOGIE SUSPENSION--1
Considerations of design variables affecting the angle of roll of bogie vehicles is discussed. A standard Russian coach bogie with divided bolster swing links is shown. Tests carried out with modern coaches running through curves at a steady speed resulting in an unbalanced lateral force equivalent to 0.1 g show that the angular displacement varies between 0.019 and 0.032 radians. With some modern bogie locomotives using laminated bolster springs and operating at speeds of up to 90 mph the angle of roll on straight track was found not to exceed about 0.005 radians. Roll stiffness of coaches, railcars, diesel and electric locomotive bogie suspensions for British Railways stock and the angle of roll are tabulated.

Koffman, JL (British Railways) *Railway Gazette* Vol. 113 Sept. 1960, pp 330-331, 1 Fig, 1 Tab, 1 Phot, 6 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-610)
DOTL RP

B2 037698
NON-LINEAR SPRINGS
The problem of ensuring satisfactory riding characteristics with vehicles operating in suburban services is particularly difficult because, as far as the bolster springs are concerned, the rush-hour load can exceed the weight of the vehicle body. Consequently, a static deflection of 4 inches under tare load will mean a static deflection of 8 inches and more under overload. General design considerations make it often necessary to deviate from the constant frequency relation, particularly when dealing with heavy overloads. To ensure a non-linear characteristic, rubber cones are used inside helical bolster springs and use is also made of suitable rubber springs sometimes incorporating helical springs vulcanised in them also to prevent undue barreling out of the hollow rubber cylinders. The use of non-linear centering devices is beneficial by reducing the degree of coupling between bogie hunting and body nosing and swaying in the range of low amplitude and frequency oscillations.

Koffman, JL (British Railways) *Railway Gazette* Vol. 113 Aug. 1960, pp 164-166, 4 Fig, 7 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-612)
DOTL RP

B2 037699
THE SUPERELEVATION OF RAILWAY CURVES
The most suitable superelevation for a given curve is determined as follows: the average speed on a tonnage basis should be ascertained from the actual known speeds of all trains, and the curve given the full theoretical

superelevation corresponding to this average speed; and the maximum permissible speed on the curve should then be fixed as that corresponding to the above superelevation plus 4 inches. The first condition will result in equal loading of the two rails, and hence equal head wear and even maintenance of surface. The second ensures passenger comfort, and gives an ample factor of safety against derailment which is uniform for all curves, while at the same time it fixes an upper limit to the lateral forces acting on the track which is also the same for all radii. A table gives the superelevation for various radii for different average speeds, and the corresponding maximum permissible speeds.

Rapley, F (Buenos Aires Great Southern Railway) *Railway Gazette* Vol. 78 May 1943, pp 509-511, 2 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-613)
DOTL RP

B2 037700
BODY ROLLING AS INFLUENCED BY BOGIE SUSPENSION--2
The effective length of the swing links should be considered in terms of the natural frequencies of lateral and nosing oscillations, as well as swaying, frequently, the use of relatively long links is desirable to reduce the sensitivity of the suspension to lateral track irregularities and to achieve a low natural frequency of the lateral track irregularities and to achieve a low natural frequency of the lateral and body nosing oscillations. Particular attention must be paid to lateral displacement for this is determined by the effective link length and the lateral force. Another solution consists of pre-loading the bolster laterally, the centering springs action increasing usually in direct proportion with the displacement, a feature found with leading bogies of steam locomotives and some modern bogie electric locomotives. The natural frequency of oscillation for a British Railways coach is determined mathematically. Articulated swing links used in Switzerland are briefly described.

Koffman, JL (British Railways) *Railway Gazette* Vol. 113 Sept. 1960, pp 393-396, 5 Fig, 6 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-614)
DOTL RP

B2 037703
HYDRAULIC DAMPERS
As far as vehicle suspension incorporating steel springs is concerned, the number of damping characteristics can be limited to two; friction damping and viscous damping. Friction damping occurs in every system and is maintained by friction forces acting in opposition to the motion. With true (Theoretical)viscous damping the damping force opposing the oscillation is proportional to the velocity of the latter. Many hydraulic dampers meet this requirement over the lower range of their characteristic. The effect of damping on the pattern of vibration decay and the effect of damping on the force and displacement transmissibility and resultant acceleration are shown. The Askania hand vibrograph is illustrated, along with the vibrograph records of diesel-electric locomotives. Typical characteristics of various damping methods encountered with railway vehicles are graphed.

Koffman, JL (British Railways) *Railway Gazette* Vol. 111 Oct. 1959, pp 362-366, 6 Fig, 2 Tab, 2 Phot, 6 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-620)
DOTL RP

B2 037705
A NEW METHOD OF DYNAMICALLY STABILIZING RAILWAY BOGIES, FOUR-WHEEL WAGONS, AND ROAD-RAILERS AGAINST UNDESIRABLE LATERAL OSCILLATIONS
A new method is described of dynamically stabilizing railway bogies, four-wheel wapons, and road-railers so as to be proof against undesirable lateral oscillations. It is generally accepted that the root cause of all such oscillations is the inherent instability of the ordinary axle-set, i.e. the integral unit of live axle and two wheels. By seeking to eliminate this instability, the new method tackles the problem as its source. The principle relied upon in the method is that of the inertia-guided axle, i.e. an axle with a leading guiding arm that is integral with it in yaw and that is connected at its forward end, by means of a velocity damper, to a floating mass whose lateral inertia provides the necessary guidance. Alternate guiding arms come into action wherever the direction of travel is reversed.

Williams, D
Institution of Mechanical Engineers Proceeding Vol. 180 PT. 3F, 1966, pp 125-139, 7 Fig, 1 Tab, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-623)
DOTL RP

B2 037711
CAR ROLLABILITY ON GRADES
This report discusses the various factors which decrease the rollability of railroad cars. These factors include: center and side bearings of trucks; broken, scored or unlubricated bearings; tolerance of axle bearing and truck bolster in side frame; plus dragging brakes. Findings suggest methods to increase rollability of rolling stock with related savings, such as improve center and side bearings with good lubrication; use of rust resistant materials; redesign brake rigging to minimize dragging of brakes resulting in locking of the truck; and creation of a device to free brakes with air is bled from the system.

Smith, FR (Union Pacific Railroad)
American Railway Engineering Association Vol. 58 1957, pp 1118-24, 6 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-701)
DOTL RP

B2 037718
CAR ROLL AND WHEEL LIFT, PROBLEM CHARACTERISTICS
The problem of car roll becomes more acute as the height of the center of gravity of the car body and lading is increased by greater car heights; and as car lengths are increased to the extent that the distance between truck centers approximates a standard rail length. While severe car roll is objectionable the most serious immediate consequences are wheel lift and resultant derailments. Commulative roll can develop very quickly to cause wheel lift. With rail joints 3/4-inch low, wheel lift can develop in four rail lengths at critical speed. Wheel lift can also be obtained on track with joints only 3/8-inch to 1/2-inch low if the joint stagger is midway and uniform, all joints are equally low, and the critical speed is maintained for about ten rail lengths. Fortunately, only a small percentage of wheel lifts result in derailments. When car roll is severe enough to cause wheel lift, there is a sizeable lateral force in the direction of the wheels staying on the rail, so that on tangent track, the wheels that are lifted simply come back down on the rail. In addition to the derailment hazard possibility there will be an increase in fatigue failures of journals, wheels and rail near joints as the result of the repeated high wheel loads being sustained due to severe rolling of heavier cars on track with less-than-perfect rail joint conditions.

Scott, HL (Norfolk and Western Railway) *Engineering Interchange for Railroad Advancement* Tech Proc Sept. 1965, pp 30-32

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-719)
DOTL RP

B2 037719
CAR ROLL AND WHEEL LIFT, PROBLEM SOLVING APPROACHES
The author discusses the problem of derailment and larger hopper cars as a two step process, (1) problem definition and (2) the selection of possible solutions or alternatives. It is pointed out that not all 100-ton cars derail. Only a relative few derail and, those which do, derail at more or less predictable locations. In the rail-versus-car controversy, it is obviously not very reasonable to spend the money to overhaul every mile of railroad track, nor is it any more reasonable to condemn the 100-ton car since it is one of the major factors contributing to increased railroad business. One possible solution might be to correct the very bad areas of track where the rail joint conditions produce severe dip, and the track arrangement is such that roll is reinforced; then do enough to the car itself to make it tolerate the remaining track. A few solutions on which there has been some work during the last year or two include improvement of the track and roadbed, and control of operation of the train so that susceptible cars don't move over troublesome curves at the critical speed or under certain conditions of draft or buff. Most derailments occur with newer cars, and when substantial milage is accumulated so all contact surfaces are worked in and maximum freedom of movement is attained there is a distinctly lessened tendency toward derailment. However, work on hopper car derailments has not produced a generalized solution which is widely adopted.

Reed, G (ACF Industries, Incorporated) *Engineering Interchange for Railroad Advancement* Tech Proc Sept. 1965, pp 32-38

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-720)
DOTL RP

B2 037727
THEORETICAL STUDY OF A TRAIN PARTING
The author reviews the results of a mathematical analysis of a problem involving run-out of slack on a 100-car train headed by six diesel units. The cars were 100-ton gondolas. The solution of the problem indicated that the forces developed were high enough to overstress either undamaged knuckles or drawbars.

Fillion, SH (Waugh Equipment Company) *Engineering Interchange for Railroad Advancement* Tech Proc Sept. 1965, pp 63-69, 3 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-728)
DOTL RP

B2 037732
CAR ROLL AND WHEEL LIFT TESTS ON SIMULATED SERVICE TRACK: TEST CONDITIONS AND RESULTS AT PRR ALTOONA TEST SITE
The class H-43, 100-ton hopper car began derailing at increasing rates beginning in the Spring of 1964 as more and more of these cars were placed in service. It was decided to set up a test track to simulate the rock-off phenomena and determine what modifications could be made to the car to reduce wheel lift and car roll. All cars were tested first on a tangent track with rails shimmed 3/4" to produce an 1-1/2" total change in cross level at each 39-ft. joint over a distance of ten rail lengths at speeds in the range of ten miles per hour to 22 miles per hour at approximately one mile per hour increments or until the critical speed was exceeded. The cars were then tested on a 3 degree curve having a 4-1/2" super-elevation with an 1-1/2" change in cross level superimposed at each joint over a distance of six rail lengths. Speeds on the 3 degree curve did not exceed 15 miles per hour. After testing, it was decided to adopt the following truck modifications:--1. Replace the 2-1/2" travel springs with 3-11/16" travel springs. 2. Add two friction snubbers to each spring group to absorb energy input into the spring group: 3. Move the side bearings in from 50" centers to 46" centers. 4. Machine the bolster gibs to permit more bolster lateral freedom. Even though a truck modification eliminate wheel lift on the test track, it was not certain just how close the wheel is to becoming unloaded.

Bertram, LW (Pennsylvania Railroad) *Engineering Exchange Forum* Tech Proc Sept. 1966, pp 23-27

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-734)
DOTL RP

B2 037733
CUSHIONING REQUIREMENT TRENDS IN NEW CAR DESIGN
The early history of cushioning and car design is reviewed. During the period from the early 1900's to the present, it is interesting to note the changes that were made in the couplers and yokes. The size of the head and shank of coupler was increased several times to what we now have, and the material was changed to high tensile steel several years ago. There has been quite a change in the yoke, too, from the old riveted type to the current designs in cast steel. During this period, the car structure was undergoing changes and modifications in an attempt to provide more strength and reduce or eliminate failures. Today, only a small percentage of impacts in classification yards occur below five miles per hour. Impacts at speeds from eight to ten miles per hour are not uncommon. The cushion underframes and end-of-car devices are doing a good job in affording better protection to the lading, and they have reduced the stresses substantially in the car structure, particularly the body bolster and ends of box cars. In the future the use of cushion underframes and end-of-car devices for fragile commodities will increase but not in general use.

Leriche, CC (Association of American Railroads) *Engineering Exchange Forum* Tech Proc Sept. 1966, pp 18-23

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-733)
DOTL RP

B2 037743
COUPLERS--LONG CAR PROBLEMS
Concern for increased car length and the resultant need generated by such cars for a 60" coupler is discussed. Included are the results of tests and effect of longer couplers negotiating various crossovers. These couplers would also reduce lateral forces and wheel lift when cars are in a buff mode.

Byrne, R (Association of American Railroads) *Engineering and Operations Interface* Tech Proc Sept. 1967, pp 23-27, 2 Fig, 3 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-742)
DOTL RP

B2 037744
BODY STRUCTURAL PERFORMANCE
When cracks begin to show up on cushion underframe castings of 70-ton cars, laboratory work was initiated to find and correct the problem. It was quickly determined the car rocking and rolling was causing cracking problems in the reinforcing ribs of the casting. A special casting was developed to provide for all rocking moments within the underframe coating itself. After running a number of laboratory tests measuring stresses at the critical areas, tests then were run on such a bolster that was built into a car. The car was loaded, detrucked, and supported at the ends of the bolster as had been done in the lab. Known loads then were jacked into the car and stresses were measured in critical areas. Field tests and lab data were compared, thereby permitting evaluation of the effect of the car structure on the bolster. It was found that the car structure does assist the bolster in resisting rock and roll and that top cover plate reinforcements were effective.

Fillion, SH (Waugh Equipment Company) *Engineering and Operations Interface* Tech Proc Sept. 1967, pp 28-30, 4 Fig, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-743)
DOTL RP

B2 037746
TRUCK PERFORMANCE
This paper discusses truck performance from four aspects: rock and roll problems (defined as roadability), ride qualities, durability, and maintainability. Numerous slides depict worn truck parts from dismantled 100-ton cars.

The author is also affilicated with the Baltimore and Ohio Railway Company.

Melrose, MF (Chesapeake and Ohio Railway) *Engineering and Operations Interface* Tech Proc Sept. 1967, pp 33-38, 17 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-745)
DOTL RP

B2 037747
TRUCK EFFECT ON TRAIN OPERATION
While specifications for freight car trucks cover bolsters, side frames, wheel, axles, springs and many other parts, the author feels that truck performance standards are needed to optimize riding qualities between the rail, the car body and the lading. It is suggested that a practical approach to truck design be maintained to insure the retention of desirable characteristics such as simplicity, interchangeability, rugged construction, and reasonable cost.

Garin, PV (Southern Pacific Company) *Engineering and Operations Interface* Tech Proc Sept. 1967, pp 39-44

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-746)
DOTL RP

B2 037748
AUTO-PEOPLE OPERATION
The concept of the auto-train is examined including its background, service aspects, equipment involved, and procurement process. The idea was to transport primarily vacationers and retirees to destinations where their own car would be useful. The trains consist of auto cars, a service car at each end of the train and a locomotive at each end. Service and auto car are double decked. Service was planned for a 780 mile trip from Washington, D.C. to Jacksonville, Florida. At the time of this article, design work was two thirds completed.

Lawson, KL (Federal Railroad Administration) *Engineering and Operations Interface* Tech Proc Sept. 1967, pp 45-49, 6 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-747)
DOTL RP

B2 037751
BENDING STRESSES IN A MOTORED AXLE ON ELECTRIC ROLLING STOCK--1

This article gives results of strain gauge tests on a motored axle both empty and loaded. Deductions from the results lead to an emphasis on the transverse friction between wheel and rail. This factor, neglected in axle stress formulae, is shown to be of major importance in the bending moment on the wheel seat of an axle, amounting to about 40 percent of the total on a curve with equilibrium cant. Support for the deduced theory is given by the correspondence between calculated and measured stresses, and also by the results of direct comparative tests. Additional stresses from cant deficiency, track irregularities, and acceleration or braking are discussed. The apparatus used in the test and the procedure of testing are fully described.

Broadbent, HR Richards, J (London Transport Executive) *Railway Gazette* Vol. 104 June 1956, pp 511-514, 6 Fig, 1 Tab, 1 Phot, 4 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-751)
DOTL RP

B2 037752
BENDING STRESSES IN A MOTORED AXLE ON ELECTRIC ROLLING STOCK--2

A further check of the theory that transverse friction is a major item in the stressing of axles was made by a series of comparative tests. While vertical differences in track level apparently affect the stress in the axle very little, it has been found that the test axle assembly is very sensitive to the condition of the running edge of the high rail on a curve. Contrary to expectation, passage over the toes of switches and the noses of crossings did not produce high stresses in the axle. Passage through the lead of turn-outs caused high values to appear, though no higher than those which occurred on some curves.

Broadbent, HR Richards, J (London Transport Executive) *Railway Gazette* Vol. 104 June 1956, pp 543-547, 8 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-752)
DOTL RP

B2 037757
ASEA AND SJ TEST TILTING SUSPENSION WITH PANTOGRAPH ADJUSTMENT

An electronic pendulum or accelerometer senses the lateral acceleration in a curve, and the deflection of the pendulum determines the tilting angle of the coach. The air suspension raises one side of the coach body and lowers the other side; full tilting angle is obtained within 1.5 sec. The system is stable and unaffected by irregularities in the track; the air suspension itself provides a simple level control so that the relation between coach floor and platform height remains constant irrespective of whether the coach is loaded or empty. As well as practical tests, computer simulations of the equipment have been performed. The two-car electric unit used for the tests so far has a maximum speed of 120 km/h, but its gear ratio is to be altered to permit speeds up to 200 km/h.

Railway Gazette Vol. 126 May 1970, p 364, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-767)
DOTL RP

B2 037771
DEVELOPMENTS IN WAGON BOGIE DESIGN

Cast-steel bogie frames and bolsters are being used for goods stock on many railways. Basically, there are two designs, one employing springs without friction damping and the other, springs which are friction controlled. The bogies can be of either the plank or plankless type, but the self-aligning spring plankless type gives better riding qualities with consequent reduction of wear on bogie guides and on wheel flanges and rails. There is also a reduction in cost and weight due to the elimination of the plank. Friction controlled bogies have long travel bearing springs, although they can be designed for short travel springs, with adequate reserve travel and constant control of spring action. Tests have shown friction controlled bogies give improved riding of wagons at all speeds with consequent reduction in wear and maintenance. Unit brake beams are described.

Railway Gazette Vol. 100 Apr. 1954, pp 466-467, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-781)
DOTL RP

B2 037773
RUBBER SUSPENSION FOR BOGIES

The object of these experiments is to determine the practicability of suspending the whole bogie on rubber, and so bring about a reduction in maintenance costs by eliminating all wearing parts such as rubber plates, hanger pins, and bushes, as well as the steel springs. Such suspension would also go a long way toward reducing if not eliminating the running noises resulting from conventional type bogie suspension, particularly in tunnels. A preliminary investigation indicated that the cost per bogie was approximately 50 pounds more than for the standard arrangement. It is anticipated that the life of the rubber units will be approximately ten years, if not longer. The saving in maintenance would more than compensate for the extra initial cost.

Railway Gazette Vol. 99 Dec. 1953, pp 626-627, 5 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-783)
DOTL RP

B2 037780
SIMPLIFIED RIDE INDEX MEASUREMENT

This portable instrument will provide a continuous meter indication of the ride index of the vehicle in which it is placed. The meter uses a variable inductance accelerometer as an acceleration element. The meter is placed on the floor of the vehicle and the plane of measurement selected, either vertical or horizontal. The ride quality is shown directly on the meter scale as a continuous reading.

Railway Gazette International Jan. 1971, p 35, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-795)
DOTL RP

B2 037782
RUNNING THROUGH CURVES

Economic considerations demand high average, rather than occasional high maximum speeds. Rapid acceleration and retardation are essential and vehicles must also be able to negotiate curves at high speeds, which is of particular importance for lines with many curves. The forces acting on a vehicle running in a curve are shown and the limiting valves of speed and the effect of axle load on speed through curves are established mathematically. Transverse flexibility is important in reducing dynamic forces at curve irregularities. Time-speed and time-distance curves for a single car and for a car and trailer are plotted for electric hydraulic and mechanical transmissions.

Railway Gazette. Vol. 96 June 1952, pp 682-684, 9 Fig, 12 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-797)
DOTL RP

B2 037783
CONFINES OF BRAKING--1

Factors reducing braking rates below the limit imposed by adhesion between wheel and rail are discussed. Braking efficiency can be related to adhesion, but only when the braking is straight line from moment of application to standstill. This is never so in practice, and the braking efficiency can therefore be considered only as an average ratio, and not the adhesion value which is the limit in maximum braking. No braking starts at the maximum rate instantaneously, nor does it usually carry on to a stop at the maximum rate. The reasons are regard for passenger comfort and the speed of equipment response. Manufacturing inaccuracies and maintenance problems which cause differences in brake cylinder air pressure are mentioned.

Broadbent, HR *Railway Gazette* Vol. 97 Oct. 1952, pp 488-489, 5 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-798)
DOTL RP

B2 037786
CONFINES OF BRAKING--4

Braking force can be no higher than the co-efficient of friction between wheel and rail will allow. Various factors affecting the friction between the wheels

and rail are discussed, such as, variation in passenger loading, weight transfer, deposits on the rail, effect of speed, mutual wheel/rail contact, gradients, winds, and frictional resistance of the train.

Broadbent, HR *Railway Gazette* Vol. 97 Nov. 1952, pp 570-571, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-801)
DOTL RP

B2 037788
IMPROVING THE SUSPENSION AND STABILITY OF RUNNING OF BOGIES

New coaches have been equipped with an improved Pennsylvania bogie, having reduced play about 1 mm. in new stock designed to take nearly 50 percent of the total load on the bogie. Coaches fitted with these new bogies have an excellent degree of stability in running, up to speeds of 100 mph and over. Double elliptical springs in the bogie were eliminated and were replaced by something flexible, able to damp all stock gradually. The design enabled the total vertical accelerative movements, measured inside the vehicle, to be reduced by some 50 percent, and the shocks caused by passing over the rail joints to be noticeably lessened. These bogies have a control device or system composed of longitudinal and lateral stay-bars, which dispenses with horn plates on the axle boxes, or guides at the ends of the swing bolsters.

Lejeune, M (French National Railways) *Railway Gazette* Vol. 95 Dec. 1951, pp 660-661, 1 Fig, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-803)
DOTL RP

B2 037790
RIDING AND WEARING QUALITIES OF RAILWAY CARRIAGE TYRES

The article discusses testing begun in 1935 to study transverse wheel oscillation and to determine if any benefits might come to changing the 1 in 20 coned wheel to a cylindrical tread wheel. The riding qualities of each wheel type were unique to that profile, but there was a marked influence by track upon wheel motion, at times when motion was controlled by track conditions. The best riding occurred with the cylindrical profile in new conditions and a coning of 1 in 100 as a close second. After much milage the riding factor was the same as the 1 in 20 coning in new condition.

Railway Gazette Vol. 80 Mar. 1944, p 310

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-817)
DOTL RP

B2 037795
NEW TYRE PROFILES FOR BRITISH RAILWAYS

This article discusses the factors used by the British Railways in determining new wheel profiles which when adopted will result in stability of profile shape, reduced Hertzian stress and improved guidance in curves. These new profiles incorporate "hollow tread" profiles which are the result of wear between wheels and rails. The profiles were selected on the basis of tests conducted to determine the profile which would distribute wear over the tread and to achieve stability of wheel/rail contact. The characteristics of the form profiles are discussed, compared and illustrated.

King, BL (British Railways Research Department) *Railway Gazette* Vol. 124 No. 1, Jan. 1968, pp 60-64, 8 Fig, 4 Tab, 11 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-836)
DOTL RP

B2 037806
DISCUSSION OF THE PERMISSIBLE SPEED OF FREIGHT TRAINS ON CURVES

The information content concerns the speed of freight trains on curves and the possibility of increasing permissible unbalance to 3 inches, the same as applying to passenger trains. An analysis of the problem and supporting data are given along with a recommendation to increase freight train speed equivalent to passenger trains, namely 3" unbalance speed.

Letter Correspondence.

Sandberg, CH Feb. 1967, 3 pp, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-881)
DOTL RP

B2 037822
DERAILMENT NEAR SITTINGBOURNE

The train comprising 24 empty continental ferry vans and a brake van, became derailed on plain track approximately one mile west of Sittingbourne Station. The train was running at 55-60 mile/h when it derailed, a speed substantially in excess of the 45 mile/h limit. Since the intermittent side-cutting of the high rail contributed to this derailment, the possibility of reducing it by making some change in train behavior over the curve deserved consideration. Train behavior itself should be altered if the cant were reduced to three-fourths inches at which equilibrium speed would be 39 mile/h. The fast trains which appeared to cause the intermittent side-cutting would then run more firmly against the outer rail and the intermittent side cutting would be checked.

Railway Gazette Vol. 123 July 1967, p 513

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-903)
DOTL RP

B2 037827
FLANGE AND RAIL LUBRICATION

The Japanese National Railways has experimented with systems to reduce wheel and rail wear. Results of tests show that rail oiling reduces electric current consumption by 66%, reduces wheel wear to 1.25%, and reduces rail wear to 1%, compared with dry rail. Three systems have been suggested for lubricating the rails: site lubrication where it is picked up by the flange; flange lubrication in the vehicle; and automatic lubrication of the inside rail edge. A comparison of various devices to accomplish lubrication is included as well as a description of each system. Benefits of lubrication for different situations are included in a series of tables and charts.

Fujinawa, I (Kinki Nippon Railway) *Railway Gazette* Vol. 123 Dec. 1967, pp 899-902, 10 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-909)
DOTL RP

B2 037840
HEUMANN-LOTTER TYRE PROFILE

The Heumann-Lotter tyre profile was evolved with the idea of giving somewhat greater safety against derailment of locomotives and rolling-stock. This profile was applied to all engine and tender wheels, and was felt to be of particular value with tender-first running with the tender nearly empty, a condition which gave the greatest risk of derailment. Before adoption as the standard profile by the German Federal Railway, 68 percent of all tyre-turning costs were due to needed flange re-profiling. Observations showed that the tyre mileage was 30 percent greater with the new profile than with the old.

Railway Gazette Vol. 122 July 1966, p 568, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-924)
DOTL RP

B2 037861
HEUMANN TYRE PROFILE TESTS ON BRITISH RAILWAYS

A new tire profile, based on the studies of Prof. Heumann, was designed and is illustrated. This tire profile should assist in ensuring good riding qualities, increase the resistance against derailment and this in turn should reduce tire and rail wear, and ensure a favorable wear pattern. This can be done by ensuring one-point contact running and a gradual transition of the throat profile. The result of trials carried out with standard 32 ton British Railways coaches running on B4 type bogies with 3-ft. wheels, positive axle guides, 19-1/2 in. effectively long swing-links and helical springs throughout are shown. Ride index values during acceleration and wear patterns for the tires are given. The tests have shown beneficial results, although further tests are needed.

Koffman, JL (British Railways Board) *Railway Gazette* Vol. 121 Apr. 1965, pp 279-283, 9 Fig, 17 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-997)
DOTL RP

B2 037932
MANGANESE-STEEL AXLEBOX LINERS
Wear of axleboxes, more than any other single feature, is responsible for requiring locomotives to be returned to the workshop for repairs, and the mileage between shoppings is directly connected with the wear-resisting properties of the materials of which the axlebox rubbing surfaces are composed. It became clear that any considerable improvement in shopping mileage would require different material for the flat surfaces of the axleboxes, and the practice of fitting manganese steel liners to roller bearing axleboxes suggested a line of attack. Details for fitting axleboxes with new liners are presented. The leading features which were observed during examination in the shops and sheds following mileage runs average 80,000 miles shows. 1. The surfaces of the liners which are in contact with one another become work hardened in service and take on a high polish. 2. A very interesting feature has been that reduction of "knock" or wear in a longitudinal direction has had also a beneficial effect on lateral wear. 3. Bolts and rivets of the horn liners have remained tight. 4. Scoring of the liners has been negligible. The manganese steel liner has been adopted as standard and it has fitted to new construction of all types. Apart from the potential increase in shopping mileage, the liners already are proving of considerable value from an operating point of view in reducing development of rough riding.

Railway Gazette Vol. 88 Apr. 1948, pp 514-516, 4 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1126)
DOTL RP

B2 037985
AXLE-FATIGUE TESTING MACHINE
A testing machine, designed for investigating the fatigue strength of railway rolling-stock axles, has been installed in the new Central Research Laboratory of London Transport at Chriswick. The machine is of the resonant type driven by an electric motor through a slipping clutch which is incorporated to ease the starting and stopping conditions. The test specimen are of a typical axle size. The stress is measured by several resistance strain gauges, calibrated in position, and various protective devices are provided to enable the machine to be left running unattended

Railway Gazette Vol. 113 Dec. 1960, p 714, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1405)
DOTL RP

B2 037987
RUBBER-CUSHIONED RESILIENT WHEELS FOR MAIN-LINE RAILWAYS
Most types of rubber-cushioned resilient wheels, including those for tramways and for narrow-gauge railways, consist of three metallic discs. Between these discs are placed either circular rubber blocks, positioned in one or two concentric rows, depending upon axleload, or a single pair of large rubber discs, which may be divided into segments. The central metal disc is fixed either to the wheel or to the wheel hub. Several applications of rubber-cushioned wheels, both on tramways besides main and secondary railway lines, have shown considerable reduction of maintenance costs for the mechanical parts and electric equipment, particularly collectors, because of the radial and tangential flexibility introduced by these wheels. The reduction of the wear on tires and flanges with resilient rubber-cushioned wheels, must result in a corresponding reduction of the wear of the rails.

Hug, AM *Railway Gazette* Vol. 110 Feb. 1959, pp 155-158, 6 Fig, 5 Phot, 2 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1407)
DOTL RP.

B2 039011
A CALCULATION OF THE LATERAL HUNTING MOTION OF A TRACKED VEHICLE
The lateral hunting motion of a vehicle running on tracks is not only prejudicial to riding comfort, but may also cause dangerous derailment. The initial step in the design of a safe high-speed train is a theoretical and experimental investigation of this lateral hunting motion and a practical method of preventing it. The usual railroad train may be idealized as a system consisting of a number of cars connected end to end like links of a chain. The transfer-matrix technique purports to be applicable to such a system, whereby once the transfer matrices of each component (car) are derived, it is only necessary to perform successive matrix multiplications to fit the entire system. It is demonstrated that the transfer matrix method may be applied successfully in a study of lateral hunting motion. The stability problem associated with this motion, and forced vibrations caused by irregularities and lateral distortions in the rails may also be investigated by the use of the transfer-matrix technique. (Author)

Iguchi, M
Massachusetts Institute of Technology DSR-76109-5, Nov. 1966, 27 pp

Contract C-85-65t

ACKNOWLEDGMENT: NTIS (PB-173652)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-173652, DOTL NTIS

B2 039277
SUMMARY OF METROLINER TEST RESULTS
Laboratory dynamic test results are presented for Metroliner railroad car. Power spectra of road test also included. Track geometry power spectra of roadbed input are also documented. (Author)

Herring, JMJ Strong, PM
Budd Company Feb. 1972, 272 pp

Contract DOT-FR-1-0035

ACKNOWLEDGMENT: NTIS (PB-208284)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-208284, DOTL NTIS

B2 039320
WHEEL AND RAIL LUBRICATION
Remarkable increases in life of rails and wheel flanges through lubrication, by as much as 700 percent, are quoted by Dr. Fritz Birmann, in his paper "Lubrication of Rails and Wheels." The requirements of a lubricating system to reduce wear of rails and tires, are that the lubricant must be prevented from spreading to the running surface of the rail, thereby reducing traction; that the efficiency of the system must not be spoiled by dust, dirt or weather influences; that the lubricating devices and spray nozzles must be profile free on the rail and vehicle; and that lubrication must not start too late on the curve, so that it is preferable, where possible, to lubricate tires before entering the curve.

Birmann, F (German Federal Railways) *Railway Gazette* Vol. 107 Oct. 1957, p 413

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1483)
DOTL RP

B2 039416
RANDOM LATERAL MOTIONS OF RAILWAY VEHICLES
The study is concerned with the random motions made with a truck of experimental design. The behavior is studied of this truck on a test track and is compared with the empirically predicted behavior. Results of the program show that there is close agreement between observed and predicted performance; spin effect results in considerable de-stabilizing of the truck.
Question B52. Restrictions on the use of this document are contained in the explanatory material.

Stassen, HG (Delft University of Technology)
International Union of Railways ORE Pub-28, Jan. 1969, pp 16-19, 5 Fig, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-665)
DOTL RP

B2 039476
CARRIAGE-BOGIE DESIGN
Factors involved in determining the riding characteristics of coaching stock are numerous. By means of suitable formulae, the path of a wheel set, will be a sine curve. It is influenced by the profile of the rail head. The characteristics of springs are carefully considered as suggested that helical springs might be used to deal with both vertical and lateral forces or by arranging for bogie center to bear against large rubber pads disposed at an oblique angle, so as always to be in shear.

Koffman, J *Railway Gazette* Vol. 88 Mar. 1948, p 297

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-808)
DOTL RP

B2 039479
RESILIENT WHEELS FOR RAILWAY VEHICLES
Radial thrusts between tire and hub are transmitted through rubber inserts, giving better riding qualities and reduced wear on track. A suggested method of fitting Silentbloc bearings to eliminate metallic contact between the hub and tire of a wheel is shown.

Railway Gazette Vol. 85 Oct. 1946, p 386, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-811)
DOTL RP

B2 039480
WHEEL HUNTING AND IRREGULAR RAIL WEAR
In addition to the "hunting" of rolling stock wheels, there is the constant side-to-side movement of individual pairs of wheels. The standard taper of coning of wheel-treads is at 1 in 20, so the tread of a new tyre may be at right-angles to the centre-line of the rails. Experiments have been tried in varying the angle of taper of the treads and the radius of the railhead, but the wear of tires and rails complicates the problem, and hitherto has made it difficult to come to any final conclusion as to how the hunting problem may be solved. Persistent bogie hunting can cause bogie stock to ride uncomfortably. Of even greater importance is the wear-and-tear of rolling stock and the damage to rails caused in this way.

Torns, AH *Railway Gazette* Vol. 83 Dec. 1945, p 636

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-812)
DOTL RP

B2 039490
PREVENTION OF DERAILMENT OF GOODS WAGONS ON DISTORTED TRACKS
A mathematical study is presented to determine the critical value of relative wheel unloading of the leading wheel of a freight car on a track twist. Also determined are the maximum track twist which can safely be negotiated by a vehicle and the measures which need to be taken to adapt freight cars to meet the standard without modification of the torsional stiffness. The standard adopted by the Specialists Committee B55 of the ORE is a maximum permissible relative wheel unloading equal to 0.6, at a maximum permissible track twist of 7 percent.

Question B55. Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways ORE Pub-24, Jan. 1967, pp 27-29

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-875)
DOTL RP

B2 039501
AREAS OF CONCERN FOR FREIGHT CAR ENGINEERING
The aims of containerization are to provide cheaper, safer and quicker transportation for commodities which can be placed in standard size boxes. To obtain maximum benefits, special equipment is necessary and economically justified. The size of the containers, loading and securing methods, and size and capacity of the cars are described. A series of tests were made to determine the source and methods to eliminate the poor ride qualities of 60 feet container cars used on the Canadian National Railways. The tests were run over the same track at a range of speeds. The acceleration was measured in the vertical and lateral directions. Track hunting was apparent above 45 mph. The results of the tests are shown.

Technical Proceedings from 1969 Railroad Engineering Conference.

Radford, RW (Canadian National Railways)
Dresser Transportation Equipment Division Tech Proc Sept. 1969, pp 16-25, 19 Fig, 12 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1003)
DOTL RP

B2 039502
ENGINEERING CRITERIA FOR FUTURE FREIGHT CAR TRUCK DESIGN AND PERFORMANCE
To establish the criteria for design and performance of freight car trucks, the environmental effects on the truck must be examined. These environmental effects are grouped as: external environment from track conditions, carbody and train speed; and internal environments which are induced by the truck design, the specialty components, such as roller bearings and the state of the art in developing the most desirable elements in the truck assembly. Each of these effects is described. The lack in the U.S. of a full-scale wheel-rail dynamics research facility to test trucks and tracking has hampered the efforts on truck design. A British Railways test using a U.S. truck design and their Freighliner test equipment is briefly described.

Technical Proceedings from 1969 Railroad Engineering Conference.

Garin, PV (Southern Pacific Company)
Dresser Transportation Equipment Division Tech Proc Sept. 1969, pp 26-30

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1004)
DOTL RP

B2 039504
CARBUILDER'S APPROACH TO THE SOLUTIONS OF THE TRUCK--CAR BODY RELATIONSHIPS
Three failure modes for center plate areas are discussed and illustrated. Wear of vertical wall inboard and outboard has been reduced by the wear ring and harder center plate. By use of these modifications, the 50 and 70 ton service experience should be approached. Cracking of center plates was prevalent prior to 1967, and was a function of the center plate center filler contact area. Failures had not occurred at conference time of the solid forced plate designed to eliminate the cracking problem. Cracking of the cushioned underframe center plate is a function of the overall bolster design and with proper design and reinforcement, this mode of failure should not occur.

Technical Proceedings from 1969 Railroad Engineering Conference.

Ruppecht, WJ (ACF Industries, Incorporated)
Dresser Transportation Equipment Division Tech Proc Sept. 1969, pp 32-39, 18 Fig, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1006)
DOTL RP

B2 039506
CARBUILDER'S APPROACH TO THE SOLUTIONS OF THE TRUCK-CAR BODY RELATIONSHIPS
In early 1967 General American standardized on a cast steel combination center brace, center plate, and rear draft lug. This casting is attached using the two-piece rivet; that is, the Huck or Townsend bolt. Laboratory tests were conducted for all capacities through 125-tons with impact loads beyond AAR design requirements. This design has operated successfully in service. Test results on the center plates on car built from 1960 to 1967 are given. The test showed that a solid bowl is not as good as the recessed type bowl because of slight deviations in the bolster.

Technical Proceedings from 1969 Railroad Engineering Conference.

Krause, JF, JR (General American Transportation Corporation)
Dresser Transportation Equipment Division Tech Proc Sept. 1969, pp 41-42

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1008)
DOTL RP

B2 039507
DRAFT RIGGING AND CONNECTIONS AND THEIR EFFECTS UPON AVAILABILITY AND PERFORMANCE
The main discussion concerns failures of unit train equipment due to the excessive train load, gradients and curves through mountainous areas, and car impact. Photographs show wear and deformation of couplers, draft gear and yokes. In tests of a general service car operating on a mixed freight train from Washington, D.C. to Birmingtom, Alabama, a peak drawbar pull was recorded in excess of 300,000 lbs. in slack action territory. The average drawbar pull over eight grades was recorded as 218,000 pounds. Southern specifies Grade E couplers and yokes on all 100-ton equipment. Magnafluxing all knuckles is being considered.

Technical Proceedings from 1969 Railroad Engineering Conference.

Simpson, WW, Jr (Southern Railway)
Dresser Transportation Equipment Division Tech Proc Sept. 1969, pp 44-49, 4 Fig, 10 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1009)
DOTL RP

B2 039511
TOTAL CAR DESIGN FOR OPTIMUM CAR UTILIZATION
A new hopper car is described, which was to be tested by the Canadian National in late 1969. Truck and car design to minimize rail corrugation are described. Illustrations show rail corrugation being measured, track locations subject to corrugation, and bearing configurations.
Technical Proceedings from 1969 Railroad Engineering Conference.

Giesking, PF (National Steel Car Corporation)
Dresser Transportation Equipment Division Tech Proc Sept. 1969, pp 59-63, 12 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1013)
DOTL RP

B2 039513
RESUME OF LONG CAR TRACKING PROBLEMS
It was necessary to employ a special coupler in the design of the 86'6" Hy-Cube box car for automotive stampings. To permit those cars to negotiate curves it was necessary to use a nonstandard 60-in. "F" shank coupler with a Type "E" head. The coupler carriers have been broken on several of the cars as they were passing over vertical curves of lesser radii than the cars were designed to negotiate. Coupler carriers on other cars coupled to Hy-Cube cars have been literally torn off while negotiating vertical curves. The most prevalent difficulty with the long couplers on cars with long overhangs, is caused by missed couplings. Accidents of this kind smash angle cocks, train line nipples, uncoupling mechanisms and in many cases causes much damage to the center sills, especially to sliding center sills. The answer to longer trains and reduced draw-bar pull may be automatically controlled locomotives spaced in trains.
Technical Proceedings from 1964 Railroad Engineering Conference.

Douglass, JR (Louisville & Nashville Railroad)
Symington Wayne Corporation

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1025)
DOTL RP

B2 039518
TRUCK PROBLEMS FROM CURRENT OPERATING DEMANDS
Increasing axle loads, vertical vibration causing damage to lading wheel lift on autorack flat cars, long cars and heavy hoppers, and fabrication and durability problems connected with recent truck designs are discussed. The economic desirability of adopting new truck designs is briefly mentioned.
Technical Proceedings from 1964 Railroad Engineering Conference.

Adams, DW (Pennsylvania Railroad)
Symington Wayne Corporation Tech Proc Sept. 1964, pp 30-34

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1030)
DOTL RP

B2 039522
PARTICULARS OF CAR IMPACT AND ROAD TEST DEMONSTRATIONS
The Symington car impact test plant is briefly described. The results of a road test taken during this conference is included. The type XL-70 truck was being evaluated in the test. The portion of the test from Depew to Batavia was very good with a considerable amount of high speed running. The XL trucks gave their usual good performance, while considerable periods of truck swiveling with accompanying car nosing was noted in Car SX-107 having the A-3 trucks.
Technical Proceedings from 1964 Railroad Engineering Conference.

Suckow, FG
Symington Wayne Corporation Tech Proc Sept. 1964, pp 49-54, 7 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1034)
DOTL RP

B2 039545
TESTS OF LUMBER LOADED ON FLAT CARS WITH AND WITHOUT CUSHION UNDERFRAME
Two flat cars, one with and one without cushion underframe, were loaded with lumber identically and coupled back to back. These test cars were run in a train for two trips between Everett and St. Paul. The conditions of the loads were noted at the end of each trip, and the superiority of the cushion underframe car is plainly evident from the test results.

Weyerhaeuser Company 2 pp, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1171)
DOTL RP

B2 039553
ROLLING STOCK SHOCK ABSORBERS
Tests were conducted in America under actual running conditions by Waugh Laboratories on the Woodhead-Monroe shock absorber which is of the bleed and blow-off type. Resistance characteristics are extremely versatile since there are six variables on both compression and rebound strokes. Results on a 40-ton refrigerator car were expressed as a percentage of that experienced without shock absorbers, and ranged as low as 7 percent in the vertical plane and 53 percent in the lateral plane for a 25,000 lb. load.

Railway Gazette Vol. 99 July 1953, pp 100-101, 1 Fig, 1 Tab, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1192)
DOTL RP

B2 039555
RESEARCH ON INDIAN RAILWAYS
The main objectives of the Indian Directorate of the Railway Board, located at Lucknow, are maximum safety in rail travel, sufficiency in equipment, and economy. The Lucknow center carries out research on fuel, the dynamic effects of vehicles on track and bridges and riding quality and performance lists on locomotives and carriages. The sub-center at Lonavla is carrying out research on soil mechanics and foundation engineering problems; chemical and metallurgical studies on lubricants, paints, water softeners, and other aspects are being undertaken at Chittaranjan.

Railway Gazette Vol. 99 Sept. 1953, pp 312-313

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1194)
DOTL RP

B2 039569
THE FRENCH RAILWAY SPEED RECORD
As part of a study of the technical and economic aspects of high-speed operation, the SNCF conducted four days of trial runs at progressively higher speeds. The purpose of the tests was to investigate the margin of safety allowed by the speeds now regularly scheduled with normal types of locomotives and rolling stock. They were also regarded as a contribution to research into methods of improving the productivity of transport and reducing its cost, by showing how the building of vehicles able to run at ever-increasing maximum speeds can reduce maintenance expenditure on locomotives and track when operating at the speeds now normally scheduled. The test train consisted of three coaches of a recent design. Continuous records were made on all the runs by means of piezo-electric apparatus of the lateral forces exerted on the track by the first and third axles of the locomotive bogies. It was found that these did not exceed 4.2 tons.

Railway Gazette Vol. 100 Mar. 1954, p 352, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1208)
DOTL RP

B2 039587
SHOCK ABSORBER FOR GOODS WAGONS
The French National Railways have been experimenting with a shock absorbing device designed to prevent damage to goods arising from heavy impact during shunting operations or movements occurring during rail transit. The equipment can be installed in ordinary goods wagons and its essential feature is the ability of a chassis mounted on wheels to move up or down inclined ramps in accordance with the movements of the wagon on which it is fixed. Movement of the chassis is restricted by springs. The shock absorber has been subjected to severe tests, including collisions with vehicles travelling at 12 mph, and it has also been tried out under normal service conditions.

Railway Gazette Vol. 95 July 1951, p 69, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1232)
DOTL RP

B2 039635
TORSION BAR BOGIES ON THE RHAETIAN RAILWAY
As a result of experiments with a novel type of bogie designed to provide improved riding at speeds up to 40 mph on their metre-gauge electrified

system, the Rhaetian Railway are equipping four types of carriages with a bogie built by SIG. The results of road tests with the SIG bogie are shown, along with the road tests of the bogies originally on the carriages. These latter bogies were built before 1930. Transverse oscillations have been reduced considerably when compared to that experienced with the original bogies. Longitudinal movement is little influenced by the type of bogie, and this was slightly reduced. Tare weight of the cars is approximately one ton less than the original weight.

Railway Gazette Vol. 102 Feb. 1955, p 158, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1331)
DOTL RP

B2 039655
EASIER MAINTENANCE CONTROL FOR RAILWAYS
A small Canadian railway has initiated a planned maintenance system to detect excessive maintenance costs. The system is designed to point out when equipment should be replaced rather repaired. This method is applicable to anything that has to be maintained: locomotives and rolling stock; roadbeds and tracks; machine-shop equipment; buildings and their components (floors and roofs); paving of roads, and so on. Tables are shown as examples of the system. A measure of operating conditions are established using a Table of Wear Points. This Table shows arbitrary values for various degrees of operating conditions. Multiplying these wear points by each other a wear factor can be arrived at. History cards are kept on each piece of equipment to accumulate the wear factors.

Margo, BA *Railway Gazette* Vol. 103 Sept. 1955, pp 359-360, 5 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1351)
DOTL RP

B2 039658
TALGO TRAINS IN ARGENTINA
The inventor of the Talgo train conducted technical studies in Argentina in 1954 and 1955, during which scale models of tank cars and box cars were built and tested. Experimental passenger and freight trains are being constructed. This is the first application of the Talgo principle to freight train design. A cost estimate was made for constructing an elevated track for the train. The estimate was ten times the estimated cost of ground level track.

Railway Gazette Vol. 103 Oct. 1955, pp 412-413

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1354)
DOTL RP

B2 039669
BRAKING PRACTICE AND DEVELOPMENTS
The article describes features which are standardized and in widespread use by British Railways and certain designs still under investigation. The object was to provide a picture of developments taking place in the country for the non-expert in matters of braking. Elementary considerations of energy absorbtion and the forces acting on a wheel during braking, followed by a concise statement of the limiting factors involved are considered.

Railway Gazette Vol. 112 Jan. 1960, pp 96-97

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1385)
DOTL RP

B2 039680
TUBULAR CONSTRUCTION OF LIGHTWEIGHT STOCK
Experiments with tubular structure under impact conditions revealed that buckling in both circular-and square-section thin-wall tubes under dynamic loading always started at an end, and at high speeds it was largely confined to that part of the specimen. As related to conventional railway-coach structure (where the longitudinal strength resides mainly in the heavy underframe) the tubular structure can absorb more collision energy for a given shortening. Some projections to coach construction are also given.

Railway Gazette Vol. 113 July 1960, pp 93-94

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1397)
DOTL RP

B2 039689
EFFECT OF SPRING TRAVEL, HEIGHT OF CENTER OF GRAVITY AND SPEED ON FREIGHT CAR CLEARANCE REQUIREMENTS ON CURVED AND TANGENT TRACK
This test report discusses the effects of partially loaded freight cars, branch line standards of track maintenance for clearance requirements. The test vehicles were two 70 ton, gondola cars with differing spring travel which were ran on main and branch lines at varying speeds.

Schinke, R
Association of American Railroads Technical Center Tech Rpt ER-28, Jan. 1963, 25 pp, 21 Fig, 3 Tab, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1468)
DOTL RP

B2 039694
TESTS OF HEAD END PASSENGER EQUIPMENT PERMANENTLY ASSIGNED TO FREIGHT SERVICE
Tests were made of three types of baggage cars which have been permanently assigned to freight service, equipped with trucks as described below: 1. Six wheel trucks with outside swing hangers. 2. Six wheel trucks with inside swing hangers. 3. Four wheel trucks with outside swing hangers. These tests were made in buff or squeeze to determine the stability of these cars before and after modification to reduce lateral truck frame to truck bolster clearance to plus or minus 3/8 inch. In the first case, the modified six wheel truck showed a reduction in lateral wheel force to drawbar force ratio of 79%. In the second case, the modified six wheel truck showed a reduction in this ratio of 73% and in the third case, the reduction was 54% for the modified four wheel truck. The modified six wheel trucks produced no skewing. The cars with four wheel trucks did assume a skewed position, but the L/V ratio did not exceed 0.66. All these cars with modified trucks had good stability under all these conditions.

Flebbe, PE
Union Pacific Railroad 0-310-3 340-103-1/413-011/40, 14 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1473)
DOTL RP

B2 039695
TESTS OF F-70-25 MODIFIED AND UNMODIFIED BAGGAGE FLAT CARS
These tests were made to determine the modifications that would be necessary to improve the stability of flat cars redesigned for container service. Preliminary squeeze tests with unmodified trucks resulted in these cars skewing and derailing, indicating that the original 2-1/2 inch bolster to truck frame clearance on each side was too much and should be reduced to at most 1/2 inch on each side. Tests made with instrumented wheels and truck bolsters on both unmodified and modified trucks under these flat cars showed the following: On trucks with unmodified clearance, lateral force of wheel to rail reached 10,000 lbs. with 200,000 lbs. squeeze, resulting in derailment of test car, L/V ratio exceed 0.68. Further tests on unmodified trucks with 450,000 lbs. squeeze developed lateral force of wheel to rail up to 15,000 lbs., resulting in turning rail over and derailing. L/V ratio exceeded 0.68. On trucks with modified clearance, lateral force of wheel against rail reached a maximum of only 2,000 lbs., for an L/V ratio of 0.22. All unmodified cars assumed a skewed position, while all modified cars with restricted bolster to truck frame clearance remained straight in line with axis of track. It was determined that the limitation of the truck bolster to truck frame clearance did not adversely affect the curving ability of the modified car, and rendered the car stable under all tracking conditions.

Flebbe, PE
Union Pacific Railroad 400-310-3/413-011, 22 pp, 1 Fig, 7 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1474)
DOTL RP

B2 039696
DYNAMIC TESTS OF FREIGHT CAR TRUCKS UNDER MECHANICAL REFRIGERATOR CARS 70 TON CAPACITY
The objective of these tests was a comparison of the ride characteristics of the various designs of premium type trucks currently being marketed with the ride characteristics of the AAR standard friction snubbed truck. The trucks tested included: The AAR standard 70 ton, narrow pedestal roller

bearing truck. The XL-70 truck, the Rockwell Express truck, the National Castings Division truck, and the Chevron freight truck. The following conclusions were reached: Vertical forces received by the car body floor were not adequately snubbed or controlled by any of the five trucks tested. Lateral force levels at the car body floor were at a low amplitude with all of the trucks tested with new wheels with the exception of the GSI Chevron truck. Lateral car body force reactions to rail joints and other track irregularities increased materially at higher speeds and when worn wheels were substituted for new wheels, especially with the AAR standard truck and the XL-70 Syminton Wayne truck. The spring plank swing motion arrangement on the National Swing Motion truck showed excellent control of car body lateral force levels, while the Transom linked side frames of the Rockwell Express truck showed acceptable control of these force levels. Vertical and lateral force levels were lowered when speed was reduced, but they did not reach acceptable levels until below 50 mph.

Joint report by Southern Pacific, Union Pacific and Pacific Fruit Express, January 1971.

Pacific Fruit Express, Southern Pacific Company, Union Pacific Railroad Tech Rpt Jan. 1971, 47 pp, 19 Fig, 3 Tab, 10 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1476)
DOTL RP

B2 039699
TRACKING TEST OF AN EIGHTY FIVE FOOT FLAT CAR TRAILER CARRIER ON THE BURLINGTON RAILROAD

The report details an investigation to determine the cause of a derailment of a 85 foot flat car trailer. The investigation showed that high drawbar pull, flat car overhang, short coupler and short overhang of the covered hopper produces a situation suited for derailment. The means to avoid accident prone situations are discussed as well as suggest design changes.

Business confidential not for general distribution or publication.

Ferguson, R
Association of American Railroads Tech Rpt ER-27, Jan. 1963, 26 pp, 16 Fig, 5 Tab, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1479)
DOTL RP

B2 039700
TRACKING TEST OF A FLAT CAR TRAILER CARRIER ON A 6.5 DEGREES AND 12 DEGREES CURVE

This report is concerned with the tracking characteristics and best location in a train of a loaded trailer carrier flat car. Such car have derailed on sharp curves when high drawbar pull is present resulting in the inner rail overturning or tht wheel flange climbing the inner rail. Test results show that situations with these cars can be avoided by avoiding acceleration and high draw bar pull while in curves.

Business Confidential not for general distribution or publication.

Schinke, R Gitlin, I
Association of American Railroads Tech Rpt ER-49, Oct. 1965, 36 pp, 19 Fig, 10 Tab, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1480)
DOTL RP

B2 039701
RUNNING TESTS OF A FLAT CAR TRAILER CARRIER AND A THREE LEVEL AUTO CARRIER ON THE BURLINGTON RAILROAD

This test report discusses the program and results which investigated dynamic action for a flat car trailer carrier and a tri level auto carrier. In addition to the interaction of the cars, clearances, stability and riding quality were also tested.

Association of American Railroads Res Rpt ER-17, Feb. 1962, 59 pp, 44 Fig, 4 Tab, 4 Ref, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1482)
DOTL RP

B2 039918
CAR TEST FACILITY

The article describes a car testing facility to test full size rail vehicles. A comparison between the capabilities of Japanese, British and French test facilities is included with a detailed facility projected by Battelle Memorial Institute, which would provide simulation of actual track conditions with the addition of curves and coupler forces.

Proceedings of 1968 Railroad Engineering Conference.

Voorhees, JE (Battelle Memorial Institute) *Car Design Inputs* Proceeding Sept. 1968, pp 45-51, 18 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1062)
DOTL RP

B2 039919
DYNAMICS OF A STANDARD CAR DURING IMPACT

The purpose of this report is to present data that may be used for comparing rubber type draft gears versus friction type draft gears under identical conditions of impact speed, car structure, and lading. These data also may be used for establishing minimum requirements for affording adequate protection against end shock to freight cars of all types and their lading. Another purpose of this report is to call attention to the fact that the cushioning capacity of any of the A.A.R. certified draft gears, regardless of type, is not sufficient to afford adequate shock protection to freight cars and their lading under the severe conditions of hump yard service. In view of the fact that a limited survey of impact conditions in local hump and flat switching yards showed that 50% of the observed impacts occurred at 6 mph and above, and 28% at 8 mph and above, it can be concluded that neither the friction type draft gear nor the rubber draft gear investigated in this report has adequate cushioning capacity to properly protect freight car and their lading under the severe conditions that are encountered in switching service. The rubber draft gear has considerably more cushioning capacity than the friction gear. Top and bottom bolster cover plates are stressed excessively by impacts above 6 mph. The improvement in cushioning capacity and smoothness of action of the rubber draft gear is due to the elimination of metal-to-metal over-solid limiting stops.

Pullman-Standard Tech Rpt Nov. 1950, 83 pp, 39 Fig, 9 Phot, 3 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1168)
DOTL RP

B2 039921
REPORT OF TEST OF WELEX HYDRAULIC DRAFT GEAR

The purpose of this test was to determine the cushioning qualities of the production model hydraulic draft gear manufactured by Welex Jet Service. The new Welex draft gears have a self-aligning socket plate on the end of the piston rod, which is designed to eliminate any bending forces on the piston rod. A car equipped with Welex draft gears, was used as the striking car throughout the test, being empty for one series of runs and loaded to 169,000 pounds gross weight during the remainder. Car AT-64999, also equipped with Welex draft gears, was used as the struck car during part of the test, and car AT-75377, equipped with reconditioned Minor A-22XL friction draft gears, was used during the remaining runs. Both struck cars were loaded to 169,000 pounds gross weight, and were backed up by six loaded cars with the brakes set, except in a few runs in the series when the striking car was loaded to 169,000 pounds, when the struck car was standing free to roll. A Hathaway electronic oscillograph and amplifier unit were used to record the coupling force, draft gear travel, speed, and longitudinal acceleration during the various impacts. A 16-mm Wollensak Fastax high-speed camera was used to show the draft gear action at impact. It was concluded that the Welex hydraulic draft gear has very desirable characteristics in buff, in that it brings about a marked reduction in coupling forces and accelerations in the equipment at impact. It is not felt, however, that equivalent protection is afforded by the gear in draft or run-out. The Welex gear would give adequate protection to the lading and equipment at switching impacts of 10 miles per hour.

Santa-Fe Railway Tech Rpt Oct. 1971, 41 pp, 25 Fig, 10 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1172)
DOTL RP

B2 039939
WIND-TUNNEL STUDY OF STREAMLINER PASSENGER TRAIN

In the subsonic wind tunnel of the University of Michigan, tests were made in which the six components of aerodynamic force acting on a 1/12 scale model of a car of Train X were measured. The purpose of the tests was to obtain data for calculation of the stability of the train in high winds. Tests

were made on the car by itself and in the presence of other cars. Tests were made with and without rails, and with and without a raised roadbed. Parameters varied in the tests were: (a) angle of yaw of the train to the wind; (b) angle of lateral rail of the car to the horizontal; (c) height of car above ground; and (d) wind-tunnel speed. Tests were also made on a 1/12-scale model of a standard boxcar, to obtain a standard of comparison. The results of the tests are presented in tables and figures.

Lesher, EJ (Michigan University)
Michigan University Tech Rpt M883, Feb. 1951, 48 pp, 29 Fig, 3 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1273)
DOTL RP

B2 039940
STUDY OF FREQUENCIES AND ACCELERATIONS PRESENT IN RAILROAD FREIGHT CARS

A series of tests was conducted to obtain data on vibratory conditions in a freight car and its effect on damage to lading. This type of data is helpful in establishing lading damage index and as a criterion for packaging against vibration. The tests indicated that the vibrations present in the freight cars can be divided into three groups: (a) Those, caused by excitation of the suspension system, (b) Those, caused by excitation of major structural members, (c) Noise and resonance of the structural components. The damaging effect is probably in the same order as mentioned above. It was definitely shown that the accelerations in the cars equipped with A.A.R. 1915 trucks are by far the largest.

Guins, SG Kell, JA
Chesapeake and Ohio Railway Tech Rpt Research Report 13, Dec. 1950, 28 pp, 23 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1275)
DOTL RP

B2 039947
BEHAVIOR OF THE METAL OF RAILS AND SMALL DIAMETER WHEELS

This question is concerned with small diameter wheels on rail vehicles and stresses present which limit wheel diameters. Tests were performed with a derailment test stand and at an actual crossing to measure stresses. The test results were fragmentary and inconclusive.

Question C 53 Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Report ORE Pub No. 25,26, 4 pp, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1325)
DOTL RP

B2 039950
RADIAL-AXLE CARRIAGE BOGIE

British Patent No. 717,965 for the new design of a radial-axle bogie which will permit railway vehicles to negotiate sharp curves at higher speeds with safety, than is possible with bogies having a rigid wheel-base has been granted. The elevation and plan of the six-wheel bogie are shown to describe the design and the arrangement of pivots. The links and pivots are so proportioned that, when the vehicle is negotiating a curve, the axes of the leading and trailing axles intersect at the center of the curve.

Railway Gazette Vol. 103 Oct. 1955, p 423, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1355)
DOTL RP

B2 039971
IMPACT TESTS CONDUCTED ON: A. HULSON HIGH CAPACITY CUSHION UNDERFRAME B. ALL AAR APPROVED FRICTION DRAFT GEARS AND C. ALL AAR FREIGHT RUBBER DRAFT GEARS

The purpose of these tests was to evaluate the various cushioning means available for protecting freight cars against longitudinal forces of impact. All gears were new and taken from stock except one rubber type and one friction type, both of which were shipped direct from the manufacturers. The outstanding performer in this series of tests was that of the Hulson High-Capacity Cushion Underframe. Studies of the detail test records show the average of friction draft gear closure was at a coupling speed of 3.9 mph and all gears were closed at 5 mph when used in fully loaded cars. No closing point was found for the freight rubber draft gears. They continued to operate during the entire range of coupling speeds. It is to be noted that these are the results for new gears and might properly be followed with similar tests on gears that have been in service over a period of years.

Union Pacific Railroad Tech Rpt May 1952, 38 pp, 23 Fig, 4 Phot, 2 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1403)
DOTL RP

B2 039977
COMPARATIVE IMPACT TESTS OF THE HYDROCUSHION UNDERFRAME

The report describes the construction and operation of a Hydrocushion Underframe, discusses some of the aspects of the design of the metering pin and gives a force time diagram produced by impacts at various speeds. While this device has undergone much additional development and redesign, the report has considerable value in understanding the dynamics of impact and means to control its effect.

Mac Curdy, WK
Stanford Research Institute Tech Rept SR1 Project 1648, July 1956, 33 pp, 12 Fig, 3 Ref, 2 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1440)
DOTL RP

B2 039998
PASSENGER RIDE COMFORT ON CURVED TRACK

The objective of this study was to obtain data for formulating recommendations on (1) the permissible speed of rolling stock on curves, (2) the length of transition curves for passenger comfort, and (3) the clearance requirements on curved track. The first test was run on the L&N Railway using the C&O track inspection car and making use of 20 observers to obtain a correlation between passenger reaction and the amount of unbalanced centrifugal force on curves as determined by measurements of the lateral acceleration. Results of this test indicated the importance of the tilting of the car in reducing the effective elevation of the track insofar as passenger comfort was concerned. Results from a second series of tests made it possible to establish a very satisfactory relationship between passenger reaction and the amount of lateral acceleration so that in subsequent tests it was not necessary to use passenger observers. Tests on permissible speed have indicated that for the types of modern equipment having soft springs and no provision for restricting the roll of the car body on curves the present AREA limitation of 3 in unbalance should be continued. Upon this basis the permissible speed on a curve is equal to the calculated equilibrium speed for the actual elevation of the curve plus 3 in. For cars having stiffer springs, outside swing hangers or roll stabilizers reducing the amount of roll with unbalanced elevation, the tests have shown that a permissible unbalance on curves of as much as 4-1/2 in. can be tolerated by the more favorable types of equipment. A new and different procedure is recommended for determining the length of transition curves. The formula recommended, L(sub min) = 4.88 V, gives a minimum length of spiral about 2/3 of that of the present AREA recommendation. However, this should be considered as a minimum length and a longer length is desirable if practical. With respect to clearance the test data gives displacement characteristics due to tilting of the car body on the springs of the various types of passenger cars included in the tests as related to the unbalanced elevation. A method for determining the angle of lean from static measurements of any particular type of car is also explained.

Association of American Railroads Tech Rpt AAR-MR-227, Apr. 1954, 95 pp, 50 Fig, 3 Tab, 9 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1465)
DOTL RP

B2 040000
SPEED OF TRAINS THROUGH TURNOUTS

This report discusses testing by the AAR to determine standard turnouts which would give maximum comfort at maximum speed. Field tests used #24 frogs with 39 ft. switch points at 50 mph and #20 frogs with 30 ft. swtich points at 40 mph. It was concluded that the frog/switch speed combination gave the maximum lateral accelerations expected in high speed running.

Association of American Railroads AAR-ER-14, Aug. 1961, 14 pp, 4 Fig, 5 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1467)
DOTL RP

B2 040015
TRAFFIC IN A CURVE WITH RAILWAY COACHES FITTED WITH INCLINABLE BODIES

Further tests of the pendular type coach have been effected, during which the body has been given a boost to speed up the time taken for it to get the correct inclination when negotiating connecting transition. This is done by means of a hydraulic ram monitored by a accelerometer detecting, permanently, the non-compensated acceleration. Another arrangement is being worked out with a coach for which the axis of oscillation is below the center of inertia of the body. Tests are described which show that it is possible to get a coach to negotiate a curve with 0.3 insufficient cant, which is considerable, by employing assisted pendular motion. The first tests have shown that the assisted pendular motion gives considerably improved smooth riding while negotiating the transition as compared with natural pendular motion.

French Rail News Vol. 3 1970, pp 40-42, 8 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1498)
DOTL RP

B2 040043
CRITERIA FOR TRACK GEOMETRY DESIGN AS RELATED TO MODERN EQUIPMENT

A proposal is being considered for establishing standards for the minimum tangent distance between reverse points of various degrees of curves to permit negotiation of the curves by long, box cars having 68-ft. truck centers and coupler force less than 200,000 lb. A list of tangent lengths with corresponding degrees of curvature are shown.

Hillman, AB *AREA Bulletin* 1970, p 414

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1526)
DOTL RP

B2 040048
STRENGTH REQUIREMENTS FOR SPECIAL CARS TO TRANSPORT 40-FT TRAILERS

The need for a lightweight flat car capable of carrying two refrigerated highway trailers 40 ft. in length is pointed up. The design parameters for such a car are discussed; basic dimensions of 85 ft. length, 8 ft. 6 in. width, and 62 ft. truck centers are established, and the expected static and dynamic forces including those engendered by the use of the trailer hitch on the car structure are analyzed. Three design solutions fulfilling the necessary basic dimensions and strength requirements are described along with subsequent changes which service experience and later testing indicated.

Decker, HL (Pennsylvania Railroad)
American Society of Mechanical Engineers Conf Paper 60-WA-263, Dec. 1960, , pp, 10 Fig, 1 Tab, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1531)
DOTL RP

B2 040070
CAR ROLLING CHARACTERISTICS DATA DEVELOPED BY USSR RAILROAD

The USSR Railroad collected data on car rolling characteristics on two hump yards. Results are expressed in W-Kilograms/Ton resistance and were analyzed in the following groupings: by car weight; by speed of cars; by type of car; by ambient temperature; by weather conditions; for wind velocity. Table I gives effect of wind on rolling resistance for various kinds of cars. The larger discrepancy in flat cars is explained by the varieties of loads carried that would affect frontal area. The tests established that the effect of weather on rolling resistance is not significant. Since variations due to wind and weather were small, these variables were eliminated in development of distribution curves and evaluation of the other variables. By use of statistical methods a mean value and standard deviations were calculated, extreme values eliminated, and a new mean determined. Fig. 1 gives a distribution curve for both yards studied during the summer months. The major number of cars have an average rolling resistance value.

Railroad Transport Vol. 2 1967, pp 21-24, 4 Fig, 5 Tab, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1565)
DOTL RP

B2 040078
DYNAMIC LOADING AT RAIL JOINTS--EFFECT OF RESILIENT WHEELS

This study of a simplified vehicle model passing over an idealised dipped rail joint using values applying to a BR Class 86 locomotive shows that resilient wheels give an equivalent reduction in unsprung axle mass of 2,500 kg. The following conclusions were made: The suggested model for a broadened analysis of the vertical response of vehicle and track at a dipped rail joint is workable and produces dynamic wheel load values which are in full agreement with observed data. Fitting a Class 86 locomotive with resilient wheels will have the effect of reducing the dynamic wheel load increment at severe dipped rail joints by some 40 percent. The effect of resilient wheels on a Class 86 locomotive--based on the dynamic loading at rail joints--is equivalent to a reduction of the unsprung mass from 4,200 kg to 1,700 kg on the leading axle. Thus the results of the analysis suggest that a power-unit comprising axle-hung motors and resilient wheels is a highly competitive alternative to conventional, mechanically complicated and expensive arrangements used to obtain fully-suspended traction motors.

Bjork, J (Svenska Aktiebolaget Bromsregulator) *Railway Gazette* Vol. 126 June 1970, pp 430-434, 9 Fig, 1 Tab, 7 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1574)
DOTL RP

B2 040081
OBTAINING A SMOOTH-RUNNING BOGIE--2

An approach to improve the conventional type truck as used on multiple-unit and locomotive-hauled stock by considering its faults is suggested. The tendency of the bogie to snake can be greatly reduced by guiding both axles rigidly in the frame and so forcing them to remain parallel, i.e., within 0.04 in. by using roller bearings. The second method of attacking hunting is to prevent the whole bogie frame from snaking by deliberately introducing friction to discourage it from rotating slightly about its pivot. The sidebearer friction will rise in step with tire wear and snaking tendency if the sidebearers are greased only once when the tires are profiled.

Railway Gazette Vol. 114 Jan. 1961, pp 74-77, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1577)
DOTL RP

B2 040083
CARRIAGE AND RAILCAR BOGIES: THEIR DESIGN AND DEVELOPMENT--IV

Design factors considered in this part include brake ratios; axle fatigue; adhesion, and P.D. More effective braking will require ratios 1:1.5 to 2.2 of the tare weight, cut back to 0.8 at lower speeds. A routine method of axle fatigue calculation indicating the influence of such design variables as fillet radii, type of vehicle, speeds, whether four-wheeler or bogie, and so on, relating to dynamic load allowance and other factors is long overdue. Adhesion improvement through truck linkage to the body at low level requires care that bogie pitching will not cause high stress peaks at the kingpin or cause intense shuttle of the body.

Koffman, JL (British Railways) *Railway Gazette* Vol. 115 Aug. 1961, pp 216-218, 4 Fig, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1579)
DOTL RP

B2 040084
CARRIAGE AND RAILCAR BOGIES: THEIR DESIGN AND DEVELOPMENT--V

The determination of bolster-spring oscillation amplitudes, swing-link displacements, and their phasing using oscillographic instrumentation can be used for definite assessment of riding qualities. Vibrograph wedge tests permit determination of damping factors. The frequency of lateral/swaying oscillations can be determined by placing the vehicle on a transfer table and imparting an impulse by suddenly stopping the moving table. Similarly, body-nosing can be excited by placing the vehicle on a turntable, the center of gravity of the body being in line with the center of rotation. A sudden stop

of the turntable will then excite body-nosing oscillations at their natural frequency. It should be stressed, however, that as far as vertical body oscillations are concerned wedge tests are not fully representative of road conditions.

Koffman, JL (British Railways) *Railway Gazette* Vol. 115 Sept. 1961, pp 363-366, 8 Fig, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1580)
DOTL RP

B2 040085
SOME ASPECTS OF THE THEORY AND PRACTICE OF DAMPING--II
When mounting dampers across the secondary suspension of a vehicle body pitching and swaying oscillations must be accounted for. The lateral motion on the swinglinks can be damped without difficulty, however, rolling on the bolster springs is difficult to damp with hydraulic units since the frequency of the oscillations is often low (about 0.5 to 0.8 c/s) and the moment arm short. Resonance conditions in the swaying mode must if at all possible be avoided at the operationally important speeds since control by hydraulic damping is unlikely to prove an acceptable solution.

Batchelor, GH (British Transport Commission) *Railway Gazette* Vol. 115 Dec. 1961, pp 628-630, 2 Fig, 9 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1581)
DOTL RP

B2 040093
SIDE THRUST ON TRACK AT HIGH SPEEDS
Measurement of lateral forces on wheels and track for high speed running on the Tokaido line were carried out in two different ways; by measuring and recording the stresses in the wheels of an inspection test car, and by measurements on the track. These measurements were made for speeds up to 150 mile/h.

Railway Gazette Vol. 121 July 1965, pp 529-530, 3 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1589)
DOTL RP

B2 040097
VEHICLE RIDING CONVENTION
The convention on interaction between vehicle and track convened by the Railway Engineering Group of the Institution of Mechanical Engineers consisted of four sessions at which 10 papers were read: "An Appreciation of the Practical Problems--a Survey of the Problems and their Importance," "Some Observations on Linear Theory of Railway Vehicle Instability," "The Dynamics of Railway Vehicles on Straight Track: Fundamental Considerations on Lateral Stability," "Dynamics of Railway Vehicles on Curved Track," "Hunting Problem of High-Speed Railway Vehicles with Special Reference to Bogie Design for the new Tokaido Line," "Track Parameters Static and Dynamic," "The Influence of Track Twist on Vehicle Design," "The Static and Dynamic Parameters of Railway Coaches."

Railway Gazette Vol. 121 Nov. 1965, pp 913-916, 3 Fig, 1 Tab, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1593)
DOTL RP

B2 040101
LAMINATED SPRING FRICTION
The advantages and disadvantages of using properly designed laminated springs for rolling stock are explored. Attention is focused on the static aspects os spring friction, the effect of twisted track on vehicle performance, derailment tests and performance characteristics of laminated and helical springs.

Koffman, JL (British Railways Board) *Railway Gazette* Vol. 120 Apr. 1964, pp 279-284, 11 Fig, 11 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1597)
DOTL RP

B2 040105
TRACTIVE RESISTANCE OF ROLLING-STOCK
An examination of the resistance of modern British Railways vehicles is made. This study is subdivided into resistances caused by track irregularities, bearing friction, wheel rolling resistance, total rolling resistance, rail joint resistance, parasitic motion resistance, sinusoidal motion, wheel contact, flange to rail clearance, suspension oscillation resistance, and damping characteristics. Dynamometer readings were taken from field tests.

Koffman, JL (British Railways Board) *Railway Gazette* Vol. 120 Nov. 1964, pp 899-902, 5 Fig, 2 Phot, 13 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1601)
DOTL RP

B2 040108
TRACTIVE RESISTANCE OF MODERN B.R. ROLLING-STOCK
The effects of curved track, air resistance, transmission, torque distribution, car design, and welded track on tractive resistance are studied. The tractive resistance for diesel-electric and diesel-hydraulic locomotives is shown. From the data presented, it is concluded that designers must be concerned with the finer points of vehicle and track interaction in terms of static and dynamic track parameters, tire and rail design, flange to rail clearance and the matching of vehicle design features with the suspension and damping characteristics to reduce tractive resistance.

Koffman, JL (British Railways Board) *Railway Gazette* Vol. 120 Dec. 1964, pp 1028-10, 31

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1604)
DOTL RP

B2 040113
SOME ASPECTS OF BOGIE PITCHING
The desire to increase passenger comfort makes it necessary to pay careful attention to the effects which bogie pitching can have on body oscillations. The general aim is to use dampers between axlebox and bogie frame which would be equally effective in compression and expansion because pitching takes place symmetrically and regularly about the lateral axis. Proprietary hydraulic dampers are theoretically the most suitable to deal with these oscillations provided the correct characteristic has been determined, produced, and maintained. Body and bogie primary suspension oscillations with and without auxiliary friction dampers are shown for a passenger coach travelling at 70 mph. The beneficial effect of the friction damper reducing the magnitude of the fore and aft accelerations is apparent.

Koffman, JL (British Railways Board) *Railway Gazette* Vol. 122 July 1966, pp 574-576, 2 Fig, 1 Phot, 5 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1609)
DOTL RP

B2 040116
RUNNING THROUGH CURVES
Simple methods for the determination of forces and wear are discussed. Flange forces are determined by constructing a Heumann Minimum Diagram of the friction moment curve. A Vogel diagram is plotted to show the center line of the vehicle in a curve. The center of friction is located mathematically in the Vogel diagram. Axlebox clearance values are determined from the diagrams and corresponding force diagrams are plotted.

Koffman, JL (British Railways Board) *Railway Gazette* Vol. 123 Apr. 1967, pp 307-311, 7 Fig, 1 Tab, 27 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1612)
DOTL RP

B2 040117
PRACTICAL RESEARCH INTO VEHICLE DYNAMICS
Stability theory is evaluated by running an experimental car, HSFV-1, on a roller rig and on the track. The underframe and drawgear is standard, and the suspension is designed for an unladen weight of 10 tons and a laden weight of 35 tons. The wheel profiles conform to the RD6 profile. The first tests consisted of vertical and lateral damper tests; vertical and longitudinal spring stiffness tests; accurate turning and measurement of wheel and roller rig profiles; measurement of masses, moments of inertia and centres of mass;

and, re-assembly of vehicle, checking and correction of dimensions. The next step was to measure the natural modes and frequencies of the vehicle, again with wheels fixed, in the frequency range 0 to 10 c/s. The longitudinal springs were modified for stability tests. The vehicle was completely stable up to a speed of about 100 mile/h, where wheelset instability occured. The purpose of initial track tests was to confirm that the lateral stability of the vehicle on the track was satisfactory and consistent with the roller rig tests, and to measure the response of the vehicle to track irregularities. The results and techniques established by the work on HSFV-1 are applicable to all railway vehicles.

Wickens, AH (British Railways) *Railway Gazette* Vol. 123 June 1967, pp 467-469, 4 Phot, 15 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1613)
DOTL RP

B2 040118
THE TORSIONALLY STIFF BOGIE WAGON

Torsional stiffness is an important factor bearing on the ability of vehicles to run over twisted track. Results of British Railways tests of tank cars with tare of 26 to 28 tons and 41.75 ft. truck centers are described. Track twist varied from 1 in 400 to 1 in 150. The design limitations for wheel load is calculated. Suspension changes to eliminated derailment tendencies are discussed.

Koffman, JL (British Railways Board) *Railway Gazette* Vol. 123 Aug. 1967, pp 629-632, 4 Fig, 2 Phot, 6 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1614)
DOTL RP

B2 040120
RELATION BETWEEN TRACK IRREGULARITIES UNDER TRAIN LOADS AND NO LOAD

Track irregularities were measured under train load conditions using a new high speed inspection car, Maya 341. The sizes of the irregularities were compared with the sizes measured under no load conditions with a light weight, Yoshiike type, inspection car. A unique rule connecting measurement under load versus no load conditions could not be formulated. Relationships are established for load versus no load conditions in a mathematical model.

Ikemori, M *Railway Technical Research Institute* Vol. 4 N2 June 1963, pp 48-50, 4 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1616)
DOTL RP

B2 040123
THE DYNAMIC STABILITY OF RAILWAY VEHICLE WHEELSETS AND BOGIES HAVING PROFILED WHEELS

The dynamic instability of railway vehicle bogies and wheelsets is caused by the combined action of the conicity of the wheels and the creep forces acting between the wheels and rails. The instability is investigated in the important case where the wheels are profiled rather than purely conical. Equations of motion are formulated and stability criteria obtained which indicate the effect of varying the various parameters of the system. The nature of the motion at the critical speed is investigated and the mode of energy conversion between the forward motion of the vehicle and the lateral motion of the bogie or wheelset is explained.

Wickens, AH (British Railways Board) *International Journal of Solids and Structures* Vol. 1 1965, pp 319-341, 8 Fig, 25 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1619)
DOTL RP

B2 040124
THE DYNAMICS OF RAILWAY VEHICLES ON STRAIGHT TRACK: FUNDAMENTAL CONSIDERATIONS OF LATERAL STABILITY

Existing and recently developed theories of the lateral motion of railway vehicles are discussed in relation to experimental work on both models and full-scale vehicles. It is shown that a realistic theory taking into account flexibility between the wheelsets and the frame in the longitudinal, lateral, and vertical directions, and the influence of wheel and rail profiles, yield values for the critical speeds which are consistent with experimental results. The influence of various parameters on stability is discussed and it is explained how railway vehicles can be designed for stable running at high speeds. Examples of suitable choices of suspension and other parameters are given and experiments carried out in order to verify these concepts are described.

Proceedings from the Institution of Mechanical Engineers

Wickens, AH (British Railways Board)
Institution of Mechanical Engineers Proceeding Vol. 180 pp 29-44, 10 Fig, 3 Tab, 4 Phot, 27 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1620)
DOTL RP

B2 040126
COMBINED EFFECT OF FRICTIONAL AND ELASTIC MOMENTS AGAINST TRUCK TURNING UPON HUNTING OF TRUCK

The hunting of a truck is analyzed theoretically and a numerical calculation for an actual example is made to provide the data on truck design. By a numerical example, combined effect of friction and rigidity against truck turning upon the hunting speed was investigated and was checked by analog computation. The spring action against truck turning plays the leading role to increase the hunting speed and the frictional resistance plays an important supporting role to make the spring action effective to the range of a large amplitude though the friction itself has no action to prevent truck hunting. In order to determine appropriate magnitudes of these factors, the supporting stiffness of the axle with respect to the truck frame should be taken into consideration.

Matsudaira, T Arai, S Yokose, K *Railway Technical Research Institute* Vol. 7 N3 1966, 6 pp, 9 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1622)
DOTL RP

B2 040127
TESTS OF EFFECT OF BALANCED WHEELS ON PASSENGER CAR RIDE PERFORMANCE

The test of balanced wheels in Car 20 of the Pere Marquette Steamliner indicated that the ride can be improved by using balanced wheels. Actual balancing of the wheels and the tests on the road show that if new wheels are statically balanced after they are finish-bored and ready to be pressed on the axles, they will give a good ride up to 100 m.p.h. For higher speeds closer balancing will be required. The amount of unbalance of new wheels should not exceed 3 ft. lbs. Closer balancing is not economically justifiable and will not improve the ride comfort. The ride quality was measured with accelerometers at train speeds of 40 to 90 m.p.h.

Guins, SG (Chesapeake and Ohio Railway)
Chesapeake and Ohio Railway Test Rpt No 5, May 1948, 12 pp, 3 Fig, 1 Phot, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1623)
DOTL RP

B2 040128
THE DRAG OF RAILWAY CARS OF NEW DESIGN

The air resistance characteristics of two train configurations, one of modern, conventional design and the other aerodynamically designed to reduce drag, were determined from train models. The lower drag of the new design was due to the reduction in total surface area, to the important improvement in underbody design including the recessing of trucks and wheels, to the removal of the many appurtenances on the tops and sides of the cars, and the reduction of wake drag. Not only was the absolute drag reduced, but the tests showed that the rate of change of drag with velocity was considerably less for the new design than for the conventional train.

Burlage, H, Jr (Case Institute of Technology)
Chesapeake and Ohio Railway Test Rpt Dec. 1954, 35 pp, 9 Fig, 6 Phot, 5 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1624)
DOTL RP

B2 040134
THE GENERAL 70, A NEW FAMILY OF TRUCKS FOR RAPID TRANSIT, COMMUTER AND MAIN LINE EQUIPMENT
The development is described of an improved passenger-car truck concept arrived at meeting the equipment requirements of future rapid transit and commuter systems. The new arrangement is designed to provide an optimum combination of low cost, light weight, good riding qualities, overall stability and flexibility. Numerous photographs of the trucks are included.

Lich, RL (General Steel Industries, Incorporated)
American Society of Mechanical Engineers Conf Paper 63-WA-331, Nov. 1963, Assistant, Vice Presi, dent-Engin, eering

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1634)
DOTL RP

B2 040143
ADAPTING THE AUTOMATIC COUPLER TO FUTURE DEVELOPMENTS ON THE RAILWAYS
Consideration is given to certain desires and requirements of the railways for the development of the fully automatic coupler, which will not only serve as a coupling, but also will absorb the buff between cars, and make the pneumatic and electrical connections as well. This coupler must be adaptable to use with other designs of center couplings. the opening and closing of cut-out cocks on the air lines is to be automatic, actuated by coded signals from the locomotive or the train yard. Consideration must be given to operation with container cars, where overhanging must be limited. The desired coupler travel will have to be determined. A description of the "Eurocoupler 1968" is included. [German]

Bobbert, G (Salzgitter AG) *Eisenbahntechnische Rundschau* Vol. 18 N Mar. 1969, pp 94-97, 2 Fig, 2 Phot, 3 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1642)
DOTL RP

B2 040144
DEVELOPMENTS BY THE MASCHINENFABRIK AUGSBURG-NUERNBERG A.G. IN AIR SPRUNG TRUCKS FOR RAIL VEHICLES
With increased train speeds on existing track structures, designs of truck suspension systems, which would permit higher speeds on curves by tilting the coach inward to compensate for the centrifugal force, have been designed and tested recently. An important factor in such designs has been the development of air-spring suspension systems for the trucks, which are described. [German]

Kayserling, U (Maschinenfabrik Augsburg-Nurnberg A.G.) *Eisenbahntechnische Rundschau* Vol. 18 N Apr. 1969, pp 127-133, 2 Fig, 7 Phot, 3 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1643)
DOTL RP

B2 040148
STUDIES ON INTERVAL DISTANCE BRAKING WITH PRIMARY AND SECONDARY RETARDERS IN THE HUMP INSTALLATIONS IN TRAIN YARDS
One important problem of the automation of train hump yards is the automatic control of the speed of all cars in the distribution track zone between the hump and the last of the distribution switches. The results of the studies of this problem are described, which the Swiss Federal Railways researched with the aid of their Computer-Program. The basic observations of the free-running of cars in the distribution zone were considered, which required the distinction between "free-rollers" and "hard-rollers". To equalize this situation, the "hard-rollers" required acceleration and the "free-rollers" required deceleration or braking. In addition, the basic considerations of braking in the distribution zone required studies to attain the desired speed interval braking of the various types of rolling cars. A detailed description of the programmed braking is given, as well as its application to these hump yard operations. [German]

Koenig, H (Bauabteilung der Generaldirektion derr SBB) *Eisenbahntechnische Rundschau* Vol. 19 N No. -2, Feb. 1970, pp 13-20, 3 Fig, 2 Tab, 6 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1648)
DOTL RP

B2 040154
SOME PROBLEMS IN VEHICLE RIDING
This is an integrating paper, which seeks to survey the field. It emphasises that sound suspension design only meets part of the problem, and refers to the many aspects of mechanical inter-action and wear which are just as important. The practical application of the theoretical and development work which has been undertaken by a number of groups on British Railways is described, and six particular riding problems are analyzed and the steps taken to deal with them are outlined.

Cox, ES (British Railways) *Institution of Locomotive Engineers Journal* Vol. 51 N No. 83, PAPER NO. 625, pp 574-659, 14 Fig, 6 Tab, 14 Phot, 18 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1672)
DOTL RP

B2 040157
TRUCK TO DETERMINE TRUCK ACTION
Static effects of warped track surface in causing derailments under varying truck conditions are measured. The tests were confined to the determination of the amount of depression or super-elevation in the outside rails of curves, measured in terms of track warp in a distance equal to that between the truck centers, required to cause derailment of a box car of rigid body construction which had a total weight of 82,000 lb., and to the determination of the turning resistance of trucks under various conditions. The results of the tests are shown in the table. They indicate that center plate resistance is not the major factor in the resistance to turning, which must be overcome by rail pressure at the flange, under the truck conditions prevailing when such turning is normally required. The flange pressure required to turn the truck on level track ranges approximately from 600 to 1,000 lb. with center plates greased. Forces greater than these are the result of side-bearing friction caused by the tilting of the center plate in the bearing as the side bearings on one side of the truck are brought into contact. The results do not indicate that the presence of graphite or grease on these center bearings had any consistent influence on total truck resistance under track conditions which bring the side bearings into action.

Railway Age Vol. 85 N No. 7, Oct. 1928, pp 798-800, 1 Tab, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1883)
DOTL RP

B2 040169
LATERAL OSCILLATIONS OF BOGIE BOLSTERS
It is imperative to break away from the adherence to general recipes regarding spring rates and swing link angles of inclination often regarded as a universal panacea against ailments generally diagnosed as "bad riding." Vertical leaf springs succeed only in increasing the lateral centering force thus reducing the effective length of the swing link arrangement and increasing its natural frequency, inadvertently acting as swing link spoilers. So far as design layouts are concerned detail components should be used along rational lines, each component being allowed to perform the basic function allotted to it. Thus swing links should be permitted to swing and dampers used to ensure damping. Excessive body amplitudes sometimes encountered with some designs can be controlled with the aid of lateral centering springs preferably with a non-linear characteristic and here suitably shaped rubber units can be of great help.

Koffman, JL (British Railways) *Railway Gazette* Vol. 112 No. 9, Feb. 1960, pp 245-250, 7 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-650)
DOTL RP

B2 040171
PERMISSIBLE SPEED OF FREIGHT CARS ON CURVES
In Part I, the dynamic effects due to lateral roll motion of a freight car are analyzed and the position of the resultant dynamic force with respect to center line of track for cars having 71, 85 and 99 inches combined center of gravity heights is calculated. These calculations use data on the amplitudes of the lateral roll motion of a fully loaded 70-ton 55-ft gondola which were measures during an extensive series of running tests on the Lackawanna Railroad in 1955. In Part II, calculations, based on extensive tests with freight cars having center-of-gravity heights of 71, 85 and 99 in with 3 11/16 in travel springs and conventional snubbing, were used to establish the

elevation for curves and maximum permissible speeds for the operation of freight trains.

American Railway Engineering Association Vol. 70 1969, pp 1019-10, 29

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-697)
DOTL RP

B2 040180
DYNAMIC TEST OF 10TH SCALE "TRAIN X" CAR MODELS
Test were run to establish the type of vibrations that could be expected in the full scale cars at various speeds and to control those that would be considered undesirable. The tests proved the undesirability of using parallel tie-rods as originally proposed and indicated that a 4 degree toe-in is desirable as it prevented any self-excited vibrations. Use of lateral damping to prevent resonance due to forced vibration produced by rail joints was also indicated. These features were then incorporated in the designs of full scale cars.

Guins, SG Kell, JA Duppstadt, EN
Chesapeake and Ohio Railway Res Rpt 49 RESEARCH RPT NO 14, 79 pp, 4 Fig, 1 Tab, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1548)
DOTL RP

B2 040183
IMPACT TEST OF C.&O. RY.CO. 70-TON GONDOLA CAR WITH FLOATING PALLET CAR NO. 218924
The object of these tests was to determine reduction in end shock transmitted to lading, obtained with installation of floating pallet and rubber draft gears in a standard gondola car. The test car was loaded with 95,840 pounds of rolled steel sheet to a total car weight of 170,140 pounds for all tests. The striking car was a 70-ton gondola loaded with heavy steel scrap to a total weight of 210,940 pounds and was equipped with friction draft gears. Impacts were started at 2 mph and speeds were increased in 2 mph increments. Tests were continued in each series to a point where the shocks on the pallet attained a force approximately equivalent to six times that of gravity. Peak acceleration records with the peaks corrected for frequency were used to intrepret accelerometer shock records. It was found that the shock transmitted to lading in a gondola car with floating pallet and rubber draft gear was approximately the same at 8 mph as the shock in a standard car with friction draft gear at 4 mph, thus four times as much energy was absorbed by the experimental car.
Company Report

Kell, JA (Chesapeake and Ohio Railway); Sammet, EH
National Malleable and Steel Castings Company PROJECT J-9706, Jan. 1955, 24 pp, 9 Fig, 1 Tab, 4 Phot, 6 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1551)
DOTL RP

B2 040186
ROAD TEST OF BOX TYPE BAGGAGE CARS B&O SERIES 1700 AND 1800
At a test speed of 55 mph the cars exhibited stable ride characteristics. At 60 mph an increase in lateral and vertical motions were noted. At 70 mph the cars become erratic and a definite bounce mode could be noticed. In several instances over one stretch of the test area wheel unloading was experienced on the car equipped with freight trucks. It was concluded by all those present that these cars should be restricted to a maximum operating speed of 60 miles per hour.
Letter Correspondence.

Burns, JE
Chesapeake and Ohio Railway FILE 540, May 1970, 2 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1554)

B2 040187
ROCK OFF DERAILMENTS
A tabular summary of rock-off derailments indicating curvature, elevation, velocity and cause is provided for about 30 accidents.
Unpublished Report

Baltimore and Ohio Railroad, Chesapeake and Ohio Railway 5 pp, 5 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1555)
DOTL RP

B2 040190
SD TRUCK PERFORMANCE ON THE BALTIMORE & OHIO RAILROAD AND RELATED WHEEL WEAR ON THE CUMBERLAND DIVISION
This test program was designed to determine the causes of excessive rail wear and associated wheel flange wear, and derailments involving SD-35 locomotive units, which resulted during operation of the first SD-35 units on coal trains between Grafton and Terra Alta, W.V. The test program was to measure the actual wheel-to-rail lateral loads and the associated truck motions under all possible operating conditions. Also, wheel wear tests were run on standard wrought steel and new cast steel wheels as a first step in an effort to find a better wear resistance wheel. Test results are reported and recommendations are made.

Marta, HA
General Motors Company Test Rpt 128, Dec. 1966, 165 pp, 54 Fig, 10 Tab, 11 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1625)
DOTL RP

B2 040194
ON THE RELATION BETWEEN SUPERELEVATION AND CAR ROLLING
Weighting function of the track inspection car for rolling is obtained by random data analysis and this weighting function is verified practically. Some applications of this function are shown.

Nakamura, I (Japanese National Railways)
Japan Railway Civil Engineering Association Vol. 9 N1 Dec. 1961, pp 10-16, 14 Fig, 5 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1653)
DOTL RP

B2 040195
VEHICLE SUSPENSION AND BOGIE DESIGN IN RELATION TO TRACK CONDITIONS
The relationship of vehicle suspension to track conditions is expressed analytically. Significance of coning lies in its property to transmit and magnify the effects of track misalignment to the vehicle body. This effect will become greater as tread wear develops. In the event of build-up of wheel movement, flang-climbing and bogie hunting oscillations may occur. The effects of conicity can be reduced in new designs by the provision of positive guiding of axles by means of telescopic or other guides, together with roller bearing boxes and wheels having a minimum of coning, to avoid running against one rail. Frictional effects of laminated springs and suspension links transmit shock vertically and laterally from the track, and the elimination of such friction is desirable and beneficial. Suspension link length is important, and an increase in length will diminish the transmitted shock. A relationship has been established between track shape and vehicle response, which may be applied by a special application to an analog.

Hancock, RM (British Railways) *Institution of Locomotive Engineers Journal* pp 457-565, 35 Fig, 10 Ref, 6 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1654)
DOTL RP

B2 040196
VEHICLE DYNAMICS AND WHEEL-RAIL INTERFACE PROBLEMS
This paper reviews problems of wheel-rail contact in terms of present knowledge of the conventional steel-on-steel system and on possibilities for research and innovation arising out of extensions to this present knowledge. Specific directions for research suggested are: experimental work on wheel-rail contact forces, followed by refinements of theory to include effects such as surface chemistry, surface roughness and unsteady motion; studies of new structural forms for wheels and rails which might yield a superior overall system design; investigation of the wear-vehicle dynamics feedback process for steel wheels on steel rails, particularly where there are radical changes in vehicle suspension design; and studies of various wheel-track kinematic and guidance systems to provide basic information for overall system design.

Wickens, AH (British Railways Board) pp 157-171, 11 Fig, 34 Ref
ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1655)
DOTL RP

B2 040198
THE RIDING OF RAILWAY VEHICLES
Some of the basic facts are outlined for the definition and control of vibration and shock in railway vehicles and their loads. The action of conic wheelsets and the kinematic motion of wheelsets are clearly illustrated and describe the hunting principle. A laterally restrained wheelset connected to a high inertia vehicle body by perfectly elastic lateral springs is described and the stability criterion is shown. These theories are then applied to the analysis of railway vehicle stability and response.

Wickens, AH (British Railways Board)
Society of Environmental Engineers Proceeding 1963, pp 39-44, 13 Fig, 5 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1658)
DOTL RP

B2 040199
THE RIDING QUALITY OF A TRAIN PASSING A CURVE AS DETERMINED BY SUPERELEVATION AND CENTRIFUGAL FORCE
The relationship is clarified between the riding quality and a lateral acceleration on a curved track. The opinions were polled of 50 persons who took part in the test by riding a test train and the findings were correlated with different degrees of lateral acceleration. Thus, the limit of excessive acceleration on curved tracks was examined from the standpoint of riding quality.

Koyama, M (Japanese National Railways) *Permanent Way* Vol. 11 N Jan. 1963, pp 19-25, 6 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1657)
DOTL RP

B2 040200
HOW HIGH CAN TRAIN SPEED BE INCREASED? A REVIEW OF PRESENT AND FUTURE
The effect of wave propagation in air and on the rail is discussed as a theoretical limit for train speed. As practical limits to speed, the deflection by the pantograph to the wire at point of contact is described. By this principle the critical speed of the New Tokaido Line (NTL) train has been calculated as 400 km/h. Adhesion force is plotted versus tractive resistance for a 12-car NTL train, which gives the limit to speed as 370 km/h. Vibration limits speed to 230 km/h on straight track due to passenger comfort. The problems concerning curved track are also briefly discussed.

Matsudaira, T (Japanese National Railways) *Japanese Railway Engineering* June 1966, pp 131-134, 5 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1659)
DOTL RP

B2 040217
WHEEL, AXLE, AND RAIL STRESS PROBLEMS RELATED TO HIGHER CAPACITY CARS--PART IV-EFFECT ON RAIL
Those items that have been found advantageous in reducing shelling caused by higher capacity (85 to 100-ton) cars are wheel loads should be limited in proportion to wheel diameter. Higher strength material in the rail will greatly reduce shelling but not entirely eliminate it (under the wheel loading conditions existing with 70-ton capacity cars before the allowable load was increased 5%). Modified rail head contours in today's modern rail sections which approach the average worn wheel condition, have been helpful in reducing shelling. Rail lubrication on curves extends the rail life but results in the removal of more rails for shelling rather than abrasive wear.

Stampfle, RB
American Society of Mechanical Engineers Paper Nov. 1963, 13 pp, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1680)
DOTL RP

B2 040220
RESEARCH ON THE OPERATING STRESSES IN PATH RAILCAR AXLES, DRIVE SYSTEMS, WHEELS, AND RAIL JOINTS
This paper identifies the cause of premature cracking of axles with inboard bearings as being the bending-mode oscillation of the axle. It points out the importance of gear-tooth separation produced by torsional oscillations in the drive motor system in both right angle and parallel drive gear failures. A unique technique of simultaneous measurement of impulse and thermal loads on the wheel tread is explained and the test data are presented. The relation between the wheel impact loads and the dynamic behavior of rail joints is shown.

Yontar, M (New York Port Authority :)
American Society of Mechanical Engineers Conf Paper 66-RR-6, May 1966, 21 pp, 33 Fig, 2 Phot, 36 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1683)
DOTL RP

B2 040225
A COMPUTER PROGRAM FOR DETERMINING THE EFFECT OF DESIGN VARIATION ON SERVICE STRESSES IN RAILROAD WHEELS
Two computer analyses have been prepared relating service stresses in railroad wheels to wheel shape and dimensions. One program computes the temperature distribution and stresses due to heat input by brake shoe friction at the wheel tread. The other computes stresses due to lateral, vertical, and tractional forces between the wheel and rail. Both programs have been validated for certain known conditions using theoretical solutions and are in agreement with available design and experimental stress data to the degree that differences in wheel geometry and loading conditions permit a comparison with experimental stress data. The next step contemplated is better experimental confirmation by computations for specific wheels and loadings for which test results are available and use of the programs to study trends resulting from changes in wheel geometry and dimensions. This work is directed toward optimization of wheel design, and elucidation of the nature and specific effects of excessive service loads.

Riegel, MS (American Iron And Steel Institute); Levy, S Sliter, JA (General Electric Company) *ASME Journal of Engineering For Industry* RR-1 Paper No 65-WA/, Nov. 1965, pp 6, 8 Fig, 22 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1689)
DOTL RP

B2 040233
THE TRANSPORTATION ENVIRONMENT
Rail shipping is compared to truck shipping. In both cases the over-the-road environment is characterized by a continuous low amplitude vibration with random and periodic shock type inputs superimposed. The basic periodic inputs are rail joints for rail transportation and expansion joints for highway transportation. The random inputs for rail transportation are road crossings, bridges, switches, railroad crossings and the like. For highway transportation, the random inputs are railroad crossings, bridges, pot holes, etc. The continuous low level input is what creates resonant damage to products. The shock inputs create the dented, crushed, and broken hinge type of damage. Both types occur in both modes. The environment is divided into natural frequencies of vibration, vertical accelerations, shock spectra, impact forces and lateral acceleration, the magnitude of which is displayed graphically.
Received From General Motors Corporation Technical Center

Luebke, RW
Chesapeake and Ohio Railway, Baltimore and Ohio Railroad Conf Paper Mar. 1971, 22 pp, 12 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1697)
DOTL RP

B2 040244
COOPERATIVE FREIGHT CAR TRUCK AND SNUBBER RESEARCH PROGRAM
This item consists of the conclusions and four appended reports to MR114. It was found that in trucks with all-coil springs without snubbers, the best performance was obtained with 1 5/8" spring travel. All snubbing devices tested provided definite improvement in riding quality over that provided by

unsnubbed springs. None of the fifteen Unit Snubbers tested provides performance considered satisfactory to a speed of 65 mph. Five of the eleven Package Snubbers tested provide performance considered satisfactory ("fair") to a speed of 90 mph. Two of the three Modified Conventional Trucks tested provide performance considered satisfactory ("fair") to a speed of 90 mph. These two trucks are as follows: HOLLAND RS-8 with 2 1/2" springs and HOLLAND RS-8 with CESD springs. Twenty-eight of the thirty-five High-Speed Trucks tested provided performance considered satisfactory to a speed of 90 mph. The appendices includes reports of studies on the performance of solid-type journal bearings, roller bearing research, lateral action of freight car trucks and accelerometer performance and side frame stress.

First 12 pages of report missing.

Association of American Railroads AAR MR-114, June 1951, 13 pp, 1 Fig, 5 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1708)
DOTL RP

B2 040270
COMPARISON OF CAR STABILITY AND TRUCK CONDITION--100 TON LOADED COAL HOPPER CARS

Tests were conducted in the Hollidaysburg, Pa. yard, of modified and unmodified Class H-43 Hopper cars on tangent track and on a 2 degree curve having 4 inches superelevation, subsequently changed to 5 and to 6 inches. Track surface was warped to predetermined amounts. Results of selected test runs have been tabulated to show the effect of speed, superelevation and increase in number and severity of successive uniform changes in cross level on the stability of these cars. The H-43 cars can negotiate an indefinite succession of uniform changes in cross level, regardless of interval or speed. Elevation in excess of 6 inches should be corrected regardless of uniformity.

Unpublished Data.

Penn Central Company Jan. 1967, 11 pp, 10 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1739)
DOTL RP

B2 040296
REPORT TESTS OF STABILITY OF 100 TON CAPACITY HOPPER CARS UNDER VARIOUS TRACK CONDITIONS HOLLIDAYBURG, PA.

Tests were started in June 1966 and completed in January 1967. No. 14 track, approximately 3600 feet in length, including 1000 feet of two degree curve, was selected as a suitable test site. Tangent track test runs were made with the track warped successively at intervals of 19'-6", which is normal joint stagger for 39 foot rails, and intervals of 31 and 39 feet. Curve track tests were made with the track warped at 19'06" and 15'-6" intervals. The modified H43 loaded hopper car and the H46 loaded covered hopper car should satisfactorily negotiate an indefinite succession of cross level changes in opposing directions of 1-1/2 inches in tangent track, 1 inch on curves with no more than 5 inches of superelevation and 1/2 inch where the superelevation exceeds 5 inches, regardless of speed. Continuous succession of cross level changes limits speed to 15 mph. The unmodified H43 loaded hopper car should satisfactorily negotiate an indefinite succession of cross level changes in opposing directions of 1 inch in tangent track, but not more than 1/2 inch on superelevated curve track regardless of speed. Continuous succession of cross level changes limits speed to 10 mph.

Hammond, WT Dixon, LA
Penn Central Company Test Rpt 4 pp, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1769)
DOTL RP

B2 040297
LETTER ON PERFORMANCE OF HYDRAULIC "A" SNUBBERS

Hydraulic "A" snubbers were tested on the AAR test track. Charts show the measured roll angle and lateral acceleration at the center of gravity with respect to speed. Wheel lift was observed on a number of runs and on two runs the flange climbed up on top of the high rail. Charts of several other runs without the Hydraulic "A" snubbers are included for comparison.

Unpublished Data.

Magee, GW
Association of American Railroads Technical Center July 1968, 5 pp, 3 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1770)
DOTL RP

B2 040298
SPECIFICATIONS FOR TESTING SPECIAL DEVICES TO CONTROL STABILITY OF FREIGHT CARS

These specifications cover testing and performance requirements for trucks or other special devices to control car stability for application to freight cars with 4-wheel trucks having 6.5" times 12" journals or larger with loaded center of gravity 84" or higher above top of rail. The tests shall be conducted using a 100-ton high center of gravity hopper car on 4-wheel trucks. This test will be run over a track section with a superelevated curvature especially prepared with low joints. Instrumentation for the test car is described.

Association of American Railroads Technical Center Specs 1969, 4 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1771)
DOTL RP

B2 040299
CHARTS OF SELECTED TEST RUNS ON AAR TEST CURVE ON LOUISVILLE AND NASHVILLE RR

Lateral acceleration and roll angle are shown for test runs on the AAR test track. Three and six inch elevations, and 0.5, 0.25, and 0.34 inch shims were used. The vehicles had 2.5 or 3.7 inch springs, and in one test, volute snubbers and widened gibs. Wheel lifts were recorded.

Unpublished Data.

Association of American Railroads Technical Center 8 pp, 8 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1772)
DOTL RP

B2 040300
ROLLER BEARINGS FREIGHT CAR SERVICE

The use of roller bearings on freight cars is justified on the basis of reduced maintenance and inspection time and derailment expense. The fitting of roller bearings to cars already in service is discussed. The coasting characteristics of roller bearing cars in hump yards and the rolling resistance of these cars in train starting are compared to plain-bearing cars.

Horger, OJ (Timken Roller Bearing Company, Incorporated)
Car Foremen's Association Conf Paper Mar. 1949, 13 pp, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1781)
DOTL RP

B2 040306
A VIBRATING RIG TEST FOR RAILWAY BEARING GREASES

A test rig utilizing a standard reaction type vibration test machine was developed to determine the consistent stability of grease lubricants in anti-friction bearings. This program was undertaken in view of the ever increasing demands upon greases in railway service and also the lack of direct correlation among performance characteristics obtained through existing standardized bench tests, full scale rotational tests lacking vibration, and those characteristics displayed in the field. General performance of the products tested appeared to be insensitive to the parameters of vibration within the range of parameters occurring in service. A 48 hours test which subjects the test cartridge to 4 G's at 38 cps with the grease bulk temperature thermostatically controlled at 180 F emerged as the condition which yielded results duplicating field service conditions.

Lieser, JE West, CH
Timken Roller Bearing Company, Incorporated Conf Paper May 1968, 10 pp, 4 Fig, 4 Tab, 6 Phot, 8 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1787)
DOTL RP

B2 040314
WHEEL-RAIL DYNAMICS OF LOADED ORE CARS ON THE Q.C.M. AND B. AND L.E. RAILROADS

This study was initiated to determine the possible cause and to recommended a practicable remedy for excessive wear and damage to rails on the

Quebec Cartier Mining Company Railroad. Using instrumented car trucks and trackside rail deflection indicators, measurements of wheel-rail dynamics were made during test runs on the Bessemer and Lake Erie Railroad to evaluate the effect of different cars, car-truck combinations, and track structures on the forces between the wheels and the rails. The primary causes of the severe rail damage and rail corrugation experienced by the Q.C.M. are the unit train method of operation in conjunction with the undesirable car behavioral traits inherent in the design of the trucks of the standard Q.C.M. car. The effects of "bouncing", "rocking", "hunting", and "oscillation" of cars on tangent track, and of the "skewing", and "unbalance" on curves were measured quantitatively.

Bessemer and Lake Erie Railroad Test Rpt Oct. 1970, 104 pp, 44 Fig, 4 Tab, 4 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1799)
DOTL RP

B2 040319
CONSIDERATIONS FOR THE DESIGN OF LONG CARS FOR IMPROVING CURVE NEGOTIABILITY

Graphs derived from theoretical considerations are presented in this report to show the effects of applying 60-in. couplers to long cars and to indicate the extent to which truck centers require increased dimensions to provide acceptable flange forces. For purposes of illustration, calculations are based on an 85-ft. car coupled to two 31-ft. cars with all cars operating on a curve of uniform degree and with variously applied drawbar forces. The following is recommended: whenever possible, cars of 85 ft. and over should be equipped with 60-in. couplers; when cars cannot be equipped with 60-in. couplers truck centers should be spaced to produce a reduction in lateral forces.

Association of American Railroads Res Rpt MR-435, Nov. 1966, 20 pp, 13 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1823)
DOTL RP

B2 040322
ROLLER BEARING ADAPTER MOUNTINGS FOR RAILROAD CARS

This paper deals with the development of an elastomeric mounting for installation between the roller bearing adapters and truck side frames of railroad cars. This mounting will provide for a controlled lateral motion between the adapter and side frame of a nominal plus minus 5/16 in. Test installations and the results of these preliminary tests are discussed and the advantages of a roller bearing adapter mounting are pointed out. Most of the purported advantages are supported with test results while others are predicted as a result of the test data.

Sherrick, JW (Lord Manufacturing Company)
American Society of Mechanical Engineers 68-WA/RR-5, Dec. 1968, 8 pp, 4 Fig, 3 Tab, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1845)
DOTL RP

B2 040324
RELATION OF WHEEL TREAD WEAR AND BRAKE SHOE WEAR

Brake shoe requirements on freight cars equipped with conventional brake rigging are not completely equitable at all shoe locations. Studies indicate that replacments of mated shoes on the same brake beam can vary from 8 percent on the inside beams to 13 percent on the outside beams. Four diagonal locations are found to have a shoe requirement approximately 55 percent, and the four mating positions 45 percent of total replacements. The unequal shoe wear adversely in so far as realizing uniformity of service life on the wheels in the four positions as well as on mated wheels at the respective locations. The pattern of wheel wear disclosed is not conductive to economy of car maintenance not to the best standard attainable in car utilization.

Jennings, JR (Wilson Car Lines)
American Society of Mechanical Engineers 61-WA-217, Dec. 1961, 11 pp, 7 Fig, 5 Tab, 1 Phot, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1847)
DOTL RP

B2 040325
STUDY OF VIBRATION FREQUENCIES UNDER IMPACT CONDITIONS

A study is presented of vibration frequency characterisitcs under impact conditions for typical friction type draft gears used on railroad freight cars of a comparison of typical instrumentation records showing force-closure clutch action of typical and of representative electronic equipment used to measure these vibration forces. When determining the reaction-force characteristics of draft gears during closure, careful selection of instrumentation must be made. Instrumentation having a flat frequency response of 0 to 600 cycles is prefereed in order to attenuate the higher frequencies encountered in friction-draft-gear characterisitcs. Instrumentation having higher frequency response can be used but this usually results in confusion in interpreting the records to determine the fundamental force measurements.

Newcomer, GH (Association of American Railroads)
American Society of Mechanical Engineers 59-A-250, Dec. 1959, 8 pp, 1 Fig, 2 Tab, 10 Phot, 2 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1848)
DOTL RP

B2 040344
ROLL ACTION OF HOPPER CARS INDUCED BY STAGGERED RAIL JOINTS

Loaded hopper cars were tested on a test track at elevations of 3 and 6 inches and low joints from .25 to .75 inches. The suspension system was varied to determine the effect on car rocking. Some tentative conclusions drawn from the tests are as follows: if joints are not more than 1/2 in. low in the loaded condition, wheel lift and derailment are not likely to occur; derailment is less likely to occur with 3 inches elevation than with 6 inches elevation; the use of 3 11/16 in. travel springs, widened gibs and supplemental snubbers, substantially reduces the likelihood of wheel derailment from roll action; and the hydraulic snubbers between the underside of the car body and the spring seat on the truck frame were effective in eliminating car roll and flange climbing; and provision of 2000 lb. friction resistance between the underside of the car body and the spring seat on the truck frame was effective in reducing the roll amplitude but did not prevent derailment.

Magee, GM
Association of American Railroads Test Rpt Jan. 1968, 20 pp, 19 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1773)
DOTL RP

B2 040352
STUDIES TO ELIMINATE HARMONIC ROLL OF HEAVY CARS

The purpose of this study was to observe controlled tests and fine solutions for harmonic roll in 100-ton hopper cars during low speed operation on staggered joint track which initiated wheel lift and subsequent derailment. These studies indicated that lower spring rates, extended center of the spring nests, applied swivel center plates, and preloaded laminated side bearings can be attenuated but not fully eliminated. Also, some improvement has veen obtained by permitting more lateral between the side frame and the bolster, in the bearing system, and by reducing the distance between the centers of the side bearings. Experimental truck arrangements are being developed which will permit the truck to follow the irregularities of track and which will prevent the introduction of the forcing frequency into the body of the car at such a phasing as to cause harmonics in the car rolling. Also, snubbing and energy absorption are being studied from a theoretical standpoint and practical applications of snubbers have been made which help to reduce the incidence of wheel lift when the snubbers are applied in combination with other changes.

Association of American Railroads Prog Rpt AAR-MR-440, Apr. 1965, 23 pp, 6 Fig, 3 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1793)
DOTL RP

B2 040358
LABORATORY INVESTIGATION OF THE EFFECT OF COLLAPSED SPRINGS OF LONG TRAVEL DESIGN ON CAR CLEARANCES

This investigation was made as a result of concern that serious trouble might be experienced with car clearances especially on gondola and flat cars

equipped with springs of long travel design particularly when springs are in a collapsed condition. A seventy-ton drop end gondola, equipped with 3-11/16 inch travel springs in A.S.F. design A-3 Ride Control trucks, was furnished for this investigation. Using the measured car lean of 8-1/4 inches for empty car on 6 inch superelevated track with all springs in place as a base line, the static lean increased for the different conditions tested as follows: car empty--4 springs removed 5/8 increase; car loaded--all springs in place 3/4 inch increase; and car loaded--4 springs removed 1 inch increase. These data indicate that the effect of broken springs with this type truck and spring arrangement may increase car lean up to 1 inch with the type load we were able to place in the car.

Keller, WM
Association of American Railroads Test Rpt MR-211, 1954, 10 pp, 1 Fig, 2 Tab, 2 Phot, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1802)
DOTL RP

B2 040370
IMPACT TESTS OF HOPPER CAR LOADED WITH FERROMANGANESE ORE
This report describes impact tests made on a four pocket hopper car loaded with ferromanganese ore in order to determine whether or not it is safe to ship such a product in hopper cars. Tests were made on both the A and B ends of the hopper car at speeds up to 11.3 miles per hour, and measurements and observations were made to check for any permanent deformation in major structural members of the car and for adequacy of the experimental wood bracing arrangement. It was included that hopper cars can be employed safely for the transportation of ferromanganese ore if adequate bracing is applied to the doors of the loaded hoppers. Only approved methods of bracing should be used and wood wedges should be used to secure the locking pawls of the door latches.

Association of American Railroads Res Rpt AAR MR-321, Aug. 1958, 1 p

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1815)
DOTL RP

B2 040373
IMPACT TESTS OF BALTIMORE AND OHIO RAILROAD TWO-POCKET FIFTY-TON HOPPER CAR LOADED WITH FERROMANGANESE
This report covers the results of a series of impact tests with a two-pocket fifty-ton hopper car loaded with ferromanganese. The purpose of this series of impact tests was to determine the safety of shipping this dense commodity in a standard hopper car that has auxiliary bracing between the hopper doors and also to determine the extent of the damage that can normally be expected on the hopper pockets and door equipment when the car is subjected to over-solid impacts. The following conclusions were made. The Baltimore and Ohio two-pocket hopper car, Class N-44, is representative of equipment that can be safely used to transport ferromanganese if the hopper doors are properly braced in the same manner used in this series of tests. The results of this test show that it is reasonable to expect a certain amount of bulging and distortion to the hopper doors, frames, and the hopper sheets adjacent to the door when ferromanganese is transported in this type car when the car is subjected to impacts at speeds of 6 mph or greater. The impacts in this series of tests were as high as 10.9 mph, which is higher than would be expected in normal service.
See also AAR MR-321 for similar studies.

Association of American Railroads Res Rpt AAR MR-350, Apr. 1959, 1 p

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1818)
DOTL RP

B2 040375
A COMPUTER STUDY OF DYNAMIC LOADS CAUSED BY VEHICLE-TRACK INTERACTION
Computer analyses of vehicle and track are producing enlightening results regarding actual dynamic loads and the manner in which various parameters of vehicle and track structure affect these loads. Using this information, it is possible to decide more intelligently how to alleviate the high wheel-rail stresses caused by today's unique traffic and track conditions. Possible solutions range from better track maintenance to different wheel rail geometries to changes in stiffness and damping of trucks and the track structure itself.

Meacham, HC Ahlbeck, DR (Battelle Memorial Institute) *ASME Journal of Engineering for Industry* Aug. 1969, pp 808-816, 12 Fig, 3 Tab, 3 Phot, 11 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1825)
DOTL RP

B2 040381
THE RELATION BETWEEN THE SWAYING OF HOPPER CARS AND THE STAGGER OF RAIL JOINTS IN TRACK
Freight cars with high-center-of-gravity loads sway considerably, especially on tracks with low joints. To produce synchronism, the time of swaying must have a definite relation to the speed of the train. A principle that maybe used to destroy cumulative swaying is that the stagger of rail joints must be such that a car must hit, simultaneously, a pair of joints, the joints being in opposite lines of rails. A second principle is that the stagger should be unequal in such a way that enough joints occur at suitable phases of swaying to neutralize the effects of the other joints. Frictional resistance helps in this principle. The amplitude of swaying may be increased by a series of low joints, provided that the swaying of cars synchronizes with the impulses given by the joints.

Leffler, BR
American Railway Engineering Association Vol. 27 1926, pp 1243-51, 2 Fig, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1831)
DOTL RP

B2 040384
DYNAMICS OF "SHIMMY" IN PASSENGER CAR TRUCKS
This paper was concerned with only one phase of passenger truck dynamics and therefore the solutions developed won't necessarily be valid when one encounters severe lateral oscillations in a passenger car. Tests were conducted to investigate the causes and the solutions of "Shimmy" motion. It was found that this type of truck motion can be not only controlled but prevented if a proper angular damping is introduced between the truck frame and the car body.
Contributed by the Railroad Division of the ASME at the Semi-Annual Meeting, St. Louis, Missouri, June 19-23, 1950.

Guins, SG (Chesapeake and Ohio Railway)
American Society of Mechanical Engineers Paper 50-SA-21, June 1950, 13 pp, 9 Fig, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1834)
DOTL RP

B2 040385
INVESTIGATION OF THE TRUCK HUNTING INSTABILITY PROBLEM OF HIGH-SPEED TRAINS
The problem of trucking hunting instability and the design implications for high-speed trains were investigated. Linearized theoretical analyses were made to identify the most important design parameters for speeds of 125 to 200 mph. Truck wheelbase, truck mass, wheel coning ratio, and springs to oppose yaw and transverse motions of the truck relative to the car body--all have large effects on the critical speed for secondary hunting instability. It appears probable that lightweight passenger cars could be designed for stable operation of speeds considerably in excess of 200 mph.
Prepared for presentation at the Sesquicentennial Form on Transportation Engineering, New York, New York, August 28-30, 1967.

Clark, JW Law, EH (United Aircraft Research Laboratories)
American Society of Mechanical Engineers Paper 67-TRAN-17, Aug. 1967, pp 12, 6 Fig, 2 Tab, 14 Ref, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1835)
DOTL RP

B2 040390
UNDERSTANDING WHEEL-RAIL ADHESION
The terms of wheel-rail adhesion are defined. An extensive review of the problems associated with adhesion and the attempts to solve these problems

is presented. The results of experiments conducted by the author on scale equipment show that creep is present as long as there is adhesion demand. As the adhesion demand increases, the percentage creep increases until creep becomes slip and eventually slide. It is shown that true adhesion varies with velocity. Suggestions are given for means of approaching true adhesion values on the railroad. The danger of wheel damage caused by high adhesion could offset the advantages.

Contributed by the Railroad Division of the ASME for presentation at the ASME-AIEE Railroad Conference, Pittsburgh, Pennsylvania, April 20-21, 1960.

Cabble, GM, Jr (Westinghouse Air Brake Company)
American Society of Mechanical Engineers Paper 60-RR-3, Apr. 1960, 7 pp, 2 Fig, 57 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1841)
DOTL RP

B2 040392
DYNAMIC ANALYSIS OF ROLLING FREIGHT CARS

In this paper, an attempt is made to enhance the "state of the art" of car stability through additional theoretical work. The dynamic equations of motion describing car rocking are presented. These equations are then simplified and need to determine car body roll frequency and its dependence on roll amplitude. As a result of the analysis, a graphical technique was developed which shows the rail disturbance as a function of truck center distance for any desired rail length, wheel base, track profile and rail stagger. In addition, a brief account of the experimental history is presented.

Manos, WP Shang, JC
Pullman-Standard Res Rpt 35 pp, 6 Fig, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1843)
DOTL kP

B2 040394
THE EFFECTS OF JUMBO (HEAVY AND HIGH CUBE) CARS ON THE M OF W EXPENSES

Studies research and field observations show that the heavier wheel loads imposed on the rail today cause higher rates of rail failures, severe flaking, spalling, pitting and shelling. Track geometry also deteriorates faster. The two remedies are stronger rail material and stiffer track. But these are quite costly and economically not always possible. Instead, it is more likely that the movement of heavy loads will be continued on the present track at the expense of higher maintenance costs. This paper presents estimates and approximations with regard to the magnitude of the penalty M of W departments must pay in the area of track maintenance as a result of operating jumbo cars.

Prepared for the AAR Accounting Division's 1970 Annual Meeting held in New Orleans, Louisiana, May 25-27.

Reiner, IA
Chesapeake and Ohio Railway, Baltimore and Ohio Railroad Conf Paper 70-105, May 1970, 18 pp, 3 Tab, 4 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1857)
DOTL RP

B2 040402
COMPOSITION BRAKE-BLOCKS-EFFECTS ON ADHESION

The effects of composition brake blocks on adhesion were investigated by the DB. The measurements were analyzed statistically and the results plotted in the form of curves. Generally, lower adhesion values were ascertained when braking with K blocks than when using cast-iron blocks. As such an effect is only acceptable if it is small, severe testing is, in this respect, considered to be necessary when submitting K blocks to acceptance tests.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B64/RP 3/E, Nov. 1967, 14 pp, 32 Fig., 55 Ref.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1865)
PURCHASE FROM: UIC Repr. PC
DOTL RP

B2 040403
COMPOSITION BRAKE-BLOCKS-EFFECTS OF HUMIDITY ON BRAKING

Tests carried out by the SNCF, to determine the effects of humidity on braking; were made with 20 different types of existing composition brake-block. On the test rig at Vitry, braking tests were made from speeds of up to 160 km/h to a stop, and continuous braking tests were made with single cars at about 60 km/h. In service, fly-shunting tests at speeds of up to 140 km/h were made. The brake-block wear was not measured during the tests on wet rails. The similarity of the curves obtained with the different makes of block on dry wheels was not repeated on wet wheels. It would seem that not all the blocks have been designed and manufactured with the same object of obtaining satisfactory performances under wet conditions.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B64/RP 4/E, Apr. 1968, 16 pp, Figs., Tabs., Phots.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1866)
PURCHASE FROM: UIC Repr. PC
DOTL RP

B2 040410
DEVELOPMENT OF AN ACOUSTIC DEVICE FOR THE DETECTION OF WHEEL-FLATS OF A CERTAIN SIZE--ENQUIRY REPORT--DEFINITIONS OF WHEEL DEFORMATION: CAUSE OF WHEEL DEFORMATIONS; EFFECTS OF DEFORMED WHEELS: AUTOMATIC DETECTION OF DEFORMED WHEELS

On the basis of the facts and opinions obtained, the following can be concluded: wheel deformation is a natural though avoidable attendant phenomenon of railway traffic with high speeds and considerable tractive effort; and wheels that are damaged place a great strain on rolling stock and track. Owing to the additional bending moments and acceleration peaks the stresses to which rails and individual parts of vehicles are subjected can ready prohibitive values.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B110/RP 1/E, Oct. 1968, 54 pp, 29 Fig., 8 Tab.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1873)
PURCHASE FROM: UIC Repr. PC
DOTL RP

B2 040418
PROBLEMS OF INTERACTION OF VEHICLES AND TRACK--WORN PROFILES OF RAIL HEADS AND WHEEL TYRES

As a result of a large number of tests it has been proved that service wear on wheel tires and rail heads leads to definite profiles. These worn profiles are to a large degree independent of the initial profiles of tires and rail heads. In the worn condition the profiles maintain their form and are not subject to any further change. The worn profiles are characterized by good mutual conformity and thus by little increase in wear. The worn profile of tires results in a shortening of the wave length of the periodical wheel set motions (hunting) in the track clearance. It was concluded that to wear new profiles of rail heads and tires should be adapted as much as possible to the worn profile. The use of special wheel tire profiles promise no lasting influence on the riding quality of vehicles. Therefore other design measures on the vehicles should be preferred to control the hunting motion.

Question C9 Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Interim Report No. 6, Oct. 1962, 2 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1881)
DOTL RP

B2 040419
PROBLEMS OF INTERACTION OF VEHICLES AND TRACK--MEASUREMENTS MADE WITH RAIL VEHICLES DURING 1961 TO ASSESS THE CLEARANCE GAUGE ALLOWING FOR ROLLING MOVEMENTS OF THE VEHICLES
The purpose of these measurements was to shed light onto the behavior of the bogies, their position on the track, and to assess the lateral and rolling motions of the moving vehicles, caused by the forward traveling speed, the curve radii, and superelevation in curved track. The values so determined were to be taken as a basis for the setting up of a kinematic vehicle gauge. One of the most important results of the experiments is the linear dependence which was confirmed, for all vehicle types, between the angles of rolling, or between the transverse displacement of the sprung masses and the excess transverse accelerations respectively. This seems to indicate that the magnitude of the quasi-static angles of rolling can be precalculated, provided that the mathematical layout of the problem is sufficiently accurate. This would, however, entail complex conditions, because it would be necessary for all force effects of the connecting members between the individual masses to be incorporated in the process, with reasonable accuracy.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways C9/RP 5/E, Oct. 1962, 42 pp, Figs., Tabs., Apps.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1882)
PURCHASE FROM: UIC Repr. PC
DOTL RP

B2 040436
BEHAVIOUR OF THE METAL OF THE RAILS AND WHEELS IN THE CONTACT ZONE--ENQUIRY INTO THE PROBLEM OF SMALL DIAMETER WHEELS APPENDIX 3
The observations made at the Mairy mine concerning the wheel-rail dynamics are discussed. The width of the rolling band is wider than on the SNCF and can be explained by wear of the wheel and rail. It could also be due to transverse elastic deformation of the wheel. The calculations and measurements are summarized which were carried out in the laboratory of the SNCF to investigate the influence of the load, the curvature of the rail and the tire, and more particularly of wheel diameter on the stresses to which these components are subjected.

Partial Copy--Appendix Only-Summary of Report Abstracted Separately, Question C53. Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Interim Report No. 3, Oct. 1966, 11 pp, 5 Fig
RESPONSIBLE INDIVIDUAL:

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1902)
DOTL RP

B2 040442
TESTS CONDUCTED ON CURVE OF THE SANTA FE RAILWAY NEAR ARGENTINE, KANSAS, TO DETERMINE THE CAUSE OF DERAILMENT OF PASSENGER TRAIN NO. 17 ON FEBRUARY 3, 1968
A test was made of four classes of diesel locomotives, followed by a baggage car and 12 additional cars. The train consists simulated the passenger train which derailed February 3, 1968. The maximum lateral and vertical rail forces and lateral to vertical ratios are tabulated for each consist. No L/V values were measured in the tests that were high enough to indicate a derailment condition was being approached. Tests were made at various speeds and throttle positions and a few runs with dynamic braking. Large variations in axle thrust were measured along the track, so it is unlikely the track measurements were made at a location that would give maximum L/V values.

Letter Correspondence.

Magee, GM
Association of American Railroads July 1968, 28 pp, 12 Fig, 5 Tab, 6 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1908)
DOTL RP

B2 040443
DERAILMENT OF A PASSENGER TRAIN CONSISTING OF A DIESEL LOCOMOTIVE WITH SIX-WHEEL TRUCKS, A BAGGAGE CAR, AND A COACH
Three letters discuss the derailment of June 7, 1968. A sketch of the derailment area and photographs of sections of the track involved are included. This derailment is characteristic of a number of derailments that have occurred on curves at or near permissible speed of passenger trains having locomotives with six-wheel trucks, derailment apparently occurring first of the rear truck of the locomotive unit or the lead truck of the baggage car following. In each case the high rail of the curve was overturned. A high ratio of L/V is required to overtrun a rail and it is unlikely that this high a L/V ratio would be developed in track unless there is some unusual condition such as a jack-knifing of couplers between cars, an unloading of the lead wheel of the truck on the high rail, or some severe wedging action of the truck between rails due to a malfunction of the truck components.

Letter Correspondence.

Angold, JA (Atchison, Topkea and Santa Fe Railway); Stuppi, FN 14 pp, 1 Fig, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1909)
DOTL RP

B2 040447
DERAILMENT DATA
A series of derailments are discussed. The majority of the derailments involve a loaded car connected at one or both ends with a cushion underframe car. A test plan is suggested to simulate the derailments by using a loaded hopper car and an adjoining box car with cushioned underframe containing instruments trucks. The instruments would measure lateral and vertical forces exerted on curves similar to the derailment sites.

Derailments described in BCL-1914, Letter Correspondence.

Magee, GM
Association of American Railroads Feb. 1968, 5 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1913)
DOTL RP

B2 040448
LETTER TO AAR REGARDING DERAILMENTS OF HIGH CUBE CARS
Eight derailments occurring between November 1966, and July 1967, are briefly described. All have been written off as the result of wheel climbing on the high rail during rocking.

AAR Reply Abstracted as BCL-1913, Letter Correspondence.

Aug. 1967, 2 pp, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1914)
DOTL RP

B2 040449
DERAILMENTS OF TWO PASSENGER TRAINS
The pertinent facts are given for the two derailment sites and the train consist. In both cases derailment occurred at the rear truck of the last locomotive unit or front of the following car. A drawing of the wide gage is shown of the actual worn wheel and rail contour of the derailed axle involved in the first derailment. Both derailments are not satisfactorily explained.

Unpublished Data.

Magee, GM (Association of American Railroads) 1967, 2 pp, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1915)
DOTL RP

B2 040451
COMPARISON OF EFFECTIVENESS OF FREIGHT CAR ROLL CONTROL DEVICES
The expected cost of derailments attributable to excessive car roll over a period of time can be reduced by various modifications to the car purporting to restrain wheel lifts and stabilize the car in roll. The decreased derailment cost over this period can be traded-off against the installation and maintenance costs of the modifications over the same period to find an optimum balance, i.e. maximum rate of return on investment in roll control

devices. For open top hopper cars, double Barber side coils or stiffer A-3 springs were found to be most economic. For covered hopper cars, the Roll Stabilizer or 2 Holland snubbers per spring group were found to be the optimum solution.

Luebke, RW
Baltimore and Ohio Railroad, Chesapeake and Ohio Railway Test Rpt 68-121, Aug. 1968, 22 pp, 4 Fig, 4 Tab, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1917)
DOTL RP

B2 040452
ANALYSIS OF COVERED HOPPER CAR DERAILMENTS ON THE BALTIMORE AND OHIO RAILROAD
Covered hopper car derailments on the B&O system during 1967 were analyzed to update previous work. The analysis confirmed and strengthened the conclusions found earlier. The conclusions reached were that (1) in-service life has a significant effect on rock-off derailments, and (2) the April 1964 speed restriction was effective in reducing early age derailments of the cars covered. For the year 1967, it was found that derailments of C&O-B&O covered hopper cars that generated L&D claims were nonexistent. The B&O series 602000 cars have made it through their critical first-year period with only two minor derailments, neither of which generated L&D claims. This fact tends to indicate that the increased snubbing in the trucks under this series of cars has reduced their early life derailment susceptibility. Based on these results as well as on the fact that all new 100-ton covered hopper cars in AAR interchange service must now have increased snubbing, it is recommended that the April 1964 speed restrictions be expanded to cover all covered hopper cars built in 1967 which have not been modified to control the roll problem. The restriction could be withdrawn in January 1969, when all cars of this type either will have completed their "wear-in" period or will have been equipped with additional snubbing.

Luebke, RW
Baltimore and Ohio Railroad, Chesapeake and Ohio Railway Test Rpt 68-108, 1967, 8 pp, 3 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1918)
DOTL RP

B2 040502
ULTRASONIC TESTING OF RAILWAY COMPONENTS
Ultrasonic testing has expanded to the stage where it is a vitally important inspection method for two major railway components, axles and rails. It is likely that the use of the method will extend in many other fields. The success with which ultrasonic testing is now practiced is dependent upon three factors. They are: a thorough understanding of the type and position of flaws likely to occur in the component and the significance of flaw size; a sound knowledge of the principles underlying the use of ultrasonics for this purpose; and, a testing organization which can put sound techniques, well-trained men, and well-maintained instruments of the right type to work.

Wise, S (British Railways Board) *Institution of Locomotive Engineers Journal* Vol. 58 No. 321, Part 1, pp 77-110, 12 Fig, 8 Phot, 4 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1989)
DOTL RP

B2 040506
COMPOSITION BRAKE BLOCKS AND TYRES
This paper describes some of the problem which have arisen from the use of composition brake blocks in the past. For at least two of these, wet stopping performance and thermal cracking, there is now an understanding of the problem and possible solutions. Present-day production has also resulted in blocks free from the other difficulties. Other methods of avoiding the dangers associated with thermal cracking have been indicated: these involve moving away from the classic wheel and tire arrangement and the materials which have persisted for many years.

Wise, S Lewis, GR *Railway Division Journal* Vol. 1 Part 4, 1970, pp 386-443, 5 Fig, 4 Tab, 7 Phot, 13 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1993)
DOTL RP

B2 040508
A METHOD FOR ESTIMATING BRAKING DISTANCES
This method allows for a time delay in the development of full brake power after a brake application has been initiated at the driver's cab, by taking note of the actual pattern of this development during this period. Thereafter, the distance traversed with full brake power before coming to a stop can be computed. Allowance has also been made of the brake power development characteristics of the motive power units. The method is suitable for application to all brake systems, compressed air standard AVB, and AVB with Quick Application valves--in fact, for any system where the brake power development curves can be established.

Singh, A (Ministry of Railways, India) *Institution of Locomotive Engineers Journal* Vol. 57 No. 317, Part 3, pp 251-278, 14 Fig, 2 Tab, 1 Phot, 12 Ref, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1999)
DOTL RP

B2 040517
SUSPENSION DYNAMICS BY COMPUTER SIMULATION
An analytical study of the effect of changing the design parameters of a two mass, six-degree-of-freedom suspension system was made. Rail cars with coil and air springs were analyzed by analog and ditital computer. Spring stiffness, spring, spacing, damping rates, height of center of gravity, and total mass were varied. The effect on frequency and response were determined.

Diboll, WB, Jr (Washington University); Bieniecki, HS (McDonnell Douglas Corporation) *ASME Journal of Engineering for Industry* Nov. 1968, pp 708-716, 14 Fig, 2 Tab, 7 Ref, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1840)
DOTL RP

B2 040529
TWENTY YEARS' EXPERIENCE WITH DIESEL RAILCARS
The following topics are discussed: Bodies--A short discussion on the relative merits of light alloy and steel construction together with some notes on our experience with various materials used in the passenger areas and finally a discussion on the problems of heating this type of vehicle. Bogies--Some notes on the problems which have been associated with the brake gear, followed by a discussion of the riding problems experienced with these vehicles and then some notes on the problems which were encountered with axle design. Power Equipment--A short discussion on the relative merits based on experience of gear boxes and torque converters. Some notes on the various problems which have been associated with the final drive units and lastly notes on the performance.

Wakefield, FHG *Railway Division Journal* Vol. 2 No. t 1, 1971, pp 45-83, 6 Fig, 1 Tab, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1969)
DOTL RP

B2 040544
IMPRESSIONS ON THE NEW TOKAIKO LINE, JAPANESE NATIONAL RAILWAYS. BASED ON A RECENT VISIT TO JAPAN
The trains are made up of 12 coaches, but can be expanded to 15 to 16 as demand increases. The track is designed for high speed running. Track centers are widened to lessen the air impact effects as trains pass. Gradients are limited to 1.5 percent, minimum radius of curved track is 220 years, and maximum cant is 7.08 inches. Welded rail is padded by rubber and fastened to concrete cross ties with spring clips. Signals controlling train speed and operation are transmitted from a Central Train Control Office to the cab. Train brakes and speed are automatically controlled to eliminate collisions. The driver can assume control to counteract adverse environmental conditions. Revenues are described.

Burley, W *Institution of Locomotive Engineers Journal* Vol. 54 No. 302, Part 6, pp 585-595, 1 Fig, 7 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2004)
DOTL RP

B2 040548
A FEW PERMANENT WAY MATTERS OF INTEREST TO ROLLING STOCK ENGINEERS
Present track design techniques and rail maintenance problems of the British Railways are discussed. The effect of wheel design and load on track clearances and rail wear is shown. Conditions producing flat wheels, axle stresses and corresponding rail damage are described. Curve designs are shown.

Loach, JC *Institution of Locomotive Engineers Journal* Vol. 54 No. 301, Part 5, pp 465-490, 9 Fig, 7 Phot, 7 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2008)
DOTL RP

B2 040552
HYDRAULIC DAMPERS AND DAMPING
After brief review of the influence of viscous damping on free and forced oscillations of mass-spring systems, and its effect on response to impulses, suitable damping factors are quoted for control of body and truck oscillations on the suspension. This is followed by discussion of the most suitable forms of force-velocity characteristics for railway applications, and a section dealing with damping calculations. The influence of damper flexible mountings is then examined, with particular reference to impulsive suspension response and response to sinusoidal in deal with excitation. Experimental work relating to vehicle damping requirements and the recently issued B.R. specification with stipulates the requirements for dampers for use on British Railways' vehicles is discussed. Difficulties in the manufacture of dampers with linear symmetrical force-velocity characteristics are then pointed out with special reference to the tendency for current damper designs to result in S-shaped characteristics.

Batchelor, GH Stride, RCT *Institution of Locomotive Engineers Journal* Vol. 58 No. 326, Part 6, pp 563-628, 26 Fig, 7 Tab, 6 Phot, 8 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2012)
DOTL RP

B2 040799
PASSENGER RIDE COMFORT ON CURVED TRACK
Tests were carried out to obtain data for making recommendations for the permissible speed on curves and the length of transition curves for passenger comfort, and for establishing clearance requirements on curved track. The first test was run on the Louisville and Nashville, May 10, 1950, using the Chesapeake and Ohio track inspection car and making use of 20 observers. Results of this test indicated the importance of the roll of the car body in reducing the effective elevation of the track insofar as passenger comfort was concerned. A second test on the Kansas City Southern developed gyroscope and recorder techniques to show the angle of the car body from the vertical. From the results of these tests it was possible to establish a very satisfactory relationship between passenger reaction and the amount of lateral acceleration so that in subsequent tests it was not necessary to use passenger observers. To obtain data on the various types of modern passenger cars being used, running tests were subsequently made on 7 railroads. The tests have indicated that for types of modern equipment having soft springs and no provision for restricting the roll of the car body on curves the present AREA limitation of 3-in. unbalance should be continued. For cars having stiffer springs, outside swing hangers (and springs) or roll stabilizers reducing the amount of roll with unbalanced elevation, the tests
Reprinted by AAR, 3140 South Federal Street, Chicago, Illinois 60616.

Magee, GM Keller, WM *AREA Bulletin* Bulletin 516, pp 125-214, 42 Fig, 4 Tab, 13 Phot, 10 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2029)
DOTL RP

B2 040829
DISCUSSION ON "THE ENGINEERING ASPECTS OF HIGH-SPEED TRAINS" (1) MOTIVE POWER: (2) PASSENGER ROLLING STOCK; (3) BRAKING AND SIGNALLING; (4) PERMANENT WAY
This paper surveys the engineering aspects of high-speed trains in terms of motive power, passenger rolling stock, braking and signaling, and permanent way. In developing high-speed trains there is clearly a need to examine all aspects of vehicle performance on the track, and also a need to subject every item of traction equipment to the closest secrutiny to ensure that it is suitable for onerous high-speed duties. The car of the future will probably be lower and smoother, and with smaller windows than present-day cars. It will be pressurized and adjacent body ends will be closer to incorporate peripheral coupling and improve passenger access. It will also cost more. A basic consideration in obtaining the best brake performance of high-speed trains is the maximum braking retardation. When high retardations are used and as the maximum speed of trains increases from about 100 mph to 120 mph (or even 150 mph) two problems of braking which become increasingly important are adhesion and heat dissipation. Both necessitate modifications to present braking practice when higher speed stops are to be made. It is generally agreed that at high speeds some form of cab signaling is essential, and systems in use vary from the relatively simple A.W.S. as used in this country to apparatus which starts, controls, and stops the train automatically. There is every justification to believe that, from the point of construction, modern track would be quite suitable for speeds up to 160 mph--possibly more--where it is straight or flat-curved.

Sharp, E Thring, JF Peacock, DW Loach, JC *Institution of Locomotive Engineers Journal* Vol. 56 No. t 2, pp 196-219, 9 Fig, 1 Tab, 1 Phot, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1963)

B2 041123
EFFECT OF NON-LINEAR CHARACTERISTIC ON HUNTING OF CAR--EFFECT OF SIDE PLAY BETWEEN AXLE AND BEARING METAL
The equation of motion for a two-axle car was introduced when there was side play between the axle and the bearing metal, and an observation on the value of side play was made. Non-linearity of the elasticity and the side play was treated by the describing function method, linearizing of the equation of motion, and then the characteristic equation of the two-axle car was derived and the sinusoidal hunting velocity was calculated. A one-fifth sized model of a two-axle car was used in order to verify the theoretical treatment of hunting of a two-axle car experimentally. The experimental results and the theoretical calculation coincided closely and qualitatively and moreover when the damping of the supporting device for the car body was selected properly, the above results also coincided quantitatively. It was proved that the side play not only prevented the body hunting effectively but also lessened the side thrust experimentally.

Yokose, K *Railway Technical Research Institute* Vol. 13 No. 2, June 1972, pp 107-111, 4 Fig

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Railway Technical Research Institute Kunitachi, Box 9, Tokyo, Japan Repr PC
DOTL JC

B2 041674
TRUCK BOLSTER DYNAMIC LOADING MEASURED UNDER HARMONIC ROLL CONDITIONS
In service, two general types of fatigue loading conditions are imposed on railroad freight-car truck bolsters. Both types of loading involve a relative rolling or rocking motion between truck and car body bolsters but differ in amplitude and frequency of the motion. One condition, the lateral harmonic roll motion action possible with large and high center of gravity freight cars, is associated with low train operating speeds and operation on track of periodic low joint conditions. This paper illustrates the truck-bolster dynamic loadings measured under the extreme harmonic roll condition on a specially prepared test track and describes the methods of instrumentation developed to measure such loadings.
This paper was presented at the ASME Winter Annual Meeting, November 28-December 2, 1971. The notification of this paper appeared in Mechanical Engineering.

Monselle, D (Association of American Railroads)
American Society of Mechanical Engineers 71-WA/RT-6, 1971

ACKNOWLEDGMENT: Mechanical Engineering
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL TF5.A72 1971

B2 043365
STUDY OF ACTIVE VIBRATION ISOLATION SYSTEMS FOR SEVERE GROUND TRANSPORTATION ENVIRONMENTS
An investigation is conducted to evaluate the application of active mechanisms for the protection of equipment and/or personnel from the severe dynamic inputs characteristic of ground transportation vehicles. For the purposes of the study, dynamic loads and isolation system performance are defined in terms of the maximum expected vertical excitations associated with the suspension system of high speed ground transportation vehicles, and conservative levels of allowable passenger acceleration. Selected configurations employ available hardware, and consist of a static load support fluidic spring in parallel with a 0.2 Hz resonant frequency electrohydraulic isolator, which: a) provides the desired degree of isolation from both discrete frequency and broad-band vibration excitations; and b) limits the payload deflections to within plus or minus 6 inches under conditions of combined vibratory and transient dynamic loads. Rigid and flexible payloads of 1,000 3,000 and 10,000 pounds per isolator are considered. The response of the selected isolation systems is presented in terms of absolute and relative transmissibility; payload acceleration; and relative displacement between the payload and the source of excitation for the vibratory, transient, and combined excitations. In all cases the effect of increasing the payload weight by twenty percent is shown. The results indicate that the selected active isolation systems are capable of protecting a range of payloads from severe vibratory and transient dynamic loads. Systems stability, estimates of flow and power requirements, system weight, reliability, and failsafe criteria considerations are shown. Recommendations are made regarding extension of the techniques to provide isolation in the combined vertical and lateral directions. (Author)
Prepared for National Aeronautics and Space Administration.

Calcaterra, PC Cavanaugh, RD Schubert, DW
Wright (Barry) Corporation Contr Rpt NASA CR-1454, 155 pp, 20 Tab, 11 Ref, 2 App

ACKNOWLEDGMENT: National Aeronautics and Space Administration
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B2 043517
EFFECT OF COUPLING DEVICES ON LATERAL VIBRATION OF 951
The experiment investigation of the effect of coupling devices on the characteristics of lateral vibration of 951 type test electric car is described. The dominant component of lateral body vibration is forced body hunting with both modes of rolling and yawing with a wave length of 40-50m. The lateral relative motion around the position of action of coupling devices decreases markedly and the restricting force is preferably enlarged in the range of value tested. (Author)

Miyoshi, K *Railway Technical Research Institute* Vol. 13 No. 4, Dec. 1972, pp 222-225, 6 Fig

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Japanese National Railways Kunitachi, Box 9, Tokyo, Japan Repr PC
DOTL JC

B2 044006
'MILLION MILE' FREIGHT CAR SUSPENSION SYSTEM
A freight car suspension system has been introduced by American Steel Foundries. The T-11 system is designed expressly for 100-ton capacity freight cars. It combines an advanced snubbing system to absorb and dissipate energy and a design change such that longer travel load-carrying coil springs can be used. The system is warranted for a million miles or 10 years of life. The T-11 system also includes the Simplex side bearing which uses controlled friction to reduce rock and roll motion at critical speeds and to control the high speed swiveling of the truck. Recent tests indicate that the T-11 reduced the damaging effects of lateral shock to an unloaded freight car by as much as 75 percent at speeds above 50 mph. It also reduces the damaging effects of vertical shock inside of a loaded car by as much as 60 percent. Comparisons are to a conventional truck. Better riding qualities should result in longer life for truck components. The life expectancy is rated at 2.65 times that of a conventional truck.

Progressive Railroading Vol. 16 No. 2, Mar. 1973, 2 pp, 1 Fig, 3 Phot

ACKNOWLEDGMENT: Progressive Railroading
PURCHASE FROM: Murphy-Richter Publishing Company 9 South Clinton Street, Chicago, Illinois, 60606 Repr PC
DOTL JC

B2 044059
RAILWAY WHEELSETS FACING HIGHER SPEEDS AND INCREASED LOADINGS
Some 20 papers presented in Paris, July 4 to 7, at the Fourth International Wheelset Congress, by authors from railways and industry located in seven countries including USA and the Far East, consider the wheelset under high-speed operating conditions. Solid-rolled and tyred wheels are evaluated in relation to performance, chemical composition and safety, taking into account economic and production considerations under the overall chairmanship of Monsieur Hutter, SNCF.

Rail Engineering International Vol. 2 No. 8, Oct. 1972, pp 360-368

ACKNOWLEDGMENT: British Railways Board
PURCHASE FROM: Broadfields (Technical Publishers) Limited Little Leighs, Chelmsford, Essex CM3 1PF, England Repr PC
DOTL JC

B2 044187
ACCELERATION AND COMFORT IN PUBLIC GROUND TRANSPORTATION
Conventional transportation systems such as subway trains and buses are now designed to accelerate at about 4 ft/sec/sec (3 mph/sec). Electrically powered rapid transit cars of the last 10 years have an initial-acceleration range of 2.5 to 3.2 mph/sec (0.11 to 0.14 g). This performance will accelerate a vehicle to a speed of 30 mph in 10 seconds. Crucial to the longitudinal acceleration level that can be accepted by passengers is the preparedness of the passenger at the onset of motion. When the traveler is seated and expectant, the smooth takeoff of a jet airliner is not at all uncomfortable, although at 0.5 g some difficulty would be found in leaving the seat. Nevertheless, when the trains in the Paris metro system were fitted with rubbertired wheels and acceleration was increased, complaints forced a return to the previous standard of about 3.3 mph/sec that had been used with steel wheels. Sudden jerks on starting or stopping are especially objectionable, since they can cause an unwary standee to lose his balance. Longitudinal accelerations and decelerations judged comfortable and acceptable on the basis of rider ratings were in the range of 0.11 to 0.15 g, and lateral accelerations were in the range of 0.06 to 0.22 g. However, existing data are inadequate for specifying acceleration limits for future systems. Since the acceleration values found are about 0.10 g lower than those that are accepted by automobile users, it may be worthwhile to investigate methods for making higher accelerations acceptable to mass transportation passengers.

Gebhard, JW
Applied Physics Laboratory, (Trd-43) Feb. 1970

ACKNOWLEDGMENT: UMTA
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-190402, DOTL NTIS

B2 044188
HUMAN SENSITIVITY TO WHOLE-BODY VIBRATION IN URBAN TRANSPORTATION SYSTEMS: A LITERATURE REVIEW
The survey indicated that a majority of relevant data came from only a few sources whose results were frequently divergent. That is, no reliable guidelines for passenger comfort were yielded by the data; rather several conflicting results were obtained which did not provide any satisfactory basis for choosing any one of the recommended comfort limits in preference to another. The literature survey revealed two basic data sources: (1) those obtained on "shake tables" in the laboratory; and (2) those obtained in field testing. In both cases, testing considered vertical, horizontal, and sinusoidal vibrations on standing and seated vehicle passengers. The data proved either contradictory or non-correlative, widely divergent testing methods and procedures further impaired reliable correlation of the data. Appended material includes a full bibliography of sources used, relevant details from selected reports, ride indices recommended by various investigators, and selected data and analysis of anatomical and physiological effects of vibration.

Hanes, RM
Applied Physics Laboratory, (Trd-43) May 1970

ACKNOWLEDGMENT: UMTA
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-192257, DOTL NTIS

B2 044189
DYNAMICS OF A MODEL VEHICLE RUNNING ON AN IMPERFECT ELASTIC TRACK
Theoretical analyses of both longitudinal and lateral dynamics of a scaled model subway vehicle were performed to identify design parameters and the relationships among different system components and conditions. The longitudinal analyses assumed both rigid and elastic trackage to estimate critical speeds. Effects such as the eccentricity of the wheel, track imperfections, curvature in the track plane, and the coupling between rotary and translation vibration due to asymmetry of the center of gravity were considered in the analysis. Lateral dynamics were also investigated, with particular attention focused upon both wheel shimmy, which involved solid and viscous friction, and the stability of the "snake" type motion of the vehicle on a rigid imperfect track. All critical speeds in the dynamic analysis exceeded the maximum required normal operations of subway vehicles (65 miles per hour).

Developmental Sciences, Incorporated, (Dc-mtd-7) Interm Rpt Feb. 1971

ACKNOWLEDGMENT: UMTA
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-201882, DOTL NTIS

B2 044524
EFFECT OF FLAT WHEELS ON TRACK AND EQUIPMENT
Under present AAR rules governing removal of flat wheels, flat spots are limited to 2-1/2 in. length for one slid flat and 2 in. each for adjoining spots on freight car wheels and 1 in. on passenger car wheels. These limitations have been established from the experience and judgment of those concerned with the operation and maintenance of equipment and track. To date mathematical solutions to evaluate the impact effects from flat spots have not been adequate. Until recent years, instruments of sufficiently high frequency response to accurately measure the rapid stress changes have not been available. Tests made on the New York, New Haven, and Hartford RR. in 1942 established the characteristics required for reliable instrumentation. Suitable stress measuring instruments were obtained and a comprehensive test program to determine the effects of flat spots on both the track and equipment was conducted on the Chicago & North Western Railway during the summer of 1947. A special test train was used consisting of a locomotive, a passenger car carrying the measuring and recording instruments for the measurements on the test car, and a flat test car having a flat wheel and loaded with rails.

This report was prepared by the Joint Committee on Relation Between Track and Equipment.

Association of American Railroads Technical Center MR-113, May 1951

ACKNOWLEDGMENT: Association of Americans Railroads
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr PC

B2 046436
RECENT RESEARCH ON ADHESION
The various studies and contributions are drawn into a coherent statement of how wheel/rail friction varies. Surveys of a number of track sites have identified the contaminants present in the wheel/rail interface, and measurements have been made of the adhesion which is experienced by railway traffic. A principal contaminant is a surface active oily fluid spread by the passage of wheels which forms a bonded surface layer on the wear band. A simple relationship has been found between the amount present on the surface and the resulting friction.

Collins, AH Pritchard, C *Railway Engineering Journal* Vol. 1 No. 5, Sept. 1972, pp 19-28, 8 Ref

ACKNOWLEDGMENT: EI (EI 73 004002)
PURCHASE FROM: ESL Repr PC, Microfilm

B2 046921
PERFORMANCE RESULTS OF HIGH SPEED RUNNING INVESTIGATIONS CARRIED OUT ON GERMAN FEDERAL RAILWAYS [LAUFTECHNISCHE ERKENNTNISSE AUSDEN SCHNELLFAHRUNTERSUCHUNGEN DER DEUTSCHEN BUNDESBAHN]
Theoretical and experimental investigations for solution of problems of wheel flange wear at speeds of 200 km/hr and higher. Wheel profile II was devised as a result of the investigations. The progress of the development work is described on the basis of tests results. The problems of wheel tread stressing are discussed. The tests carried out on wheel sets flexibly attached to the frame are considered as a step towards on optimization of the overall design. [German]

Glasers Annalen ZEV Vol. 93 No. 11, Nov. 1969, pp 337-346

ACKNOWLEDGMENT: EI (EI 73 00642)
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DOTL JC

B2 046926
METALLOGRAPHIC OBSERVATION OF THE TREAD OF WHEELS SUBJECTED TO VARIOUS SERVICE CONDITIONS
The present paper reports the results of the metallographic observation of the tread of wheels subjected to various service conditions. Wheels in the present investigation are classified into those with on-tread brake and those without it, and the former is further divided into two groups according to the brake shoe, either castiron or composition (synthetic resin base). Work hardening of the tread region due to rolling contact with rail is observed. Heavily deformed cementile lamella in pearlite is frequently observed in the surface region. When using an on-tread brake, heat affected layers develop. There are many varieties in the heat-affected microstructure; martensite, tempered martensite, various incompletely hardened structures, and spheroidized carbide structures. Defects observed on the tread are heat-checks, spalling, flaky surface, skidding marks, fused deposits, thermal cracks, shelling, and growing.

Kunikake, T Nishimura, S (Sumitomo Metal Industries Limited); Tagashira, H *Iron and Steel Institute of Japan Transactions* Vol. 10 No. 6, 1970, pp 476-489

ACKNOWLEDGMENT: EI (EI73 66400)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

B2 047412
DRAFT-GEAR ACTION IN TRAIN SERVICE
In order to investigate the most desirable characteristics of a draft gear by mathematical analysis, a study has been made of the mechanics of an elastic bar, which is subjected to external forces that correspond to those acting in trains under various service conditions. The results of this study, including the derivation of the various equations governing the behavior of an elastic bar, solid or with free slack, are given in another paper by the author. The present paper contains substantially the same equations but transcribed so as to apply to railway trains. Numerical examples are given showing the applications of these equations to assumed test trains.

This paper appeared in Anthology of Rail Vehicle Dynamics, Volume 2: Effects of Train Action and Rail Car Vibration. The anthology was sponsored by the Rail Transportation Division, ASME. Presented at Semi-Annual Meeting, Pittsburgh, Pa.,-June 19-22, 1944.

Wikander, OR (Edgewater Steel Company)
American Society of Mechanical Engineers Paper 44-SA-13, 1971, pp 3-9, 7 Fig

PURCHASE FROM: ESL Repr PC, Microfilm
DOTL TF 550.G85 V.2

B2 047418
EVALUATION OF FREIGHT CAR CUSHIONING DEVICES TROUGH SIMULATION OF TRAIN DYNAMICS
The paper describes a means of evaluating freight car draft-gear designs through analytical studies of train action. New designs and design variations may be tested through simulation at an early stage in their development. The simulation approach described in the paper should be of interest to draft-gear manufacturers as well as to railroads. Although a manufacturer

may experimentally develop a draft gear to provide a desired characteristic, the simulation approach described will permit selection of the most promising characteristic before component design has started. In turn, the railroad may select on the basis of simulation the draft-gear device best suited to its operating conditions. Included in the paper along with a brief description of the analytical approach are examples illustrating how data required for the input to simulation programs may be developed. A form of performance evaluation for draft-gear devices is suggested. Also included for comparison purposes are results of typical train simulations along data from real-life tests of trains equipped with end-of-car hydraulic draft-gear devices.

This paper appeared in Anthology of Rail Vehicle Dynamics, Volume 2: Effects of Train Action and Rail Car Vibration. The anthology was sponsored by the Rail Transportation Division, ASME. Presented at Winter Annual Meeting and Energy Systems Exposition, Pittsburgh, Pa., Nov 12-17, 1967.

Wilson, JT Thivierge, J (Canadian National Railways)
American Society of Mechanical Engineers 67-WA/RR-3, 1971, pp 85-96, 11 Fig, 1 Ref

PURCHASE FROM: ESL Repr PC, Microfilm
DOTL TF550.G85 V.2

B2 047421
LATERAL OSCILLATIONS OF RAIL VEHICLES

The authors point out in this paper that lateral oscillations, which either do not occur or are negligible at slow train speeds, are of vital importance at the high train speeds now demanded by the railroads in order for them to complete successfully with the swiftly moving automobile and the much swifter airplane. Aside from collisions and broken rails, practically all railroad accidents result from lateral derailments, since vertical derailments occur only on those rare occasions when a bridge or trestle collapses from flood or storm. Lateral derailments are caused by lateral pressure of wheel flanges against the rail Therefore, the prevention of lateral derailments requires a knowledge of both the conditions which cause high lateral forces and of the conditions which must prevail in order to keep the lateral forces below some indicated safe value.

This paper appeared in Anthology of Rail Vehicle Dynamics, The anthology was sponsored by the Rail Transportation Division, ASME. Presented at the Annual Meeting, New York, N.Y., Dec. 2-6, 1935.

Langer, BF (Westinghouse Research Laboratories); Shamberger, JP (Westinghouse Electric Corporation)
American Society of Mechanical Engineers Paper RR-57-4, 1971, pp 121-134, 17 Fig, 4 App

PURCHASE FROM: ESL Repr PC, Microfilm
DOTL TF 550.G85 V.2

B2 047422
DYNAMIC ANALYSIS OF ROLLING FREIGHT

The dynamic equations of motion describing car rocking are presented. These equations are then simplified and used to determine car-body roll frequency and its dependence on roll amplitude. As a result of the analysis, a graphical technique was developed which shows the rail disturbance as a function of truck-center distance for any desired rail length, wheel base, track profile, and rail stagger. In addition, a brief account of the experimental history is presented.

This paper appeared in Anthology of Rail Vehicle Dynamics, Volume 2: Effects of Train Action and Rail Car Vibration. The anthology was sponsored by the Rail Transportation Division, ASME. Presented at the Winter Annual Meeting, Chicago. Ill., Nov. 7-11, 1965.

Manos, WP (Pullman-Standard Car Manufacturing Company); Shang, JC
American Society of Mechanical Engineers Paper 65-WA/RR-8, 1971, pp 135-134, 6 Fig

PURCHASE FROM: ESL Repr PC, Microfilm
DOTL TF 550.G85 V.2

B2 047426
INVESTIGATION OF THE TRUCK HUNTING INSTABILITY PROBLEM OF HIGH-SPEED TRAINS

The problem of truck hunting instability and the design implications for high-speed trains were investigated. Linearized theoretical analyses were made to identify the most important design parameters for speeds of 125 to 200 mph. Truck wheelbase, truck mass, wheel coning ratio, and springs to oppose yaw and transverse motions of the truck relative to the car body-all have large effects on the critical speed for secondary hunting instability. It appears probable that light-weight passenger cars could be designed for stable operation at speeds considerably in excess of 200 mph.

This paper appeared in Anthology of Rail Vehicle Dynamics, Volume 2: Effects of Train Action and Rail Car Vibration. The anthology was sponsored by the Rail Transportation Division, ASME. Presented at the Sequicentennial Forum on Transportation Engineering, New York, N.Y., Aug. 28-30, 1967.

American Society of Mechanical Engineers 67-TRAN-17, pp 177-188, 6 Fig, 2 Tab, 14 Ref, 1 App

PURCHASE FROM: ESL Repr PC, Microfilm
DOTL TF550.G85 V.2

B2 047428
DIGITAL COMPUTER SIMULATION OF RAILROAD FREIGHT CAR ROCKING

A mathematical model for the simulation of railroad freight car rocking is presented. The equations of the model are developed into a digital computer program. The model response is validated by two series of test results, and the model is considered reliable for engineering predictions.

This paper appeared in Anthology of Rail Vehicle Dynamics, Volume 2: Effects of Train Action and Rail Car Vibration. The anthology was sponsored by the Rail Transportation Division, ASME. Presented at the ASME-IEEE Railroad Conference, Chicago, Ill., Mar. 27-28, 1968.

Liepins, AA (Dynatech Corporation)
American Society of Mechanical Engineers Paper 68-RR-3, 1971, pp 197-204, 12 Fig, 1 App

PURCHASE FROM: ESL Repr PC, Microfilm
DOTL TF 550.G85 V.2

B2 047429
SUSPENSION DYNAMICS BY COMPUTER SIMULATION

An analytical study of the effect of changing the design parameters of a two mass, six-degree-of-freedom suspension system was made. Rail cars with coil and air springs were analyzed by analog and digital computer. Spring stiffness, spring spacing, damping rates, height of center of gravity, and total mass were varied. The effect on frequency and response were determined.

This paper appeared in Anthology of Rail Vehicle Dynamics, Volume 2: Effects of Train Action and Rail Car Vibration. The anthology was sponsored by the Rail Transportation Division, ASME. Presented at ASME-IEEE Railroad Conference, Chicago, Ill., Mar. 27-28, 1968.

Diboll, WB, Jr (Washington University, St Louis); Bieniecki, HS (McDonnell Douglas Corporation)
American Society of Mechanical Engineers Paper 68-RR-4, 1971, pp 205-214, 14 Fig, 2 Tab, 1 App

PURCHASE FROM: ESL Repr PC, Microfilm
DOTL TF 550.G85 V.2

B2 047432
GENERAL ASPECTS OF THE LATERAL DYNAMICS OF RAILWAY VEHICLES

Recent developments in research into the lateral dynamics of railway vehicles are reviewed with particular reference to dynamic stability, dynamic response, and curving. Two engineering aspects of this work are stressed-namely, the advantages of applying linear theory to a comprehensive study of vehicle dynamics, and the choice of basic assumptions required to make such studies realistic for design purposes.

This paper appeared in Anthology of Rail Vehicle Dynamics, Volume 2: Effects of Train Action and Rail Car Vibration. The anthology was sponsored by the Rail Transportation Division, ASME. Presented at the Winter Annual Meeting, New York, N.Y., Dec. 1-5, 1968.

Wickens, AH (British Railways Board Research Department)
American Society of Mechanical Engineers Paper 68-WA/RR-3, 1971, pp 241-251, 11 Fig, 34 Ref

PURCHASE FROM: ESL Repr PC, Microfilm
DOTL TF 550.G85 V.2

B2 047433
THE EFFECTS OF THE LATERAL INSTABILITY OF HIGH CENTER OF GRAVITY FREIGHT CARS

High center of gravity freight cars experience extreme weight shift from side to side as a result of lateral resonance on track with cross-level differences from alternately staggered joints, as well as soft or other local variations in either rail. Dynamic measurements from tests made on test track with controlled 3/4-in. cross-level difference changes illustrate the force and motion magnitudes resulting from resonant and near resonant operating speeds; side bearing loads of 138,000 lb and spring group loads of 100,000 lb, accompanied by center plates separating and wheels lifting. The rotational energy input to the car body can be approximated for a given motion cycle and is proportional to the product of the amplitudes of the track profile and the car body motion. The high lateral (horizontal) forces on the truck at the side bearing and center plate make the truck unstable and cause wheels to lift off the rail on one side. This lateral force at a given end of the car is proportional to the corresponding vertical side bearing load. Freight cars traveling at resonant speed are especially prone to derail on curved track under high wheel-rail friction conditions. Forces and motion generated between the car body, truck, and the track, cause high cyclical stresses and severe wear between components that can shorten equipment life and cause severe track maintenance problems.

This paper appeared in Anthology of Rail Vehicle Dynamics, Volume 2: Effects of Train Action and Rail Car Vibration. The anthology was sponsored by the Rail Transportation Division, ASME. Presented at the ASME-IEEE Railroad Conference, Chicago, Ill., Mar. 27-28, 1968

Wiebe, D (Stucki (A) Company)
American Society of Mechanical Engineers Paper 1971, pp 253-267, 16 Fig, 5 App

PURCHASE FROM: ESL Repr PC, Microfilm
DOTL TF 550.G85 V.2

B2 047436
THE HYDRACUSHION CAR

It is the object of this paper to outline briefly the unique constructional features of the Hydracushion car and to report manufacturing, operating, and maintenance experience with such cars. The damage to lading occurring in freight cars equipped with standard friction draft gears is so well recognized that many attempts have been made to develop draft gears with softer response characteristics. In any such effort the major problem is that of dissipating the energy of impact while transmitting to the contents of the car only that portion of this energy which is necessary to accelerate such contents smoothly to the final speed of the car underframe. In the Hydracushion car a hydraulic buffer has been combined with a sliding-sill cushion-type underframe to control the flux of energy to the car lading.

This paper appeared in Anthology of Rail Vehicle Dynamics, Volume 1: Freight Car Impact. The anthology was sponsored by the Rail Transportation Division, ASME. Presented at the ASME-AIEE Joint Railroad Conference, Cleveland, Ohio, April 9-10, 1958.

MacCurdy, WK Hermes, RM (Stanford Research Institute)
American Society of Mechanical Engineers Paper 58-RR-2, 1971, pp 9-13, 5 Fig, 1 Tab

PURCHASE FROM: ESL Repr PC, Microfilm
DOTL TF 550.G85 V.1

B2 047438
IMPACT AS RELATED TO FREIGHT-CAR AND LADING DAMAGE

Damage to railway cars and ladings resulting from end impact is responsible for direct and indirect losses to the American railroads probably exceeding $100,000,000 annually. The subject of impact as related to freight-car and lading damage was therefore chosen by the author's company for research study and exploration on the impact tack as a basis for the development of efficient car-cushioning products. The first part of the paper provides an analysis of the physics of impact. Next the paper reports railway-car impact studies which were made to determine the relation between car cushioning and disturbances to cars and ladings during impact.

This paper appeared in Anthology of Rail Vehicle Dynamics, Volume 1: Freight Car Impact. The anthology was sponsored by the Rail Transportation Division. ASME. Presented at the Annual Meeting, Atlantic City, N.J. Nov. 29-Dec. 4, 1959.

Baillie, WE (National Malleable and Steel Castings Company)
American Society of Mechanical Engineers Paper 59-A-249, 1971, pp 25-50, 52 Fig

PURCHASE FROM: ESL Repr PC, Microfilm
DOTL TF 550.G85 V.1

B2 047439
STUDY OF VIBRATION FREQUENCIES UNDER IMPACT CONDITIONS

This paper will present a study of vibration frequency characteristics under impact conditions for a typical friction type draft gears used on railroad freight cars, a comparison of typical instrumentation records showing force-closure clutch action of typical and representative electronic equipment used to measure these vibration forces.

This paper appeared in Anthology of Rail Vehicle Dynamics, Volume 1: Freight Car Impact. The anthology was sponsored by the Rail Transportation Division, ASME. Presented at the Annual Meeting, Atlantic City, N.J., Nov. 29-Dec. 4, 1959.

Newcomer, GH (Association of American Railroads)
American Society of Mechanical Engineers Paper 59-A-250, 1971, pp 51-58, 11 Fig, 2 Tab

PURCHASE FROM: ESL Repr PC, Microfilm
DOTL TF 550.G85 V.1

B2 047440
CUSHIONING REQUIREMENTS FOR ADEQUATE LADING PROTECTION

The problem of lading damage is approached from the standpoint of what is required to eliminate coupling impact damage to a critical class of lading under present railroad operating conditions. A series of full-scale exploratory impact tests were conducted in which a wide range of load subdividing and underframe cushion travels were studied using removable bulkheads and an adjustable cushion fixture in the test cars. The results show that to evaluate the lading protection ability of cushioned cars on the basis of the percentage reductions in coupler force or car-body accelerations alone, or because some seemingly high cushion capacity has been provided, can be very misleading when resilient types of lading are considered. Also, when 30 in. of cushion travel are used, the optimum potential of cushioning is realized and load subdividing and other means of securement are unnecessary.

This paper appeared in Anthology of Rail Vehicle Dynamics, Volume 1: Freight Car Impact. The anthology was sponsored by the Rail Transportation Division, ASME. Presented at the Annual Meeting, Atlantic City, N.J., Nov. 29-Dec. 4, 1959.

Peterson, WH (Pullman-Standard Car Manufacturing Company)
American Society of Mechanical Engineers Paper 59-A-312, 1971, pp 59-70, 21 Fig

PURCHASE FROM: ESL Repr PC, Microfilm
DOTL TF 550.G85 V.1

B2 047443
PERFORMANCE TESTS OF LONG TRAVEL CUSHION UNDERFRAMES

The concept developed in the past few years that cushion travel of at least 20 in. and preferably 30 in. is required for lading protection at impact speeds of 10 mph or more and the confirmation of this in actual practice has led to the need for further investigation of the phenomena associated with this longer range of cushion travel. In 1962 it was decided to evaluate experimentally the order of difference to be expected from sliding center-sill cars having sill travel of 20 in. and sill travel of 30 in. Also, the possibility of developing new criteria for judging the comparative performance of freight cars during impact was to be studied. The results of this investigation are reported in the paper.

This paper appeared in Anthology of Rail Vehicle Dynamics, Volume 1: Freight Car Impact. The anthology was sponsored by the Rail Transportation Division, ASME. Presented at the IEEE-ASME Railroad Conference, Atlanta, Ga., April 25-26, 1963.

Van der Sluys, W Manos, WP Marshall, MG (Pullman-Standard Car Manufacturing Company)
American Society of Mechanical Engineers Paper 63-RR-3, 1971, pp 85-99, 21 Fig, 1 App

PURCHASE FROM: ESL Repr PC, Microfilm
DOTL TF 550.G85 V.1

B2 047444
SHOCK AND VIBRATION ON RAILROAD MOVEMENT OF FREIGHT
One of the more pressing problems concerning rail movement of freight is the cost of securing lading to the car and protecting it properly from impact shock. The highway truck has an advantage in this regard because friction between rubber tires and pavement govern the maximum longitudinal forces developed, except for dock impacts. Rail, however, has the advantage in vertical and lateral shock and vibration control and, with proper design and operation, can meet the truck's longitudinal conditions. Adverse criticism has been received by the railroads because of their past reluctance to take the necessary steps to reduce lading damage. We now have the hardware to provide this protection, and the rail industry as a whole is rapidly applying it to its more critical loads. The purpose of this paper is to acquaint the shipper with the railroad environment and with the characteristics of the equipment available for controlling it.

This paper appeared in Anthology of Rail Vehicle Dynamics, Volume 1: Freight Car Impact. The anthology was sponsored by the Rail Transportation Division, ASME. Presented at the Winter Annual Meeting, New York, N.Y., Nov. 29-Dec. 4, 1964.

Simmons, LC Shackson, RH (Penn Central Transportation Company)
American Society of Mechanical Engineers Paper 64-WA/RR-7, 1971, pp 101-107, 8 Fig, 2 Tab

PURCHASE FROM: ESL Repr PC, Microfilm
DOTL TF 550.G85 V.1

B2 047446
ANALOG-COMPUTER SIMULATIONS OF END IMPACT OF RAILWAY CARS
Description is given of attempts to simulate, on an analog computer, the impact of two railway cars. It is found that considering each car as a single lumped mass gives results nowhere near those measured from physical tests. Considering each car to consist of two lumps, structure and lading, allows reasonably accurate results to be obtained, as shown by various comparisons of simulated and physical results. The complication involved in making better representations of railway cars is discussed in relation to the problems of simulating the overall motions of trains.

This paper appeared in Anthology of Rail Vehicle Dynamics, Volume 1: Freight Car Impact. The anthology was sponsored by the Rail Transportation Division, ASME. Presented at the IEEE-ASME Railroad Conference, Pittsburgh, Pa., April 7-8, 1965.

Roggeveen, RC (National Research Council of Canada)
American Society of Mechanical Engineers Paper 65-RR-3, 1971, pp 115-130, 21 Fig, 3 Tab, 16 Ref, 1 App

PURCHASE FROM: ESL Repr PC, Microfilm
DOTL TF 550.G85 V.1

B2 047447
PERFORMANCE OF TOFC-COFC ARRANGEMENTS IN YARD-TYPE IMPACT TESTS
As shipment of trailers and containers by rail continues to increase, there is a growing tendency not to provide special handling, and, ultimately, complete mixed service through hump yards is desirable. For this reason the cushion arrangements to provide protection to the lading during impact are of growing importance. There is a variety of arrangements available, but until recently no direct comparison had been made by tests of cushion effectiveness. The purpose of this paper is to present this factual comparative test data, to relate this to the normal railroad operation, and to indicate cushion requirements, limitations, and related problems in moving toward unrestricted handling of piggyback and container cars.

This paper appeared in Anthology of Rail Vehicle Dynamics, Volume 1: Freight Car Impact. The anthology was sponsored by the Rail Transportation Division, ASME. Presented at the Winter Annual Meeting and Energy Systems Exposition, New York, N.Y., Nov. 27-Dec. 1, 1966.

Van der Sluys, W Spence, JH Marshall, MG (Pullman-Standard Car Manufacturing Company)
American Society of Mechanical Engineers Paper 66-WA/RR-1, 1971, pp 131-142, 24 Fig, 1 Tab

PURCHASE FROM: ESL Repr PC, Microfilm
DOTL TF 550.G85 V.1

B2 047450
DYNAMIC ANALYSIS OF LONG-TRAVEL, HIGH-EFFICIENCY SHOCK ABSORBERS IN FREIGHT CARS
A dynamic analysis is presented relating the principle design parameters of a constant force type, dissipative shock absorber to the forces experienced by a resilient lading. The analysis, which correlates the effects of coupler force, lading force, cushion travel, closure time, impact speed, and friction, represents an application of classical mechanics to a dynamical system with sliding friction (Coulomb damping). Although a lumped-parameter analysis forms the basis of the derivation, a procedure is described which takes into account the mass-and compliance distribution within the lading.

This paper appeared in Anthology of Rail Vehicle Dynamics, Volume 1: Freight Car Impact. The anthology was sponsored by the Rail Tranpsortation Division. ASME. Presented at the ASME-IEEE Joint Railroad Conference, Philadelphia, Pa., April 7-8, 1970.

Freudenstein, F (Columbia University, New York)
American Society of Mechanical Engineers Paper 70-RR-1, 1971, pp 153-161, 8 Fig, 25 Ref, 1 App

PURCHASE FROM: ESL Repr PC, Microfilm
DOTL TF5.A72 1970

B2 047451
CUSHIONING PERFORMANCE-AN IN-SERVICE EVALUATION
Freight car cushioning equipment has been exhaustively tested over the years by railroads and railroad suppliers alike. This effort, however, has been generally limited to physical testing of the equipment performance under impact conditions. Little work has been reported in terms of the cushioning equipment effect on commodities transported in freight cars. This effect can be evaluated in terms of loss and damage claim prevention. This report relates one railroad's in-service experience with the loss and damage performance of cushioned freight cars. The statistical data upon which the evaluation is based was analyzed thoroughly to ensure that the results accurately depicted the differential utilization, commodity value or susceptibility, loading practices, yard handling practices, etc. Based on the results of this evaluation it was concluded that cushioning equipment reduces loss and damage claims but the reduction is insufficient in itself to justify the application of cushioning units to all cars.

This paper appeared in Anthology of Rail Vehicle Dynamics, Volume 1: Freight Car Impact. The anthology was sponsored by the Rail Transportation Division, ASME. Presented at the ASME-IEEE Joint Railroad Conference, Philadelphia, Pa., April 7-8, 1970.

Luebke, RW (Chessie System)
American Society of Mechanical Engineers Paper 70-RR-4, 1971, pp 169-175, 7 Fig, 4 Tab

PURCHASE FROM: ESL Repr PC, Microfilm
DOTL TF.5A72 1970

B2 047554
OPERATING DYNAMICS--AN EMERGING BASIS FOR EQUIPMENT DESIGN
It is improbable that the rate of improvement in car utilization achieved in the 1960's can be duplicated by the same factors in the 1970's. The cost per freight car is steadily rising. Utilization and serviceability of new and existing cars must increase to meet the performance required in projected demands. In April 1925 the American Railway Association published Appendix A of Circular No. D.V. 400 on fundamentals of car design. In September 1964 the railroad industry adopted "Specifications for Design, Fabrication, and Construction of Freight Cars." Car technology can be characterized as evolutionary. To upgrade existing freight car standards, and to provide for equipment of the future, recourse is necessary for incorporating dynamic inputs into freight car designs and tests.

Proceedings of the 1972 Railroad Engineering Conference, Advancing Freight Car Design to Meet the Changing Environment of Modern Train Operations, Sponsored by Dresser Industries, Incorporated, 6-8 September 1972.

Byrne, R (Southern Pacific Transportation Company)
Dresser Transportation Equipment Division Proceeding 1972, pp 46-49

PURCHASE FROM: ESL Repr PC, Microfilm
DOTL RP

B2 047839
PASSENGER RIDE COMFORT ON CURVED TRACK
This report gives the results of tests carried out to obtain the necessary data for making recommendations for the permissible speed on curves and the length of transition curves for passenger comfort, and for establishing clearance requirements on curved track. Present speed limitations were established in 1914 by mathematical analysis, personal observation and experience. Since that time changes have been made in track, increases in operating speeds, and the introduction of modern-type passenger equipment with markedly different truck and springing arrangements: In addition, electrical measuring equipment is now available permitting a more exact and scientific evaluation of quantities related to ride comfort. From the results of these tests it was possible to establish a very satisfactory relationship between passenger reaction and the amount of lateral acceleration so that in subsequent tests it was not necessary to use passenger observers. To obtain data on the various types of modern passenger cars being used, running tests were subsequently made on the New York, New Haven & Hartford, the Lackawanna, the Pennsylvania, the Milwaukee, the Santa Fe, and the Burlington Railroads. These tests included not only measurements of lateral acceleration and car body roll on many curves and many miles of track under operating speeds, but also included static lean measurements of the car to determine data on the relationship between car body roll and unbalanced elevation. From a comprehensive study and analysis of these data as presented in the accompanying report, conclusions and recommendations have been formulated.
Reprinted from AREA Proceedings, Volume 56, 1955.

Association of American Railroads Proceeding 1955, 79 pp, Tabs, Figs

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AAR Repr PC
DOTL RP

B2 047995
DERAILMENT COEFFICIENT AND CLIMBING PROBABILITY OF WHEEL FLANGE
Derailment coefficients in running of 2,500 wagons of different categories, loaded or empty, were measured and the data collected were analyzed. Meanwhile, using a derailment test car, the climbing of three different wheels on five types of rails was observed and the data on their climbing probabilities were examined for different values of derailment coefficient.

Tanahashi, H *Railway Technical Research Institute* Quart Rpt. Vol. 14 No. 1, Mar. 1973, pp 29-34, 18 Fig., 2 Tab.

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Japanese National Railways Kunitachi, Box 9, Tokyo, Japan Repr PC
DOTL JC

B2 047998
ON THE MEASURING METHOD OF THE CREEP FORCE BETWEEN WHEEL AND RAIL
When a wheel runs on a rail, there occurs a small slip at the contact surface between wheel and rail. When slip is very small the tangential force is in proportion to the slip. The proportional constant is so called creep coefficient. An experiment to measure the creep coefficient was carried out with one-fifth scale model. As the results, the following facts were obtained: 1. The value of creep coefficient increases in proportion to the wheel load to the two-thirds power, that value is nearly close to $F = 1/\pi \times$ area of ellips x Young's modulas. 2. The longitudinal creep coefficient is larger than the lateral one. 3. As slip increases, non-linear characteristics appear. 4. The value of creep coefficient is in inverse proportion to the displacement of wheelset, that is, as the displacement becomes large, the value of creep coefficient becomes small.

Yokose, K *Railway Technical Research Institute* Quart Rpt. Vol. 14 No. 1, Mar. 1973, pp 43-47, 10 Fig., 2 Tab.

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Japanese National Railways Kunitachi, Box 9, Tokyo, Japan Repr PC
DOTL JC

B2 048016
BULLET TRAINS REVISITED
The Japanese National Railroads last year opened the first extension of its high-speed Shin Kansen (New Trunk Line) System. The article summarizes the success of the ten years of operation of the original New Tokaido Line. The article discusses the planned expansion of the Shin Kansen to link all major Japanese Cities, and the passenger volume potentials in such expansions. Also discussed are the track maintenance requirements for the high speed service. The article concludes with a comparison of the proposed expanded Shin Kansen System and the short range jumbo jet 'air buses' on order by the two Japanese air carriers.

Middleton, WD *Trains* Vol. 33 No. 12, Oct. 1973, 7 pp, Figs

PURCHASE FROM: Kalmbach Publishing Company 1027 North 7th Street, Milwaukee, Wisconsin, 53233 Repr PC
DOTL JC

B2 048019
ROLLING STOCK AND VERY HIGH SPEEDS
Existing networks would seem to be limited to 200 km/h, achieving overall averages of 145/150 km/h, while body-tilting can appreciably cut journey times of services now restricted to 120/130 km/h maxima. At very high speeds the author considers such techniques of questionable value. Braking of 200/300 km/h trains are considered in three groups.

Portefaix, A (French National Railways) *Rail Engineering International* Vol. 3 No. 6, July 1973, 4 pp, 10 Fig

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DOTL JC

B2 048252
WEAR AND REPAIR--SHOP PROBLEMS IN THE CASE OF OVERSEAS HIGH PERFORMANCE FREIGHT RAILWAYS [VERSCHLEIS UND WERKSTATTPROBLEME BEI UBERSEEISCHEN HOCHLEISTUNG-GUTERBAHNEN]
With the help of details of the experience acquired by railways in America and Africa, in connection with the transport of minerals, a group of experts has examined the conditions which are necessary for achieving an optimum balance between the wear on the running gear of rolling stock and that on the rail, and the cost of maintenance. They have established the technical and economic criteria showing the effect of the weight per axle on wear in the case of the different track gauges, and in relation to the diameter of the wheels, the profile of the rail tread, and the radius of curve of the track. This study has enabled it to be established that rail-wheel wear is directly proportional to the weight per axle, and inversely proportional to the diameter of the wheels, and that resistance to traction increases with the track gauge and the wheelbase. [German]

Schroeter, H *Glasers Annalen ZEV* July 1972, 9 pp, 16 Fig, 2 Tab, 19 Ref

ACKNOWLEDGMENT: UIC (1336)
PURCHASE FROM: International Union of Railways, BDC 14 Rue Jean Rey, Paris 15, France Repr PC
DOTL JC

B2 050072
EFFECT OF FLAT WHEELS ON TRACK AND EQUIPMENT
Although old, this work is generally considered to be an excellent reference on this subject. The report describes the Test Apparatus and the Tests, presents the results of the tests, and presents some conclusions from the tests. The conclusions cover the effect of train speed, the effect of flat spot length, the effect of wheel load, and the impact force of a flat spot; and recommend guidelines for removing wheels from service and for running cars with flat wheels to terminals for service.

Association of American Railroads Technical Center May 1951, 81 pp, 27 Fig, 3 Tab, 9 Ref

ACKNOWLEDGMENT: Association of American Railroads Research Center (f4196)
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr PC
DOTL RP

B2 050352
TURBOTRAIN TESTS PROVIDE DATA FOR 260 KM/H OPERATIONS
The SNCF's experimental TGV.001 turbotrain had covered 125,000 km on test runs by mid-July, 35 of which have exceeded 300 km/h. After modifications and investigations in the works at Bischheim are complete, the test programme will be concluded in the autumn. However, results so far provide a solid basis on which commercial service at 260 km/h can be offered, while a mass of data not available hitherto on vehicle and track dynamics and train resistance in the 250 to 300 km/h range has been assembled.

Railway Gazette International Vol. 129 No. 9, Sept. 1973, 5 pp

PURCHASE FROM: IPC Transport Press Repr PC

DOTL JC

B2 050355
INFLUENCE OF SOME PARAMETERS OF THE RAILROAD ROLLING STOCK ON ITS VERTICAL DYNAMICS [VLIYANIE NEKOTORYKH PARAMETROU ZHELEZNODOROZHNOGO EKIPAZHA NA EGO VERTIKALNUYU DINAMIKU]
Analytical relations are obtained permitting an evaluation to determine to which oscillations--hopping or galloping--a particular railroad vehicle is most likely to be liable. It is shown that the inertia radius of the superstructure above the carriage spring, the number of axles and distance between them have an effect on the kind of the prevailing oscillations. A solution is found for carriages with any number of axles. It is noted that carriages with an odd number of axles are more liable to galloping oscillations. [Russian]

Nikitin, SV *Izvestiia Vysshikh Uchebnykh Zavedenii, Mashinostr* No. 4, 1973, pp 103-107

ACKNOWLEDGMENT: EI (EI 73 044917)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL RP

B2 050368
EFFECT OF TRACK GEOMETRY ON RIDE QUALITY
Track measuring cars provide an indication of what is off-standard in a section of track but give little indication of which variables are the most crucial to the production of a good ride. An approach which is being employed in an attemtp to bridge the gap between the track geometry and the quality of ride obtained on a given track section is described. Some preliminary results and conclusions are presented.

Ullman, KB (Department of Transportation); O'Sullivan, WB *IEEE Transactions on Industry & Genrl Applications* Vol. IGA-7, No. 6, pp 755-759

ACKNOWLEDGMENT: EI (EI 72 33184)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B2 050386
ADHESION CONTROL IN HIGH-SPEED WHEEL-RAIL INTERACTION
The paper presents experimental findings on a rolling contact apparatus and discusses a potential approach to improve the adhesion limits at high speeds by controlling the microvibrations in the contact area. Experiments were performed on the model rolling contact apparatus. The test wheel is driven by the 10-in. diam simulated track wheel. A braking torque can be applied to the test wheel by an air-brake through a timing belt pulley.

Presented at the Joint ASCE-ASME Transportation Engineering Meeting, July 26-30, 1971, in Seattle, Washington.

Paul, IL (Massachusetts Institute of Technology)
American Society of Mechanical Engineers Preprint #1522, July 1971, 27 pp, 23 Ref

ACKNOWLEDGMENT: EI (EI 72 15762)
PURCHASE FROM: ESL Repr PC, Microfilm

B2 050429
ELECTRONIC ANALOG COMPUTER FOR ONLINE PROCESSING OF VEHICLE OSCILLATION
The design of an analog computer is reported which is used for online computation of the ride index of railway vehicles, average and rms values of vehicle acceleration and the number of acceleration peaks exceeding the preset levels on long test runs.

Shukla, YD (Ministry of Railways, India) *Institution of Eng (India) J, Elect Telecom Eng D* Vol. 53 Part ET5, May 1973, pp 176-179

ACKNOWLEDGMENT: EI (EI 73 049907)
PURCHASE FROM: ESL Repr PC, Microfilm

B2 050430
ARE THE BIG ONES TOO BIG?
It is the author's opinion that average statistics understate the impact large cars are having on many railroads. Wear and tear on the track is significant with large cars. A tabulation of gross axle weights is presented. The author feels there are some stiff economic penalties to large cars, and that further studies are needed on impact of the cars on the track and on the economic size for cars.

Meislahn, HS *Modern Railroads* Vol. 28 No. 11, Nov. 1973, pp 76-78

PURCHASE FROM: Cahners Publishing Company, Incorporated 5 South Wabash Avenue, Chicago, Illinois, 60603 Repr PC

DOTL JC

B2 050488
DYNAMIC RESPONSE OF RC SLAB BRIDGE TO PASSAGE OF VEHICLES
The dynamic response of simple beams in railway bridge is shown. The analysis takes into account the dynamics of bridge and four moving vehicles. Applying to the slender reinforced concrete slab bridge of Shinkansen, the dynamic bending moment and deflection are calculated, and they are compared with the results of the measurement of a Shinkansen bridge.

Okada, K *Railway Technical Research Institute* Quart Rpt Vol. 14 No. 1, Mar. 1973, pp 14-15, 5 Fig

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Japanese National Railways Kunitachi, Box 9, Tokyo, Japan Repr PC

B2 050577
THE CONTRIBUTION OF TRIBOLOGY TO THE DEVELOPMENT AND OPERATION OF RAILWAYS
The contributions of the railway pioneers to the development of tribology is reviewed. The numerous locations within a modern electrified railway wherein surfaces interact in relative motion are listed and discussed from the point of view of reduction in maintenance and enhancement of reliability. In particular, recent work on adhesion between wheel and rail is reviewed.

Barwell, FT *Institution of Electrical Engineers, Proceedings* Vol. 187 No. 1, 1973, 16 pp, 8 Fig

ACKNOWLEDGMENT: International Railway Documentation
PURCHASE FROM: International Union of Railways, BDC 14 rue Jean Rey, 75015 Paris, France Repr PC

859

B2 050589
ADHESION AND THE CONTACT SURFACE BETWEEN WHEEL AND RAIL [SILOVE A GEOMETRICKE POMERY VE VZTAHU K ADHEZI VYVOZENE PUSOBENIM KILOVEHO TLAKU]
The article contains a description of the history of research into adhesion, and deals with the position in the area of contact between wheel and rail. It also contains observations concerning the correlations between the different principal factors which affect the form and dimensions of the contact surface between wheel and rail, and which determine them in cases when the normal effort is the only outside force. This simplifying hypothesis provides a possibility of constructing mathematical relations on the basis of which it is possible to develop considerations concerning the contact surface under the simultaneous effect of the adhesive weight and the tangential effort. Finally, the author describes the method of establishing, on the one

hand, the area of the surface of contact of the wheel and the rail, in the case of a used, and an unused, rail head, and, on the other, the rate and strength of the pressure in the wheel. [Czechoslovakian]

Svejnoch, V *VSD A VUD Sbornik Praci* No. 56, 1973, 31 pp, 27 Fig, 4 Tab, 7 Ref

ACKNOWLEDGMENT: International Railway Documentation
PURCHASE FROM: International Union of Railways, BDC 14 rue Jean Rey, 75015 Paris, France Repr PC

904

B2 050675
PRESENT KNOWLEDGE OF ADHESION AND ITS UTILISATION
The phenomenon of adhesion has since become the vital problem, representing the principal limitation to the increase in the magnitude of the tractive and braking forces at low speed as well as at medium speed. Scope and nature of the investigations concerning adhesion and its utilization have obviously developed in parallel to the importance attached to the problem itself. During the last decades, research on the subject of adhesion has not only developed considerably but its nature has also undergone a remarkable development. These different research programmes have already enabled several countries to achieve substantial improvements in the values of the adhesion coefficient which were applied in connection with the calculation of maximum train loads.

Verbeeck, H *Rail International* No. 6, June 1973, 34 pp, 27 Fig, 53 Ref

ACKNOWLEDGMENT: Rail International
PURCHASE FROM: International Railway Congress Association 17-21 rue de Louvrain, 1000 Brussels, Belgium Repr PC

DOTL JC

B2 050729
ANALYSES OF RAIL VEHICLE DYNAMICS IN SUPPORT OF DEVELOPMENT OF THE WHEEL RAIL DYNAMICS RESEARCH FACILITY
The development of experimental facilities for rail vehicle testing at the DOT High Speed Ground Test Center is being complemented by analytical studies. The purpose of this effort has been to gain insight into the dynamics of rail vehicles to guide the equipment development and to establish an analytic framework for the design and interpretation of tests to be conducted at the facility. The mechanics of rail vehicle lateral guidance are reviewed on the basis of linearized models. Computer programs are developed for predicting stability and general lateral response characteristics. Computer programs for predicting vertical and pitch vehicle response to track irregularities are included. (Modified author abstract)

Weinstock, H
Transportation Systems Center Intrm Rpt DOT-TSC-UMTA-72-10, June 1973, 228 pp

Contract DOT-MA-06-0025

ACKNOWLEDGMENT: NTIS (PB-222654/6)
PURCHASE FROM: NTIS Repr PC, Microfiche

PB-222654/6

B2 051374
SIDE BUFFERS AS TRAIN STABILIZERS
This short article discusses the use of side buffers as train stabilizers. It comments on their success on Amtrak's French Turbotrains, and suggests their use on the Metroliners.

Scales, BT *Railway Engineering Journal* Vol. 2 No. 6, Nov. 1973, 1 p, 1 Fig, 1 Ref

PURCHASE FROM: Institution of Mechanical Engineers 1 Birdcage Walk, Westminster, London SW1, England Repr PC

DOTL JC

B2 051395
THE FRICTION DAMPER
Constant-force dampers are attractive for rolling stock with small differences between loaded and empty conditions such as passenger coaches but are not for freight wagons where the tare/loaded weight ratio is high which calls for displacement-responsive damping. Friction damping and viscous-damping are mathematically compared and assessed. The author warns of pitfalls when 'scaling down'.

Koffman, JL *Rail Engineering International* Vol. 3 No. 9, Nov. 1973, p 414-420, 15 Fig

ACKNOWLEDGMENT: Rail Engineering International
PURCHASE FROM: Broadfields (Technical Publishers) Limited Little Leighs, Chelmsford, Essex CM3 1PF, England Repr PC

DOTL JC

B2 051407
TRANSIT CAR RIDE QUALITY: PREDICTION, TEST AND IMPROVEMENT
Techniques for evaluating rail car vibratory accelerations against various forms of ride quality criteria are discussed. The development of a computer program to predict these vibratory accelerations is described, and the results obtained from the program are validated by comparison with field test data and data obtained from laboratory vibration tests on a full-scale truck. An active suspension concept to improve ride quality is described, and laboratory test results of several candidate active suspension systems are presented.

Contributed by the Intersociety Committee on Transportation for presentation at the Intersociety Conference on Transportation, Denver, Colo., Sept. 23-27, 1973.

Rinehart, RE Roach, RE, Jr Bain, JA Croshaw, PF (General Electric Company)
American Society of Mechanical Engineers Paper 73-ICT-76, Sept. 1973, 20 pp, 17 Fig, 1 Tab, 8 Ref

ACKNOWLEDGMENT: ASME Journal of Mechanical Engineering
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL RP

B2 051904
ABBREVIATED REPORT ON FREE LATERAL OSCILLATIONS IN LONG FREIGHT TRAINS
This report is an abbreviated form of a full report which has been prepared describing a study of lateral vibrations in long freight trains. A mathematical model for investigating the dynamic stability of cars in long freight trains was developed which takes into account the effects of coupler forces. The model was used to investigate the stability characteristics of a specific three-container car employed by Canadian National Railways for which dynamic stability data is available, and the model was able to predict the behavior of this car accurately. Groups containing up to sixteen cars were investigated, and the results indicate that the range of train velocities for which a long freight train will exhibit stable behavior can apparently be determined with satisfactory accuracy by consideration of individual cars free of coupling forces. The model includes the effects of creep and spin forces at the rail-wheel interface, spin forces being found to have an important effect on the determination of dynamic behavior. The lozenge stiffness of freight-car trucks was shown to be an important parameter with regards to dynamic stability. It is possible to define an optimum value of lozenge stiffness for which freight trucks of the type used in North America would be stable for all speeds of interest for freight trains. More importantly, this optimum value would also result in a well damped response of freight trucks to track irregularities in nominally straight track.

Blader, FB Kurtz, EF
Canadian Institute of Guided Ground Transport #73-2, Feb. 1973

ACKNOWLEDGMENT: CIGGT
PURCHASE FROM: CIGGT Repr PC

B2 051916
STABILITY OF HIGH SPEED TRAINS
Recent developments in the understanding of the lateral dynamics of railway vehicles are reviewed with particular reference to the problems of dynamic stability, guidance and response to track features. The emphasis is placed on the physical models used and the broad conclusions they lead to, rather than the engineering design that represents the practical applications of the subject.

Wickens, AH *Physics in Technology* Vol. 4 No. 1, 1973, 17 pp

ACKNOWLEDGMENT: British Railways (29806)
PURCHASE FROM: American Institute of Physics 335 East 45th Street, New York, New York, 10017 Repr PC

B2 052310
ENGINEERING ASPECTS IN THE OPERATION OF LONG CARS
Engineering aspects are discussed in the operation of long cars. Problems discussed include loading and unloading, clearances, negotiability of sharp curves, derailment, fatigue cracks, and rocking action. Geometry of coupled cars is noted. Problems are being continually investigated, and progress has been made in increasing clearances, suggesting new car design, and analyzing tests dealing with impact and lateral car motion.

Magee, GM (Association of American Railroads) *AREA Bulletin* Proceeding Vol. 65 N No. 86, July 1964, pp 743-747, 2 Fig

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

B2 052380
EFFECT OF SPRING TRAVEL, HEIGHT OF CENTER OF GRAVITY, AND SPEED ON FREIGHT CAR CLEARANCE REQUIREMENTS ON CURVED AND TANGENT TRACK
Two fully loaded 70 ton cars used to determine the effect of spring travel, the height of the center of gravity, and speed on freight car clearance requirements on curved and tangent track. Car A had 5/8-inch travel springs; Car B, 3 11/16-inch travel springs. Static lean tests and dynamic tests were performed. The longer travel-springs gave a softer ride, and when used in conjunction with a damping device resonant vertical oscillations were greatly reduced. The vertical ride was improved, but lateral stability, especially in roll was much less. The average total lateral displacement on Car B with the long travel-springs was about twice that for Car A with short springs. Therefore, use of cars with long travel-springs requires careful considerations of clearances in locations where they tend to be critical. Car B also required higher vertical clearances. The larger displacements for Car B were mostly due to its larger roll angle. Speed was a factor in the dynamic action of the freight cars. Oscillations at lower speeds were sustained, indicating a resonance of the roll mode with some periodic disturbances. There were some large roll amplitudes for the higher speeds at entrances and exits of curves. Only low speeds, such as 5 mph, were free from these oscillations.

AREA Bulletin Proceeding Vol. 59 1958, pp 305-361, 30 Fig, 4 Tab, 8 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

B2 052382
CLEARANCE ALLOWANCES TO PROVIDE FOR VERTICAL AND HORIZONTAL MOVEMENTS OF EQUIPMENT DUE TO LATERAL PLAY, WEAR AND SPRING DEFLECTION
A study on a method of ascertaining the lateral displacement of a moving car due to track irregularities and the dynamic behavior of the equipment is discussed. The results of an analysis of running test tracings on 8 passenger cars with different truck types is shown. The angular variation noted is a function of speed. A comparative tabulation of lateral displacements of the cars at a point 11 feet above the top of rail, based on the cars moving at 70 mph and at 3-in. unbalanced elevation is presented.

AREA Bulletin Proceeding Vol. 59 1958, pp 661-670, 9 Fig, 1 Tab

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

B2 052438
PRELIMINARY TEST TO CORRELATE PASSENGER RIDE COMFORT ON CURVED TRACK WITH LATERAL ACCELERATIONS
A description and results of tests made on the Louisville & Nashville Railroad to obtain data for re-examining the present practice of establishing maximum comfortable speed on curved track on the basis of 3 in. unbalanced elevation was given. Accelerometers were applied to the Chesapeake & Ohio track inspection car on a regular inspection run. Measurements were obtained on sections of the L & N main line containing many curves of various degrees of curvature. Twelve observers rode in the test car and recorded their impressions of the riding conditions on each curve. These observations were correlated with the measured lateral acceleration and calculated unbalanced elevation for each curve. This was a preliminary test with the objective of establishing methods of measurements and correlation of ride impressions to form the basis for securing more extensive measurements. The important conclusions are: 1) The 3-in. unbalanced elevation gives a very satisfactory riding condition. 2) The tests demonstrated that the amount of tilting of the car body on the springs is a very important factor because it reduces the effectiveness of the elevation and increases the acceleration on the passenger. 3) The tests have greatly clarified the future course that needs to be followed to establish a satisfactory method of speed limitation based on scientific measurements.

AREA Bulletin Proceeding Vol. 52 1951, pp 576-588, 4 Fig, 1 Tab, 4 Ref

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

B2 052533
BEHAVIOR OF THE METAL OF RAILS AND WHEELS IN THE CONTACT ZONE. EXPERIMENTAL STUDIES: 1) WORK-HARDENING SPEED WITH THE EMS 60 MACHINE (ADDITIONAL MEASUREMENTS), 2) RESIDUAL STRESSES IN HARD-GRADE STEEL RAILS (ADDITIONAL MEASUREMENTS) 3) CHECKING OF FATIGUE CRITERION PROPOSED BY MR. DANG VAN
This report is in three parts: 1) Work-hardening speed examined with the EMS 60 machine: The development of the two principal residual stresses produced on the running surface of rails made of different grades of steel has been studied as a function of the repeated passages of a loaded wheel. It has been shown that this development ceases at about approximately 1 million cycles. 2) Residual stresses in hard-grade steel: These stresses have been measured inside 2 rails of hard-grade steel, one new and the other work-hardened in service. The use of the rail in the track produces severe longitudinal and transverse compressive stresses at the surface. The stress field is affected strongly throughout the height of the rail-head. 3) Checking of fatigue criterion proposed by Mr. Dang Van: The fatigue limits of a rail steel have been determined for different cases of stressing. The results have enabled the validity of the fatigue criterion proposed by Mr. Dang Van (see Report C 53/RP 7) to be confirmed.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways C53/RP 8/E, Oct. 1973, 31 pp, Figs., 2 Tab.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B2 052545
VIENNA ARSENAL VEHICLE TESTING STATION, REPORT ON TESTS DURING 1972 AND 1973 BEFORE RECONSTRUCTION
A description of the Vehicle Testing Station at Vienna Arsenal, indicating its present and future capabilites, together with a summary of the activities of 1972 and of 1973 until the closure for reconstruction is given. Standard test programmes for passenger coaches and refrigerator vans are described briefly. Tests were undertaken on coaches, wagons, containers and locomotives of many types, and in addition the facilities of the station were used in icing tests on the catenary, aerodynamic tests on a scale-model of a building development, and aerodynamic tests on bob-sleighs. Further work was done for the European Airbus group.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways AZ 30/RP 13/E, Oct. 1973, 53 pp, 15 Fig., Tabs.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B2 052547
INTERACTION BETWEEN VEHICLES AND TRACK. GEOMETRY OF THE CONTACT BETWEEN WHEELSET AND TRACK. PART I: METHODS OF MEASUREMENT AND ANALYSIS

The geometry of the contact between wheelset and track introduces the equivalent conicity concept, which is one of the important parameters intervening in the study of the riding stability of railway vehicles. After having outlined a concise theory and after having described some devices permitting the recording of wheel and rail profiles, the calculation methods and the results obtained are described.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways C116/RP 3/E, Oct. 1973, Figs., 4 Ref., 14 App.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B2 052551
STANDARDISATION OF WHEEL PROFILES. RECOMMENDATIONS CONCERNING A UNIVERSAL WHEEL PROFILE ADAPTED TO WEAR (UIC/ORE PROFILE) VALID REGARDLESS OF THE WHEEL DIAMETER AND THE TYPE OF VEHICLE

Following the studies carried out by a special group of "Rolling Stock" and "Track" Specialists, a "standard profile adapted to wear" has been developed. This profile, called the "UIC/ORE profile", does not constitute a compromise but, on the contrary, combines the best elements of the existing profiles. Together with the appropriate justifications and arguments, the present report gives the geometrical values recommended for the shape of the flange and for the outer part of the tread, the mathematical representation of the standardized profile, and the recommendations for its practical application. The "UIC/ORE profile" is valid regardless of the wheel diameter (ranging from 1000 mm to 330 mm for trailer stock) and the type of vehicle. In the opinion of the Specialists, it permits speeds of up to 140 km/h to be attained for old types of non-bogie vehicles and bogie vehicles, and 160 and even 200 km/h for vehicles equipped with modern bogies. The adoption of this "adapted wear profile", combined with the use of wheels with treated rim (see Report B 98/RP 9), should permit the greater part of the Administrations to achieve substantial economies (materials, staff, machine-tools, vehicle stoppages,...) due to the reduction in the number of re-profilings and the elimination of flange-wear.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways S1002/RP 2/E, Apr. 1973, 32 pp, Figs., Apps.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B2 052555
BEHAVIOUR OF THE METAL OF RAILS AND WHEELS IN THE CONTACT ZONE. CALCULATION OF THE COMPLEX STRESS CYCLES IN THE RAIL SUBJECTED TO ROLLING LOADS. ASSESSEMENT OF THE DANGER OF DAMAGE (CONTINUED)

This study deals with new calculations of the composition of the residual stresses and the stresses induced in the rail during the passage of wheels, for different loading values, wheel diameters and wheel-tyre transverse curvatures. One thermal stress and three residual stresses have been considered. The latter have been calcuated and then measured with the help of an original strain-gauge method. The danger of rail damage has then been evaluated by means of the damage line criterion proposed by Mr. Dang Van (see C 53/RP 7 and C 53/RP 8). It has been possible in this way to define the danger factor for each loading case. It has been shown that two types of danger exist, namely, fatigue and plastic deformation.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways C53/RP 9/E, Oct. 1973, 27 pp, 26 Fig., 5 Tab., 2 App.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B2 052563
CONSTRUCTIONAL ARRANGEMENTS FOR IMPROVING THE RIDING STABILITY AND THE GUIDING QUALITY OF ELECTRIC AND DIESEL LOCOMOTIVES AND VEHICLES. MEASUREMENT OF THE FORCES ACTING BETWEEN WHEEL AND RAIL

The knowledge of the forces acting between wheel and rail is important when studying the riding stability of a vehicle. Several procedures are available to measure these forces using measuring wheelsets. Several Administrations have developed, for this purpose, wheelset calibration rigs, whose design is described in a special chapter. Another chapter concerns the costs of these measurements. Some application examples should give an idea of the possibilities offered by the methods described.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B10/RP 14/E, Oct. 1973, 46 pp, Figs., 9 Ref., Apps.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B2 052572
AN ANALOG-DIGITAL METHOD OF DETERMINING VERTICAL TRACK IRREGULARITIES AS THE EXCITATION OF A RAIL VEHICLE'S VERTICAL OSCILLATIONS

Unknown dynamic parameters of the track have been obtained by statistical calculations. The parameters are used to design an analog-system to determinate a "substitute vertical track irregularity" as an excitation of vertical vehicle oscillations for the accepted model of the track. The signal recorded on the magnetic tape may also be used for an analog study of the vertical vibrations of other vehicles. The computations have been based on the correlation function method.

This paper was presented at the Third ORE Colloquium held in Amsterdam, May 8th to 10th 1973, and its Summary is contained in the Colloquium report #AZ40/RP 5/E; See RRIS #052511. Restrictions on the use of this document are contained in the explanatory material.

Kosieradski, W
International Union of Railways June 1973

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B2 052575
STUDY OF THE LATERAL STABILITY OF A BOGIE

This study permits a mathematical model to be found representing the movements of free bogie supporting a given load and running on a straight track of good quality. Starting from this model, it is possible to show the influence of the principal structural-design features of a bogie on its critical speed, namely: (1) characteristics of the connections between bogie-frame and axles; (2) bogie wheelbase: (3) sprung mass: and (4) equivalent conicity characterising the geometry of the contact between rail and wheel. This study has permitted the optimization of the choice of constructional characteristics of the bogies of the SNCF TGV 001 trainset.

This paper was presented at the Third ORE Colloquium held in Amsterdam, May 8th to 10th 1973, and its Summary is contained in the Colloquium report #AZ40/RP 5/E; See RRIS #052511. Restrictions on the use of this document are contained in the explanatory material.

Joly, R
International Union of Railways June 1973

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B2 052633
INTERACTION BETWEEN VEHICLES AND TRACK. EQUATIONS OF MOTION OF A RAILWAY VEHICLE
The equations of motion of a railway vehicle are derived using Newtonian methods of summing all the forces acting on each mass element. As an understanding of the dynamics of a wheelset is fundamental to the study of a complete vehicle, the equations of motion of a wheelset are derived first, followed by the equations of motion of three example vehicles.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways C116/RP 4/E, Oct. 1974, 52 pp, Figs., 4 Ref., Apps.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B2 052637
PERMISSIBLE MASSES PER AXLE FOR TRAILER VEHICLES AS A FUNCTION OF THE WHEEL DIAMETER AND SPEED. INVESTIGATION OF THE PERMISSIBLE AXLE-LOADS FOR WAGONS WITH Y25 BOGIES (920 MM WHEELS) AT HIGH SPEED (BEYOND 120 KM/H)
This report contains a description of the line tests, carried out on a bogie wagon of the SNCF with Y 25 bogies. It concerns measurements on the wagon at speeds to 160 km/h and masses per axle to 20 t. The report also contains some recommendations for the maximum masses per axle depending on the speed from the points of view of the harmful effects exerted by the vehicle on the track and the riding stability.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways C113/RP 3/E, Oct. 1974, 45 pp, 21 Fig., Tabs.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B2 052643
ESTIMATION OF MULTIVARIABLE RAILWAY VEHICLE DYNAMICS FROM NORMAL OPERATING RECORDS. LABORATORY OF APPLIED MECHANICS DELFT UNIVERSITY OF TECHNOLOGY, THE NETHERLANDS
This paper discusses a procedure developed in order to estimate the parameters in a mathematical model describing the generation of the lateral motions of railway vehicles from measurements under normal operating conditions. Computations for a cyclical least squares model reference technique are carried out on a hybrid computer. In an illustrative example for a second order system it is shown that the use of two models in parallel can substantially improve the convergence, especially if the system output is disturbed by additive noise. The first results of experiments on vehicles, which are presented, show an encouraging correspondence between the important responses of the model and the actual bogie.

Restrictions on the use of this document are contained in the explanatory material.

Broersen, PMT
International Union of Railways DT 36, Oct. 1974, 27 pp, 4 Fig., 2 Tab., 8 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B2 052649
ADHESION
This supplement to the B44 Adhesion Bibliography published in October 1973 has two parts: 1) A new set of abstracts supplementing those in the origninal document (Volume 2) and covering the period up to December 1973. 2) A new index, which replaces the pages 89-114 of Volume 1 of the original.

See also RRIS #052530 Section 02, RRIS Bulletin 7402, UIC/ORE DT 28, Bibliography on Adhesion. Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways DT 28, Jan. 1975, 115 pp
ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B2 052663
INTERACTION BETWEEN VEHICLES AND TRACK. METHODS FOR DETERMINING THE VIBRATORY PARAMETERS OF EXISTING RAILWAY VEHICLES
This report contains theoretical considerations and a description of some simple practical methods for the experimental determination of the geometric, elasticity, inertia and damping parameters to be used in a mathematical model for studying the dynamic behaviour of a railway vehicle.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways C116/RP 5/E, Apr. 1975, 45 pp, Figs., 6 Ref., 5 App.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B2 053870
PROBLEMS CONCERNING THE INTERACTION BETWEEN VEHICLE AND TRACK [PROBLEME DES ZUSAMMENWIRKENS VON FAHRZEUG UND FAHRBAHN]
A report submitted at the 14th meeting dealing with "Modern railway rolling stock", held in Graz. The German Federal Railway, Munich Technical University, Krauss-Maffei-Krupp, Rheinstahl and Mak, have founded a Company for the Study of the limits of use of the "Vehicle on rail". The report consists of a wide synthesis of the methods used, and the results obtained, in the case of the numerous works to which reference is made. The author shows the manner in which it is possible to make use of simple models, which are linear in the case of the vehicle, and reduced to periodical irregularity in the case of the track, in order to obtain data concerning the structural parameters of the vehicle and the track, and estimates of the behaviour of the vehicle based on the values of these parameters. Although these models are far from according with the reality, the estimates which they make possible are close to the results of measurements carried out during tests. It is necessary to continue this research, although it is already agreed that the limits of the system "Vehicle on Rail" are far from having been reached. [German]

Gerdsmeier, H *Glasers Annalen ZEV* No. 2-3, 1973, 14 pp, 8 Fig, 1 Tab, 19 Ref

ACKNOWLEDGMENT: UIC (1118)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B2 053978
ROLLING RESISTANCE AND TRACK
This short paper raises the question of the effect of the track structure on rolling resistance. The author points out the reduced rolling resistance of similar cars on different track structures, and suggests the heavier track structures used in America and Russia are of advantage.

Scales, BT *Railway Engineering Journal* Vol. 2 No. 3, May 1973, 1 pp, 1 Fig, 2 Ref

PURCHASE FROM: Institution of Mechanical Engineers 1 Birdcage Walk, Westminster, London SW1, England Repr PC

DOTL JC

B2 054008
ANALYSIS OF TRUCK BOLSTER CENTER PLATE RIM RESPONSE TO IMPACT LOADS
The impact of a moving freight car into a string of standing cars results in a large longitudinal load acting on the center plate rim of the truck bolster. The load is the result of the rapid deceleration of the truck. The dynamic characteristics of this load and its effects within the rim are discussed. Analytical procedures are described for processing strain gage data to determine the location on the rim where the load is applied.

Contributed by the Rail Transportation Division of The American Society of Mechanical Engineers for presentation at the ASME-IEEE Joint Railroad Conference, Pittsburgh, Pa., April 3-4, 1974

Johnson, MR Welch, RE Ojdrovich, G (IIT Research Institute)
American Society of Mechanical Engineers ASME #74-RT-5, Dec. 1973, 9 pp, 18 Fig

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL RP

B2 054692
THE EFFECT OF TRACK AND VEHICLE PARAMETERS ON WHEEL/RAIL VERTICAL DYNAMIC FORCES
The railway track and vehicle combination comprises heavy rigid wheels running on heavy rails. Imperfections in either will give rise to dynamic effects which increase with speed. These will supplement the contact forces which, on perfect track with perfect wheels, are basically the static wheel loads. The commercial necessity for higher speeds and greater axle loads has been established and this historical trend will probably continue. Forces and stresses will therefore become more severe unless technical progress is made in track and vehicle design. In this context, close co-operation between the Civil and the Mechanical Engineer is essential. Track must have a high standard of alignment and level and maintenance quality must be improved as far as practicable. The forces that the rails and track structure will withstand must also be specified. New vehicles, particularly those for high speed operation or with heavy axle loads, must not generate excessive track forces.

Jenkins, HH Stephenson, JE Clayton, GA Morland, GW Lyon, D
Railway Engineering Journal Vol. 3 No. 1, Jan. 1974, pp 2-16, 22 Fig, 4 Tab

ACKNOWLEDGMENT: Railway Engineering Journal
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B2 054718
THE DEPARTMENT FOR RIDING QUALITIES AND VIBRATION ENGINEERING OF THE FEDERAL RAILWAY RESEARCH INSTITUTE IN MINDEN (WESTPHALIA). 1. HISTORICAL DEVELOPMENT, FIELDS OF ACTIVITY, AND ORGANIZATION STRUCTURE [DIE ABTEILUNG FUER LAUF-UND SCHWINGUNGSTECHNIK IN DER BUNDESBAHN-VERSUCHSANSTALT MINDEN (WESTF.). 1. GESCHICHTLICHER WERDEGANG, ARBEITSGEBIETE UND GLIEDERUNG]
After some general remarks on the problems in connection with the riding qualities and vibration properties of railway vehicles, the present state of research in this field is outlined briefly. The department for riding qualities and vibration engineering of the research institute, which is engaged in research work in this field at Deutsche Bundesbahn, has originated from the research centres for locomotives and wagons of the former RAW in Berlin-Grunewald. As compared to the original tasks of these research centres, the present fields of activities of the department are considerably more diversified and mainly focussed on the solution of the problems arising in connection with the proposed higher train speeds. In conclusion, the setup of the department is described, referring also to the special requirements regarding the technical qualifications and character of the employees. [German]

Zottmann, W *Glasers Annalen ZEV* Vol. 98 No. 3, Mar. 1974, p 69

ACKNOWLEDGMENT: Glasers Annalen ZEV
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B2 054781
IMPROVEMENTS OF MAINTENANCE CRITERIA COVERING THE RUNNING GEAR OF SHIN-KANSEN RAILCARS BY MEASURING THE TRANSVERSAL ACCELERATIONS OF THE BODY [SHIN-KANSEN DENSHA SOKO KANRI SHIRYO SEIDO UO KOJO NI KANSURU KENKYU]
Osaka engine shed officials measure, under 200 km/h on line conditions, the body accelerations of Shin-Kansen railcars each time the wheels are re-profiled (every 70,000 km). Following these measurements, an index is calculated in accordance with an empirical formula that is a linear combination of the acceleration occurrence frequencies classified by section (linear combination of the values of the acceleration distribution analysis). Bogie overhaul is scheduled in accordance with the value of this index. In applying this method, the JNR encountered difficulties due to the effect of 3 factors on transversal accelerations: the state of the track, the speed (the index is very sensitive to speed variations of only a few km/h), weather conditions (transversal stability is distinctly improved in rainy weather). The article describes how corrective laws were worked out to eliminate the effect of the first 2 factors. For the 3rd factor, it was decided to limit measurements to periods of wet weather. [Japanese]

Tanida, I *Denkisha No Kagaku/Railway Electric Rolling Stocks* Vol. 26 No. 6, 1973, 5 pp, 8 Fig

ACKNOWLEDGMENT: UIC (95)
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr PC

95

B2 056838
NONLINEAR WHEELSET DYNAMIC RESPONSE TO RANDOM LATERAL RAIL IRREGULARITIES
The nonlinear equations of motion for a railway vehicle wheelset having profiled wheels and contact of the wheel flange with flexible rails are presented. The effects of spin creep and gyroscopic terms are included. The rails are considered to have random lateral irregularities which are described by prescribed power spectra. The equations of motion are integrated numerically and the effects on the dynamic response of quantities such as speed, track roughness, wheel wear, flange clearance, and lateral stiffness of the rails are investigated.

Law, EH (Clemson University)
American Society of Mechanical Engineers Paper N73-WA/RT-3, Nov. 1973, 20 Ref

ACKNOWLEDGMENT: EI (EIX740304670)
PURCHASE FROM: ESL Repr PC, Microfilm

B2 056839
ON THE EFFECT OF TRACK IRREGULARITIES ON THE DYNAMIC RESPONSE OF RAILWAY VEHICLES
The steady state response for models of a six-axle locomotive running on a sinusoidally irregular track has been investigated. Two mathematical models have been set up, a full model for the stationary vehicle in which creep between wheels and rails was neglected, and a full model for the moving vehicle in which creep forces gravity stiffness effects and wheel tread profiles were considered. The use of the generalized method of complex algebra to obtain the steady state response of the railway vehicle components to varying input frequencies was used. The results given in this paper are for the case of sinusoidal lateral track irregularities only, but the method is general enough to allow also for vertical track irregularities. The analysis may be used to check the response of any proposed design for a railway vehicle to economically attractive track irregularities. It may also be used to adjust geometry, spring rates and damping characteristics in order to maximize operating speeds while providing optimum damping for the trucks and body motions.

Siddall, JN (McMaster University); Dokainish, MA Elmaraghy, W
American Society of Mechanical Engineers Paper N73-WA/RT-1, Nov. 1973, 13 Ref

ACKNOWLEDGMENT: EI (EIX740304668)
PURCHASE FROM: ESL Repr PC, Microfilm

B2 056859
CORRELATION OF SHOCK ABSORBER FORCES ON PASSENGER CARS
Calculation of the correlation between front and rear excitation for a passenger car and the correlation between left hand and right hand excitation.

Voy, C (Technical University, Berlin) *Society of Environmental Engineers, Journal of* Vol. 12 No. 59, Dec. 1973

ACKNOWLEDGMENT: EI (EIX740304791)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B2 057160
LITERATURE SURVEY OF RAILWAY VEHICLE DYNAMICS RESEARCH
A survey of the research concerned with the dynamics of single, conventional railway vehicles is presented. Attention is concentrated on analytical research and experimental research performed in conjunction with analytical efforts. The often conflicting objectives for railway vehicle suspension design and the research done to understand the design implications of these objectives are discussed.

Presented at the Winter Annual Meeting of the American Society of Mechanical Engineers, Nov. 11-15, 1973, sponsored by the Applied Mechanics Division and the Automatic Controls Division. Papers presented at this meeting are compiled in "Surveys of Research in Transportation Technology", AMD-Vol. 5.

Law, EH (Clemson University); Cooperrider, NK (Arizona State University)
American Society of Mechanical Engineers 1973, pp 49-78, 6 Fig, 94 Ref

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL RP

B2 057422
METHOD FOR DESIGN OF STRUCTURAL CHANGES OF RAILROAD CARS [O jednom metodu za rekonstrukciji zeleznickih vagona]
Design criteria for an improvement of railroad cars to be used for higher speeds on the existing tracks are presented. The interaction of rail-vehicle system is studied in order to derive values for smoother riding qualities. Thus, the two mathematical models were formed in the field of nonlinear theory in order to compile all the parameters of a vehicle. [Serbian]

Cucuz, N Rusov, L
International Federation for Theory of Mach & Mech Symp. Proc pp 7-20, 5 Ref.

ACKNOWLEDGMENT: EI (EIX740603951)
PURCHASE FROM: ESL Repr PC, Microfilm

B2 057427
VIBRATION DYNAMICS OF RAIL AXLES [Dinamica vibrazionale delle sale ferroviarie]
First, the dynamic configuration of an axle, generated by forced vertical excitation of the two wheels, is considered. A mathematical model of the vehicle and the axle vibrations is derived and analyzed. The frequencies of the axle are determined with the variation of the characteristic parameters of the vehicles and of the axles themselves. In the second part of the article, the dynamic stresses are sought, generated by typical excitation of the line and acting on the axle with the variation of the speed of the vehicle, in order to achieve optimum design. [Italian]

Panagin, R *Ingegneria Ferroviaria* Vol. 28 No. 9, Sept. 1973

ACKNOWLEDGMENT: EI (EIX740602766)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

B2 057437
ROLE OF THE CENTRE PLATE AND SIDE BEARING IN THE SAFE RIDING OF RAIL VEHICLES
Problems associated with the design of the support of the vehicle underframe on the truck by a center plate are discussed. The solution presented has the advantage of allowing the rocking of the vehicle body on its two trucks.

Kereszty, P *Acta Technica* Vol. 76 No. 1-2, 1974, pp 129-152, 9 Ref

ACKNOWLEDGMENT: EI (EIX740604915)
PURCHASE FROM: ESL Repr PC, Microfilm

B2 057438
ULTRASONIC CONTROL OF THE LOOSENING OF RAILWAY WHEEL RIMS [Verifica dello stato di allentamento de cerchioni ferroviari mediante l'impiego degli ultrasuoni]
A brief outline is given of the mechanical characteristics of forced keying of the rims; as well as the operating conditions which encourage their loosening and the present empirical methods of control. The principle of the propagation of ultra-sounds in forced contacts is then theoretically introduced, and on this principle is based the study which concludes with the presentation of a new method of control of the state of keying of wheel rims by means of ultra-sound. [Italian]

Costanzo, B *Ingegneria Ferroviaria* Vol. 28 No. 12, Dec. 1973

ACKNOWLEDGMENT: EI (EIX740605341)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

B2 057460
THE GEOMETRY OF THE CONTACT BETWEEN WHEELSET AND TRACK [Geometrie der Beruhrung Zwischen Radsatz und Gleis]
The geometric relationships governing contact between wheelset and track are of fundamental importance for the running behavior of rails vehicles. This article describes the present stage of wheel profile development. [German]

Nefzger, A *Eisenbahntechnische Rundschau* Vol. 23 No. 3, Mar. 1974, pp 113-122, Figs.

ACKNOWLEDGMENT: Eisenbahntechnische Rundschau
PURCHASE FROM: Hestra-Verlag Hernichel und Dr. Strauss, Darmstadt, West Germany Repr. PC
DOTL JC

B2 057461
RAIL STRESS DUE TO LOADING AND ROUTE PROPERTIES [Beanspruchung der Schiene durch die Belastung und die Gegebenheiten des Fahrweges]
The authors report on extensive measurements of transverse forces with test wheelsets against the background of steadily higher loading as a result of heavier and faster trains. These results are placed in relation to stationary measurements of transverse forces, stresses and track subsidence, and from this deductions are made with respect to the design of permanent way and vehicles. [German]

Birmann, F Herbst, W (Berlin Technische Universitaet) *Eisenbahntechnische Rundschau* Vol. 23 No. 3, Mar. 1974, pp 104-112, Figs., 18 Ref.

ACKNOWLEDGMENT: Eisenbahntechnische Rundschau
PURCHASE FROM: Hestra-Verlag Hernichel und Dr. Strauss, Darmstadt, West Germany Repr. PC
DOTL JC

B2 057487
REVOLUTION IN FREIGHT CARS-1974
Increasingly heavy demands are being placed on freight cars today. In addition, new car designs and record car orders are operating car building plants at capacity. These conditions have led to new research in vehicle and component design. The computer is a new useful tool to aid in the studies of car physical and dynamic action and in simulation models of freight car operation.

Progressive Railroading Vol. 17 No. 2, Feb. 1974, pp 33-36

ACKNOWLEDGMENT: CNR
PURCHASE FROM: Murphy-Richter Publishing Company 9 South Clinton Street, Chicago, Illinois, 60606 Repr. PC
DOTL JC

B2 057495
CENTER PLATE EXTENSION GETS AT TRUCK HUNTING, YAW AND ROCK AND ROLL IN FREIGHT CARS
The Barber Center Plate Extension Pad was introduced several years ago and has proven to be very successful. The pads are mounted on either side of the center plate and function as extensions of the center plate. The pads reduce truck hunting and 'rock and roll' and can increase wheel life.

Progressive Railroading Vol. 17 No. 6, June 1974, pp 42-45

ACKNOWLEDGMENT: CNR
PURCHASE FROM: Murphy-Richter Publishing Company 9 South Clinton Street, Chicago, Illinois, 60606 Repr. PC
DOTL JC

B2 057738
INTRODUCTION TO THE APPLICATION OF THE DYNALIST COMPUTER PROGRAM TO THE ANALYSIS OF RAIL SYSTEMS DYNAMICS
DYNALIST, a computer program that extracts complex eigenvalues and eigenvectors for dynamic systems described in terms of matrix equations of motion, has been acquired and made operational at TSC. In this report, simple dynamic systems are used to define the DYNALIST terminology. Input parameters required to model a rail vehicle are described. Preparation of a card deck to run the program is detailed. The program output is examined in terms of an application to a hunting analysis of a rail vehicle.

Perlman, AB Lanza, JJ
Department of Transportation, (DOT-TSC-FRA-74-2) Intrm Rpt FRA-ORD&D-75-2, Aug. 1974, 46 pp, 5 Fig., 9 Tab., 4 Ref.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-235 361/AS, DOTL NTIS

B2 057865
A SIMULATION OF FREIGHT CAR MOTION DUE TO END-TO-END IMPACT
Modernization of the Japanese National Railways freight-transportation system is proceeding rapidly and is demanding better cushioning from car draft gears. This report presents a practical method which numerically simulates freight car motions due to impact, not only between single cars but also between groups of cars under various conditions.

Kobayashi, M *Railway Technical Research Institute* Quart. Rpt Vol. 15 No. 2, 1974, pp 96-101, Figs.

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Ken-yusha 1-45-6, Hikari-cho, Kokubunji, Tokyo, Japan Repr. PC
DOTL JC

B2 071986
SURVEY OF RAILWAY VEHICLE DYNAMICS RESEARCH
Presents a survey of the research concerned with the dynamics of single, conventional railway vehicles. Attention is concentrated on analytical research and only that experimental research that has been performed in conjunction with analytical efforts. The often conflicting objectives for railway vehicle suspension design and the research done to understand the design implications of these objectives are discussed.

Law, EH Cooperrider, NK *ASME Journal of Dynamic Systems, Meas and Control* Vol. 96 No. 2, June 1974, 98 Ref.

ACKNOWLEDGMENT: EI (EIX740902301)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

B2 072473
STABILITY AND RIDING QUALITY OF RAILWAY VEHICLES
The so-called critical speed of a linearized railway vehicle is shown to be no useful measure for the stability of the system in practice. The important interaction between vehicle and track can be taken into account by the riding quality for a certain vehicle on every particular piece of track. The riding quality is determined by the accelerations transmitted to the payload, weighted according to comfort standards, and the relative displacements between wheel and rail. From the riding quality demands both for vehicle design and for maintenance of the track can be derived.

Broersen, PMJ (Delft University of Technology) *Vehicle System Dynamics* Vol. 3 No. 2, Sept. 1974, pp 109-121, 1 Fig., 1 Tab., 6 Ref.

ACKNOWLEDGMENT: Vehicle System Dynamics
PURCHASE FROM: Swets and Zeitlinger BV Amsterdam, Netherlands Repr. PC

B2 072667
VIBRATION ENVIRONMENT IN FREIGHT CARS AND ITS EFFECT ON DAMAGE TO LADING
In development of suspension systems for freight cars effect on lading should be carefully analyzed. This paper by illustrating how lading reacts to vibration environment stresses the need to reduce the range of frequencies present in the freight car as being of primary importance. It is felt that the present level of accelerations is not excessive and can be considered of secondary importance.
This paper was contributed by the Rail Transportation Division of ASME for presentation at the Winter Annual Meeting, 17-22 November 1974, New York, New York.

Guins, G Young, E (Lansmont Corporation)
American Society of Mechanical Engineers No. 74-WA/RT-9, July 1974, 5 pp, 10 Fig.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ASME Repr. PC
DOTL RP

B2 072668
MINIMAX OPTIMIZATION OF RAILWAY VEHICLE SUSPENSIONS
The minimax response of a complex dynamic system, such as a railroad vehicle, can be obtained by choosing certain (optimum) values of the stiffness and damping elements in the system. The railway vehicle is mathematically modeled as a linear, stable, strictly dissipative multi-degree of freedom dynamic system. The system is excited at more than one point by synchronous harmonic forces. A minimax principle reduces the problem to that of finite dimensional optimal design problem. Non-linear mathematical programming techniques are used to minimize the non-linear objective function representing the maximum resonant response at a point of the system, and subjected to linear or non-linear constraints, over a certain frequency range. The frequency range may be finite or infinite. Dynamic response of the system before and after optimization is shown, and three-dimensional plots for the constrained and unconstrained objective function versus the two most important design parameters are illustrated.
This paper was contributed by the Rail Transportation Division of the ASME for presentation at the Winter Annual Meeting, 17-22 November 1974, New York, New York.

Elmaraghy, WH Dokainish, MA Siddall, JN (McMaster University, Canada)
American Society of Mechanical Engineers No. 74-WA/RT-3, June 1974, 12 pp, 9 Fig., 6 Ref.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ASME Repr. PC
DOTL RP

B2 072669
DAMPING REQUIREMENTS TO CONTROL VERTICAL AND ROLL MOTION OF FREIGHT CARS
Compression dampers located in the freight car spring group can effectively control the car body in the roll and vertical motion modes resulting from the more common track surface variations. Computer drawn traces show the motion and forces between car body, truck components and track resulting from a multi-degree of freedom, three-dimensional, mathematical model of a 100 ton freight car traversing track with defined surface variations. Comparisons of response resulting from hydraulically controlled springs and a conventional spring group suspension controlled only with coulomb friction shows generally that conventional suspension with only friction damping, results in a severe resonance for both vertical and roll modes with extreme weight shift and high reactions between freight car components and track-a resonance limited only by the system non-linearities. Single acting hydraulic damping can be defined with sufficient energy absorption that can limit forces and motion at each given resonance, reducing weight shift and derailment jeopardy, as well as, equipment and track damage.
This paper was presented at the Rail Transportation Division Session RT-3 of the ASME Annual Meeting 20 November 1974.

Wiebe, D
Stucki (A) Company 1974, 13 Fig., 6 Ref.

ACKNOWLEDGMENT: Stucki (A) Company
PURCHASE FROM: Stucki (A) Company Mckees Rocks, Pennsylvania, Repr. PC
DOTL RP

B2 072670
RAILWAY TRUCK RESPONSE TO RANDOM RAIL IRREGULARITIES
This paper discusses the random response of a seven degree of freedom passenger truck model to lateral rail irregularities. Power spectral densities and root mean square levels of component displacements and contact forces are reported. The truck model used in the study allows lateral and yaw degrees of freedom for each wheelset, and lateral, yaw and roll freedoms for the truck frame. Linear creep relations are utilzed for the rail-wheel contact forces. The lateral rail irregularities enter the analysis through the creep expressions. The results described in the paper were obtained using frequency domain techniques to solve the equations of motion. The reported results demonstrate that the guidance force needed when traveling over irregular rail at high speed utilizes a significant portion of the total available tangential force between wheel and rail.

This paper was contributed by the Rail and Transportation Division of ASME for presentation at the Winter Annual Meeting, 17-22 November 1974. New York, New York,

Cooperrider, NK (Arizona State University)
American Society of Mechanical Engineers No. 74-WA/RT-2, Sept. 1974, 8 pp, 11 Fig., 16 Ref.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ASME Repr. PC

DOTL RP

B2 072766
WHEELSET STEERING FOR BOGIES OF RAILWAY VEHICLES
Examined are steered wheelsets as a means of reducing tread, flange and railhead-contact wear and of minimizing derailment tendencies. Longitudinal and lateral sliding resistances of leading and trailing wheelsets are discussed and the moving of the friction force center to coincide with the trailing wheelset is shown to reduce lateral sliding resistance to zero. Described are wheelset pivoting arrangements which greatly reduce flange wear and are reported to be highly satisfactory in service.

Schwanck, U *Rail Engineering International* Vol. 4 No. 8, Oct. 1974, pp 352-359, 18 Fig.

ACKNOWLEDGMENT: Rail Engineering International
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

B2 072809
STEADY-STATE MOTION OF RAILWAY VEHICLES ON CURVED TRACK
A simplified linear theory of steady-state curve traversing is developed for truck and two axled vehicles. The approach is based on providing guidance by creep forces in conjunction with wheel conicity, so that flange contact is normally avoided. It is shown that this approach is realistic for a wide range of vehicle and track parameters. However, steering by creep forces is limited by the onset of wheel slip. Representative experimental results for a two-axled vehicle are presented.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Boocock, D *Journal of Mechanical Engineering Science* Vol. 2 No. 6, Dec. 1969, pp 556-566

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: ESL Repr. PC, Microfilm

B2 072824
CONTACT VIBRATIONS
When a wheel rolls on a rail with a randomly wavy surface, the random waviness gives rise to a displacement input to the wheel and rail with a significant high-frequency (f greater than 100 HZ) spectral content. This displacement input excites the contact resonance of the system, wherein the mass of the wheel and an "equivalent mass" of the rail vibrate on the nonlinear contact spring. The purpose of the paper is to develop an analytical model for these high-frequency contact vibrations. The wheel is assumed to undergo only rigid-body motions, apart from the localized elastic deformation near the contact region. The rail is modeled as an infinite beam on a continuous, point-reacting foundation. With the rail roughness being assumed to be a locally stationary, Gaussian random process, a complete solution is presented to the linearized problem. Three phenomena of interest are investigated in detail: plastic deformation, loss of contact, and the formation of corrugations on the rail. The effects of various wheel and rail parameters on these phenomena are explored.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Nayak, PR *Journal of Sound and Vibration* Vol. 28 No. 2, 1973, pp 277-293

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: ESL Repr. PC, Microfilm

B2 072829
DEVELOPMENT OF A RAILROAD ROUGHNESS INDEXING AND SIMULATION PROCEDURE
To simulate rail vehicle performance on an analog computer to study shock and vibration characteristics of various rail and cargo configurations, input must be provided representing the roughness characteristic of the rail surface. Methods for measuring and simulating rail surface roughness are described which resulted in a recommendation to use a white noise generator to provide the required inputs. Measured accelerations on cargo were found to approximate the characteristics of white noise.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Pursifull, LJ Prothro, BE *Shock and Vibration Bulletin* No. 39, Pt. 6, Mar. 1969, pp 47-55

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: Shock and Vibration Information Center Naval Research Laboratory, Washington, D.C., Repr. PC

B2 072842
SOME ASPECTS OF THE INTERACTION BETWEEN RAILWAY VEHICLE AND TRACK
This paper describes aspects of experimental research on the South African Railways into the conditions affecting the riding quality of railroad vehicles. Parameters which influence the vertical riding quality of railway vehicles are given against the theory of forced vibrations. Results recorded during riding quality tests were found to be in good agreement with the theory. A method of simulating vertical oscillations of railway vehicles on a digital computer is outlined.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Labuschagne, TJ Scheffel, H (South African Railways) *Civil Engineer in South Africa* Vol. 11 No. 10, Oct. 1969, pp 247-252

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: ESL Repr. PC, Microfilm

B2 080123
PROGRESS REPORT–DEVELOPMENT OF AN ASSOCIATION OF AMERICAN RAILROADS DYNAMIC BOLSTER TEST
Preliminary work was completed on the analysis of the strength of truck bolsters relative to possible service type loadings. Measurements were made of maximum tensile and compressive stresses occurring in a bolster specimen under laboratory conditions simulating predicted service imposed loadings occurring with cyclic frequency. The results of the full study are expected to lead to a laboratory fatigue test for use in an acceptance specification for bolsters. The stress measurements were made for two general types of loading conditions considered to be the principal types of cyclic fatigue loadings imposed on truck bolsters in service. For both type loadings, stress measurements were made at a number of load levels. The basic procedures used in this study are presented in this report. There were some deviations required from these procedures that are explained in the report.

Association of American Railroads Technical Center R-106, Oct. 1970, 7 pp, 11 Fig., 2 Tab., 2 Phot., 2 App.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B2 080341
TRAIN TRACK DYNAMICS-GUIDELINES FOR: TRAIN HANDLING, TRAIN AND STRUCTURE, ENGINEER EDUCATION
The abstract of guidelines taken from Track Train Dynamics Manual indicates factors in four areas which are important in improving the performance of freight trains.
An RPI-AAR cooperative program. See 080130.

Association of American Railroads Technical Center, (R-153) R-122(73T 0252), 1973, 83 pp, 29 Fig.

ACKNOWLEDGMENT: Association of American Railroads Research Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B2 080352
APPLICATION AND OPERATING EXPERIENCE OF RUBBER SUSPENSION ON RAIL VEHICLES [Anwendung und Betriebserfahrung mit Gummifedern bei Schienenfahrzeugen]
Experience with a large number of city, suburban and main line coaches and locomotives has shown the use of well developed rubber suspension designs to be of benefit as far as riding qualities and maintenance demands are concerned and that the development of suitable designs should result in further simplification. [German]

Koffman, JL (British Railways Board); Reed, AJ *Glasers Annalen ZEV* Vol. 98 No. 7-8, July 1974, pp 219-226, 9 Ref.

ACKNOWLEDGMENT: EI (EI 74 078221)
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B2 080353
PREPARATORY WORK AND THE FIRST PHASE OF TEST IMPLEMENTATION FOR THE STUDY OF RAIL RAPID TRANSIT [Vorberitung und Durchfuehrung der Versuche fuer Schienenschnellverkehr]
As part of a research program dealing with the limits of the wheel/rail system, tests were carried out on the German Federal Railway's test rack by means of a locomotive-hauled test train (locomotive 103 118 and 3 test cars) in the speed range above 200 km/hr. These successful test runs provided the basis on which systematic component research is being continued. [German]

Haefner, F Hasselhuhn, J Weidlich, E *Glasers Annalen ZEV* Vol. 98 No. 9, Sept. 1974, pp 299-309, 6 Ref.

ACKNOWLEDGMENT: EI (EI 74 080411)
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B2 080360
RIDE QUALITY-AN INCREASINGLY IMPORTANT FACTOR IN TRANSPORTATION SYSTEMS
A portable data acquisition system has been developed and used to obtain field test data on a number of air and ground vehicles. Automatic data reduction techniques have been utilized, and developed where necessary, to present the measured data in useful, concise form. The vibration data parameters found to be of significant value include power spectral density distributions and frequency-of- occurrences of given levels of vibration. Vibrations in the lateral and vertical degrees of freedom appear to have significant influence on ride comfort at vibration levels as low as, or lower than, 0.1g acceleration. Vibration environments for the various type vehicles tend to be random in nature with the vibrational energy concentrated in the frequency range below 15 Hz and with a significant amount below 1 Hz, which is the region generally associated with motion sickness. For a train, subjective ride discomfort observations could be reasonably well correlated with peak lateral vibrations. This correlation formed the basis of a trial program of using vibration measurements as a quantitative index for identifying sections of rough track which could benefit from maintenance. Of all vehicles studied, the jet transport had the lowest vibration environment.
Presented at the 1971 International IEEE Conference on Systems, Newtorks, and Computers, Oaxtepec, Mexico, January 19-21, 1971.

Conner, DW (Langley Research Center)
Institute of Electrical and Electronics Engineers Jan. 1971, 5 pp, 9 Fig., 2 Tab., 5 Ref.

ACKNOWLEDGMENT: IEEE
PURCHASE FROM: IEEE Repr. PC
DOTL RP

B2 080772
TRAIN HANDLING AND OVERTURNED RAIL
The Canadian Pacific Railway recently used the EMD's dynamometer car to explore the problem of harmonic roll and over-turned rail. The problem is particularly bad in the Rockies. The tests indicated several methods by which train handling procedures could be improved to reduce the chance of a derailment.

Progressive Railroading Vol. 17 No. 8, Aug. 1974, pp 33-34

ACKNOWLEDGMENT: CNR
PURCHASE FROM: Murphy-Richter Publishing Company 9 South Clinton Street, Chicago, Illinois, 60606 Repr. PC
DOTL JC

B2 081275
VERTICAL VIBRATIONS OF VEHICLES WITH PRIMARY AND SECONDARY SUSPENSIONS [Sur les vibrations verticales d'un vehicule comportant deux etages de suspension]
This doctorate's thesis is a mathematical study of the dynamic behavior of a rail vehicle: it examines the vibratory system constituted by the underframe resting on elastic supports with two-tier suspension, and discusses the equation models and results calculated by means of a digital computer. Study of the curves reproduced on tracing tables, and of the influence of the different vehicle-construction parameters makes it possible to assess the incidence of the geometrical characteristics of a steel body, the influence of the suspension on vertical behavior and the desirable damping value for optimizing passenger comfort. [French]

Richard, J
Universite de Paris Sud Vol. 1 1972, 61 pp, Figs., 16 Ref.

ACKNOWLEDGMENT: International Railway Documentation, Selection of (UIC Serial No. 907)
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr. PC
DOTL JC

B2 081276
FRICTION AND LUBRICATION OF WHEEL FLANGES [Spurkranzreibung und Spurkranzschmierung]
The authors examine the effect of wheel flange friction on the rails and the resistance to forward motion. They then consider measures aimed at reducing this friction by the use of special profiles and lubricants. Finally, they describe lubricating devices and their effects. [German]

Schmucker, B Kirchlechner, H *Archiv fuer Eisenbahntechnik* No. 28, 1973, 15 pp, 17 Fig., 5 Tab., 16 Ref.

ACKNOWLEDGMENT: International Railway Documentation, Selection of (UIC Serial No. 916)
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr. PC
DOTL JC

B2 081783
TRACK TRAIN DYNAMICS, HARMONIC ROLL SERIES--VOLUME I
This is the first of two installments of the report marking completion of Task 13 of Phase I of the International Government-Industry Research Program on Track Train Dynamics. The many factors of track, equipment and operations which are involved in harmonic roll of railroad equipment, a phenomenon also known as "rock and roll," are identified. The volume has

five sections: Problem Definition, Historical Background, Current Industry Practices, Recommended Guidelines, and Bibliography. Definitions of significant terms are also included in this manual.

This project was sponsored by the Association of American Railroads, the Federal Railroad Administration, the Railway Progress Institute and the Transportation Development Agency of Canada.

Association of American Railroads Technical Center Vol. 1 1974, 79 pp, 7 Fig., 16 Ref., 2 App.

PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B2 081784
TRACK TRAIN DYNAMICS. HARMONIC ROLL SERIES-VOLUME II

This is the second of two installments of the report marking completion of Task 13 of Phase I of the International Government-Industry Research Program on Track Train Dynamics. This reference manual has data on truck components and on truck characteristics and is based on work performed by American Steel Foundries. Included are reports on frictional damping forces at the side frame/truck bolster interface; vertical, lateral, torsional and pitch spring rates of standard truck coil springs; deflection characteristics of truck bolsters and side frames; torsional resistance at the truck bolster/car-body centerplate interface; theoretical clearances throughout the truck; and mass moment of intertia of the side frame and truck bolster.

This project was sponsored by the Association of American Railroads, the Federal Railroad Administration, the Railway Progress Institute and the Transportation Development Agency of Canada

Association of American Railroads Technical Center 1974, 92 pp, 61 Fig.

PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B2 083061
FINAL REPORT ON THE EVALUATION OF CUSHIONED UNDERFRAMES

This report covers a study and evaluation of special cushioning devices under impact conditions. The types of devices tested included sliding center sill, end of car hydraulic draft gears and column connected draft gears. Each device was evaluated with both canned goods and steel lading which respectively represented a resilient type of lading and a heavy rigid type of lading. This study indicates that the commodity protection needs under impact are not entirely a function of the special cushioning device but are also related to loading methods and types of packaging. In these tests the indications of cushioning protection provided by different shock absorption systems as summarized from the conclusions made in this report are: 1. Sliding sill type cars with 18 to 30 in. travel gave the highest degree of protection of lading through reduction of body force and resultant acceleration, followed in descending order by end of car hydraulic draft gears, column connected draft gears and standard draft gears. 2. The non-continuous or "split" design of sliding center sill provided the maximum protection to the car structure under dynamic squeeze, followed in descending order by end of car hydraulic draft gears, conventional continuous or through designs of sliding center sills and column connected draft gears. 3. Length of travel of sliding center sill is not an absolute indication of overall performance, particularly under dynamic squeeze conditions. 4. Small differences in sliding sill travel do not significantly change the performance characteristics. 5. Floating loads shift excessively, even with sliding center sill cars. 6. Energy absorption means are needed at the couplers in sliding center sill cars. 7. Sliding sills require high column strength to prevent bending.

Association of American Railroads Technical Center MR-443, Aug. 1965, 89 pp, 38 Fig., 35 Tab.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B2 083911
SPECIFICATION OF RIDE QUALITY CRITERIA FOR TRANSPORTATION SYSTEMS: THE STATE OF THE ART AND A NEW APPROACH

The current state-of-the-art of ride quality criteria is reviewed. In particular the existing technique of describing the guideway in terms of its spectral density and of defining the ride quality standard as the acceleration spectral density is outlined. By utilizing linear system theory an alternative deterministic approach is presented. A deterministic ride quality standard is proposed and an analytical technique to design vehicle-suspension systems to meet this standard is presented.

Fearnsides, JJ (Department of Transportation); Hendrick, JK Firouztash, H *High Speed Ground Transportation Journal* Vol. 8 No. 2, June 1974, pp 125-132, 17 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B2 083912
ANALYSIS OF THE DYNAMICS OF A RAIL CAR FROM ITS RESPONSE TO RANDOM INPUT

The parameters which define the dynamic behavior of a physical system can be determined by analyzing the response of the system to a random input. Application of the random process technique to one of the U.S. Department of Transportation's rail research cars is described. One of these railcars was instrumented, operated over selected portions of mainline track between Washington and Baltimore, and analyzed for its dynamic properties. The theory and experiment are described, and the dynamic model of the railcar which was used is briefly presented. Results including natural frequencies for the car system, mode shapes for the principle modes, and revised values for important parameters are presented.

Hutchens, WA (Mitre Corporation); Haight, EC Milner, JL *High Speed Ground Transportation Journal* Vol. 9 No. 1, Mar. 1975, pp 449-457

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B2 083919
ELASTIC-PLASTIC ANALYSIS OF A WHEEL ROLLING ON A RIGID TRACK

A consistent finite element model for a circular wheel is developed based on triangular and quasi-triangular domains and a piecewise linear displacement field. The minimum stress-rate principle of plasticity is used to obtain the solution of this two-dimensional continuum problem with internal unloading. A piecewise approximation of the Tresca yield condition is used. Elastic-plastic solutions of a wheel rolling on a rigid track under its own weight and a hub load are obtained for the first few revolutions until a steady state condition is reached. Shake-down conditions for the wheel are demonstrated.

Garg, VK (Illinois Institute of Technology); Anand, SC Hodge, PG *International Journal of Solids and Structures* Vol. 10 No. 9, Sept. 1974, pp 945-956, 10 Ref.

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: ESL Repr. PC, Microfilm

B2 083920
THE TRIBOLOGY OF WHEEL ON RAIL

The functioning of wheels and rails as a supporting and guiding system depends on a Hertzian contact of 1.2 x 10 to minus 4th power sq m (0.2 in sq) area. In addition to its supporting function, this area must withstand tangential forces to enable the functions of traction, braking and guidance to be fulfilled. Such traction forces are accompanied by a deflection known as 'creep' and classical estimates of this quantity are compared with measurements made on the track. Modes of wear of wheel and rail are described and alternative systems which avoid contact are discussed.

Barwell, FT *Tribology* Vol. 7 No. 4, Aug. 1974, pp 146-150

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: ESL Repr. PC, Microfilm

B2 083928
NEWER KNOWLEDGE OF THE RUNNING (HORIZONTAL-TRANSVERSE) OF RAIL VEHICLES
By means of a complete statement of forces the influence is investigated, which is exerted by different parameters on the behavior of horizontal movement of a wheel set in the track. It is shown under what conditions stability or instability of the wheel-set course can be attained. A stable running behaviour can be attained if the hinge of a running gear is well adapted to the body of the car, and is suitably adapted to the parameters between wheel set and rail. [German]

Hanneforth, W *Eisenbahntechnik* Vol. 22 No. 8, Aug. 1974, pp 349-352

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: Bohmann Verlag Canovagasse 5, A-1010 Vienna, Austria Repr. PC

B2 083939
PROCEEDINGS OF THE SECOND INTERNATIONAL CONFERENCE ON VEHICLE MECHANICS
This volume reports the simultaneous technical sessions that were held on four major subjects--automobile dynamics, rail-vehicle systems, off-the-road vehicle systems, and ships and hovercraft. Presented are manuscripts and abstracts of the lecture presentations. The railway engineering topics include: Basic Theory on the Torsional Strength of Freightcar Body and Container; Modern Trucks for Very High Speeds (in French); Metro on Rubber Tires (in French); Development of a Computer Model for Simulating Railroad Track Structures; Statistical Analysis of Track Defects and their effects on Vehicle Ride (in French); Vertical Dynamics of a Rail Vehicle (in French); Theoretical Study of Transverse Stability of Rail Vehicles and Initial Experimental Results.
Conference held at Paris VI University, September 6-9, 1971.

Swets and Zeitlinger B.V. 1973, 496 pp, Figs., Tabs., Phots.

PURCHASE FROM: Swets and Zeitlinger B.V. Amsterdam, Netherlands Repr. PC
DOTL TL 243.I7

B2 083946
STABILITY AND RIDING QUALITY OF RAILWAY VEHICLES
The so-called critical speed of a linearized railway vehicle is shown to be no useful measure for the stability of the system in practice. The improvement interaction between vehicle and track can be taken into account by the riding quality for a certain vehicle on every particular piece of track. The riding quality is determined by the accelerations transmitted to the payload, weighted according to comfort standards, and the relative displacements between wheel and rail. From the riding quality demands both for vehicle design and for maintenance of the track can be derived.

Broersen, P (Delft University of Technology, Netherlands) *Vehicle System Dynamics* Vol. 3 No. 2, Sept. 1974, pp 109-121, 6 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL RP

B2 083947
NEW TRUCK DEVELOPED FROM THE TYPE Y28 TO THE TYPE Y32 FOR HIGH SPEED ROLLING STOCK [Un nouveau bogie pour les voitures a grande vitesse du type Y 28 au type Y 32]
The new truck is intended for main line rolling stock suitable for 200 km/hr operation. The author explains the design and gives a full description of the parts of the pneumatic suspension of this truck which has disk brakes combined with shoe brakes, a solution giving the best adhesion. The tests gave excellent results up to 250 km/hr. [French]
The full English article can be found in French Railway Techniques, N1, pp 1-12, 1975.

Moron, P (French National Railways) *Revue Generale des Chemins de Fer* Vol. 93 Sept. 1974, pp 497-508

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B2 083948
BASIC RESEARCH AND TEST OF THE Y32 TRUCK [Le bogie Y32 etudes de base et essais]
The author gives the results of the basic research on the vertical dynamics and the transversal dynamics of the Y 32 truck and compares them with those obtained during line tests. The reference to a mathematical model has been perfected by means of spectroscopic analysis methods based on the energy density spectrum notion.
The full English article can be found in French Railway Techniques, N1, pp 12-22, 1975.

Daffos, J (French National Railways) *Revue Generale des Chemins de Fer* Vol. 93 Sept. 1974, pp 509-519

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B2 084732
ON THE EFFECT OF TRACK IRREGULARITIES ON THE DYNAMIC RESPONSE OF RAILWAY VEHICLES
The steady state response for models of a six-axle locomotive running on a sinusoidally irregular track has been investigated. Two mathematical models have been set up, a full model for the "stationary" vehicle in which creep between wheels and rails was neglected, and a full model for the "moving" vehicle in which creep forces, gravity stiffness effects and wheel tread profiles were considered. The use of the generalized method of complex algebra to obtain the steady state response of the railway vehicule components to varying input frequencies was used. The results given in this paper are for the case of sinusoidal lateral track irregularities only, but the method is general enough to allow also for vertical track irregularities. For the "stationary" vehicle the input frequency is increased from zero to 3 cycles per second. For the "moving" vehicle the input frequency is a function of the track wave length and the vehicle forward speed and is given in terms of the vehicle speed. The frequency response curves are computer plotted in each case. For the "moving" vehicle, responses for the cases of both new and worn wheels are obtained. The natural frequencies for the full model are also calculated. The results obtained show the effect of the creep forces and the condition of the wheels on the steady state response. It is recommended that slip and corresponding creep forces, wheel tread and rail profiles, and the gravity stiffness effect be included in the steady state response analysis of railway vehicles to track irregularities.

Dokainish, MA Siddall, JN Elmaraghy, W (McMaster University) *ASME Transactions* Vol. 96 No. 4, Nov. 1974, pp 1147-58, 14 Fig., 13 Ref.

ACKNOWLEDGMENT: ASME Transactions
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B2 084733
NONLINEAR WHEELSET DYNAMIC RESPONSE TO RANDOM LATERAL RAIL IRREGULATITIES
The nonlinear equations of motion for a railway vehicle wheelset having profiled wheels and contact of the wheel flange with flexible rails are presented. The effects of spin creep and gyroscopic terms are included. The rails are considered to have random lateral irregularities which are described by prescribed power spectra. The equations of motion are integrated numerically and the effects on the dynamic response of quantities such as speed, track roughness, wheel wear, flange clearance, and lateral stiffness of the rails are investigated.

Law, EH (Clemson University) *ASME Transactions* Vol. 96 No. 4, Nov. 1974, pp 1168-76, 9 Fig., 20 Ref.

ACKNOWLEDGMENT: ASME Transactions
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B2 090530
COMPARATIVE ANALYSIS OF DYNAMICS OF FREIGHT AND PASSENGER RAIL VEHICLES
This comparative analysis was an examination of the vehicle-track interactive dynamics where several types of trains are required to operate over the same route at different speeds. Two areas of concern were examined: the effects of track geometry (surface, crosslevel and alignment) on vehicle

response and track loads, and the effects of lateral force components acting on curves. A linear, 14-degree-of-freedom computer model was used to simulate a number of rail vehicles on a conventional track structure of rails, ties and ballast, including the Metroliner, passenger and freight cars, TurboTrain, and several locomotives.

Ahlbeck, DR Prause, RH Day, JB Meacham, HC
Battelle Columbus Laboratories, Federal Railroad Administration Final Rpt. Mar. 1974, 207 pp

Contract DOT-FR-20077

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-240329/3ST, DOTL NTIS

B2 094278
TRACK/TRAIN DYNAMICS TEST REPORT MODAL SURVEY
The modal survey vibration test conducted on an 80 ton open hopper freight car is described. The test data, the post-test update of the modal survey test requirements and procedure, and an index to the test data are presented. Photographs of actual measurement locations and the test historical log are included. (Author)

Vigil, RA
Martin Marietta Corporation NASA-CR-144000, Jan. 1975, 314 pp

Contract NAS8-29882

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
N76-10476/9ST, DOTL NTIS

B2 095222
SIMULATED OPERATING STRESSES IN 28-IN.-DIA WHEELS
An analytical stress analysis of B-28 and CB-28 wheels of various designs is presented. Simulated service inputs of vertical, lateral, and brake shoe forces producing thermal loads from emergency braking are used. Octahedral stress mapping is used to display the stress fields generated in the wheels under combination of the above loading conditions. The results show that both wheels have low octahedral stresses when only vertical or vertical and lateral loads are applied, but under combined loading conditions including tread braking the stress levels in the B-28 contour exceed those in the CB-28 wheels.

Contributed by the Rail Transportation Division of The American Society of Mechanical Engineers for presentation at the IEEE-ASME Joint Railroad Conference, San Francisco, California, April 15-17, 1975.

Novak, GE (Del Engineering, Incorporated); Greenfield, LP (Trailer Train Company); Stone, DH (Association of American Railroads Technical Center)
American Society of Mechanical Engineers 75-RT-10, Apr. 1975, 8 pp, 19 Fig., 6 Ref.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL RP

B2 095277
WHEEL/RAIL ADHESION-BOUNDARY LUBRICATION BY OILY FLUIDS
The observed variations in wheel/rail adhesion on dry rails are most readily associated with changes in the quantity of oil on the surface. Chemical changes have little influence in comparison. Ambient humidity has a noticeable effect such that significantly higher wheel/rail adhesion is encountered on most rails in dry air conditions.

Beagley, TM (Railway Technical Centre); McEwen, IJ Pritchard, C
Wear Vol. 31 No. 1, Jan. 1975, pp 77-88, 10 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

B2 095443
SYSTEM-ORIENTED METHODS IN THE DEFINITION PHASE FOR A HIGH-SPEED RAIL VEHICLE [Systemtechnische Methoden in der Definitionsphase fuer ein Hochgeschwindigkeits-Triebfahrzeug]
High-speed rail vehicles operating at the limit of their performance produce particularly strong interactions with the permanent way and catenary systems. Using modern work procedures and taking account of these mutual interactions, an attempt has been made, as described here, to optimate the vehicle concept for overall operating economy. [German]

Pleger, J *Eisenbahntechnische Rundschau* Jan. 1975, pp 35-43, 4 Fig.

ACKNOWLEDGMENT: Eisenbahntechnische Rundschau
PURCHASE FROM: Hestra[Verlag Holzhofallee 33, 61 Darmstadt, West Germany Repr. PC
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B2 095698
VERTICAL ACTION OF FORCES BETWEEN WHEEL AND RAIL WHEN CROSSING A RAIL JOINT
An example serves to determine the maximum dynamic vertical wheel force when a modern coach crosses a rail joint. The problem is described mathematically by a system of ordinary differential equations and is solved by means of an analog computer. The high dynamic vertical wheel forces obtained linearly increase with the travelling speed. As a result, the demand of more elastic wheels is made for railway vehicles travelling at high speed, besides that of a high quality of the permanent way. [German]

Beer, R Gudacker, E Ebert, J *DET Eisenbahntechnik* Vol. 22 No. 11, Nov. 1974, pp 509-511

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: VEB Verlag Technik Oranienburgerstrasse 13-14, 102 Berlin, East Germany Repr. PC

B2 096558
STRESSES IN THE TREADS OF RAILWAY WHEELS
The stresses arising in and below the tread of a rail vehicle wheel are very complex. The wheel material, which is in no way of a homogeneous nature, is subjected to greatly differing forces varying in magnitude, as well as to frictional forces, thermal stresses, manifold tensile stresses and wear mechanisms. Because of the great many imponderabilities, resulting from the track position and riding quality of the vehicle, a prediction of the expected life or anticipated mileage is practicable to a limited extent only. Nevertheless, it is possible to picture the complex stresses acting on the wheel tread. For practical use, a new factor is proposed, permitting an estimate of the permissible axle load for wheel sets dependent on the wheel diameter. [German]

Brohl, W Brinkmann, P *Glasers Annalen ZEV* Vol. 99 No. 1, Jan. 1975, pp 1-10

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B2 096559
CHOICE OF THE MODE OF EXCITATION IN DYNAMIC STUDIES OF NON-SPRINGING MASSES
Various modes of excitation originating from the wheel or from the rail are investigated by means of a vibration model of non-springing masses of a coach with lateral V-belt drive for the power supply unit. A comparison of theoretical and experimental results obtained by an analog computer, or in a rolling test stand, serves to recommend certain modes of excitation for studying vibration processes of the model described. [German]

Chelnokov, II *Eisenbahntechnik* Vol. 23 No. 1, Jan. 1975, pp 12-16

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: Bohmann Verlag Canovagasse 5, A-1010 Vienna, Austria Repr. PC

B2 096594
DYNASIM 3: A COMPUTER PROGRAM FOR SIMULATION OF VEHICLE RIDING MOTIONS
The purpose of this paper is to present analytical techniques for evaluating the dynamic riding behavior of a vehicle. These techniques have been applied to a fairly sophisticated model of a bus, where a three-dimensional structure, elastic frame and non-linear shock-absorbers have been considered.

Donati, F (Politec di Torino, Italy); Genesio, R Leurentini, A Mauro, V Menga, G Milanese, M *Vehicle System Dynamics* Vol. 3 No. 3, Nov. 1974, pp 141-161, 7 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: Swets and Zeitlinger BV 3476 Heerweg, Publications Department, Lisse, Netherlands Repr. PC

B2 096596
PROBLEMS ASSOCIATED WITH ROLLER TEST BENCH INVESTIGATIONS WITH VIEWS TO THE DETERMINATION OF THE RESPONSE OF FRICTIONAL CONNECTION BETWEEN WHEEL AND RAIL [Zur Problematik von Waelzpruefstandsversuchen im Hinblick auf die Ermittlung des Kraftschlussverhaltens Zwischen rad und Schiene]
The theorem associated with frictional connection and its most important parameters are discussed, with emphasis on the effects of location and time. The study is of importance in conjunction with plans for increasing the speed of railroad trains. [German]

Kretterk, O (Tech Hochsch, Germany) *Elektrische Bahnen* Vol. 45 No. 11, Nov. 1974, pp 258-264, 9 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B2 096599
INSTRUMENTATION FACILITIES FOR DYNAMIC TESTING OF RAILWAY ROLLING STOCK
A wide variety of instrumentation facilities are used for dynamic testing of railroad rolling stock. For evaluating stability, measurements of the lateral force and vertical load on the wheel are required. The former is measured with the help of a load cell and the latter by measuring spring deflections using a linear variable differential transformer. For determining riding quality the average ride index is calculated and acceleration is measured using a seismic accelerometer. A transducer system is used to convert the physical parameters to electrical signals. As the electrical signals generated by the transducer are in the range of microvolts they are amplified by amplifiers which feed the signal to the recorder where the signals actuate pens, which trace out the signals in ink on paper.

Kumar, I (Res Des and Stand Organization, India) *Institution Eng (India) Journal Elect Tele Eng Div* Vol. 54 PtET3, Aug. '974, pp 93-98, 2 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

B2 097306
A REVIEW OF RAIL-WHEEL CONTACT STRESS PROBLEMS
From its earliest days, railroad technology has been limited by an inadequate understanding of the mechanics of load transfer between wheel and rail. It is the purpose of this paper to indicate the major problems in this area, and to review the progress made to date in the solution thereof. Attention is focussed upon investigations of the stresses (normal pressure and tangential shear) on the contact patch, rather than upon studies of bending stresses in the rail. The physical basis of Hertz's widely used analysis is outlined, and the assumptions and limitations of that analysis are indicated. The need is shown for the development of solutions to important non-Hertzian problems such as: coformal contact (e.g. between worn wheels and track), contact of rough bodies, rolling friction, adhesion, and creep. The literature on these problems, as well as work in progress, is reviewed. A detailed mathematical treatment is avoided, but the principal results of much of the theory are illustrated through geometrical and physical descriptions. Recent works on the effects of surface waviness, plastic deformation, and residual stresses in rail, are reviewed.

This paper was presented at the Railroad Track Mechanics Symposium, Princeton University, 22 April, 1975.

Paul, B
Pennsylvania University, Philadelphia MEAM 75-1, Apr. 1975, 52 pp, Figs., Refs.

Contract DOT-OS-40093

ACKNOWLEDGMENT: Pennsylvania University, Philadelphia
PURCHASE FROM: Pennsylvania University, Philadelphia Department of Mechanical Engineering and Applied Mechanics, Philadelphia, Pennsylvania, 19104 Repr. PC
DOTL RP

B2 097308
MODIFIED THREE-PIECE TRUCK REDUCES HUNTING AND IMPROVES CURVING
Analysis of dynamic truck oscillations shows that hunting can be controlled by elastic links which connect the diagonally opposed journal boxes of the two wheelsets of a truck. Yaw constraint of the wheelsets in relation to the truck frame can then be minimized and full advantage taken of the ability of conical wheelsets to align themselves radially on curved track. This stability ensures that tread profile conicity does not change as wheels wear and stability can be maintained for long periods. South African Railways has incorporated such a diagonal suspension truck with encouraging test results. Although sharp curves are prevalent on the track where tests were conducted, flange wear has been negligible.

This is a paper from the proceedings of the 11th Annual Railroad Engineering Conference held at Southern Colorado State College, Pueblo, Colorado, October 23-24, 1974. Other individual papers from this conference have been accessioned separately for RRIS. The following is a list of the RRIS numbers of these papers preceded by its section number as it is contained in the bulletin: 03 097309, 13 097310, 04 097311, 03 097312, 03 097313, 04 097314, 03 097315, 03 097316, 03 097317, 03 097318, 03 097319. The entire proceedings 03 097307 has also been accessioned. All of these are contained in the Bulletin 7502.

Scheffel, H (South African Railways)
Federal Railroad Administration 1974, pp 41-46, 13 Fig., 5 Ref.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC
PB-241730/1ST, DOTL NTIS

B2 097309
THE FREIGHT CAR TRUCK "CAPABILITY GAP"
The freight car truck is discussed as background to the question of what can be done about it. Because of the greater demands of today's freight service, a capability gap has developed between the truck performance required and that provided by contemporary running gear. The evolution of the three-piece truck, from the archbar design through stages to the contemporary arrangements, is illustrated. Some other car problems are covered and the possible end of cut-and-try design in running gear is foreseen. The possibility that a premium truck might be cost effective is suggested.

This is a paper from the proceedings of the 11th Annual Railroad Engineering Conference held at Southern Colorado State College, Pueblo, Colorado, October 23-24, 1974. Other individual papers from this conference have been accessioned separately for RRIS. The following is a list of the RRIS numbers of these papers preceded by its section number as it is contained in the bulletin: 03 097308, 13 097310, 04 097311, 03 097312, 03 097313, 04 097314, 03 097315, 03 097316, 03 097317, 03 097318, 03 097319. The entire proceedings 03 097307 has also been accessioned. All of these are contained in the Bulletin 7502.

Smith, LW (Dresser Industries, Incorporated)
Federal Railroad Administration 1974, pp 26-32, 25 Fig.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC
PB-241730/1ST, DOTL NTIS

B2 097317
FREIGHT CAR DYNAMICS--ONE CARBUILDER'S APPROACH
Amcar Division of ACF Industries, like the other carbuilders, is taking on additional responsibilities for all aspects of car dynamics design and test, particularly with respect to carbody structure. Explained is the ACF computerized system for analysis of carbody structural dynamics, intended to combat fatigue problems. Mathematical modeling is used to develop load

paths and stress profiles of complex structures. Road testing is important in developing environmental data and ACF has acquired an instrument car for this purpose. Modified Goodman Diagrams are developed and their use is discussed.

This is a paper from the proceedings of the 11th Annual Railroad Engineering Conference held at Southern Colorado State College, Pueblo, Colorado, October 23-24, 1974. Other individual papers from this conference have been accessioned separately for RRIS. The following is a list of the RRIS numbers of these papers preceded by its section number as it is contained in the bulletin: 03 097308, 03 097309, 13 097310, 04 097311, 03 097312, 03 097313, 04 097314, 03 097315, 03 097316, 03 097318, 03 097319. The entire proceedings 03 097307 has also been accessioned. All of these are contained in Bulletin 7502.

Billingsley, RH, Jr (ACF Industries, Incorporated)
Federal Railroad Administration 1974, pp 11-15, 10 Fig.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC
PB-241730/1ST, DOTL NTIS

B2 098006
CORRUGATION AND PITTING OF ROLLING SURFACES-ARE THEY CONTINGENT UPON ULTRASONICS?
This article is an abridged version of essay number 28/1973 held in the Archiv fuer Eisenbahntechnik. Rail corrugations, which were a familiar phenomenon in the 1890's and similar periodic forms of wear occur in other rolling contact combinations. An attempt is made in this paper to explain these manifestations. It is suggested in conclusion that it would appear that troublesome corrugations and perhaps damaging pitting could be avoided if, besides the attenuation of low-frequency oscillations, a means could be found to prevent the agitation and propagation of intensive ultrasonic fields within the area of the running surfaces.

Werner, K *Wear* Vol. 32 No. 2, Apr. 1975, pp 233-248, 18 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

B2 098684
EFFECT OF WAGON-BOGIE SUSPENSION CHARACTERISTICS ON DYNAMIC LOADS
Recent British Railways tests show total forces induced by track joints, frogs and crossings are influenced by the square root of unsprung mass as well as other criteria. Sprung and unsprung mass accelerations call for careful damping. Load deflection characteristics examined show the need for closer scrutiny and suspensions must be designed to give satisfactory ride in normal speed ranges. Ride index and rotational resistance are important.

Koffman, JL *Rail Engineering International* Vol. 5 No. 3, Apr. 1975, pp 87-90, 3 Fig., 2 Tab., 8 Ref.

PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B2 099362
EFFECTS OF LONGITUDINAL IMPACT FORCES ON FREIGHT CAR TRUCK BOLSTERS
The design of truck bolster center plate rims was investigated as a result of increased reports of their failure on 100-ton capacity freight cars. The damage occurs when cars are coupled at moderate to high speeds, since the rapid deceleration of the truck causes high loads between the truck and body bolsters. Test measurements were made on an unloaded 100-ton hopper car impacting a string of loaded cars. The forces between the truck and body bolsters on the moving car were determined at impact speeds from 2.9 to 9.2 mph. Tests were made with two different energy absorbing capacities of draft gear. Loads at the truck-bolster/body-bolster interface averaged approximately 40,000 lbs for impact velocities up to 5 mph and reached 100,000 lbs at 7 mph. A peak load of 160,000 lbs was measured at 8.4 mph. Within the lower speed range there were no significant differences in load associated with the two draft gear, but at 6.7 mph the loads with the higher capacity gear were 25 percent less. Strain gages placed near the center rim indicated yielding on the first impact at 2.9 mph. Additional yielding continued as the impact velocity was increased. A finite-element stress analysis showed that loads of the magnitude measured on the test would cause severe stresses in the center plate rim and that yielding of the material would be expected. Several potential modifications of the truck bolster center plate rim were analyzed which showed that significant improvements could be obtained by making the rim wider and by increasing the radius of the fillet at the inside of the rim.

The project was sponsored by US DOT, Federal Railroad Administration's Office of Research and Development. IIT Research Institute was under contract to US DOT, Transportation Systems Center.

Johnson, MR
IIT Research Institute, Transportation Systems Center, Federal Railroad Administration, (DOT-TSC-FRA-74-7) Final Rpt. FRA ORD&D-75-10, Sept. 1974, 42 pp, 18 Fig., 2 App.

Contract DOT-TSC-727

ACKNOWLEDGMENT: FRA, NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-244225/9ST, DOTL NTIS

B2 099771
ON WHEEL-RAIL ADHESION. DIMENSIONAL CONSIDERATIONS FOR TESTS WITH MODELS [Sull'aderenza ruotarotaia Considerazioni dimensionali per esperienze su modelli]
After recalling the main notions of the wheel-rail adhesion phenomenon and establishing a rational working dependence between the adhesion coefficient and a series of characteristic undimensioned groups, the author defines the appropriate similitude criteria enabling the phenomenon in question to be reproduced on the model. Finally, consideration is given to the possibility of carrying out research with the model which would not only be useful in throwing light by experimental means on several important interactions between vehicle and track, but also because such research could quickly lead to the development of practical and economical methods for full-scale applications. [Italian]

Chiesa, W Di Santolo, D *Ingegneria Ferroviaria* May 1974, pp 23-28, 1 Fig., 1 Tab., 16 Ref.

ACKNOWLEDGMENT: International Railway Documentation, Selection of
PURCHASE FROM: Collegio Ingegneri Ferroviari Italiani Piazza Croce Rossa, Rome, Italy Repr. PC

B2 099772
LONGITUDINALLY FLEXIBLE OR RIGID WHEELSETS FOR GOODS WAGON BOGIES? [Bewegliche oder in Fahrzeuglaengsrichtung starre Radsaetze fuer Gueterwagen-Drehgestelle]
In connection with the planned standardization of bogie wagons, the DB has carried out comparative tests on bogies specially equipped for measurement purposes. The results of these tests are represented by the cross stresses recorded both for the outside wheel on curves and for the inside wheel and in relation to the curve radius. They confirm that longitudinally rigid wheelsets cause inadmissible rail wear on curves with radii of less than 700 m. [German]

Madeyski, T *Eisenbahningenieur* Vol. 25 No. 12, 1974, pp 419-423, 8 Fig.

ACKNOWLEDGMENT: International Railway Documentation, Selection of
PURCHASE FROM: Dr Arthur Tetzlaff-Verlag Niddastrasse 64, Frankfurt am Main, West Germany Repr. PC

B2 099811
ECONOMIC IMPACT OF TRIBOLOGY
Friction and wear-caused mechanical failures and maintenance normally have their roots in phenomena based on tribology, the science and technology of interacting surfaces in relative motion. Developments in tribology since the publication of the "Jost Report" have utilized existing and new knowledge from physics, chemistry, mathematics, statistics, engineering, etc. As a result, advances in diverse fields, from metalworking to medicine or space technology, have been produced. The economic benefits that may accrue to industry can be substantial; in the case of the U.S. the savings obtainable through tribology could amount to as much as $16 billion per annum. Some of the means used in the United Kingdom in order to reap the benefits attainable by application of the principles of the multi-disciplinary subject of tribology, and some of the results obtained, are described.

Jost, HP (Angel Lodge Laboratories) *ASME Journal of Mechanical Engineering* Vol. 97 No. 8, Aug. 1975, pp 26-33

ACKNOWLEDGMENT: ASME Journal of Mechanical Engineering
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B2 099842
ANALYSIS OF RAILROAD CAR TRUCK AND WHEEL FATIGUE. PART I-SERVICE LOAD DATA AND PROCEDURES FOR THE DEVELOPMENT OF FATIGUE PERFORMANCE CRITERIA
The development of fatigue performance standards for freight car truck components and wheels requires a knowledge of the fluctuation service load environment, and a basis for stating the conservatism of the design with respect to the environment. On this program special emphasis was given to determining the load environment by analyzing data from 53 test runs conducted on the Erie Branch test track of the Bessemer and Lake Erie Railroad. A number of test parameters were varied, such as speed, type of truck, modifications to the suspension system, etc., to determine those parameters having the greatest influence on the severity of the load. Vertical loads were measured at the side-frame-pedestal/roller-bearing-adapter interface and lateral loads were determined at the wheel/rail interface. The cyclic load data are summarized in a series of load spectra. Factors which must be considered in the development of fatigue performance standards from these spectra include reliability goals, the statistical spread of both load and fatigue strength data, and the philosophy followed in the design of the truck itself.

Sponsored by Federal Railroad Administration and under contract from Transportation Systems Center.

Johnson, MR
IIT Research Institute, Federal Railroad Administration, Transportation Systems Center, (DOT-TSC-FRA-75-11) Intrm Rpt. FRA-OR&D-75-68, May 1975, 146 pp, Figs., Tabs., Phots., 20 Ref., 4 App.

Contract DOT-TSC-727

ACKNOWLEDGMENT: FRA, NTIS
PURCHASE FROM: NTIS Repr. PC
PB-244090/AS, DOTL NTIS

B2 125801
ANNUAL BOOK OF ASTM STANDARDS, 1975--PART 4. STRUCTURAL STEEL; CONCRETE REINFORCING STEEL; PRESSURE VESSEL PLATE AND FORGINGS; STEEL RAILS, WHEELS, AND TIRES
This volume contains the specifications for structural steel; steel for concrete reinforcement and prestressed concrete; steel plate, forgings and rivets for boilers and pressure vessels; steel rails and accessories, wheels, axles and tires. A metric practices guide is included.

American Society for Testing and Materials Apr. 1975, 720 pp

ACKNOWLEDGMENT: EI
PURCHASE FROM: American Society for Testing and Materials 1916 Race Street, Philadelphia, Pennsylvania, 19103 Repr. PC
01-004075-02

B2 125819
RESEARCH INTO THE OPTIMIZATION OF THE AXLE OF ROLLING STOCK ON FRENCH NATIONAL RAILWAYS [Recherches sur l'optimisation des essieux-axes de la S.N.C.F.]
The research work described is intended, among other things, to study how far in particular it would be possible to reduce the unsprung weight represented by the axle, a parameter whose influence increases with the speed of the vehicles. Various investigations, which are explained in detail as well as their results, were conducted in the following specific areas: more specific approach of the conditions with which the gear connections wedged on the axles must comply; possibilities provided by certain special steels; improvements to be expected from superficial mechanical treatments; and influence of different types of anti-corrosion methods. In French with English abstract. [French]

Revillon, A Leluan, A *Revue Generale des Chemins de Fer* Vol. 94 Mar. 1975, pp 179-189

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B2 125848
AMERICAN TEST ROLLER TRACK IN PUEBLO, COLORADO [Der Amerikanische Rollpruefstand in Pueblo, Colorado/USA]
The authors emphasize that the problems of the wheel/rail system are investigated all over the world, with different methods being adopted in various countries. In their first phase, American tests are focused on a translatory simulation of faults in track position, while in Germany efforts are made to analyze the separate and combined effect of disturbance functions and also to find a method for separate representation of faults in track aligement by rotatory movement of each test roller. [German]

Althammer, K (German Federal Railway) *Glasers Annalen ZEV* Vol. 99 No. 4, Apr. 1975, pp 111-115

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B2 125867
STABILITY AND RIDING QUALITY OF RAILWAY VEHICLES
The so-called critical speed of a linearized railway vehicle is shown to be no useful measure for the stability of the system in practice. The important interaction between vehicle and track can be taken into account by the riding quality for a certain vehicle on every particular piece of track. The riding quality is determined by the accelerations transmitted by the payload, weighted according to comfort standards, and the relative displacements between wheel and rail. From the riding quality demands both for vehicle design and for maintenance of the track can be derived.

Broersen, PMT *Vehicle System Dynamics* Vol. 3 No. 2, Sept. 1974, pp 109-121

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: ESL Repr. PC, Microfilm

B2 125885
INSTRUMENTATION FOR MEASUREMENT OF FORCES ON WHEELS OF RAIL VEHICLES
The information in this report covers the procurement, development and testing of instrumentation designed to measure the dynamic forces and temperatures which are created in the wheels of a load rail vehicle truck. The information contained herein is intended for use by scientific, research and engineering personnel who are involved in the measurement of dynamic loads of rail vehicle wheels.

Sponsored by DOT Federal Railroad Administration.

Association of American Railroads Technical Center, ENSCO, Incorporated, (LT-328) Proj Engr. FRA-ORD&D 85-11, May 1974, 103 pp, Figs., Tabs., 13 Phot.

Contract DOT-FR-20010

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-247154/AS, DOTL NTIS

B2 126400
DEMANDS ON RAIL TRAVELING ALUMINUM TRAINS FROM THE VIEWPOINT OF THE TRAFFIC DEPARTMENT [Forderungen an Aluminium-schienenfahrzeuge aus der Sicht des Verkehrsbetriebes]
Large scale use of aluminum trains contributes to a reduction of energy consumption and of wear of the track. Consideration of the economics of using aluminum trains leads to suggestions for reducing costs by changes in design and methods of production. Some of the cars of the German Federal Railway now in service are discussed. [German]

Rappenglueck, W *Aluminum* Vol. 51 No. 4, Apr. 1975, pp 277-280

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

B2 126402
DAMPING PROPERTIES OF RUBBER-STEEL SHOCK ABSORBERS [Wlasnosci tlumiace amortyzatorow gumowo-stalowych]
The results of the author's own studies of the effect of repeated loading and artifical aging of rubber-steel shock absorbers on their mechanical characteristics are presented. An evaluation is made of the suitability of rubber-steel

shock absorbers for use in railway couplers in comparison with the hitherto used spring-type shock absorbers which consist of elastic-frictional rings. [Polish]

Mikula, S *Przeglad Mechaniczny* Vol. 34 No. 1, Jan. 1975, 3 pp

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

B2 126409
MATHEMATICAL STRESS ANALYSIS AND TESTS OF COMPONENTS IN THE DEVELOPMENT OF WHEEL SETS
[Rechnerische Spannung-sanalyse und Bauteilpruefung in der Radsatzentwicklung]
The dynamic forces between wheel and rail increases with increasing traveling speeds. This fact requires minimization of the unsprung weight of the wheel sets. For the solution of this problem, the stresses caused by the dynamic forces and the stress-sustaining capacity of the material must be known. Stresses in highly strained areas of wheel sets are calculated and compared with experimentally determined fatigue strengths of the steels used. [German]

Raquet, E (Krupp Huettenwerke); Knorr, W *Technische Mitteilungen Krupp, Werksberichte* Vol. 33 No. 2, May 1975, pp 69-72

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

B2 126416
WHEEL/RAIL ADHESION. THE INFLUENCE OF RAILHEAD DEBRIS
Evidence that rust is a major source of railhead debris, is presented. Particles are observed to spread on the wear band in wet weather and to be worn off in the dry. Laboratory experiments show that debris has little effect on friction except when mixed with an oil. Friction is then reduced depending on the quantity of oil and the surface area of the particles. A considerable proportion of oil is needed to reduce friction to its lowest value. Water can also substantially reduce friction on debris covered surfaces. A correlation is demonstrated between friction and humidity in which the friction coefficient is shown to be a simple function of the amount of water absorbed.

Beagley, TM (Railway Technical Center, England); McEwen, IJ Pritchard, C *Tavistock Institute of Human Relations* Vol. 33 No. 1, June 1976, pp 141-152

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

B2 126974
LABORATORY WEARING TESTS OF WHEEL MATERIALS
Laboratory tests were made of the stress imposed on materials in the boundary layer, of the hardness of materials and of the wearing process with a view to analysing the causes of frictional wearing between wheel and rail. For the choice of optimum wheel materials recommendations are given with respect to their temperature sensitivity (lower carbon content). [German]

Pigors, O *DET Eisenbahntechnik* Vol. 23 No. 8, Aug. 1975, pp 359-361

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: VEB Verlag Technik Oranienburgerstrasse 13-14, 102 Berlin, East Germany Repr. PC

B2 126982
THE DEVELOPMENT OF CONTAINER CARRYING WAGONS
[Zur Entwicklung von Containerwagen]
Trains conveying containers must operate as complete wagon loads, at a maximum speed of 140 km/h. The most economical wagons for container transport are articulated units. The author discusses problems of running stability, running gear and brake gear in connection with maximum operating speeds of 140 km/h. [German]

Ehinger, M *Schienenfahrzeuge* Vol. 19 No. 2, Feb. 1975, pp 47-50, 5 Fig., 8 Ref.

ACKNOWLEDGMENT: International Railway Documentation, Selection of
PURCHASE FROM: VEB Verlag fuer Verkehrswesen Franzoesische Strasse 13-14, 108 Berlin, West Germany Repr. PC

B2 127710
HARMONIC ROLL SERIES: FREIGHT CAR MODELS, DESIGN PARAMETER STUDY: FREIGHT CAR SIMULATION SERIES. VOLUME 3
To present the findings related to the primary objectives of Task 13, it was decided to present a series of harmonic roll related documents to the industry to be used as reference material in a similar manner to that of the Track-Train Dynamics Bibliography. The document presents technical information about computerized mathematical models used to simulate the dynamic response of freight cars to various operating conditions. Particular emphasis is placed on studying changes in certain basic freight car design parameters and how these changes affect the dynamic response. It is hoped that this information will be used as guidelines by the AAR Mechanical Division for establishing car design specifications and setting maintenance standards that insure the dynamic stability of freight cars.
An International Government-Industry Research Program on Train-Track Dynamics. Requests for this publication should be directed to J.G. Britton, Director of Operations, AAR.

Association of American Railroads AAR-R174, 1975, 98 pp, 58 Fig., 8 Tab., 2 App.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B2 127836
RAILWAY DYNAMIC TESTS
The verification of running safety and the quantitative assessment of the comfort of railway vehicles involves the taking of many dynamic measurements. The author first lists the range of the main recordings required and explains how they are taken: fitting of gauges, isolation of the phenomenon to be studied and transformation of the results into readings that can be interpreted more easily (usually an electric process), amplification, filtering, remote transmission of this data, reception and recording. The complex behaviour of a moving vehicle means that numerous phenomena must be recorded simultaneously and continuously by a whole series of measuring instruments. The author describes and explains in three sections the techniques used for measuring stresses and wheel-rail interaction, the series of measuring instruments, and the interpretation of the many and varied experimental results obtained, particularly with the TGV 001 trainset and the Z 7001 railcar. These results are very close to those obtained by calculation; they show the high value of the method using an analogue computer. [French]

Joly, R *Revue Generale des Chemins de Fer* Vol. 94 July 1975, pp 417-452

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B2 127842
RESEARCH PROGRAMME: LONG DISTANCE RAIL TRAFFIC
Systematic investigations in the necessary sub-fields of the wheel/rail system, particularly regarding the interactions between track and vehicle, the dynamic loading of the track, the aerodynamics, the data transmission and train control, and finally the influences of high-speed transport systems on the environment, are to provide the prerequisites for the development and operation of a modern transport system of advanced wheel/rail technology. [German]

Janousch, R Kurz, H *Glasers Annalen ZEV* Vol. 99 No. 7/8, July 1975, pp 193-196

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B2 127851
150TH ANNIVERSARY ISSUE
The Institutions of Mechanical, Civil, Electrical and Railway Signal Engineers conducted an International Engineering Conference in September 1975 to commemorate the 150th anniversary of passenger railway. This issue has editorical comment designed to complement the papers presented at the Conference. The contents of this issue are as follows: Modern track

fastenings; Developments in Welding techniques for rolling stock; Modern dc traction motor design practice; Non-ferrous brake materials; Bridge reconstruction for overhead electrification; Ferrous fittings for overhead equipment; Roller bearings for railway rolling stock; Thyristor control of traction motors; Appraisal of tank car valves and their application; Australia's railways invest in passengers; Electric cables for signalling and track to train communications; Brake blending and wheelslide protection; High speed track recording coach; Ultrasonic rail flaw detection; Flexicoil suspensions; Prestressed concrete beams for bridges; Recent developments in plain bearings; Asynchronous motor drive for locomotives; Gangway connections between long carriages; Point heaters--progress in design; Batteries for railway applications; TOPS equipment; electrical carbon and the challenge of railways; Design and cost of containers; Railway roller bearings; Computer aided design in railway signalling; Adoption of AWAC catenery on BR, Powered doors for rail vehicles; Signal control desks.

Railway Engineering Journal Vol. 4 No. 5, Sept. 1975, 160 pp, Figs., Tabs., Phots.

PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

B2 128605

MECHANICS OF TRANSPORTATION SYSTEMS

This is a continuation of the work of the Applied Mechanics Division of the American Society of Mechanical Engineers on dissemination of information on application of mechanics in transportation. In no aspect of transportation technology does applied mechanics play a more decisive role than in suspension system design. The papers in this volume are: (1) Classifying Track by Power Spectral Density by Corbin and Kaufman, (2) Active Suspensions for Ground Transport Vehicles, A State of the Art Review by Hedrick and Wormley, (3) The Tire as a Vehicle Component by Segel, (4) Development of Advanced Suspension Systems for High Speed Railcars-The Metroliner, A Case Study. Part I-Dynamic Performance Requirements by Strong and Herring, Part II- Prototype Development and Testing by Dean.

The papers in this book were presented at the winter Annual Meeting of ASME, Houston, Texas, Nov 30-Dec 5, 1975. Individual papers are RRIS 03 128606, 03 128607, 01 128608 and 02 128609.

American Society of Mechanical Engineers AMD-Vol. 15, 1975, 110 pp

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ASME Repr. PC

DOTL RP

B2 128606

DEVELOPMENT OF ADVANCED SUSPENSION SYSTEMS FOR HIGH SPEED RAILCARS. THE METROLINER, A CASE STUDY. PART 1 DYNAMIC PERFORMANCE REQUIREMENTS

This paper describes a technique for development of improved suspension systems for railcars. The Metroliner Ride Improvement Program 1 results are used to illustrate the application of the technique, to determine methods of improving ride quality of the Metroliners, and to establish the requirements for a new truck which should result in ride quality improvement.

This paper was presented at the Winter Annual Meeting of ASME, Houston, Texas, Nov 30-Dec 5, 1975 and is from ASME Mechanics of Transportation Systems, RRIS 02 128605.

Strong, PM Herring, JM (Atomic Energy Commission)
American Society of Mechanical Engineers AMD-Vol. 15, 1975, pp 67-81, 16 Fig., 1 Tab.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ASME Repr. PC

DOTL RP

B2 128609

ACTIVE SUSPENSIONS FOR GROUND TRANSPORT VEHICLES-A STATE OF THE ART REVIEW

This paper surveys the state-of-the-art in ground transport vehicle active suspension development and research. The advantages and disadvantages of active suspensions are discussed. Suspension performance criteria and techniques for design and optimization of active suspensions are reviewed. Applications of active suspensions in automotive, rail and tracked levitated air cushion and magnetic suspensions are cited. Finally current and future directions of active suspension research are discussed.

This paper was presented at the Winter Annual Meeting of ASME, Houston, Texas, Nov 30-Dec 5, 1975 and is from ASME Mechanics of Transportation Systems, RRIS 02 128605

Hedrick, JK Wormley, DN (Massachusetts Institute of Technology)
American Society of Mechanical Engineers AMD-Vol. 15, 1975, pp 21-39, 9 Fig., 67 Ref.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ASME Repr. PC

DOTL RP

B2 128625

HUNTING STABILITY OF RAIL VEHICLES WITH TORSIONALLY FLEXIBLE WHEELSETS

The effects of torsionally flexible wheelsets on the hunting stability of rail vehicles have been investigated by solving the eigenproblem. The primary model is that of a single truck with two torsionally flexible wheelsets. Results for a complete car model consisting of the car body, two trucks and four torsionally flexible wheelsets are also presented for comparison. This study shows that the hunting critical speed of rail vehicles is reduced significantly by the use of torsionally flexible wheelsets.

This paper was contributed by the Rail Transportation Division of the ASME for presentation at the Winter Annual Meeting, Houston, Texas, November 30-December 5, 1975.

Doyle, GR, Jr Prause, RH (Battelle Columbus Laboratories)
American Society of Mechanical Engineers 75-WA/RT-2, July 1975, 8 pp, 14 Fig., 2 Tab., 1 App.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL RP

B2 128627

VERTICAL MOTIONS DURING RAILCAR IMPACTS

In yard type impact situations, railcars strike other railcars producing car body pitching and vertical bounce. This vertical motion, if large enough, can cause vertical disengagement of couplers which could explain the penetration of tank car ends observed in accident situations. Preliminary investigation of vertical motions during impact, using a mathematical model, has successfully reproduced simulations of impacts in the elastic range. Examples confirm the possibility of coupler disengagement or center plate disengagement of railcars undergoing high speed impact. The computer program developed will solve for horizontal and vertical coupler force, vertical motion at the trucks and couplers, and slippage between adjacent car couplers. This work was sponsored by the RPI/AAR Tank Car Safety Research and Test Project Committee and represents one phase of the overall RPI/AAR study of means to improve tank car safety in accidents.

This paper was contributed the Rail Transportation Division of the ASME for presentation at the Winter Annual Meeting, Houston, Texas, November 30-December 4, 1975.

Raidt, JB Manos, WP Johnstone, B (Pullman-Standard Car Manufacturing Company)
American Society of Mechanical Engineers 75-WA/RT-10, July 1975, 7 pp, 10 Fig., 1 Tab., 10 Ref.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL RP

B2 128629

AN INVESTIGATION OF CONTAINER FLAT CAR RIDE QUALITY

This paper contains summaries and analyses of data recorded during a two-phase program, run between 1970 and 1974, which investigated the ride quality of a container flatcar. The program was undertaken because certain wear conditions found in the wheels, trucks, container pedestals, and trailer hitches on intermodal flatcars appeared to be related to their ride qualities. Phase I showed the importance of such basic variables as length of containers, rigidity of lading, amount of lading, speed of train, position of container on car, condition of wheels, and design of friction damping. Phase II showed the importance of truck design, side bearing design, and track condition.

This paper was contributed by Rail Transportation Division of the ASME for presentation at the Winter Annual Meeting, Houston, Texas, November 30-December 4, 1975.

Greenfield, LP (Trailer Train Company); Hodges, RN (Halliburton Services)
American Society of Mechanical Engineers 75-WA/RT-7, July 1975, 12 pp, 2 App.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL RP

B2 128632
PROPOSED SOLUTIONS TO THE FREIGHT CAR TRUCK PROBLEMS OF FLANGE WEAR AND TRUCK HUNTING

This paper reports on the progress of a development program whose objective is to devise cost effective solutions to the problems of excessive flange wear and truck hunting. It is expected that later papers will deal with separate aspects of this program in greater detail. Three solutions for freight cars are proposed: (1) a retrofit steering assembly kit for application to the trucks of existing roller bearing cars, (2) modification of the side frame and bolster castings to incorporate a more cost effective steering assembly for new trucks and (3) a completely new truck design incorporating improvements in car suspension as well. All three designs include a steering feature which will reduce wheel and rail wear in curves and elminate truck hunting. The second and third designs also provide better brake shoe/wheel alignment for additional savings in wheel wear. The appendices define the terminology used and identify the design characteristics of conventional trucks which lead to the present high cost of ownership.

This paper was contributed by the Rail Transportation Division of the ASME for presentation at the Winter Annual Meeting, Houston, Texas, November 30-December 4, 1975.

List, HA (Instrument Society of America); Caldwell, WN Marcotte, P (Canadian National Railways)
American Society of Mechanical Engineers 75-WA/RT-8, July 1975, 7 pp, 7 Fig., 2 App.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL RP

B2 128634
INVESTIGATION OF A TORSIONALLY FLEXIBLE FREIGHT CAR

With the introduction of a new design wood chip gondola car on the Seaboard Coast Line Railroad, problems arose which defied attempts at solutions by analytical methods and laboratory testing. To positively identify the source of these problems and at the same time analyze the effects of rigidizing the car body, Seaboard Coast Line in a joint effort with Pullman-Standard conducted tests in the actual operating environment of a car. The results of these tests, which are herein discussed, led to the conclusion that "truck hunting" action on the empty car was the primary source of structural problems. The test results are presented in graph form followed by a discussion and conclusions. A summary of the ongoing efforts to determine the most economical solution to the problem is also presented.

This paper was contributed by the Rail Transportation Division of the ASME for presentation at the Winter Annual Meeting, Houston, Texas, November 30-December 4, 1975.

Mims, WE (Seaboard Coast Line Railroad); Yang, TH (Pullman-Standard Car Manufacturing Company)
American Society of Mechanical Engineers 75-WA/RT-13, July 1975, 8 pp, 12 Fig., 1 Tab.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL RP

B2 128635
ANALYTICAL AND EXPERIMENTAL DETERMINATION OF NONLINEAR WHEEL/RAIL GEOMETRIC CONTRAINTS

The wheel/rail geometric constraint relationships for actual wheel and rail profiles are generally nonlinear functions of wheelset lateral displacement. Two of these relationships which strongly influence the lateral dynamics of railway vehicles are the effective conicity and gravitational stiffness. An algorithm for the digital computer is presented that calculates these nonlinear relationships for arbitrary wheel and rail head profiles. An experimental apparatus was developed to determine the location of the wheel/rail contact points as a function of wheelset lateral displacement for arbitrary profiles. Experimental data obtained with this apparatus are presented for various cases which validate the results of the analytical procedure.

To be presented at the Winter Annual Meeting.

Cooperrider, NK (Arizona State University); Law, EH (Clemson University); Hull, R (Arizona State University); Kadala, PS Tuten, JM (Clemson University)
American Society of Mechanical Engineers 1975, 44 pp, 11 Fig., 9 Ref.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL RP

B2 129104
FREIGHT CAR TRUCK DESIGN OPTIMIZATION. LITERATURE SEARCH. VOLUME I

This document serves as an introduction to the literature known to be available and relevant to rail freight car trucks, their components and performance characteristics. In connection with the Federal Railroad Administration sponsored research in Truck Design Optimization a literature search was conducted to review and assemble all relevant publications, papers, and articles. The collected documentation has been organized into five sections: (1) The History of the Freight Car Truck; (2) Truck Design; (3) Truck Compaments; (4) Track-Train Dynamics as Related to Truck Performance; and (5) Truck Performance. Each section contains; an introduction dealing with literature selected for reprinting, reprints of articles judged particularly representative or salient, and a bibliography alphabetized by author. The five sections have been organized into three-volumes. Volume I contains the sections entitled: "The History of the Freight Car Truck" and "Truck Design." Volumes II and III will complete the compilation. It is expected that supplements to the three initial volumes will be published at a later date as additional information becames available.

This interim report represents the first of a three volume set. Volume II (RRIS 02 129105) and Volume III (RRIS 02 129106) bear the same report number with B and C suffixes respectively.

Southern Pacific Transportation Company, Federal Railroad Administration, (TDOP 75-251) Intrm Rpt. FRA-OR&D 75-81A, June 1975, 124 pp, Figs., Phots., Refs.

Contract DOT-FR-40023

ACKNOWLEDGMENT: FRA, NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-248350/1ST, DOTL NTIS

B2 129105
FREIGHT CAR TRUCK DESIGN OPTIMIZATION. LITERATURE SEARCH. VOLUME II

Volume II of the TDOP Literature Search contains the sections entitled: "Truck Components" and "Track-Train Dynamics As Related To Truck Performance." Each of the two sections contains: An introduction dealing with literature selected for reprinting, Reprints of articles judged particularly representative or salient, A bibliography alphabetized by author. The "Bibliography--Truck Components" is further organized into the following subsections: Brakes and Brake Rigging; Centerplates; Side Frames and Bolsters; Snubbers and Dampers; Springs; Wheels, Axles, and Roller Bearings; Miscellaneous Component Systems.

This interim report represents the Second of a three volume set. Volume I (RRIS 02 129104) and Volume III (RRIS 02 129106) bear the same report number with A and C suffixes respectively.

Southern Pacific Transportation Company, Federal Railroad Administration, (TDOP 75-252) Intrm Rpt. FRA-OR&D-75-81B, July 1975, 198 pp

Contract DOT-FR-40023

ACKNOWLEDGMENT: FRA, NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-248351/9ST, DOTL NTIS

B2 129106
FREIGHT CAR TRUCK DESIGN OPTIMIZATION. LITERATURE SEARCH. VOLUME III
Volume III of the TDOP Literature Search contains the sections entitled: "Truck Performance" and "Literature Search Title Index." The section dealing with truck performance contains: An introduction dealing with literature selected for reprinting, Reprints of articles judged particularly representative or salient, A bibliography alphabetized by author. The "Bibliography--Truck Performance" is further organized into the following subsections: Computer Analysis of Truck Performance, Field Analysis of Truck Performance, Laboratory Analysis of Truck Performance. The index section contains a listing alphabetized by title of all publications included in the three-volume Literature Search.

This interim report represents the third of a three volume set. Volume I (RRIS 02 129104) and Volume II (RRIS 02 129105) bear the same report number with A and B suffixes respectively. Bibliographical additions will be made as more information becomes available throughout the Truck Design Optimization Project.

Southern Pacific Transportation Company, Federal Railroad Administration, (TDOP 75-253) Intrm Rpt. FRA-OR&D-75-81C, Aug. 1975, 215 pp

Contract DOT-FR-40023

ACKNOWLEDGMENT: FRA, NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-248352/7ST, DOTL NTIS

B2 129152
FREIGHT CAR TRUCK DESIGN OPTIMIZATION. DETAILED TEST PLANS FOR SERIES 5 TESTS-PHASE 1
This document presents the detailed test plans for Series 5 Tests of Phase I of the Truck Design Optimization Project. It is a continuation of previous reports for the same project presenting the introduction and detailed test plans for Series 1, 2, and 3 Tests in the first volume and the detailed test plans for Series 4 Tests in the second volume. It includes a description of the trucks and cars to be used in the testing, the basis for selecting them, and a description of the tests themseleves. It lists the instrumentation to be used and the sequence of testing. The reader is referred to the previous documents for details of the instrumentation and data analysis.

The reports entitled Introduction and Detailed Test Plans For Series 1, 2, and 3 Tests, Phase I, and Detailed Test Plan for Series 4 Tests, Phase I are prereguisite to this document. Sponsorship was from FRA, DOT.

Southern Pacific Transportation Company, (TDOP 75-153) Intrm Rpt. FRA-OR&D 75-82, TDOP-75-153, Nov. 1975, 32 pp, 6 Fig., 2 Tab.

Contract DOT-FR-40023

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-248631/4ST, DOTL NTIS

B2 129153
FREIGHT CAR TRUCK DESIGN OPTIMIZATION. INTRODUCTION AND DETAILED TEST PLANS-SERIES 1, 2, AND 3 TESTS-PHASE I
This document serves as an introduction to the Freight Car Truck Design Optimization Project (TDOP) and presents the detailed test plans for Series 1, 2, and 3 Tests of a contemplated group of four series for that project. Some of the background of the project is given, the development of the test method is described, a description of the instrumentation on the test track and test car and of the facilities of Southern Pacific Transportation Co, (SPT Co.) are given, a data collection and processing plan and analytical procedures for comparing test results with predicted values are presented. A description of the Series 1, 2, and 3 Tests, the contemplated test schedule, and the management structure for the project are also given. In the appendix, the tasks required to be performed by the statement of work for Phase I are outlined.

This is a prerequisite to the forthcoming interim report covering the test plan for Test Series 4, FRA Report FRA-OR&D 75-60. This document supersedes issue of July 1975. Sponsored by FRA.

Southern Pacific Transportation Company, (TDOP-75-11) Intrm Rpt. FRA-OR&D 75-59, TDOP-75-11, Oct. 1975, 120 pp, 28 Fig., 11 Tab.

Contract DOT FR-40023
ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-248632/2ST, DOTL NTIS

B2 129198
FREIGHT CAR TRUCK DESIGN OPTIMIZATION. SURVEY AND APPRAISAL OF TYPE II TRUCKS
This report serves as an introduction to the family of truck designs known as Type II that will be studied in connection with the Federal Railroad Administration's Truck Design Optimization Project. An investigation was made of existing trucks and truck designs qualifying as Type II trucks and this investigation considers features which would be of interest in selecting candidates for testing and evaluation of such trucks under Phase II of the Truck Design Optimization Project. Type II special service designs embody new concepts that utilize current wheel set and journal bearing assemblies and braking arrangements compatible with current air brake systems. Car coupler height is maintained but car body support other than center plates can be employed. Ride quality and minimum maintenance cost are of major importance to Type II designs.

This project was sponsored by the Federal Railroad Administration, DOT.

Southern Pacific Transportation Company, (TDOP 75-201) Intrm. Rpt FRA-OR&D-76-05, TDOP-75-201, Dec. 1975, 133 pp, Figs.

Contract DOT-FR-40023

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-248633/0ST, DOTL NTIS

B2 129284
THE GUIDANCE OF RAILWAY VEHICLES
World-wide the consensus is generally towards the use of rather low conicities for high speed vehicles. Whether the improvement of understanding and prediction techniques will alter this trend remains to be seen. For lower speed vehicles the consensus is less general. Some freight vehicles already succesfully use a high-conicity approach with good linear curving, and the authors expect to see this trend continued. They also expect to see improvements in the design of commuter vehicles to increase the linear curving regime and therby reduce flange and rail wear problems.

Gilchrist, AO Hobbs, AEW *Vehicle System Dynamics* Vol. 4 No. 2-3, 1975, pp 152-156

ACKNOWLEDGMENT: International Union of Railways, BD
PURCHASE FROM: ESL Repr. PC, Microfilm

B2 129403
COUPLED VEHICLE/TRACK DYNAMICS
Dynamic coupling occurs between a railway vehicle and the track due to the reaction forces acting between the wheels and the track, and the elasticity of the track and the foundation. It has become apparent that track elasticity can influence the dynamic behaviour of the railway vehicle, yet in most of the research work in the area of railway vehicle dynamics reported so far, the track is regarded simply as a rigid structure, providing the reactions to the loads of passing vehicles. In this paper the models used for the analyses of the vehicle dynamics (on rigid track) and for the coupled vehicle/track dynamics are described. The equations of motion are derived, and the results obtained for the coupled vehicle/track model are presented and compared with those obtained for the case of an infinitely rigid track. Particular empahsis is on the lateral stability and the response to vertical track irregularities.

Maraghy, WHE Dokainish, MA *Vehicle System Dynamics* Vol. 4 No. 2-3, 1975, pp 203-207

ACKNOWLEDGMENT: International Union of Railways, BD
PURCHASE FROM: ESL Repr. PC, Microfilm

B2 129406
HUNTING MOVEMENT AND CONDITIONS OF STABILITY OF RAILWAY VEHICLES. STABILITY OF TRANSVERSAL OSCILLATIONS OF VEHICLES [Vlnivy pohyb a jeho stabilita u kolejovych vozidel. Stabilita pricneho kmitani lokomotivy]
Methods of calculating the stability of the transversal play of powered and hauled railway vehicles. The author discusses the influence of constructional parameters of the vehicles, and of the dynamic variations of the load applied to the track on critical speeds. [Czech]

Rus, L *Technicke Zpravy CKD* No. 4, 1973, pp 24-29

ACKNOWLEDGMENT: International Union of Railways, BD
PURCHASE FROM: Technicke Zpravy CKD Prague, Czechoslovakia Repr. PC

B2 129849
INFLUENCE OF THE CONCRETE CONDITIONS OF CONTACT BETWEEN WHEEL AND RAIL ON THE RUNNING OF VEHICLES OVER RAILWAY LINES [Einfluss konkreter Rad-Schiene Beruhrungsverhaltnisse auf das Laufverhalten von Schienenfahrzeugen]
The authors speak of the effects of a number of different wheel, and rail profiles on the stability of rolling stock, and also of the influence on such stability of the wheel/rail friction coefficient. From the studies carried out, it transpires that a wheel profile close to the shapes created by natural wear between wheel and rail is more advantageous than conical profiles as regards maintenance and running stability. [German]

Hanneforth, W Fischer, W *DET Eisenbahntechnik* Vol. 23 No. 9, Sept. 1975, pp 409-412, 1 Tab., 11 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: VEB Verlag Technik Oranienburgerstrasse 13-14, 102 Berlin, East Germany Repr. PC

B2 129850
LATERAL DYNAMICS OPTIMIZATION OF A CONVENTIONAL RAILCAR
The attempt to develop a railway vehicle that can operate in the 150 to 300-mph (240 to 480-km/h) speed regime is seriously hampered by the problems of ride comfort, curve negotiation, and "hunting." This latter phenomena involves sustained lateral oscillations that occur above certain critical forward velocities and cause large dynamic loads between the wheels and track as well as contributing to passenger discomfort. This paper presents results of an initial effort to solve these problems by utilizing optimization procedures to design a high speed railway vehicle. This study indicates that the problem is more easily treated as a constrained optimization problem than as an unconstrained problem with several terms in the objective function. In the constrained optimization problem, the critical "hunting" speed was maximized subject to constraints on (1) the acceleration of the car body, (2) the suspension stroke length, and (3) the maximum suspension stroke while negotiating a curve. A simple, three degree- of-freedom model of the rail vehicle was used for this study. Solutions of this constrained problem show that beyond a minimum yaw stiffness between truck and car body the operating speed remains nearly constant. Thus, above this value, the designer may trade off yaw stiffness, wheel tread conicity and stability margin.

Cooperrider, NK Cox, JJ (Arizona State University); Hedrick, JK (Massachusetts Institute of Technology) *ASME Journal of Dynamic Systems, Meas and Control* Vol. 97 No. 3, Sept. 1975, pp 293-299

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

B2 130812
LONGITUDINAL FORCES IN A TRAIN WHEN TAKING A CONVEX CURVE CONNECTING WITH A LONGITUDINAL SECTION [Prodolnye sily v poezde na soprjazenii ogranicivajuscih uklonov vypuklyh ucastkov profilja puti]
The article studies the profiles to be given to these connecting curves, and their effects when they are taken by heavy trains under traction conditions. Recommendations are made for reducing the dynamic longitudinal forces of quasi-static nature appearing in the couplings of such trains. [Russian]

Versinskij, SV Sakovic, LA *Vestnik Vniizt* Vol. 34 No. 7, 1975, pp 34-38, 3 Tab., 4 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Vestnik Vniizt Moscow, USSR Repr. PC

B2 130833
A REVIEW OF RAIL-WHEEL CONTACT STRESS PROBLEMS
Nearly 200,000 defective rails were located on U.S. railroads in 1972 Rail failures are one of the largest single causes of derailments, ranking somewhat ahead of the next most substantial contributor: wheels and axles (bearings). Furthermore, a high degree of correlation was observed between the rail-related accidents and the ton-miles carried, suggesting that a higher utilization of the rail system may lead to yet higher accident rates. The defective rails and rail-failure-related accidents occur in spite of a massive inspection effort and the installation of over 700,000 tons of new rail annually. Not all defects are equally likely to cause derailments. Rail-end failures (bolt-hole cracks and head/web separations) occur most frequently, but are not proportionately the largest cause of accidents. Transverse defects, which are less frequent, can account for a disproportionately high number of accidents.

This article is extracted from Symposium on Railroad Track Mechanics, RRIS 01 130826, Publication 7602. The complete volume is $3.75, Microfiche $2.25.

Paul, B
Princeton University 76-TR-1, Oct. 1975, pp 25-26

Contract DOT-FR-54175

ACKNOWLEDGMENT: Princeton University
PURCHASE FROM: NTIS

DOTL RP

B2 130834
STRESSES AND BEHAVIOR OF RAIL TRACKS DURING THE PASSAGE OF TRAINS TRAVELLING AT VERY HIGH SPEEDS; STANDARDS ADOPTED BY THE SNCF FOR ITS FUTURE VERY HIGH SPEEDS LINES (250/300 KM/H)
On the Paris-Madrid line in Southwest France, between Bordeaux and Dax, there is a section on which there are two straight stretches of 20 to 45 km, separated by a curve with a radius of 2850 meters. This SNCF line allows tests to be carried out at speeds of over 250 km/h. Since August 1972, two prototype trains, the TGV 001 turbotrain, and the Z 7001 electric motor train, have been traveling four times a day at speeds between 250 and 320 km/h. This paper summarized the knowledge acquired in France as the result of systematic tests carried out at those speeds in anticipation of the new Paris-Sud-Est line on which trains will travel at speeds of over 250 km/h. Although the problems are not yet completely solved, they are at least now defined very clearly, and none of them is of a fundamental type. The doubts raised a few years ago now appear to be baseless, at least for speeds of up to 300 km/h.

This article is extracted from Symposium on Railroad Track Mechanics, RRIS 01 130826, Publication 7602. The complete volume is $3.75, Microfiche $2.25.

Prud'Homme, A (French National Railways)
Princeton University 76-TR-1, Oct. 1975, pp 29-31

Contract DOT-FR-54175

ACKNOWLEDGMENT: Princeton University
PURCHASE FROM: NTIS

DOTL RP

B2 130910
TECHNICAL STABILITY OF THE LATERAL VIBRATION OF A SINGLE WHEEL SET MOVING ALONG A TRACK WITH A NONLINEAR TRANSVERSE ELASTICITY [Statecznosc techniczna drgan bocznych pojedynczego zestawu kolowego poruszajacego sie wzdluz toru z nieliniowa sprezystoscia poprzeczna]
The technical stability of a mechanical system with a single degree of freedom, a nonlinear elasticity characteristic, free play, and damping by dry fricition, is considered. This system performs forced lateral vibrations produced by a harmonic force. The system is acted on by constantly acting perturbations of the elasticity and damping characteristics. The regions of

the stability were considered from the practical point of view. The problem is analyzed by means of the second method of Lyapunov. The relations obtained for the stability conditions contain the elasticity coefficient, the damping, and the rate of lateral motion of the body. [Polish]

Pieniazek, A Pieniazek, W *Mechanika Teoretyczna i Stosowana* Vol. 13 No. 1, 1975, pp 107-115

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

B2 131018
CONSTRUCTION OF LIHGT-WEIGHT VEHICLES AND CONSEQUENCES ON TRACK-VEHICLE INTERACTION [Der Einfluss des Fahrzeuggleichbaus auf die Wechselwirkung von Fahrzeug und Gleis]
The author reviews progress made in the construction of vehicles using light-weight metal since 1930-1940. He re-defines a few of the concepts in the specific area of vehicle-track interaction and stresses the critical points of the "complex oscillation system". He also compares the interactions dealt with in this article with the results obtained from previous experience and mentions work under way in various Transport Institutes. [German]

Nothen, J *Leichtbau der Verkehrsfahrzeuge* Vol. 19 No. 4, July 1975, pp 65-69, 7 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Leichtbau der Verkehrsfahrzeuge Munich, West Germany Repr. PC

B2 131032
FREQUENCY DOMAIN COMPUTER PROGRAMS FOR PREDICTION AND ANALYSIS OF RAIL VEHICLE DYNAMICS. VOLUME 1-TECHNICAL REPORT
Frequency domain computer programs developed or acquired by TSC for the analysis of rail vehicle dynamics are described in two volumes. Volume I defines the general analytical capabilities required for computer programs applicable to single rail vehicles and presents a detailed description of frequency domain programs developed at TSC in terms of analytical capabilities, model description, equations of motion, solution procedure, input/output parameters, and program control logic. Descriptions of programs FULL, FLEX, LATERAL, and HALF are presented. TSC programs for assessing lateral dynamic stability of single rail vehicles are also described. Volume II contains program listing including subroutines and card-by-card descriptions for inputing data for the four TSC frequency domain programs described in Volume I.

Perlman, AB DiMasi, FP
Transportation Systems Center, (DOT-TSC-FRA-75-16.I) Final Rpt. FRA-OR&D 76-135.I, Dec. 1975, 116 pp, Figs., Tabs., 5 Ref.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche
DOTL NTIS

B2 131033
FREQUENCY DOMAIN COMPUTER PROGRAMS FOR PREDICTION AND ANALYSIS OF RAIL VEHICLE DYNAMICS. VOLUME II-APPENDIXES
Frequency domain computer program developed or acquired by TSC for the analysis of rail vehicle dynamics are described in two volumes. Volume I defines the general analytical capabilities required for computer programs applicable to single rail vehicles and presents a detailed description of frequency domain programs developed at TSC in terms of analytical capabilities, model description, equations of motion, solution procedure, input/output parameters, and program control logic. Descriptions of programs FULL, FLEX, LATERAL, and HALF are presented. TSC programs for assessing lateral dynamic stability of single rail vehicles are also described. Volume II contains program listings including subroutines for the four TSC frequency domain programs described in Volume I.
See also Volume II, RRIS 02 131032, Publication 7602.

Perlman, AB DiMasi, FP
Transportation Systems Center, (DOT-TSC-FRA-75-16.II) Final Rpt. FRA-OR&D-76-135.II, Dec. 1975, 102 pp

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche
DOTL NTIS

B2 131272
EFFECT ON TRACK OF HEAVY AXLE LOADS
The author recalls and makes reference to numerous studies on the problems of damage to rails caused by heavy axle loads. He quotes recommendations developed by AREA with regard to permissible axle loads in relation to wheel diameter and vehicle speed, and the ultimate tensile strength of rail steels. He mentions the experience of Australian Railways operating meneral lines with block- trains made up of very heavy wagons. He then gives formulae and tables in which the track maintenace cost, as per traffic unit, is expressed in relation to various variables and parameters: speed, axle weight on rail, age of ballast, linear weight of rail, curve radius, etc.
International Engineering Conference Paper. 150th Anniversary of passenger railways.

Gordon, ER Brew, JR
Institution of Mechanical Engineers Sept. 1975, pp 40-43, 3 Tab., 14 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: ESL Repr. PC, icrofilm 3
DOTL JC

B2 131302
STUDY INTO THE STABILITY OF EMPTY CARS RUNNING AT HIGH SPEEDS OVER LINE SECTIONS WITH ARTIFICIALLY-CREATED IRREGULARITIES [Issledovanie ustojcivosti prooznih gruzovyh vagonov pri povysennyh skorostjah na ucastkah puti s iskusstvennymi nerovnostjami]
The article gives the results of dynamic tests with empty cars worked at up to 300 km/h; then tests took place in a test yard, over line sections with artificially- created irregularities. Proof is given of the possibility for freight cars equipped with MT-50 trucks to run at speeds of up to 100 km/h. The creation of irregularities on the track is an efficient and promising method for studying the dynamic properties of rolling stock. [Russian]

Versinskiji, SV Kondrasov, VM *Vestnik Vniizt* Vol. 34 No. 3, 1975, pp 3-8, 1 Tab., 6 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Vestnik Vniizt Moscow, USSR

B2 131307
CRITERIA FOR EVALUATING RAIL VEHICLE DYNAMICS BY COMPUTER MODELING TECHNIQUES
The problem is tackled by means of a 14-degree-of-freedom computer model excited by two track geometry errors: a deterministic input based on bolted-rail track, and random geometry power spectra based on continuous welded rail. The model is not described, and the paper is devoted to the study of possible criteria and the results obtained from application of these criteria to various types of rolling stock. The authors review the classical ride-comfort criteria of JNR, ISO, BR and devise complex criteria combining vertical and cross vibration, and characterising: the maximum permissible weight of the vehicles; the stability of the track/vehicle system; comfort in curves; the ride quality.

Ahlbeck, DR
High Speed Ground Transportation, Intl Conf Jan. 1975, pp 1-17, 3 Tab., 10 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr. PC

B2 131637
SOME RELATIONSHIPS BETWEEN DYNAMIC PERFORMANCE OF FREIGHT CAR TRUCKS AND WORN WHEEL TREAD
Stability of flanged wheels on steel rails involves wheel tread and rail head contours. But after 150 years of railroading, the merits of various tread profiles are still being debated. To fix the importance of wheel profile on lateral stability of the freight car truck and riding qualities of the car, extensive tests were conducted by Southern Pacific on 89-foot flat cars used in container service. It was found that wheel contours have overriding influence on truck stability. While asymetrical wear patterns may develop

from external influences, not all such uneven wear produces unstable operation. Hollow treads seem to stabilize a wheel set. Further investigations, assisted by computer analysis, are needed to understand the dynamic performance of car trucks as influenced by worn wheels. Brake shoe wear has an influence on wheel wear which can affect wheelset stability but this is not understood fully.

Direct enquiries to P.V. Garin. Prepared for the Joint ASME/IEEE Meeting, Chicago, Illinois, April 6-8, 1976.

Garin, PV Cappel, KL (Wyle Laboratories)
Southern Pacific Transportation Company Apr. 1976, 31 pp, 27 Fig., 1 Tab., 7 Ref.

ACKNOWLEDGMENT: ASME, IEEE
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL RP

B2 131639
WHEELSET SUSPENSIONS DESIGNED TO ELIMINATE THE DETRIMENTAL EFFECTS OF WHEEL WEAR ON THE HUNTING STABILITY OF RAILROAD VEHICLES

Traditionally, railroads use wheels having conical wheeltreads, the conicity being 1/20 normally. In practice it has been found that wheeltreads tend to wear hollow. There is also considerable wear to wheel flanges. Such wheel wear changes the effective conicity of the wheeltread and railroad practice has shown that worn wheels frequently excite the vehicle, often to violent oscillations in the lateral plane at certain critical speeds. These undesirable oscillations are generally referred to as hunting. The hunting phenomenon can be explained adequately by the creep theory. A consequent application of this theory leads to the design of wheelset suspensions which result in wheel wear being minimized and distributed evently over the tread surface, thus reducing the tendency for the wheeltread conicity to change with wheel wear. Such suspensions require wheels having profiled wheeltreads of a relatively high effective conicity. In addition, the elastic yaw constraint between wheelset and truck frame must not exceed certain values.

Presented at the 1976 Joint ASME/IEEE Railroad Technical Conference, Chicago, Illinois, April 6-8, 1976. For the complete volume see RRIS No. 02 131638, Publication 7602.

Scheffel, H (South African Railways)
American Society of Mechanical Engineers 1976, pp 1-23, 17 Fig., 4 Ref.

ACKNOWLEDGMENT: ASME, IEEE
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL RP

B2 131640
LATERAL DYNAMICS OF A RAILWAY VEHICLE

A 17-degrees-of-freedom model is used for investigating the lateral stability of a four-axle railway vehicle. Influence of various design parameters on primary and secondary hunting is studied. The study provides useful information to the practicing engineers engaged in the suspension design of railway vehicles.

Presented at the 1976 Joint ASME/IEEE Railroad Technical Conference, Chicago, Illinois, April 6-8, 1976. For the complete volume see RRIS No. 02 131638, Publication 7602.

Garg, VK (General Motors Corporation); Chu, KH (Illinois Institute of Technology); Mels, KD (General Motors Corporation)
American Society of Mechanical Engineers 1976, pp 25-40, 6 Fig., 1 Tab., 8 Ref.

ACKNOWLEDGMENT: ASME, IEEE
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL RP

B2 131641
ANALYTICAL AND EXPERIMENTAL DETERMINATION OF NONLINEAR WHEEL/RAIL GEOMETRIC CONSTRAINTS

The wheel/rail geometric constraint relationship for actual wheel and rail profiles are generally nonlinear functions of wheelset lateral displacement. Two of these relationships which strongly influence the lateral dynamics of railway vehicles are the effective conicity and gravitational stiffness. An algorithm for the digital computer is presented that calculates these nonlinear relationships for arbitrary wheel and rail head profiles. An experimental apparatus was developed to determine the location of the wheel/rail contact points as a function of wheelset lateral displacement for arbitrary profiles. Experimental data obtained with this apparatus are presented for various cases which validate the results of the analytical procedure.

Presented at the 1976 Joint ASME/IEEE Railroad Technical Conference, Chicago, Illinois, April 6-8, 1976. For the complete volume see RRIS No. 02 131638, Publication 7602. Also available from NTIS, PB-252290/AS.

Cooperider, NK (Arizona State University); Law, EH (Clemson University); Hull, R (Arizona State University); Kadala, PS Tuten, JM (Clemson University)
American Society of Mechanical Engineers 1976, pp 41-69, 11 Fig., 9 Ref.

ACKNOWLEDGMENT: ASME, IEEE
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL RP

B2 131644
EFFECT OF VERTICAL TRACK IRREGULARITIES ON CAR BODY VERTICAL ACCELERATIONS

Using Power Spectral Density and Voltage Density techniques, this paper studies the influence of Track Irregularities, Speed and Spring Design on Vertical Ride Characteristics of Freight Cars.

Presented at the 1976 Joint ASME/IEEE Railroad Technical Conference, Chicago, Illinois, April 6-8, 1976. For the complete volume see RRIS No. 02 131638, Publication 7602.

Guins, SG
American Society of Mechanical Engineers 1976, pp 71-85, 15 Fig., 1 Tab., 5 Ref.

ACKNOWLEDGMENT: ASME, IEEE
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL RP

B2 132931
STANDARD TEST RAILROAD CAR OF THE WEST GERMAN RAILROAD SYSTEM FOR TESTING AT HIGH SPEEDS-1,2 [Der Einheitsmesswagen der Deutschen Bundesbahn fuer Versuche mit Hohen Geschwindigkeiten-1,2]

A vehicle is described which can be used for performing a wide variety of tests. Constructional details and a description of the electric and power supply equipment are presented. For application when the basic equipment is insufficient, some cars are provided with supplementary equipment. However the universality of the vehicle is not restricted thereby. [German]

Hofmeister, K Knau, U Hugo, K *Elektrische Bahnen* Vol. 46 No. 9, Sept. 1975, pp 219-226

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

B2 132937
TRACK-TRAIN DYNAMICS

The purpose of this paper is to outline one of the serious dynamic problems involving railroad cars and to propose an orderly approach to the definition of a dynamic model through analysis and testing that can be used to investigate various fixes. The problem in question is the hunting phenomenon involving lateral instability of the car suspension (trucks). This phenomenon has been recognized as a major contributing factor in a significant number of derailments causing millions of dollars in losses. This paper expounds on the mechanics and characteristics of hunting. The planned solution is outlined as a building block approach directed at formulating a test verified dynamic model of an open hopper freight car-truck assembly. Results obtained to date are presented together with conclusions related to the program.

Presented at a meeting Nov. 17-20, 1975.

Abbott, PW (Martin Marietta Corporation); Morosow, G Macpherson, J
Society of Automotive Engineers Preprint N751058, 1975, 13 pp

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

B2 132938
DYNAMIC ANALYSIS OF RAIL-VEHICLE SYSTEMS USING DYNALIST II
The purpose of this paper is to introduce the DYNALIST (Dynamics of Articulated Linear Systems) computer program and demonstrate its application to rail-vehicle systems. The program is available through the U.S. Department of Transportation. Transportation Systems Center, and offers general modeling and computational tools for Linear analysis in the frequency domain based on modal superposition. The paper describes the lateral dynamic analysis of a passenger type vehicle including calculations for sinusoidal, periodic and stationary random rail irregularities. A transient response capability is also demonstrated. Approximate results based on modal truncation are compared to exact solutions.

Presented at a meeting Nov. 17-20, 1975.

Hasselman, TK (Wiggins (JH) Company); Bronowicki, AJ
Society of Automotive Engineers Preprint N751059, 1975, 10 pp

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

B2 132958
EFFECT OF HEAVY AXLE LOADS ON TRACK
Sessions included track developments, suspension developments and track/-train interaction. Eighteen papers were presented by authors from the United States, Canada, Mexico and Europe.

Proceedings of the 12th Annual Railroad Engineering Conference held at Pueblo, Colorado, October 23 and 24, 1975. Individual papers are RRIS Numbers 02 132959, 01 132960, 01 132961, 02 132962, 01 132963, 01 132964, 03 132965, 03 132966, 03 132967, 03 132968, 03 132969, 24 132970, 02 132971, 02 132972, 18 132973, 00 132974, 02 132975, and 00 132976.

Federal Railroad Administration FRA OR&D 76-243, Oct. 1975, 174 pp, Figs., Refs.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-252968/AS, DOTL NTIS, DOTL RP

B2 132959
DETERMINATION OF LOADS ON TRACK
In the past decade, advances in the technology of instrumentation and of computers have made possible the determination of wheel/rail loads so that proper design and maintenance procedures may be developed for vehicles and track so that the industry can live with today's axle loadings. Methods of determining such loads by measurements on the vehicle and the track are discussed. Mathematical modeling procedures may also be utilized to calculate such loads. Computer simulation which includes both vehicle and track in a dynamic interacting system permits specification of outputs in the form of vertical and lateral forces between wheel and rail. Some of the research programs in load determination are then described.

Proceedings of the 12th Annual Railroad Engineering Conference held at Pueblo, Colorado, October 23-24, 1975. The complete volume is RRIS 02 132958, Pricing is for the complete volume: Repr. PC $6.75, Microfiche$2.25, NTIS PB-252968/AS.

Meacham, HC
Federal Railroad Administration FRA OR&D 76-243, Oct. 1975, pp 8-16, 28 Fig.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS
DOTL NTIS, DOTL RP

B2 132960
TESTING CONCRETE TIES
After commenting on the resons for increased interest in concrete ties in the U.S., the author describes the feasibility study undertaken by Chessie System to investigate the technical and economic aspects of such substitution. Experience elsewhere and the economics of such substitution were first examined. Laboratory tests were then made of selected ties. Finally three field tests were made. There was evidence of higher lateral resistance for the concrete-tie track. The reduced resistance to buckling after tamping is discussed, and the advantage of ballast compactors must be studied.

Proceedings of the 12th Annual Railroad Engineering Conference held at Pueblo, Colorado, October 23-24, 1975. The complete volume is RRIS 02 132958, Pricing is for the complete volume: Repr. PC $6.75, Microfiche$2.25, NTIS PB-252968/AS.

Reiner, IA (Chessie System)
Federal Railroad Administration FRA OR&D 76-243, Oct. 1975, pp 17-26, 23 Fig., 8 Ref.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS
DOTL NTIS, DOTL RP

B2 132961
TRACK STRUCTURES FOR HEAVY WHEEL LOADS
The load bearing capability of track depends on the combined characteristics of foundation, superstructure and loads to be carried. Evidence is that loads imposed by 100-ton cars exceed the load-bearing capacity of much of the track over which they operate. Track deterioration under heavy loads appears in the form of loss of surface and line; in conversion of subgrade and ballast sections into plastic masses that pump mud and water, in wide gauge, plate cutting, tie splitting and spike-killed ties; in rapid wear, battered rail ends and in formation of corrugated and shelly rail. After discussing facets of track design and track deflection, the problems of ballast and subgrade are examined and the effects of wheel loads are detailed. Ten recommendations for combatting effects of high wheel loads and two other lines of action for limiting or accounting in advance for track deterioration are suggested.

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Hay, WW (Illinois University, Urbana)
Federal Railroad Administration FRA OR&D 76-243, Oct. 1975, pp 27-36, 10 Fig., 13 Ref.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS
DOTL NTIS, DOTL RP

B2 132963
EFFECT OF HEAVY AXLE LOADS ON RAIL AND TIES
The Quebec North Shore and Labrador Railway was built in 1953 to handle iron ore from mines 350 miles north of the St. Lawrence River. Trains of up to 280 cars with five locomotive units are operated. This presentation reports the maintenance experience on track which carries up to 50 million net tons annually, and has handled almost 700 million gross tons since opening. Among the findings: line, surface and gauge must be maintained even on tangent track; corrugated rail develops quickly on grades and curves and must be countered promptly; joint bars must be kept tight and rail ends restored; oilers are all-important on curves.

Proceedings of the 12th Annual Railroad Engineering Conference held at Pueblo, Colorado, October 23-24, 1975. The complete volume is RRIS 02 132958, Pricing is for the complete volume: Repr. PC $6.75, Microfiche$2.25, NTIS PB-252968/AS.

Monaghan, BM (Iron Ore Company of Canada)
Federal Railroad Administration FRA OR&D 76-243, Oct. 1975, pp 45-48, 9 Fig.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS
DOTL NTIS, DOTL RP

B2 132965
PROGRESS REPORT ON THE TRUCK DESIGN OPTIMIZATION PROJECT
The Federally funded Truck Design Optimization Project (TDOP) is being conducted by Southern Pacific Transportation Company to furnish new technical and economic insights into the procurement and use of freight car trucks. A variety of outputs are emerging, including digital data tapes that may prove useful to future investigators of freight car truck dynamics. TDOP will furnish railroads with technical and economic information on freight car truck performance. Performance data is required to correct existing problems and establish future truck system needs. Phase I effort is anticipated to include technical performance specifications and an economic methodology for use in evaluating trucks.

Proceedings of the 12th Annual Railroad Engineering Conference held at Pueblo, Colorado, October 23-24, 1975. The complete volume is RRIS 02 132958, Pricing is for the complete volume: Repr. PC $6.75, Microfiche$2.25, NTIS PB-252968/AS.

Byrne, R (Southern Pacific Transportation Company)
Federal Railroad Administration FRA OR&D 76-243, Oct. 1975, pp 59-64, 15 Fig.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS

DOTL NTIS, DOTL RP

B2 132966
IMPROVED SUSPENSION FOR 100-TON CARS ON ROUGH TRACK

American Steel Foundries set out to develop a freight car suspension defined as a highly refined, state-of-the-art, three-piece truck designed as a system rather than a collection of components. This article discusses suspension reserve work capacity, optimum damping, design process, ride quality findings in the vertical, lateral and rocking modes, and the determination of the wheel-rail forces as evidenced by factors such as flange wear and truck component wear.

Proceedings of the 12th Annual Railroad Engineering Conference held at Pueblo, Colorado, October 23-24, 1975. The complete volume is RRIS 02 132958, Pricing is for the complete volume: Repr. PC $6.75, Microfiche$2.25, NTIS PB-252968/AS.

Love, RB (American Steel Foundries)
Federal Railroad Administration FRA OR&D 76-243, Oct. 1975, pp 65-73, 20 Fig.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS

DOTL NTIS, DOTL RP

B2 132967
TRUCK DESIGN-A SYSTEMS APPROACH TO SOLVING PROBLEMS

The responsibility for freight-car truck design is difficult to fix. After examining the functions of various agencies involved in design, truck problems are examined. Two areas for improved truck performance are modification of existing trucks to improve reliability and complete redesign to improve performance.

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Hawthorne, VT (Dresser Transportation Equipment Division)
Federal Railroad Administration FRA OR&D 76-243, Oct. 1975, pp 74-78, 9 Fig.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS

DOTL NTIS, DOTL RP

B2 132969
MODIFIED THREE-PIECE TRUCK REDUCES HUNTING AND IMPROVES CURVING-STATUS REPORT

The often-condemned three-piece cast steel freight truck has two advantages: It is inexpensive to manufacture and it has excellent load equalization that allows it to negotiate large changes in crosselevation. This paper describes Standard Car Truck's work with the Anchor Truck design of the South African Railways which improves the basic three-piece truck's curving ability and yet gives it high-speed stability. Utilizing the creep theory in which a wheel is displaced from its position of pure rolling, various conclusions are drawn about wheelset and truck stability. The role of the SAR-developed diagonal anchors and the service experience on SAR's ore car and with a US installation on a 100-ton hopper are described.

Proceedings of the 12th Annual Railroad Engineering Conference held at Pueblo, Colorado, October 23-24, 1975. The complete volume is RRIS 02 132958, Pricing is for the complete volume: Repr. PC $6.75, Microfiche$2.25, NTIS PB-252968/AS.

Bullock, RL (Standard Car Truck Company)
Federal Railroad Administration FRA OR&D 76-243, Oct. 1975, pp 85-92, 16 Fig.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS

DOTL NTIS, DOTL RP

B2 132970
ORE ORGANIZATION AND ITS STUDIES IN TRACK, SUSPENSION AND TRACK/TRAIN INTERFACE

The procedures and facilities utilized by the office for Research and Experiments of the International Union of Railways are described. The studies on conventional and on concrete slab track are described. The investigations of train/track interraction and of derailments are then discussed, as well as axle loading as a function of speed and wheel diameter. It is concluded that in Europe the ballasted conventional track is nearly optimized and much study is being made of concrete slab track. Studies of car suspension systems have only involved two-axle cars. Recommendations on improving the riding stability and quidance of locomotives have been formulated and of maximum loadings for axles and bridges are being progressed.

Proceedings of the 12 th Annual Railroad Engineering Conference held at Pueblo, Colorado, October 23-24, 1975. The complete volume is RRIS 02 132958. Pricing is for the complete volume: Repr. PC $6.75, Microfiche$2.25, NTIS PB-252968/AS.

Schrotberger, K (International Union of Railways)
Federal Railroad Administration FRA OR&D 76-243, Oct. 1975, pp 93-102, 17 Fig.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS

DOTL NTIS, DOTL RP

B2 132975
RAIL WEAR AND CORRUGATION PROBLEMS RELATED TO UNIT TRAIN OPERATIONS: CAUSES AND REMEDIAL ACTION

This paper is a case study of rail wear problems on Canadian National's main line through the Rocky Mountains as a result of unit train operation. The problems are gauge-face wear on the high rail on curves, rail head flow on the low rail and corrugations having a wavelength varying from 8 to 30 inches on the low rail. Prior to introduction of unit trains there were almost no such problems. A study of the lateral forces is described. Remedial action requires a concentrated effort by Engineering, Equipment and Transportation groups with no quick "fix" available. Absence of any action will only cause track deterioration and if it is desired to more bulk commodities in unit trains, the problem must be attacked in an organized manner.

Proceedings of the 12th Annual Railroad Engineering Conference held at Pueblo, Colorado, October 23-24, 1975. The complete volume is RRIS 02 132958, Pricing is for the complete volume: Repr. PC $6.75, Microfiche$2.25, NTIS PB-252968/AS.

King, FE (Canadian National Railways)
Federal Railroad Administration FRA OR&D 76-243, Oct. 1975, pp 139-147, 11 Fig.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS

DOTL NTIS, DOTL RP

B2 132976
HEAVY AXLE LOADS IN NATIONAL RAILWAYS OF MEXICO AND NEED FOR STRENGTHENING OF BRIDGES

National Railways of Mexico has been confronted with many low-capacity bridges on lines where heavy cars are being, or will be handled. While the new bridge standard is Cooper E72 rating, those built prior to 1970 range downward from E60 to E35 on some former narrow-gauge routes. NdeM has raised the ratings on some bridges since diesel locomotives have replaced steam with resultant reduced impact loadings. Slow orders are imposed on certain structures to handle concentrated program of strengthening bridges where it is reduce impact on bridges and use of neoprene pads under the rail base for the same reason have been widely applied. A concentrated program of strenthening bridges where it is economical has been undertaken. Bridges of low capacity or in bad condition are replaced.

Proceedings of the 12th Annual Railroad Engineering Conference held at Pueblo, Colorado, October 23-24, 1975. The complete volume is RRIS 02 132958, Pricing is for the complete volume: Repr. PC $6.75, Microfiche$2.25, NTIS PB-252968/AS.

Diaz, GR (National Railways of Mexico)
Federal Railroad Administration FRA OR&D 76-243, Oct. 1975, pp 148-154, 29 Fig.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS

DOTL NTIS, DOTL RP

B2 134536
TILTING OF VEHICLES IN CURVES [Inclinacion de los vehiculos en las curvas]
Most Railways carry out research on the problem of tilting vehicle bodies on curves so that speed may be maintained without causing discomfort to passengers. The author reviews current developments in the tilt system and its operative and logical progress. He refers to the safety limits for tilting and the economic aspects of this system. [Spanish]

Di Majo, F
Asociacion de Investigacion del Transporte-AIT No. 7, Dec. 1975, pp 7-15, 11 Fig.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Asociacion de Investigacion del Transporte-AIT Madrid, Spain

B2 134540
FURTHER DEVELOPMENT OF THE WHEEL/RAIL TECHNIQUE [Weiterentwicklung der Rad/Schiene Technik]
The writer outlines the German Federal Republic's development policy, which is aimed at further development of the wheel/rail system. The study of models, simulation programmes and experiments on a test platform provide the necessary data for the design and construction of highly efficient vehicle and track components. A stationary rig has been built in Munich for testing running techniques. [German]

Kurz, H *Glasers Annalen ZEV* Vol. 100 No. 1, Jan. 1976, pp 12-15, 1 Fig., 1 Phot.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

B2 134591
GUIDING OF TRACKED VEHICLES. 2444 BIBLIOGRAPHICAL REFERENCES FROM 1826-1974. WITH A HISTORICAL INTRODUCTION [Spurfuehrung, 2444 Zitate aus den Jahren 1826-1974. Mit geschichtlicher Einfuehrung]
This bibliography is the result of 50 years' activity by Professors H. Heumann and W. Basler, and the engineers R. Vogel, J. Troitzsch and V. Schwank, concerning the guiding of vehicles on narrow-gauge track and in curves. [German]

Document at the DOT Library RRIS Repository is available in microfiche form only.

Liechty, R 1975, 636 pp

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Swiss Federal Railways Documentation Bureau 6 rue de l'Universite, CH 3000 Berne, Switzerland

DOTL RP

B3 033088
COMPARISON OF LIGHT INTENSITIES OF VARIOUS LOCOMOTIVE HEADLAMPS AND VISUAL RANGE BY HEADLAMP ILLUMINATION
With the increasing train speed more powerful headlamps are demanded to prevent accidents especially at highway crossings. The light intensity distributions of the various headlamps installed in the actual locomotives were measured at the neighborhood of the Shinmachi Station of the Takasaki Line. The photometric property of the sealed beam headlamps is superior to that of the ordinary type. To secure good illumination, two or more headlamps are to be installed in a locomotive.

Masaki, H Suzuki, S Tanaka, H (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 1 No. 2, June 1960, pp65-66

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-025)
DOTL RP

B3 033328
FIRE PRECAUTIONS IN LOCOMOTIVES AND ROLLING STOCK
Presentation concerning the types of fires on British Railways, the causes, and discussion concerning the means to avoid such hazards. Discussion includes types of extinguishing systems, detecting equipment, and types of equipment. Locomotives, passenger and freight cars, as sources of fires, are among the topics included, as are materials which are hazardous as inflammables and sources of toxic gases. Discussion between members is included.

Jarvis, JM *Railway Division Journal* Vol. 2 No. 2, Mar. 1971, pp94-162, 16 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-279)
DOTL RP

B3 037266
SAFETY ON THE RAILWAYS
The article comments on the improvement of railway safety on the German Federal Railways over the past 15 years. Between 1954-1960 a relatively short period, passenger deaths dropped from 115 to 72 and the number of passenger injuries decreased from 830 to 531. The improvement in railway safety is attributed to a general improvement in technical standards. Many improvements have been or are proposed to meet the demand for higher maximum speeds and to cope with the higher bending stresses and slightly higher axle-loads produced by diesel and electric locomotives as compared with the heaviest steam locomotives. An important measure is the introduction of the S54 rail which may supercede the S49 standard profile. Also, improvements in bridge and tunnel construction, the redefinement of clearance gauges and signalling techniques have enhanced safety operation.

Railway Gazette Vol. 118 Feb. 1963, p 147

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-973)
DOTL RP

B3 039319
FIRST MAIN-LINE DIESEL-HYDRAULIC LOCOMOTIVE FOR BRITISH RAILWAYS
The first diesel-hydraulic main-line locomotive ordered under the British Railways modernization plan has been completed. The power rating is 2,000 hp and the wheel arrangement A1A-A1A incorporates two 12 cylinder diesel engines each set to 1,100 hp. The engines, transmissions, trucks, brake system, and drive controls are described. Exterior dimensions ares hown. Safety features include warning lights provided at each engine position and a general warning light which shows the driver if a fault has developed. Failure of air pressure or vacuum prevents the engine being used to drive the locomotive.

Railway Gazette Vol. 108 Feb. 1958, pp 221-223, 1 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1481)
DOTL RP

B3 039555
RESEARCH ON INDIAN RAILWAYS
The main objectives of the Indian Directorate of the Railway Board, located at Lucknow, are maximum safety in rail travel, sufficiency in equipment, and economy. The Lucknow center carries out research on fuel, the dynamic effects of vehicles on track and bridges and riding quality and performance lists on locomotives and carriages. The sub-center at Lonavla is carrying out research on soil mechanics and foundation engineering problems; chemical and metallurgical studies on lubricants, paints, water softeners, and other aspects are being undertaken at Chittaranjan.

Railway Gazette Vol. 99 Sept. 1953, pp 312-313

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1194)
DOTL RP

B3 040149
CHICAGO AND NORTHWESTERN RAILROAD TEST-DIESEL LOCOMOTIVE WHEEL LIFE DATA
Maintenance data are accumulated for 46, Class-B wheels for an average mileage of 201,532 miles. The mileage, reason for turning, date, and tread remaining before and after turning are recorded.

Chicago and North Western Railway 60-1013, June 1952, 9 pp, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1649)
DOTL RP

B3 040150
WHEEL TREAD FAILURE-CHICAGO AND NORTHWESTERN RAILROAD
Two 36" locomotive wheels were tested after their removal from service because of shelling. These wheels had approximately 10,000 service miles under an E-8 locomotive after they had been turned down once. The wheels had previously seen 77,700 service miles under a locomotive before being turned down. The tests run included visual examination with magnafluxing, chemical analysis, hardness evaluation, and microstructure. The tests showed that the wheels were classified incorrectly at the factory as Class B wheels. They were actually Class A type, which were not capable of withstanding the severe service to which they were subjected.

Novy, SF
General Motors Corporation Eng Rpt 53-139, May 1953, 15 pp, 2 Fig, 10 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1650)
DOTL RP

B3 040151
TEST NUMBERS LD-2 AND LD-14
The groups of test wheels were tested for life expectancy under E-8 locomotives for passenger trains. Tests were suspended because the test wheels could not surpass the performance of the standard type F-36 multiple wear steel wheels of the non-heat-treated class.

General Motors Corporation Apr. 1955, 9 pp, 4 Fig, 3 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1651)
DOTL RP

B3 040192
SD-45 LOCOMOTIVE DYNAMIC BRAKE TRAIN HANDLING TESTS ON PENNSYLVANIA RAILROAD
Because of a major derailment near Johnstown, Pa., a series of dynamics brake handling tests were conducted between Harrisburgh and Pittsburgh, on severe grades and curves. The trains in which the test unit and the adjacent long overhang boxcar operated were varied in nature, ranging from tonnage trains while operating in a two-unit consist to trailer trains and PR trains in four-and eight-unit consists. In general, with the loaded long overhang boxcar leading the train, the records indicate that at no time did the danger of derailing due to drawbar forces exist. No instances in the entire test program exhibited lateral force levels which would be of concern with respect to derailment. The boxcar was loaded with freight during all of the tests.

Klinke, WR Buesing, EJ
General Motors Corporation Test Rpt 898-68-132, Aug. 1967, 76 pp, 39 Fig, 1 Tab, 8 Phot, 7 Ref, 2 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1627)
DOTL RP

B3 040309
USE OF DYNAMIC BRAKES
Instructions are given to update previous methods for use of dynamic brakes, handling engines dead in tow, making up of multiple engine consists and backing up and pusher movements.
Unpublished Communications.

Hastings, DC Dec. 1970, 3 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1790)
DOTL RP

B3 040486
SOME DESIGN PROBLEMS OF DIESEL LOCOMOTIVES
This paper focuses on the problems of diesel-hydraulic vibration systems, the power transmission to axles via a geared system, and the ride problems of the D.800 and D.1000 locomotive classes. Illustrations reveal shaft failures, comparisons of original and tuned vibration systems, crankshaft torsional vibrations, vertical movements of locomotive bogies, and tire profiles of new and worn wheels.

Ell, SO (British Railways) *Institution of Locomotive Engineers Journal* Vol. 56 No. 6, Paper No. 685, pp 543-571, 13 Fig, 2 Tab, 2 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1960)
DOTL RP

B3 040537
THE USE MADE OF SPECTROGRAPHIC ANALYSIS OF DIESEL ENGINE SUMP OIL BY THE ENGINEER
The inspection program of the London Midland Region of the British Railways is described. Important metals whose concentration in the oil are measured include: iron, lead, silicon, sodium, aluminum and copper. Bearing wear is predicted by abnormal concentrations of lead from the flushing followed by copper, since the bearing surface contains 90 percent lead and the underly contains 70 percent copper. Piston seizure is predicted by abnormal concentrations of iron and aluminum, since the pistons are of aluminum alloy and the rings are of iron alloy. The oil samples are taken every 200/250 hours or about every 2-3 weeks. A summary of examinations is given for a two year period.

Dunn, K *Institution of Locomotive Engineers Journal* Vol. 59 No. 328, Part 2, pp 138-142, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1994)
DOTL RP

B3 043675
IDENTIFICATION AND CATEGORIZATION OF ACCIDENTS AND INJURIES IN CABS OF LOCOMOTIVES
A review and categorization is made of available published locomotive cab accident reports and statistics, as well as of unpublished accident reports from a number of individual railroads. Major hazards related to locomotive control compartment accidents are identified and categorized in summation form. Conclusions stress the need for designing greater elemental safety in strength and location of the control compartment, as well as providing a more livable environment for occupants in the control compartment of locomotives. (Author)

Kurz, F
Central Technology, Incorporated Summ Rpt Sept. 1972, 84 pp

ACKNOWLEDGMENT: NTIS (PB-214129)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-214129, DOTL NTIS

B3 046789
STUDY OF BODIES FOR HIGH SPEED HIGH POWER LOCOMOTIVES
The article discusses how to improve snake motion (which is related to stability), and longitudinal vibration (which is related to riding comfort), and enhance traction. Guidelines are given for actual design.

Shirai, N (Hitachi Limited); Ishida, S Hirotsu, T *Hitachi Review* Vol. 22 No. 1, 1973, pp 14-21

ACKNOWLEDGMENT: EI (EI 73 022309)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL RP

B3 046911
PRINCIPLES OF DYNAMIC TRANSPORTATION PERTAINING TO AUTOMATIC DRIVE AND BRAKE CONTROL [FAHRDYNAMISCHE GESICHTSPUNKTE ZUR AUTOMATISCHEN FAHR-UND BREMSSTEUERUNG]
The importance of the braking curve for automatic drive and brake control is discussed. An analysis is presented which correlates braking time and distance for given braking characteristics. The properties of the pneumatic brake are considered. Economic aspects are dealt with. [German]

Blueck, H *Elektrische Bahnen* Vol. 43 No. 7, July 1972, pp 147-152

ACKNOWLEDGMENT: EI (EI 73 027924)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

B3 046960
DEVELOPMENT TRENDS AND PERFORMANCE EXAMPLES OF THE AUTOMATIC DRIVE AND BRAKE CONTROL AT THE BROWN-BOVERI COMPANY [ENTWICKLUNGSTENDENZEN UND AUSFUEHRUNGSBEISPIELE DER AUTOMATISCHEN FAHR-UND BREMSSTEURUNG IM BROWN-BOVERI-KONZERN]
Problems associated with the automatic drive and brake control are discussed. Examples described include the speed control of a switch engine, automatic operation of an industrial railroad, control of a locomotive for an express train in West Germany, control of a motor car of the Swiss railroad system, and control of a train type 420 of the West German railroads. [German]

Eikermann, J *Elektrische Bahnen* Vol. 43 No. 7, July 1972, pp 152-158

ACKNOWLEDGMENT: EI (EI 73 027925)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

B3 046962
DRIVE AND BRAKE CONTROL OF THE LOCOMOTIVE TYPE E 103 [DIE FAHR-UND BREMSSTEUERUNG DER LOKOMOTIVE E 103]
In 1965 the West German Railroad System put into operation four locomotives, type E102, having a maximum speed of 200 km/hr. Some modifications in these locomotives are reported which were incorporated as a result of operational experience. [German]

Assmus, A *Elektrische Bahnen* Vol. 43 No. 7, July 1972, pp 163-167

ACKNOWLEDGMENT: EI (EI 73 027927)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

B3 046992
AAR: UPGRADING THE INTERCHANGE FLEET
The General Committee of the AAR Mechanical Division last month cited "the strong trend toward improving safety and performance through upgrading the interchange fleet, and thus more capably and successfully meeting the growing demands of modern railroading."

Railway Locomotives and Cars Vol. 147 No. 6, July 1973, 3 pp

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B3 047420
SAFE OPERATION OF HIGH-SPEED LOCOMOTIVES
In this paper are presented the basic theories, test information, and the chief conclusions of an investigation of factors entering into the mechanical design of locomotives for high-speed operation. The author points out that (1) recent trends in railroad operation have been toward higher speeds over longer distances and (2) the development of electric and oil-electric power, and lightweight equipment have changed many of the conditions under which these higher speeds are attained. In view of the radically new types

of equipment available, the increased severity of requirements both as to performance and cost of equipment, and the necessity for preserving the railroad's record for safety, it has been necessary to make an extended theoretical and experimental analysis of high-speed locomotive operation. Such an analysis is given in this paper.

This paper appeared in Anthology of Rail Vehicle Dynamics, Volume 2: Effects of Train Action and Rail Car Vibration. The anthology was sponsored by the Rail Transportation Division, ASME. Presented at the Annual Meeting, New York, N.Y., Dec. 2-6, 1935.

Cain, BS (General Electric Company)
American Society of Mechanical Engineers Paper RR-57-3, 1971, pp 111-120, 10 Fig, 1 Tab

PURCHASE FROM: ESL Repr PC, Microfilm
DOTL TF 550.G85 V.2

B3 047460
DYNAMIC BRAKING MUST BE CAREFULLY CONTROLLED
This is the fifth of a series of articles discussing the wheel and rail loadings developed by diesel locomotives. Data are based on calculations and experiments conducted by Electro-Motive. The information may assist in explaining and preventing some of the derailments which railroads experience. The next installment will mark the conclusion of this series.

Koci, LF (General Motors Corporation) *Railway Locomotives and Cars* Vol. 146 No. 2, Feb. 1972, p 13

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B3 047471
SP DERAILMENT INVOLVES PC FUNCTION
After a runaway locomotive indicated what the Federal Railroad Administration has termed "serious deficiences in the capability of a PC system to function as intended under certain conditions," Southern Pacific, AAR, locomotive builders and air-brake manufacturers have mounted a nationwide program to assure that atuomatic power shutoff will take place in emergencies.

Railway Locomotives and Cars Vol. 176 No. 8, Sept. 1972, 1 pp

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B3 050036
M420TR IS ROAD TRANSFER UNIT
The newly designed Canadian National 2000-hp locomotive is powered by an MLW/Alco Model 251 turbocharged 12-cylinder engine. This four-cycle prime mover has 9-in. bore, 10 1/2-in. Stroke and a full-load speed of 1050 rpm. Its output is transmitted through a General Electric 581 d-c main generator and four 752 traction motors. A distinctive feature of the locomoitve profile is the lowered hood next to the cab. The 50-ft locomotive has a 2400 gallon (U.S.) fuel tank and carries 24 cubic feet of sand. It is designed to traverse a 30-degree curve when coupled.

Railway Locomotives and Cars Vol. 146 No. 8, Sept. 1972, 2 pp

ACKNOWLEDGMENT: EI (EI 73 001217)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

B3 050377
MODULAR CONTROLS FOR 1972 EMD UNITS
How reliability and maintainability were improved in the locomotive field, with Electro-Motive Div. of General Motors modular electrical control systems in its 1972 models. Seventeen different control circuits were designed in module form for easy plug-in in an all-new high-voltage electrical cabinet for the yet-to-be-bult units.

Railway Locomotives and Cars Vol. 145 No. 9, Sept. 1971, pp 17-19

ACKNOWLEDGMENT: EI (EI 72 40171)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

B3 050378
RECENT APPLICATION OF THYRISTORS TO JNR ROLLING STOCK
A general introduction is made of the application of thyristors to Japanese National Railroads rolling stock, dealing with the usage of thyristors for the controlling of power running and braking of electric rolling stock, and also as thyristor inverters for coach heating on dc electrification lines, ac power sources for train radio equipment at times of power failure, and controlling circuits for the purpose of saving manpower in maintenance work by realizing contact-less and arc-less circuits.

Sato, T *Japanese Railway Engineering* Vol. 12 No. 2, 1971, pp 4-8

ACKNOWLEDGMENT: EI (EI 72 51815)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

B3 053867
A PRELIMINARY STUDY OF HEAD-ON AND REAR-END COLLISIONS INVOLVING LOCOMOTIVES
Control of hazards to occupants of locomotive cabs is the primary goal of the FRA-B of LE-UTU-AAR Locomotive Control Compartment Committee. The study reported herein is intended to provide further clarification of head-on and rear-end collisions, particularly in regard to structural damage and fatalities to cab occupants. Recommendations for further study are made where additional knowledge is needed.

Hawthorne, KL
Association of American Railroads V-804-74-01, Jan. 1974, 48 pp, 10 Fig, 7 Tab, 7 Ref

PURCHASE FROM: AAR Repr PC
DOTL RP

B3 054605
DEFECT REPORTING
The problem of engineers' defect work reports, relating from trouble in having crews furnish them, maintenance people using them properly and correcting items reported on them, and other related problems associated with work reports, has been one of controversy for many years. Engineers do not always seem to appreciate the task of furnishing work or defect reports and yet an intelligent work report has no limit as to the valuable information it can furnish the maintenance man and the railroad.

Thirty-Seventh Annual Proceedings of the Railway Fuel and Operating Officers Association, 1973.

Beig, EC (Union Pacific Railroad)
Railway Fuel and Operating Officers Association Proceeding 1973, 3 pp

PURCHASE FROM: Railway Fuel and Operating Officers Association 10414 South Wood Street, Chicago, Illinois, 60643 Repr PC
DOTL RP

B3 056831
RESTORING FORCE OF THE HELICAL SPRINGS IN THE CROSS DIRECTION SHOWN ON THE EXAMPLE OF REMODELING THE LOCOMOTIVE E 3173 ON BRITISH RAILWAYS [DIE DUECKSTELLKARAFT VON SCHRAUBENFEDERN IN DER QUERRICHTUNG AM BEISPIEL DES UMBAUES DER LOKOMOTIVE E 3173 DER BRITISH RAILWAYS]
The results of calculations carried out in accordance with spring formulas are compared with experimentally obtained data. Road test results are dealt with particular reference to riding qualities and tractive resistance of the modified locomotive at speeds of up to 125 mph. [German]

Koffman, JL *Glasers Annalen ZEV* Vol. 97 No. 7-8, Aug. 1973, 9 Ref

ACKNOWLEDGMENT: EI (EIX740100232)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

B3 056844
NEW LOCOMOTIVE FEATURES NOVEL SUSPENSION AND SAFETY/LUXURY CAB
The first of a new generation of locomotives designed and manufactured by MLW-Worthington of Montreal was delivered to Canadian National earlier

this year. Designated the M420, the new model is rated at 2,000 hp for traction and incorporates many innovations such as new trucks, an updated diesel engine, a crew-comfort operator's cab, a specially tailored electrical package and improved chassis systems.

McInerney, FT Parker, JH *Design Engineering* Vol. 19 No. 12, Dec. 1973

ACKNOWLEDGMENT: EI (EIX740204396)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

B3 057728
SUBJECTING IMPACT RESISTANT DRIVERS' SIGHT SCREENS TO THE TEST
Triplex windscreens tested for Italian State Railways high-speed Ale 601 requirements establish reliability at speeds in the order of 250 km/h as did an incident on a test run with the BR HST on last August 2.

Rail Engineering International Vol. 4 No. 5, June 1974, p 233

PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B3 082922
DEVELOPMENT OF SCRATCH-AND SPALL-RESISTANT WINDSHIELDS
Studies were performed to evaluate possible ways of improving the primary weaknesses in existing Army helicopter windshields, namely, scratching and spalling. Three experimental windshield material configurations offering a potential solution were fabricated for test and evaluation. The spall problem was approached by using plycarbonate as a backup material and was incorporated into each design. The scratch problem was approached by employing either (1) a hard surface coating, (2) an acrylic cladding, or (3) a thin glass cladding to the polycarbonate backup material. Commercially available materials and abrasion-resistant coatings were evaluated utilizing a windshield wiper apparatus, while spall performance was studied by ballistic testing and high-speed photography of each of three test configurations. /NTIS/

Presented at Proceedings of Conference on Transporent Aircraft Enclosures, Las Vegas, Nev., 5-8 Feb. 1973. See also report dated June 73, AD-769 344.

Plumer, JR
Army Materials and Mechanics Research Center, (DA-1728005) Final Rpt. AMMRC-TR-74-19, Aug. 1974, 22 pp

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
AD/A-002513/0SL, DOTL NTIS

B3 095283
CHEC A NEW EXCITATION SYSTEM FOR DIESEL-ELECTRIC LOCOMOTIVES
This paper describes the objectives sought in the development of a new System of Electronic Control of Traction Alternator Excitation for Diesel Electric Locomotives, describes the system itself to show how these objectives were achieved, and discusses field experience with Horsepower Excitation Control.

A paper recommended by the IEEE Land Transportation Committee of the IEEE Industry Application Society for presentation at the 1975 Joint ASME/IEEE Railroad Conference, San Francisco, Cal., April 13-16, 1975.

Johansson, AV (General Electric Company)
Institute of Electrical and Electronics Engineers Conf Paper C-75-352-0-IA, Mar. 1975, 9 pp, 12 Fig., 4 Ref.

ACKNOWLEDGMENT: IEEE
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL RP

B3 095676
HIGH SPEED TRAIN PROTOTYPE PROVES ITS WORTH
Unhappy experience with small batches of diesel locomotives ordered off the drawing board in the 1950s ensured that extensive prototype testing would precede series production of British Rail's next generation of 200 km/h intercity trains. The prototype High Speed Train completed in 1972 has already proved its value, but further modifications are continually being introduced so as to prove their acceptability before they are incorporated in the next batch of production trains.

Sephton, BG (British Railways) *Railway Gazette International* Vol. 131 No. 2, Feb. 1975, pp 58-62, 3 Fig.

PURCHASE FROM: XUM Repr. PC
DOTL JC

B3 096618
THE IMPACT OF STONES HITTING AGAINST THE LOCOMOTIVE WINDSCREENS [Steine gegen Lokomotivscheiben]
The windscreens on motive power units must be strong to protect drivers from the impact of solid objects, especially since train speeds are increasing. The author describes an experimental measuring device to help in choosing windscreens which are acceptable both from the technical and and the economic point of view and which provide satisfactory protection for locomotive drivers. A solid propellant is used to project a stone weighing one kg at 400 km/h in a tube measuring one metre long and with an inside diameter of 100 mm. A photoelectric method is used to measure the speed of the stone before it hits the the windscreen. [German]

Kalkbrenner, E *Eisenbahningenieur* Vol. 25 No. 10, Oct. 1974, pp 345-346, 3 Fig.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Dr Arthur Tetzlaff-Verlag Niddastrasse 64, Frankfurt Am Main, West Germany Repr. PC

B3 098060
MEASURING DEVICE FOR SLIDING SURFACE WIDTH OF TWO CONTACT WIRES
Inspection of trolley wire is of growing importance as electrification spreads on the Japanese National Railways. A measuring device for the sliding surface width of the contact wire, developed in 1971, has proved to have an accuracy of 0.1 mm at 210 kph. The device consists of a camera, mirrors, flood lights, servo mechanism and control panel. Results of tests with this system are given.

Ichikawa, M Yasumatsu, E Horiki, K *Railway Technical Research Institute* Vol. 16 No. 1, Mar. 1975, pp 46-47, 3 Fig., 2 Tab.

PURCHASE FROM: Ken-yusha 1-45-6, Hikari-cho, Kokubunji, Tokyo, Japan Repr. PC
DOTL JC

B3 098773
DIESEL RECORDS SYSTEM
The file name is DIESEL RECORDS MASTER FILE. The objectives of this computer program are: 1. To aid in scheduling and verifying completion of locomotive maintenance items. 2. To aid in isolating problems with specific locomotives by providing a history of pertinent information for each unit. Output consists of a semi-monthly printout showing the following information for each unti due maintenance during the next fifteen days: 1. Maintenance items due to be performed including repetitive maintenance items which are done at fixed intervals and special upgrading or correction projects. 2. A history of traction motor failures on each unit by pedestal number. 3. An indication if the traction motor model is not one of the models which is recommended for use on the specific locomotive model. (Recommendation is based on reliability considerations). Other outputs include a current "cab card" and various inventory listings of main components (traction motors, main generators, turbochargers, etc.). Feedback is provided when maintenance items are completed by having the person who did the work sign the computer report and then keytyping data from the report. A maintenance item will continue to appear on the report each month until it is reported completed. Input consists of: 1. Oil control lab data, in-service failures, and defects from the Locomotive In-service Failure/Defect Analysis Program. 2. Feedback data from the shops on each maintenance item or project completed. 3. Traction motor applications and removals from the diesel shops. 4. Tables of frequency of repetitive maintenance items. 5. Tables identifying which units are due for special projects.

Tritt, RF
Southern Railway System 1960

ACKNOWLEDGMENT: AREA (AREA 12-01-002)
PURCHASE FROM: Southern Railway System 99 Spring Street, SW, Atlanta, Georgia, 30303

B3 098774
TRACTION MOTOR RELIABILITY
Computer program: MAIN DIESEL COMPONENT INVENTORY, CAR MOVEMENT HISTORY FILE. Program produces a family of reports giving traction motor reliability data by model. Reports provide basis for decision rules for vendor selection, and preferred combinations of traction motor model--locomotive model. Input consists of traction motor application (to locomotive units) and removal records, traction motor disassembly and reassembly records. Mileage is obtained from the car movement history file. Output consists of the following reports: 1. Traction motor overhaul data by motor serial number. 2. Traction motor overhaul data by armature serial number. 3. Traction motor armature overhaul rates by armature manufacturer for each 100,000 mile increment since manufacture or rewinding. 4. Traction motor model-locomotive model failure rates by combination showing number of motors in class, mileage last 3 months; reason for overhaul and number of overhauls.

Tritt, RF
Southern Railway System 1969

ACKNOWLEDGMENT: AREA (AREA 12-01-003)
PURCHASE FROM: Southern Railway System 99 Spring Street, SW, Atlanta, Georgia, 30303

B3 098776
LOCOMOTIVE IN-SERVICE FAILURES/DEFECT ANALYSIS
File name is LOCOMOTIVE FAILURE/DEFECT FILE, CAR MOVEMENT HISTORY FILE. Major objective of computer program is to isolate major causes of locomotive in-service failures. Input consists of: 1. Data on the results of a monthly spectrographic analysis of samples of the cooling water, crank case oil, and air compressor oil from each locomotive. 2. Data on in-service failures (motive power failures which result in either reducing the tonnage of a train or in a train delay.) 3. Diesel shop report on in-service failure giving cause, type to defect, data repaired, etc. 4. Reports of locomotive defects (conditions not causing failure). Monthly output reports include: 1. A raw data tabulation of each failure listing all pertinents data and sorted by locomotive model and within model by cause of failure. 2. A summary of locomotive in-service failures by maintenance points, locomotive model, and failing component for both one month and three-month periods giving number of failures and failures per million miles. 3. Summary of locomotive defects by defective component and by the reporting Road Foremen of Engines. 4. A summary of in-service failures by operating division and by type of service (passenger, freight, or switching). 5. Identification of units which have had repetitive duplicate oil lab findings.

Smith, SH
Southern Railway System 1969

ACKNOWLEDGMENT: AREA (AREA 12-01-005)
PURCHASE FROM: Southern Railway System 99 Spring Street, SW, Atlanta, Georgia, 30303

B3 125818
INTERNAL COMBUSTION ENGINE FAILURES: A STATISTICAL ANALYSIS
The company's primary interest is in the safe operation of all insurable equipment and in the prevention of failure of that equipment, wherever possible, by means involving manufacturing, operation and maintenance, and inspection techniques. The equipment involved includes diesel and dual-fuel engines, spark-ignited gas and gasoline engines and internal combustion engines driving reciprocating compressors. The accident analysis coding system provides three basic categories under which each reported failure is coded for future analysis. These are: Type of Accident. Initial Part to Fail. Primary Cause of Failure. For convenience the items are handled in that order with a brief discussion following each.
Prepared for meeting 6-10 April 1975.

Blue, GB (Hartford Steam Boiler Inspection and Insurance Co)
American Society of Mechanical Engineers Paper 75-DGP-16, 1975, 7 pp

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

B3 126414
CONSUMPTION OF THE WIRE IN CONTACT LINES IN RELATION TO INCREASES IN SPEED AND CURRENT [Il consumo del filo nelle linee di conttato in rapporto agli aumenti di velocita e di corrente]
An enquiry is made into the effects which the speed of trains and the current absorbed by them has on the consumption of the conductors. Speed and current are considered as independent parameters and their effects are considered through friction, insofar as speed is concerned, and through the joule effect with regard to the current. One reaches the definition of two coefficients, K sub V and K sub I, which quantitize the phenomena referring K sub V to an average speed V sub O, whilst the coefficient K sub I is used to identify levels of wear, choosing as reference the value I of the coefficient K sub I calculated on the wear of the entire network. To the product K sub V-K sub I, calculated line by line, is attributed the significance of the coefficient of wear of the line. The question is handled with a theoretical formulation and thus an experimental control is suggested. [Italian]

Capobianco, L *Ingegneria Ferroviaria* No. 2, Feb. 1975, pp 17-22

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B3 127358
TEST OF FIRE FIGHTING FOR LIVE LINE ELECTRIC EQUIPMENT
Fighting of fires in cars on electrified lines normally requires the cutting of power. Damage can be increased substantially while waiting for confirmation that power has been disconnected. This study was concerned with the possibility of fighting fires with the power system energized. Various equipment was sprinkled with differing nozzle patterns and using water and other extinguishing materials. The results are expected to be reflected in the fire fighting equipment to be provided in long tunnels and the extinguishers to be carried on electric cars and locomotives.

Arai, K Watanabe, H Furuhata, T Tajima, T *Railway Technical Research Institute* Vol. 16 No. 2, July 1975, pp 92-93

PURCHASE FROM: Ken-yusha 1-45-6, Hikari-cho, Kokubunji, Tokyo, Japan Repr. PC

B3 129263
LOCOMOTIVE TO AUTOMOBILE BASELINE CRASH TESTS
Four Locomotive to Automobile Crash tests were performed by the Dynamic Science Division of Ultrasystems at DOT's High Speed Ground Test Center under contract to the Transportation Systems Center, which is conducting the work for the Federal Railroad Administration. This report documents these four tests, which will provide baseline data for evaluation of future locomotive front structure modifications designed to attenuate the severity of the grade crossing accident. The automobiles were all 1973 standard size sedans of the same model with similar options. For each test, a 130-ton Alco locomotive impacted a stationary automobile at a nominal 50 mph. The first two tests contained no instrumentation on either the locomotive or automobile except for high-speed cameras. The last two tests were instrumented repeats of the first two tests which also involved a direct side impact and a side impact centered on the automobile front fender. The last two tests had an anthropomorphic dummy in the automobile and over 50 accelerometers installed in it. Each test had extensive high frame rate photographic coverage.
Sponsorship was from Federal Railroad Administration, DOT.

Anderson, RL
Ultrasystems, Incorporated, (DOT-TSC-FRA-75-18) Final Rpt. FRA-OR&D-76-03, Aug. 1975, 150 pp

Contract DOT-TSC-700

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-250564/AS, DOTL NTIS

B3 129268
POWERFULL ELECTRIC BRAKING ON FAST ELECTRIC LOCOMOTIVES. ADJUSTMENT OF THE UNIVERSAL RHEOSTATIC ELECTRODYNAMIC BRAKE ON ELECTRIC LOCOMOTIVES [Le freinage electrodynamique puissant des locomotives electriques rapides-raba et Kyr-reglage du frein electrodynamique rheostatique universel des locomotives electriques]
The first article is a general description of the rheostatic braking system on Skoda electric locomotives. The second article describes the technical characteristics of the main components. [French]

Stekl, M Raba, F *Skoda-Revue* No. 1-2, 1975, 14 pp, 1 Fig., 1 Tab.

ACKNOWLEDGMENT: International Union of Railways, BD
PURCHASE FROM: Skoda-Revue Prague, Czechoslovakia Repr. PC

B3 129840
ELECTROCUTION, VOLTAGE LIMITS FOR HUMAN BEINGS WHEN THEY TOUCH LIVE WIRES, SAFETY MEASURES [Korperstrome, Beruhrungsspannungsgrenzen und Schutzmassnahmen]
No Abstract. [German]

Biegelmeier, G *Elektrotechnische Zeitschrift, Ausgabe A* Vol. 27 No. 17, 1975, pp 461-464, 2 Tab., 10 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: ESL Repr. PC, Microfilm

B3 131013
THE MEDICAL ASPECTS OF TRANSPORT AND THE COMPLEX ERGONOMETRIC ANALYSIS OF WORK TASKS: VISUAL DISPLAY RELAY CONTROL DESKS AND DIESEL LOCOMOTIVES [Verkehrsmedizinische Aspekte der ergonomischen Komplexanalyse der Arbeitsplatz: Gleisbildstellwerk und Dieseltriebfahrzeug]
The forms of effort to be made in carrying out a job and the extent of the effort to be made by the Chief Safety Officer at visual display relay control desks have been defined and it was concluded that staff working at visual display relay control desks must undergo special medical and psychological tests. As a result of changes in traction modes, diesel operation has caused an increase in noise disturbance for staff working on motive power units. Medical checks should be carried out to avoid professional diseases. [German]

Lessing, G *Verkehrsmedizin und Ihre Grenzgebiete* Vol. 22 No. 8/9, Aug. 1975, pp 290-297, 3 Fig., 1 Tab.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Transpress VEB Verlag fuer Verkehrswesen Leipziger Strasse 125, 108 Berlin 8, East Germany Repr. PC

B4 033083
WHEEL-RAIL ADHESION
The subject of adhesion between locomotive wheels and rails has been an area of vital interest to locomotive manufactures and to the railroads. Horsepower of internally powered locomotives has continued to increase significantly, thereby providing more power for traction. The trend of increasing horsepower has been the product of progress in technology and engineering development. Wheel-to-rail adhesion within the lower speed range has been a limiting factor in tonnage ratings for locomotives in drag service on U.S. railroads. Factors Affecting Adhesion are: (1) Vehicle Factors, (2) Track Factors, and (3) Contact-Area Common Factors. Additional discussion of the conclusions follows.

Marta, HA Mels, KD (General Motors Corporation) *ASME Journal of Engineering for Industry* 68-WA/RR-1, Aug. 1969, pp839-854, 69 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-019)
DOTL RP

B4 033208
MUTUALLY PERMISSIBLE WEAR PROFILES OF WHEEL TYRES AND OF POINTS AND CROSSINGS. ASSESSMENT CRITERIA FOR THE PERMISSIBLE WEAR PROFILES OF WHEEL FLANGES AND SWITCH COMPONENTS.
Studies include the investigation of the wear forms of a great number of worn wheel flanges used on various types of vehicles (passenger coaches, wagons, railcars, electric and diesel bogie locomotives) and of worn rails in areas containing points and crossings so as to obtain an adequate basis, adapted to practical demands, for arriving at a judgment. Starting from a characteristic wear profile of a flange a track guage was developed, permitting the verification of the compatibility of the wear profiles of the ironwork of switches with such a flange.

Measurements conducted using the gauge enable development of wear forms of rails endangering the traffic to be detected (particularly in sections containing switches and stock rails) and they indicate, at the same time, how this risk can be eliminated and how their use can be prolonged by reprofiling operations. The results of the studies are that it will be possible to deduce, from an analysis of the geometry of the contact between flange wear shapes and track, the compatibility criteria adapted to practical conditions and only requiring simple measures to be taken on the wheel and the switch work items (checking by means of the gauge). This procedure will lead to a decisive improvement of the riding safety of vehicles.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Rpt C70/RP 1/E, Apr. 1969, 30 pp, 22 Figs., Tabs, 5 App.

ACKNOWLEDGEMENT: Battelle Memorial Institute (BCL-166)
PURCHASE FROM: UIC Repr. PC

B4 033236
THE DIGITAL TYPE SLIP DETECTOR
Article discusses the system used on the new Tokaido line electric cars to minimize wheel slip when the brakes are applied. This wheel slip detector is designed to release brakes when any one axle exceeds 20-30 percent of the train velocity. A block diagram of the system is included.

Obu, T Wada, H (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 9 No. 4, Dec. 1968, pp245-246

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-182)
DOTL RP

B4 033237
A NEW TRANSIT PROPULSION UNIT SUSPENSION-PROVED ON NORTHEAST CORRIDOR HIGH SPEED TEST CARS
The old generation propulsion units for lightweight, inboard journal trucks had the motor and gear unit bolted solidly together, driving the axle through, and supported on, rubber around the axle. By correcting deficiencies in this design, yet retaining the principle of floating the motor in rubber to isolate it from rail shocks, this new propulsion unit arrangement for lightweight, inboard journal trucks has successfully permitted the car operating speeds to double, from 75 to 150 mph in one jump. Paper has been written to emphasize the growing importance of dynamic vibration analysis in the design of rail vehicle trucks and truck and axle-mounted propulsion equipment. Detailed analytical studies of the wheel and axle, truck, and propulsion equipment suspension dynamics has generally been deferred in the past. The car body dynamics have been studied closely to ensure that the passengers receive a smooth ride, but the ride of the trucks and their equipment has been of little concern to most. We will point out why the suspension dynamics of the truck must be studied, how they can be analyzed, and the consequences of failure to do so.

Conference Paper.

Nelson, JA Hapeman, MJ (General Electric Company)
American Society of Mechanical Engineers 69-RR-3, 12pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-183)
DOTL RP

B4 033267
SPECIAL ACCOUNTS SUMMING UP THE REPORTS ON THE QUESTIONS FOR DISCUSSION AT THE EIGHTEENTH SESSION OF THE INTERNATIONAL RAILWAY CONGRESS ASSOCIATION (MUNICH, 1962)
The data and opinions are set out in the following five chapters: (1) Effect of locomotives and rolling stock on the track; (2) Track alignment points and crossings; (3) Gauges; distances between running lines, obstructions; (4) Equipment and ballasting of present day high-speed tracks; track renewal conditions. (5) Safety of trains and staff on high speed lines; control of these lines; measures taken concerning the quality of track; increase in maintenance costs due to increased maximum speeds.

Thille, A (French National Railways) *Rail International* Vol. 39 No. 6, June 1962, pp888-924

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-217)
DOTL RP

B4 033274
TRAIN RESISTANCE, POWER AND ENERGY REQUIREMENT OF M-U CARS
Equations to be used in determination of multiple-unit train resistance,

power and energy requirement are developed. Curves are presented for air resistance in tunnels. For open air the effect of wind speed and direction is also analyzed. Methods are presented for energy requirement optimization. Considerable energy savings can be realized by using these methods as guide lines for operational criteria. This study extends the work of W.J. Davis, Jr., for all kinds of M-U cars. The Davis equations were prepared and still are successfully used for conventional rapid transit train speeds and shapes, but not for high speeds and streamlining.

de Koranyi, L (General Electric Company)
Institute of Electrical and Electronics Engineers Conf Paper 34CP 66-201, Mar. 1966, 13pp, 14 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-225)
DOTL RP

B4 033285
TESTS OF PENNSYLVANIA RAILROAD ELECTRIC LOCOMOTIVES AT CLAYMONT, DELAWARE

In 1934 studies were made by the Pennsylvania of larger size electric motive power in anticipation of the heavier trains to come. A class R-1 locomotive was designed and built in 1934 with a 4-8-4 wheel arrangement. It was considerably heavier on the axles than the consulting firm which electrified the Pennsylvania deemed desirable, and they persuaded the Pennsylvania Railroad to borrow one of the new New Haven locomotives, which had a wheel arrangement of 4-6-6-4 and had a comparable axle load to the earlier class of Pennsylvania locomotives. The R-1 could not match the tracking flexibility of the GG-1, wheel arrangement of which was articulated. The GG-1 was safer and smoother riding at high speed with less destructive forces being exerted on the rail than the R-1.

From the book "The Locomotives that Baldwin Built".

Westing, F
Superior Publishing Company Book 1966

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-236)
DOTL RP

B4 033297
TRACK-TRAIN DYNAMICS STUDY PROJECT TR-14 RAIL-VEHICLE INTERACTION STUDY REPORT NO. 1 (PRELIMINARY ANALYSIS OF SAMPLE DATA)

As a result of various derailments, a task force was formed to investigate the dynamic forces exerted by locomotive and freight car wheels against the rail. Critical study was directed at the 3 and 2 axle trucks of high horsepower locomotives, 85 feet TFC cars, and 50 feet box cars. The objective of this investigation was to determine if dynamic forces of sufficient magnitude to cause derailment were being generated by equipment, track structure and operating practice, and to recommend whatever corrective action might be indicated. Extensive field tests of wheel-rail interaction were conducted in various territories between Los Angeles and Pine Bluff, Arkansas. An analysis of these test results led to the following general conclusions: 1. Dynamic forces of sufficient magnitude to cause derailments are being generated in every day operation of revenue trains. 2. The forces are also sufficient to cause greatly accelerated wheel and rail wear. 3. Forces of sufficient magnitude to exceed the ability of the track structure to resist permanent deformation in alignment are also being generated.

Lynch, JP TenBroeck, HR Wagner, TB (Southern Pacific Company)
Southern Pacific Company Report No.1, June 1970, 126pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-250)
DOTL RP

B4 033350
PROTECTION OF RAIL JOINTS FROM CORROSION TO PREVENT RAIL END BREAKS

Many parts of the railway track including the rails are made of carbon steel. Carbon steel excels in strength but is prone to be corroded. Rail end breaks are considered as fatigue destruction caused by corrosion. Since stress and corrosion act at the same time, cracking is developed easily. It is because the fatigue strength of a rail decreases sharply in acid environments, that end breaks are more liable to occur in non-electrified sections than in electrified sections. Since corrosion has much to do with end breaks of rails in tunnels, the application of a proper protective method prevents end breaks of rails.

Kose, Y (Japanese National Railways) *Permanent Way* Vol. 6 No. 3, No. 22, Sept. 1963, pp1-13

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-304)
DOTL RP

B4 033725
RUNNING VIBRATION TEST OF TYPE ED61 ELECTRIC LOCOMOTIVE

It was detected by a running test that the for-and-aft vibration of newly manufactured ED61 electric locomotive was too large. Running vibration of each part of this locomotive was measured and analyzed. Results revealed that the vibration comes from pitching of the track and that application of oil damper between the end frame of the track and the car body is effective for prevention of these vibrations.

Kunieda, M (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 1 No. 1, Mar. 1960, pp77

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-022)
DOTL RP

B4 033741
THE ANALYSIS OF TRUCK FORCES ON CURVED TRACK

This report contains an analysis of the static, steady state forces on a four-wheel truck moving on curved track. The truck is used in the general sense to describe any four-wheel rigid wheel base of conventional truck size or as large as experimental four-wheel cars. This work should represent one phase of a program to attempt a rationalization of various truck phenomena. Appended to this report is an 8-part series of published articles: "The Mechanics of a Locomotive on Curved Track". These articles appeared in The Railway Engineer, 1934-1935.

Unpublished Data.

Johnson, MR Apr. 1957, 40pp, 8 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-240)
DOTL RP

B4 033743
JACKKNIFING OF DIESEL ELECTRIC LOCOMOTIVES REPORT OF THE JOINT COMMITTEE ON RELATION BETWEEN TRACK AND EQUIPMENT

A number of railroad companies had been reporting difficulties with diesel electric locomotives under buffing or pusher operation. This action was evidenced by lateral instability between the several units, especially those under the largest buffing forces and resulted in lateral displacements and lateral forces of such magnitude that the rails were turned over and derailments caused in some cases. To obtain as complete an understanding of the jackknifing action as possible it was decided to make measurements on both the locomotive and the track. A test location was picked on a right curve of 8 deg. 6'. The grade was 1.72 percent at the curve but within a mile became 2.20 and 2.40 percent so that part of the train on the steeper grade when the recordings were made. The rail was 131 lb. RE Section laid in 1946 and rather badly curve worn. The test locomotives were GP-7 Electro Motive general purpose road switchers. The following conclusions were drawn: Jackknifing is the result of lateral instability of the several units and its severity is dependent on the magnitude of the buffing force and the eccentricity of the force. It is evident the eccentricity of the force will depend on the amount of overhang and the clearance available for lateral movement. Reduction of the bolster clearance to a small amount improves the conditions sufficiently that operation is not excessively difficult. Lateral forces are reduced about 50 percent. Operation of the general purpose units with full bolster clearance and standard couplers under buffing forces is not practicable with four units and probably undesirable with three units. Forces of almost 25,000 lb were measured at 10 mph and 140,000 to 175,000 lb

tractive force and higher forces can be developed at lower speeds or under impact conditions. These laterals applied continuously will be very detrimental to rail and wheels, cause journals to run hot, and may cause derailment. The use of the alinement control coupler attachments reduced the forces to a normal amount for the curvature of the test location. The lateral forces under full regenerative braking with alinement control couplers for an undetermined reason were a little higher in the few tests made than in the pusher operation which had twice the tractive force. However, they are still quite moderate. The jacknife position, once assumed, remains until the train is stretched out.

Magee, GM Keller, WM Ferguson, R (Association of American Railroads)
Association of American Railroads Rept. 10838, Jan. 1955, 21 pp, 2 Ref.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-290)
DOTL RP

B4 037287
TRUE GAUGE IN STRAIGHT TRACK
The permissible amount of slack gauge in straight track in relation to the lateral oscillation or nosing of locomotives is considered. S or slack gauge, for any one locomotive and type of track will vary inversely as the square of the speed. Mathematical derivations for engineering physics aspects of the problem are given.

Inglis, RA *Railway Gazette* Vol. 82 May 1945, p 445, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1138)
DOTL RP

B4 037438
PLASMA TORCH PROVED FOR LOW SPEED APPLICATIONS
The article discusses research results of the British Railways attempts to improve adhesion of rail vehicles by using a plasma torch to remove materials from rail surfaces. Laboratory tests confirmed the feasibility of using such a device, in two areas: low speed operation for freight trains and high speed operation for passenger trains. A test vehicle was made up to field test the plasma rail vehicle. Results of the testing show that mechanical condition of the rail head is important; old rail with large areas of contact required higher output than new rail. The tests show conclusively that starting and low speed operation of freight vehicles with low adhesion can be resolved by the application of the plasma torch.

Dobbs, DJ (British Railways Board) *Railway Gazette* Vol. 125 Nov. 1969, pp 812-814, 5 Fig, 1 Phot, 3 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-863)
DOTL RP

B4 037592
METHODS OF TESTING AND EVALUATING LOCOMOTIVE RUNNING QUALITIES
The German Railways initiated a thorough research into the question whether the new developments in locomotive and car construction assured safety in relation to the new developments in rail and track structures. Present day techniques are described in the ongoing studies and tests of the vehicle dynamics and wheel to rail interaction of locomotives. Among the data cited were measurements of an electric locomotive that indicated that the trailing axle wheel set of the two wheel truck imposed about double the lateral load against the rail as the leading axle wheel set on straight track. The discussion concluded that more research and testing would be continued, using more sophisticated measuring means that are available.

Schwanck, U Minden, IW *Eisenbahntechnische Rundschau* Vol. 13 No. 4, Apr. 1964, pp 149-165, 23 Fig, 2 Tab, 2 Phot, 30 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-477)
DOTL RP

B4 037598
LATERAL RAIL FORCES DUE TO VARIOUS LOCOMOTIVE AND TRAIN CONSISTS
A series of tests was performed to determine the lateral forces developed by various types of locomotives and train consists. Analysis of the data indicates that no excessive lateral forces were developed by any of the test consists. The maximum average force, 7,400 pounds was developed by the T.P.F.C. freight. The effect of roadway irregularities on lateral forces generated by normal consists remains largely unknown. Based on the results of this test series, it is concluded that light locomotive, passenger and freght consists generate relatively low lateral force on good roadway. There is a slight reduction in maximum lateral forces as training tonnage is increased. A study of the available research literature on the forces required to overturn rail shows that the maximum pressures measured were about 30% of the forces theoretically needed.

Luebke, RW
Chesapeake and Ohio Railway, Baltimore and Ohio Railroad Test Rpt Apr. 1967, 14 pp, 8 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-484)
DOTL RP

B4 037611
SWITCH LOCOMOTIVE V 90 OF THE GERMAN FEDERATED RAILWAYS
Only a portion of the article describes this locomotive. One portion deals with the latest design of cardan shafts having ball joints made of plastic that eliminate the need for periodic lubrication servicing. The other describes the truck design, which includes springs made of rubber "sandwiched" with steel plates that are used at the journal boxes and over the coil springs between the truck and the locomotive frame. The truck is simple, with cast members welded together, and with the traction transfer points below the axle center line. The composite design has effectively reduced lateral and vertical accelerations.

Schmuecker, H *Eisenbahntechnische Rundschau* Vol. 14 No. 3, pp 91-92, 7 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-512)
DOTL RP

B4 037612
TESTS WITH THE E 10 CLASS LOCOMOTIVES FOR THE DEVELOPMENT OF THE HIGH SPEED LOCOMOTIVES CLASS E 03
The author describes a research program on the testing of the locomotive design and components for the development of the high speed (200 km/h) electric locomotive, Class E 03 on the German Railways. One of the test locomotives was equipped with trucks having leaf springs over the journal boxes in addition to coil springs between the truck frames and the body; the other was equipped with trucks having coil springs throughout. The former gave a very hard ride at the lower speeds, with much body vibration up to 100 km/h, and over 140 km/h there was excessive fore and aft vibration longitudinally. The locomotive with coil spring suspension gave a very satisfactory ride up to the desired 200 km/h. Since, at the speed of 200 km/h, 1 km is traversed in 18 seconds, the enginemen's controls were designed semiautomatic, an electronic system of controls was built in to take over the control of the acceleration of speed from 30 km/h to 200 km/h. Conversely, reduction in speed is also automatically controlled. Thyristors are used with the high voltage transformer, which eliminate the troublesome high voltage switch gear with contacts.

Nebelung, HR *Eisenbahntechnische Rundschau* Vol. 14 No. 5, May 1965, pp 159-166, 11 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-513)
DOTL RP

B4 037692
LATERAL FORCES BETWEEN WHEELS AND RAILS, AN EXPERIMENTAL INVESTIGATION
The paper deals with a new method of measuring continuously the lateral forces between the wheels and the rails over long distances. Fundamental knowledge concerning these forces has been obtained both from studies of the results from short test runs and from statistical assessments of the results from long sections of the Swedish railway network. Since the tests are concerned only with a single locomotive, the results should not be generalized. It is clear, however by means of the individual diagrams of curve

forces as well as the statistical evaluation of about 40 curve runs, that the lateral forces between the rails and the wheels of the leading axle are on the whole substantially greater than the resulting force on the permanent way. This factor should be all the more noticed, since the utilized friction coefficient can assume such unexpectedly high values, as is shown from the measurements.

Presented at ASME-AIEE Railroad Conference Pittsburgh, Pa., April 20-21, 1960.

Olson, PE Johnsson, S (Swedish State Railways)
American Society of Mechanical Engineers Paper 60-RR-6, Apr. 1960, 8 pp, 19 Fig, 1 Tab, 2 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-606)
DOTL RP

B4 037694
THOUGHTS OF A CURVE DERAILMENT
The derailment of the New York Central New York to Chicago express on April 19, 1940, at Little Falls curve is described. The train was about half-way around the curve travelling 14 mph in excess of the stipulated limit when derailment occurred. Speed alone was not responsible for the accident. A locomotive inspector had instructed the driver to brake. It is believed that the driver either became confused and closed the throttle or applied the brakes which slowed the locomotive much slower than the remaining train and caused the jack-knife action between the engine and tender.

Railway Gazette Vol. 74 Apr. 1941, 3 pp, 1 Fig, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-608)
DOTL RP

B4 037704
VERTICAL OSCILLATIONS OF LOCOMOTIVE BODIES
This review article discusses the effect of spring stiffness and damping factors on bouncing. The effect of static deflection and viscous damping factors on body acceleration of 100-ton Co-Co locomotive is illustrated.

Koffman, JL (British Railways) *Railway Gazette* Vol. 111 Sept. 1959, pp 140-142, 4 Fig, 24 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-621)
DOTL RP

B4 037751
BENDING STRESSES IN A MOTORED AXLE ON ELECTRIC ROLLING STOCK--1
This article gives results of strain gauge tests on a motored axle both empty and loaded. Deductions from the results lead to an emphasis on the transverse friction between wheel and rail. This factor, neglected in axle stress formulae, is shown to be of major importance in the bending moment on the wheel seat of an axle, amounting to about 40 percent of the total on a curve with equilibrium cant. Support for the deduced theory is given by the correspondence between calculated and measured stresses, and also by the results of direct comparative tests. Additional stresses from cant deficiency, track irregularities, and acceleration or braking are discussed. The apparatus used in the test and the procedure of testing are fully described.

Broadbent, HR Richards, J (London Transport Executive) *Railway Gazette* Vol. 104 June 1956, pp 511-514, 6 Fig, 1 Tab, 1 Phot, 4 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-751)
DOTL RP

B4 037752
BENDING STRESSES IN A MOTORED AXLE ON ELECTRIC ROLLING STOCK--2
A further check of the theory that transverse friction is a major item in the stressing of axles was made by a series of comparative tests. While vertical differences in track level apparently affect the stress in the axle very little, it has been found that the test axle assembly is very sensitive to the condition of the running edge of the high rail on a curve. Contrary to expectation, passage over the toes of switches and the noses of crossings did not produce high stresses in the axle. Passage through the lead of turn-outs caused high values to appear, though no higher than those which occurred on some curves.

Broadbent, HR Richards, J (London Transport Executive) *Railway Gazette* Vol. 104 June 1956, pp 543-547, 8 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-752)
DOTL RP

B4 037793
ADHESION RESEARCH
The use of an arc plasma generator (apg) to improve wheel to rail adhesion is examined in a letter to the editor. It is pointed out that rail contaminants affecting adhesion adversely fall into two groups: oil and water films and emulsions not bonded to the rail, and metallic soaps produced by chemical reaction between fatty acids and steel which are integral with the rail surface. Both contaminants must be treated. The gross films can be removed mechanically, but the chemical structure of the soaps must be broken down by heating to about 30 deg C. The second task is most demanding and forms a basis for performance predictions. The maximum power requirement occurs at high speed, say 240 km/h, when both traction and "steering" rely upon enhanced adhesion. A graph shows the variation of power with the penetration depth of the 300 deg C isotherm in a steel rail. Power decreases with plasma length, but the power intensity increase outside the attainable range. The variation of power with length (and consequently with speed) is strongley non-linear. The authors of this letter believe that each fast train must carry an a.p.g. module.

Kelly, JC Scott, BF (Birmingham University) *Railway Gazette* Vol. 124 Jan. 1968, pp 7, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-834)
DOTL RP

B4 037800
BR CLASS 40 LOCOMOTIVE SUSPENSIONS MODIFIED
The article discusses the suspension design of the British Railways class 40 locomotive, which was modified to minimize the maintenance and repair of the laminated springs. The suspension system also subjected the truck frame to high vertical and lateral stresses. The modification replaced the laminated springs by helical springs. Result was improvement in the vertical riding qualities especially over 50 mph. A reduction of dynamic forces was also achieved, which will result in longer suspensions and track frame life.

Koffman, JL (British Railways Board) *Railway Gazette* Vol. 126 Feb. 1970, pp 142-144, 4 Fig, 1 Phot, 7 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-841)
DOTL RP

B4 037809
THE OPERATIONAL EFFICIENCY OF THE V200 DIESEL LOCOMOTIVES OF THE GERMAN FEDERAL RAILWAYS
The article describes briefly the development of the V 200 starting from the first prototypes and deals more comprehensively with the experience gained in actual operation. Consumption figures and particulars of the running performance of locomotives which have not suffered any damage are given.

Glasers Annalen ZEV
Verlagsbuchhandlung (Georg Siemens) No. 4, 1958, pp 3-15, 7 Fig, 6 Tab, 3 Phot, 33 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-888)
DOTL RP

B4 037811
THE 2,000 HP DIESEL LOCOMOTIVE OF THE GERMAN FEDERAL RAILWAYS
This document discusses the advantages of the design of the 2,000 HP diesel locomotive as used by the German Federal Railways. The power transmission unit, cooling system, and engine are described and illustrated. The

maintenance requirements are given.

Lampe, C Gossl, N *Railway Technical Review* Oct. 1955, pp 2-16, 13 Fig, 2 Tab, 6 Phot, 6 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-890)
DOTL RP

B4 037815
ADHESION RESEARCH ON B.R.
The British Railways has conducted research into means to increase rail adhesion. The means used fall into 4 categories: mechanical; chemical; thermal; and quantal. The mechanical methods include scrubbing, abrading and sanding rails which tend to foul points and to be detrimental to the rail surface. Chemicals to remove contaminants in the rail surface have also been evaluated, but results are difficult to evaluate. Thermal and quantal methods include the use of an electric ore between the vehicle and rail head and the plasma jet. This device produces thermal, quantal and chemical effects, as well as increasing adhesion coefficient from 0.1 to 0.5 in laboratory tests.

Coates, PJ (British Railways) *Railway Gazette* Vol. 123 Oct. 1967, pp 741-742, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-894)
DOTL RP

B4 037816
WHEEL SLIP PROTECTION
The problems associated with wheel slip of rail vehicles are minimized with the use of axle mounted detectors on each track. These detectors are designed to control axle behavior by the application or release of brakes to prevent sliding. The system consists of a detector fitted to the driving axle box and a pneumatic relay on each track which are connected by flexible air hoses.

Railway Gazette Vol. 123 Apr. 1967, pp 263-264, 1 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-896)
DOTL RP

B4 037826
CHEMICALS TO IMPROVE RAIL ADHESION
The chemical spraying method developed by British Railways offers a promising solution to the wheel slip problem, and it is significant that there is now a proprietary spraying device known as the P and M Maxi-mu. An important and essential feature in the application of the chemical spray method is the making of adhesion surveys, using the tribometer, of portions of the track where wheel slip is serious prior to the installation of distributors. This enables the most effective positions for distributors to be determined. Spreading of the chemical fluid is actually performed by the train wheels. During 1964-65 extensive tests of ethyl caprillate were made, and it is now established that this is the most generally satisfactory of all the chemicals which have been so far tried.

Railway Gazette Vol. 123 Nov. 1967, pp 831-832, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-908)
DOTL RP

B4 037829
UNIVERSAL BOGIE DESIGNS FOR HUNGARIAN BUILT LOCOMOTIVES
Multi-gauge twin-axle truck designs are described for locomotive power from 600 to 2,000 hp and axleloads up to 20 tons. An important aspect was to design with three principal objects: to keep down the unsprung weight; increase the wheelbase, and provide suitable spring characteristics and adequate damping. Riding properties of locomotives equipped with this basic type of bogie have been found to be very good. Effectiveness of the non-linear primary suspension has fulfilled expectations and even without damping at this stage, no tendency to resonance conditions has been encountered.

Railway Gazette Vol. 123 Feb. 1967, pp 112-113, 5 Fig, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-913)
DOTL RP

B4 037835
HYDRODYNAMIC BRAKING FOR LOCOMOTIVES
Dynamic braking has one feature in common with the normal air or vacuum brakes. The limit of its force is dependent on the adhesion between a steel wheel and a steel rail. However, with dynamic braking there is no possibility of slide; over-braking dynamically produces a reverse slip, which is much less damaging to wheels, rails and braking elements. A very detailed description of this type of brake is provided, covering such topics as cooling factors, braking efforts and ranges, decelerating characteristics, driving technique and air control.

Railway Gazette Vol. 122 Oct. 1966, pp 837-42, 8 Fig, 1 Tab, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-919)
DOTL RP

B4 037840
HEUMANN-LOTTER TYRE PROFILE
The Heumann-Lotter tyre profile was evolved with the idea of giving somewhat greater safety against derailment of locomotives and rolling-stock. This profile was applied to all engine and tender wheels, and was felt to be of particular value with tender-first running with the tender nearly empty, a condition which gave the greatest risk of derailment. Before adoption as the standard profile by the German Federal Railway, 68 percent of all tyre-turning costs were due to needed flange re-profiling. Observations showed that the tyre mileage was 30 percent greater with the new profile than with the old.

Railway Gazette Vol. 122 July 1966, p 568, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-924)
DOTL RP

B4 037897
NOVEL AXLEBOXES FOR EXPRESS LOCOMOTIVES
The axleboxes are of the Athermos mechanically-lubricated type. All the accepted components of an Isothermos axlebox are incorporated, namely: a bearing ensuring copious fluid film lubrication over the whole journal, an oilflinger conveying a large volume of oil to the bush; an oil sealing ring shrunk on the axle; and a safety pad which effectively protects the oil flinger from damage. The special features peculiar to this new axlebox are; a novel guiding system consisting of forked links mounted in Silenblocs which permit the axlebox to move vertically without fore and aft deviation; and a novel device allowing a controlled lateral play of 20 mm which has a marked effect in easing the running on sharp curves.

Harrison, FC *Railway Gazette* Vol. 92 May 1950, pp 539-545, 2 Fig, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1088)
DOTL RP

B4 037936
DESIGN OF BOGIES FOR ELECTRIC LOCOMOTIVES
An improved bogie developed by the Swiss Locomotive and Machine Works of Winterthur incorporates transverse coupling together with a centering device to prevent hunting, and friction dampers on the axlebox guides. Experimental results showed that if two bogies are coupled by means of a transverse bar that there is a reduction in (a) the guiding pressure on the leading axles of both bogies, and (b) the angle of incidence of the leading axles. The two bogies are connected by a spring coupling at the end of a triangular yoke on each bogie. The coupling permits a degree of side play adjustable to any value between 20 and 500 mm. after which further relative movement is controlled by two helical springs, which may be adjusted to allow a maximum movement of 24 mm.

Railway Gazette Vol. 88 May 1948, pp 601-602, 2 Fig, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1130)
DOTL RP

B4 039206
EVALUATION OF THE PLASMA TORCH. STUDY OF OPERATIONAL TESTING AND EVALUATION OF AN ARC PLASMA GENERATOR AS A MEANS TO IMPROVE WHEEL-RAIL ADHESION
Effectiveness of the d.c. are plasma generator as a tool for improving

wheelrail adhesion was measured. Two torches per rail were found very effective in eliminating low adhesion areas. Generally, adhesion values of 0.1 to 0.2 were increased to nearly 0.3. More specifically, adhesion corresponding to the 2% slip risk level, averaged over all tests in the speed range up to 30 mph, was increased from 0.19 to 0.29. Significant improvement of adhesion was found up to six hours after treatment with the plasma torch even though climatic changes had brought about changes in the adhesion of both control and test sections. Over longer periods, large numbers of freight and passenger trains distribute fresh contamination over the test and control sections thereby changing the identity of the sites. The power used was increased with the square root of speed up to 15 mph when it totalled 60 kw for both rails. Above 15 mph the power was held approximately constant at 66 kw. Constant power operation results in adhesion increases which are significant but less than would have been obtained if power had been increased. The power level used in all the trials was such that no damage could occur to the rails. Experiments in the laboratory have shown that even with much greater plasma powers the mechanical properties of rail steel were unaffected; this provides a high level of operational safety should the power control system malfunction. With this equipment the problem of wheel slip on starting, for heavily laden freight and passenger trains, can be confidently said to be overcome.

Dobbs, DJ
British Railways Board Research Department Final Rpt Jan. 1970, 59p*

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B4 039311
REDUCING FLANGE-WEAR ON BOGIE LOCOMOTIVES
The phenomenon of relatively rapid flange-wear on sharp curves with the bogies of Bo-Bo and Co-Co locomotives must be accepted pending the results of further research into the reduction of bogie weight and unsprung weight, the height of the bogie centre of gravity, different relative speeds of the axles and motors, weight transfer, etc. Flange or rail lubrication using a lubricant matched in viscosity to suit the ambient temperature lengthens the flange life from six to nine times, this factor varying according to the tire steel used. A change from tires of "D" steel to those of 70-ton tensile steel alone can increase flange life by as much as three times. A combination of lubrication, hard tires, and the fitting of a centralizer linking the movement of the two bogies and which is capable of drastically reducing flange forces on curves, will improve flange life by 12-15 times.

Railway Gazette Vol. 111 Dec. 1959, p 559

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1427)
DOTL RP

B4 039313
MOTIVE POWER FOR HIGH SPEEDS
This article traces the growth of high speed operation engineering and planning on the German Railways from 1903. Projected plans call for even heavier and higher speed units of motive power, with 25 ton axle load and capable of 300 km/h. Further developments are in progress in motive power elements, as the asynchronous motor drive. Similar progress is evidenced in the application of computer techniques to train control and operation. The demands for faster travel speeds are being constantly considered by the German Federal Railway.

Kuckuck, R Niekamp, K (Hauptverwaltung der Deutschen Bundesbahn)
Die Bundesbahn No. 7/8, July 1971, pp 339-343, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1429)
DOTL RP

B4 039314
BOGIE PITCHING
Mathematical studies are reported which relate the effect of bogie pitching on body oscillations. The factors considered are spring stiffness, inertia, frame pitching and wheel spinning. The prevention of undue bogie pitching should be faced in early design stages. The method of attaching the body to the bogie, spring design, incorporating provisions for dampers and prototype testing for natural oscillation frequencies are all important factors in the vehicle design.

Koffman, JL *Railway Gazette* Vol. 112 No. 15, Apr. 1960, pp 418-421, 4 Fig, 2 Phot, 5 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1430)
DOTL RP

B4 039317
SCIENTIFIC INVESTIGAIONS OF DIESEL-POWERED TRACK VEHICLES
The diesel-powered vehicles of the German Federal Railroads are investigated by a specialized testing institute, the Research Center for Internal Combustion Engineering, under similarized service conditions on the route by means of test cars for their performances and the proper operation of their mechanical equipment, and the grade of their energy transforming efficiency is determined. The modern electronic testing methods are described and several test results are presented. An efficiency field diagram of a 1100 HP diesel locomotive, a temperature and pressure diagram recorded from a 3000 HP diesel, and a torsional vibration oscillogram recorded from the articulated shaft of a diesel, are shown.

Roehrs, F *Krauss-Maffei News* No. 217, June 1960, pp 17-22, 4 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1433)

B4 039320
WHEEL AND RAIL LUBRICATION
Remarkable increases in life of rails and wheel flanges through lubrication, by as much as 700 percent, are quoted by Dr. Fritz Birmann, in his paper "Lubrication of Rails and Wheels." The requirements of a lubricating system to reduce wear of rails and tires, are that the lubricant must be prevented from spreading to the running surface of the rail, thereby reducing traction; that the efficiency of the system must not be spoiled by dust, dirt or weather influences; that the lubricating devices and spray nozzles must be profile free on the rail and vehicle; and that lubrication must not start too late on the curve, so that it is preferable, where possible, to lubricate tires before entering the curve.

Birmann, F (German Federal Railways) *Railway Gazette* Vol. 107 Oct. 1957, p 413

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1483)
DOTL RP

B4 039409
ADHESION OF LOCOMOTIVES
High frequency sparks were tested as a means to remove foreign matter from rail to improve the friction coefficient. The results showed an improvement in the coefficient for sparked rail. An unresolved problem is radio signal, interference caused by the sparking. No detrimental effect has yet been found on the steel of the wheel or rail by sparking and there has been no effect on the fatigue strength.

Question B44. Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Report Vol. N2 No. ,25, ORE Pub-21,25, 4 pp, 1 Fig, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-658)
DOTL RP

B4 039458
BENDING STRESSES IN A MOTORED AXLE ON ELECTRIC ROLLING STOCK--3
This article presents formulae used in the determination of bending moment of axles of powered tracks. Also comments concerning track irregularities upon wheels are also discussed. Mention is made of the differences between calculated stresses and recorded stresses, which are usually small except in stress increase by press fitting of wheel brakes. Conclusions are that vertical track irregularities are unimportant in stress of axles and that the use of check rails can reduce axle stresses. Finally, a prediction of axle life and axles stress is close between calculated and test results.

Broadbent, HR Richards, J (London Transport Executive) *Railway Gazette* Vol. 104 June 1956, pp 579-581, 7 Fig, 2 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-753)
DOTL RP

B4 039474
MECHANICS OF WHEEL AND RAIL
Tire-profiling tests undertaken in New South Wales to reduce oscillation resulted in an increase in the severity of the oscillations, which was directly traceable, not to the contact of the flange root with the edge of the rail, but of the steeply inclined portion of the tread adjoining the flange root. This is a well-known characteristic of all worn or hollow tire profiles. The objective of the tests was to defer the formation of the objectionable tread ramp near the flange in a worn tire. The design specifically allowed that there should always be a portion of the root radius still available to contact the edge radius of the rail. Diagrams representative of each of the tire contours and conditions of service are reproduced. In these diagrams, there will be noted a step developed after service at the junction of the flange root and the recess due to flange wear.

Railway Gazette Vol. 92 Mar. 1950, pp 247,253, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-806)
DOTL RP

B4 039475
ADHESION AND FRICTION IN RAIL TRACTION
For dry rails, a coefficient of adhesion of 0.25 may be assumed for speeds up to 40-50 m.p.h. At higher speeds, however, there is less information to draw on. Above the 40-50 m.p.h. range, the dependence of adhesion on speed introduces a bend into the curve connecting speed and power output. For wet rails, the coefficient of adhesion is reduced to about 0.6 of the value determined for dry rails. Of the many variables encountered in brake-block friction, there is abundant evidence of the dependence of coefficient of friction on speed and brake-block pressure. Substances should be saught for blocks for which the coefficient of friction is less affected by speed than in the case of cast iron; the effect would be to allow acceptable braking distances without having to use high braking ratios, so that a reduction in the weight of brake gear could be contemplated.

Koffman, J *Railway Gazette* Vol. 89 Oct. 1948, p 484

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-807)
DOTL RP

B4 039563
WEARING PARTS OF ELECTRIC ROLLING STOCK
The subject of wear and tear on vehicles is considered. Focus is on two aspects; wear resulting from the work accomplished by the rolling stock and wear, particularly bogie frame wear, resulting from vibrations generated during operation. Tyre wear is also mentioned. This results in sharp flanges, deep flanges, thermal checking and flaking, and hollow treads. Each of these problems is briefly examined.

Railway Gazette Vol. 100 Jan. 1954, p 116

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1202)
DOTL RP

B4 039569
THE FRENCH RAILWAY SPEED RECORD
As part of a study of the technical and economic aspects of high-speed operation, the SNCF conducted four days of trial runs at progressively higher speeds. The purpose of the tests was to investigate the margin of safety allowed by the speeds now regularly scheduled with normal types of locomotives and rolling stock. They were also regarded as a contribution to research into methods of improving the productivity of transport and reducing its cost, by showing how the building of vehicles able to run at ever-increasing maximum speeds can reduce maintenance expenditure on locomotives and track when operating at the speeds now normally scheduled. The test train consisted of three coaches of a recent design. Continuous records were made on all the runs by means of piezo-electric apparatus of the lateral forces exerted on the track by the first and third axles of the locomotive bogies. It was found that these did not exceed 4.2 tons.

Railway Gazette Vol. 100 Mar. 1954, p 352, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1208)
DOTL RP

B4 039697
GP-7 LOCOMOTIVE WHEEL TO RAIL LATERAL LOADING TEST ON ILLINOIS CENTRAL RAILROAD
The report is based upon testing conducted by EMD to determine causes of derailments which involved GP-9 locomotives. The EMD Test Car was used to determine wheel loading levels for the GP-9 locomotive to determine wheel loading at the derailment sites. The test train from which data for this report was obtained represented a typical freight train operating in normal service through the areas where previous derailments occurred. The loads measured between wheel and rail during the testing were substantially below levels which are normally considered necessary to cause derailment by wheel climbing rail, rail turn-over, or shift of entire track structure. The maximum steady state net lateral load measured on the guiding wheel was 13,200 lbs. which represents 41.2% of the nominal wheel vertical load. Accompanying this load was a 5,400 lb. axle lateral load which represented 8.5% of the nominal axle vertical load. The above loads were measured in a 6-1/2 inch curve. Threshold tendency of wheel climbing rail is generally expected when net lateral force on guiding wheel is 90 to 100% wheel vertical load. Rail turnover demands that total lateral load compared to total vertical load on an entire rail length unsupported, or practically unsupported, by adjacent lengths gives a ratio great enough to cause the load resultant to fall outside of the base of the rail. Dynamic instanteous peak loads which are of very short duration resulting from sudden rail irregularities (joints) are not believed to affect wheel climbing rail or rail turn-over. Train speed did not significantly change steady state forces in a particular curve. However, increased speed did significantly change the level of dynamic loading as much as 200%.

Klinke, WR
General Motors Corporation Tech Rpt 119, Mar. 1965, 49 pp, 33 Fig, 18 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1477)
DOTL RP

B4 039698
ANALYSIS OF WHEEL-RAIL LOADING OF FP-45 LOCOMOTIVE ON A 3 DEGREES 3' TRACK CURVE SANTA FE RAILROAD
This report is an investigation of lateral loading of an EMD FP-45 locomotive to determine the relationship to derailments. Included is a comparison between the FP-45 and other six, four and two axled locomotives. Finally, with a discussion of lateral load data and dynamic lateral forces, the report concludes that the derailments caused by rail turnover were the result of poor rail joints which were present in the section.

Marta, H
General Motors Corporation Tech Rpt 898-133, Feb. 1968, 19 pp, 1 Fig, 45 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1478)
DOTL RP

B4 039942
THE APPLICATION OF BEARING SPRINGS TO LOCOMOTIVES AND OTHER RAIL UNITS
The design, maintenance and characteristics of suspension systems for locomotives and railcars are discussed. The design of a locomotive places restrictions upon suspension systems, which differ from railway cars. The characteristics of steam locomotives require different suspension systems than electrics. Stresses and dimensions for laminated springs for railway vehicle use are tabulated.

McArd, GW *Railway Gazette* Vol. 76 Feb. 1942, pp 263-266, 4 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1320)
DOTL RP

B4 039963
BOGIE DESIGN FOR ELECTRIC LOCOMOTIVES--2
Suspension, adhesion, and good riding requirements of general service

locomotives are discussed. Attention is given to three-point suspension, weight transfer reduction, Bo-Bo characteristics, bogie behavior on curves, and the need for three-dimensional rigidity in the frame types.

Croft, EH (General Electric Company) *Railway Gazette* Vol. 105 Sept. 1956, pp 384-385, 4 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1374)
DOTL RP

B4 039976
RUNNING PROPERTIES OF ELECTRIC AND DIESEL MOTIVE POWER UNITS

This report contains a comprehensive description of the theoretical bases, used on the riding properties of an electric locomotive as well as of the methods of measurement and evaluation applied. In this connection, an account of the level which the development of these methods has attained is also given.

Question B10. Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Rpt ORE Publ No. 21, July 1965, pp 5-9, 6 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1439)
DOTL RP

B4 039991
LATERAL FORCES ON TRACK AND EQUIPMENT DUE TO DYNAMIC BRAKING ON THE SOUTHERN PACIFIC LINES

This report embraces a description and analysis of data secured during the operation of regular scheduled freight trains on the Southern Pacific Company between Roseville, California and Sparks, Nevada. The purpose of the investigation was to determine the coupler forces and resulting lateral forces exerted on the rails by the passage of an 85 ft. car coupled to a short car in a train with the locomotive using dynamic braking while operating on steep grades and curves up to 10 deg. During the investigation, data were secured on coupler and car angles, lateral and vertical truck forces and longitudinal acceleration of the 85 ft. car with the train operating at various speeds. The analysis of data contained in this report may be summarized as follows: 1. The steady or longitudinal coupler forces for both pull and push conditions, as expected, are in proportion to the weight of that portion of the train behind the point of measurement. The compressive coupler forces were reduced considerably when the train air line pressure was reduced with the locomotive under dynamic braking on the descending grades. 2. The coupler angles are in direct proportion to the track curvature with the values obtained under the pulling condition slightly greater than those under the pushing condition. 3. The data indicate there is a linear relationship between the track curvature or coupler angle and the lateral truck forces acting on the rail. 4. The occurrence of slack action was rather infrequent due to the long and almost continuous grades for but some coupler forces as large as 90,000 lb were obtained by an application of the dynamic brakes which permitted the slack to run-in. 5. The sprung weight of the 85 ft. car was subjected to longitudinal accelerations as large as 2.2 g but there does not appear to be any direct relationship between the direction and magnitude of this acceleration with respect to the direction and magnitude of the slack action coupler force.

Schinke Aggarwal
Association of American Railroads Technical Center ER-69, Oct. 1966, 30 pp, 9 Fig, 4 Tab, 3 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1456)
DOTL RP

B4 040010
THE RAIL MOTOR-BRAKE

Achieving train speeds of 300 to 400 KMH are discussed. Over 200 km/h no conventional technical solution is suitable as to the fundamental aspects of traction, and mainly the braking. The rail would become an integral part of the electric motor, propulsion and braking systems regenerating linearly, rapidly and indefinitely under the field part of the motor, of which it becomes, electrically, the armature. The motor or braking effort, the system being reversible, hence are produced between the rail head, wherein flows induced currents producing the effort. A magnetic core, provided with windings, constitutes this part of the motor which provides the inductor field necessary for propulsion, asynchronous sliding field, by its feed with variable frequency, polyphase, alternating current. This motive power unit would employ classical railway, yet would be independent of traction adhesion and braking limits.

French Rail News No. 4, 1968, pp 58-59, 1 Fig, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1493)
DOTL RP

B4 040012
THE BEHAVIOUR OF THE MOTIVE POWER AXLES (WHEELS) ON THE S.N.C.F.

Wheel-set stresses are modified by the action of the strains inherent in service which may be categorized as follows: those affecting the shrinking-on; those which correspond either to vertical effort exerted by the wheel on the rail, essentially cylical, or to the lateral reactions of the rail on the wheel both cyclical and erratic (abnormal shocks); and those set up by a temperature rise, due to braking. The SNCF has tested, both in the laboratory and in service, the diverse stresses as they are linked up with strains. Common damages to wheelsets are described and are shown. Wheel manufacturers are using the test results to enhance wheel design criteria.

French Rail News Vol. 4 1969, pp 52-54, 9 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1495)
DOTL RP

B4 040021
APPLICATION OF GRINDING STONE BLOCK TO PREVENTION OF WHEEL-SKIDDING OF HIGH SPEED VEHICLES

Resin-bonded grinding stone block was applied to the shoe of a special tire cleaning device mounted on the vehicle for the New Tokaido Line in order to improve the adhesion and prevent the wheel-skidding. The grinding stone shoe which was apt to be abraded and to grind the wheel-tread more or less had the tendency to remove undesirable adhesive material and produce a more active surface with improvement of adhesion. The abrasion of grinding stone block increased in the order of emery, single crystal aluminium oxide, regular aluminium oxide and silicon carbide as abrasive grain material and with grain percent and inversely with grain size. A running test with the vehicles has shown the tendency of the frequency of wheel-slips being reduced under use of the grinding stone shoe.

Ishizawa, M Maruyama, H Ohyama, T Satoh, K (Japanese National Railways) *JSME Bulletin* Vol. 14 No. 70, Sept. 1963, p 381

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1504)
DOTL RP

B4 040024
WHEEL AND RAIL LOADING FROM DIESEL LOCOMOTIVES

This review is divided into the following areas: sample derailment data; basic curve negotiation mechanics; experimentally determined wheel-to-rail forces; rail profile data; the effect of dynamic brake levels; and mechanical considerations. Sample derailment data was taken from all six areas and well illustrated with examples. A summary of results is shown. There are a number of mechanical areas involved in the locomoitve which can and do affect the wheel-rail loading. Among these, although there are many others, are the alignment control draft gear, matching wheel sizes, and maintenance of truck bolster stops.

Marta, HA Koci, LF (Electro-Motive) Conf Paper pp 146-177, 30 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1507)
DOTL RP

B4 040076
SUITABILITY OF SIX-AXLE LOCOMOTIVES FOR C&O--B&O SERVICE--THE INTERACTION WITH TRACK STRUCTURE

A series of tests was conducted with 6-axle locomotives in heavy, coal drag service on Cranberry Grade to investigate the interaction of locomotive tractive power and track conditions. Particularly, the performance of 6-axle locomotives in this service was investigated to determine the relative merits of that design versus the 4-axle units previously used. Five major areas were found to be significant and completely interdependent: I. Locomotive wheel life with 6-axle units. II. Rail cleanliness affects locomotive adhesion. III. The condition of the track and the rail govern overall acceptability of 6-axle locomotives. IV. Operating practices covering the use of sand are related to increased wheel wear and increased track maintenance. V. Instrumented wheel tests: A. To determine to what extent and under what circumstances the wheel and rail wear attributable to 6-axle locomotives exceeds that of 4-axle units. B. To determine effect of track surface on locomotive riding qualities. C. To determine suitability of 6-axle locomotives.

Schmidt, JJ
Chesapeake and Ohio Railway, Baltimore and Ohio Railroad Res Rpt Feb. 1966, 27 pp, 3 Tab, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1572)
DOTL RP

B4 040077
FLEXICOIL SECONDARY SUSPENSIONS IMPROVE HIGH SPEED RIDING
Following successful experiments with flexicoil secondary suspension fitted to a Class 86 electric locomotive, British Railways intends to make further use of this type of springing. Faulty hydraulic dampers caused pitching oscillations of 2.42 c/s resonant at 100 mile/hr with 60 ft. rail joints and body nosing oscillations of 1.25 c/s on straight track. Design installation and evaluation of a flexicoil suspension system resulted in significant improvement in the riding characteristics at high speed.

Clayton, GA *Railway Gazette* Vol. 126 June 1970, pp 460-464, 3 Fig, 1 Tab, 1 Phot, 19 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1573)
DOTL RP

B4 040087
THE TRACTIVE RESISTANCE OF DIESEL LOCOMOTIVES
This report of tractive resistance data from a British Transport Commission bulletin in terms of lb. per ton yielded a dimensionless drag of 0.6 to 0.9 and rolling resistance values of 3.5 to 4 lb. per ton for various diesel locomotives. At speeds above 10 mph and particularly in the speed range of 20 to 80 mph the values of r or R are influenced by the component proportional to (V/10) and not by C(sub d) and the (V/10(super 2)) factor. This suggests that the effect of transmission and coupled axles action is of considerable influence.

Koffman, JL (British Railways) *Railway Gazette* Vol. 115 Dec. 1961, pp 738-739, 2 Fig, 4 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1583)
DOTL RP

B4 040088
PERFORMANCE OF LOCOMOTIVE BOGIE BOLSTER SPRINGS--I
The lateral rigidity of helical springs in bolster suspensions of truck vehicles is evaluated in terms of displacements between the top and bottom bolster planks. The effects of lateral flexibility on working stresses and lateral displacement and oscillation characteristics, particularly nosing, swaying and lateral oscillations are calculated.

Koffman, JL Batchelor, GH (British Transport Commission) *Railway Gazette* Vol. 116 Jan. 1962, pp 16-18, 2 Fig, 2 Tab, 15 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1584)
DOTL RP

B4 040091
PROPULSION OF TRAINS AT SPEED
Safety aspects on unrestricted main-line track were investigated by instrumenting axleboxes to measure lateral force on hauled vs propelled trains. It was found that it is the combination of sharp curves and high propulsive efforts, both demanding low speeds, which requires close examination.

Pocklington, AR (British Railways Board) *Railway Gazette* Vol. 121 Apr. 1965, pp 317-329, 6 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1587)
DOTL RP

B4 040104
PRACTICAL ADHESION FACTORS
An examination and comparison of the torque and slipping characteristics, and the starting performance of electric locomotives and diesel-hydraulics are made. The accepted adhe sion value for rigid-frame coupled axle locomotives is 0.33 and for the truck locomotive is 0.30. This article suggests that a coefficient of 0.37, which is commonly adopted for the electric locomotive, might be more correct. Notchless control is suggested to improve the starting performance of the diesel hydraulic.

Krishnemurti, R *Railway Gazette* Vol. 120 Oct. 1964, p 856, 1 Fig, 1 Phot, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1600)
DOTL RP

B4 040115
THE LIMITS OF ADHESION
A comparison of adhesive data for 15-types of electric locomotives shows that at least ten are overpowered. The adhesion coefficient is defined and the relationship between tractive effort and wheel slip is shown. Measures to prevent wheel slip are discussed. The fluctuations of wheel load and adhesion on dry, wet, and oily rail are illustrated. It is concluded that elaborate mechanical axle-load-equalizers which have been used to improve adhesion are not as important as carefully designed suspension and damping systems.

Steiner, B (Oerlikon Engineering Company) *Railway Gazette* Vol. 123 Apr. 1967, pp 268-273, 5 Fig, 1 Tab, 4 Phot, 10 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1611)
DOTL RP

B4 040119
SPARKING TO IMPROVE ADHESION
Development of the use of arc plasma as a means of improving adhesion between wheel and rail is discussed. For ordinary thin oil films energies of 50 J/cm2 or more are needed. The main factor involved in adhesion increase by sparking is the removal of the pollution from the rail surface, including moisture, and any effect on the actual surface itself. An example of the improvement in spark tests that can be achieved is shown in several slip risk probability graphs for a severely polluted rail. On unsparked rail the use of a tractive effect requiring 17 1/2 per cent adhesion would result in a 10 percent slip risk, but after the successive amounts of sparking used the same slip risk occurs at 26 1/2, 33 and 45 1/2 per cent respectively. The mobile test bed is an experimental device to measure the changes in adhesion; it is not a tool for the practical application of sparking in service.

Railway Gazette Vol. 123 Sept. 1967, pp 663-664, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1615)
DOTL RP

B4 040133
THE NEW ELECTRIC LOCOMOTIVE TYPE RE 4/4 OF THE SWISS FEDERAL RAILWAYS AND THE PROBLEMS RELATED TO THE DEVELOPMENT OF ITS MECHANICAL PART
In 1964 the Swiss Federal Railways introduced the prototype of a very efficient, high-power electric locomotive type Re 4/4II of the wheel arrangement Bo'Bo'. The locomotive weighs 80 tons overall and has a 1-hr rating of 6340 hp, and it had to be especially designed for small lateral forces between wheel and rail and good adhesion properties. The basic theoretical problems related to the development of the mechanical part of the locomotive are outlined. The technical solutions of the various mechanical problems are described. A few remarks on the numerous tests carried out with the completed locomotive are included.

Borgeaud, G Loosli, H (Swiss Locomotive and Machine Works) *ASME Journal of Engineering For Industry* 67-RR-1, 1967, 15 pp, 24 Fig, 1 Tab, 12 Phot, 3 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1633)
DOTL RP

B4 040191
ANALYSIS FO DD-35 LOCOMOTIVE & TRUCK IN OPERATION ON NEW YORK CENTRAL R.R. TRIBES HILL 2 DEGREE 58' CURVE
This report is a study of the conditions associated with operating the DD-35 locomotive over the 2 degree, 58 minute curve involved in the derailment at Tribes Hill on February 21, 1964. The expected lateral loading considered likely to occur on the Tribes Hill curve under the most extreme conditions would give net lateral wheel load of 15,900 pounds with instantaneous peaks to approximately 25,000 pounds. This extreme value of 15,900 pounds represents only 37 per cent of the associated vertical wheel load. Analysis and test results accumulated from numerous tests, including curve negotiation of many different locomotive models and measurements of wheel stresses, axle stresses, and lateral loads, indicate: the instantaneous peak values acting over and above the base loads are not significant in rail turnover, and, lateral loadings representing 90-100 per cent of vertical load can be applied to the rail at a single wheel location without any indication of rail turnover or wheel climbing.

Koci, LF
General Motors Corporation 118, July 1964, 111 pp, 32 Fig, 1 Tab, 11 Phot, 43 Ref, 4 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1626)
DOTL RP

B4 040192
SD-45 LOCOMOTIVE DYNAMIC BRAKE TRAIN HANDLING TESTS ON PENNSYLVANIA RAILROAD

Because of a major derailment near Johnstown, Pa., a series of dynamics brake handling tests were conducted between Harrisburgh and Pittsburgh, on severe grades and curves. The trains in which the test unit and the adjacent long overhang boxcar operated were varied in nature, ranging from tonnage trains while operating in a two-unit consist to trailer trains and PR trains in four-and eight-unit consists. In general, with the loaded long overhang boxcar leading the train, the records indicate that at no time did the danger of derailing due to drawbar forces exist. No instances in the entire test program exhibited lateral force levels which would be of concern with respect to derailment. The boxcar was loaded with freight during all of the tests.

Klinke, WR Buesing, EJ
General Motors Corporation Test Rpt 898-68-132, Aug. 1967, 76 pp, 39 Fig, 1 Tab, 8 Phot, 7 Ref, 2 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1627)
DOTL RP

B4 040197
BOGIE LOCOMOTIVE RIDING PROBLEMS

The performance of vehicle suspension can be adversely affected by lateral plane design, which appears to be of minor importance. The low order restoring forces due to swinglinks, which are about one ton per inch per bolster, are discussed as to their relationship to ride quality. A Bo-Bo electric locomotive with 20 inch vertical swinglinks is used as an example. The link ends were mounted on rubber and rubber snubbers were required to prevent impact between the bolster and the track frame. Lateral pull tests are described on this system, which were conducted to determine source of the poor ride quality. It is shown that the effective length of the 20 inch swinglinks is only 6.8 inches.

Batchelor, GH (British Railways Board) *Railway Gazette* Vol. 120 May 1964, pp 353-356, 7 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1656)
DOTL RP

B4 040227
LATERAL LOADING BETWEEN LOCOMOTIVE TRUCK WHEELS AND RAIL DUE TO CURVE NEGOTIATION

Curve-negotiation mechanics and forces resulting when locomotive trucks negotiate curves are well recognized. However, meaningful and reasonable prediction of forces resulting in service conditions has been limited. An instrumented wheel-axle assembly was developed and used on 2,3, and 4-axle trucks to study the effect of creep and the transverse load reactions resulting between wheel and rail. Instrumentation was used to measure these forces and the reactions between axles and truck frame under operating conditions. Test results confirm predicted phenomena and indicate the effect of creep on resulting loads. This paper includes a brief and general review of curve-negotiation mechanics and presents the test results and their relation to the theoretical analysis.

Contributed by the Railroad Division of the ASME at the Annual Winter Meeting, Chicago, Illinois, November 7-11,1965.

Koci, LF Marta, HA (General Motors Corporation)
American Society of Mechanical Engineers Paper 65-WA/RR-4, Nov. 1965, 11 pp, 7 Fig, 18 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1691)
DOTL RP

B4 040249
WHEEL AND RAIL LOADING FROM DIESEL LOCOMOTIVES

A review of various test programs conducted jointly by the Electro-Motive Division of GM and selected railroads is presented. These tests covered not only the wheel-rail loadings of locomotives but the effects of some on rail. This review is divided into the following six areas: 1. Sample Derailment Data; 2. Basic Curve Negotiation Mechanics; 3. Experimentally Determined Wheel-to-Rail Forces; 4. Rail Profile Data; 5. The Effect of Dynamic Brake Levels; and 6. Mechanical Considerations.

Koci, LF
General Motors Corporation Apr. 1971, 50 pp, 28 Fig, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1713)
DOTL RP

B4 040271
COMMENTS ON PENNSYLVANIA RAILROAD ELECTRIC LOCOMOTIVE TRACK TESTS CONDUCTED BETWEEN 1930 AND 1938

These are the first tests in which a section of track was equipped with special ties with means of measuring the maximum lateral force exerted outwardly on the rail by an electric locomotive on a test run. The tests were quite extensive with respect to instrumentation and also the number of run made with various types of locomotives. The section of test track consisted of steel ties spaced on 43 inch centers. The applied loads would be considerably different than on wood ties placed on 20 inch centers. A loaded profile of the right rail and left rail on the tangent track test section 440 ft. long including 128 test ties was intentionally made with variations in cross level in order to develop the performance of locomotives under unusually large variations in track cross level for very high speed running. The second phase of the tests included the use of weight bars equipped with magnetic strain gages to measure the lateral force exerted by the axle against the locomotive frame. These tests are of limited value to diesel locomotives and freight car equipment now in service.

Unpublished Report.

Magee, GM
Penn Central Transportation Company Nov. 1971, 31 pp, 11 Fig, 7 Tab, 8 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1740)
DOTL RP

B4 040320
LOCOMOTIVE WHEEL-TO-RAIL TRACTION

It is shown (on the basis of laboratory data) that the low values of locomotive wheel-to-rail traction caused by contaminants can be increased and stabilized under both driving and braking conditions by the application of a high-frequency (HF) induction-coupled air plasma torch to each rail ahead of the lead drive wheel. Descriptions are given of experiments to investigate friction effects of RF ionized gases, corona discharge, an acetylene torch, a do argon plasma torch, and an HF induction-coupled air plasma torch. The plasma torch has given a two to three-fold friction increase under laboratory conditions, even with oiled surfaces.

Albachten, HT (Stanford Research Institute)
American Society of Mechanical Engineers Nov. 1966, 9 pp, 6 Fig, 5 Tab, 6 Phot, 11 Ref, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1824)
DOTL RP

B4 040345
MEASUREMENTS OF VERTICAL AND LATERAL FORCES ON BOTH RAILS OF A SIX-DEGREE REVERSE CURVE UNDER DIFFERENT TYPES OF SIX-AXLE AND FOUR-AXLE DIESEL LOCOMOTIVES

An investigation was conducted on a 6 deg. reversed curve with 150 ft. spirals and practically no tangent between them. The track was instrumented at two locations, one on each of the spirals near the juncture with the 6 deg. curve. Vertical and lateral wheel loads were measured for each passing wheel of the locomotives on both rails. Four classes of locomotive were included in the tests having six wheel trucks as well as locomotives having four wheel trucks. The lateral force exerted against the high rail increases with speed; is relatively low for the freight diesel locomotives with four axles and the passenger diesel locomotives with six axles; and is appreciably higher for the two types of freight locomotives with the trimount trucks.

Magee, GM
Association of American Railroads Mar. 1967, 27 pp, 24 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1774)
DOTL RP

B4 040355
EFFECT OF LOCOMOTIVE WEIGHT UPON RAILWAY BRIDGES AND TRACK
The purpose of this evaluation is to generate a model which will give the safe speed-rail size for a diesel locomotive upon railway bridges and track. The results are presented in the form of a monograph and also a graph of relative track depressions, pressure intensity, and bending moments versus distance along the rail from load point.

Petersen, L
General Motors Corporation Res Rpt 8050-1, June 1953, 16 pp, 5 Fig, 1 Tab, 3 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1796)
DOTL RP

B4 040377
IS RAIL ADHESION A LIMITATION ON THE GROWTH OF INTERNALLY POWERED LOCOMOTIVES?
This paper examines the extent in which internally powered locomotives are pressing the limit of the coefficient of adhesion between wheel and rail. Data are reviewed showing the results of tests to establish the coefficient. These data are compared to operating results on locomotives of high power per axle to show that there is ample room for growth in the power ratings before the adhesion limit is reached.

Contributed by the Railroad Division of the ASME for presentation at the Winter Annual Meeting, New York, New York, November 25-30, 1962.

Meier, DR (General Electric Company)
American Society of Mechanical Engineers Paper 62-WA-294, Nov. 1962, pp 8, 3 Fig, 4 Tab, 3 Phot, 13 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1827)
DOTL RP

B4 040378
DYNAMIC MEASUREMENT OF RAIL PROFILE AND RELATED LOCOMOTIVE TRUCK MOTIONS
The profile of the railroad track on which a railway vehicle operates represents an input into the vehicle. This input is due to vertical and lateral rail irregularities and can cause dynamic loads that result in excessive damage or wear and tear on vehicle components and on the track itself. In order to study the dynamic operation of rail vehicles, it is necessary to know the profile of the track on which they operate. Since the unloaded profile of the rail can vary significantly from the loaded condition, it is the loaded-rail profile that must be known. This paper presents a method developed by the authors' company for the rapid measurement of the loaded-rail profile and includes some typical rail profiles and related truck motions resulting from these profiles. The instrumentation resulting from this work appears to have immediate application in day-to-day railroad operation and in high-speed rail transportation studies.

Contributed by the Railroad Division of the ASME for presentation at the 9th Joint ASME-IEEE Railroad Conference, San Francisco, California, May 4-6, 1966.

Spangler, EB Marta, HA (General Motors Corporation)
American Society of Mechanical Engineers Paper 66-RR-1, May 1966, 9 pp, 12 Fig, 3 Phot, 18 Ref, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1828)
DOTL RP

B4 040390
UNDERSTANDING WHEEL-RAIL ADHESION
The terms of wheel-rail adhesion are defined. An extensive review of the problems associated with adhesion and the attempts to solve these problems is presented. The results of experiments conducted by the author on scale equipment show that creep is present as long as there is adhesion demand. As the adhesion demand increases, the percentage creep increases until creep becomes slip and eventually slide. It is shown that true adhesion varies with velocity. Suggestions are given for means of approaching true adhesion values on the railroad. The danger of wheel damage caused by high adhesion could offset the advantages.

Contributed by the Railroad Division of the ASME for presentation at the ASME-AIEE Railroad Conference, Pittsburgh, Pennsylvania, April 20-21, 1960.
Cabble, GM, Jr (Westinghouse Air Brake Company)
American Society of Mechanical Engineers Paper 60-RR-3, Apr. 1960, 7 pp, 2 Fig, 57 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1841)
DOTL RP

B4 040402
COMPOSITION BRAKE-BLOCKS-EFFECTS ON ADHESION
The effects of composition brake blocks on adhesion were investigated by the DB. The measurements were analyzed statistically and the results plotted in the form of curves. Generally, lower adhesion values were ascertained when braking with K blocks than when using cast-iron blocks. As such an effect is only acceptable if it is small, severe testing is, in this respect, considered to be necessary when submitting K blocks to acceptance tests.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B64/RP 3/E, Nov. 1967, 14 pp, 32 Fig., 55 Ref.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1865)
PURCHASE FROM: UIC Repr. PC
DOTL RP

B4 040403
COMPOSITION BRAKE-BLOCKS-EFFECTS OF HUMIDITY ON BRAKING
Tests carried out by the SNCF, to determine the effects of humidity on braking; were made with 20 different types of existing composition brake-block. On the test rig at Vitry, braking tests were made from speeds of up to 160 km/h to a stop, and continuous braking tests were made with single cars at about 60 km/h. In service, fly-shunting tests at speeds of up to 140 km/h were made. The brake-block wear was not measured during the tests on wet rails. The similarity of the curves obtained with the different makes of block on dry wheels was not repeated on wet wheels. It would seem that not all the blocks have been designed and manufactured with the same object of obtaining satisfactory performances under wet conditions.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B64/RP 4/E, Apr. 1968, 16 pp, Figs., Tabs., Phots.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1866)
PURCHASE FROM: UIC Repr. PC
DOTL RP

B4 040443
DERAILMENT OF A PASSENGER TRAIN CONSISTING OF A DIESEL LOCOMOTIVE WITH SIX-WHEEL TRUCKS, A BAGGAGE CAR, AND A COACH
Three letters discuss the derailment of June 7, 1968. A sketch of the derailment area and photographs of sections of the track involved are included. This derailment is characteristic of a number of derailments that have occurred on curves at or near permissible speed of passenger trains having locomotives with six-wheel trucks, derailment apparently occurring first of the rear truck of the locomotive unit or the lead truck of the baggage car following. In each case the high rail of the curve was overturned. A high ratio of L/V is required to overtrun a rail and it is unlikely that this high a L/V ratio would be developed in track unless there is some unusual condition such as a jack-knifing of couplers between cars, an unloading of the lead wheel of the truck on the high rail, or some severe wedging action of the truck between rails due to a malfunction of the truck components.

Letter Correspondence.

Angold, JA (Atchison, Topkea and Santa Fe Railway); Stuppi, FN 14 pp, 1 Fig, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1909)
DOTL RP

B4 040445
TEST TO DETERMINE VERTICAL AND LATERAL FORCES IMPARTED TO THE RAIL BY A TYPE U28CG GENERAL ELECTRIC LOCOMOTIVE, SANTA FE CLASS 350
The test runs were made using a train consisting of two lightweight chair cars and three baggage cars and a locomotive of two units, one having the instrumented truck. Tests were run at speeds up to 90 mph on dry rail and

moderate temperature. The test results show lateral forces of substantial magnitude being exerted on the rails, an occasional one having a finite duration of ten feet. They also show vertical wheel loads of low value in some locations. The test results indicate it is possible for these two conditions to occur simultaneously on two or three adjacent wheels of a truck and produce an effective L/V ratio of sufficient magnitude to overturn the rail.

Angold, JA
Atchison, Topeka and Santa Fe Railway Test Rpt Aug. 1969, 37 pp, 17 Fig, 3 Tab, 2 Phot, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1911)
DOTL RP

B4 040446
MEMORANDA ON CONFERENCES HELD TO DISCUSS THE DERAILMENT PROBLEM WITH 6-AXLE TRUCK LOCOMOTIVES

Two memoranda discuss derailments involving 6-wheel truck locomotives in which the high rail of a curve has been rolled over. An itemization is made of 20 derailments involving six railroads during the time period 1964 to 1970. The memoranda discuss the deliberations of a meeting between representatives of each of the railroads involved and the AAR.

Angold, JA Lanning, HK
Atchison, Topeka and Santa Fe Railway File 32-03.07, 3 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1912)
DOTL RP

B4 040449
DERAILMENTS OF TWO PASSENGER TRAINS

The pertinent facts are given for the two derailment sites and the train consist. In both cases derailment occurred at the rear truck of the last locomotive unit or front of the following car. A drawing of the wide gage is shown of the actual worn wheel and rail contour of the derailed axle involved in the first derailment. Both derailments are not satisfactorily explained.

Unpublished Data.

Magee, GM (Association of American Railroads) 1967, 2 pp, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1915)
DOTL RP

B4 040486
SOME DESIGN PROBLEMS OF DIESEL LOCOMOTIVES

This paper focuses on the problems of diesel-hydraulic vibration systems, the power transmission to axles via a geared system, and the ride problems of the D.800 and D.1000 locomotive classes. Illustrations reveal shaft failures, comparisons of original and tuned vibration systems, crankshaft torsional vibrations, vertical movements of locomotive bogies, and tire profiles of new and worn wheels.

Ell, SO (British Railways) *Institution of Locomotive Engineers Journal* Vol. 56 No. 6, Paper No. 685, pp 543-571, 13 Fig, 2 Tab, 2 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1960)
DOTL RP

B4 040506
COMPOSITION BRAKE BLOCKS AND TYRES

This paper describes some of the problem which have arisen from the use of composition brake blocks in the past. For at least two of these, wet stopping performance and thermal cracking, there is now an understanding of the problem and possible solutions. Present-day production has also resulted in blocks free from the other difficulties. Other methods of avoiding the dangers associated with thermal cracking have been indicated: these involve moving away from the classic wheel and tire arrangement and the materials which have persisted for many years.

Wise, S Lewis, GR *Railway Division Journal* Vol. 1 Part 4, 1970, pp 386-443, 5 Fig, 4 Tab, 7 Phot, 13 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1993)
DOTL RP

B4 040508
A METHOD FOR ESTIMATING BRAKING DISTANCES

This method allows for a time delay in the development of full brake power after a brake application has been initiated at the driver's cab, by taking note of the actual pattern of this development during this period. Thereafter, the distance traversed with full brake power before coming to a stop can be computed. Allowance has also been made of the brake power development characteristics of the motive power units. The method is suitable for application to all brake systems, compressed air standard AVB, and AVB with Quick Application valves--in fact, for any system where the brake power development curves can be established.

Singh, A (Ministry of Railways, India) *Institution of Locomotive Engineers Journal* Vol. 57 No. 317, Part 3, pp 251-278, 14 Fig, 2 Tab, 1 Phot, 12 Ref, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1999)
DOTL RP

B4 040529
TWENTY YEARS' EXPERIENCE WITH DIESEL RAILCARS

The following topics are discussed: Bodies--A short discussion on the relative merits of light alloy and steel construction together with some notes on our experience with various materials used in the passenger areas and finally a discussion on the problems of heating this type of vehicle. Bogies--Some notes on the problems which have been associated with the brake gear, followed by a discussion of the riding problems experienced with these vehicles and then some notes on the problems which were encountered with axle design. Power Equipment--A short discussion on the relative merits based on experience of gear boxes and torque converters. Some notes on the various problems which have been associated with the final drive units and lastly notes on the performance.

Wakefield, FHG *Railway Division Journal* Vol. 2 No. t 1, 1971, pp 45-83, 6 Fig, 1 Tab, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1969)
DOTL RP

B4 040539
THE SULZER 12LDA29 DIESEL ENGINE AS APPLIED TO RAIL TRACTION

It is very difficult to make a fabricated structure which has no 'stress raisers' due to either bad geometry or lack of welding quality. Any fabricated structure which carries a high general stress is likely to develop fatigue fractures in certain areas. In order to avoid this situation and provide an engine structure which will reliably last the life of the engine, it is necessary to design the engine to a standard which will avoid a generally high stress and avoid areas which will concentrate stress. It will also be necessary to ensure a very high standard of welding quality. The additional expense and weight penalty of raising the standard of the structure in this way will tend to narrow the economic gap between the fabricated structure and the cast structure and may indeed close it completely.

Holmes, SC *Institution of Locomotive Engineers Journal* Vol. 59 No. 328, Part 2, pp 153-167, 4 Fig, 10 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1996)
DOTL RP

B4 040540
MODERN DEVELOPMENTS IN WHEELSLIP CONTROL ON ELECTRIC LOCOMOTIVES

The reasons for wheelslip are discussed indicating what happens when it does occur on different types of locomotive and under different circumstances, and what action can be taken to correct it. The coefficient of friction is shown versus slip speed and the probably maximum useful adhesion is shown for various speeds on wet and dry rail. The natural and slipping characteristics of a number of motors shows why some locomotives are less steady on their feet than others. Wheelslip results in loss of tractive effort and at a standstill or at low speeds can cause wheel burns. Ways of avoiding wheelslip by correcting weight transfer problems, by controlling the acceleration cycle with small notches in the contactors and by limiting the tractive effect. When slip is detected, one of the following actions is recommended: reduction of tractive effort, applications of sand, light application of air brakes, and armature shunting.

Scott, M *Institution of Locomotive Engineers Journal* Vol. 59 No. 328, Part 2, pp 182-190, 5 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1997)
DOTL RP

B4 040549
RAIL-WHEEL ADHESION ON DIESEL AND A.C. ELECTRIC LOCOMOTIVES
This paper is based on the results of dynamometer car tests carried out on Indian Railways to determine the adhesion at start and during running of diesel and a.c. electric locomotives placed in service in recent years on the Broad-Gauge (5 ft. 6 in.) and on diesel-electric locomotives on the Metre-Gauge systems. Dynamometer car results afford a practical assessment of the average maximum values in day-to-day operation under varying climatic and track conditions.

Narasimhan, RV (Research Designs & Standard Organization, India) *Institution of Locomotive Engineers Journal* Vol. 55 No. 305, Part 3, pp 276-323, 13 Fig, 10 Tab, 8 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2009)
DOTL RP

B4 040552
HYDRAULIC DAMPERS AND DAMPING
After brief review of the influence of viscous damping on free and forced oscillations of mass-spring systems, and its effect on response to impulses, suitable damping factors are quoted for control of body and truck oscillations on the suspension. This is followed by discussion of the most suitable forms of force-velocity characteristics for railway applications, and a section dealing with damping calculations. The influence of damper flexible mountings is then examined, with particular reference to impulsive suspension response and response to sinusoidal in deal with excitation. Experimental work relating to vehicle damping requirements and the recently issued B.R. specification with stipulates the requirements for dampers for use on British Railways' vehicles is discussed. Difficulties in the manufacture of dampers with linear symmetrical force-velocity characteristics are then pointed out with special reference to the tendency for current damper designs to result in S-shaped characteristics.

Batchelor, GH Stride, RCT *Institution of Locomotive Engineers Journal* Vol. 58 No. 326, Part 6, pp 563-628, 26 Fig, 7 Tab, 6 Phot, 8 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2012)
DOTL RP

B4 040791
TRACKING CHARACTERISTICS OF GREAT NORTHERN ELECTRIC LOCOMOTIVES ON A 10-DEG CURVE
This report covers a test program to measure the loads imposed on curved track by electric locomotives to determine if their power and size could be correlated with increased maintenance. The test locomotive was No. 5019 of Class W-1, but the other similar locomotive (No. 5018) was also used in the tests. Measurements were also made on two other locomotives as a matter of general interest and for comparison with the test locomotive. Both vertical and lateral forces were measured.

Ferguson, R Magee, GM (Association of American Railroads) *AREA Bulletin* Vol. 55 1953, pp 223-244, 12 Fig, 9 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2078)
DOTL RP

B4 040820
STRESS MEASUREMENTS IN 115 RE AND 132 RE RAIL ON CURVED TRACK
Stress distribution in 112, 115, 131, and 132 RE rails on curved track is shown. Most measurements were made for steam locomotive wheel load; however, a diesel locomotive was used for one measurement with 115 RE rail. Fatigue test results are shown on a Goodman diagram.

Magee, GM (Association of American Railroads) *AREA Bulletin* Vol. 53 1952, pp 1140-50, 10 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2091)
DOTL RP

B4 046436
RECENT RESEARCH ON ADHESION
The various studies and contributions are drawn into a coherent statement of how wheel/rail friction varies. Surveys of a number of track sites have identified the contaminants present in the wheel/rail interface, and measurements have been made of the adhesion which is experienced by railway traffic. A principal contaminant is a surface active oily fluid spread by the passage of wheels which forms a bonded surface layer on the wear band. A simple relationship has been found between the amount present on the surface and the resulting friction.

Collins, AH Pritchard, C *Railway Engineering Journal* Vol. 1 No. 5, Sept. 1972, pp 19-28, 8 Ref

ACKNOWLEDGMENT: EI (EI 73 004002)
PURCHASE FROM: ESL Repr PC, Microfilm

B4 047450
DYNAMIC ANALYSIS OF LONG-TRAVEL, HIGH-EFFICIENCY SHOCK ABSORBERS IN FREIGHT CARS
A dynamic analysis is presented relating the principle design parameters of a constant force type, dissipative shock absorber to the forces experienced by a resilient lading. The analysis, which correlates the effects of coupler force, lading force, cushion travel, closure time, impact speed, and friction, represents an application of classical mechanics to a dynamical system with sliding friction (Coulomb damping). Although a lumped-parameter analysis forms the basis of the derivation, a procedure is described which takes into account the mass-and compliance distribution within the lading.

This paper appeared in Anthology of Rail Vehicle Dynamics, Volume 1: Freight Car Impact. The anthology was sponsored by the Rail Tranpsortation Division. ASME. Presented at the ASME-IEEE Joint Railroad Conference, Philadelphia, Pa., April 7-8, 1970.

Freudenstein, F (Columbia University, New York)
American Society of Mechanical Engineers Paper 70-RR-1, 1971, pp 153-161, 8 Fig, 25 Ref, 1 App

PURCHASE FROM: ESL Repr PC, Microfilm
DOTL TF5.A72 1970

B4 047454
EXPERIMENTS HAVE DETERMINED THE FORCES BETWEEN THE WHEELS AND RAIL
This is the third of a series of articles discussing the wheel and rail loadings developed by diesel locomotives. The data is based on calculations and experiments conducted by Electro-Motive. The information may assist in explaining and preventing some of the derailments which railroads encounter. The next installment will discuss the "dynamic" profile of track and its measurement.

Koci, LF *Railway Locomotives and Cars* Vol. 145 No. 12, Dec. 1971, p 16

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B4 047458
IMPORTANCE OF RAIL PROFILES IN WHEEL LOADING IS DEMONSTRATED
This is the fourth of a series of articles discussing the wheel and rail loadings developed by diesel locomotives. Data are based on calculations and experiments conducted by Electro-Motive. The information may assist in explaining and preventing some of the derailments which railroads experience. The next installment will discuss the effects of dynamic braking.

Railway Locomotives and Cars Vol. 146 No. 1, Jan. 1972, p 20

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B4 047460
DYNAMIC BRAKING MUST BE CAREFULLY CONTROLLED
This is the fifth of a series of articles discussing the wheel and rail loadings developed by diesel locomotives. Data are based on calculations and experiments conducted by Electro-Motive. The information may assist in explaining and preventing some of the derailments which railroads experience. The next installment will mark the conclusion of this series.

Koci, LF (General Motors Corporation) *Railway Locomotives and Cars* Vol. 146 No. 2, Feb. 1972, p 13

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B4 047466
WHEEL AND RAIL LOADINGS FROM CONTEMPORARY DIESEL LOCOMOTIVES
This is the first of a series of articles discussing the wheel and rail loadings developed by diesel locomotives. The data is based on calculations and experiments conducted by Electro-Motive Division. The information may assist in explaining and preventing some of the derailments which railroads encounter.

Koci, LF (General Motors Corporation) *Railway Locomotives and Cars* Vol. 145 No. 10, p 19

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B4 052261
WHEEL AND RAIL LOADINGS FROM DIESEL LOCOMOTIVES
A review of wheel and rail loadings from diesel locomotives is presented in six areas: 1) sample derailment data, 2) basic curve negotiation mechanics, 3) experimentally determined wheel-to-rail forces, 4) rail profile data, 5) the effect of dynamic brake levels, and 6) mechanical considerations. In summarizing all of these factors the following areas deserve the most attention: 1) locomotive braking practice with regard to delay in power to brake transfer, gradual buildup of braking level and control of braking level over crossovers, turnouts, and curves; 2) track in relation to gage widening, level of rail irregularities, and possible thermal strain investigations; and 3) mechanical factors including proper alignment control in draft gears, and proper bolster stops on units without alignment control.

Koci, LF (General Motors Corporation) *AREA Bulletin* Proceeding Vol. 72 N No. 33, July 1971, pp 500-528, 6 Fig, 22 Tab

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

B4 052406
CURVE WEAR WITH DIESEL LOCOMOTIVES ON THE BESSEMER AND LAKE ERIE RAILROAD
A series of test runs were made to obtain definite information on the amount of rail curve wear produced by diesel locomotives relative to that produced by the remainder of the train. A second series of tests was made for the purpose of relating the effectiveness of flange oilers on the locomotive and rail lubricators in the track in controlling the amount of curve wear. Instrumentation consisted of a box to catch metal abraided by diesel units from the track and a motion picture camera to photograph the passing wheel flange on the high rail. The tests show that although the rate of rail and wheel wear with a diesel unit is greater than for a heavily loaded freight car, the greater amount of rail wear is due to the train rather than the diesel units. Rail and wheel flange wear on curved track can be practically eliminated by lubrication with either flange oilers on the diesel units or rail lubricators in track, or a combination of the two.

AREA Bulletin Proceeding Vol. 56 1955, pp 269-281, 1 Fig, 2 Tab, 9 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

B4 052507
CONSTRUCTIONAL ARRANGEMENTS FOR IMPROVING THE RIDING STABILITY AND THE GUIDING QUALITY OF ELECTRIC AND DIESEL LOCOMOTIVES AND VEHICLES. INVESTIGATIONS CONCERNING THE RIDING PROPERTIES OF THE CO'CO' ELECTRIC LOCOMOTIVE AE6/6 11414 OF THE SWISS FEDERAL RAILWAYS (CFF)
Measurements have been made on this locomotive up to 200 km/h for estimating the influence of the constructional parameters of this type of motive power unit on the guiding forces arising between wheel and rail. Statements can be made concerning the most important points to be taken into consideration for reducing these forces.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B10/RP13/E, Apr. 1973, 23 pp, 50 Fig., 1 Tab., 1 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC
DOTL RP

B4 052530
BIBLIOGRAPHY ON ADHESION (2 VOLUMES)
A bibliography of an initial choice of 385 selected articles and 5 films dealing with wheel-rail adhesion particularly during traction. Summaries of each article, in English, French and German, and bibliographical details are given. The articles are classified by the keyword system, keyword lists in 13 languages being included.

Additional summaries will be published at regular intervals to keep the bibliography up to date.

International Union of Railways DT28, Oct. 1973

ACKNOWLEDGMENT: UIC
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr PC
DOTL RP

B4 052563
CONSTRUCTIONAL ARRANGEMENTS FOR IMPROVING THE RIDING STABILITY AND THE GUIDING QUALITY OF ELECTRIC AND DIESEL LOCOMOTIVES AND VEHICLES. MEASUREMENT OF THE FORCES ACTING BETWEEN WHEEL AND RAIL
The knowledge of the forces acting between wheel and rail is important when studying the riding stability of a vehicle. Several procedures are available to measure these forces using measuring wheelsets. Several Administrations have developed, for this purpose, wheelset calibration rigs, whose design is described in a special chapter. Another chapter concerns the costs of these measurements. Some application examples should give an idea of the possibilities offered by the methods described.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B10/RP 14/E, Oct. 1973, 46 pp, Figs., 9 Ref., Apps.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC
DOTL RP

B4 052661
CONSTRUCTIONAL ARRANGEMENTS FOR IMPROVING THE RIDING STABILITY AND GUIDING QUALITY OF ELECTRIC AND DIESEL LOCOMOTIVES AND VEHICLES. SUMMARY OF TEST RESULTS AND VEHICLE DESIGN RECOMMENDATIONS
During the investigations and studies relating to the riding stability and guiding quality of tractive units, various data have been collected which have enabled constructional recommendations to be elaborated. These have been grouped together in such a way that it will be possible to choose, from among these recommendations, those which are apt to reduce the forces between wheel and rail to the greatest possible extent, while a good riding stability of the tractive unit is still ensured.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B10/RP 15/E, Oct. 1974, 59 pp, Figs., 25 Ref., 2 App.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC
DOTL RP

B4 052666
ADHESION OF LOCOMOTIVES FROM THE POINT OF VIEW OF THEIR CONSTRUCTION AND OPERATION. ADHESION TESTS OF AUTUMN 1972
The report describes the adhesion tests carried out during Autumn 1972 using the B 44 Test Machine 18 000 equipped for operation with a 25 kV, 50 Hz feeding locomotive. The tests were a continuation of those already described in RP 9 and RP 10 but 1400 mm driving wheels were fitted. New data was obtained using the measuring axle-boxes, and the traction forces transmitted by each of the two driving wheels were measured. As before, both manual and statistical evaluations have been made to obtain the greatest information from the recorded results.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B44/RP 11/E, Apr. 1975, 25 pp, Figs., Tabs., Phots., 3 App.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B4 052682
CONSTRUCTIONAL ARRANGEMENTS FOR IMPROVING THE RIDING STABILITY AND THE GUIDING QUALITY OF ELECTRIC AND DIESEL LOCOMOTIVES AND VEHICLES. COMPARISON OF THREE MEASURING METHODS FOR DETERMINING THE FORCES EXERTED BY THE WHEELS OF A MOTIVE POWER UNIT ON THE RAILS IN A CURVE OF 300M RADIUS (GIORNICO 1957)

In order to make a comparison between the measuring methods developed by the NS and the SJ for determining the forces occurring between wheel and rail, comparative tests were carried out on a curve of 300 m radius on the Gothardline in October 1957. For these tests the following measuring apparatuses were used: one measuring rail of the CFF; six measuring base plates of the NS; six measuring base plates of the SJ. For an initial series of tests, the measuring rail was laid on six adjacent sleepers fitted with the measuring base plates of the NS and, for a second series of tests, on six adjacent sleepers fitted with the measuring base plates of the SJ. The measuring rail was secured to the other sleepers by means of the usual CFF fastenings. The forces indicated by the CFF measuring rail on the one hand and by the NS measuring baseplates and the SJ measuring baseplates on the other hand, were determined at various speeds and compared with each other. Considerable differences were shown by the lateral forces determined in this way, by means of the measuring rail and the measuring baseplates of the NS and the measuring rail and the measuring baseplates of the Sj, respectively. Better agreement was displayed by the vertical forces, though, in this case, comparison was only possible between the measuring rail and the measuring baseplates of the NS (the measuring baseplates of the SJ not being designed for the measurement of the vertical forces). The considerable differences between the measured values were considered to have been caused chiefly by the mutual influence of the measuring rail and the measuring baseplates of the NS and the measuring rail and the measuring baseplate s of the SJ respectively, on each other. Since the test arrangement used at Giornico-measuring rail laid on measuring baseplates-did not prove satisfactory, it is suggested, when making comparative tests in the future, to have the three methods of rail measuring equipment arranged at adjacent sites on a curve. The relationship between the values supplied by the three measuring methods should be established with the aid of a fourth measuring method, e.g. by means of directly measuring on the wheel of the vehicle under test the forces exerted on the rails (as already developed by the SJ to a certain degree of perfection).

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B10/RP 4/E, Nov. 1960, 14 pp, Figs., Tabs., Apps.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B4 052683
CONSTRUCTIONAL ARRANGEMENTS FOR IMPROVING THE RIDING STABILITY AND THE GUIDING QUALITY OF ELECTRIC AND DIESEL LOCOMOTIVES AND VEHICLES. MEASUREMENTS OF THE FORCES EXERTED ON THE RAILS BY VARIOUS TYPES OF MOTIVE POWER UINTS (MEASURED IN A CURVE OF 300M RADIUS AT GIORNICO)

In 1955 the CFF decided to intitiate investigations in order to determine by means of experiments the extent of the wear to which the track would be subjected in a curve of 300 m radius by the then newly developed locomtive types of the series Ac 4/4 (BoBo) and Ae 6/6 (CoCo). The measuring rail working according to the Schlumpf system was used as measuring apparatus. The results of these measurements have shown that the modern bogie locomotives subject the track to less wear at the same speed (BoBo) or to hardly any heavier wear (CoCo) than the rigid frame locomotives of not so recent date. Following the tests which had been made at the suggestion of the Working Group "Measurements on the track" of the B 10 Specialists Committee, for the comparison between three different measuring methods (see B 10 RP 4), arose the possibility of repeating the tests made in 1955. The measuring rail was again used as measuring apparatus, as it had been done for the tests made in 1957, but the tests included a larger number of locomotive types and a considerable versine error was intentionally arranged in the test track. The tests made in 1957 have confirmed the fundamental results of 1955, moreover they have shown that 1) a transverse coupling between the bogies and 2) the lateral movement of the rubber cushioned leading axles of the CoCo locomotives considerably reduce the forces exerted on the track.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B10/RP 5/E, Nov. 1960, 18 pp, Figs., Apps.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC

DOTL RP

B4 056839
ON THE EFFECT OF TRACK IRREGULARITIES ON THE DYNAMIC RESPONSE OF RAILWAY VEHICLES

The steady state response for models of a six-axle locomotive running on a sinusoidally irregular track has been investigated. Two mathematical models have been set up, a full model for the stationary vehicle in which creep between wheels and rails was neglected, and a full model for the moving vehicle in which creep forces gravity stiffness effects and wheel tread profiles were considered. The use of the generalized method of complex algebra to obtain the steady state response of the railway vehicle components to varying input frequencies was used. The results given in this paper are for the case of sinusoidal lateral track irregularities only, but the method is general enough to allow also for vertical track irregularities. The analysis may be used to check the response of any proposed design for a railway vehicle to economically attractive track irregularities. It may also be used to adjust geometry, spring rates and damping characteristics in order to maximize operating speeds while providing optimum damping for the trucks and body motions.

Siddall, JN (McMaster University); Dokainish, MA Elmaraghy, W American Society of Mechanical Engineers Paper N73-WA/RT-1, Nov. 1973, 13 Ref

ACKNOWLEDGMENT: EI (EIX740304668)
PURCHASE FROM: ESL Repr PC, Microfilm

B4 072821
WHEEL AND RAIL LOADINGS FROM DIESEL LOCOMOTIVES

This presentation was prepared to review Electro-Motive Division's background, particularly regarding locomotives in the area of wheel-to-rail loadings as they affect maintenance, wear, and potential train derailments. This review is divided into the following six areas: sample derailment data; basic curve negotiation mechanics; experimentally determined wheel-to-rail forces; rail profile data; the effect of dynamic brake levels; and mechanical considerations.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration. The report was presented at the AREA Convention, Chicago, Illinois, 1971.

Koci, LF Marta, HA
General Motors Corporation 1971, 15 pp

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: ESL Repr. PC, Microfilm

B4 072846
THE EFFECT OF FORCES ON THE RAIL JOINTS, AND THE NOSE-SUSPENDED MOTOR DRIVES OF LOCOMOTIVES

With the help of an analogue computer, the author analyses the reciprocal effects in relation to the speed, the uneveness, and the resilience of the joints. It is concluded that there is close interdependence between the quality of the motor suspension and the reaction on the motor axle. [German]

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Handel, H *Deutsche Eisenbahntechnik* Jan. 1972, pp 31

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: VEB Verlag Technik Oranienburgerstrasse 13-14, 102 Berlin, East Germany Repr. PC

B4 084732
ON THE EFFECT OF TRACK IRREGULARITIES ON THE DYNAMIC RESPONSE OF RAILWAY VEHICLES

The steady state response for models of a six-axle locomotive running on a sinusoidally irregular track has been investigated. Two mathematical models have been set up, a full model for the "stationary" vehicle in which creep between wheels and rails was neglected, and a full model for the "moving" vehicle in which creep forces, gravity stiffness effects and wheel tread profiles were considered. The use of the generalized method of complex algebra to obtain the steady state response of the railway vehicule components to varying input frequencies was used. The results given in this paper are for the case of sinusoidal lateral track irregularities only, but the method is general enough to allow also for vertical track irregularities. For the "stationary" vehicle the input frequency is increased from zero to 3 cycles per second. For the "moving" vehicle the input frequency is a function of the track wave length and the vehicle forward speed and is given in terms of the vehicle speed. The frequency response curves are computer plotted in each case. For the "moving" vehicle, responses for the cases of both new and worn wheels are obtained. The natural frequencies for the full model are also calculated. The results obtained show the effect of the creep forces and the condition of the wheels on the steady state response. It is recommended that slip and corresponding creep forces, wheel tread and rail profiles, and the gravity stiffness effect be included in the steady state response analysis of railway vehicles to track irregularities.

Dokainish, MA Siddall, JN Elmaraghy, W (McMaster University) *ASME Transactions* Vol. 96 No. 4, Nov. 1974, pp 1147-58, 14 Fig., 13 Ref.

ACKNOWLEDGMENT: ASME Transactions
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B4 084946
THE "CREEP" OF LOCOMOTIVE DRIVING WHEELS (PART 1)

Creep, or the additional rotation of a wheel transmitting tractive force due to the elasticity of the tire and rail, is important in solving many riding and other problems and there appears to be some difficulty in its calculation because estimated values often do not agree with actual measurements. The author presents the problem in a simpler manner and a revised expression is obtained from which creep can be easily calculated.

See also RRIS 02 097274, RRIS Bulletin 7502.

Andrews, HI *Rail Engineering International* Vol. 5 No. 1, Jan. 1975, pp 8-10, Figs.

ACKNOWLEDGMENT: Rail Engineering International
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B4 095277
WHEEL/RAIL ADHESION-BOUNDARY LUBRICATION BY OILY FLUIDS

The observed variations in wheel/rail adhesion on dry rails are most readily associated with changes in the quantity of oil on the surface. Chemical changes have little influence in comparison. Ambient humidity has a noticeable effect such that significantly higher wheel/rail adhesion is encountered on most rails in dry air conditions.

Beagley, TM (Railway Technical Centre); McEwen, IJ Pritchard, C *Wear* Vol. 31 No. 1, Jan. 1975, pp 77-88, 10 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

B4 095656
AXLE-DRIVE DYNAMICS FOR HIGH RUNNING SPEEDS OF A DIESEL LOCOMOTIVE [La dynamique d'entrainement de l'essieu pour vitesses de marche elevees d'une locomotive Diesel]

A study of the vibratory movement of the drive system using seven coordinates to define vertical displacement, angular direction and inertia moments in relation to their balancing position. From an analysis of the specific example of a locomotive driven independently by an electric transmission it has been possible to reach the following conclusions: a tangentially flexible wheel reduces dynamic stresses by 40 percent over rigid transmission; the flexible suspension of the engine reduces the torque whilst improving the rate of adherence; for speeds between 10 and 200 km/h, the maximum axle discharge value is virtually constant. [French]

Zahradka, J *L'Industrie Lourde Tchecoslovaque* No. 11, 1973, pp 6-10, Figs.

ACKNOWLEDGMENT: International Railway Documentation, Selection of
PURCHASE FROM: L'Industrie Lourde Tchecoslovaque Prague, Czechoslovakia Repr. PC

B4 097274
THE "CREEP" OF LOCOMOTIVE DRIVING WHEELS (PART 2)

The first part of this article showed that there has been some misunderstanding about the value of creep obtained in a driving wheel exerting a tractive effort and a revised expression for this was obtained. In this second part, values so calculated are compared with values measured both in the laboratory and in service. While the estimated values of creep are confirmed, it is shown that there are certain other factors occuring in service which must also be taken into account.

See also RRIS 02 084946, RRIS Bulletin 7502.

Andrews, HI *Rail Engineering International* Vol. 5 No. 2, Feb. 1975, pp 45-49, 8 Fig.

PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B4 126416
WHEEL/RAIL ADHESION. THE INFLUENCE OF RAILHEAD DEBRIS

Evidence that rust is a major source of railhead debris, is presented. Particles are observed to spread on the wear band in wet weather and to be worn off in the dry. Laboratory experiments show that debris has little effect on friction except when mixed with an oil. Friction is then reduced depending on the quantity of oil and the surface area of the particles. A considerable proportion of oil is needed to reduce friction to its lowest value. Water can also substantially reduce friction on debris covered surfaces. A correlation is demonstrated between friction and humidity in which the friction coefficient is shown to be a simple function of the amount of water absorbed.

Beagley, TM (Railway Technical Center, England); McEwen, IJ Pritchard, C *Tavistock Institute of Human Relations* Vol. 33 No. 1, June 1976, pp 141-152

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

B4 127851
150TH ANNIVERSARY ISSUE

The Institutions of Mechanical, Civil, Electrical and Railway Signal Engineers conducted an International Engineering Conference in September 1975 to commemorate the 150th anniversary of passenger railway. This issue has editorical comment designed to complement the papers presented at the Conference. The contents of this issue are as follows: Modern track fastenings; Developments in Welding techniques for rolling stock; Modern dc traction motor design practice; Non-ferrous brake materials; Bridge reconstruction for overhead electrification; Ferrous fittings for overhead equipment; Roller bearings for railway rolling stock; Thyristor control of traction motors; Appraisal of tank car valves and their application; Australia's railways invest in passengers; Electric cables for signalling and track to train communications; Brake blending and wheelslide protection; High speed track recording coach; Ultrasonic rail flaw detection; Flexicoil suspensions; Prestressed concrete beams for bridges; Recent developments in plain bearings; Asynchronous motor drive for locomotives; Gangway connections between long carriages; Point heaters--progress in design; Batteries for railway applications; TOPS equipment; electrical carbon and the challenge of railways; Design and cost of containers; Railway roller bearings; Computer aided design in railway signalling; Adoption of AWAC catenery on BR, Powered doors for rail vehicles; Signal control desks.

Railway Engineering Journal Vol. 4 No. 5, Sept. 1975, 160 pp, Figs., Tabs., Phots.

PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B4 129187
HIGH-SPEED DYNAMICS OF DRIVING AXLES OF A DIESEL LOCOMOTIVE, ANALYSIS OF TRANSIENT VIBRATION IN LOCOMOTIVE AXLES [Dyanmika pohonu napravy pro vyssi iizdni

rychlosti motorove lokomotivy. Analysa nahodnych vibraci v pohonu napravy motorove lokomotivy]
The two articles analyse dynamic phenomena which appear when a diesel locomotive is running on an uneven track, and their effect on the axle movements. [Czechoslovakian]

Joradka, J *Technicke Zpravy CKD* No. 3, 1973, pp 44-53, 16 Fig.

ACKNOWLEDGMENT: International Union of Railways, BD
PURCHASE FROM: Technicke Zpravy CKD Praque, Czechoslovakia Repr. pC

B4 129274
DEVELOPMENT OF A FLANGE LUBRICATING DEVICE AND BRAKE-SHOE INSERTE GUIDED BY THE FLANGE FOR THE DIESEL LOCOMOTIVE BR120 [Die Entwicklung einer Spurkranzschmiereinrichtung sowie spurkranzgefuehrter bremssohlen fuer die Diesellok BR120]
Wear on the flanges of motive units running on winding lines can be reduced by using flange lubricating devices. However, instead of brake-shoe inserts to exert a braking force on the flange, inserts guided by the flange must be used. The authors describe the flange lubricating device and guided brake-shoe inserts for the diesel locomotive BR 120. These brake-shoe inserts guided by the flange do not affect the flange lubrication in any way.

Bolke, G *Schienenfahrzeuge* Vol. 14 No. 5, May 1975, pp 161-165, 6 Fig.

ACKNOWLEDGMENT: International Union of Railways, BD
PURCHASE FROM: VEB Verlag fuer Verkehrswesen Franzoesische Strasse 13-14, 108 Berlin, East Germany Repr. PC

B4 130814
PROBLEMS OF THE ADHESION COEFFIEIENT OF ELECTRIC LOCOMOTIVES [Problemy Koefficienta sceplenija elektrovozov]
The article examines:-the various adhesion coefficient concepts to be applied to these locomotives,-a method for determining the adhesion coefficient,-the tasks involved in making an objective evaluation of this coefficient, taking into account the running conditions of an electric locomotive when adhesion is at a maximum. In addition, details of the extent and methods for preparing a new method of determining the adhesion coefficient are given. A statistical study of wheel slipping must be made in order to establish a technically and economically optimal theoretical adhesion coefficient for electric locomotives in operation at present and for those which will be improved upon later, especially using electrical means for obtaining greater adhesion. This study is necessary because it takes into account all of the various aspects of adhesion. The study of wheel slip and the operation of the motor equipment of electric locomotives must be the basis for the creation of a method of controlling these locomotives by means of a constant command of adhesion. [Russian]

Golovatyj, AT Nekrasov, OA *Vestnik Vniizt* Vol. 34 No. 7, 1975, pp 1-5, 10 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Vestnik Vniizt Moscow, USSR Repr. PC

B4 132972
COMPARATIVE STUDY OF LOCOMOTIVE LATERAL STABILITY MODELS
In this paper a comparative study is made between present investigation of the 39 degree-of-freedom mathematical model and other simplified models. The results of the study of a typical six-axle locomotive obtained from the 39 DOF model are presented. The lateral stability is appraised, and the model includes the coupling between vertical and lateral motions. The merits and demerits of various models are discussed. A bibliography is included.

Proceedings of the 12th Annual Railroad Engineering Conference held at Pueblo, Colorado, October 23-24, 1975. The complete volume is RRIS 02 132958, Pricing is for the complete volume: Repr. PC $6.75, Microfiche$2.25, NTIS PB-252968/AS.

Garg, VK Mels, KD (General Motors Corporation)
Federal Railroad Administration FRA OR&D 76-243, Oct. 1975, pp 123-129, 5 Fig., 13 Ref.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS

DOTL NTIS, DOTL RP

B4 133574
FUNDAMENTAL STUDY ON IMPROVEMENT OF ADHESION
An increase or stabilization of adhesion under car or locomotive wheels by means of plasma or ionized gas jets has been studied. With any condition of the rail surface, the coefficient of adhesion does increase, but then decreases with the passage of time after the treatment. The increase of the adhesion coefficient is attributed to the cleaning action and to conversion of rust into ferric oxide particles which increases the adhesion just as sanding would. The metallurgy of the rail itself is unaffected.

Iwamoto, M Tomisawa, M Deguchi, S *Railway Technical Research Institute* Quart. Rpt Vol. 16 No. 4, Dec. 1975, pp 177-180, 8 Fig.

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Ken-yusha 1-45-6, Hikari-cho, Kokubunji, Tokyo, Japan

DOTL JC

B4 134594
INSTRUMENTATION TECHNIQUES FOR LOCOMOTIVE TESTING
With reference to the basic diagram for measuring operations: sensor or transducer coding transmitter recording receiver, the author describes the instrumentation used by Indian Railways to measure: tractive effort, speeds, distances, acceleration, time, ratings, output, torque, etc.

David, R *Indian Railway Technical Bulletin* Vol. 31 No. 194, Aug. 1974, pp 81-87

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Research Design and Standards Organization Alambagh, Lucknow 5, India

DOTL JC

B4 135166
WHEEL/RAIL ADHESION-THE OVERRIDING INFLUENCE OF WATER
Laboratory experiments are described which show how water reduces friction between rail and tire steel surfaces. Depending on the amount of oily containation, the friction coefficient is reduced to a value between 0.3 (no oil present) and the friction which is characteristic of an excess of the oil. Lower friction on oil-free surfaces is observed using laboratory machines which involve continuous rolling; water mixes with wear debris or surface rust to form a lubricating past, and friction coefficients as low as 0.05 result. The lowest friction occurs when the ratio of water to debris is small,and a viscous (non-Newtonian) paste is formed which is observed on the laboratory rigs for a few seconds wherever wetted surfaces are on the point of drying completely. Trains similarly encounter low adhesion in slightly wet conditions, most noticeably on little used lines where a substantial coverage of debris particles is present on the wear band.

Beagley, TM (British Railways Board); Pritchard, C *Wear* Vol. 35 No. 2, Dec. 1975, pp 299-313

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

B4 135169
ADHESION AND DYNAMIC PHENOMENA DURING SLIPPAGE OF ELECTRICAL ROLLING STOCK-3. SELF-EXCITED VIBRATION DURING SLIPPAGE OF ELECTRIC LOCOMOTIVE TRUCKS
When the driving axles of an electric locomotive slip, self-excited vibration will occasionally occur in its trucks. To suppress such self-excited vibration, detailed theoretical calculations of the vibrations during slippage of typical trucks were made and stability criteria were sought by simplifying the system. Theoretical expressions were derived for the vibrations during slippage of typical trucks, that is, individual quill spring drive type trucks, and individual axle-hung motor type trucks, and numerical calculations regarding actual examples were made. The calculated and observed results generally agree with each other, revealing that the behavior of trucks can be predicted through theoretical calculations. Stability criteria were sought for several problematical modes of vibration, that is, the torsional vibration of both individual and monomotor driving systems and the pitching of an axle-hung motor about the axle. The validity of the stability criteria was proved by comparing them with actual examples, and some instances of success in suppressing self-excited vibration were disclosed.

Hirotsu, T (Hitachi Research Laboratory); Ishida, S *JSME Bulletin* Vol. 18 No. 125, Nov. 1975, pp 1236-45, 3 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Mircofilm

B5 032182
FIRE HAZARD CLASSIFICATION OF CHEMICAL VAPORS RELATIVE TO EXPLOSION-PROOF ELECTRICAL EQUIPMENT–REPORT II
At the request of the U.S. Coast Guard, a detailed study has been made by the Electrical Hazards Panel of the Committee on Hazardous Materials to determine the feasibility of classifying some 200 chemicals of commerce according to the classifications given in the National Electric Code, NEC 500, by using a scheme based entirely on available physical and flammability properties only. This is the second progress report submitted by the Committee to the U.S. Coast Guard.

Committee on Hazardous Materials Oct. 1971, 27pp

ACKNOWLEDGMENT: Committee on Hazardous Materials
PURCHASE FROM: Committee on Hazardous Materials 2101 Constitution Avenue, NW, Washington, D.C., 20418 Repr PC

B5 033240
TANK CAR DESIGN SURVEY SULFURIC ACID
Collection of specifications from GATX-General American Transportation Corporation which lists the details of 9 tank cars. Lists the type trucks, brake types, bearings, and the unique qualities of the tank proper, dome, heads, top plate, shell, bottom plate, reinforcements. The type of manway, safety/vent, and discharge pipe are also included. The side and end view of each car is also illustrated with dimensions given.

Design Survey Feb. 1966, 32pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-186)
DOTL RP

B5 033241
TANK CAR DESIGN SURVEY SULFURIC ACID. SUPPLEMENT 1
Supplement of Tank Car Survey, which is a comparison between the ICC-103A-W and the ICC-111A100-W-2 tank cars of GATX. Included front and side views of the two cars, and various details of their construction. Finally, a questionnaire for customer preferences in the two cars is included.

Design Survey Supplement Vol. 6 No. 1, Feb. 1966, 8pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-187)
DOTL RP

B5 033242
TANK CAR DESIGN SURVEY. SULFURIC ACID. SUPPLEMENT 2
Details of 4 different tank cars which are designed for sulphuric acid transport. Lists the specifications of these four different cars and the unique qualities of each car.

Design Survey Supplement No. 2, Mar. 1967, 11pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-188)
DOTL RP

B5 033251
RECOMMENDED DESIGN LIQUID TEMPERATURES WITH SUMMER AND WINTER FILLING DENSITIES FOR TANK CARS IN ANHYDROUS AMMONIA AND LP-GAS SERVICE
Phillips Petroleum Company issued a report recommending new filling densities for tank cars in anhydrous ammonia and LP-Gas service. Two conclusions drawn from the test data and study were: Light liquids with low specific heats would reach higher temperatures in insulated tank cars than in uninsulated tank cars; heavy liquids with high specific heats would reach higher temperatures in uninsulated tank cars than in insulated tank cars. In comparing data, it was learned that the apparent phenomenon was caused by reflected radiation on the ambient temperature thermocouple at the test site. This radiation was enough to cause the test site ambient temperatures to occasionally read higher than they otherwise would have. Amended recommendations for summer operations are contained in this report.

Baird, DS (Phillips Petroleum Company)
Phillips Petroleum Company EDR-410, Nov. 1962, 24pp, 7 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-199)
DOTL RP

B5 033286
TANK CARS IN THE NEWS
Report on a speech concerning effective rail car utilization and applications to the 4 wheel, 125 ton car. Lists the objectives to the same car which are; light rail, rail wear, and bridges and trestles. Proposes several alternatives to the problem of meeting the railroad costs by increasing the payload of each car.

Traffic World

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-238)
DOTL RP

B5 033287
PROCEEDINGS OF SEMINAR ON RAIL CAR UTILIZATION
It was the purpose of this seminar to explore the newest techniques in rail car and systems design along with railroad programs which provide the greatest degree of rapid recovery of use of rail cars. The effective adaptation of almost instantaneous data retrieval is one method explored as a means of more fully utilizing available rail car capacities. Other means included more efficient use of railcars while in the hands of shippers, reduced warehousing use of existing cars and better designed cars and systems. All of these methods were discussed in this seminar with the hope that it would provide all interested in reduced distribution costs with a greater knowledge of the latest tools available to move the goods of commerce faster and more efficiently. Specific presentations included: Planning for Improved Rail Fleet Utilization; Designing for Improved Car Utilization; Inventory Control of Rail Equipment; and use of a Computer Based Information System to Reduce Total Distribution Costs.
Seminar Proceedings.

Bonham, FS (Monsanto Company); Phillips, EA (Union Tank Car Company); Sulik, LR (Dow Chemical Company)
Manufacturing Chemists Association Nov. 1967, 66pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-239)
DOTL RP

B5 037107
RAILROAD ACCIDENT REPORT. DERAILMENT OF TOLEDO, PEORIA AND WESTERN RAILROAD COMPANY'S TRAIN NO. 20 WITH RESULTANT FIRE AND TANK CAR RUPTURES, CRESCENT CITY, ILLINOIS, JUNE 21, 1970
Train No. 20, an eastbound freight train of the Toledo, Peoria and Western Railroad Company, consisting of a four-unit diesel-electric locomotive and 109 cars derailed the 20th to the 34th cars, inclusive, at the west switch of the siding in Crescent City, Illinois, at about 6:30 a.m. on June 21, 1970. Included in the 15 derailed cars were nine tank cars loaded with liquefied petroleum gas. During the derailment one of the tank cars was punctured, and the leaking propane was immediately ignited, engulfing the other tank cars in the fire. A series of explosions of the remaining tank cars occurred, beginning about 1 hour following the derailment, resulting in the injury of 66 persons and the destruction of a number of buildings within the town of Crescent City. The National Transportation Safety Board determines that the probable cause of this accident was the breaking of the L-4 journal of CB and O 182544, the 20th car, due to excessive overheating, which permitted the truck side to drop to the track and derail the leading wheels of the car. The cause of the overheating could not be determined. (Author)
Railroad Accident Report

National Transportation Safety Board NTSB-RAR-72-2, Mar. 1972, 47p

ACKNOWLEDGMENT: NTIS (PB-210614)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-210614, DOTL NTIS

B5 037242
DERAILMENT AND COLLISION AT HENWICK HALL
This accident report describes the derailment of a freight train and consequent collision with a passenger train on October 28, 1964, near Henwich Hall, England. It was concluded that the basic cause of the accident was the condition of some of the privately-owned tank cars in the train, the events leading up to the derailment being initiated by the failure of a rear coupling at a fault in the weld. Both crowns of this link had been severely reduced by wear, and the quality of the iron was inferior to that specified. The derailment itself occurred due to excessive difference in face

camber in four bearing springs and excessive wear on the locating lugs in all four brass bearings in the axleboxes on one wagon.

Railway Gazette Vol. 121 Dec. 1965, p 963

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-938)
DOTL RP

B5 037472
SYNTHETIC MATERIALS AND GLUED CONNECTIONS FOR RAILWAY ROLLING STOCK
Fiberglass reinforced resin composites are desirable over metal structural components because of light weight, high elasticity, corrosion resistance, and high acoustic, electric and thermal insulation capacities. Principal applications of synthetic materials for large components are discussed and include: end walls, framework and roof parts for locomotives; sliding doors and roofing for freight cars; vehicle bodies for refrigerator vans; and tanks for tank cars.

Question B68. Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Comm Rpt ORE No. 26, Jan. 1968, pp 23-24, 1 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-666)
DOTL RP

B5 037715
THE 125-TON FOUR-WHEEL TRUCK
The designing and building of large and more efficient tank cars requires analysis of the car cost in relation to gallonage capacity and maintenance requirements. The author offers some observations that have been made to date in progressing tank car design from the 100-ton capacity truck to the use of the four-wheel 125-ton truck and the six-wheel 150-ton truck with particular emphasis on cost and maintenance problems.

Moyes, SH (General American Transportation Corporation) *Engineering Interchange for Railroad Advancement* Tech Proc Sept. 1965, pp 17-22, 5 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-716)
DOTL RP

B5 037779
TANK WAGON FIRE AT CRICH JUNCTION
The train consisted of ten 100-ton Class A tank wagons loaded with light distillate feed stock with an empty coal wagon as a barrier at each end, drawn by a Class 48 diesel locomotive. The cause of the fire was brake block sparks during braking that ignited vaporized oil spilt from unsecured hatches. The subsequent heavy braking by the driver after he first saw the wagons on fire caused more oil to spill and so increased the extent of the fire. Out-of-place hatch lids may have been the prime cause of spillage rather than oversight in fastening. It is now the rule that hatches shall be secured after loading before the wagons are moved forward, as well as an independent inspection after securing before despatch.

Railway Gazette Vol. 126 Jan. 1970, p 37

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-794)
DOTL RP

B5 037801
TANK WAGONS THAT SURVIVE DERAILMENT
The conclusion of a U.S. Department of Transportation study to reduce the hazards of tank car transportation is cited. A primary hazard of tank cars undamaged during derailment is explosion caused by extreme heat from burning cars in the accident. The pressure relief valves now in service are incapable of discharging the contents sufficiently fast to prevent explosion. A secondary pressure-relief device of substantial capacity such as a rupture disc is recommended for all but highly toxic materials.

Railway Gazette Aug. 1971, p 290

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-842)
DOTL RP

B5 037838
DERAILMENT AT ROTHWELL HAIGH
Derailment of a train comprising three empty six-wheel milk tank wagons marshalled next to the 2,500 hp Type 4 diesel-electric locomotive, and eight passenger coaches two of which were sleeping cars is described. It was travelling at about 60 mile/h. The rolling of the leading tank wagon as it approached Rothwell Haigh may have synchronized with the natural slight impact of the first common crossing, and its pattern could have matched the reversals in cant through the obtuse crossings, thus accentuating the roll. The tendency under the influence of the roll would be to lift and the falling cant gradient of the crossing was 1 in 93 for about 3 feet, it did so lift coming down on its next roll on the head of the rail at the point of derailment.

Railway Gazette Vol. 122 Aug. 1966, p 627

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-922)
DOTL RP

B5 037847
GLASS-FIBRE TANK WAGON
This tank car was designed for the transport of up to 3,960 gal. of chemicals. It has a welded frame, automatic couplings, rubber springs, and is fitted with air brakes and a screw brake.

Railway Gazette Vol. 19 Nov. 1963, p 607, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-958)
DOTL RP

B5 039249
HAZARDOUS MATERIAL TANK CARS-TANK HEAD PROTECTIVE 'SHIELD' OR 'BUMPER' DESIGN
The objective of the study program is to design a railroad tank car head protective device which will reduce the frequency of head punctures in accidents. Accident data were reviewed in detail for the years 1965 through 1970 to correlate head damage frequency and severity with various types of tank cars, to determine distribution patterns of damage over tank car head surfaces, and to assess the costs to the railroad shipping industry of head punctures. Full scale head impact tests, previously run were also reviewed. From these two reviews, design criteria were established and used to reduce an initial compilation of 74 concepts to a group of 15, which when applied to various classes of cars, comprised a semi-final total of 42 combinations, or schemes, as referred to in this report. Designs for these 42 schemes were then detailed and cost estimated. Next, a comprehensive cost/benefit analysis was applied. Three schemes appear attractive for the non-insulated pressure cars of the DOT 112A or 114A type. A recommended test program is outlined, and a preliminary estimate of its cost is given. (Author)

Everett, JE Phillips, EA
Association of American Railroads Final Rpt Aug. 1971, 187 pp

Contract DOT-FR-00035

ACKNOWLEDGMENT: NTIS (PB-202624)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-202624, DOTL NTIS

B5 039269
A STUDY TO REDUCE THE HAZARDS OF TANK CAR TRANSPORTATION
The report details the findings of a 4-month study contract directed at reducing the hazards of tank car transportation. A number of shortcomings with existing safety-relief specifications were indicated. A key finding was that the controlling condition in sizing for propane relief should be the liquid feed, or 'upset' car condition, and not vapor feed per the current criterion. The net result is a significant undersizing of relief area considering the existing heat flux criterion to be accurate. Analytical studies and review of test data indicate the existing heat flux criterion to be significantly low--further increasing the possibilities of overpressure. A staged safety relief system was recommended for cars with liquefied compressed gas ladings. The primary relief element would be a pressure-maintaining system sized for handling abnormal operating conditions other than severe fire exposure. The secondary relief system would be a 'dump' type to drop system pressures to levels preventing catastrophic rupture and 'rocketing' under severe fire exposure conditions. Both model and full scale test programs are recommended. (Author)

Bullerdiek, WA Vassallo, FA Adams, DE Matheis, CW
Cornell Aeronautical Laboratory Final Rpt Nov. 1970, 177 pp

Contract DOT-FR-00028

ACKNOWLEDGMENT: NTIS (PB-199154)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-199154, DOTL NTIS

B5 039472
CAST-STEEL BOGIES FOR GOODS VEHICLES
Accurate bolster guides and a locking device on axlebox lids are features of a cast-steel spring plankless bogie with integral axleboxes and brake suspension brackets to the side frame. This design has been fitted to tank wagons with a 12-1/2-ton axle load, and 10 in. x 5 in. journals.

Railway Gazette Vol. 94 Mar. 1951, p 269, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-804)
DOTL RP

B5 039485
DERAILMENT AT CHIPPING SODBURY
On September 20, 1966, the train consisting of 46 empty six-wheel milk tank wagons and two bogie brake vans, and travelling along the down main line at a speed well above the maximum of 50 mile/h allowed for empty milk tanks derailed when the trailing wheels under the 30th tank wagon became derailed. The train ran on for 1-1/2 miles to Chipping Sodbury Station where the derailed wheels struck the connection just short of the platform, causing the rear section of the train to become detached and derailed. Calculations suggested that the train speed was 60 to 65 mile/h when the brakes were applied. The cause of this derailment was excess of speed. The milk tank left the rails because of its inherent instability at speeds above its limit rather than any specific fault in the milk tank itself or any serious imperfection in the track.

Railway Gazette Vol. 124 Jan. 1968, p 73

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-829)
DOTL RP

B5 039487
WELDED ALUMINUM ALLOY BOGIE
A prototype unit with a one-piece frame and axleboxes fabricated from aluminum alloys has been on trial in Switzerland. Use of the alloys in construction has resulted in a weight saving of about 20 percent over the equivalent steel bogie. Experience in service, mounted under a tank wagon on the metregauge line where conditions are more severe than encountered on standard-gauge main lines, with sharper curves and steep gradients has resulted in no operating problems.

Railway Gazette International Oct. 1970, p 755, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-831)
DOTL RP

B5 039623
ALL WELDED RAILWAY TANK WAGONS
Some time ago the Swedish firm commenced building all-welded tank wagons differing considerably in design and construction from the usual type. The Olsson wagon has no separate underframe but instead, at each end, a fixed two-wheel frame welded to the tank, and consisting of bearing forks, buffer beam, draw box, and cross bars. These end parts carry buffer, draw gear, spring suspension, brake mechanism, and so forth. The tank is strong enough by itself to support the load, and also to withstand all drawgear and buffer forces.

Railway Gazette Vol. 78 Apr. 1943, pp 360-361, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1279)
DOTL RP

B5 039686
LARGE BOGIE TANK WAGONS
Bogie tank wagons of standard-gauge design with a welded light-alloy tank of 3,500 cu. ft. capacity for gas transport have been completed recently. The tank is 3.0 m dia. by 15.0 m overall length. It is welded from an alloy steel, 60/72 kg per sq. mm (38/45 tons per sq. per sq. mm (29 tons per sq. in.). Discharge of the contents is through a quick-acting valve supplemented by an outside shut-off valve.

Railway Gazette Vol. 113 Dec. 1960, p 709, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1404)
DOTL RP

B5 039814
HAZARDOUS MATERIALS TRANSPORTATION INTRUSION PROTECTION FOR HAZARDOUS CARGO TANKS
Tanker population data was collected along with data resulting from accidents involving over-the-road tank carriers of flammable liquids. This data was evaluated and analyzed with respect to the incidence of lateral piercing or intrusion. Significant results include the total number of tank trucks in the country including combinations, the number of tank combinations meeting flammable liquid specifications and the percent of these reporting to DOT, the finding the lateral intrusion is not a significant problem, but that fire on tankers is a significant problem, and the finding that onboard fire supressing system are feasible and desirable.

Krasner, LM Wiener, SA Buckley, JL
Factory Mutual Research Corporation Final Rpt June 1971, 42 pp

Contract DOT-FH-11-7269

ACKNOWLEDGMENT: NTIS (PB-207374)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-207374, DOTL NTIS

B5 039855
PROCEEDINGS OF THE CONFERENCE ON HAZARD EVALUATION AND RISK ANALYSIS HELD IN HOUSTON, TEXAS ON 18-19 AUGUST 1971
The report presents papers on a symposia concerning the transportation of hazardous materials by water. The papers primarily discuss hazard evaluation and risk analysis as they relate to hazardous materials in transport.

National Research Council, (CG-11775-A) Aug. 1971, 169p

Contract DOT-OS-00035

ACKNOWLEDGMENT: NTIS (AD-736942)
PURCHASE FROM: NTIS Repr PC, Microfiche
AD-736942, DOTL NTIS

B5 039884
A STUDY OF HAZARDOUS MATERIALS INFORMATION NEEDS AND IDENTIFICATION SYSTEMS FOR TRANSPORTATION PURPOSES
Information needs and methods to transmit that information are analyzed to determine the basic requirements of a hazard identification system for packages containing, and vehicles carrying, hazardous materials. Persons who come in contact with hazardous materials shipments are identified and a typology is developed. Information needs by type, amount, and timing are listed by category, and sixteen existing labeling systems are evaluated according to these and human factors criteria. Another dimension of users considered is transportation mode and job function of personnel. Conclusions and recommendations based on this analysis are discussed.

Rath, GJ Bottoms, AM Hagerty, D Morin, D Money, WH
Northwestern University, Evanston DDC-72-4, May 1972, 183p

Contract DOT-OS-10042

ACKNOWLEDGMENT: NTIS (PB-210143)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-210143, DOTL NTIS

B5 039909
CAR USER INPUT
The presentation is concerned with the approach by DuPont as a shipper. The consideration by the shipper in the selection and design of freight cars is discussed and may be summarized by considering: the lowest physical distribution cost combined with safety; low designs must take into account restrictions in car movement which would result in higher costs; and the

designs must consider the future not restricted by old conditions and practices. The mix of railway cars in the DuPont fleet is described.
Proceedings of 1968 Railroad Engineering Conference.

Hansen, EG (Du Pont de Nemours, EI, and Company) *Car Design Inputs* Proceeding Sept. 1968, pp 7-12, 13 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1015)
DOTL RP

B5 040003
ALUMINUM IN ROLLING STOCK: THE VALUE OF RESEARCH AND DEVELOPMENT
In Canada, aluminum is considered standard for box cars roofs, the inside lining of refrigerator cars, brine tanks, hopper cars for bauxite and alumina, hopper car hatch covers, piggy-back trailers and passenger car furnishings. The properties of aluminum which make it ideal for use in rolling stock are good strength and impact resistance, light weight, excellent corrosion resistance and good fabricating characteristics. Service experience and impact tests, which were more rigorous than conditions encountered normally, have shown that all-welded aluminum hopper cars are strong and rugged enough to withstand such severe treatment. Impact and fatigue test results are reported for several types of aluminum cars. The lightness of aluminum cars mean that fewer of these cars are required to transport a given cargo. The excellent resistance of aluminum to the weather and corrosive cargoes means that annual maintenance costs can be lowered appreciably. The life of the aluminum cars will be governed by failure due to mechanical causes rather than corrosion and even after their normal service life they will have a high scrap value.

Campbell, RA Whiting, JF Kemp, RA (Aluminum Laboratories, Limited)
Aluminum Company of Canada, Limited Tech Rpt Nov. 1957, 36 pp, 8 Fig, 1 Tab, 12 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1486)
DOTL RP

B5 040023
STRENGTH OF A HORIZONTAL RESERVOIR SUPPORTED PARTIALLY BY EQUIDISTANT SADDLES
This theory could be considered in the designs of railway tank cars, especially those of the "jumbo" size. In a horizontal reservoir, partially supported by saddles, great stresses arise near the supports, and the magnitude of these stresses is closely related with the form of the saddle supports. The strength is discussed of such a reservoir and its relationship to the form of the saddle supports, utilizing the fundamental differential equation of cylindrical shells, and the importance of the form of the saddle supports is pointed out. To decrease the magnitude of the stresses arising near the supports, research on the optimum form of the saddle supports was made. The deformation of such a reservoir was very large.

Mizoguchi, K Hatsuda, T (Osaka University, Japan) *JSME Bulletin* Vol. 14 N No. 4, Aug. 1971, p 745, 12 Fig, 1 Tab, 7 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1506)
DOTL RP

B5 040118
THE TORSIONALLY STIFF BOGIE WAGON
Torsional stiffness is an important factor bearing on the ability of vehicles to run over twisted track. Results of British Railways tests of tank cars with tare of 26 to 28 tons and 41.75 ft. truck centers are described. Track twist varied from 1 in 400 to 1 in 150. The design limitations for wheel load is calculated. Suspension changes to eliminated derailment tendencies are discussed.

Koffman, JL (British Railways Board) *Railway Gazette* Vol. 123 Aug. 1967, pp 629-632, 4 Fig, 2 Phot, 6 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1614)
DOTL RP

B5 040357
ANALYSIS OF HOT BOX DATA SUBMITTED BY FOURTEEN MEMBER ROADS
The result of this study of 2,161 hot boxes' data indicates that hot boxes occur less frequency on spring plankless trucks. However the cars with spring plankless trucks are newer cars, a fact which should be given weight in any conclusions reached. The ratio of ownership of spring plank trucks to spring plankless trucks is 2,48 to 1.0 but the ratio of hot boxes on spring plank trucks to spring plankless trucks is 3.45 to 1.0. It was concluded that the major causes of hot boxes (71.16%) are derived from the conventional waste pack. Elimination of this waste pack by substituting an improved method or material to provide the lubrication would eliminate many hot boxes. Periodic repacking, and the associated attention to the box assembly at that time does not reduce the frequency of hot boxes during the immediately following months, as might be expected. The higher capacity cars run hot less frequently than the lower capacity cars, but the higher capacity cars are generally more modern. The number of hot boxes caused by bearing defects indicates need for improvement of bearing design and box assembly. Tank and refreigerator car performance is less satisfactory than the average of all other types.

Association of American Railroads Res Rpt AAR MR-210, Dec. 1953, 2 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1801)
DOTL RP

B5 040395
REPORT ON A STUDY OF METAL SPECIMENS REMOVED FROM TANK CAR TANKS INVOLVED IN A DERAILMENT AND EXPLOSIONS AT LAUREL, MISSISSIPPI
On January 25, 1969, Southern Railway freight train 154, derailed at Laurel, Mississippi as a result of a broken wheel on the leading truck of the 62nd car a non-insulated, non-continuous centersill tank car transporting liquified petroleum gas. Fifteen tank cars of similar design and containing LPG were involved in an ensuing general derailment. Thirteen of the cars ruptured at various time intervals following the derailment resulting in ignition of contents and a general fire. General elements of this study were as follows: specimens were selected to determine if the tank steels met the minimum requirements; tests to determine the brittle and ductile characteristics of the steels involved; studies of the tensile properties of tank steels at elevated temperatures; studies of welds and weld quality; and, metallographic analyses. All data is tabulated. Temperature-impact energy transition curves for the Charpy tests are shown. It appears that tank steel toughness requirements at low temperatures should be incorporated in appropriate steel specifications for the cars involved. Research should be immediately progressed to determine performance characteristics of current designs of pressurized tanks exposed to high thermal inputs, both general and localized and to temperature gradients produced in the tank shell when exposed to high localized temperatures.

Byrne, R
Association of American Railroads Test Rpt MR-453, July 1969, 90 pp, 25 Fig, 13 Tab, 50 Phot, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1858)
DOTL RP

B5 040397
REPORT ON A STUDY OF TANK CARS INVOLVED IN A COLLISION AT CRETE, NEBRASKA
On February 18, 1969, a Chicago, Burlington & Quincy eastbound freight train derailed cars and freight cars standing on an adjacent double-end siding. The group of standing cars included three tank cars loaded with anhydrous ammonia. The center car of this standing group of tank cars was a stub-sill, non-insulated tank with a nominal capacity of 33,500 gal. In the collision, the tank ruptured, permitting contents to escape. Temperature-impact energy transition curves from the Charpy tests are shown. The fracture of the Crete tank car was almost entirely of a brittle nature. The metallurgical processing of the tank led to a microstructure conducive to low toughness and a high NDTT.

Byrne, R
Association of American Railroads Technical Center Test Rpt MR-454, July 1969, 83 pp, 15 Fig, 10 Tab, 37 Phot, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1860)
DOTL RP

B5 040505
TANK WAGONS FOR OVERSEA RAILWAYS
Railways served by British designed cars vary in gauge between 2.5 ft. and 5.5 ft. and some maintain single line traffic in tropical or sub-tropical climates. Designing to compensate for environment changes are discussed. Truck, tank, underframe, and fittings designed are illustrated and described for African railways.

Barrow, TAW Smith, AD *Institution of Locomotive Engineers Journal* Vol. 55 No. 303, Part 1, pp 60-128, 20 Fig, 24 Phot, 4 Ref, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1992)
DOTL RP

B5 040615
FIRE PROTECTION OF RAILROAD TANK CARS CARRYING HAZARDOUS MATERIALS-ANALYTICAL CALCULATIONS AND LABORATORY SCREENING OF THERMAL INSULATION CANDIDATES
In recent years there have been a number of incidents in which railroad tank cars carrying liquefied petroleum gas (LPG) have been engulfed in fires. The LPG cars have ruptured from the fires, causing extensive property damage and loss of life. This report describes a laboratory screening program to select two thermal insulation candidates for use in future fire tests of fifth-scale and full scale LPG tank cars. Also included are analytical calculations to predict pressures and liquid levels in LPG tank cars being heated by fires. (Author)

Levine, D Dancer, DM
Naval Ordnance Laboratory, (NOL-541/FRA-X01) NOLTR-72-142, July 1972, 59 pp

ACKNOWLEDGMENT: NTIS (AD-747974)
PURCHASE FROM: NTIS Repr PC, Microfiche
AD-747974, DOTL NTIS

B5 041156
1972 SPECIFICATIONS FOR TANK CARS
Numerous additions and revisions keeping this publication current with AAR and DOT requirements has necessitated a complete reprinting. There are revisions in safety relief flow rating requirements and approvals, a new list of certified facilities for tank fabrication and repair, an index of special commodity requirements, and a new section giving tank car definitions. Many of the appendixes have been completely rewritten.

Notice of this publication was given in Volume 146, No. 11 of "Railway Locomotives and Cars", dated December 1972.

Association of American Railroads

ACKNOWLEDGMENT: Railway Locomotives and Cars
PURCHASE FROM: AAR Repr PC

B5 041227
PRICE LIST OF PUBLICATIONS ISSUED BY TIME ASSOCIATION OF AMERICAN RAILROADS
The main headings are: Operations and Maintenance Department; Research and Test Department; Management Systems Department; Economics and Finance Department.

Association of American Railroads Jan. 1972, 61 pp

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AAR Repr PC

B5 041310
STUDY TO REDUCE HAZARDS OF TANK CAR TRANSPORTATION
This 172-page report of a four-month study undertaken for the Federal Railroad Administration by Cornell Aeronautical Laboratory defines the rate of generation of vapors of hazardous materials in tank cars and then attempts to develop the performance of safety devices which might prevent catastrophic explosions. It was found that safety devices should function to release liquids, as well as vapors, from upset tank cars. Staged safety relief devices were recommended with a secondary arrangement to dump ladings when primary devices were no longer adequate.

This report was announced in Railway Locomotives and Cars, V145, N9, September 1971.

Bullerdiek, WA Vassallo, FA Adams, DE Matheis, CW
National Technical Information Service 172 pp

ACKNOWLEDGMENT: Railway Locomotives and Cars
PURCHASE FROM: NTIS Repr PC
DOTL NTIS

B5 041770
TRANSPORTATION OF LIQUEFIED NATURAL GAS BY RAIL AND BY HIGHWAY [TRANSPORT DE GAZNATURAL LIQUEFIE PAR RAIL ET PAR ROUTE]
The design and fabrication of two transport vehicles for liquefied natural gas is described. One is a railroad tank car and the other is a highway tractor-trailer. In addition to an introductory history and some administrative detail, the design limitations, safety regulations, material specifications, and similar design considerations are discussed. Both carriers utilize an inner tank of 5% nickel austenitic stainless steel which is designed for 95% liquid content and 5% ullage. The outer tank is common boiler plate. The annular space (220-250-mm thick) contains insulation, perlite for the trailer and hostaflon for the railroad car. The inner tank is attached to the outer longitudinally by tension-compression tie-rods with ball-and-socket joints at both ends. It is supported transversely by a bottom rail and lateral elastic pads. This complex support system is designed to minimize thermal stresses in and loading thermal shock to the internal tank. [French]

This article was also published by Erdoel-Erdgas- Zeitschriff, V83, N12, pp 430-435 in Dec. 1967 issue.

Stahl, G *Gaz D'Aujourd'hui* Vol. 92 No. 9, Sept. 1968, pp 319-324

ACKNOWLEDGMENT: Air Pollution Technical Information Center (19887)
PURCHASE FROM: Industries du Gaz 120 F. 62 rue de Courcelles, Paris (8e), France Repr PC

B5 041781
CHICAGO, BURLINGTON, AND QUINCY RAILROAD COMPANY TRAIN 64 AND TRAIN 824 DERAILMENT AND COLLISION WITH TANK CAR EXPLOSION, CRETE, NEBRASKA, FEBRUARY 18, 1969
A train accident is reported in which one consequence was the complete fracture of a tank car and release of its load of 29,200 gallons of anhydrous ammonia into the atmosphere. A gas cloud was formed which blanketed the surrounding area for a considerable time because of prevailing weather conditions. All persons directly exposed to the cloud of ammonia gas received either fatal (six people) or serious (53 people) chemical injury to the respiratory tract; people within the area of the gas concentration who remained in their homes or who had adequate protection escaped with little or no injury. The cases of the complete failure of the tank car following derailment were heavy impact with another car and the brittleness of the tank car steel at the ambient temperature of four F. More than 11,000 tank cars of this type are in service, most carrying liquefied petroleum gas. In low-temperature conditions, the consequences of accidents involving some large LPG cars are most likely to be catastrophic than in warm weather. The failure to thoroughly test tank cars for such hazards as flammability and brittleness before they are put in service is both false economy and an injustice to persons living along the tracks. Thorough study of tank car materials and of methods for rapid dispersion or absorption of clouds of toxic vapors is recommended.

National Transportation Safety Board RR Acc Rpt NTSB-RAR-71-2, Feb. 1971, 82 pp

ACKNOWLEDGMENT: Air Pollution Technical Information Center (34825)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-198790, DOTL NTIS

B5 041820
TRANSPORTATION AND STORAGE OF LNG
A detailed consideration of the various techniques available for building LNG storage tanks and ships. Factors considered are safety, durability, and low operation cost.

Gondouin, M Murat, F (American Technigaz, Incorporated) *Chemical Engineering Progress* Vol. 68 No. 9, Sept. 1972, pp 71-76

ACKNOWLEDGMENT: United States Merchant Marine Academy (N-532)
PURCHASE FROM: American Institute of Chemical Engineers 345 East 47th Street, New York, New York, 10017 Repr PC
DOTL JC

B5 043676
CONFERENCE PROCEEDINGS ON LNG (LIQUEFIED NATURAL GAS) IMPORTATION AND TERMINAL SAFETY HELD IN BOSTON, MASSACHUSETTS ON 13-14 JUNE 1972
The purpose of a two-day conference held in Boston in June 1972 was to review the current state of knowledge of LNG safety. The proceedings provide a useful reference for persons concerned with technical aspects of transporting LNG. (Author)

Fawcett, HH Basiliko, ML Jacobs, RC
National Academy of Sciences, (CG-733211) June 1972, 299 pp

Contract DOT-OS-00035

ACKNOWLEDGMENT: NTIS (AD-754326)
PURCHASE FROM: NTIS Repr PC, Microfiche
AD-754326, DOTL NTIS

B5 043788
PROCEEDINGS: CONFERENCE ON HAZARDOUS CARGOES (7TH) HELD AT THE U. S. COAST GUARD ACADEMY, NEW LONDON, CONNECTICUT ON 8-9 JULY 1970
The report presents articles given at the symposium on chemical reactions and hazard information control systems as they relate to hazardous materials in transport. (Author)

Fawcett, HH
National Academy of Sciences, (CG-713211) Aug. 1970, 259 pp

Contract DOT-OS-00035

ACKNOWLEDGMENT: NTIS (AD-754891)
PURCHASE FROM: NTIS Repr PC, Microfiche
AD-754891, DOTL NTIS

B5 043791
RECLASSIFICATION OF MATERIALS LISTED AS TRANSPORTATION HEALTH HAZARDS
The study consisted of three phases. Phase I--An extensive literature search was conducted for pertinent human and acute animal toxicity data for about 200 materials, classed as Poison A, B, or C in the Commodity List, Section 172.5, Title 49 CFR, and/or as Toxic (Class 6.1) in the Subsidiary Risk Category in the United Nations publication, Volume I, Transportation of Dangerous Good, 1966. Materials were classified according to the proposed classification criteria. Phase II--Inhalation (LC50) toxicity tests were run on mice and rats for five materials and oral toxicity (LD50) tests were run on mice and rats for 40 other materials. The phosphine evolution rate for aluminum phosphide in air (55% relative humidity) and in water were determined. The results were summarized and the materials classified. Phase III--Verification inhalation toxicity (LC50) tests were run on mice and rats exposed to chlorine, anhydrous ammonia and hydrogen sulfide. Results were included and reflected in the classification of these materials.

Back, KC Thomas, AA MacEwen, JD
Aerospace Medical Research Laboratory Final Rpt Aug. 1972, 347 pp

Contract DOT-AS-10028

ACKNOWLEDGMENT: NTIS (PB-214270/1)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-214270/1, DOTL NTIS

B5 044001
STUDY OF HAZARDOUS MATERIALS INFORMATION NEEDS AND IDENTIFICATION SYSTEMS FOR TRANSPORTATION PURPOSES
Information needs and methods to transmit that information are analyzed to determine the basic requirements of a hazard identification system for packages containing and vehicles carrying hazardous materials. Persons who come in contact with hazardous material shipments are identified, and typology is developed. Information needs by type, amount, and timing are listed by category, and 16 existing labeling systems are evaluated according to these and human factors criteria. Another dimension of users considered is transportation mode and job function of personnel. Conclusions and recommendations based on this analysis are discussed.

Rath, GJ
Northwestern University May 1972, 183 pp

PURCHASE FROM: NTIS Repr PC, Microfiche
DOTL NTIS

B5 044009
TANK CAR SAFETY PROJECT...MILEPOST IN RAILROAD RESEARCH
The tank car is a special type of freight car and has a unique character of its own. This unique character relates to what happens when a tank car is damaged or derailed and releases its lading. Much has been learned about tank cars as a result of the Tank Car Safety Research and Test Project. Four results have been achieved: (1) a better understanding of tank car performance, of how to improve tank car safety, (2) a better understanding of the design character of certain components of any freight car that can reduce the severity of damage when a wreck or derailment occurs, (3) various forces in the railroad industry joined ranks and proved that they could get far more done by working in unison than separately, and (4) there is an emerging methodology of railroad research that has been applied more extensively and more intensively to the tank car project than any other heretofore. Significant is the conclusion that "while head punctures can be reduced significantly by a head shield, the E top and bottom shelf coupler is not only more effective, but is significantly more cost-effective." To evaluate the shelf coupler in normal service, 200 car sets are currently being installed by railroads and tank car companies.

Progressive Railroading Vol. 16 No. 2, Mar. 1973, pp 57-58, 4 Phot

ACKNOWLEDGMENT: Progressive Railroading
PURCHASE FROM: Murphy-Richter Publishing Company 9 South Clinton Street, Chicago, Illinois, 60606 Repr PC
DOTL JC

B5 044067
COUPLER IS SUBJECT OF TWO SAFETY PROJECTS
The freight car coupler's sphere of operation is one of almost constant violence. Couplers must take the brunt of crushing forces. But when something goes wrong, the strong coupler can damage other components. A key safety recommendation is that car couplers should be modified to prevent uncouplings in derailments. Both the Type F coupler, with a top shelf, and the Type E coupler, with top and bottom shelves, have the ability to reduce the probability of vertical separation. For better than two years, the Type F coupler has been required on new tank cars. It is felt the Type E coupler would not only do a better job of preventing punctures of tank cars, but would be more cost effective. Service testing of 200 car sets of the Type E coupler is now in progress. Plans call for an instrumented boxcar to be operated over 25,000 miles by more than eight railroads to produce a fair sampling of the railroad environment.

Railway Locomotives and Cars Vol. 147 No. 2, Feb. 1973, pp 18-19, 1 Phot

ACKNOWLEDGMENT: Railway Locomotives and Cars
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B5 044386
LNG TRUCK, RAIL, AND BARGE TRANSPORTATION
Reviews the state-of-the-art of truck, rail, and barge transport of LNG and summarizes the relative costs and investment requirements of each method. Paper for meeting September 7-21, 1972.

Biederman, NP (Institute of Gas Technology)
American Society of Mechanical Engineers 72-Pet-55, Sept. 1972, 12 pp

ACKNOWLEDGMENT: EI (EI 72 078513)
PURCHASE FROM: ESL Repr PC, Microfilm

B5 044405
STAINLESS STEEL FOR CHEMICAL TANKERS [L'ACCIAIO INOSSIDABILE NELLE NAVI CISTERNA PER PRODOTTI CHIMICI]
The paper reviews practical considerations for the transport of bulk liquids with chemical tankers and the advantages offered by stainless steels for the tanks. Conditions and requirements of the single main cargoes are examined in connection with the grades of stainless steel used or suggested in the different cases. Design and fabrication aspects for cargo tanks and related accessories are covered. Operating factors, particularly procedure for cleaning stainless steel tanks between cargoes are indicated. [Italian]

Swales, GL (International Nickel Limited)
Tecnic Italiana Vol. 37 No. 1-6, 1972, pp 1-14, 15 Ref

ACKNOWLEDGMENT: EI (EI 72 081048)
PURCHASE FROM: ESL Repr PC, Microfilm

B5 046133
WHAT HAPPENS WHEN LNG SPILLS?
The worldwide shortage of natural gas, largely methane, has led to widespread activity in setting up projects to transport liquefied natural gas (LNG) from producing countries to gas-hungry population centers. There is some concern that transportation of LNG may lead to accidents that will release the liquefied product and endanger lives and property. This paper reviews the development of LNG technology, cites a number of misconceptions regarding LNG, and reviews information on the behavior of LNG during and after spills.

Crouch, WW Hillyer, JC (Phillips Petroleum) *Chemical Technology* Apr. 1972, pp 210-215, 15 Ref

ACKNOWLEDGMENT: American Chemical Society
PURCHASE FROM: American Chemical Society 1155 16th Street, NW, Washington, D.C., 20036 Repr PC
DOTL JC

B5 046174
TECHNOLOGY AND ECONOMICS OF TRANSPORTING AND STORING LNG
An overview presents the technology involved in the various phases of LNG transportation from well head to user. The economic cost of each step in the process is presented to show why decisions are made. The impending energy crisis with natural gas in short supply requires trade-offs in cost considerations. This is further unbalanced by the newness of LNG transportation into many areas and environmental considerations concerning its handling and storage.

Johnson, PC (Distrigas Corporation)
American Institute of Chemical Engineers Feb. 1972, 27 pp

ACKNOWLEDGMENT: American Institute of Chemical Engineers
PURCHASE FROM: American Institute of Chemical Engineers 345 East 47th Street, New York, New York, 10017 Repr PC

B5 046216
RAILROAD ACCIDENT REPORT: DERAILMENT OF MISSOURI PACIFIC RAILROAD COMPANY'S TRAIN 94 AT HOUSTON, TEXAS, OCTOBER 19, 1971
The Missouri Pacific Railroad's freight train 94 was traveling north on track which belongs to the Atchison, Topeka and Santa Fe Railway when 20 of its cars derailed in Houston, Texas, on October 19, 1971, at 1:44 p.m. There were four diesel-electric locomotive units and 82 cars in the train. Derailed cars included six tank cars containing vinyl chloride monomer and two cars containing other hazardous materials. Two tank cars were punctured in the derailment. The vinyl chloride monomer escaped and ignited. The Houston Fire Department attempted to control the fire. Approximately 45 minutes after the initial derailment, one tank car ruptured violently and another tank car 'rocketed' approximately 300 feet from its initial resting place. This sequence of events caused the death of a fireman. Fifty people were injured and there was considerable property damage. Most of the injured were firemen. The Safety Board determines that the probable cause of this accident was an unexplained emergency brake application which induced lateral forces exceeding the holding capacity of the track fasteners.

National Transportation Safety Board NTSB-RAR-72-6, SS-R-16, Dec. 1972, 58 pp

ACKNOWLEDGMENT: NTIS (PB-216608/0)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-216608/0, DOTL NTIS

B5 046420
CHEMICAL TRANSPORTATION SAFETY INDEX
All chemicals can be safely transported and handled if necessary precautions and control measures are observed. However, in the event of an accident, hazardous chemicals present a particularly dangerous situation, often requiring rapid, critical handling by personnel not aware of the specific hazards and methods of handling the chemicals involved. Although there is extensive literature on the hazards of chemicals, it is widely scattered and generally not on hand at an accident. Deepening the severity of this information and communication problem is the fact that actions taken in the first few minutes of an emergency can spell the difference between disaster and orderly return to normal operations. Faced with this problem and the desire to provide a quick, concise and accurate guide to the handling of over 200 commonly transported hazardous chemical substances, the RSMA has developed the Chemical Transportation Safety Index as the "first-aid" step in its comprehensive Commodity Safety System.

Railway Systems and Management Association Index

ACKNOWLEDGMENT: Chemical Transportation Safety Index
PURCHASE FROM: Railway Systems and Management Association 181 East Lake Shore Drive, Chicago, Illinois, 60611 Repr PC
DOTL RP

B5 046566
EVALUATION OF THE HAZARD OF BULK WATER TRANSPORTATION OF INDUSTRIAL CHEMICALS. A TENTATIVE GUIDE
This study rates 337 industrial chemicals that are bulk shipped by water transportation. The rating system used to determine their hazardousness is in keeping with their objective to provide the Coast Guard with technical information that can be used as a guide for establishing safety regulations. The ratings are designed only toward water transportation of these chemicals and are not valid when used in any other manner. The rating system is designed for reclassification when new information becomes available. Thus the report originally printed in 1966 was updated in 1969, 1970 and this 1972 edition.

A report prepared by the Evaluation Panel of the Committee on Hazardous Materials, Division of Chemistry and Chemical Technology, NRC, for the Coast Guard under Task Order 13.

National Academy of Sciences Sept. 1972, 55 pp

Contract DOT-OS-00035

ACKNOWLEDGMENT: National Research Council
PURCHASE FROM: National Research Council 2101 Constitution Avenue, NW, Washington, D.C., 20418 Repr PC

B5 046780
IMPACT VULNERABILITY OF TANK CAR HEADS
An Impact Vulnerability study of tank car heads was undertaken by means of semi-analytical evaluation of head failures through careful observation of indentations and punctures produced in a series of full scale tests. Vulnerability influencing parameters were identified. Simple formulas to determine the permanent indentation and the impact force were developed in conjunction with a theoretical analysis of influential dimensionless parameters and an application of Hertz' force-indentation law to collision problems. Finally, the tank car head failure criteria were established.

Shang, JC (General American Transportation Corporation) *Shock and Vibration Bulletin* No. 42, Part 1, Jan. 1972, pp 197-210, 11 Ref

ACKNOWLEDGMENT: EI (EI 73 016226)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

B5 047467
RPI-AAR TANK CAR SAFETY PROJECT READY WITH INITIAL RECOMMENDATIONS
The railroad industry itself--as well as individual suppliers of rail equipment and the Department of Transportation--has long been on the trail of a cure

for the derailment. In-depth research into track/train dynamics is currently being carried out under the guidance of the Association of American Railroads. One of the key objectives is derailment prevention. Just winding down is a far-reaching study into the performance of tank cars in accidents and the means of improving their resistance to punctures and ruptures when involved in these accidents.

Railway Locomotives and Cars Vol. 146 No. 8, Sept. 1972, pp 38-40, 4 Fig

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

B5 047827
HAZARDOUS MATERIALS: CAN THEY BE TRANSPORTED SAFELY AND PROFITABLY

A recent series of incidents has caused concern that the enviable safety record of the rail industry in transporting hazardous materials may be changing. Therefore the AAR has created a committee to study the problem of transporting hazardous materials both safely and profitably. The committee found that there are many forces of an economic nature from outside the rail industry working against the safe movement of these commodities. These include competitive factors associated with product manufacturing and distribution, larger-volume and lower-unit-cost concepts, service requirements and investments in jumbo equipment. The committee does not believe that hazardous materials can be transported safely and profitably under present circumstances. It cannot condone the sacrifice of safety responsibilities to serve a short term economic gain at the expense of potential consequences which at the very least can wipe out any economic gain for the future. The committee therefore recommends: greater efforts to minimize train accidents, better coordination as an industry by means of a specialized technical organization with authority such as the Bureau of Explosives, stronger control of the practice of issuance of special permits for movements which have not been thoroughly evaluated as to potential hazards.

Proceedings of the Seventy-Sixth Annual Meeting, American Association of Raildroad Superintendents, Chicago, Illinois, 13-15 June 1972.

American Association of Railroad Superintendents 1973, 246 pp

PURCHASE FROM: American Association of Railroad Superintendents 18154 Harwood Avenue, Homewood, Illinois, 60403 Repr PC

DOTL RP

B5 047832
INTRINSIC SAFETY

Now engineers involved in design, construction, or operation of electrical equipment in hazardous situations can find in this one volume all important safety practices, installations, and design features, including in-depth coverage of testing, certification, safety barrier devices, power sources, applications, cabling and installation--plus references and detailed index.

Redding, RJ
McGraw-Hill Book Company 142 pp

PURCHASE FROM: McGraw-Hill Book Company 1221 Avenue of the Americas, New York, New York, 10020 Orig PC

B5 047834
SPECIFICATIONS FOR PIPELINES CONVEYING FLAMMABLE SUBSTANCES

These specifications cover pipelines installed on railway rights-of-way to carry oil, gas, petroleum products, or other flammable or highly volatile substances under pressure.

Association of American Railroads No. T5, 1972, 11 pp, 2 Fig, 1 Tab

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AAR Repr PC

B5 047924
SAFETY SYSTEM DESIGN CONSIDERATIONS FOR THE TRANSPORTATION OF HAZARDOUS MATERIALS AND CHEMICALS

A computer-aided specification system for handling transportation of hazardous materials by rail is proposed which would classify the risk potential of the shipment, provide safety controls such as fire-extinguishing agents and provide data to all personnel involved on freight handling.

Gilfillan, JH (Chicago, Rock Island and Pacific Railroad) *Railway Management Review* Vol. 72 No. 2, 1972, pp 1-6

ACKNOWLEDGMENT: EI (EI 73 036291)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B5 047943
SAFETY, RISK AND REGULATION--BASIC CONCEPTS FOR "SAFETY" RISK ANALYSIS

This paper discusses the applicability of risk-based concepts to "safety" problems generally. "Safety" programs exist to fulfill future expectations of people to live out their useful days free of accidental interruption. Utilizing a proposed generalized accident theory, the author describes the probabilistic nature of the existence of the ingredients necessary for an accident to occur, and the effects of man's capability to change such probabilities. An "accident risk" approach to "safety," in terms of the probable accidental reduction in useful life span associated with an activity, is presented. Establishment of an acceptable accident risk level as a "safety" objective, and the effects of risk creation and risk bearing on the establishment of that objective are discussed. "Safety" regulation is described as a risk-setting function, and the implications of that view in terms of "safety" responsibility, authority, and accountability are explained. Effects of a risk-based approach on safety data generation and collection are suggested. Additional research needed to permit implementation of the proposed approach is described.

Proceedings of the Thirteenth Annual Meeting, Transportation Research Forum, Brown Palace Hotel, Denver, Colorado, 8-10 November 1972.

Benner, L, Jr (Department of Transportation)
Transportation Research Forum Proceeding Vol. 13 No. 1, 1972

ACKNOWLEDGMENT: Transportation Research Forum
PURCHASE FROM: Vietsch (Grant C) 181 East Lake Shore Drive, Chicago, Illinois, 60611 Repr PC

DOTL TH1145.T85

B5 047944
RISK EVALUATION--MARINE TRANSPORT OF LIQUEFIED NATURAL GAS (LNG)

Due to the energy shortage in the United States, new energy sources are being developed; one such source is the importation of liquefied natural gas (LNG). In the coming decade LNG terminals to handle ships carrying large quantities of this material (of the order of 750,000 barrels) will proliferate. Our firm was retained to make a risk evaluation associated with moving a large tanker full of LNG up a busy river on the East Coast of the United States. The basic purpose of this evaluation was to provide a systematic framework for deciding which factors are important and to determine the impact upon these factors of alternative actions and/or design parameters in the system. The systematic framework or model adopted was that provided by the National Transportation Safety Board (NTSB) with some modification to suit the case at hand. In this paper, we shall provide a cursory discussion of the models, its results, and the data gaps which we found in constructing the model and attempting to obtain reliable values.

Proceedings of the Thirteenth Annual Meeting, Transportation Research Forum, Brown Palace Hotel, Denver, Colorado, 8-10 November 1972.

Silvestro, FB Sowyrda, A (Ecology and Environment, Incorporated)
Transportation Research Forum Proceeding Vol. 13 No. 1, 1972

PURCHASE FROM: Vietsch (Grant C) 181 East Lake Shore Drive, Chicago, Illinois, 60611 Repr PC

DOTL TH1145.T85

B5 047945
THE ANALYSIS OF TRANSPORTATION RISKS FROM A SHIPPER'S VIEWPOINT

Du Pont as a manufacturer and shipper of hazardous commodities is concerned not only with safety during the manufacturing process but also with the safe transportation of such commodities. It relies to a substantial degree on experience derived from manufacturing and plant handling for achieving safety during transportation of its hazardous products. Du Pont supports new procedures or refinement of existing methods which will

enhance safety in the transportation of hazardous commodities, but believes it will be necessary to rely on the present regulatory system while new approaches are being tested and evaluated.

Proceedings of the Thirteenth Annual Meeting, Transportation Research Forum, Brown Palace Hotel, Denver, Colorado, 8-10 November 1972.

Boyd, DA (Du Pont de Nemours (EI) and Company, Incorporated)
Transportation Research Forum Proceeding Vol. 13 No. 1, 1972

PURCHASE FROM: Vietsch (Grant C) 181 East Lake Shore Drive, Chicago, Illinois, 60611 Repr PC

DOTL TH1145.T85

B5 047946
A RAILROAD HAZARD ANALYSIS

Why should Southern Railway be interested in hazard analysis? It goes beyond Laurel, Miss. Southern's revenue from traffic classed as hazardous by the current classification methods is about $40,000,000 per year. Some segments of this traffic are growing at a rate faster than the average of all commodities handled by Southern. There is a substantial stake in this area now and it could be even greater in the future. At the same time there is the extraordinary exposure faced with handling some of these commodities. It was logical to try to assess what this traffic is worth, including the exposure to extraordinary costs from accidents.

Proceedings of the Thirteenth Annual Meeting, Transportation Research Forum, Brown Palace Hotel, Denver, Colorado, 8-10 November 1972.

Stanek, WM (Southern Railway)
Transportation Research Forum Proceeding Vol. 13 No. 1, 1972

PURCHASE FROM: Vietsch (Grant C) 181 East Lake Shore Drive, Chicago, Illinois, 60611 Repr PC

DOTL TH1145.T85

B5 047947
RISK ANALYSIS FOR TRANSPORTATION SAFETY THE REGULATOR'S VIEWPOINT

It is clear that the consumer is a very important person in the regulatory process. In this brave new world of cost benefit analysis user acceptance or nonacceptance of a standard is a strong consideration in the tradeoff of competing requirements. The concept of risk management and its application to the transportation regulatory process is an orderly and reasonable course to follow. There is a world of difference in doing something in a systematic way and doing it because it seems a good idea. The gain may be difficult to measure but the increased knowledge will help the decision-maker. It is possible that a mathematical prediction model would be most useful to the decisionmaker in evaluating the effectiveness of various programs and standards. When coupled with cost information the maximum benefit could be obtained by proper allocation of resources. Finally, I believe that risk technology is a great and coming field. One can no longer wait for damaging events to warn of hazards to people, to products or to the environment.

Proceedings of the Thirteenth Annual Meeting, Transportation Research Forum, Brown Palace Hotel, Denver, Colorado, 8-10 November 1972.

McGuire, CW (Department of Transportation)
Transportation Research Forum Proceeding Vol. 13 No. 1, 1972

PURCHASE FROM: Vietsch (Grant C) 181 East Lake Shore Drive, Chicago, Illinois, 60611 Repr PC

DOTL TH1145.T85

B5 048014
EXPLOSIVE INTERACTION OF LIQUEFIED NATURAL GAS AND ORGANIC LIQUIDS

When LNG is spilled onto water, a violent explosion may be caused by the sudden release of energy stored in a superheated, metastable LNG phase. In view of the very large number of LNG transport schemes now under consideration, which may involve use of as many as 100 LNG tankers, possibilities of LNG explosions are discussed.

Yang, K (Continental Oil Company) *Nature*Tech Rpt Vol. 243 No. 5404, May 1973, 2 pp

ACKNOWLEDGMENT: Environment Information Access (73-06980)
PURCHASE FROM: MacMillan Journals Limited Little Essex Street, London WC2, England Repr PC

B5 048298
TRANSPORTING, LOADING AND UNLOADING HAZARDOUS MATERIALS

With emphasis on safety, this overall review discusses the methods and equipment used for transporting, loading, and unloading bulk hazardous substances on railroad, highway, and water. Emergency procedures and safety regulations, as well as what manufacturers, shippers, and carriers are doing to comply with them, are thoroughly discussed. The work of the Chemical Transportation Emergency Center (CHEMTREC) is described.

Wood, WS *Chemical Engineering* Vol. 80 No. 15, Reprint #184, June 1973, pp 72-94

PURCHASE FROM: McGraw-Hill, Incorporated 1221 Avenue of the Americas, New York, New York, 10020 Repr PC

DOTL JC

B5 050101
DETONATION OF A FLAMMABLE CLOUD FOLLOWING A PROPANE PIPELINE BREAK: THE DECEMBER 9, 1970, EXPLOSION IN PORT HUDSON

This report summarizes the incidents that preceded the December 9, 1970, propane-air explosion in Port Hudson, Mo., and then attempts to establish the nature of the explosion from the ensuing events. Special emphasis is given to possible ignition sources, the distribution of flammable vapors, and the analysis of blast damage. Both near-and far-field damage indicated that this explosion may be attributed to the detonation of propane in air with an energy release equivalent to that from about 50 tons of detonating TNT.

Burgess, DS Zabetakis, MG
Bureau of Mines Publications Distribution Branch 1973, 26 pp, 15 Fig

ACKNOWLEDGMENT: Bureau of Mines (RI 7752)
PURCHASE FROM: Bureau of Mines Publications Distribution Branch 4800 Forbes Avenue, Pittsburgh, Pennsylvania, 15213 Repr PC

B5 050129
HAZARDOUS LOADS

A quick-reference guide, giving possible dangers and the action to be taken at incidents involving hazardous loads in transit. This second edition of Hazardous Loads has been completely revised and enlarged and includes information about the substances listed in the Schedule to the Petroleum (Inflammable Liquids) Order 1968.

Institution of Fire Engineers 1972, 267 pp

PURCHASE FROM: Institution of Fire Engineers 148 New Walk, Leicester Le1 7QB, England Orig PC

DOTL T55.3.H3I7

B5 050438
EVALUATION OF THE HAZARD OF BULK WATER TRANSPORTATION OF INDUSTRY CHEMICALS--A TENTATIVE GUIDE

The ratings put forth in this report represent the considered opinion of the Committee regarding the over-all potential hazard connected with the bulk water shipment of specified industrial chemicals. The ratings were prepared specifically to reflect to the Coast Guard the hazards or absence of hazards in shipping chemicals in their present industrial grades in bulk by water. They are not intended to be used for any other purpose and they are not considered valid to estimate the degree of hazard of handling these chemicals in any other manner.

National Research Council Aug. 1973, 55 pp, Tabs

Contract DOT-OS-00035/13

PURCHASE FROM: National Research Council 2101 Constitution Avenue, NW, Washington, D.C., 20418 Repr PC

DOTL RP

B5 051413
EQUIVALENT SAFETY AND HAZARDOUS MATERIALS TRANSPORTATION

This paper proposes a methodology to assess hazards, safety, and safety requirements in the marine transportation of hazardous materials. The basic approach is to quantify on a relative basis rather than on some absolute

scale. The authors suggest that each hazardous commodity can be graded on a numerical scale indicating the relative hazard while the vessels can be graded on a numerical scale for relative safety provided by the design, operation, etc. By combining the commodity relative hazard rating with the vessel relative safety rating an overall transportation safety rating may be obtained. Different commodities carried in vessels of differing designs could have the same transportation safety rating if equivalent safety had been obtained. The paper also suggests a method to quantify, on a relative basis, the safety requirements for waterways (including ports and terminals). By relating the transportation safety rating to the port safety requirement, one can determine what vessel design features are required to transport a specific hazardous commodity to a specific terminal over a specific water route.

Contributed by the Intersociety Committee on Transportation for presentation at the Intersociety Conference on Transportation, Denver, Colo., Sept. 23-27, 1973.

Danahy, PJ (United States Coast Guard); Gathy, BS (United States Coast Guard Academy)
American Society of Mechanical Engineers Paper 73-ICT-86, Sept. 1973, 11 pp, 7 Tab, 4 App

ACKNOWLEDGMENT: ASME Journal of Mechanical Engineering
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL RP

B5 051423
CRITICAL VELOCITY FOR COLLAPSE OF A SHELLING CIRCULAR CROSS SECTION WITHOUT BUCKLING

Many practical devices involve high-speed collapse of shells of circular cross section. In all of the devices the stability of the collapse motion is of interest and in some it is essential for successful operation. In this paper, the buckling motion of shells of circular cross section during high-speed collapse is analyzed and critical collapse velocities are determined for which the growth of initial nonuniformities by buckling during collapse is 10 and 100.

Contributed by the ASME Applied Mechanics Division for presentation at the Applied Mechanics Western Conference, Stanford Research Institute, Menlo Park, Calif., Sept. 17-19, 1973.

Abrahamson, GR (Stanford Research Institute)
American Society of Mechanical Engineers Paper 73-APMW-31, Sept. 1973, 5 pp, 6 Fig, 4 Ref

ACKNOWLEDGMENT: ASME Journal of Mechanical Engineering
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL RP

B5 051465
EVACUATION AREAS FOR TRANSPORTATION ACCIDENTS INVOLVING PROPELLANT TANK PRESSURE BURSTS

Evacuation areas are defined for those transportation accidents where volatile chemical propellant tanks are exposed to fire in the wreckage and eventually explode with consequent risks from fragments in surrounding populated areas. An evacuation area with a minimum radius of 600 m (2000 ft) is recommended to limit the statistical probability of fatality to one in 100 such accidents. The result was made possible by the derivation of a distribution function of distances reached by fragments from bursting chemical car tanks. Data concerning fragments was obtained from reports or tank car pressure bursts between 1958 and 1971. (Author)

Conf-Presented at the 1972 Jannaf Propulsion Meeting, New Orleans, 27-29 Nov. 1972.

Siewert, RD
Lewis Research Center, (E-7597) NASA-TM-X-68277, 1972, 19p

ACKNOWLEDGMENT: NTIS (N73-29987/7)
PURCHASE FROM: NTIS Repr PC, Microfiche
N72-29987/7, DOTL NTIS

B5 051574
THE TRANSPORTATION OF HAZARDOUS MATERIALS: TRANSPORT OF BENZENE BY TANK CAR

The research is an investigation of the problems involved in the transportation of hazardous materials with emphasis placed on the transport of benzene by railroad. Specific recommendations on the identification and labeling of the hazards associated with benzene are discussed and a risk rating model is suggested for general use in the transportation of hazardous materials. Through use of a gross hazard analysis and a fault free analysis, the basic parameters involved in the transport of benzene are determined. (Author)

Lippian, JM
Army Material Command MS Thesis USAMC-ITC-3-73-8, May 1973, 94 pp

ACKNOWLEDGMENT: NTIS (AD-771105/4)
PURCHASE FROM: NTIS Repr PC, Microfiche
AD-771105/4, DOTL NTIS

B5 051582
RECLASSIFICATION OF MATERIALS LISTED AS TRANSPORTATION HEALTH HAZARDS. SUPPLEMENT

In a previous report the toxicity of several compounds of interest to the Department of Transportation was discussed. This was done in the light of a reexamination of existing data or the determination of acute toxicity data on those compounds where no previous data existed. The information so gathered was used to help reclassify these compounds into categories which may help to define shipping and handling requirements concomitant with the hazard associated with each compound. The classifications assigned are not official regulatory classifications and are presented for technical information only. Seven new compounds were examined in this same light to provide additional information to the Department of Transportation. These compounds are as follows: mixed cresols, allyl isothiocyanate, methyl isothiocynate, methyl isocyanate, ortho-nitroaniline, ethyl chloroacetate and phenyl isocyanate. Portions of this document are not fully legible.

See also PB-214 270.

Back, KC Thomas, AA MacEwen, JD
Aerospace Medical Research Laboratory Final Rpt Sept. 1973, 24 pp

Contract DOT-AS-10028/2

ACKNOWLEDGMENT: NTIS (PB-225283/1)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-225283/1, DOTL NTIS

B5 051588
HAZARD CLASSIFICATION OF EXPLOSIVES FOR TRANSPORTATION- EVALUATION OF TEST METHODS. PHASE II

The report correlates proposed explosives testing with proposed testing for the classification of other related types of hazardous materials-inorganic oxidizers, organic peroxides, and flammable solids. The work also provides information relative to additional hazard classification testing, further refinements in hazard classification test methodology and expanded hazard classification test criteria. Portions of this document are not fully legible.

See also report dated May 72, PB-223 769.

Lasscigne, AH
General Electric Company Final Rpt GE-HERE-FR-009, May 1973, 148 pp

Contract NAS8-27750

ACKNOWLEDGMENT: NTIS (PB-225422/5)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-225422/5, DOTL NTIS

B5 051900
HAZARDOUS MATERIAL TANK CARS--TANK HEAD PROTECTIVE "SHIELD" OR "BUMPER" DESIGN

The objective of this study program is to design a railroad tank car head protective device which will reduce the frequency of head punctures in accidents. Accident data were reviewed in detail for the years 1965 through 1970 to correlate head damage frequency and severity with various types of tank cars, to determine distribution patterns of damage over tank car head surfaces, and to assess the costs to the railroad shipping industry of head punctures. Full scale head impact tests, previously run were also reviewed. From these two reviews, design criteria were established and used to reduce an initial compilation of 74 concepts to a group of 15, which when applied to various classes of cars, comprised a semi-final total of 42 combinations, or schemes, as referred to in this report.

Federal Railroad Administration Final Rpt Aug. 1971, 117 pp, Figs, Tabs, 6 App

Contract DOT-FR-00035
PURCHASE FROM: NTIS Repr PC, Microfiche
DOTL TF481.00035

B5 051913
ASSEMBLY AND ANALYSIS OF FRAGMENTATION DATA FOR LIQUID PROPELLANT VESSELS
The objective of this work was to assemble and analyze fragmentation data for exploding liquid propellant vessels. These data were to be retrieved from reports of tests and accidents, including measurements or estimates of blast effects, fragment velocities, masses, shapes, and ranges. Correlations were to be made, if possible, of fragmentation effects with type of accident, type and quantity of propellant, blast yield, etc. A significant amount of data was retrieved from a series of tests conducted for measurement of blast and fireball effects of liquid propellant explosions (Project PYRO), a few well-documented accident reports, and a series of tests to determine autoignition properties of mixing liquid propellants. The data were reduced and fitted to various statistical functions. Comparisons were made with methods of prediction for blast yield, initial fragment velocities, and fragment range. Reasonably good correlation was achieved. Methods presented in the report allow prediction of fragment patterns, given type and quantity of propellant, type of accident, and time of propellant mixing. However, more work must be done before the results of this study can be easily applied to estimation of damaging effects of fragments from exploding liquid propellant vessels.

Project Managers: C. David Miller and R.D. Siewert, Aerospace Safety Research and Data Institute, Lewis Research Center.

Baker, WE Parr, VB Bessey, RL Cox, PA
Southwest Research Institute Contr Rpt NASA CR-134538, Jan. 1974, 235 pp, 54 Fig, 19 Tab, 48 Ref, Apps

Contract NAS 3-16009

ACKNOWLEDGMENT: National Aeronautics and Space Administration
PURCHASE FROM: NTIS Repr PC
DOTL RP

B5 052163
HAZARDS CLASSIFICATION OF FLAMMABLE AND OXIDIZING MATERIALS FOR TRANSPORTATION. EVALUATION OF TEST METHODS (PHASE II)
This report contains the Phase II results of a two-phase investigation of a recommended system for classifying solid flammable and oxidizing materials for transportation, and a preliminary evaluation of flammable liquids classification. Specifically, this report resolves specific discrepancies in the above test methods, contains data for classifying additional materials, and provides preliminary evaluation on hazards classification tests of flammable liquids.

Hough, R Lasseigne, A Pankow, J
General Electric Company Final Rpt Apr. 1973, 83 pp

Contract DOT-AS-10058

ACKNOWLEDGMENT: NTIS (PB-227019/7)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-227019/7

B5 053754
TRANSPORTATION FIRE HAZARDS BY NATIONAL FIRE PROTECTION ASSOCIATION
The 40-page soft-cover publication aims to focus on the cause and effects in transportation fires, including the problems of intermodal transfers. Separate chapters are devoted to movement of hazardous materials and to fire safety involving aircraft, motor vehicles, ships, and railroads. Not only the vehicles but their particular environments are discussed.

National Fire Protection Association Book 40 pp

ACKNOWLEDGMENT: Railway Locomotives and Cars
PURCHASE FROM: National Fire Protection Association 470 Atlantic Avenue, Boston, Massachusetts, 02210 Repr PC

B5 054446
LIQUIFIED NATURAL GAS TECHNOLOGY
The report contains a bibliography of the applications, storage, handling, production, economics, and safety engineering relative to liquefied natural gas.

National Bureau of Standards Bibliogr B-1075, Oct. 1973, 54 pp

ACKNOWLEDGMENT: NTIS (COM-74-10324/3)
PURCHASE FROM: NTIS Repr PC, Microfiche
COM-74-10324/3, DOTL NTIS

B5 054447
FIREFIGHTING EFFECTIVENESS OF AQUEOUS-FILM-FORMING-FOAM (AFFF) AGENTS
Information was obtained by conducting laboratory experiments and full-scale fire-modeling tests which were of value in estimating the firefighting effectiveness of two aqueous-film-forming-foam (AFFF) agents. Minimum quantities and application rates were established for each AFFF agent in relation to the size and configuration of simulated aircraft ground fuel-spill fires involving JP-4, JP-5 and aviation gasoline. (Author)

Geyer, GB
National Aviation Facilities Experimental Center Final Rpt FAA-NA-72-48, Apr. 1973, 73 pp

Contract F33615-71-M-5004

ACKNOWLEDGMENT: NTIS (AD-774025/1)
PURCHASE FROM: NTIS Repr PC, Microfiche
AD-774025/1, DOTL NTIS

B5 054512
THE INCIDENCE OF HAZARDOUS MATERIAL ACCIDENTS DURING TRANSPORTATION AND STORAGE
This report is one of a series describing background research concerning the incidence of abnormal loading. The report is organized in terms of modes of hazardous material transportation and storage. These modes--pipeline, water, motor vehicle, and railroad transportation systems--are addressed in four sections with Storage Systems discussed in a fifth. The sections depend on the amount of available data, rather than the risk involved in an accident. A summary of the results is presented in the last section. On the whole, there is little empirical evidence to substantiate a threat to buildings from hazardous materials transport. However, trends in volumes shipped in proximity to structures of interest raises the prospect of future incidents.

Steele, WA Bowser, D Chapman, RE
National Bureau of Standards, (NBS-4314426) Final Rpt NBSIR-73-412, Nov. 1973, 41 pp

ACKNOWLEDGMENT: NTIS (COM-74-10512/3)
PURCHASE FROM: NTIS Repr PC, Microfiche
COM-74-10512/3, DOTL NTIS

B5 054590
MILLION GALLON "TANK CAR"
General American Transportation, applying the benefits of volume transportation through the unit train, has come up with an integral train concept that it calls a "million gallon tank car." Since it involves handling techniques of storage tanks, it holds potential of improving the distribution of bulk liquid commodities. The new system has a unique combination of interconnects of flexible hoses and special valves. With them a million gallon 40 car tank train can be filled or emptied from a single connection. The train thus brings that capability to the terminal.

Progressive Railroading Vol. 17 No. 1, Jan. 1974, p 59

ACKNOWLEDGMENT: CNR
PURCHASE FROM: Murphy-Richter Publishing Company 9 South Clinton Street, Chicago, Illinois, 60606 Repr PC
DOTL JC

B5 054919
COATINGS: A $30 MILLION MARKET--AND STILL GROWING
The railroads represent a $26-30 million market for the coating industry and the market is growing. However, there are increasing shortages in the coating industry and the price of the products are increasing rapidly. The new car

market represents about one-half of the total railroad market for coatings. New coatings are being developed that will protect surfaces better and are easier to apply. A thermal shield coating is under investigation for tank cars to reduce the danger of fires in the event of a rupture. Several railways have opened new paint shops in recent years and two of the newest are CP Rail's Ogden Shops, Calgary and Burlington Northern's at Havelock, Nebraska.

Bartley, RD *Railway Age* Vol. 175 No. 7, Apr. 1974, 4 pp

ACKNOWLEDGMENT: CNR
PURCHASE FROM: XUM Repr PC

DOTL JC

B5 056883
PROGRESS IN RAILROAD RESEARCH
This report describes the AAR research work now underway or planned for the near future. It also describes the facilities available at the Chicago Railroad Technical Center. It describes the AAR programs involving university research. The research projects described deal with train track dynamics, track stresses, track structure, computer models, freight car information systems, and with safety and hazardous materials.

Harris, WJ, Jr
Association of American Railroads 1973, 241 pp, Figs, Refs

PURCHASE FROM: AAR Repr PC

DOTL RP

B5 056906
RISK ANALYSIS IN HAZARDOUS MATERIALS TRANSPORTATION, VOLUME I
A contracted research project was undertaken by the University of Southern California for the Office of Hazardous Materials, Department of Transportation, on the subject topic. The results are as follows: (1) A risk analysis model is developed which is provided with input from existing data bases with some minor extensions and revisions and is logically consistent and satisfying. In fact, several agencies are already employing like models in analysis and operations; (2) Twenty examples are shown which demonstrate the procedure, its flexibility in accepting different levels of detail of data, and the type of results which are obtainable. In this phase several specific recommendations for data input needs and procedural development are made; and (3) The petition evaluation shows a clear dominance of one alternative over the other in terms of risk, bodily injury, deaths (equal), normal and total cost.

Jones, GP Barrow, RW Stuckenbruck, LC Holt, EL Keller, RP
University of Southern California Final Rpt RAPO-73-7, Mar. 1973, 297p

Contract DOT-OS-20114

ACKNOWLEDGMENT: NTIS (PB-230810/4)
PURCHASE FROM: NTIS Repr PC, Microfiche

PB-230810/4, DOTL NTIS

B5 056907
RISK ANALYSIS IN HAZARDOUS MATERIALS TRANSPORTATION, VOLUME II, BIBLIOGRAPHY
This is the second of two volumes prepared under the Risk Analysis in Hazardous Materials Transportation contract awarded by OHM/DOT. It is divided into two major sections. Section 1 contains relevant bibliographic entries and abstracts from among Department of Defense publications and Governmental Research Abstracts. Section 2 is merely a concise listing of all bibliographic entries gathered over the course of the entire project. All of the entries in this section have been previously shown in Monthly Progress Reports between June and December 1972.
See also PB-230 810.

Jones, GP Barrow, RW
University of Southern California Final Rpt RAPO-73-8, Mar. 1973, 425p

Contract DOT-OS-20114

ACKNOWLEDGMENT: NTIS (PB-230811/2)
PURCHASE FROM: NTIS Repr PC, Microfiche

PB-230811/2, DOTL NTIS

B5 057355
PREDICTION OF HAZARDS OF SPILLS OF ANHYDROUS AMMONIA ON WATER
Maritime transport of liquid anhydrous ammonia (LNH3) poses a potential hazard to the public, to aquatic life, and to other shipping should there be an accidental surface or underwater release of ammonia. This report contains the results of an experimental and analytical program aimed at evaluating the hazards presented by a 3,000 ton release of liquid anhydrous ammonia on water. Test spills were conducted in the laboratory (up to 1/2 gallons), in a swimming pool (5 gallons) and in a lake (50 gallon size) and the fraction of released ammonia dissolving in water and the amount vaporizing were determined. The dispersion of vapor in air was measured and a theory was developed to predict the movement. Analytical models to predict water dispersion are also presented. (Modified author abstract)

Raj, PK Hagopian, J Kalelkar, AS Final Rpt. ADL-74763-F, Mar. 1974, 257 pp

Contract DOT-CG-22182-A

ACKNOWLEDGMENT: NTIS (AD-779400/1)
PURCHASE FROM: NTIS Repr. PC, Microfiche

AD-779400/1, DOTL NTIS

B5 057538
SYSTEM FOR EVALUATION OF THE HAZARDS OF BULK WATER TRANSPORTATION OF INDUSTRIAL CHEMICALS
This is a report of results, to date, of the efforts of the Committee on Hazardous Materials to develop and evolve a scheme of hazard evaluation. The Hazard Evaluation System described in this report employs four main classes of hazards: fire, health, water pollution, and reactivity; and further subdivides the health, water pollution, and reactivity into subclasses. Under each class or subclass, a numerical rating is given to indicate the relative degree of potential hazard. General guidelines were developed to describe five levels of severity for each. The Committee, using those general guidelines, has rated 367 industrial chemicals suggested by the Coast Guard. It should be borne in mind that these ratings relate to hazardous situations that may arise in the marine transportation of the materials under consideration, and are not necessarily applicable to other situations.
This is a report to the Department of Transportation, United States Coast Guard.

National Academy of Sciences Proj. Rpt. Feb. 1974, 42 pp, Tabs., Refs.

Contract DOT-CG-41680-A

PURCHASE FROM: National Academy of Sciences-Natl Research Council 2101 Constitution Avenue, NW, Washington, D.C., 20418 Repr. PC

DOTL RP

B5 057878
RAILROAD ACCIDENT REPORT: HAZARDOUS MATERIALS RAILROAD ACCIDENT IN THE ALTON AND SOUTHERN GATEWAY YARD IN EAST ST. LOUIS, ILLINOIS, JANUARY 22. 1972
At about 6:20 a.m., on January 22, 1972, an overspeed tank car loaded with liquid petroleum gas collided with a standing hopper car in the Alton & Southern Railroad Company's Gateway Yard in East St. Louis, Ill. In the overspeed impact, an overriding coupler on the empty freight car punctured the tank head. The pressurized propylene gas in the tank car leaked to the ground and vaporized. A large vapor cloud was formed, which ignited and exploded. More than 230 people were injured as a result of the explosion, and property damage was estimated at more than $7-1/2 million. The National Transportation Safety Board determines that the probable cause of the overspeed impact was the failure of the retarding system in the hump classification yard to decelerate effectively heavy cars with oil or grease on their wheel rims; the absence of a backup system to halt cars passing through retarders at overspeeds; and the routine acceptance at the Gateway Yard of uncontrolled overspeeds. Propylene leaked from the tank car because the tank head was too weak to resist the impact of the overriding coupler of the hopper car. Lack of specifications that define permissible impact and adequate crash resistance was a contributing factor.
Railroad Accident Report. This report contains Railroad Safety Recommendations R-73-1 through R-73-4.

National Transportation Safety Board, (SS-R-18) NTSB-RAR-73-1, Jan. 1973, 25 pp, Figs., Tabs., Phots.

ACKNOWLEDGMENT: National Transportation Safety Board
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-217429/0, DOTL NTIS

B5 057920
A MODAL ECONOMIC AND SAFETY ANALYSIS OF THE TRANSPORTATION OF HAZARDOUS SUBSTANCES IN BULK. EXECUTIVE SUMMARY (REVISED)
This summary presents the results of the six-month study begun in October 1973 and is an abbreviated version of the final report (COM-74-11271). The objective in the study was to analyze quantitatively the economics and safety of transporting selected bulk hazardous substances, other than oil, by inland waterway and overland (rail, truck, and possibly pipeline) modes, so that the costs and risks associated with the different modes could be compared. There were three major components to this process: (1) choosing the substances, origin-designation combinations, and shipment characteristics to be studied; (2) determining all costs involved in transporting each substance between the designated points by barge and relevant overland modes; and (3) determining the frequency and quantity of spills likely with each mode and the resultant risk to people, property, and the environment.
See also Final Report COM-74-11271. RRIS #057921.

Little (Arthur D), Incorporated Final Rpt. ADL-C-76446-5, May 1974, 38p

Contract C-76446t

ACKNOWLEDGMENT: NTIS (COM-74-11270/7)
PURCHASE FROM: NTIS Repr. PC, Microfiche
COM-74-11270/7, DOTL NTIS

B5 057921
A MODAL ECONOMIC AND SAFETY ANALYSIS OF THE TRANSPORTATION OF HAZARDOUS SUBSTANCES IN BULK
The movement of hazardous materials through transportation channels creates risks which are not fully understood. Consequently, the question of which was the best mode of transportation for the movement of hazardous substances had to be examined quantitatively. The objective of this study was to quantitatively analyze the economic and safety aspects of transporting hazardous substances by inland waterway and overland (pipeline, rail and highway) modes so that the comparative costs and risks of the different modes could be assessed. The chemicals studied as examples are acrylonitrile, anhydrous ammonia, benzene, caustic soda, chlorine, ethylene glycol, methanol, styrene, sugar, and sulfuric acid.
See also Executive Summary rept., COM-74-11270. RRIS #057920.

Little (Arthur D), Incorporated Final Rpt. ADL-C-76446-F, May 1974, 266 pp

Contract C-76446t

PURCHASE FROM: NTIS Repr. PC, Microfiche
COM-74-11271/5, DOTL NTIS

B5 071747
RAILROAD ACCIDENT REPORT: CHICAGO, BURLINGTON AND QUINCY RAILROAD COMPANY TRAIN 64 AND TRAIN 824 DERAILMENT AND COLLISION WITH TANK CAR EXPLOSION CRETE, NEBRASKA, FEBRUARY 18, 1969
At about 6:30 a.m., on February 18, 1969, Chicago, Burlington, and Quincy Train No. 64 derailed the 72nd to the 90th cars, inclusive, at a turnout located on the spiral of a 2 degree curve as the train was entering Crete, Nebraska, at a speed of about 52 miles per hour. The derailed cars struck standing cars on a siding south of the main track and the cars of train 824 standing on a track north of the main track. A tank car in train 824 was completely fractured on impact with the derailed cars which released the lading of 29,200 gallons of anhydrous ammonia into the atmosphere. A gas cloud was formed which blanketed the surrounding area for a considerable time due to the weather conditions. Three trespassers riding on train 64 were killed as a result of the derailment and six people were killed and 53 were injured as a result of exposure to the cloud of ammonia. The Safety Board determined that the derailment was caused by the movement of a rail of the turnout due to lateral forces produced by the locomotive as it moved over track alignment and surface deficiencies of the track. The complete fracture of the tank car on impact was contributed to by the brittleness of the steel of the car caused by the low ambient temperature.

National Transportation Safety Board NTIS-RAR-71-2, Feb. 1971, 79 pp, Figs., Tabs.

ACKNOWLEDGMENT: National Transportation Safety Board
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-198790, DOTL NTIS

B5 071749
RAILROAD/HIGHWAY ACCIDENT REPORT: BOSTON AND MAINE CORPORATION SINGLE DIESEL-POWERED PASSENGER CAR 563 COLLISION WITH OXBOW TRANSPORT COMPANY TANK TRUCK AT SECOND STREET RAILROAD-HIGHWAY GRADE CROSSING EVERETT, MASSACHUSETTS, DECEMBER 28, 1966
At 12:10 AM, on December 28, 1966, eastbound firstclass passenger train No. 563, consisting of a single car diesel-powered passenger unit operated by the Boston and Maine Corporation collided with a northbound motor tank truck owned and operated by the Oxbow Transport Corporation stopped across the Second Street grade crossing at Everett, Mass. The collision resulted in the death of 11 of a total of 28 passengers and 2 of the 3 train crew members and other injuries and damage to property. The semi-trailer of the tank truck containing 8,200 gallons of fuel oil ruptured on impact, covering the forward end of the passenger car with the oil. A spread of flames immediately covered the forward section of the car. The fatalities were due to thermal burns and smoke inhalation. There was a lack of emergency exits in the car, in addition to an inward opening rear door which became jammed in a closed position while people were attempting to escape. The truck driver had left the vehicle prior to impact and was not injured. The probable cause of the accident was the loss of air pressure in the brake systems of the tractor-trailer which resulted in an automatic application of the brakes that could not be released from the cab of the tractor and therefore held the tractor-trailer directly across the Boston and Maine track at the collision point.

National Transportation Safety Board Feb. 1968, 56 pp, Figs., Phots., 5 App.

ACKNOWLEDGMENT: National Transportation Safety Board
PURCHASE FROM: NTIS Repr. PC
PB-190212, DOTL NTIS

B5 071755
RAILROAD ACCIDENT REPORT: PENN CENTRAL TRANSPORTATION COMPANY FREIGHT TRAIN DERAILMENT PASSENGER TRAIN COLLISION WITH HAZARDOUS MATERIAL CAR, SOUND VIEW, CONNECTICUT, OCTOBER 8, 1970
At 8:50 p.m., October 8, 1970, Penn Central Transportation Company's freight train derailed near Sound View, Connecticut. Freight cars obstructed track in the path of Penn Central passenger train. The passenger train struck the freight cars, puncturing an LPG tank car designated as "empty." The derailed units of the passenger train passed through ignited gases from the punctured tank car and crossed a railroad bridge. Train crewmembers and passengers were injured. The Safety Board has determined that the probable cause of the derailment of the freight train was the breakage of a truck side of a car on the freight train which followed a progressive fatigue crack failure. The breakage of the truck side resulted in damage to a turnout, which caused derailment of the following cars. The cause of the collision to the passenger train was the obstruction of track No. 2 by cars of the freight train. The Board concluded industry controls to prevent application of improper car components are inadequate, empty tank cars may be hazardous, and suggested that the industry should incorporate crashworthy concepts, improve communication and equipment design, and controls over maintenance, retirement, and testing of equipment components. The Board requested that bridge standards and joint corridor usage be reviewed.

National Transportation Safety Board NTSB-RAR-72-1, Dec. 1971, 49 pp, 16 Fig., Phots., 5 App.

ACKNOWLEDGMENT: National Transportation Safety Board
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-207621, DOTL NTIS

B5 071759
RAILROAD ACCIDENT REPORT: ILLINOIS CENTRAL RAILROAD COMPANY TRAIN SECOND 76 DERAILMENT AT GLENDORA, MISSISSIPPI, SEPTEMBER 11, 1969
About 2:35 p.m., September 11, 1969, an Illinois Central freight train struck a pedestrian near the Glendora, Mississippi, station. When the engineer applied the brakes in full emergency in an attempt to avoid striking the pedestrian, the 149-car train buckled at the 108th car. The resulting derailment involved 15 cars, including eight tank cars loaded with vinyl chloride. The cars separated in the derailment and the coupler of one of the cars punctured one of the tank cars, spilling its contents on the ground. Initially, the breeze dispersed the vapor; however, about 8:30 p.m. the vapor accumulated in low places and was ignited by an unknown source. The ignition was followed by several explosions. Upon advice from a State chemist, an estimated 17,000 to 21,000 persons were evacuated because of an alleged danger from phosgene. The following morning a fire-impinged tank car of vinyl chloride exploded violently, seriously damaging the surrounding area. Four tenant houses, several auxiliary buildings, automobiles, and equipment were destroyed and damaged by fire. The pedestrian was seriously injured and a power company employee was burned. Both recovered. The Safety Board determines that the derailment was caused by the buckling of the underframe of the 108th car when the engineer made a full emergency brake application in an attempt to avoid striking a pedestrian who was walking in the track. The car buckled because of excessive and uncontrollable compression in the train which developed when the full emergency brake application created greater braking force on the head of the train than on the rear. The fire and explosions resulted from the rupture of a tank car of vinyl chloride by the coupler of one of the derailed cars. The absence of underlocking couplers and other means of preventing separation and jacknifing allowed the cars to jam up together. The pileup resulted in additional mechanical damage to the tanks and allowed the fire from the leaking tank to impinge on the others.

National Transportation Safety Board NTSB-RAR-70-2, Aug. 1970, 24 pp, 2 Fig.

ACKNOWLEDGMENT: National Transportation Safety Board
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-194696, DOTL NTIS

B5 071789
FOUR-AXLE ALUMINUM TANK CAR FOR TRANSPORTING PHENOL (MODEL UADHS) [Vierachsiger Aluminum-Kesselwagen fuer den Transport von Phenol (Bauart Uadhs)]
The design and material features, operational characteristics, manufacture, and testing of a new model of a four-axle aluminum tank car constructed by Norwegian Company A/S Strommesis Vaerksted for the Norwegian Railroads are described. [German]

Groholt, K (Strommesis Vaerksted, Norway) *Schweizer Alumin Rundschau/Revue Suisse de Alumin* Vol. 24 No. 4, Apr. 1974, pp 118-126, 3 Ref

ACKNOWLEDGMENT: EI (EIX740802800)
PURCHASE FROM: ESL Repr PC, Microfilm

B5 071941
AT DERAILMENTS-DON'T BECOME A PROBLEM OR A CORPSE
With the chemical industry growing at 6% to 7% annually, and up to 60% of this new exotic products, the problems of tank car damage in derailments are increasing. While most attention has been given to cars containing highly volatile flammable liquids and liquefied compressed gases, there are other commodities which are more deadly, though not so spectacular. At derailments it is essential to determine what each car contains, and what it last contained. Needed immediately is information on the behavior of chemicals with and without fire, and on their possible reaction with each other. The AAR has recommended ten steps for safe transportation of compressed gases to the National Transportation Safety Board in response to its request.

Presented in the Proceedings of the Seventy-eighth Annual Convention of the American Railway Bridge and Building Association, Chicago, Illinois, 17-19 September 1973.

Schlaf, ER (Illinois Central Gulf Railroad)
American Railway Bridge and Building Association Proceeding Sept. 1973, pp 44-55

PURCHASE FROM: American Railway Bridge and Building Association 18154 Harwood Avenue, Homewood, Illinois, 60430 Repr. PC

B5 072103
STOWING OF GOODS IN CONTAINERS AND ON FLATS
This handbook consists of a summary of the experience and practical applications acquired in various branches of the transportation sector. The stowing instructions summarized are very well detailed and include information on loading stress, packing material, securing loads on flats and in containers, and a section on the handling of dangerous goods. Illustrations are included.

Also available from the International Cargo Handling Coordination Association.

Swedish Transport Research Commission, International Cargo Handling Coordination Assn 1968, 72 pp, 40 Fig.

ACKNOWLEDGMENT: TSC
PURCHASE FROM: Swedish Transport Research Commission Grev Turegatan 12D, 11446 Stockholm, Sweden, Repr. PC
DOTL TA1215.R69

B5 072592
RAILROAD ACCIDENT REPORT: PENNSYLVANIA RAILROAD TRAIN PR-11A, EXTRA 2210 WEST AND TRAIN SW-6, EXTRA 2217 EAST DERAILMENT AND COLLISION DUNREITH, INDIANA, JANUARY 1, 1968
About 9:30 p.m., January 1, 1968, Pennsylvania Westbound freight train PR-11A, consisting of 98 cars and five-unit diesel-electric locomotive, was passing Dunreith, Indiana, at 42 miles per hour when the trailing wheels of the 88th car, an empty tank car, AESX 850, derailed at a broken rail near the eastern edge of the town. At the same time, eastbound freight train SW-6 consisting of a five-unit diesel-electric locomotive and 106 cars, was moving eastward at 32 miles per hour on the adjacent track. The derailed car in train PR-11A continued westward until it became disengaged from its trailing truck when it struck the crossing board at a grade crossing about 723 feet west of the point of original derailment. One or more cars collided with cars of hazardous materials moving in the opposite direction in SW-6's train, causing a general derailment and puncturing several tank cars of flammable materials. A large-scale fire ensued, followed by a violent explosion of a tank car of ethylene oxide forty-five minutes later. Immediately after the derailment and outbreak of fire the population of Dunreith was evacuated without injury. A cannery and several residences and businesses were destroyed. Three firemen and two police- men were slightly injured in the fire and explosion. The probable cause of the initial derailment in train PR-11A was the broken rail within the compromise joint where two different sizes of rail were joined. A contributing causal factor was the inadequate track maintenance which left the joint unsupported and allowed the development of the break in the rail. This initial derailment and the design of the lift-off type of center-pin connection between the truck and body of AESX car 850 which allowed the truck to separate from the car under impacts of a simple derailment, led to the secondary collision and general derailment.

National Transportation Safety Board No. SS-R-2, Dec. 1968, 73 pp, 11 App.

ACKNOWLEDGMENT: National Transportation Safety Board
PURCHASE FROM: NTIS Repr. PC
PB-190213, DOTL NTIS

B5 072673
THE EFFECT OF THE STATE OF STRESS ON THE STRAIN AT FRACTURE
Tension tests on solid cylindrical specimens and internal pressure tests on one type of tubular specimen showed that a superimposed hydrostatic pressure increased the ductility. Internal pressure tests on a similar tubular specimen that was supported in a different manner showed that the hydrostatic pressure had almost no effect on the ductility.

This paper was contributed by the Materials Division for publication in the Journal of Engineering Materials and Technology.

Davis, EA (Westinghouse Research Laboratories)
American Society of Mechanical Engineers No. 74-MAT-K, May 1973, 5 pp, 3 Fig., 2 Tab., 5 Ref.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ASME Repr. PC

DOTL RP

B5 072710
RAILROAD ACCIDENT REPORT: DERAILMENT AND SUBSEQUENT BURNING OF DELAWARE AND HUDSON RAILWAY FREIGHT TRAIN AT ONEONTA, NEW YORK, FEBRUARY 12, 1974

This report describes and analyzes a derailment which occurred when a train separation resulted in unequal deceleration of the two parts of the train. Unusual lateral forces at the rear of the third locomotive unit canted the outside rail of a 3 degrees 30' curve outward enough to allow the wheels to drop inside. A tank car of propane was punctured and the ensuing fire impinged other tank cars and caused the violent rupture of three of them. Fifty-four person were injured by the fire and rocketing parts of tank cars. The National Transportation Safety Board determines that the probable cause of this accident was the inability of the track to resist the lateral forces which canted the outside rail outward and widened the gage of the track. These forces which were induced at the third locomotive unit resulted from the emergency application of the brakes when the train was separated between the third and fourth cars as it entered the 3 degrees 30' curve. The train separated as a result of the broken center sill on the fourth car.

This report contains Railroad Safety Recommendations R-74-31 through R-74-34.

National Transportation Safety Board NTSB-RAR-74-4, Oct. 1974, 25 pp, 4 Fig.

ACKNOWLEDGMENT: National Transportation Safety Board
PURCHASE FROM: NTIS Repr. PC, Microfiche

PB 237336/3SL, DOTL NTIS

B5 072761
TANK WAGONS FOR THE CONVEYANCE OF DANGEROUS GOODS ON BR LINES

Summarized are some of the important factors which warrant special attention in the design of tank cars for dangerous commodities. Quality of manufacture, coupled with rigorous inspection and testing procedures are cited. Ride and braking performance are essential elements in safe operation; the need for high maintenance standards during the car's service life must be recognized. British Rail and private owners strive to assure the containment of dangerous commodities in derailments, but the involvement of public agencies must also be encouraged.

Smith, AD *Railway Engineering Journal* Vol. 3 No. 5, Sept. 1974, pp 6-12, 8 Fig., 3 Ref., 1 App.

ACKNOWLEDGMENT: Railway Engineering Journal
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

B5 080102
RAILROAD ACCIDENT REPORT: SOUTHERN RAILWAY COMPANY TRAIN 154 DERAILMENT WITH FIRE AND EXPLOSION LAUREL, MISSISSIPPI JANUARY 25, 1969

Southern Railway train 154 was wrecked at Laurel, Mississippi on January 25, 1969 at about 4:15 a.m., when 15 tank cars of liquefied petroleum gas derailed. The train, with four diesel-electric locomotive units, 139 cars and caboose was moving northward at about 30 mph when the west wheel on the lead truck of the 62nd car in the train broke. The wheel which broke as it was passing over the crossing of the Gulf, Mobile, and Ohio Railroad, derailed about 256 feet north of the crossing, and the train continued northward for about 2,146 feet before the 62nd car and 14 loaded tank cars behind it were derailed. Most of the tanks were mechanically damaged by the derailment resulting in an immediate violent eruption of fire and explosion. Two fatalities resulted from injuries caused by the fires and explosions after the wreck, 33 persons were hospitalized. Property damage in the town was extensive and total damage to Southern Railway track, equipment and lading was estimated at about $3,000,000.

National Transportation Safety Board 1969, 74 pp, Figs., Phots., 4 App.

ACKNOWLEDGMENT: National Transportation Safety Board
PURCHASE FROM: NTIS Repr. PC

PB-190208, DOTL NTIS

B5 080115
METALLOGRAPHIC EXAMINATION OF SPECIMENS REMOVED FROM A SECTION OF TANK CAR IN SOUTH BYRON, NEW YORK DERAILMENT

The analysis presented in this report was conducted on the two specimens removed from shell plates. There are variations in banding, ferrite volume, blocky and acicular ferrite, but these represent normal variations in ingot freezing practice and rolling mill practice. None of these variations should result in significant differences in tensile rupture characteristics.

An RPI-AAR Cooperative Project.

Olson, LL
Association of American Railroads Technical Center, (RA-03-2-4) R-127, Mar. 1971, 10 pp, 14 Fig., 12 Phot.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC

B5 080116
METALLOGRAPHIC EXAMINATION OF SPECIMENS REMOVED FROM SECTIONS OF TANK CARS IN CRESCENT CITY DERAILMENT

Phase 03 report on Metallographic Examination of Specimens Removed from Sections of Tank Cars in Crescent City Derailment. Samples were removed for the purpose of later examination by fracture mechanics experts. In preparation for these later examinations and to insure against the possibility of an untimely later discovery of some important material shortcomings, a brief metallurgical examination was made of these specimens. The results are presented in this report.

An RPI-AAR Cooperative Project.

Reedy, CR Olson, LL Weston, RA
Association of American Railroads Technical Center, (RA-03-1-2) R-125, Oct. 1970, 19 pp, 14 Fig.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC

DOTL RP

B5 080117
SEQUENCE OF EVENTS FOLLOWING CRESCENT CITY DERAILMENT

Phase 01 Report on Sequence of Events Following Crescent City Derailment. Report concerns only the behavior of the tank cars following the derailment. Further, there are no conclusions drawn since this would be premature and inconsistent with plan of doing so only after assembly and study of all past and current accident data.

Reedy, CR Olson, LL Weston, RA
Association of American Railroads Technical Center, (RA-01-1-1) R-124, Aug. 1970, 19 pp, 11 Fig.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC

DOTL RP

B5 080122
COUPLER STEEL STUDY

FRA regulations stipulate that only approved couplers may be used on tank cars. Since some considerations was given a requirement for the use of Grade "E" steel in Type "F" couplers, the AAR Research and Test Department undertook a preliminary study of the properties of "C" and "E" steels in "F" couplers selected at random from stocks about to be utilized by railroads. The increase of strength between "C" steel and "E" steel does not contribute to an increase in a tendency toward brittle failure. In fact, the increase in strength is accompanied by a reduction in the transition temperature. Brittle service failures can be expected, especially in winter operating circumstances with heavy loads. The macroscopic examination reveals that the quality of the castings is lower than should be expected of material subjected to high service loading.

Contributing agencies are the Battelle Memorial Institute and the Southern Railway System.

Wisnowski, MJ
Association of American Railroads Technical Center, (70-R-61) Proj. Rpt. R-107, Dec. 1970, 49 pp, 23 Fig., 10 Tab., 20 Phot., 2 App.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B5 080279
OVERALL PROJECT SUMMARY REPORT
As a prerequisite to accomplishing the Project objective, over 4 man-years of effort were devoted to accumulating and analyzing accident data. Data on all accidents involving tanks cars were collected for the 6-year period 1965-1970, and for all major accidents back through 1958. The results of the accident review showed during the 1965-1970 period a loss of about $23.3 million was incurred due to product loss from tank cars that were punctured in accidents. About $15.4 million was caused by fire and about $7.9 million was attributable to non-fire causes. Careful attention was given to accidents involving tank cars that ruptured violently (vs. cars that were punctured) since these contributed primarily to the total losses. During the period from 1958 through 1970, a total of 113 cars ruptured violently, 41 during the single year of 1969. With this background the joint industry effort undertook numerous approaches to improving tank car safety with each appraised from a cost effectiveness standpoint. The various facets of the investigation are described with initial conclusions included. There are a series of detailed reports on the individual investigations available separately. A final report with added conclusions and recommendations is to be issued.
An RPI-AAR Cooperative Project.

Phillips, EA
Association of American Railroads Technical Center, (RA-00-1-22) R-145, Oct. 1972, 65 pp, Figs.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B5 080280
REPORT ON ANALYSIS OF TANK CAR TUB ROCKETING IN ACCIDENTS
The objective of Phase 12 of the RPI-AAR Tank Car Safety Project is to explain fundamentally the phenomena of tank car fracture behavior in accidents, particularly those fractures which led to violent ruptures. The Battelle Columbus Laboratories was engaged to conduct this research, and Battelle's final report on the study has been published under Report RA-12-2-20, "Phase 12 Report on Analysis of Fracture Behavior of Tank Cars in Accidents". The analysis explained the various fracture phenomena that have occurred and which have led to various tank rupture patterns. One type involves a fracture which runs longitudinally, then turns to a circumferential tearing shear fracture. This sometimes completely encircles the tank and creates a tank section open at the fractured end and closed at the other end by the tank head. The unreleased pressure acting on the closed end creates an unbalanced force on the "tub" and causes it to rocket. Battelle analyzed this rocketing phenomena and discusses the effectives on possible design changes which would offer the potential of reducing the distance travelled by the tubs, or eliminating the rocketing completely.
An RPI-AAR Cooperative Project.

Phillips, EA
Association of American Railroads Technical Center, (RA-12-2-23) R-146, Dec. 1972, 52 pp, Figs., Tabs., Refs., 3 App.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B5 080282
PRELIMINARY REPORT ON LABORATORY FIRE TEST APPARATUS FOR EVALUATING THERMAL SHIELD MATERIAL
RPI-AAR Report RA-01-2-7, "Summary of Ruptured Tank Cars Involved in Past Accidents," tabulated 84 cases of major ruptures and 14 cases of minor (local) ruptures of tank cars since 1958. Of these, the cause of rupture was known for 75 cases. Of these 75 cases, 66 were caused by fire impingement. As discussed in that report, there is strong evidence that most of these were a result of the unwetted (vapor space) steel being overheated and weakened. One method of reducing the probability of tank car ruptures due to fire exposure is to reduce the heat input to the steel with an intumescent paint, an ablative coating, a high temperature insulation, or some combination thereof. These are termed "Thermal shield materials" under the RPI-AAR Project, but, for brevity, will be called "coatings" in the remainder of this report. The original objective of the laboratory tests described in this report was to compare and screen such coatings in order to find attractive candidates early in the program for selection for subsequent 1/5 and full scale fire tests. The test apparatus was designed to simulate the behavior of the unwetted steel portion of a tank car when exposed to fire. Most of the thermal coatings tested were obtained from commercially available sources. This report is a synopsis of the test work completed to date.
An RPI-AAR Cooperative Project.

Brown, F
Association of American Railroads Technical Center, (RA-11-3-15) R-138, May 1972, 65 pp, Figs., Tabs., 4 App.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B5 080283
REPORT ON ANALYSIS OF 1/5 SCALE FIRE TEST DATA
Under the RPI-AAR Phase II "Thermal Effects Study," a Series of 1/5 and full scale fire tests were conducted in cooperation with FRA. The tests were carried out at the White Sands Missile Range by personnel of the Naval Ordnance Laboratory. Under this cooperative arrangement, RPI-AAR is furnishing the 1/5 scale tanks and full scale tank cars, complete with lading, appropriate fittings and safety devices, and NOL is furnishing the instrumentation and providing the data reduction. Three tests were conducted on tanks constructed to a 1/5 linear scale of a nominal 33,500 gallon DOT 112A340W, tank car, except that full scale tank wall thickness was maintained, water was employed as lading in the first two tests, and propane was used in the third. All three tanks were bare (non insulated). Because of instrumentation difficulties in the water tests, all future 1/5 and full scale tests will be conducted with propane. This report covers an analysis of the results of the third (propane) test; analyses, results, conclusions and recommendations represent only the work and views of the RPI-AAR Project team and not those of DOT (FRA).
An RPI-AAR Cooperative Project.

Manda, L
Association of American Railroads Technical Center, (RA-11-2-14) R-137, Apr. 1972, 37 pp, 18 Fig.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B5 080289
FINAL PHASE 09 REPORT ON TANKS, FITTINGS, AND ATTACHMENTS IN THE MECHANICAL ENVIRONMENT OF ACCIDENTS
Phase 09 of the RPI-AAR Tank Car Safety Research and Test Project concerns the behavior of tank car tanks and their appurtenances in the mechanical environment of railroad accidents. Thus, the items treated under this Phase 09 are: Tank shell-the portion of the tank between the heads, Tank fittings-the appurtenances attached to the tank shell and heads which are associated with openings through the vessel wall, and tank attachments-appurtenances attached to the tank shell and heads which are not associated with openings through the vessel wall. As an underlying principle, in the cost/benefit analyses under this study, the benefit values of design improvements, such as protective devices or "shields," are developed from accident data only from cases involving lading loss, the total dollar losses being the value of the lost lading plus that of subsequent losses caused by the lading loss. The cost of mechanical damage itself to shells or appurtenances is not considered reducible by a design change, it being assumed that the cost of repairing the "shield" is the same as that of

repairing the unshielded item. Following the statement of the objective, the report comprises four main sections: (1) review of typical current tank car shell and appurtenance designs, (2) review and analysis of accident data, (3) discussion and conclusions, and (4) recommendations.

An RPI-AAR Cooperative Program.

Reedy, CE Phillips, EA
Association of American Railroads Technical Center, (RA-09-1-24) R-147, 88 pp, Figs., 3 App.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B5 080291
EFFECTS OF FIRE ON LPG TANK CARS. PHASE II REPORT

The response of a DOT 112A340W tank car to a fire environment is investigated theoretically in this study, giving particular attention to propane lading. The possibility of tank rupture arising from variations in filling density, tank thickness, safety-relief valve setting and discharge rate is analyzed for fire conditions ranging from a unit heat input of 34,500 BTU/HR-FT over the entire tank surface to approximately one quarter of this value. The analysis and, hence, conclusions are based on several assumptions necessitated by the lack of data in certain areas; thermodynamic properties of commercial propane; valve discharge efficiencies with saturated fluids and slightly subcooled liquid; stratification effects; and of course, the statistical spectrum of the fire environment. Nevertheless, the results are published at this time as a foundation upon which further project work will be based.

An RPI-AAR Cooperative Project.

Manda, L
Association of American Railroads Technical Center, (RA-11-1-5) R-128, Apr. 1971, 68 pp, 19 Fig., 5 App.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B5 080292
REPORT ON TANK CAR ACCIDENT INVESTIGATION GUIDE. PHASE 12 REPORT

The purpose of this guide is to provide assistance to an investigator examining a tank car involved in a railroad accident and which ruptured or was punctured. The guide is intended to provide background information for the identification of fracture mode, the determination of the fracture origin and fracture pattern, and suggestions for the selection of samples for laboratory examination.

An RPI-AAR Cooperative Program.

Reedy, CE
Association of American Railroads Technical Center, (RA-12-1-6) R-129, May 1971, 12 pp, 6 Fig.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B5 080293
REPORT ON SUMMARY OF RUPTURED TANK CARS INVOLVED IN PAST ACCIDENTS. PHASE 01 REPORT

This report constitutes an extension and refinement of previously issued Report RA-01-2-3, "Summary of Ruptured Tank Cars Involved in Accidents-12/4/70." Damage to a tank in an accident, leading to loss of lading, can be divided into two main categories: (1) Punctures, tears, dents with peripheral cracks, etc., caused by an external impact and involving little or no crack propagation away from the area of impact. (2) Ruptures, or outwardly moved metal, involving the propagation, and sometimes branching, or a crack (or cracks). A crack, once initiated, may or may not propagate. The propagation phenomenon--or tank rupture--is influenced by many variables, including the amount of energy which is available in the system and properties of the tank material at its existing temperature. As a result many modes of rupture occur. A comprehensive analysis of this entire subject is being performed by Phase 12 research contractor, Battelle Memorial Institute, and no attempt will be made in this report to develop explanations for the various rupture modes. This report is organized as follows: All ruptured cars (113 since 1958) are divided into two categories--those involving cracks which remained within a heat-weakened area (18 cars--listed in Appendix B), and those involving crack propagation beyond the heat-weakened area, or in tanks having no heat-weakened area (95 cars--listed in Appendix A). The ruptures in these two categories were generally "local" and "major", respectively; so, for brevity these terms will be used in this report. The data in Appendices A and B are summarized in Table 1 through 10, in Sections II, III, IV and V of this report. No conclusions or recommendations are made, since the only objective of this report is to publish information which we have been able to derive from a large collection of records and photographs on this important subject.

An RPI-AAR Cooperative Project.

Weston, RA
Association of American Railroads Technical Center, (RA-01-2-7) R-130, July 1972, 72 pp, Figs., Tabs., 2 App.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B5 080294
REPORT ON LITERATURE AND RELATED EXPERIENCE. PHASE 04 REPORT

Knowledge of the work done by others in technical areas related to the RPI-AAR Cooperative Research Program was largely unknown to project personnel. A review of the technical work already done was necessary to optimize project planning and avoid duplication of work while fulfilling project objectives. It was decided that the review would be most effectively accomplished by: 1. Engaging a research organization to review the literature pertaining to non-tank car pressure vessel destructive testing; puncture resistance; size and grouping vs. hazard; and material testing and selection. 2. Conducting a seminar attended by experts from industry, technical associations, consultants, research organizations and government. 3. Reviewing the files of trade associations. 4. Reviewing literature in areas of tank car accidents, properties of pressure vessel materials (including tank cars), safety valve technology, model theory, pressure vessel stress analysis, safety relief valve sizing, LPG and NH3 behavior under fire conditions, and intumescent, ablative and insulative coatings. 5. Collecting and assembling all pertinent literature in a library and cataloguing each article for ready reference.

An RPI-AAR Cooperative Project.

Skogsberg, AM
Association of American Railroads Technical Center, (RA-04-1-8) R-131, July 1971, 51 pp, 326 Ref.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Rerp. PC
DOTL RP

B5 080295
REPORT ON SEQUENCE OF EVENTS FOLLOWING HOUSTON, TEXAS DERAILMENT. PHASE 01 REPORT

This report concerns only the behavior of the tank cars following the derailment. Further, there are no conclusions drawn since this would be premature and inconsistent with the plan of doing so only after assembly and study of all past and current accident data.

An RPI-AAR Cooperative Project.

Reedy, CE
Association of American Railroads Technical Center, (RA-01-3-9) R-132, Oct. 1971, 13 pp, 3 Fig.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B5 080296
REPORT ON DOLLAR LOSS DUE TO EXPOSURE OF LOADED TANK CARS TO FIRE, 1965-1970. PHASE 02 REPORT
The purpose of this study is to estimate the maximum probable savings that might be realized by preventing fire damage to loaded tank cars in accidents. This information will be used in the economic evaluation of the thermal shield systems being sought under Phase II.
An RPI-AAR Cooperative Project.

Weston, RA
Association of American Railroads Technical Center, (RA-02-1-10) R-133, Feb. 1972, 35 pp, Figs., Tabs., 2 App.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B5 080297
REPORT ON DETERMINATION OF MOMENT CHARACTERISTICS IN A HORIZONTAL PLANE OF MATED COMBINATIONS OF TYPE "E" AND "F" COUPLERS. PHASE 10 REPORT
The objectives of this laboratory test were to determine the moment-angle relationship in a horizontal plane for each of three coupler combinations (E-E, F-F, and E-F) installed complete with draft gear, yoke, etc., in tank car stub sills and to study the elastic-plastic behavior of failure of the various components in the assemblies. The lateral moment resistance in all three coupler combinations is of the same magnitude. The moment-angle curves exhibit an identifiable elastic and plastic range. In the higher load region, the two "E" couplers exhibited greater ductile behavior--probably due to the elongation of the knuckles. In the case of the two "F" couplers, an earlier fracture occurred with less yielding of components. In the "E" combination, the higher load portion of the curve exhibited yielding somewhat between that of the other combinations. Failure in each test occurred in the coupler shank between the horn and that portion which contacted the striker side.
An RPI-AAR Cooperative Project.

Sims, RD
Association of American Railroads Technical Center, (RA-10-1-11) R-134, Feb. 1972, 19 pp, 3 Fig., 11 Phot.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B5 080298
REPORT ON COMPUTER DERAILMENT STUDY. PHASE 08 REPORT
Train accidents involving cars carrying hazardous materials have been the cause of substantial losses in recent years. This is a source of great concern to carriers, owners, and government agencies. When a derailment takes place, little is known of the phenomenon of car behavior immediately thereafter. All that is known are the end results. Inasmuch as car derailments cannot be practically duplicated in the laboratory, an analytical approach is the obvious method to use in obtaining data on derailment behavior. The objective of this study is to set forth a mathematical model to find the motions, forces and accelerations experienced by the derailed cars at each instant of time in the train derailment. The information obtained can offer a promising path to evaluate car design and train makeup as related to derailment losses. In this theoretical analysis of the derailment, the equations of motion for each derailed car are derived in general in the horizontal plane. These are then coupled with a system of constraint equations and the equation of motion for the non-derailed cars. The equations are then solved numerically (by digital computer) in their non-linear forms with the first car derailed as the sole initially assumed conditions; the ground friction, mating coupler moment and brake retarding forces are in action accordingly. A total of twenty-six (26) simulations were run to show the influence of variables on derailment behavior over a range of feasible train design parameters.

Phillips, EA
Association of American Railroads Technical Center, (RA-081-12) R-135, Feb. 1972, 72 pp, 30 Fig., 2 Tab.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B5 080299
DATA DISPLAY REPORT ON RESULTS OF TESTS ON MILL PLATE SAMPLES AND SAMPLES REMOVED FROM TANK CARS INVOLVED IN ACCIDENTS. PHASE 03 REPORT
One of the primary objectives of the Phase 03 "Material Study" was to assemble, through tests, the physical, chemical and metallurgical properties of: (1) Steels currently used in tank car fabrication (mill plate samples); (2) Steel samples removed from tank cars involved in accidents. To accomplish Item 1, steel samples were obtained from several of the tank car companies sponsoring the RPI-AAR Project. These samples included both shell and head plate steels and reflected various conditions of heat treatment. Steels rolled in both domestic and foreign mills were included in the program. The steel producers are identified by a code letter only since the program objective is to establish data ranges for similar steels and not to isolate particular producers. Steel samples under Item 2 above were collected by the AAR Research Center prior to the formation of the RPI-AAR Project (Glendora, Miss.; Troup, Texas; Lehigh, Kansas) and by the RPI-AAR Project team from accidents which occurred since that time (Crescent City, Ill.; South Byron, N.Y.; Callao, Mo.; Kamloops, B.C.; Houston, Texas). Metallurgical reports have been previously issued by the Project based on examination of samples from Crescent City and South Byron. The purpose of this report is to simply display all test data in tabular and graphical form in order to make it immediately available. Analysis of results, conclusions and possible recommendations will be made in the final Phase 03 report and in the Overall Project Report. This report is organized as follows: Tables 1 through 10 list all the steel samples tested and tabulate their properties and the primary results of the tests. Figures A through K shown the location of the steel samples removed from cars involved in accidents and show their relationship to the fracutre patterns in the tank plates. Finally, the results of all the Charpy V-Notch tests are given in Figures 1 through 43, the Dynamic Tear Tests in Figures 44 through 84, and the Drop Weight Tear Tests in Figures 85 through 93.

Olson, LL
Association of American Railroads Technical Center, (RA-03-3-13) R-136, Apr. 1972, 122 pp, 93 Fig., 10 Tab.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B5 080336
ANALYSIS OF FRACTURE BEHAVIOR OF TANK CARS, PHASE 12 REPORT
The objective of Phase 12 of the RPI-AAR Tank Car Safety Project is to explain fundamentally the phenomena of tank car fracture behavior in accidents, particularly those fractures which led to violent ruptures. The Battelle Columbus Laboratories was engaged to conduct this research and Battelle's final report on the study is included. Battelle's charge was to examine all accident data accumulated under the RPI-AAR Project and to supplement this with tests, accident site investigations, and other studies, as appropriate, to explain why the fractures behaved as observed. Based on the results, Battelle was asked how tank car modifications would alter the fracture behavior. This was done for all observed types of fracture patterns which were catalogued in scenario fashion. Conclusions are drawn on the effectiveness on reducing accident losses of various tank car modifications, particularly in the area of steel metallurgy and tank fabrication. These conclusions will be combined with the results of the RPI-AAR Phase 02 accident review to establish cost-effectiveness for each modification. From this recommendations will be made in the Overall Project Summary Report RA-00-1-22.
An RPI-AAR cooperative program.

Phillips, EA Wenk, RL Fessler, RR Eiber, RJ
Association of American Railroads Technical Center Ra-12-2-20(R-143), Sept. 1972, 187 pp, 31 Fig.

ACKNOWLEDGMENT: Association of American Railroads Research Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B5 080337
COUPLERS AND TRUCK SECUREMENT. PHASE 10 REPORT
Phase 10 of the RPI-AAR Tank Car Safety Project was established to study the influence on tank car behavior in accidents of all non-tank components of a tank car. Of these components, couplers and trucks were later selected as the only significant items for study. The influence of couplers on tank car accidents was evidenced by the accident data collected for the years 1965 through 1970. During this 6 year period, 173 tank cars incurred head punctures, and of these, 148 were known to have been caused by couplers on adjacent cars. The data also showed that truck components, particularly wheels, often punctured tank car shells. Finally, of interest was the influence on the severiry of derailments (i.e. number of cars derailed and degree of jackknifing) of various coupler deisgns and the concept of truck securement. The purpose of this report is to review and discuss the results of the studies and to draw conclusions regarding functional efficiencies of current and modified coupler and truck designs toward improving tank car safety in accidents.
An RPI-AAR cooperative program.

Sims, RD
Association of American Railroads Technical Center, (T-5-1) Final Rpt. RA-10-2-19(R-142), Sept. 1973, 35 pp, 7 Fig., 13 Phot.

ACKNOWLEDGMENT: Association of American Railroads Research Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B5 080338
ACCIDENT REVIEW. PHASE 02 REPORT
This report summarizes the activities under Phase 02 of the RPI-AAR Railroad Tank Car Safety Research and Test Project. Phase 02 was concerned with the analysis of tank car accidents to determine the probability of lading loss from tank cars involved in accidents and the potential value of various design concepts that would reduce the probability of lading loss. This report summarizes the incidents of lading loss from tank cars due to mechanical damage incurred in accidents in the period 1965 through 1970, the available information on tank car utilization during this same period, and the various statistics on risk levels and loss experience that were derived from this data. The values of various design concepts are presented, and an analysis is made of the effect of overlapping effects which would result from the implementation of more than one of the concepts.
An RPI-AAR cooperative program.

Weston, RA
Association of American Railroads Technical Center, (T-5-1) Final Rpt. RA-02-2-18(R-141), Aug. 1972, 253 pp

ACKNOWLEDGMENT: Association of American Railroads Research Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B5 080339
TANK CAR HEAD STUDY. PHASE 05 REPORT
During initial planning of the RPI-AAR Tank Car Safety Project, it was known that tank car heads were punctured in accidents with sufficient frequency to warrant assigning a specific Project Phase (05) for its study. The sequence of analyses and tests that were conducted under this phase were: Analysis of scale model laws for establishing feasibility of reduced scale tests; Preliminary drop weight tests on 1/12 scale tank car heads; Head impact tests on full scale old rivited tank cars; Development of head protection schemes and related cost/benefit analyses under contract to DOT; Head impact tests on 1/5 scale pressure and non-pressure cars with and without sill-head reinforcements; Head impact tests on 1/5 scale 112A340W pressure cars; Head impact tests on full scale new pressure cars to evaluate final head shield design; Analysis of all tests to correlate data, evaluate sensitivity of parameters, and predict degree of protection offered by final head shield design under various accident conditions. The purpose of this final Phase 05 Report is to present all the results under one cover, discuss them, and draw conclusions.
An RPI-AAR cooperative program.

Phillips, EA
Association of American Railroads Technical Center, Federal Highway Administration, Indiana State Highway Commission, (T-5-1) Final Rpt. RA-05-1-17(R-140), July 1972, 119 pp

ACKNOWLEDGMENT: Association of American Railroads Research Center
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-246433/7ST, DOTL/NTIS

B5 080340
REPORT ON ACCIDENT REVIEW. PHASE 01 REPORT
This report summarizes the activities under Phase 01 of the RPI-AAR Railroad Tank Car Safety Research and Test Project. Phase 01 was concerned with the collection and cataloging of tank cars in an accident environment. This report summarizes the procedures used to gather and catalogue the data, the sources from which data was collected, and the organization of the data in the Project files. Much of the data was coded and transferred to a magnetic tape for computer retrieval. The data codes, format of the data tape, copies of the computer programs used to maintain the tape and retrieve information, and examples of the summary information obtained from computer analysis of the data are also included in this report.
An RPI-AAR cooperative program.

Weston, RA
Association of American Railroads Technical Center, (T-5-1) Final Rpt. RA-01-4-16 (R-139), June 1972, 75 pp

ACKNOWLEDGMENT: Association of American Railroads Research Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B5 080370
EXTENSION STUDY OF TANK CAR BOTTOM FITTINGS-EXECUTIVE SUMMARY. PHASE 09 REPORT
In its previous study of accident data over the 1965-1970 period, the RPI-AAR Tank Car Safety Project found that the most vulnerable tank car fitting was the bottom outlet on stub-sill non-insulated non-pressure class 111A cars. However, no cost-effective means were found to protect these outlets. In the final report RA-09-1-24, it was stated that with more current accident data and additional design ingenuity, this cost effectiveness picture may be altered. As a result, this Phase 09 extension effort was undertaken. Comprehensive studies were made of: 1) All accidents involving damage to bottom fittings during the 3 year period 1971-1973 2) Current designs of bottom fittings 3) Populations of tank cars with various bottom fitting designs 4) Numerous design solutions to reduce bottom fittings vulnerability (26 for new cars and 19 for existing cars) 5) Current tank car shipper/-receiver practices and philosophies regarding top and bottom loading and unloading of tank cars. With this background, cost-effectiveness calcualtions were made for solutions for all classes of cars. As found previously, the cars with the most vulnerable bottom fittings were the stub sill cars.
Direct requests to the Project Directors Office, Earl Phillips.

Phillips, EA
Association of American Railroads Technical Center, (RQ-09-2-27) Final Rpt. R-161, May 1974, 111 pp, 8 Fig., 13 Tab., 6 App.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B5 080371
REPORT ON FEBRUARY 9, 1974, ACCIDENT INVOLVING TYPE E TOP AND BOTTOM SHELF COUPLERS (4/22/74). PHASE 10 REPORT
While it has not been within Project policy to issue reports on specific accidents, a second derailment has occurred which involved the Type E top and bottom shelf coupler (The previous derailment occurred on July 1, 1973 and is reported on in RA-10-3-25, dated 12/11/73) and is of sufficient interest to warrant departure from policy. The performance of these "shelf" couplers in accidents is of vital interest in view of the Project recommendation (ref. Section VI, Report RA-00-1-22) that all new tank cars and certain existing ones be equipped with these couplers to reduce the probability of head punctures, whereas the previous derailment involved a hopper car so

equipped (L&N 191421). The car is one of 225 cars which have been in trial service to determine if any problems exist with these couplers in normal railroad operational environment, satisfactory performance being a prerequisite to adoption of the Project recommendations. Conversely, it was not expected that sufficient derailments would occur with 225 cars to make the prime objective of this trial service one of evaluating the couplers' performance in the derailment environment; however, since a second accident has occurred, it is obviously worthy of careful review.

An RPI-AAR Cooperative Project. Direct requests to the Project Director's Office, Earl Phillips.

Phillips, EA
Association of American Railroads Technical Center, (RA-10-4-28) R-159, Apr. 1974, 13 pp

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B5 080372
REPORT ON JULY 1, 1973 ACCIDENT INVOLVING TYPE E TOP AND BOTTOM SHELF COUPLERS (12/11/73). PHASE 10 REPORT

While it has not been within Project policy to issue reports on specific accidents, a derailment on July 1, 1973 near Romney, Ky. is of sufficient interest to warrant departure from policy. This derailment involved a tank car equipped with Type E top and bottom shelf couplers (hereinafter referred to as "Shelf couplers"). The performance of these couplers in accidents is of vital interest since the Project has recommended that all new tank cars and certain existing ones be equipped with these couplers to reduce the probability of head punctures. The involved car, UTLX 59641, is one of 225 cars which have been equipped with the shelf couplers under a trial service program. The objective of this program is to determine if any problems exist with these couplers in normal railroad operational environment, satisfactory performance being a prerequisite to adoption of the Project recommendations. Conversely, it was not an objective to determine the couplers' performance in the derailment environment; however, since the accident has now occurred, it is obviously worthy of careful review.

An RPI-AAR Cooperative Project. Direct requests to the Project Director's Office, Earl Phillips.

Phillips, EA
Association of American Railroads Technical Center, (RA-10-3-25) R-154, Dec. 1973, 15 pp, 11 Fig., 9 Phot.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B5 080373
REPORT ON ANALYSIS OF 1/5 SCALE FIRE TESTS (12/12/73). PHASE 11 REPORT

Phase 11 of the RPI-AAR Project has addressed the question of tank car exposure to fire environments with the ultimate objective of developing cost-effective methods of reducing the probability of tank car ruptures in fires. By means of accident investigations, tests, and theoretical analyses, this study has sought to determine both the characteristics of the fire environment and the tank car response to fire exposure, including the assessment of thermal stresses. The study has emphasized the Class DOT 112A and 114A non-insulated cars since they have been involved in more significant accident loss cases. The several Phase 11 activities have included a series of laboratory fire tests conducted on plates simulating tank car steels and field fire tests conducted on 1/5 scale and full scale tank cars. The purpose of these tests has been to: 1. Study a single type of fire (i.e., the all-enveloping fire); 2. Characterize the response of 112A/114A type tank cars to the all enveloping fire; and 3. Evaluate representative state-of-the-art thermal protection systems (coatings) which might be applied to such cars. In addition to the above, the data from the 1/5 scale and full scale field tests will be used to improve a computer program which has been developed to predict the transient pressure/temperature histories of 112A/114A tank cars exposed to a variety of fires, including the all enveloping type. The data will also be used to improve the laboratory fire test apparatus. Both the computer program and laboratory test will be used in the development of performance requirements and specifications for candidate thermal shield materials. A specific purpose of the 1/5 scale tests has been to prepare for the full scale tests by gaining preliminary knowledge of the fires, instrumentation techniques, methods of data reduction and analysis, and the behavior of several thermal shield materials. The complete series of fire tests has consisted of seven (7) 1/5 scale and two (2) full scale tests, all conducted in cooperation with the DOT, FRA. These tests were performed at the White Sands Missile Range, initially by personnel of the Naval Ordnance Laboratory (NOL) and subsequently by the Ballistics Research Laboratory (BRL) under contract to the DOT (FRA). Under this cooperative arrangement the RPI-AAR furnished the 1/5 scale tanks and the full scale tank cars complete with lading, appropriate fittings and safety devices. The NOL (later BRL) provided the instrumentation, conducted the instrumentation, conducted the tests, and furnished reduced data. The report presented here analyzes the data obtained from the seven (7) 1/5 scale tests. The two (2) full scale tests will be treated in a subsequent report. All seven (7) tanks were constructed to a 1/5 linear scale of a nominal 33,500 gallon DOT 112340W tank car, except that the full scale shell thickness and safety valve were maintained. Figure A is a sketch of the 1/5 scale tank and the typical instrumentation and test setup. It is emphasized that the results, and particularly the conclusions, presented here apply only to the 1/5 scale tanks, and should not be extrapolated to the full scale case. Moreover, it is emphasized that this report represents only the analyses and views of the RPI-AAR Project, and does not necessarily reflect those of the DOT (FRA).

Phillips, EA Manda, L
Association of American Railroads Technical Center, (RQ-11-5-26) R-155, Dec. 1973, 41 pp, 25 Fig.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B5 080413
ANALYSIS OF NAD CRANE MAINTENANCE OF WAY

The report represents an in-depth comprehensive analysis of NAD Crane's railroad maintenance of way (M/W) program. Quantitative tools have been developed to provide a rational framework for decision making for M/W. This analysis was prompted by the occurrence of numerous derailments attributed to poor track conditions. The safety aspects of derailments of hazardous material including high explosives required a thorough analysis of causes related to operations of the Ordnance Department and the Public Works Transportation, Maintenance, and Maintenance Control Division. The report presents several recommendations for the establishment of annual levels of maintenance, recommendations on the equipment required, and recommendations on the priority use of maintenance resources. (Author)

Lucking, JR Hinkle, GJJ
Naval Ammunition Depot NAD-CR-RDTR-285, Sept. 1974, 133p

ACKNOWLEDGMENT: NTIS (AD/A-000066/1SL)
PURCHASE FROM: NTIS Repr. PC, Microfiche
AD/A-000066/1SL, DOTL NTIS

B5 080426
EXPLOSION HAZARDS ASSOCIATED WITH SPILLS OF LARGE QUANTITIES OF HAZARDOUS MATERIALS. PHASE I

The report documents the results of Phase I of a program whose object is to quantify the explosion hazards associated with spills of large quantities of hazardous material such as liquefied natural gas (LNG), liquefied petroleum gas (LPG), or ethylene. The principal results are (1) a phenomenological description of a spill, (2) an examination of the detonation properties of methane, (3) a qualitative theory of non-ideal explosions, and (4) a plan for Phase II of the study.

Lind, CD
Naval Weapons Center, United States Coast Guard Final Rpt. Oct. 1974, 63 pp

Contract DOT-CG-34095

ACKNOWLEDGMENT: NTIS (AD/A-001242/7ST)
PURCHASE FROM: NTIS Repr. PC, Microfiche
AD/A-001242/7ST, DOTL NTIS

B5 080647
INVESTIGATION OF THE FEASIBILITY OF THE DELPHI TECHNIQUE FOR ESTIMATING RISK ANALYSIS PARAMETERS
An assessment was made of the feasibility of establishing by subjective estimates inputs for a previously developed risk analysis model. The model combines data on the likelihoods and costs of accidents that could arise in the transportation of hazardous materials. It thereby develops a measure of risk suitable for comparisons of possible alternate means of transportation. This can provide information of value to decision-making on transportation safety regulations and special permits.The present report covers the potential for this augmentation through organized surveys of experts following the procedures of the Delphi technique. The Delphi experiment that was conducted is described in detail and its results, concerned with alternate means of transporting hydrogen sulfide, are presented. A Bayes procedure for combining such results with any statistical accident data that may become available is also defined.

Prepared in cooperation with Department of Transportation, Washington, D.C. Office of Hazardous Materials.

Philipson, LL
University of Southern California, Department of Transportation Final Rpt. RAPO-74-501, Apr. 1974, 177 pp

Contract DOT-OS-20114/1

ACKNOWLEDGMENT: NTIS (PB-236774/6ST)
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-236774/6ST, DOTL NTIS

B5 082921
AN APPRAISAL OF THE PROBLEM OF THE HANDLING, TRANSPORTATION, AND DISPOSAL OF TOXIC AND OTHER HAZARDOUS MATERIALS
The report presents detailed narrative, tables, and graphs as follows: Hazardous materials classification; Types and quantities of hazardous materials; Accidents involving hazardous materials; Transportation environment; Disposal of hazardous materials; and references and contacts. Hazardous materials discussed are flammable materials, compressed gases, corrosive materials, explosives, oxidizers, poisons including chemical warfare agents and pesticides, infectious agents, radioactive materials, and Molten Materials.

Booz-Allen and Hamilton, Incorporated, Department of Transportation, Council on Environmental Quality Final Rpt. Jan. 1970, 180 pp

Contract DOT-OS-05-00033

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-236599/7SL, DOTL NTIS

B5 082923
CHRIS: A CONDENSED GUIDE TO CHEMICAL HAZARDS
The Chemical Hazards Response Information System (CHRIS) manual is an official publication of the U.S. Coast Guard and consists of the following four volumes: A condensed guide to chemical hazards; hazardous chemical data; hazard assessment handbook; response methods handbook. The manual provides timely information essential for proper decision-making by responsible Coast Guard personnel and others during emergencies involving the water transport of hazardous chemicals. It also provides certain basic nonemergency related information to support Coast Guard efforts to achieve improved levels of safety in the bulk shipment of hazardous chemicals. The four manuals contain chemical data, hazard-assessment methods and response guides.

United States Coast Guard CG-446-1, Jan. 1974, 459 pp

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
AD/A-002390/3SL, DOTL NTIS

B5 083076
DIRECTORY OF FIRE RESEARCH IN THE UNITED STATES: 1971-1973
The Committee on Fire Research of the National Research Council is supported by several federal agencies and has as its mission "to advise, recommend, and identify areas of research and development needed for fire prevention and control and the alleviation of fire damage." This Directory has established itself as a general reference and resource for interchange of information for a diffuse and worldwide endeavor to understand the destructive action of fire. It reveals emerging frontiers of research in attempting to cover all fire research activities in the U.S. Included are the R&D efforts of the U.S. Department of Transportation involved in the Tank Car Safety Test and Research Project.

The work on this publication was done by the Committee on Fire Research, Division of Engineering.

National Academy of Sciences, (ISBN 0-309-02327-0) 1975, 361 pp

PURCHASE FROM: National Academy of Sciences 2101 Constitution Avenue, NW, Washington, D.C., 20418 Repr. PC
DOTL RP

B5 090555
DEVELOPMENT OF PERFORMANCE ORIENTED SPECIFICATIONS FOR DRUMS AND PAILS USED FOR PACKAGING OF HAZARDOUS MATERIALS FOR TRANSPORTATION
A study was carried out to develop performance requirements and tests for drums and pails used to ship hazardous materials. The current requirements and tests were obtained by studying DOT regulations and other standards and specifications on drums and pails. Reports on the hazards of shipping and the tests used in the packaging industry were also studied. Hazard classifications, performance requirements and tests, and a container rating system were developed. The rationale behind the development is presented in the report. Test plans for Qualification and Periodic testing and detailed test procedures were prepared. Tests included were Leak, Distortion, Pressure-Proof, Repetitive Shock (Vibration), Wet Strength-Stacking, Drop, and Puncture Tests and a Temperature Cycle.

Fridinger, CE Vickers, CVJ Gott, JS
Naval Surface Weapons Center, Department of Transportation Final Rpt. Dec. 1974, 105 pp

Contract DOT-AS-20065

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-240647/8ST, DOTL NTIS

B5 090647
RAILROAD TANK CAR FIRE TEST: TEST NUMBER 7
A fire test was conducted on a one-fifth scale model pressurized railroad tank car on 7 February 1973. The tank car model had a thermal insulation of four inches (10.16 cm) of polyurethane encased in a 0.125 inch (0.318 cm) steel jacket. The model was loaded with propane and then engulfed in a JP-4 jet fuel fire.

Anderson, C Townsend, W Zook, J Wright, W Cowgill, G
Ballistic Research Laboratory, Federal Railroad Administration Final Rpt. Dec. 1973, 154 pp

Contract DOT-AR-30026

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-241145/2ST, DOTL/NTIS

B5 090970
MINUTES OF THE EXPLOSIVES SAFETY SEMINAR (16TH), HELD AT THE DIPLOMAT HOTEL, HOLLYWOOD, FLORIDA ON 24-26 SEPTEMBER 1974. VOLUME II
The document presents discussions and papers reviewed at a seminar on hazards relative to handling, storing, and transporting explosive materials. See also Volume I, AD-A007 557.

Department of Defense Explosives Safety Board Sept. 1974, 764 pp

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
AD-A007566/3ST, DOTL NTIS

B5 090971
MINUTES OF THE EXPLOSIVES SAFETY SEMINAR (16TH), HELD AT THE DIPLOMAT HOTEL, HOLLYWOOD, FLORIDA ON 24-26 SEPTEMBER 1974. VOLUME I
The document presents discussions and papers reviewed at a seminar on hazards relative to handling, storing, and transporting explosive materials.
See also report dated 20 Sep 73, AD-775 660 and Volume 2, AD-A007 566.

Department of Defense Explosives Safety Board Sept. 1974, 780 pp

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
AD-A007557/2ST, DOTL NTIS

B5 091178
HAZARDOUS MATERIALS TRANSPORTATION (A BIBLIOGRAPHY WITH ABSTRACTS)
The transportation of explosives, rocket propellants, chemical warfare agents, industrial chemicals, liquefied natural gas, chlorine, and other hazardous materials are covered in this bibliography which contains 126 abstracts. All means of transportation are described. Accidents, economics, and statistics are also included in these reports. See also Published Search, NTIS/PS-75/285, Hazardous Materials Waste Disposal. Radioactive wastes are excluded.

Smith, MF
National Technical Information Service Feb. 1975, 131 pp

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
NTIS/PS-75/286/5ST, DOTL NTIS

B5 091253
ANALYTICAL INVESTIGATION OF A GRADE-CROSSING ACCIDENT BETWEEN A RAILROAD TRAIN AND A SPENT REACTOR FUEL CASK
No Abstract.

Dennis, AW
Sandia Laboratories Jan. 1975, 59 pp

Contract AT(29-1)-789

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
SAND-74-0317, DOTL NTIS

B5 091264
ATMX-600 RAILCAR SAFETY ANALYSIS REPORT FOR PACKAGING (SARP)
No Abstract.

Adcock, FE
Dow Chemical Company Oct. 1974, 37 pp

Contract AT(29-1)-1106

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
RFP-2244, DOTL NTIS

B5 091279
EVALUATION OF COMPUTERIZED TECHNIQUES FOR PREDICTING CHEMICAL REACTIVITY AND STABILITY
The purpose of this research project was to evaluate and optimize existing computer programs based on classical thermodynamics in regard to their ability to predict chemical reactivity, stability, and cargo compatibility in ship-board situations where unusual combinations might exist. Numerous calculated thermodynamic and experimental parameters were evaluated for their ability to predict the stability (self-reactivity) and reactivity (with other chemicals) of chemical substances. Also, thermodynamic prediction of toxic combustion products was accomplished for 20 bulk-transported chemicals under varying conditions. It was concluded that the relationship between the parameters considered and chemical stability and reactivity is too obtuse for conventional statistical analysis. Subsequently, pattern recognition techniques were employed and 11 of the more promising parameters were evaluated. It was concluded that thermodynamic prediction of toxic combustion products offered greater utility in assessing the hazard of burning chemicals than present consensus rating systems (USCG-(NAS-NRC) and NFPA), and a few experimental evaluations would be desirable to confirm the validity of the thermodynamic approach.

Alexander, CA Hoyland, JR Treweek, DM
Battelle Columbus Laboratories, United States Coast Guard Final Rpt. Apr. 1975, 74 pp

Contract DOT-CG-23223

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
AD-A009561/2ST, DOTL NTIS

B5 091295
RAILROAD TANK CAR FIRE TEST: TEST NO. 6
The Department of Transportation is conducting an extensive research program designed to develop methods to minimize personal injury and damage to property caused by fire from ruptured railroad tank cars filled with hazardous materials. The Ballistic Research Laboratories were requested by the Department of Transportation to conduct a series of field tests with scaled model and standard size railroad tank cars. The test described is one of the scaled model series which had no thermal protective coating, and where the relief valve was turned ninety degrees from the vertical.

Anderson, C Townsend, W Zook, J
Ballistic Research Laboratory, Federal Railroad Administration Final Rpt. Aug. 1973, 178 pp

Contract DOT-AR-30026

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-241207/0ST, DOTL NTIS

B5 091301
FRAGMENTATION AND METALLURGICAL ANALYSIS OF TANK CAR RAX 201
On 28 July 1973, the Ballistic Research Laboratories performed a full-scale fire test on a 33,000 gallon, DOT 112A340W non-insulated, pressure, rail rank car for the Federal Railroad Administration and Association of American Railroads. The car was filled with liquefied petroleum gas (LPG). After 24.5 minutes of exposure to the fire, the tank car ruptured. This report concerns the mapping of the fragments and metallurgical analysis of the ruptured car, along with an investigation of the cause and initial location of failure.

Anderson, C Norris, EB
Ballistic Research Laboratory, Federal Railroad Administration Final Rpt. Aug. 1974, 37 pp

Contract DOT-AR-30026

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-24125/2ST, DOTL NTIS

B5 091313
COST/BENEFIT ANALYSIS OF THERMAL SHIELD COATINGS APPLIED TO 112A/114A SERIES TANK CARS
A cost/benefit analysis of thermal shield coatings on 112A/114A tank cars was performed. Thermal shield coatings are coatings which are applied to the outside of a tank to act as an insulator in the event of a fire. The intent is that the coating prevent or delay overheating and overpressurization of the tank which could lead to tank rupture and large loss of life and property. The data for the analysis were taken from Railway Progress Institute (RPI)-Association of American Railroads (AAR) cooperative research program reports. The RPI/AAR determined accident data for the years 1965-1970 and based their cost/benefit analysis on this data. In this report, the data of RPI/AAR is updated to present dollars and a re-evaluation of the accident losses is made.

Adams, DE
Calspan Corporation, Federal Railroad Administration Final Rpt. CAL-SPAN-ZL-5226-D-3, Dec. 1974, 29 pp

Contract DOT-FR-20069
ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-241295/15ST, DOTL NTIS

B5 091314
COST/BENEFIT ANALYSIS OF HEAD SHIELDS FOR 112A/114A SERIES TANK CARS
A cost/benefit analysis of head shields installed on new and existing 112A/114A series pressure tank cars was performed based on a redistribution of accident dollar losses. Head shields are designed to prevent puncture of a tank car head during an accident with resulting loss of lading and possibly extensive fire damage. The design of the head shields and data for the analysis were obtained from Railway Progress Institute (RPI)-Association of American Railroads (AAR) cooperative research program reports. The RPI/AAR considered accident data for the years 1965-1970 and assigned accident dollar losses during that period according to the tank element that failed. Supporting evidence is presented indicating that dollar losses are strongly related to puncture distribution for a more extensive set of data including all classes of tank cars.
Study sponsored by the U.S. Department of Transportation, Federal Railroad Administration, Washington, D.C.

Adams, DE Bullerdiek, WA Pattern, JS Vassalo, FA
Calspan Corporation, Federal Railroad Administration, (CALSPAN-ZL-5226-D-1) Final Rpt. FRA-OR&D 75-34, Mar. 1974, 15 pp

Contract DOT-FR-20069

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-241298/9ST, DOTL NTIS

B5 091318
THE EFFECTS OF A FIRE ENVIRONMENT ON A RAIL TANK CAR FILLED WITH LPG
A 127 kiloliter (33,600 gallon) railroad tank car was instrumented and filled with liquefied petroleum gas. A large JP-4 fuel pool fire then engulfed the tank car, and measurements of temperature, pressure, etc., were recorded as a function of time. After 24.5 minutes, the car failed catastrophically via stress-rupture. Mass flow rates and a discharge coefficient have been obtained for the relief valve. An analytical expression has been derived and then used to obtain the heat flux to the wetted surface of the tank car. The rupturing of the car is briefly discussed.

Anderson, C Townsend, W Zook, J Cowgill, G
Ballistic Research Laboratory, Federal Railroad Administration Final Rpt. Sept. 1974, 289 pp

Contract DOT-AR-30026

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-241358/1ST, DOTL NTIS

B5 091319
DEVELOPMENT OF A COMPUTER PROGRAM FOR MODELING THE HEAT EFFECTS ON A RAILROAD TANK CAR
A mathematical model has been programmed in FORTRAN IV that represents the response to a fire environment of a railroad tank car laden with a volatile, flammable fluid. Inputs to the program include total mass of lading per foot of tank length, tank length, number and flow area of relief valves, their opening and closing pressure, thickness and thermal conductivity of exterior insulation, and array of the thermodynamic properites of the lading, its initial condition, and heat transfer coefficient and fire temperature at various points on the tank. Output includes tank pressure, temperatures of the liquid and vapor, temperatures of the interior surface of the shell, mass of liquid remaining, and location of the liquid level. These are printed for the end of every computing interval, thus indicating the history of each.
Study sponsored by the U.S. Department of Transportation, Federal Railroad Administration, Washington, D.C.

Graves, KW
Calspan Corporation, Federal Railroad Administration, (CALSPAN-YE-5176-D-1) Final Rpt. FRA-OR&D 75-33, Jan. 1973, 101 pp

Contract DOT-AR-20036

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-241365/6ST, DOTL NTIS

B5 091406
COMPARISON OF THERMALLY COATED AND UNINSULATED RAIL TANK CARS FILLED WITH LPG SUBJECTED TO A FIRE ENVIRONMENT
Two fire tests were conducted on 128 kiloliter, high pressure rail tank cars filled with liquefied petroleum gas. Both tank cars were exposed to an intense hydrocarbon fire after being outfitted with appropriate instrumentation. The instrumentation was monitored and its output recorded throughout the fire tests. To test the feasibility of insulating railroad tank cars to protect them from fire exposure, one of the cars was coated with a 0.318 cm thermal shield. A comparison of data conclusively shows that a thermal shield significantly alters the thermal response of a rail tank car in a fire environment.

Townsend, W Anderson, C Zook, J Cowgill, G
Ballistic Research Laboratory, Federal Railroad Administration Final Rpt. Dec. 1974, 53p

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-241702/0ST, DOTL NTIS

B5 092091
RAILROAD ACCIDENT REPORT: COLLISION OF ST. LOUIS-SAN FRANCISCO RAILWAY TRAINS 3210 AND 3211, MUSTANG, OKLAHOMA, SEPTEMBER 1, 1974
On September 1, 1974, at 1:44 to 1:46 p.m., the St. Louis-San Francisco Railway Company's eastbound freight train 3210 and westbound train 3211 collided head-on 1.7 miles west of Mustang, Oklahoma. The trains were scheduled to meet in Mustang. However, train 3211 passed Mustang ahead of schedule. As a result of the collision, 4 locomotive units were destroyed, 23 cars derailed, and hazardous materials caught fire in the wreckage. As a result of the fire, eight families were evacuated from their homes. A brakeman on train 3211 was killed, and the three other crewmembers of that train were injured seriously. The National Transportation Safety Board determines that the probable cause of this accident was the failure of the crew of train 3211 to take preventive action after the train passed Mustang ahead of schedule.

National Transportation Safety Board NTSB-RAR-75-6, May 1975, 25 pp

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-242771/4ST, DOTL NTIS

B5 093327
CHEMICAL HAZARDS RESPONSE INFORMATION SYSTEM FOR MULTIMODAL ACCIDENTS (CHRISMA). (A REEVALUATION OF CHRIS FOR ALL MODES OF TRANSPORTATION)
This report examines the need for improved technical and other information for meeting emergencies connected with the transportation of hazardous materials, particularly actual or potential chemical discharges regardless of mode. The Chemical Hazards Response Information System (CHRIS), under development by the United States Coast Guard to furnish in-depth guidance during emergencies involving waterborne transport, was seen as a likely prototype for other modes as well. Accordingly, a reevaluation of CHRIS has been conducted to determine the desirability of enlarging its scope to encompass all modes of transportation. It is concluded that the expanded system would indeed be beneficial in reducing losses to life, property, and the environment. Necessary modifications to CHRIS are conceptually quite modest in nature. The information system would be composed of a decentralized organization providing response guidance on request to local emergency services personnel, a computerized hazard assessment system operated at Headquarters, and three reference manuals furnished to all response organizations.

Allan, DS Harris, GH
Little (Arthur D), Incorporated, United States Coast Guard Final Rpt. ADL-C-74685-60-F, USCG-D-148-75, Apr. 1975, 133 pp

Contract DOT-CG-24655-A

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
AD-A016296/6ST, DOTL NTIS

B5 093423
A REVIEW OF VIOLENT MONOMER POLYMERIZATION: A SELECTED LITERATURE SURVEY
In recent years, there have been a number of serious explosions involving violent monomer polymerizations. As a first step in the study of the causes and mechanisms of these violent polymerizations, a 20 years literature search was performed for twelve monomers. The monomers included in the search were: acrylic acid, acrylonitrile, butadiene, 1, 3, ethylene, ethylene oxide, methyl acrylate, methyl-methacrylate, B-propiolactone, styrene, vinyl acetate vinyl chloride, vinylidene chloride. This document presents the results of the literature search, annotation and data extraction work. To maximize the utility of the findings from this effort, they are organized into the four sections that follow this introduction. Section II provides basic descriptive data on each monomer, their properties, consumption and a discussion of handling hazards. Section III is a matrix presenting the properties of the monomers. These two sections will serve as inputs for the assessments by violent polymerization risk. Section IV is the annotated bibliography organized by key work for each monomer. For the

Harmon, M King, J
Operations Research, Incorporated, United States Coast Guard Final Rpt. USCG-D-159-75, Oct. 1974, 142 pp

Contract DOT-CG-51765-A

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
AD-A017443/3ST, DOTL NTIS

B5 095399
CONDITIONS FOR THE TRANSPORT OF DANGEROUS GOODS-PROBLEMS AND SOLUTIONS [Befoerderungsbedingungen fuer Gefahrengueter-Probleme und Loesungen]
The author summarizes several aspects of the conditions for the transport of dangerous goods from the railway point of view, mentions the problems involved and proposes optimal solutions. He also presents the standard symbols on labels used for the transport of dangerous goods to show the first results of work for the harmonization and unification of both road and railway transport conditions. [German]

Koppel, G *Chemische Rundschau* Vol. 27 No. 25, 1974, pp 1-7, 6 Fig.

PURCHASE FROM: Chemie-Verlag Vogt-Schild AG 4500 Solothurn 2, Switzerland Repr. PC

B5 095689
TANK CAR DESIGN
This article describes the methods of tank calculation used in the USSR which have been considerably refined due to studies carried out by the Moscow Institute of Railway Engineers, as well as by the Zdanov Heavy Machinery Works, and other organizations. The authors who have personally contributed to improving the methods of calculating tank car shells are sure that an exchange of experience in this problem would facilitate a further development of progressive tank car designs.

Shadur, L (Moscow Institute of Railway Engineers); Koturanov, V *Rail International* Vol. 6 No. 1, Jan. 1975, pp 19-40, 6 Fig., 5 Tab., 9 Ref.

ACKNOWLEDGMENT: Rail International
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B5 095703
RAILROAD ACCIDENT REPORT-SOUTHERN PACIFIC TRANSPORTATION COMPANY FREIGHT TRAIN 2ND BSM MUNITIONS EXPLOSION, BENSON, ARIZONA, MAY 24, 1973
On May 24, 1973, Southern Pacific Transportation Company's freight train 2nd BSM 22, was approaching Benson, Arizona, when 1 of 12 munitions boxcars in the train's consist caught fire. The boxcars were loaded with 500-lb. MK 82 bombs. As the train stopped, the cargo exploded, and the explosions continued for several hours. The National Transportation Safety Board determines that the probable cause of the accident was the exposure of heat-sensitive bombs in Car 38 to a fire inside the car. The fire most likely originated from sparks off the brakeshoes which ignited the sodium nitrate impregnated floorboards.
This report contains Railroad Safety Recommendations R-75-8 through R-75-10.

National Transportation Safety Board, (1114C) NTSB-RAR-75-2, Feb. 1975, 40 pp, 9 Fig., Apps.

ACKNOWLEDGMENT: National Transportation Safety Board
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-241580/0ST, DOTL NTIS

B5 095870
RAILROAD TANK CAR FIRE TEST: TEST NO. 7
A fire test was conducted on a one-fifth scale model pressurized railroad tank car on 7 February 1973. The test, designated as Test Number 7, was conducted by the Ballistic Research Laboratories for the Federal Railroad Administration of the United States Department of Transportation at the White Sands Missile Range. The tank car model has a thermal insulation of four inches (10.16 cm) of polyurethane encased in a 0.125 inch (0.318 cm) steel jacket. The model was loaded with propane and then engulfed in a JP-4 jet fuel fire.

Anderson, C Townsend, W Zook, J Wright, W Cowgill, G
Department of the Army Final Rpt. FRA-OR&D 75-37, Dec. 1973

Contract DOT-AR-30026

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB 241145/AS, DOTL NTIS

B5 096595
THERMAL HAZARD FROM PROPANE FIREBALLS
Tank trucks and rail cars containing such hazardous materials as commercial propane are often involved in accidents wherein the tanks are ruptured and fires occur. In this study, a model for determining the thermal hazard associated with the resulting fireball is developed, and the results are compared with available test data. One way to minimize the fireball hazard is to distribute the propane in the proper size container for shipment and to space the containers so that ignition of one would not result in ignition of additional containers.

Hardee, HC (Sandia Laboratories) *Transportation Planning and Technology* Vol. 2 No. 2, 1973, pp 121-128, 13 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

B5 097295
RAILROAD ACCIDENT REPORT: HAZARDOUS MATERIALS ACCIDENT IN THE RAILROAD YARD OF THE NORFOLK AND WESTERN RAILWAY AT DECATUR, ILLINOIS, JULY 19, 1974
GATX 41623 and four other tank cars loaded with isobutane gas were uncoupled at the west end of Decatur Yard by a switching crew and allowed to free roll eastward on yard track 11. The car impacted an empty boxcar, and its coupler overrode the tank car coupler and punctured the tank. Isobutane escaped and vaporized for 8 to 10 minutes before it exploded. The yard, surrounding residences, and commercial facilities were damaged extensively by fire and shock waves. Seven employees died from burns, and 33 employees were injured. Three hundred sixteen persons outside the rail yard were also injured as a result of the explosion. Property damage was estimated at $18 million. the National Transportation Safety Board determines that the probable cause of the accident was the overspeed impact between the heavy cut of tank cars and the uncoupled light boxcar, which resulted from the release of the tank cars at a higher-than-acceptable switching speed. The lack of written guidelines to assist the switchman in determining the proper switching speed contributed to the accident. The crew members' lack of understanding of the risks involved in switching hazardous materials also was a contributing factor. Recommendations were made regarding tank head shields and couplers, employee training, hazardous materials accident data reporting, and regulations to limit losses in hazardous materials accidents.
This report contains Railroad Safety Recommendations R-75-18 through R-75-22.

National Transportation Safety Board NTSB-RAR-75-4, Apr. 1975, 30 pp, Figs.

ACKNOWLEDGMENT: National Transportation Safety Board, NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-242807/6ST, DOTL NTIS

B5 098077
PHASE 10 REPORT ON DEVELOPMENT OF SHELF COUPLERS
The Type E top and bottom shelf coupler development program has been completed to the state where approval of applications of these couplers to tank cars is to be sought from the AAR and DOT. Service tests of 100 Carsets are being arranged, retrofitting 112A or 114A cars having Type F couplers. The early study is appended as information. Shelves in the final design, as now approved, are somewhat different from that considered in the preliminary stages of this phase of the project.

This is an RPI-AAR Cooperative Program.

Association of American Railroads Technical Center, (RA-10-5-30) R-166, Sept. 1974, 53 pp, Figs., 1 App.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B5 098078
PHASE 05 REPORT ON JUNE 9, 1974 ACCIDENT INVOLVING HEAD SHIELDS
The head shield was recommended as a cost effective device for prevention of catastrophic punctures of tank car heads and 104 new cars for liquefied petrolium gas service were so equipped after 1972. One of these cars was involved in a derailment on the Norfolk & Western in Iowa. While the service trial was not to evaluate the shields' effectiveness in accidents, and statistically it was unlikely that a car would be so involved, this derailment did show the shield performing well. It was not possible to conclude it prevented a head puncture definitely, but it is probable it did so. Method of attachment appears good. No conclusion could be drawn about the effectiveness of mated F couplers because of the conditions of this specific accident.

This is an RPI-AAR Cooperative Program.

Association of American Railroads Technical Center, (RA-05-2-29) R-165, Aug. 1974, 9 pp, Phots.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B5 099172
COMPARISON OF THERMALLY COATED AND UNINSULATED RAIL TANK CARS FILLED WITH LPG SUBJECTED TO A FIRE ENVIRONMENT
Two fire test were conducted on 128 kiloliter, high pressure rail tank cars filled with liquified petroleum gas. Both tank cars were exposed to an intense hydrocarbon fire after being outfitted with appropriate instrumentation. The instrumentation was monitored and its output recorded throughout the fire tests. To test the feasibility of insultating railroad tank cars to protect them from fire exposure, one of the cars was coated with a 0.318 cm thermal shield. A comparison of data conclusively shows that a thermal shield significantly alters the thermal response of a rail tank car in a fire environment.

This document was prepared for the Department of Transportation, Federal Railroad Administration.

Townsend, W Anderson, C Zook, J Cowgill, G
Department of the Army Final Rpt. FRA-OR&D 75-32, Dec. 1974, 56 pp

Contract DOT-AR-30026

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-241702/AS, DOTL NTIS

B5 099182
RAILROAD ACCIDENT REPORT: HAZARDOUS MATERIALS ACCIDENT AT THE SOUTHERN PACIFIC TRANSPORTATION COMPANY'S ENGLEWOOD YARD IN HOUSTON, TEXAS SEPTEMBER 21, 1974
About noon on September 21, 1974, 2 loaded "jumbo" tank cars, cars 17 and 18 of a 145-car complement, were uncoupled as a unit at the crest of the gravity hump in the Southern Pacific Transportation Company's (SP) Englewood Yard at Houston, Texas. The two cars passed through the hump master retarder and group retarder without being slowed and accelerated as they moved down the grade into bowl track 1. At a speed of 18 to 20 mph, the two tank cars impacted an empty tank car. Upon imppact, the coupler of the empty tank car rode over the coupler of car 17 and punctured the tank head. Butadiene spilled from the car and formed a vapor cloud, which dispersed over the area. AFter 2 to 3 minutes, the vapor exploded violently; as a result, 1 person died and 235 were injured. Total damages amounted to about $13 million, which included the destruction of 231 railroad cars and substantial damage to 282 others. The National Transportation Safety Board determines that the probable cause of the overspeed impact was the failure of the retarding system to slow the two coupled tank cars and the absence of a backup system to control cars which pass through the retarders at excessive speeds. The failure of the retarding system was caused by foreign substances on the wheels of the two cars that preceded the two tank cars through the retarders. Contributing to the accident was the failure of the Southern Pacific Transportation Company to enforce procedures to exclude cars with a foreign substance on their wheels from the humping system, and the Shell Oil Company's failure, after notification of the hazard, to eliminate spilled epoxy resin from the flangeways of their track.

This report contains Railroad Safety Recommendations R-75-28 through R-75-30.

National Transportation Safety Board NTSB-RAR-75-7, May 1975, 39 pp

ACKNOWLEDGMENT: National Transportation Safety Board, NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-243598/QST, DOTL NTIS

B5 099814
SHIPPING HAZARDOUS MATERIALS
This special report is designed to give a balanced report on the significance of the passage of the Hazardous Materials Act. Included are the views of the Department of Transportation, motor carriers, railroads, barge lines and the military.

Davis, BO, Jr Burns, WJ German, JG O'Brien, CJ, Jr Geary, JD Pratt, EJ *Defense Transportation Journal* Vol. 31 No. 4, Aug. 1975, pp 6-75

PURCHASE FROM: National Defense Transportation Association 1612 K Street, NW, Washington, D.C., 20006 Repr. PC
DOTL JC

B5 126415
RISK ANALYSIS OF SHIPMENTS IN THE NUCLEAR POWER INDUSTRY
A study is undertaken to determine risks from the transportation of radioactive materials generated in the production of electricity in the United States for the period 1970-2020. Radiation exposures under conditions of both routine transport and transport accidents are considered. Movements of spent fuel, recycled plutonium, and high level radioactive solidified waste are studied. The calculated gamma dose to the growing population from all routine shipments of these materials is found to not exceed 50 persons-rems-/yr by 2020.

Proceedings of the 4th Symposium, 22-27 September 1974.

Hodge, CV (Holmes & Narver, Incorporated); Baldonado, OC
Packaging and Transp of Radioact Mater, Int Symp No. t2, pp 814-829, 6 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: NTIS Repr. PC
DOTL NTIS

B5 126422
IMPACT OF THE PROPOSED DISPOSAL OF HIGH-LEVEL RADIOACTIVE WASTE AT THE NEVADA TEST SITE ON THE TRANSPORTATION OF REACTOR WASTE PRODUCTS
A recent concept proposes the conversion of high-level radioactive waste to glass and its disposal at the Nevada Test Site (NTS). Application of this concept has a certain impact on the packaging and transportation of the high-level waste. The proposed storage sites are compared with the NTS in terms of differences of transportation distances and certain other criteria.
Proceedings of the 4th Symposium, 22-27 September 1974.

Carter, MW (Georgia Institute of Technology); Moghissi, AA
Packaging and Transp of Radioact Mater, Int Symp No. t2, 1974, pp 785-797, 6 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: NTIS Repr. PC

DOTL NTIS

B5 126435
TRANSPORTING, LOADING AND UNLOADING OF HAZARDOUS MATERIALS IN RAILROAD CARS
Safer rail transportation of hazardous materials involves close cooperation between the container manufacturer, shipper, rail carrier, and consignee so as to minimize any hazard to the public. Standards under the Federal Railroad Administration Railroad Safety Act are specifically presented.
Presented at the Joint Materials Handling Conference, Sheraton-Cleveland Hotel, Cleveland, Ohio. 23-25 September 1975.

Black, WF
Society of Manufacturing Engineers MS75-660, Sept. 1975

ACKNOWLEDGMENT: Society of Manufacturing Engineers
PURCHASE FROM: Society of Manufacturing Engineers 20501 Ford Road, Dearborn, Michigan, 48128 Repr. PC

B5 127838
A SCHEME FOR RECOGNIZING CHEMICALS AND THEIR HAZARDS IN AN EMERGENCY
In recent years a number of potential emergency situations have arisen following traffic accidents or fires involving chemicals. In an attempt to minimise the danger from such incidents in the U.K., an emergency advice scheme has been established by the Chemical Industries Association (CIA) in collaboration with Central Government. As part of the scheme, chemical companies are providing information to facilitate the identification of products and their hazards, and advice for their safe treatment in an emergency. The information is being organised so that it can easily be searched using a computer-based information retrieval system. The data being collected initially are related to the requirements of the public emergency services but they can be extended to meet the needs of other organisations. Indeed, the data bank is being augmented in this way under a contract from the E.E.C.

Cumberland, RF Hebden, MD *Journal of Hazardous Materials* Vol. 1 No. 1, Sept. 1975, pp 35-43

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: Journal of Hazardous Materials

B5 127851
150TH ANNIVERSARY ISSUE
The Institutions of Mechanical, Civil, Electrical and Railway Signal Engineers conducted an International Engineering Conference in September 1975 to commemorate the 150th anniversary of passenger railway. This issue has editorical comment designed to complement the papers presented at the Conference. The contents of this issue are as follows: Modern track fastenings; Developments in Welding techniques for rolling stock; Modern dc traction motor design practice; Non-ferrous brake materials; Bridge reconstruction for overhead electrification; Ferrous fittings for overhead equipment; Roller bearings for railway rolling stock; Thyristor control of traction motors; Appraisal of tank car valves and their application; Australia's railways invest in passengers; Electric cables for signalling and track to train communications; Brake blending and wheelslide protection; High speed track recording coach; Ultrasonic rail flaw detection; Flexicoil suspensions; Prestressed concrete beams for bridges; Recent developments in plain bearings; Asynchronous motor drive for locomotives; Gangway connections between long carriages; Point heaters–progress in design; Batteries for railway applications; TOPS equipment; electrical carbon and the challenge of railways; Design and cost of containers; Railway roller bearings; Computer aided design in railway signalling; Adoption of AWAC catenery on BR, Powered doors for rail vehicles; Signal control desks.

Railway Engineering Journal Vol. 4 No. 5, Sept. 1975, 160 pp, Figs., Tabs., Phots.

PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

B5 128627
VERTICAL MOTIONS DURING RAILCAR IMPACTS
In yard type impact situations, railcars strike other railcars producing car body pitching and vertical bounce. This vertical motion, if large enough, can cause vertical disengagement of couplers which could explain the penetration of tank car ends observed in accident situations. Preliminary investigation of vertical motions during impact, using a mathematical model, has successfully reproduced simulations of impacts in the elastic range. Examples confirm the possibility of coupler disengagement or center plate disengagement of railcars undergoing high speed impact. The computer program developed will solve for horizontal and vertical coupler force, vertical motion at the trucks and couplers, and slippage between adjacent car couplers. This work was sponsored by the RPI/AAR Tank Car Safety Research and Test Project Committee and represents one phase of the overall RPI/AAR study of means to improve tank car safety in accidents.
This paper was contributed the Rail Transportation Division of the ASME for presentation at the Winter Annual Meeting, Houston, Texas, November 30-December 4, 1975.

Raidt, JB Manos, WP Johnstone, B (Pullman-Standard Car Manufacturing Company)
American Society of Mechanical Engineers 75-WA/RT-10, July 1975, 7 pp, 10 Fig., 1 Tab., 10 Ref.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL RP

B5 129146
HAZARDOUS MATERIALS TANK CARS-EVALUATION OF TANK CAR SHELL CONSTRUCTION MATERIAL
A metallurgical analysis of a steel plate sample (the Bell sample) was requested by the Federal Railroad Administration. The steel sample was taken from a tank car (number 88300) which had been involved in an accident near Bell, West Virginia. An investigation was conducted at the National Bureau of Standards to characterize the steel from the failed tank car and to determine whether the steel meets the specification AAR Tc 128-69. Another purpose of the investigation is to determine the nature of the fracture of the head plate of the failed tank car.
Sponsorship was from the Federal Railroad Administration, DOT.

Hicho, GE Brady, CH
National Bureau of Standards, (312.01/14) Final Rpt. FRA-OR&D 75-46, Sept. 1975, 35 pp, 25 Fig., 6 Tab.

Contract DOT-AR-10023

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche

DOTL NTIS

B5 129147
METALLURGICAL ANALYSIS OF A STEEL SHELL PLATE TAKEN FROM A TANK CAR ACCIDENT NEAR SOUTH BYRON, NEW YORK
A metallurgical analysis of a steel plate sample (the South Byron sample) was requested by the Federal Railroad Administration. The steel sample was taken from a tank car (number PPGX9990) which had been involved in an accident near South Byron, New York. This sample was reported to have been produced to specification AAR-M-128-65-DTD-1966-Flange Quality-Grade B, and it was reportedly taken from the second course of shell plate of car number PPGX9990. The fracture in this course circumscribed the tank car and resulted in the division of the car into two sections. An investigation was conducted at the National Bureau of Standards to

determine if the plate sample conformed with the above Association of American Railroads (AAR) Specifications for Tank Cars and to gather information pertinent to the question of the suitability of this type of steel for use as the shell plate of tank cars.

Sponsorship was from Federal Railroad Administration, DOT.

Interrante, CG Hicho, GE
National Bureau of Standards, (312.01/35) Final Rpt. FRA-OR&D 75-47, Oct. 1971, 57 pp, 14 Fig., 7 Tab., 2 App.

Contract DOT-AR-10023

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche
DOTL NTIS

B5 129148
A METALLURGICAL ANALYSIS OF ELEVEN STEEL PLATES TAKEN FROM A TANK CAR ACCIDENT NEAR CALLAO, MISSOURI

A metallurgical analysis of eleven steel plate samples designed as Callao samples K-1, K-2, K-3 and K-5 to K-12 was requested by the Bureau of Railroad Safety, Federal Railroad Administration, Department of Transportation. The Callao samples were removed from a tank car numbered GATX 94451 which had been involved in an accident near Callao, Missouri where the ambient temperature was reportedly 15 degrees F. An investigation was conducted at the National Bureau of Standards to determine if the plate sample conformed with the Association of American Railroads (AAR) Specification AAR-TC128-65 (flange quality, grade B, fine-grain practice) for high-tensile strength, carbon- manganese steel plates for tank of this type of steel for use as plate materials of tank cars.

Sponsorship was from Federal Railroad Administration, DOT.

Interrante, CG Hicho, GE Harne, DE
National Bureau of Standards, (312.01/51) Final Rpt. FRA-OR&D 75-29, Sept. 1972, 184 p, 42 Fig., 9 Tab., 9 App.

Contract DOT-AR-10023

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche
DOTL NTIS

B5 129149
ANALYSIS OF FINDINGS OF FOUR TANK-CAR ACCIDENT REPORTS

A comprehensive overview of the findings and metallurgical analyses of tests conducted at the National Bureau of Standards on samples of tank-car materials submitted by the Federal Railroad Administration is presented. The submitted samples were taken from tank cars which had been involved in accidents during the period January 1970 to January 1971. The testing conducted during the metallurgical analyses included full chemical analyses, ambient temperature tensile tests on longitudinal and transverse specimens, quantitative metallography to determine ferrite grain size, peralite colony size, and inclusion content, size, and shape, hardness tests, bend tests on longitudinal and transverse specimens, and a very comprehensive program of impact testing, which is covered in a separate report on Impact Properties.

Sponsorship was from Federal Railroad Administration, DOT.

Interrante, CG Early, JG Hicho, GE
National Bureau of Standards, (NBSIR 75-655) Final Rpt. FRA-OR7D 75-50, Jan. 1975, 76 pp, 13 Fig., 4 App.

Contract DOT-AR-40008

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-251097/AS, DOTL NTIS

B5 129154
PHASE 05 REPORT ON HEAD SHIELD FATIGUE TESTS

In order to reduce the probability of DOT Class 112A and 114A railroad tank car head punctures, the Department of Transportation has required that one-half inch thick steel head shields be applied to these cars. They are to be spaced in front of the tank head and are to cover approximately the lower half of the head. Recognizing the need to assure that the method of attachment of these heavy plates is adequate, the RPI-AAR Tank Car Safety Project conducted an extensive series of instrumented impact and in-train tests of four different attachment designs. Using these test data and data on predicted in-service environment, fatigue life calculations were made for each design. This report describes the entire study and concludes with a proposed specification which is recommends be adopted by the AAR Tank Car Committee to qualify candidate attachment designs.

Phillips, EA
Association of American Railroads Technical Center, (AAR R-197) RA-05-3-35, Nov. 1975, 35 pp, 11 Fig., 5 Tab.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B5 129196
PHASE 03 REPORT ON FRACTURE PROPERTIES OF TANK CAR STEELS--CHARACTERIZATION AND ANALYSIS

Questions of fracture characteristics of tank car steels have been fully clarified by statistical examination of fracture properties based on rational fracture mechanics criteria. It is analytically proven that brittle fracture of tank cars is not a significant problem at any temperature of service. This independent finding is in agreement with general experience based on accident investigation and analysis. A clear relationship has been demonstrated between ASTM ferrite grain size and Dynamic Tear (DT) test rational criteria (true fracture mode for full section). It is possible to examine a metallographic sample and to predict within a narrow range of temperature the type of fracture to be expected for a tank car steel. The mechanical significance of deviations from unusual grain structures (such as mixed grain size, etc.) can be understood in terms of heat treatment or fire environments-based on the knowledge generated in this study. The relationship of plastic fracture properties to tearing type rupture of tank cars at elevated temperatures has been clarified.

This is a RPI-AAR Tank Car Safety Research and Test Project.

Pellini, WS Eiber, RJ Olson, LL
Association of American Railroads Technical Center, (AAR R-192) Res. Rpt. RA-03-4-32, Aug. 1975, 81 pp, 56 Fig., 6 Ref.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B5 129197
FINAL PHASE 03 REPORT. MATERIAL STUDY ON STEELS USED IN CURRENT AND FORMER TANK CAR CONSTRUCTION AND FROM CARS INVOLVED IN ACCIDENTS

A study has been made of the steels used in the construction of pressure tank car tanks as part of the RPI-AAR Tank Car Safety Research and Test Project. The number and type of tests made represent the most comprehensive ever performed on tank car tank steels. Fracture toughness properties are not a part of the material specifications for tank car tanks except for certain low temperature applications. None-the-less, the fracture toughness properties were determined using the Charpy V-notch Test, Drop Weight Tear Test, Dynamic Tear Test, and NDT Drop Weight Test for current, accident, and old materials. The fracture properties obtained represent the best properties that are technologically attainable for the current steels for the heat treatment employed. For TC128-B material, no significant transition temperature improvement can be achieved by changing to other pearlitic type steels. It was concluded that the TC128-B steel is an optimum product for the service and that changes are not justified on the basis of the fracture properties.

This is a RPI-AAR Tank Car Safety Research and Test Project.

Eiber, RJ Olson, LL
Association of American Railroads Technical Center, (AAR R-193) RA-03-5-33, Aug. 1975, 193 pp, 38 Fig., 16 Tab., 11 Ref.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL JC

B5 129308
THE TORSIONAL STRENGTH OF BOGIE WAGONS [Der Verwindungswiderstand von Drehgestell-Guterwagon]
The number of wagons with torsional rigidity and widely spaced bogie king pins is increasing. The greatest attention should be given to the constructional rigidity of wagons. The author gives comments on calculations for a tank-wagon design in which torsional strength does not endanger safety against derailment. He adopts as a basis the test results of the ORE B 55 Specialists Committee on "Prevention of derailment of goods wagons on distorted track", and on the estimated derailment of an empty 102-tonne tank wagon. [German]

Koffman, JL *DET Eisenbahntechnik* Vol. 23 No. 8, Aug. 1975, pp 355-358, 4 Fig., 2 Tab., 4 Ref.

ACKNOWLEDGMENT: International Union of Railways, BD
PURCHASE FROM: VEB Verlag Technik Oranienburgerstrasse 13-14, 102 Berlin, East Germany Repr. PC

B5 130841
PHASE II REPORT ON FULL SCALE FIRE TESTS
This report presents an analysis of the results obtained in two tests of propane-laden DOT class 112/114A340 tank cars completely immersed in all-enveloping fires generated using JP-4 fuel. In the first test, an uninsulated car (RAX 201) ruptured at a pressure of about 335 PSIG after 24.6 minutes exposure to the fire. The safety valve incorporated on this car limited the maximum tank pressure to less than 350 PSIG, even in the all-enveloping fire. However, a rise in the temperature of the unwetted upper section of the steel shell to about 1200 degrees F precipitated rupture when the tank was about half full of liquid propane. In the second test, car RAX 202, insulated with a spray-on thermal protective coating, ruptured after about 93.7 minutes exposure to fire. With a heating rate averaging about 12,100 btu/hr/sq ft (43% of the 27,650 btu/hr-sq ft average from the first test), the longer time to rupture in this test is not solely due to insulation, as lower fire temperatures and other variables played an important part. As in the first test, rupture was precipitated by a rise in unwetted shell temperature to levels at which the shell strength could not withstand even the reduced tank pressures. As well as can be determined, it appears that the shell failure was initiated in an area which contained flaws or non-uniformities in the insulative coating.

An RPI-AAR Cooperative Program. Railroad Tank Car Safety Research and Test Project.

Manda, LJ
Railway Progress Institute, Association of American Railroads Technical Center RA-11-6-31, Dec. 1975, 114 pp, 14 Ref.

ACKNOWLEDGMENT: Railway Progress Institute
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B5 130842
PHASE II REPORT ON SPECIFICATIONS FOR THERMAL SHIELD SYSTEMS ON DOT 112A (114A) TANK CARS
This study was prompted by the need to find a thermal shield system which will reduce the probability of rupture of DOT 112A(114A) tank cars in accident fires. Importantly, this will reduce the severity of the "chain reaction" type accident wherein a fire initiates from one car in the derailment and causes a sequence of thermally induced rupture of other cars. This study is directed toward insulation-steel jacket type systems; however, the proposed thermal qualification criteria apply equally well to any type system, including sprayed-on coatings. Over a hundred fire tests of various materials were conducted on a specially constructed laboratory apparatus at the AAR Technical Center using both "pool" fires (1550-1650 degrees F flame) and "torch" fires (2100-2200 degrees F flame). Data from two full scale fire tests and many accidents were used in developing this apparatus. Several of the attractive materials were also tested in full scale torch fires at the FRA Pueblo Test Center. With available clearance on many existing cars limited to one inch, most tests were conducted on materials near this thickness. The report concludes with a recommendation that the laboratory apparatus be adopted as a qualification device with acceptance criteria being that the candidate system not allow the back side plate (representing the tank car shell) to rise above 800 degrees F. The time criteria will be later developed from further correlation tests between the laboratory and Pueblo facilities; however, 35 minutes appears a probable time for the torch test.

An RPI-AAR Cooperative Program. Railroad Tank Car Safety Research and Test Project.

Phillips, EA Skogsberg, AM
Railway Progress Institute, Association of American Railroads Technical Center RA-11-7-34, Jan. 1976, 109 pp, Figs., Tabs., Refs.

ACKNOWLEDGMENT: Railway Progress Institute
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B5 130918
HAZARDOUS MATERIALS SHIPMENT DATA IN RISK ANALYSIS
An experimental integrated risk analysis system (IRAS) has been developed for analyzing the interstate transportation of explosives, corrosives, flammables, poisons and other hazardous materials. This system includes as components a risk analysis model and methods for obtaining estimates of its parameters relevant to the evaluation of the risks associated with alternative ways of transporting hazardous materials.

Philipson, LL (University of Southern California); Schaeffer, MS
Annu Reliab Maintainability Symp, Proceedings Proc Paper #1304, 1975, pp 519-527, 3 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

B5 131039
A METALLURGICAL INVESTIGATION OF A FULL-SCALE INSULATED RAIL TANK CAR FILLED WITH LPG SUBJECTED TO A FIRE ENVIRONMENT
An analysis of the failure of an insulated rail tank car, RAX 202, which had been tested to failure in a fire environment at White Sands Missile Range, New Mexico, was requested by the Federal Railraod Administration, Department of Transportation. The tank car, filled with approximately 33,000 gallons of liquified petroleum gas (LPG), failed after approximately 94 minutes of exposure to a JP-4 jet fuel fire. The car fractured into four fragments which were examined in the field. Five plate samples from the four fragments were selected for laboratory study at the National Bureau of Standards.

Early, JG Interrante, CG
National Bureau of Standards, (NBSIR 75-657) Final Rpt. FRA-OR&D 75-52, Jan. 1975, 71 pp, 31 Fig., 3 Tab., 7 Ref.

Contract DOT-AR-40008

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr PC, Microfiche
DOTL NTIS

B5 131040
A METALLURGICAL ANALYSIS OF FIVE STEEL PLATES TAKEN FROM A TANK CAR ACCIDENT NEAR CRESCENT CITY, ILLINOIS
A metallurgical analysis of five steel samples (numbered FRA-1 through FRA-5) was requested by the Bureau of Railroad Safety, Federal Railroad Administration, Department of Transportation. These steel samples were taken from two tank cars (numbered SOEX 3037 and SOEX 3219) which had been involved in an accident near Crescent City, Illinois. Sample FRA-1, FRA-4, and FRA-5 were reported to be shell plates and sample FRA-3, a head plate. Sample FRA-2 was a welded sample of head plate and shell plate and it was used for most of the mechanical properties determinations in this report. An investigation was conducted at the National Bureau of Standards to determine if the samples conformed with the appropriate specifications for tank car materials and to gather information pertinent to the question of the suitability of these steels for use as plate materials of tank cars. Samples FRA-1,-2, and-5 were reportedly produced to the specification for ASTM A 212-65 Grade B, flange quality steel (A 212-B); and FRA-3 and-4 were reportedly produced to specification AAR M128 Grade B, flange quality steel (M128-B).

Interrante, CG Hicho, GE Harne, DE
National Bureau of Standards, (312.01/39) Final Rpt. FRA-OR&D 75-48, Mar. 1972, 95 pp, 26 Fig., 9 Tab., 12 Ref., 2 App.

Contract DOT-AR-10023
ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche
DOTL NTIS

B5 131267
TANK CAR DESIGN [Kesselwagenentwuerfe]
The article describes the methods of calculating dimensions for tank cars in the USSR, and shows how these methods are constantly developed through research at the Moscow Institute of Railway Engineers, at the Adanov heavy machinery construction institute, and other organisations. Among the methods explained, approximate calculations are also given for use in preliminary projects, as well as methods for accurate stress analysis. [German]

Shadur, L Koturanov, V *Schienen der Welt* Vol. 6 No. 11, Nov. 1975, pp 862-884, 5 Tab., 9 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Schienen der Welt Brussels, Belgium Repr. PC

B5 131326
RAILROAD ACCIDENT REPORT: BURLINGTON NORTHERN, INC., MONOMETHYLAMINE NITRATE EXPLOSION, WENATCHEE, WASHINGTON, AUGUST 6, 1974
At 12i32 p.m. on August 6, 1974, a shipment of monomethylamine nitrate solution (PRM) detonated during routine switching operations in the Burlington Northern Inc. Apple Yard in Wenatchee, Washington. The explosion killed 2 persons, injured 113, and destroyed equipment and buildings. Estimated losses exceeded $7,500,000. The National Transportation Safety Board was unable to determine the probable cause of the accident. A partial list of the possibilities that could not be ruled out completely includes a reaction of dried crystals, a reaction of spilled or leaking crystals in the insulation space, a reaction in one of the tank components, cavitation and recompression of the solution, compression of an air bubble entrained in the solution, a reaction of solution or crystals sensitized by contamination, or the ignition of escaped product by friction. The Safety Board concludes that the classification of monomethylamine nitrate as a "flammable solid" permitted shipment of the chemical without proper safeguards against predictable hazardous conditions. The National Transportation Safety Board made five recommedations to the Department of Transportation.

National Transportation Safety Board NTSB-RAR-76-1, Feb. 1976, 69 pp, 4 App.

ACKNOWLEDGMENT: National Transportation Safety Board
PURCHASE FROM: NTIS Repr. PC, Microfiche
DOTL NTIS

B5 141001
IMPACT PROPERTIES OF STEELS TAKEN FROM FOUR FAILED TANK CARS
An overview of the results and metallurgical analyses of the findings of impact tests conducted at the National Bureau of Standards on samples of tank-car materials submitted by the Federal Railroad Administration is presented. The submitted samples were taken from tank cars which had been involved in service accidents during the period January 1970 to January 1971. One of the tank cars had been fabricated from ASTM A212 steel and the remaining four tank cars from AAR TC128 steels. The impact test data were reported earlier in four tank-car accident reports.

Sponsorship was from Federal Railroad Administration, DOT.

Interrante, CG
National Bureau of Standards (75-656) Final Rpt. FRA-OR&D 75-51, June 1976, 160 pp, 6 Fig., 13 Tab., 6 App.

Contract DOT-AR-40008

ACKNOWLEDGMENT: FRA
PURCHASE FROM; NTIS

B5 132205
PREPARATION OF THE BRL TANK CAR TORCH FACILITY AT THE DOT, TRANSPORTATION TEST CENTER, PUEBLO, COLORADO
The Tank Car Torching Facility was designed and fabricated on a site located at the Transportation Test Center, Pueblo, Colorada. The torch configuration was calibrated and the operational procedures and requirements determined. A series of thirteen (13) tests were run on specimen tank car plates, both bare and thermally insulated with the two different coatings. This report concerns itself with the instrumentation and procedural requirements; however, none of the data from these tests are reported at this time. The next phase of the program is briefly discussed.

Townsend, W Markland, R
Ballistic Research Laboratory Final Rpt. FRA-OR&D 76-72, Nov. 1975, 24 pp, 12 Fig.

Contract DOT-AR-30026

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-251151/AS, DOTL NTIS, DOTL RP

B5 135186
ULTIMATE DISPOSAL OF SPILLED HAZARDOUS MATERIALS
Factors governing the disposal of sludges and slurries recovered during the cleanup of spilled chemicals are outlined. These include analyzing the constraints identifying available options; various types of existing disposal facilities; and factors that govern a choice between land disposal, chemical treatment and long-term storage.

Lindsey, AW (Environmental Protection Agency) *Chemical Engineering* Vol. 82 No. 23, Oct. 1975, pp 107-114, 21 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B5 141002
MECHANICAL PROPERTIES OF AAR M128-69-B STEEL PLATE SAMPLES TAKEN FROM INSULATION FIRE TESTED TANK CAR RAX 202
Studies were undertaken to measure the elevated-temperature mechanical properties and to determine the elevated-temperature fracture behavior of selected AAR M128-B steel plates. In addition, the ambient-temperature mechanical properties were measured to determine if the requirements of specification AAR M128-69-B were satisfied. The NBS results of check chemical analyses, hardness surveys, thickness measurements, macroscopic observations, and metallographic analyses of the plate samples had been reported previously. The results of hot-tensile tests showed a continuous decrease in strength properties and an increase in tensile ductility as the test temperature was increased from 1100 F to 1250 F. An analysis of stress-rupture data for specimens from all plate samples in the same temperature range indicated that a straight line in a log-log plot of initial stress versus rupture life reasonably represented the data at each test temperature. In the temperature and stress range studied, a decrease in the initial stress of about 20 to 30 percent resulted in a twelvefold increase in rupture life from 15 minutes to three hours. A comparison of the results of the metallographic analysis of hot-tensile and representative stress-rupture specimens with the previously reported metallographic results on the initial rupture site in the failed shell course indicates the presence of the identical fracture mode. This mode is characterized by many intergranular voids which originate primarily at the proeutectoid ferrite-pearlite boundaries. These results confirm the previously reported finding that the initial ruture of the tank car was a stress-rupture crack.

Sponsorship was from Federal Railroad Administration, DOT.

Early, JG
National Bureau of Standards (75-725) Final Rpt. FRA-OR&D 76-74, June 1976, 82 pp, 25 Fig., 3 Tab.,

DOT-AR-40008
ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS

B6 033074
COLLISION TEST OF RAILWAY CAR AND DUMP TRUCK (SECOND SERIES)
Collision test of actual cars is one of the projects for the prevention of railway crossing accidents. The shock, the movement and the deformation of the car body are investigated by the test using actual railway cars and dump trucks at a railroad crossing, and furthermore it is examined how passengers and drivers are affected by the collision. Problems on collision are divided into five items as follows: (1) Shock deceleration, (2) Velocity change and mean deceleration, (3) Deformation of front surface of car, (4) influence on passengers and drivers, (5) Prediction of train collision.

Arai, S Nihonyanagi, T (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 7 No. 2, Mar. 1966, pp28-32, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-010)
DOTL RP

B6 033161
A TRAIN DETECTOR FOR LEVEL CROSSING PROTECTION
A train detector for the use of the level crossing alarm initiation was developed. It does not require any exclusive line wires between the detector and the crossing like in the standard type detector now in use in JNR. The detector is attachable to any part of a conventional AC track circuit and can detect approaching trains by decrease of track voltage to specified value. The detected information is transmitted to the crossing with a carrier frequency over a pair of existing line wires. The effect of attaching the detector on the track relay is negligibly small.

Nakayama, M Sase, K (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 8 No. 3, Sept. 1967, pp163-164

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-115)
DOTL RP

B6 033162
LOOP-COIL TRAIN DETECTOR
Many devices, mechanical or electrical, are available for guarding the railway crossings against the approaching train. The author proposes a loop-coil frequency deviation type detector for a light weight vehicle like railbus. The detector works on the principle of detecting the inductance change in a loop-coil placed in the track as caused by the approaching train.

Sase, K (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 8 No. 3, Sept. 1967, pp173-175

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-116)
DOTL RP

B6 033420
JNR IMPROVING METHODS OF SUPPRESSING TRAIN OPERATION ACCIDENTS
Discusses the increase of railroad accidents, the contributory factors and steps which are being taken to eliminate them. Includes the prevention of grade crossing accidents by reducing the numbers, erection of warning devices, automatic train stop system, automatic signal and relay interlock plus devices to cut off power to catenary lines when an obstruction is present.

Akashi, T (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 6 No. 2, June 1965, pp10-12

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-384)
DOTL RP

B6 037232
RAILWAY ACCIDENTS IN GREAT BRITAIN DURING 1965
Railway accidents in Great Britain increased by 59 to a total of 1,268 in 1965. The greatest increase was in "other cause" accidents. Malicious acts by the public increased from 76 to 111. Technical defects were responsible for 227 train accidents compared with 259 in 1964. There was a 20 percent increase in 1965 in the rate per million train miles of significant accidents for passenger and freight trains. Maximum permitted speed of freight trains with four-wheeled short wheelbased wagons was reduced from 50 to 45 miles per hour. Total fatalities was 162 compared to 167 in 1964. Of these, 19 occurred in train accidents compared with 30 in 1964. Passenger fatalities numbered 28 of which 2 occurred in train accidents. Overall fatality rate was 1 in 690 million passenger journeys. Railway staff fatalities increased by 7 percent. The accident rate at public level crossings increased over the past two years from 32 to 47 accidents per 1000 crossings. During 1965, 41 public crossings were equipped with automatic half barriers bringing the total number so equipped to 56.

McMullen, D (Ministry of Transport, England) *Railway Gazette* Vol. 123 Jan. 1967, p 73

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-911)
DOTL RP

B6 037274
ACCIDENTS ON BRITISH RAILWAYS IN 1960
A comparison of accidents, deaths, and equipment failures for the years 1959 and 1960 show that there were a total of 1213 train accidents in 1959 (1175 in 1960). Out of these, passenger and freight trains were involved in 416 in 1959 (415 in 1960). The total accidents at level crossings were 231 (1959) and 242 (1960). Deaths at level crossings totaled 37 (1959) and 35 (1960). Railway personnel deaths were 160 (1959) and 143 (1960). Failures, including engines, couplings, and rails amounted to 1271 in 1959 and 1395 in 1960.

Railway Gazette Vol. 115 Nov. 1961, pp 562-563

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-981)
DOTL RP

B6 037474
HIGH SPEEDS RECENT EXPERIENCE IN ECONOMICS AND IN PRACTICE
A thorough examination of current problems and evaluation of feasibility and economic justification of speeds over 200 km/h discussed by 500 delegates to the IRCA-UIC symposium at Vienna and of the 27 papers presented and discussed, 17 dealt with experience and design development obtained in revenue earning services and then examined the immediate future or long-term problems. Brief summaries of the topics presented are reviewed in this article.

Railway Gazette Vol. 124 July 1968, pp 545-546

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-820)
DOTL RP

B6 037589
THE PROBLEMS OF CALCULATING RESPONSE INTERVALS FOR FLASHING LIGHTS (AND GATE PROTECTION) AT RAILWAY GRADE CROSSINGS
The length of the response interval for flashing light signals to be activated depends upon the approach time of the highway vehicle, the speed of the train, and the relationship between certain signalling and operational conditions. Since safety requires the assumption of the fastest train when calculating the response interval, slower trains and trains that come to a stop before reaching the crossing impose longer waiting times, and cause annoyance to the highway users. This can be avoided by having the response made sensitive to the speed of the train, which will cause the response interval to be adjusted accordingly. This article describes this system, presenting mathematical equations, charts and tables of the data.

Endmann, K *Eisenbahntechnische Rundschau* Vol. 15 No. 3, Mar. 1966, pp 101-106, 5 Fig, 2 Tab, 5 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-473)
DOTL RP

B6 037613
OPERATING TRAINS ON ELECTRIC VISION--WHY AND HOW?
The author presents the signalling system of today as an example of the way in which much of the present state of the art of the railways reflects the developments from past methods and states of the art. New techniques have been superimposed onto the old, without changing the fundamental principles. A new system is envisioned where the operations would be through constantly moving blocks, with a predetermined time interval controlling the movement of the trains. This system is described in considerable detail, as also its advantages in congested train conditions. Complete safety of operations, including the absolute protection at railroad crossings at grade, and protection to maintenance of way workers, as well as supervision of compliance with speed restrictions, are included in the

functions of this system. Economic considerations are also dealt with. The characteristics and simplicity of this system makes it suitable for application to all transportation systems, including urban rapid transit.

Lagershausen, H *Eisenbahntechnische Rundschau* Vol. 14 No. 6, June 1965, pp 221-238, 9 Fig, 6 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-514)
DOTL RP

B6 037841
SAFETY ON THE INDIAN RAILWAYS
This is primarily a review of the safety record of Indian Railways. This analysis, for 1962-63, 1963-64, and 1964-65, differentiates between significant and other accidents, such as collisions at level-crossings, fires in trains, and running into cattle and other obstructions. Accidents caused by train-wrecking are included under derailments. Partings of trains which have not resulted in collisions or derailments are excluded, as are other types of failure. In general, there was a substantial drop in accidents in recent years following a big rise in traffic over the last decade and a half. Detailed data are presented throughout the article.

Langley, CA (British Railways Board) *Railway Gazette* Vol. 122 June 1966, pp 473-475, 7 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-925)
DOTL RP

B6 039175
A PROGRAM DEFINITION STUDY FOR RAIL-HIGHWAY GRADE CROSSING IMPROVEMENT
The report describes in general terms the present status of grade crossing inventories, improvement programs and other significant considerations. It identifies available information with respect to the cost of accidents and motor vehicle operations, as well as the preparation of estimates of the number of crossings in classes related to the volume of train movements and the volume of vehicle traffic. From these estimates, the number of crossings at which improvements would yield benefits in excess of costs was estimated, together with the reduction in accidents which those improvements could be expected to bring. It develops a five-year program of study related to policy formulation, program administration and research; also, it identifies and describes projects which can be initiated as action programs, research and special studies. This includes a recommended program to correct data deficiencies and develop a comprehensive information system. (Author)

Schoppert, DW
Voorhees (Alan M) and Associates, Incorporated Final Rpt AMV-R-71-1028, Oct. 1969, 171 pp

Contract DOT-FR-9-0028

ACKNOWLEDGMENT: NTIS (PB-190401)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-190401, DOTL NTIS

B6 039248
TECHNOLOGICAL INNOVATION IN GRADE CROSSING PROTECTIVE SYSTEMS
The constraints on innovative grade crossing protective systems are delineated and guidelines for development indicated. Inventory data has been arranged to permit an estimate of the classes of systems needed, the allowable costs, and contribution of various types of crossings to accidents. A number of approaches are discussed for the intermediate cost classes, based on use of conventional signals with low-cost activation systems. Use of similar elements, singly or in combination, is suggested to improve effectiveness of more expensive systems. The very high cost locations may well benefit from interconnection of train and vehicle detectors and small computers. Extensive analysis and laboratory investigation has been carried out relating to a microwave telemetry alternative to conventional track circuits and possible crossing-located radar and impedance train detection systems. (Author)

Hopkins, JB Hazel, ME
Transportation Systems Center Tech Rpt DOT-TSC-FRA-71-3, June 1971, 89 pp

ACKNOWLEDGMENT: NTIS (PB-201624)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-201624, DOTL NTIS

B6 039261
THE VISIBILITY AND AUDIBILITY OF TRAINS APPROACHING RAIL- HIGHWAY GRADE CROSSINGS
The study investigates devices and color schemes, proposed or in use on locomotives, which serve to make the train visible or audible to motorists approaching grade crossings. A color scheme using two contrasting colors, each color at least 3 1/2 x 5 feet in area, is recommended for visibility at 1000 feet. One color should be very bright, such as fluorescent or bright yellow. Two high-output xenon strobe lamps are recommended, one on each side of the cab roof, to flash alternately whenever the train is moving. At night, lighted panels are recommended as supplements to the strobe lamps. The sound level required to reliably alert a motorist was found to be 105 dB just outside the vehicle. In high speed encounters, present horns cannot reliably warn motorists early enough. A horn with enough output to be totally effective would not be an unacceptable nuisance. The report includes a bibliography and tables of required ranges. (Author)
See also Addendum Rept. dated Jul 71, PB-202 669.

Aurelius, JP Korobow, N
Systems Consultants, Incorporated Final Rpt May 1971, 163 pp

Contract DOT-FR-00006

ACKNOWLEDGMENT: NTIS (PB-202668)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-202668, DOTL NTIS

B6 039355
RAILROAD/HIGHWAY ACCIDENT REPORT. ATCHISON, TOPEKA AND SANTA FE PASSENGER TRAIN NO. 212 COLLISION WITH STILLWATER MILLING COMPANY MOTORTRUCK NEAR COLLINSVILLE, OKLAHOMA. APRIL 5, 1971
A grade crossing accident in Oklahoma is described in which a loaded motor truck struck a passenger train. A report of the accident investigation is given.
Railroad/Highway Accident Report

National Transportation Safety Board NTSB-RHR-72-1, SS-R/H-4, May 1972, 45 pp

ACKNOWLEDGMENT: NTIS (PB-210992)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-210992, DOTL NTIS

B6 039630
THE U.S.A. ACCIDENT SITUATION
In 1941, 5,086 persons were killed and 37,811 were injured on the lines covered by the report, the figure for fatalities shows an increase of 10-28 percent over 1940 nearly the same percentage increase 10-87 as in the number of train-miles the total for which was 969,000,000--making a fatality rate of 5.25 to one million train-miles. These injuries increased, however, by 27.78 percent to 39 in every million train-miles, a higher rate than for the previous three years. The distribution of casualties by types of accidents shows that the highest figures were caused by accidents at level crossings and to persons who were struck or run over at other points. Over 3,600 train accidents in 1941 were attributed to defects of some kind, and over 4,000 to negligence.

Railway Gazette Vol. 88 Aug. 1943, p 201

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1286)
DOTL RP

B6 039793
RAIL-HIGHWAY GRADE CROSSING SAFETY IMPROVEMENTS ARE SUGGESTED BY TEAM
Technical study of 36 rail-highway grade crossings by a diagnostic team has provided safety recommendations. New advance warning signs were designed and standards for application were prepared. These standards covered the following types of crossings and visibility conditions--protected crossing with obstructed view, protected crossing with unobstructed view, nonprotected crossing with obstructed view, and nonprotected crossing with

unobstructed view. These new standards were implements at eight rail-highway crossings. Evaluations of the crossings using the diagnostic team showed that the advanced warning signs were highly effective.

Texas Transportation Researcher Vol. 7 No. 4, Oct. 1971, pp 6-7

ACKNOWLEDGMENT: EI (EI 72 50018)
PURCHASE FROM: ESL Repr PC, Microfilm

B6 039840
REPORT TO CONGRESS. RAILROAD-HIGHWAY SAFETY, PART I: A COMPREHENSIVE STATEMENT OF THE PROBLEM
The report identifies the extent and nature of the safety problem associated with railroad-highway intersections nationwide and to pedestrians along railroad rights-of-way, particularly within and near urban areas. A cost-benefit analysis is employed to present the problem in order of magnitude. (Author)

Prepared in cooperation with the Federal Railroad Administration, Washington, D.C.

Federal Highway Administration Nov. 1971, 134 pp

ACKNOWLEDGMENT: NTIS (PB-206792)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-206792, DOTL NTIS

B6 039951
ACCIDENTS IN 1954
The number of train accidents increased slightly in Great Britian, over 1953; however, there were no passenger fatalities and the total fatalities in all rail movements was the lowest recorded, 0.5 per million train miles. The total main-line train mileage decreased slightly over 1953. The progressive decline in cases due to failure to obey signals was maintained. An encouraging trend was again recorded in accidents resulting from technical defects, probably reflecting better attention to detail in routine maintenance and examination. Warnings to children in schools and at home, and improved fencing of the lines, have led to a continual decline in the number of trespassers killed or injured by contact with live rails. Accidents at grade level crossings continue to be a problem. New signalling methods are briefly introduced.

Railway Gazette Vol. 103 Oct. 1955, p 468

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1356)
DOTL RP

B6 040035
SIGNALLING ON A MODERN RAILWAY SYSTEM
Signalling techniques on the railways have progressed through the manual block system to the Centralized Traffic Control, where the movement of trains is controlled from a central headquarters, with the track display of a district and the appertaining switch and signal actuating equipment located in the usual desk arrangement, observed and operated manually. Interlocking of crossings at grade are included in this system. The longer braking distances resulting from the 200 km/h and more operation presently necessitate modification of this system to include continuous automatic train control, which can be projected ultimately to automatic train operation and travelling on instrument vision. This article describes the use of computers for this type of control of trains. The computers are presently used for indirect control of train movements through existing signal equipment. The problems of extending this system to direct control of train movements are under consideration. The question whether the direct control of trains is possible or economical without local interlocking frames is at present unresolved. [German]

Ernst, W *Eisenbahntechnische Rundschau* Vol. 20 No. 1,2, Feb. 1971, pp 21-27, 7 Phot, 9 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1518)
DOTL RP

B6 041005
MANY SIGNS POINT TO SAFER GRADE CROSSINGS
For the fifth straight year, deaths from railway-highway grade crossing accidents declined in 1971. The 1970-71 drop in fatalities was 5.3%. The more optimistic outlook for safer grade crossings is due to several factors, among them more interest and funding for protection equipment by government agencies, improved and expanded driver education programs, improved signs and markings at crossings, and improved devices and systems of crossing protection equipment. Grade crossings statistics for the years 1951-71, and a Buyer's Guide for Crossing Protection are included.

Railway System Controls Vol. 3 No. 5, May 1972, pp 12-15, 1 Fig, 1 Tab, 1 Phot, 3 Ref

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B6 041054
GRADE CROSSING SAFETY GAINS
Rail-highway grade crossing safety is now receiving attention from all levels of government-federal, state and local-the railroads and manufacturers of crossing protection equipment. Factors important to grade crossing safety include the following: Grade crossing accident fatalities represent 2-3% of the total killed on U.S. highways each year; Federal, state, county and city aid are available for installation of automatic protective devices; Nine manufacturers provide automatic protection devices and/or controls in an annual market of approximately $12 million; Automatic flashing-light signals with or without gates are being installed at 1300-1500 rail-highway grade crossings each year.

Railway System Controls Vol. 2 No. 1, Jan. 1971, pp 9-14, 1 Fig, 2 Phot

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B6 041056
HOW TO MAKE CROSSING SIGNALS MORE OBSERVABLE TO DRIVERS
About one-third of all grade crossing accidents occur at crossings protected by flashing-light signals. The most common signal in use at crossings today is one in which the horizontal spread angle is 30 deg. and the vertical deflection angle is 14 deg. The minimum brightness necessary for a flashing red signal to be detected in daylight has not been accurately determined but it seems that it probably lies between 100 and 400 candelas for a lamp the size of a crossing signal. Two new bulbs are described; the reflectorized bulb and the quartz-iodine bulb.

Lindberg, VL (Ford Motor Company) *Railway System Controls* Vol. 2 No. 1, Jan. 1971, pp 24-30, 15 Fig, 2 Phot

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B6 041134
CROSSING HAS ONE CIRCUIT
A rail highway grade crossing on the East Erie Commercial at Erie presented some problems since the track is used by General Electric for testing of locomotives and transit cars. The track is equipped with catenary for 50,000 volts at 60 or 25 Hz, and speeds can vary up to 80 miles per hour. Due to light trains a very high shunting sensitivity was required of the track circuit. Due to varying speeds, a constant warning time was required. Also, insulated joints were to be avoided. Transcontrol Corp. furnished a jointless, center fed track circuit using 387 Hz energy modulated at 180 code per minute. The constant warning time unit uses a short measuring section just ahead of the approach track circuit on each side. This unit meets all fail safe requirements.

Pelikan, JM (Transcontrol Corporation) *Railway System Controls* Vol. 3 No. 8, Aug. 1972, pp 16-17, 1 Fig, 1 Phot

ACKNOWLEDGMENT: Railway System Controls
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B6 041161
CROSSING SAFETY GAINS SUPPORT
A grade crossing information system has been announced. The project includes planning and design of the highway-rail intersection information and numbering system. The second Phase of the project encompasses a field test of the inventory and numbering phases and paper flow procedure of the

nformation system. The third phase calls for the collection of highway-rail ntersection data on all highway-rail crossings in the U.S. The final phase will prepare information for automatic data processing and the coordination of additional input from the FHA and state and local highway authorities.

Railway System Controls Vol. 3 No. 10, Oct. 1972, pp 20-21, 1 Phot

ACKNOWLEDGMENT: Railway System Controls
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

B6 041162
CROSSING SAFETY DEPENDS ON GOOD MAINTENANCE
It is estimated there are 231,750 highway-railroad grade crossings in the United States. Of these, 20,730 were protected by highway crossing signals, gates or other active protection devices for the motorist. To be useful, these protective devices must be maintained in proper working order for use at anytime. Annual maintenance charges may range from $650 for the simplest type crossing signal to $1,250 for a gate installation.

This article was originally a paper presented at the 4th Annual Crossing Safety Conference of the AAR, held at Ohio State University, Columbus, Ohio, on August 29-31, 1972.

De Priest, JR (Seaboard Coast Line Railroad) *Railway System Controls* Vol. 3 No. 10, Oct. 1972, pp 21-25, 2 Phot

ACKNOWLEDGMENT: Railway System Controls
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

B6 041631
TELEMETRY APPLICATIONS IN GRADE CROSSING PROTECTION
Two microwave system concepts are described, representing application of telemetry and radar to grade crossing protection. Principle criteria for viable final components include simple installation and maintainance, low cost, very high reliability, and suitability to the difficult railroad environment.

This report consists of the proceedings of the International Telemetering Confernce, Washington, D.C., September 27-29, 1971, Volume 7.

Hopkins, JB
Instrument Society of America Proceeding 1971, pp 159-165

ACKNOWLEDGMENT: EI (EI 72 072055)
PURCHASE FROM: ESL Repr PC, Microfilm

B6 043620
REPORT TO CONGRESS. RAILROAD-HIGHWAY SAFETY PART II: RECOMMENDATIONS FOR RESOLVING THE PROBLEM
A comprehensive analysis is made of the railroad-highway grade crossing problem nationwide. An economic analysis is employed to assess the need for improving public grade crossings. Alternative levels of improvement needs on a nationwide basis are set forth including the number and type of improvements, costs, anticipated reductions in accidents and casualties, and total benefits. Alternative methods of financing an expanded program of public grade crossing improvements are presented to aid the Congress in their deliberations on this matter. An equitable allocation of improvement costs among the railroads, the Federal government, and others is recommended. Specific attention is given to the problems of pedestrian safety along railroad rights-of-way in densely populated urban areas; private crossings; high-speed rail corridors; and railroads in urban areas. (Author)

Prepared in cooperation with The Federal Railroad Administration, Washington, D.C. See Also Part I, PB-206792.

Federal Highway Administration Final Rpt Aug. 1972, 119 pp

ACKNOWLEDGMENT: NTIS (PB-213115)
PURCHASE FROM: NTIS Repr PC, Microfiche

PB-213115, DOTL NTIS

B6 044085
AUTO-TRAIN DERAILED IN CROSSING ACCIDENT
Southbound Auto-Train No. 107 was derailed early on the morning of March 13 at Hortense, Ga., after being struck by a pulpwood truck at a grade crossing. No. 107 consisted of two diesel units and 30 cars. It was carrying 298 passengers and 107 automobiles, and was reportedly traveling at 70 to 75 mph. The pulpwood truck, loaded and moving at high speed, is said to have ignored crossing signal lights, plowing into the second diesel unit, causing the derailment of both units and 27 of the 30 cars. The truck driver was killed. Of the 298 passengers, only 35, along with three crew members, were hospitalized. All but four passengers were released. An adjustment to Auto-Train's daily schedules from Lorton, Va., to Sanford, Fla., to trips southbound on odd dates and northbound on even dates has been placed in effect until equipment can be repaired and returned to service. Auto-Train pointed out that this is its first derailment since service was inaugurated Dec. 6, 1971--900 trips have been operated since that time.

Railway Age Vol. 174 No. 6, Mar. 1973, p 8

ACKNOWLEDGMENT: Railway Age
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

B6 044313
RAILROAD--HIGHWAY VEHICULAR MOVEMENT WARNING DEVICES AT GRADE CROSSINGS
Railroad operations have for many years been plagued with poor safety performance at grade crossings. Many lives are lost each year in accidents at crossings, to say nothing of costly injuries and property damage sustained. The situation has gotten worse with the advent of the soundproofed car, being driven at high speed in conditions of poor visibility. Clearly then some improved method of warning motorists as they approach a grade crossing is needed. Analysis of a critical encounter between a road vehicle and a locomotive reveal that the presently used equipment is inadequate to meet the needs of present day high speed vehicles. A system of vehicular movement warning devices is described in this paper, that might improve to some extent, the safety of grade crossing operations. Two methods are detailed; one involves static directional sonic devices positioned at the crossing; warning activation is made on a real time closing velocity determination. The other system employs a special variety of cattle guard in the roadway, to issue a tactile warning. Both systems are designed to give adequate warning to a motorist in a critical encounter situation as he approaches the crossing with a convergent locomotive on the track(s). A bonus feature in the use of selectively activated static directional sound warning sources, would be the curtailment of urban noise levels, where trains presently use the mobile audible source to issue warnings.

This paper was recommended by the IEEE Land Transportation Committee of the IEEE Industry Applications Society for presentation at the 1973 Joint ASME/IEEE Railroad Conference, St. Louis, Mo., April 11-12, 1973. The price is $1.35 for members.

Longrigg, P (Forney Engineering Company)
Institute of Electrical and Electronics Engineers Paper C73930-5-IA, Mar. 1973, 10 pp, 16 Fig, 4 Ref

ACKNOWLEDGMENT: IEEE
PURCHASE FROM: IEEE Repr PC

B6 044319
NATIONAL CONFERENCE ON RAILROAD-HIGHWAY GRADE CROSSING SAFETY, AUGUST 29-31, 1972
The keynote speaker of the conference noted that 12,000 motor vehicle-train collisions occur annually. Papers presented are addressed to problems of reducing this number through technology or by altering present traffic patterns. The solution of universal grade separation seemed to be too expensive an investment, and lines of authority and responsibility are not clear. The large number of crossings that carry low volumes of both vehicular traffic and railroad movement complicate possible solutions economically. The technology of passive devices and protective and warning needs were studied.

Ohio State University, Columbus Proceeding Aug. 1972, 63 pp

PURCHASE FROM: Ohio State University, Columbus 2070 Neil Avenue, Columbus, Ohio, 43210 Repr PC

B6 046079
RAILROAD-HIGHWAY COOPERATION INCREASES CROSSING SAFETY
Diagnostic teams composed of railroad representatives, federal and state highway officials have been working to improve railroad-highway grade

crossing safety. On-site inspections of crossings, use of "index of hazard", plus common sense and education of the public are leading to greater safety at grade crossings.

Blevins, WE (Missouri Pacific Railroad) *Railway System Controls* Vol. 4 No. 5, May 1973, 6 pp, 16 Fig

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

B6 046189
A RAILROAD CROSSING SIGNALLING SYSTEM
Discussed is a highway-railroad crossing signalling system using microwave telemetry to convey control information from a remote sensing location to a receiver coupled to an active motorist warning device. (Author)

Government-owned invention available for licensing. Copy of application available NTIS.

Hopkins, JB
Department of Transportation Patent Apl DOT/Case-TSC-10009, PAT-APPL-184 828, 17 pp

ACKNOWLEDGMENT: NTIS (PB-216155/2)
PURCHASE FROM: NTIS Repr PC, Microfiche

PB-216155/2, DOTL NTIS

B6 046211
BEHAVIORAL ENHANCEMENT
The report reviews research progress on motor vehicle operators and alcohol and their effects on highway safety.

Hurst, PM
Institute for Research Final Rpt Feb. 1973, 15 pp

Contract N00014-71-C-0219

ACKNOWLEDGMENT: NTIS (AD-758411)
PURCHASE FROM: NTIS Repr PC, Microfiche

AD-758411, DOTL NTIS

B6 046221
DEVELOPMENT OF WARRANTS FOR RURAL AT-GRADE INTERSECTION ILLUMINATION
A methodology is formulated that measures the effects of illumination of rural at-grade intersections in quantifiable terms. Previous research indicated that accident reduction is a valid criteria for evaluating lighting effectiveness. The effectiveness of illumination in modifying seven accident measures was evaluated by an analysis of variance. No significant relationship between accident severity and illumination could be inferred from the data. A predictor of accident reduction was developed based on the ratio of night accidents to total accidents after illumination. Values derived using the predictor were found to agree reasonably well with actual values obtained in two previous studies. (Author Modified Abstract)

Report on Illinois Cooperative Highway Research Program Series-135. Prepared in cooperation with State of Illinois Dept. of Transportation and Federal Highway Administration.

Wortman, RH Lipinski, ME Fricke, LB Grimwade, WP Kyle, AF
Illinois University, Urbana, (IHR-001) Engr Study UILU-ENG-72-2022, Nov. 1972, 108 pp

ACKNOWLEDGMENT: NTIS (PB-218057/8)
PURCHASE FROM: NTIS Repr PC, Microfiche

PB-218057/8, DOTL NTIS

B6 046721
FACTORS INFLUENCING SAFETY AT HIGHWAY-RAIL GRADE CROSSINGS
In 1961 motor vehicle accidents at highway-rail grade crossings numbered 2,931. In the accidents, 1,173 people were killed and 3,031 people were injured. The highway fatality rate at highway-rail grade crossings is disproportionately high when compared to the national total. Furthermore, almost one-third of the accidents occurred at crossings protected by audible and/or visible signals, 56 occurred despite lowered gates, and 88 occurred in the presence of trainmen or watchmen. It was with these thoughts in mind that this project was initiated by action of a joint committee of the American Association of State Highway Officials and the Association of American Railroads meeting in Miami, Florida, on December 6, 1962. Experimental and conventional signs for crossing protection were designed, installed, and tested in the field. A motion picture of the signs installed in the field was made and a group of engineers subjectively rated the experimental signs. Research findings include the development of a mathematical model for predicting accidents. The model was based on accident data obtained from a wide variety of private sources, state highway departments, and regulatory agencies. From the Interstate Commerce Commission the investigators obtained more than 15,000 accident reports spanning a five-year period. Warrants and criteria for the improvement of railroad crossings are presented in a graphic form.

Highway Research Board NCHRP RPT 50, 2 pp

PURCHASE FROM: Highway Research Board 2101 Constitution Avenue, NW, Washington, D.C., 20418 Repr PC

B6 046830
DRIVER INFORMATION SYSTEMS FOR HIGHWAY-RAILWAY GRADE CROSSINGS
The first objective of this research was to evaluate driver attitudes concerning hazards at highway-railway grade crossings. Respondents considered highway-railway grade crossings relatively more hazardous than other potential highway hazards but considered none of the potential hazards to be very serious. The second objective was to evaluate the economic priorities for improving railroad grade crossings relative to eight other highway improvements. Respondents considered safety at highway-railway grade crossings to be very important. The third objective was to evaluate driver preferences for information systems to be used at highway-railway grade crossings. An overhead changeable-message sign was the most preferred alternative method of warning. The fourth objective was to evaluate driver preferences for messages to be used in an information system for highway-railway grade crossings. The respondents preferred information even when no train was present and preferred full words rather than abbreviations.

Heathington, KW Urbanik, T, II *Highway Research Record* No. 414, 1972, pp 59-77, 13 Fig, 2 Tab, 23 Ref

ACKNOWLEDGMENT: Highway Research Record
PURCHASE FROM: Highway Research Board 2101 Constitution Avenue, NW, Washington, D.C., 20418 Repr PC

DOTL JC

B6 046915
PROPOSED WARRANTS FOR PROTECTIVE DEVICES AT RAILROAD-HIGHWAY GRADE CROSSINGS
Based on research that was completed at Purdue Univ, rational procedures have been developed for determining systematic reductions in the hazard which exists at railroad-highway grade crossings. Various statistical methods were utilized to evaluate the effects of environment, geometric characteristics, highway and railroad traffic patterns, and types of protective device on the accident experience at 530 rural and 465 urban grade crossings in the state of Indiana.

Berg, WD Schultz, TG Oppenlander, JC *Traffic Engineering* Vol. 40 No. 8, May 1970, pp 42-43

ACKNOWLEDGMENT: EI (EI 73 22702)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B6 046987
CROSSING PROTECTION HAS HIGH INTEREST
It is evident that there is considerable interest in railroad-highway grade crossing safety. And at long last, it appears that Congressional legislation will provide funds for grade crossing protective devices. Heretofore, any federal funds allocated for "increasing safety at rail-highway grade crossings," usually were for grade separations, improved signing and sight distances at existing grade crossings. However, there is some support in the Congress to provide funds for grade crossing protection equipment.

Railway System Controls Vol. 4 No. N7, July 1973, 1 pp

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B6 047265
SPEED PROFILES AND TIME DELAY AT RAIL-HIGHWAY GRADE CROSSINGS
Concern for railroad-highway grade crossing safety prompted the Department of Transportation to develop and implement more effective protective systems. The purpose of the study was to provide a data base reflecting the behavior of motorists in the vicinity of crossings. Crossing parameters of urban/rural, two/four lane, high/low volume and active/passive grade crossing protection were considered in the selection of 26 crossings for instrumentation. At each site, the highway was instrumented at five points in each lane using the Traffic Evaluator System. The resulting magnetic tape permitted determination for each of over 40,000 vehicles at each point, speed, lane changing behavior, headway, wheelbase, and number of axles. Manual inputs were made to the system to indicate vehicles which were required to stop at the crossing, the activation of protective devices, the arrival and departure of trains, and train speed. The data base was organized to verify and improve an existing traffic flow model designed to provide information on motorist speed and time delay at crossings.

Prepared in cooperation with Integrated Systems Inc., Wheaton, Md.

Sanders, JH
Biotechnology Incorporated Final Rpt May 1972, 152 pp

Contract DOT-FH-11-7867

ACKNOWLEDGMENT: NTIS (PB-220713/2)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-220713/2, DOTL NTIS

B6 047279
RAILROAD/HIGHWAY ACCIDENT REPORT. PENN CENTRAL FREIGHT TRAIN/SCHOOLBUS COLLISION NEAR CONGERS, NEW YORK, 24 MARCH 1972
The report describes a schoolbus freight train collision at a railroad highway grade crossing. As a result of the accident five students died, and the bus driver and all 44 remaining students were injured. None of the train crew was injured. The National Transportation Safety Board determines that the cause of the accident was the failure of the schoolbus driver to stop at the stop sign until the crossing was clear of railroad traffic. Contributing to the accident was the unnecessary routing of the schoolbus over a not specially protected railroad/highway grade crossing.

National Transportation Safety Board Acc Rpt NTSB-RHR-73-1, SS-R-H-6, Mar. 1973, 48 pp

ACKNOWLEDGMENT: NTIS (PB-221137/3)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-221137/3, DOTL NTIS

B6 047384
VIEWING OF RAILWAY FLASHING LIGHT SIGNALS
An attempt is made to bridge the gap existing between theoretical knowledge and published material on the one hand, and the practical application to an efficient outdoor flashing light warning system for railway purposes, on the other. The relative effectiveness of flashing light highway crossing signals under the full range of environmental conditions likely to be experienced in service is determined by many diverse factors, the principal ones being contrast brightness, apparent brightness magnitude, intensity of light output, signal colour, alignment and focusing of lights, and signal range. An examination is made of the above items and conclusions are drawn as to the minimum standards necessary for optimum viewing.

Perception and Application of Flashing Lights, International Symposium, 19-22 April 1971.

Cox, JJ (Victorian Railways)
Imperial College pp 189-207, 14 Ref

ACKNOWLEDGMENT: EI (EI 73 024032)
PURCHASE FROM: ESL Repr PC, Microfilm

B6 047410
CROSSING SAFETY IMPROVES YEARLY
Safety at railroad-highway grade crossings has shown a steady improvement. More grade crossings are being protected with automatic devices and the number of accidents at crossing is declining. Additionally, there is optimism for continued improvement, due mainly to a greater public awareness that is manifesting itself in federal legislative action to provide more funds for grade crossing protective devices to be installed, not only at federal-aid highways, but at other highways as well. The recently passed Federal Aid Highway Act of 1973 includes specific moneys for installation of protective devices at railroad-highway grade crossings.

Railway System Controls Vol. 4 No. 8, Aug. 1973, 4 pp

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B6 048183
ROAD-RAIL PROTECTION--AUDIBLE WARNING EFFECTIVENESS
Audible warning is becoming progressively less effective with modern high speed road traffic and noisy vehicles interfering with reception. Subjective examination of warning sounds can be misleading as the ear does not directly compare sound pressure levels. Sound reduces in intensity in accordance with the inverse square law. To double the range of hearing, a fourfold increase in pressure level is required. Suggestions are made on changes in methods of road vehicle operation which would take into consideration high winds and other factors and improve overall safety on crossing approaches. Suggestions are also made on improvements to roadside audible warnings and standardisation of audible signals that it would be practical to carry out without degradation of the total environment. It is concluded that audible warnings still play a vital part in road-rail protection. In many instances revised motor vehicle operation could lead directly to a substantial reduction in the serious type of collision with high noise level road transports during periods of high winds, and an overall improvement in protection levels.

Cox, JJ (Victorian Railways) *Australian Road Research Board Proceedings* Proceeding Vol. 6 No. t2, 826, pp 448-466, 1 Ref

PURCHASE FROM: Australian Road Research Board 60 Denmark Street, Kew, Victoria, Australia Repr PC
DOTL RP

B6 048237
MODERN SAFETY EQUIPMENT FOR THE PROTECTION OF LEVEL CROSSINGS
The author gives a clearly-arranged synopsis of the large number of safety installations employed on the German Federal Railway for the protection of level crossings. Their application is explained in relation to the conditions of road traffic, railway operation and modern signalling. [German]

Endmann, K *Eisenbahntechnische Rundschau* Vol. 22 No. 4, Apr. 1973, pp 123-133

ACKNOWLEDGMENT: British Railways (29396)
PURCHASE FROM: Hestra-Verlag Darmstadt, West Germany Repr PC
DOTL JC

B6 050339
RAILROAD CONSOLIDATION AND RELOCATION
This case study points out the complexity of the railroad "problem" in a medium-sized city, and it shows how one solution is being achieved through public sector and railroad cooperation. This situation posed by rail operations is common in most cities where downtown and urban area railroad crossings create traffic problems and safety hazards. The solution in Lincoln, Nebraska offers one type of legal and financial arrangement possible. Of most importance in this case study is the basic recognition that the city and the railroads shared a problem which is being solved by joint efforts. Lincoln was one of the first cities to come to grips with the "railroad problem" and its relationship to highways and community redevelopment. It offers an example to others across the nation. A recent Federal Railway Administration (FRA), Department of Transportation, study proposal listed the Lincoln program as a primary reference for analysis of railroad and urban area coordination.

Chamberlain, EA (Sverdrup and Parcel and Associates, Incorporated)
Planners Notebook Vol. 3 No. 3, June 1973, 6 pp

PURCHASE FROM: American Institute of Planners 917 15th Street, NW, Washington, D.C., 20005 Repr PC

B6 050733
PROCEEDINGS 1972 CONFERENCE ON RAILROAD-HIGHWAY GRADE CROSSING SAFETY. 29-31 AUGUST 1972, HELD AT OHIO STATE UNIVERSITY, COLUMBUS
The objective of the conference was to bring together key interest groups to discuss new ways and means to insure increased safety and to achieve optimum efficiency in the use of both highway and railroad facilities. The report contains presentations made by various experts in railroad, highway, and urban affairs. Individual sessions were devoted to urban railroad problems; train-activated rail-highway protection; passive devices at rail-highway crossings; implementation of major crossing protection programs; warrants for safety improvements at crossings; and maintenance of automatic protection devices at grade crossings.

Prepared in cooperation with Highway Research Board, Washington, D.C. and National Safety Council, Chicago, Ill. See also PB-222 039.

Ohio State University Aug. 1972, 76p

ACKNOWLEDGMENT: NTIS (PB-222882/3)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-222882/3

B6 050744
HUMAN FACTORS COUNTERMEASURES TO IMPROVE HIGHWAY-RAILWAY INTERSECTION SAFETY
A field demonstration study in support of the evaluation of alternative railway-highway grade crossing accident countermeasures was conducted. Guidelines were provided for the development of countermeasure concepts. Investigations of the causative factors of accidents showed that maintenance of protective warning devices, driver attention and driver expectancy were precipitating and predisposing factors in accidents. An appraisal of inherent driver safety potential was made which included driver education and licensing, safety programs and law enforcement, attitude and habit components of railway-highway safety and psychophysiological capabilities and limitations. A broad base of data was obtained in a demonstration field study conducted in five states. (Modified author abstract)

Sanders, JHJ Kolsrud, GS Berger, WG
Biotechnology Incorporated Final Rpt July 1973, 230 pp

Contract DOT-HS-190-2-300

ACKNOWLEDGMENT: NTIS (PB-223416/9)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-223416/9

B6 050748
GRADE CROSSING PROTECTION IN HIGH-SPEED, HIGH-DENSITY, PASSENGER-SERVICE RAIL CORRIDORS
The report is a preliminary examination of special aspects of grade crossing protection for operation of high-speed passenger trains in rail corridors for which complete grade separation is not possible. Overall system needs and constraints are indicated, and their implications examined. Applications of conventional and improved hardware is considered, with special attention to activation criteria, appropriate motorist-warning devices, stalled-vehicle indicators, and train-mounted components. Non-technical aspects of the problem are also discussed, and areas for which future research efforts may be appropriate are identified.

Hopkins, JP
Transportation Systems Center Final Rpt DOT-TSC-FRA-73-3, Sept. 1973, 40 pp

Contract DOT-RR-302

ACKNOWLEDGMENT: NTIS (PB-223738/6)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-223738/6

B6 050894
AN EVALUATION OF SAFETY AT HIGHWAY-RAILWAY GRADE CROSSINGS. FINAL REPORT
An attitudinal survey was used to evaluate driver attitude concerning the hazard at railroad grade crossings, citizen appraisal of properties for improving grade crossing safety, driver evaluation of possible warning systems for crossings, and the development of the general design of a proposed new advance warning system. The research indicates that the respondents considered railroad grade crossings more hazardous than several other highway hazards. However, all hazards were, at most, only considered moderately hazardous. The improvement of safety at railroad grade crossings was given high priority by the respondents. An overhead changeable message sign was the most preferred method of warning at railroad grade crossing. It was concluded that a field installation is desirable. (HSL)

Urbanik, T, II
Purdue and Indiana State Highway Commission JHRP-11, 1971, 163 pp

Contract DOT/HS-011869

PURCHASE FROM: NTIS Repr PC, Microfiche
HS-011 869, DOTL NTIS

B6 051469
ENHANCEMENT OF TRAIN VISIBILITY
The report describes a study of the most effective and practical means of enhancing the conspicuity of the trailing end of trains, in order to reduce the possibility of train--train collisions. There are five elements: (a) Definition of a usable number of categories of target, background, and ambient conditions which include the great majority of situations actually encountered; (b) estimation of the stimuli required for each category to increase significantly the detection probability for typical observers; (c) examination of all potentially feasible visibility aids in terms of these criteria; (d) determination of estimated costs, lifetime, and power consumption of techniques which appear promising in terms of effectiveness, and (e) delineation of alternative systems, consistent with one another, comprising a hierarchy of effectiveness and cost. Special deficiencies, advantages, and implications for policy which may be associated with particular realizations are indicated. The devices suggested as optimal include large areas of fluorescent material arranged in a distinctive pattern, retro-reflectors at each corner, and flash lamps of moderate intensity. Detailed specifications are given for such aids.

Hopkins, JB
Transportation Systems Center Final Rpt DOT-TSC-FRA-73-1, Sept. 1973, 84p

ACKNOWLEDGMENT: NTIS (PB-223899/6)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-223899/6, DOTL NTIS

B6 051966
THE USE OF MODERN SAFETY EQUIPMENT AT LEVEL CROSSINGS [ANWENDUNG NEUZEITLICHER SICHERUNGSEINRICHTUNGEN FUER BAHNUEBERGANGE]
Guide lines are laid down for the use of technical equipment ensuring safety at level crossings, and a summary is given of its development on the German Federal Railway. The use at level crossings of safety equipment operated by hand, as well as by the trains, is described. Details are also shown of the difficulties and possibilities involved in the operation of the barriers by the signals, and the connection between level-crossings and modern central signal cabins. [German]

Endmann, K *Eisenbahntechnische Rundschau* No. 4, 1973, 11 pp, 13 Fig, 12 Ref

ACKNOWLEDGMENT: UIC (1006)
PURCHASE FROM: International Union of Railways, BDC 14 rue Jean Rey, 75015 Paris, France Repr PC
1006, DOTL JC

B6 053727
ECONOMIC ANALYSIS OF GRADE CROSSING IMPROVEMENTS
A Rail-Highway Crossing Study was initiated by the Chicago Transportation Study in 1972. The project goal was to develop an analytical tool which

could identify optimal capital investments for improvements to the 3,100 at-grade crossings, and replacements of the 2,000 grade-separated crossings within the region. Using the analytical results, the project set regional priorities for feasible improvements to, and replacements of, rail-highway crossings.

Sponsored in cooperation with the U.S. Dept. of Transportation, Federal Highway Administration.

Halagera, RT Miller, MS
Chicago Area Transportation Study CATS 313-05, Dec. 1973, 55 pp, 12 App

ACKNOWLEDGMENT: Chicago Area Transportation Study
PURCHASE FROM: Chicago Area Transportation Study 300 West Adams STreet, Chicago, Illinois, 60606 Repr PC

DOTL RP

B6 053832
ELIMINATION OF LEVEL CROSSINGS ON THE STRASBOURG-BASLE LINE IN THE HAUT-RHIN DEPARTMENT [SUR LA LIGNE STRASBOURG-BASLE SUPPRESSION DES PASSAGES A NIVEAU DANS LE DEPARTMENT DU HAUT-RHIN]

The Assistant Regional Manager of the SNCF who is the author of this article gives brief historical details of the routing and the construction of the Strasbourg-Basle line across the plain on the left bank of the Rhine which is a particularly fertile and much parcelled out part of the country. This situation and the large number of tracks crossing the line involved the construction of many level crossings (236 between Strasbourg and Basle), and the policy followed subsequently has been to eliminate these level crossings progressively. The final phase has now been reached with the section across the Haut-Rhin department up to Mulhouse, which is being dealt with globally. It is expected that by 1976 the remaining 48 level crossings will have been closed and replaced by 24 new structures. [French]

Cailliez, R (French National Railways) *Revue Generale des Chemins de Fer* Dec. 1973, 6 pp, 7 Fig

ACKNOWLEDGMENT: Revue Generale des Chemins de Fer
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B6 054940
THE CASE FOR THE WALKOUT CANTILEVER

Cantilevers have received increasing emphasis over the last few years for several reasons. Street and roadways have become wider and safety legislation has required signaling devices to be set back further from the roadway. Unlike the traditional flashing light signal, cantilevers put the signal over the traffic lanes, providing greater safety for both highway and rail traffic. And they can be set further back from the roadway.

Railway System Controls Vol. 5 No. 5, May 1974, pp 21-22, 3 Phot

ACKNOWLEDGMENT: Railway System Controls
PURCHASE FROM: XUM Repr PC

DOTL JC

B6 054941
NEW PRIORITY FOR GRADE CROSSING SAFETY

Grade crossing safety has a new national priority. For the first time in history, Highway Trust Fund money is authorized specifically for rail-highway crossing safety projects. Also for the first time, Federal money is available for crossing projects off the Federal-aid highway systems. How much money is actually available? What kind of projects can it be used for? Who has charge of planning how it will be spent? The purpose of this article is to provide answers to these and other questions—as a guide for follow-up action at local and state levels.

Railway System Controls Vol. 5 No. 5, May 1974, 3 pp, 1 Tab, 1 Phot

ACKNOWLEDGMENT: Railway System Controls
PURCHASE FROM: XUM Repr PC

DOTL JC

B6 057168
THE BIG BREAKTHROUGH IN GRADE-CROSSING IMPROVEMENT

The Federal Highway Act of 1973, for the first time in history, authorized the use of Federal Funds for defraying the entire cost of projects designed to eliminate safety hazards at intersections of railways and highways at grade. Betterment of the crossing surfaces is included. In these pages RT&S editors first summarize the essential points of the legislation, particularly those that serve as guide lines on how the money is to be spent. This is followed by a comprehensive report on the "state of the art" in grade-crossing surfaces, and a showcase of the latest developments in this area.

Railway Track and Structures Vol. 70 No. 6, June 1974, pp 15-16

ACKNOWLEDGMENT: Railway Track and Structures
PURCHASE FROM: XUM Repr. PC

DOTL JC

B6 057349
A FORTRAN PROGRAM FOR GRADE CROSSING COLLISIONS STUDIES USING COMPUTER GRAPHICS

A computer program is presented in the FORTRAN language to simulate the co-planar dynamic response of vehicles to the collision situation in which a rail vehicle impacts a highway vehicle at a grade crossing. The simulation incorporates 28 individual parameters associated with vehicle geometry, initial conditions, and other variables describing vehicle structural characteristics and a point-mass occupant situated inside the struck vehicle. A complete listing of the program is given along with descriptions of the program logic, sample input and output. Inputs include the mass, velocity, and force-deflection properties of each vehicle. The displacements and rotations of the vehicles are calculated as well as the penetration of the highway vehicle and the accelerations of its occupant compartment. As a special feature, this program is capable of producing computer generated diagramatic aerial-view movies of the collision event representing a locomotive striking a sedan broadside. (Author)

Taylor, J Spencer, P
Control Systems Research, Incorporated Final Rpt. CSR-351-001-01, July 1973, 146p

ACKNOWLEDGMENT: NTIS (PB-232368/1)
PURCHASE FROM: NTIS Repr. PC, Microfiche

PB-232368/1, DOTL NTIS

B6 057537
EVALUATION OF SAFETY IMPROVEMENTS AT HIGHWAY-RAILWAY GRADE CROSSINGS

In recognition that added effort must be placed on reducing the conflict at highway-railroad grade crossings, this research to evaluate means of supplying motorists with more credible and forceful information was developed. Many innovative active protection devices for grade crossings have been tried or proposed. Many such devices are reviewed with evaluations of their effectiveness, if any were available. The "Monon green light" signal, several of which are in Indiana, was field observed for effectiveness and recommendations are made for improvements. A study of speed profiles of vehicles approaching a crossing protected by a standard flashing light system is also reported. A photographic data collection system was developed which allowed determination of vehicle speed profiles, thus indicating driver reaction to the crossing condition. Speed profiles for nonactuated and actuated signal conditions are analyzed. It was determined that drivers approaching the crossing under progressively greater stimulus relative to an approaching train entered the approach at correspondingly slower speeds.

Conducted in cooperation with the U.S. Department of Transportation, Federal Highway Administration.

Butcher, TA
Purdue & Indiana State Highway Comm JHRP Intrm Rpt. JHRP-1-73, Feb. 1973, 138 pp, 27 Fig., 22 Tab., 61 Ref.

Contract HPR-1(10)Part 2

ACKNOWLEDGMENT: Purdue & Indiana State Highway Comm JHRP
PURCHASE FROM: Purdue & Indiana State Highway Comm JHRP Civil Engineering Building, Purdue University, West Layafette, Indiana, 47907 Repr. PC

B6 071612
RAILROAD/HIGHWAY ACCIDENT REPORT: ILLINOIS CENTRAL RAILROAD COMPANY TRAIN NO. 1 COLLISION WITH GASOLINE TANK TRUCK AT SOUTH SECOND STREET GRADE CROSSING, LODA, ILLINOIS, JANUARY 24, 1970
About 9:55 a.m., on January 24, 1970, Illinois Central Railroad southbound passenger train No. 1, moving at a speed of 79 miles per hour on track No. 1, struck a motortruck loaded with gasoline on the South Second street crossing in Loda, Illinois. The tank of the truck was split open, spilling the gasoline which exploded and caught fire. The burning gasoline covered the exterior of the locomotive unit and entered the control compartment through the nose door, damaged nose, and other openings. Three employees of the railroad, who were occupying the control compartment of the lead locomotive unit at the time of the accident, and the driver of the motortruck received fatal injuries from the burning gasoline. The National Transportation Safety Board determines that the probable cause of this accident was that the operator drove the gasoline-laden truck, without stopping, onto the tracks immediately in front of the approaching train, while the crossing warning device was indicating the train's approach.

National Transportation Safety Board NTSB-RHR-71-1, July 1971, 28 pp, Phots., Apps.

ACKNOWLEDGMENT: National Transportation Safety Board
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-202869, DOTL NTIS

B6 071749
RAILROAD/HIGHWAY ACCIDENT REPORT: BOSTON AND MAINE CORPORATION SINGLE DIESEL-POWERED PASSENGER CAR 563 COLLISION WITH OXBOW TRANSPORT COMPANY TANK TRUCK AT SECOND STREET RAILROAD-HIGHWAY GRADE CROSSING EVERETT, MASSACHUSETTS, DECEMBER 28, 1966
At 12:10 AM, on December 28, 1966, eastbound firstclass passenger train No. 563, consisting of a single car diesel-powered passenger unit operated by the Boston and Maine Corporation collided with a northbound motor tank truck owned and operated by the Oxbow Transport Corporation stopped across the Second Street grade crossing at Everett, Mass. The collision resulted in the death of 11 of a total of 28 passengers and 2 of the 3 train crew members and other injuries and damage to property. The semi-trailer of the tank truck containing 8,200 gallons of fuel oil ruptured on impact, covering the forward end of the passenger car with the oil. A spread of flames immediately covered the forward section of the car. The fatalities were due to thermal burns and smoke inhalation. There was a lack of emergency exits in the car, in addition to an inward opening rear door which became jammed in a closed position while people were attempting to escape. The truck driver had left the vehicle prior to impact and was not injured. The probable cause of the accident was the loss of air pressure in the brake systems of the tractor-trailer which resulted in an automatic application of the brakes that could not be released from the cab of the tractor and therefore held the tractor-trailer directly across the Boston and Maine track at the collision point.

National Transportation Safety Board Feb. 1968, 56 pp, Figs., Phots., 5 App.

ACKNOWLEDGMENT: National Transportation Safety Board
PURCHASE FROM: NTIS Repr. PC
PB-190212, DOTL NTIS

B6 071750
RAILROAD ACCIDENT REPORT: SOUTHERN PACIFIC RAILROAD COMPANY FRUITRIDGE ROAD GRADE CROSSING SACRAMENTO, CALIFORNIA, FEBRUARY 22, 1067
On February 22, 1967 at 12:05 PM, a station wagon traveling east on Fruitridge Road in Sacramento, California collided with a Southern Pacific Company freight train traveling north at the intersections of the Southern Pacific railroad tracks and Fruitridge road. Immediately prior to and after the collision, the flashing lights and bells of the automatic railroad crossing warning devices were functioning properly. In addition, the engineer was sounding the locomotive's horn and bell in the prescribed manner, and the locomotive's regular and oscillating headlights were functioning. The station wagon was destroyed and the nine occupants killed. The train was not derailed nor was the train crew harmed and the lead locomotive suffered only minor damage. The probable cause of the accident was failure of the driver of the station wagon to stop his vehicle short of the grade crossing and to remain clear of the track as required by California State law.

National Transportation Safety Board Jan. 1968, 31 pp, 2 App.

ACKNOWLEDGMENT: National Transportation Safety Board
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-190216, DOTL NTIS

B6 071839
HIGHWAY-RAILROAD ACCIDENT REPORT: WATERLOO, NEBRASKA, PUBLIC SCHOOL BUS UNION PACIFIC RAILROAD COMPANY FREIGHT TRAIN ACCIDENT WATERLOO, NEBRASKA OCTOBER 2, 1967
At 8:10 A.M. on October 2, 1967, a school bus carrying 13 children to school, traveling east on County Road 29, near Waterloo, Nebraska, was driven across an unprotected highway grade crossing and was struck by a westbound Union Pacific Railroad freight train traveling at 56 m.p.h. The locomotive struck and held the right rear quarter of the bus dragging it backward, and then deflected it into a communications pole. The rear of the bus body was disintegrated. Four of the children on the bus were killed and the other nine injured. There were no other fatalities or injuries in the accident. The probable cause of the accident was the failure of the school bus driver to ascertain that there was a train approaching the grade crossing and to hold his vehicle until the way was safe for passage.

National Transportation Safety Board Sept. 1968, 51 pp, Phots.

ACKNOWLEDGMENT: National Transportation Safety Board
PURCHASE FROM: NTIS Repr. PC
PB-190204, DOTL NTIS

B6 072758
RECOMMENDED PRACTICES FOR RAILROAD-HIGHWAY GRADE CROSSING WARNING SYSTEMS
The recommended practices contained in this bulletin are composite evaluations from sources in the railroad industry, Federal and state governments and manufacturers of grade crossing warning devices. These recommendations are intended to serve as guide lines only and are not to be taken or interpreted as absolute standards to be followed in all circumstances.

Approved as an American National Standard by the American National Standards Institute.

Association of American Railroads Bulletin No. 7, 1974, 30 pp, 20 Fig.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AAR Repr. PC
DOTL RP

B6 072774
RECOMMENDED PRACTICES FOR GRADE CROSSING WARNING SYSTEMS
Technological changes in available materials and methods used in development of warning devices and systems, as well as changes in highway concepts presented in the AAR's "Recommended Practices", Bulletin No. 7 are reviewed.

Railway System Controls Vol. 5 No. 8, Sept. 1974, pp 55-56

ACKNOWLEDGMENT: EI (EI 74 072834)
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B6 080399
ANALYSIS OF DRIVER REACTION TO WARNING DEVICES AT A HIGH-ACCIDENT RURAL GRADE CROSSING
The objectives of this research were to analyze the effect on motorists of improving the warning devices at a high-accident, rural grade crossing, from 8-inch flashers to automatic gates and 12-inch flashers activated by a Marquardt speed predictor and having additional strobe lights; to evaluate suitable parameters to make the analysis; to study accident history and site conditions and relate these to motorist reaction to the system-before and after; and to evaluate the data collection system itself. Spot speeds were taken at eight points on each approach to obtain an appraoch speed profile for various groups under various conditions after the signal system was

improved. These were compared to similar data taken before system improvement. It was shown that an activated gate arm can be as effective in slowing the average approaching vehicle as a train across the road. Train and signal conspicuity were a problem and contributed to the poor accident record of older drivers. The Strobe lights made the warning system more visible after activation. Most drivers approach a grade crossing safely and mean speed of various groups shows trends but is a relatively weak parameter to test effectiveness, because they do not insolate the occasional, unsafe driver. Percent reduction of fastest cars, along with examining individual "fastest" cars, is a better parameter than mean speeds and decelerations to show improved effectiveness.

Russell, ER
Purdue and Indiana State Highway Commission, JHRP, Federal Highway Administration, Indiana State Highway Commission, (C-36-59N) Final Rpt. Aug. 1974, 233 pp

Contract HPR-1 (11) Part II

ACKNOWLEDGMENT: Highway Safety Research Institute (HSRI-30627), Federal Highway Administration (T-0126)
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB0245608/5ST, DOTL NTIS

B6 080463
MECHANISED SNOW CLEARANCE KEEPS NORWAY'S TRAINS ON THE MOVE
Few lines in the world suffer from winter conditions as severe as those on the Bergen line, but the whole Norwegian State Railways network requires specialised equipment to clear snow and ice at an annual cost of 14 million kroner. Careful selection and positioning of mechanised snowplows and static devices such as fences and snowsheds keep the line clear of bulk snow, while points, rodding and flangeways have to be heated or protected by techniques still evolving.

Evenmo, O (Norwegian State Railways) *Railway Gazette International* Vol. 130 No. 11, Nov. 1974, pp 423-426, 1 Fig., 5 Phot.

ACKNOWLEDGMENT: Railway Gazette International
PURCHASE FROM: XUM Repr. PC
DOTL JC

B6 081203
AN EVALUATION OF FIVE RAILROAD ENGINE ALERTING AND WARNING LIGHT SYSTEMS
Five lighting systems proposed for improved other-vehicle operator approach warning alerting were evaluated in a simulated grade crossing decision paradigm. Additional evaluations were conducted on system conspicuousness. The systems, a Bicolor Radial Beacon, Slow-rate Strobe 2.5 flash per second (FPS), Fast-rate Strobe 1 FPS, truck clearance lights, and side mounted Flourescent Panels, were examined at 10, 20, 30 miles per hour under daylight and night conditions. Some advantage was found for the strobe systems and for the clearance lights as compared to the usual fixed locomotive headlight. Recommendations for further research were made. (Author)

Sanders, MS Aylworth, CE O'Benar, JD
Naval Ammunition Depot NAD-CR-RDTR-265, Feb. 1974, 81 pp

ACKNOWLEDGMENT: NTIS (AD-779878/8GA)
PURCHASE FROM: NTIS Repr. PC, Microfiche
AD-779878/8GA, DOTL NTIS

B6 081262
WANTED: NEW STANDARDS FOR AFO
Paper presented by the author, senior research engineer for the General Railway Signal Co., at the 1974 annual meeting of the AAR Telecommunications and Signalling Dept. It deals overall with the problems of audio-frequency track circuits: (1) track impedance in relation to frequency; (2) voltage drop at the end of the circuit, in relation to circuit length and different frequencies; (3) effect of ballast resistance and safety margins for system operating depending on variations in ballast resistance; (4) preshunt and extended shunt phenomena; and (5) choice of the feed and receive end impedances of transmitters and receivers and of the figurative impedance of shunting by a vehicle. The author comments on the diagrams illustrating these phenomenae and draws conclusions as to the beneficial or harmful effects resulting from modifications of: (1) the impedance of the equipment used; (2) the frequency used; and (3) the energy level of the signal transmitted or the receiver gain.

This publication, Rail Engineering International, 13 also available from Broadfields (Technical Publishers) Limited Little Leights, Chelmsford, Essex CM3 1PF, England.

Freilinghaus, K *Rail Engineering International* Vol. 4 No. 4, May 1974, pp 182-188, 12 Fig.

ACKNOWLEDGMENT: International Railway Documentation, Selection of (UIC Serial No. 1154)
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B6 081949
HIGHWAY ACCIDENT REPORT--AUTOMOBILE INTRUSION ONTO THE LONG ISLAND RAILROAD ELECTRIFIED TRACKS, AND FIRE, GARDEN CITY, NEW YORK, AUGUST 8, 1973
At 4:30 p.m., e.d.s.t., on August 8, 1973, an automobile carrying five teenagers was driven onto the electrified tracks of the Long Island Railroad by an unlicensed 15-year-old girl. The car's contact with the third rail caused a momentary short circuit and initiated severe electrical arcing. The car immediately began to burn at the front, and the fire spread to the rear. The two girls in the front seats escaped through the right door. The three girls in the back seat died in the fire. The National Transportation Safety Board determines that the cause of this accident was the driving of the automobile by an unlicensed and untrained juvenile of the roadway onto electrified tracks, where it crashed into the third rail.

National Transportation Safety Board NTSB-HAR-74-3, Sept. 1974, 33 pp

ACKNOWLEDGMENT: NTIS (PB-236267/1SL)
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-236267/1SL, DOTL NTIS

B6 083969
TECHNOLOGICAL ASPECTS OF PUBLIC RESPONSIBILITY FOR GRADE CROSSING PROTECTION
Recent interest in improvement of safety at railroad-highway grade crossings has been accompanied by a growing involvement of government at all levels. Public responsibility typically has been confined to providing funding, developing information, planning, and regulating; the design, installation, and maintenance of automatic protection has been exclusively a railroad activity. This paper examines the technical limitations that constrain public authorities from taking total responsibility for crossing protection devices, which are the only highway traffic control devices that are not the responsibility of highway officials. Research directed toward removal of those limitations is described. A review of the legal history and current role of governmental units precedes a description of conventional technology in terms of impact on a wider public role. Means of train detection and motorist warnings are discussed; the conclusion drawn is that the principal technological impediment to non-railroad responsibility for crossing protection is the present dependence on track circuit techniques for determination of train presence. Recent research directed at removing this constraint is presented. Analysis of system requirements and available technology has identified a discrete train detector-microwave communication link concept, and the results of field testing indicate a number of attractive features and general feasibility.

Hopkins, JB (Transportation Systems Center) *Transportation Research Record* No. 514, 1974, pp 33-43, 4 Fig., 8 Ref.

PURCHASE FROM: TRB Publications Off Orig. PC
DOTL JC

B6 084724
HAMMOND RAIL RELOCATION PROPOSAL
This report, developed by the Railroad Relocation Committee and submitted to the mayor, is proposed to relieve traffic congestion in the Indiana city. The plan would relocate existing operations on a consolidated and greatly simplified track system to be used by all the railroads involved. The result would be elimination of many grade crossings and creation of no new ones. Existing lines of Penn Central would be supplemented with additional tracks to handle the trains of Chesapeake & Ohio, Louisville & Nashville, Erie Lackawanna and Norfolk & Western.

Railroad Relocation Committee Feb. 1973, 15 pp
PURCHASE FROM: Hammond Chamber of Commerce Hammond, Indiana, Repr. PC
DOTL HE1613.H2H27

B6 091253
ANALYTICAL INVESTIGATION OF A GRADE-CROSSING ACCIDENT BETWEEN A RAILROAD TRAIN AND A SPENT REACTOR FUEL CASK
No Abstract.

Dennis, AW
Sandia Laboratories Jan. 1975, 59 pp

Contract AT(29-1)-789

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
SAND-74-0317, DOTL NTIS

B6 094029
NORTHEAST CORRIDOR HIGH-SPEED RAIL PASSENGER SERVICE IMPROVEMENT PROJECT. TASK 10N GRADE CROSSINGS AND FENCING
Recommendations for the eliminations of at-grade crossings and provisions of fencing programs for safety on the Northeast Corridor from New Haven to Boston are developed. Construction and land acquisition cost estimates are included. Each at-grade crossing site is discussed in detail, including alternate proposals which were considered. The special crossing problem at New London is investigated. Fencing standards are developed. Alternative applications are discussed. Special problem areas such as commuter stations and overhead bridges are investigated.
See also PB-243 420.

Kraffmiller, SE Moore, WE White, RJ
DeLeuw, Cather/STV, Federal Railroad Administration Final Rpt. 2503-10, 2503-11, Sept. 1975, 213 pp

Contract DOT-FR-40026

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-248704/9ST, DOTL NTIS

B6 095212
TRAFFIC AND TECHNICAL ASPECTS AT LEVEL CROSSINGS. USE OF MODERN SAFETY SYSTEMS FOR PROTECTION AGAINST THE DANGER OF SLANTING COLLISIONS AND THEIR EFFECT ON ROAD TRAFFIC [Verkehr und Bahnuebergangstechnik. Anwendung moderner Bahnuebergangssicherung als Flankenschutz und deren Wirkung auf den Strassenverkehr]
Railway priority at level crossings necessitates the protection of both rail and road against the danger of slanting collisions. The author shows how the DB is endeavouring to solve the multiple problems that arise in this sphere, by using modern safety measures. Such devices as barriers, colour-light signals and audible warning signals are simply of an informative character. The installation of reciprocal interlocking between the barriers and the road signals on one hand, and the railway signals on the other, is necessary. The problem of controlling the danger zone remains to be solved. It is essential to re-examine the psychological influence of level crossing devices on road users as regards the recognition, perceptibility and assimilation of the information. [German]

Endmann, K *Eisenbahningenieur* Vol. 25 No. 8, Aug. 1974, pp 253-259, 14 Fig.

ACKNOWLEDGMENT: International Railway Documentation, Selection of
PURCHASE FROM: Dr Arthur Tetzlaff-Verlag Niddastasse 64, Frankfurt am Main, West Germany Repr. PC

B6 095296
PROCEEDINGS. 1974 NATIONAL CONFERENCE ON RAILROAD-HIGHWAY CROSSING SAFETY
This transcript of the three-day conference covers many facets of the grade crossing problem; the objective of the sessions was "to demonstrate how each of the partners in grade crossing improvement programs is using or can best use new techniques and new funding in a cooperative effort to implement an effective grade crossing improvement program. Twelve papers, four panel discussion and opening addresses are included.
Conference held at U.S. Air Force Academy Interim Education Center, August 19-22, 1974.

Department of Transportation Aug. 1974, 92 pp, Figs., Tabs.

ACKNOWLEDGMENT:
PURCHASE FROM: DOT Repr. PC, Microfiche
PB-245231/6ST, DOTL NTIS

B6 095378
REGULATIONS COVERING LEVEL CROSSING INSTALLATIONS [La reglementation de l'equipement des passages a niveau]
Analysis of the measures taken as a result of the ministerial decree dated 8 February 1973 concerning level crossing installations in France. They mainly relate to the definition of optimal equipment to be installed at railroad intersections. [French]

Jeanmasson, M *Informations Techn SNCF-Direction de l'Equipement* No. 13, June 1974, pp 33-39, 3 Tab.

ACKNOWLEDGMENT: International Railway Documentation, Selection of
PURCHASE FROM: Societe Nationale des Chemins de Fer Francais Paris, France Repr. PC

B6 096545
WHAT PROGRESS FOR FEDERAL GRADE-CROSSING SAFETY PROGRAM?
While states got off to a slow start in obligating funds authorized by 1973 legislation, there are signs that the pace could pick up in what is turning out to be a long- range program. For the first time a situation has been created which permits new and modern grade crossing surfaces to be installed without any cost to the railroads. The first phase was an inventory of the 450,000 such crossings, information that is being put into an FRA computer file. Examples of the operation of the pertinent sections of the Highway Safety Act of 1973 in Illinois and Iowa are given. Supplementary information with this article includes descriptions of contemporary commercial grade crossing surfaces.

Railway Track and Structures Vol. 71 No. 5, May 1975, pp 27-31, 8 Phot.

PURCHASE FROM: XUM Repr. PC
DOTL JC

B6 096615
RAILROAD-HIGHWAY GRADE CROSSING WARNING SYSTEMS
The selection of equipment components and the layout of a grade crossing warning installation should aim at attracting the attention of the motor vehicle operator and assist him in the exercise of his obligations. The object of this bulletin is to serve as a guide for those whose duties include promotion of safety at such crossings. The recommended practices contained in this bulletin are composite evaluations from sources in the railroad industry, Federal and state governments and manufacturers of grade crossing warning devices. These recommendations are intended to serve as guide lines only and are not to be taken or interpreted as absolute standards to be followed in all circumstances.

ANSI Standard No. D8.1, 1974, 32 pp

PURCHASE FROM: ESL Repr. PC, Microfilm

B6 098767
SIGNAL DEPARTMENT INVENTORY
Computer Program purely an inventory of fixed property-crossing protection, spring switches, and interlockers. Input-physical description of existing material. Output-listings as required. Program will be expanded to include capabilities of listing selected records only.

Velebit, M
Illinois Central Gulf Railroad 1974

ACKNOWLEDGMENT: AREA (AREA 10-04-001)
PURCHASE FROM: Illinois Central Gulf Railroad 233 North Michigan Avenue, Chicago, Illinois, 60601

B6 099354
STATE GRADE CROSSING PROGRAMS: A CASE STUDY
This report reviews the California Railroad-Highway Grade Crossing program, analyzing the factors influencing the reduction in grade crossing accidents. The report concludes that the greater than average success in grade crossing safety in California has resulted from the long standing financial support of the installation and maintenance of grade crossing warning devices, a strong, well managed Public Utilities Commission providing the analytical support for crossing improvement decisions, unusually strong safety efforts by the financially healthy railroads operating within the state, and an effective framework for city-county-state cooperative determination of grade crossing priorities. California ranks eighth overall in terms of active protection installed and first in the percentages of total crossings equipped with automatic gate installations. Areas for potential improvement and refinement of the California program are likewise discussed.

This program was sponsored by US DOT, Federal Railroad Administration's Office of Research and Development.

Kennedy, RG, III
Consad Research Corporation, Transportation Systems Center, Federal Railroad Administration, (DOT-TSC-FRA-74-5) Final Rpt. FRA ORD&D-75-8, Sept. 1974, 66 pp, Figs., Tabs.

Contract DOT-TSC-34

ACKNOWLEDGMENT: FRA, NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-244175/6ST, DOTL NTIS

B6 099360
FIELD EVALUATION OF LOCOMOTIVE CONSPICUITY LIGHTS
Flashing xenon strobe lamps were installed on locomotives in revenue service as a means of alerting motorists to the hazards they are approaching at a rail-highway grade crossing. Effectiveness of these lights in attracting motorists' attention was evaluated. The reactions of both motorists and locomotive crews to the use of strobe lights were also evaluated. Field observations, interviews, and experiments confirmed the attention-getting value of locomotive-mounted strobe lights used in revenue service to alert motorists and suggested operational procedures and device specifications that are the subject of a separate application guideline report. Experimentation and observation of the strobe lights under railroad operating conditions verified that these lights do not interfere with perception of trackside signals or with normal motorist and crew operations. The work reported in this document supports a technical recommendation favoring use of strobe lights on more extensive research tests in railroad operational service.

The project was sponsored by US DOT, Federal Railroad Administration's Office of Research and Development.

Devoe, DB Abernethy, C
Transportation Systems Center, (DOT-TSC-FRA-74-11) Final Rpt. FRA-OR&D-75-54, May 1975, 66 pp, Figs., Tabs.

ACKNOWLEDGMENT: FRA, NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-244532/8ST, DOTL NTIS

B6 099361
GUIDELINES FOR ENHANCEMENT OF VISUAL CONSPICUITY OF TRAINS AT GRADE CROSSINGS
This report summarizes a comprehensive study of potential means of reducing the probability of train-motor vehicle collisions at railroad-highway grade crossings through enhancement of the visual conspicuity of locomotives. Passive techniques are reviewed, and requirements and constraints upon active systems are described. Past research is reviewed, followed by derivation of functional specifications and discussion of practical operating considerations. Operational tests of devices deemed most appropriate to the application are described, with detailed recommendations. The preferred system consists of clear (white) xenon flash-tube beacons mounted on opposite sides of the locomotive cab roof, flashed alternately, used in conjunction with amber incandescent lamps outlining the locomotive.

This project was sponsored by US DOT, Federal Railroad Administration's Office of Research and Development.

Hopkins, JB Newfell, AT
Transportation Systems Center, (DOT-TSC-FRA-74-75) Final Rpt. FRA-OR&D-75-71, May 1975, 56 pp, 17 Fig., 8 Ref.

ACKNOWLEDGMENT: FRA, NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-244551/8ST, DOTL NTIS

B6 099799
P&LE UPGRADES CROSSING PROTECTION
In the course of installing welded rail, the Pittsburg & Lake Erie was confronted with eight grade crossings in a 1 1/2-mile stretch. The goal was to produce a safe system that would not unduely delay vehicular traffic. Audiofrequency overlays of the conventional type would have been extremely complicated. The solution was installation of electronic movement detection through measurement of rail impedance changes. Several frequencies are overlapped for some distance beyond the crossings.

Progressive Railroading Vol. 18 No. 8, Aug. 1975, pp 43-44, 3 Phot.

PURCHASE FROM: Murphy-Richter Publishing Company 9 South Clinton Street, Chicago, Illinois, 60606 Repr. PC
DOTL JC

B6 099835
POINTS AND TRAFFIC LIGHTS UNDER COMMON CONTROL USING VETAG
A trial installation of Philips' Vetag (vehicle tagging) equipment will be made in Amsterdam following a policy decision on adopting a standard method of automatic control of tramway switches and traffic lights. Vetag functions to detect, identify and locate selected vehicles in a stream of road traffic and is adapted to automation of LRT or streetcar signalling which must operate without external supervision. Vetag consists of three basic units--an interrogator installed along the roadway, a detection loop in the roadway surface and a transponder underneath each vehicle.

Meyer, F *Railway Gazette International* Vol. 131 No. 5, May 1975, pp 193-194, 1 Phot.

PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B6 126975
A COMMUNICATION LINK APPROACH TO ACTUATION OF GRADE-CROSSING MOTORIST-WARNING SYSTEMS
Previous studies indicate that one promising avenue to grade-crossing motorist-warning systems, offering lower cost and independent of railroad-track circuits, is use of a radio-communication link for signal activation. By this means, the presence of a train approaching a crossing can be communicated to the crossing from an appropriate distance. This study describes analysis, development, and test activities carried out at the Transportation Systems Center to determine the basic feasibility and practicality of a microwave realization of this approach. A brief review of the conceptual framework is followed by detailed discussion of field-test procedures and results, with special attention then given to train detectors, microwave-propagation aspects, use of solar power, and radar train detection.

Hopkins, JB Abbott, R Holmstrom, FR White, EF Newfell, AT
Transportation Systems Center, (DOT-TSC-FRA-75-7) Final Rpt. FRA-OR&D-75-80, July 1975, 118 pp, Figs., Tabs., Phots., 7 Ref.

ACKNOWLEDGMENT: FRA, NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-244584/AS, DOTL NTIS

B6 127384
OPERATING PROGRAMME AND PRACTICE FOR THE NEW LINES OF THE GERMAN FEDERAL RAILWAY, HAVING REGARD TO THE EXISTING RAILWAY NETWORK AND TO A EUROPEAN HIGH-SPEED NETWORK
In order to realize the corporate plan of the German Federal Railway, and this to stabilize their economic position, the fulfilment of the "Development programme for the network of the German Federal Railway" is an indispensable condition. This development programme has the objective of creating, in the German Federal Republic, a basic network for modern rail

transport of quantitatively and qualitatively high capacity where land use aspects are also taken into account; the core of this network will be formed by the future new and reconstructed lines. In addition to the construction of new lines along the most heavily used traffic corridors, it is envisaged to reconstruct a number of existing lines where, having regard to the expected increase in traffic demand, such reconstruction is called for because of existing bottlenecks or topographical conditions. In addition to the increase in line capacity to match future demands, the qualitative improvement of the lines, too, has an important bearing on the realization of a homogeneous performance pattern. Among the measures involved in the reconstruction of existing lines are, e.g., improvements in the alignment and in the signalling equipment, two-way working between stations, the construction of additional main line tracks and of platform access subways. Other measures such as the reinforcement of the permanent way, the elimination of level crossings or the conversion to push-button signalling are the subject of separate programmes.

Sitzmann, E *Rail International* No. 8, Aug. 1975, pp 663-686, 22 Fig., 9 Ref.

ACKNOWLEDGMENT: Rail International
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

B6 128616
URBAN RAILROAD RELOCATION: NATURE AND MAGNITUDE OF THE PROBLEM AND PLANNING FOR REMEDIAL ACTION--EXECUTIVE SUMMARY
This executive summary reports the significant findings and recommendations of a project to analyze the nationwide magnitude and nature of urban railroad relocation and prepares a methodology for future relocation studies. Three other volumes report the results in detail. Volume 2 is a guide for preliminary assessment of the potential for planning/ Volume 3 is a detailed quidebook for planning/ and Volume 4 presents a nationwide estimate of the nature and magnitude of urban railroad relocation. The investigators found that there is a conflict between communities and railroad operations that evidences itself in delays and added costs to highway users at grade crossings, hazards to the safety of the community, community barriers, environmental degradation, incompatible land use, and reduced railroad efficiency. Relocation or consolidation of railroad facilities are potential remedies for the conflict. The nationwide cost of relocating railroad lines in all places where there is a potential conflict is estimated at $3 to $11 billion. However, if projects are restricted to locations where substantial benefits accrue, the program will be closer to $2 billion. Railroad yards could also be relocated with substantial benefits, but at an additional nationwide cost of $1 billion. The high cost of individual projects deters communities and railroad companies from undertaking beneficial projects, so financial assistance and incentives are recommended to encourage relocation projects.
Sponsorship was provided by FRA, FHWA.

Moon, AE
Stanford Research Institute Final Rpt. Vol. 1 RP-31, Aug. 1975, 13 pp

Contract DOT-FR-20037

ACKNOWLEDGMENT: FRA, Federal Highway Administration
PURCHASE FROM: NTIS Repr. PC, Microfiche

DOTL NTIS

B6 129845
COLLISIONS BETWEEN TRAIN AND CAR AT LEVEL CROSSINGS [Kollisioner mellan tag och vagfordon i plankorsningar]
Sweden has about 26,000 level crossings and at these crossings about 100 collisions occur each year. More than 50% cause personal injuries. The report questions the rational of the present allocations to the different forms of crossing safety devices. [Swedish]

Thorson, J Sande, J *Svenska Vagforeningens Tidskrift* Vol. 62 No. 6, 1975, pp 4-5

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Svenska Vagforeningen Fridhemsgaten 15, 11240 Stockholm K, Sweden Repr. PC

B6 130988
THE EFFECTIVENESS OF AUTOMATIC PROTECTION IN REDUCING ACCIDENT FREQUENCY AND SEVERITY AT PUBLIC GRADE CROSSINGS IN CALIFORNIA
To assist the California PUC in performing its duties related to grade crossing regulation, the Office of Traffic Safety sponsored this project to determine the scope of the vehicle-train accident problem in California, to gauge the effectiveness of various types of protective devices and to investigate critically the possible use of warrants or criteria to assist in recommending where money should be spent on railroad-highway crossing protection improvements. A questionnaire was mailed to all cities and counties. The before-and-after accident histories of 1,552 crossings currently protected by automatic devices were examined. The actual and estimated costs of installing automatic devices at 1,296 locations were summarized. The feasibility of criteria to assist in placing grade crossing protection devices was examined. Information on each crossing was used to develop accident rate predictions and hazard indices.

California Public Utilities Commission June 1974, 196 pp, Tabs., 4 App.

PURCHASE FROM: California Public Utilities Commission Transportation Division, San Francisco, California, 94102 Repr. PC

B6 131300
CONSTRUCTION AND MAINTENANCE OF LEVEL CROSSINGS [Bau und Unterhaltung von Bahnuebergangsbefestigungen]
A chapter on level crossings in the well-known German manual of railway technology. The chapter states and discusses the possible solutions to level crossing problems such as the closing of the flange way, elasticity of the road surface, and the track bed. Economic requirements should take into account the cost of maintenance and renewal. According to the solutions adopted, costs may vary between 50 and 300 DM per/sq m. [German]

Endmann, K *Elsners Taschenbuch der Eisenbahntechnik* 1975, pp 71-105, 2 Tab., 12 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Elsners Taschenbuch der Eisenbahntechnik Frankfurt am Main, West Germany Repr. PC

B6 131327
STRUCTURAL AND GEOMETRIC CHARACTERISTICS OF HIGHWAY- RAILROAD GRADE CROSSINGS
This report is the first in a series dealing with structural and geometric characteristics of highway-railroad grade crossings. The report details a study of crossing distribution and geometric characteristics, crossing appraisals, drainage, dynamic loadings, stabilization fabrics, and structural details for improved life and rideability.
Sponsored by the Texas State Department of Highways and Public Transportation, Transportation Planning Division.

Newton, TM Lytton, RL Olson, RM
Texas Transportation Institute, (No. 164-1) Intrm Rpt. TTI-2-18-74-164-1, Aug. 1975, 113 pp, Figs., Tabs., 30 Ref.

Contract 2-28-74-164

ACKNOWLEDGMENT: Texas Transportation Institute
PURCHASE FROM: NTIS Repr. PC, Microfiche

DOTL NTIS, DOTL RP

B6 131531
MORE MONEY FOR CROSSING PROTECTION?
An interview with Patrick J. McCue, executive director of AAR'S Highway-Rail Programs, explains the implications of the funding of the 1975 Federal Highway Act for elimination of grade crossing hazards. Over 3 1/3 years, an inventory has identified 402,000 rail crossings of Federal and non-Federal-aid public roads, private crossings, pedestrian crossing and grade-separated crossings which is now incorporated in FRA's information center files. The $175 million for grade-crossing projects on Federal-aid and other roads should permit automatic warning devices on 10,000 crossings over a 27 month period.

Railway Age Vol. 177 No. 3, Feb. 1976, pp 21-22

PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

B6 132886
IS A NEAR-ACCIDENT NEARLY AN ACCIDENT? AN EXPLORATIVE ANALYSIS OF NEAR-ACCIDENTS ON RAILWAY-CROSSINGS [Is een Bijna-Ongeval Bijna een Ongeval? Een Exploratieve Analyse van de Bijna-Ongevallen op Overwegen]
1915 so-called near miss accidents on level crossings were counted by railway drivers in 1971 in the Netherlands. A near miss was defined as the traversing of a level crossing when the safety installation was working, or-in absence of this-the traversing when the train according to the judgement of the driver was already very close. With the aid of a prediction formula, by which the number of expected accidents on level crossings can be forecasted, it is possible to pursue a policy based on objective safety norms for example regarding the kind of level crossing safety measures. /TRRL/ [Dutch]

Paymans, PJ
Amsterdam University R&D Rept. June 1972, 84 pp, Figs., Tabs., Phots., Refs.

ACKNOWLEDGMENT: Institute for Road Safety Research (SWOV46005E), Transport and Road Research Laboratory (IRRD 216263)
PURCHASE FROM: Amsterdam University Psychology Department, Amsterdam, Netherlands

B6 132980
RAILROAD ACCIDENT REPORT: COLLISION OF READING COMPANY COMMUTER TRAIN AND TRACTOR-SEMITRAILER, NEAR YARDLEY, PENNSYLVANIA, JUNE 5, 1975
About 11:06 p.m. on June 5, 1975, a Reading Company commuter train struck a tractor-semitrailer (truck) at a grade crossing near Yardley, Pennsylvania. The truck was transporting three coils of steel, two of which penetrated the first commuter car. The three occupants of the lead car were killed and an occupant of the second car was injured slightly. The truck driver was uninjured. The semitrailer was torn from the tractor and damaged beyond repair and the lead commuter car was damaged extensively. At the time of the collision, the automatic grade crossing signal system was functioning. The truckdriver said he had not seen or heard the warning signals. The National Transportation Safety Board determines that the probable cause of the accident was the failure of the truckdriver to stop the truck in accordance with the warning signals.

National Transportation Safety Board NTSB-RAR-76-4, Mar. 1976, 24 pp, 8 Fig.

ACKNOWLEDGMENT: National Transportation Safety Board
PURCHASE FROM: NTIS Repr. PC, Microfiche
DOTL NTIS

B6 134300
ANA ABSERVATIONAL STUDY OF DRIVER BEHAVIOR AT SIGNALIZED RAILROAD CROSSINGS
This is a study of the behavior that normally occurs when drivers approach railroad grade crossings. Observation of 2,344 cars and trucks at six Ontario grade crossings showed that high potential for accident is due primarily to the great variability in vehicles, track configuration and signal duration. A Sequential and Standardized Warning Signal (SSWS) systems is suggested as being unambiguous in that it clearly indicates the specific course of action and reduces the decisional uncertainty of motorists to a minimum. Other changes suggested include a standardized crossing surface, emergency sirens on trains, and slight alteration in the basic SSWS system in proximity to train stations. Further research plans are also indicated.

Wilde, GJS Cake, LJ McCarthy, MB
Canadian Institute of Guided Ground Transport CIGGT 75-16, Nov. 1975, 166 pp, Tab., App.

ACKNOWLEDGMENT: CIGGT
PURCHASE FROM: Canadian Institue of Guided Ground Transport Queen's University, Kingston, Ontario K7L 3N6, Canada
DOTL RP

B7 028742
DEVELOPMENT OF STUDIES ON NOISE AND VIBRATIONS IN RAILROAD TRANSPORTATION AND THEIR RESULTS
The report is a survey of studies on the adverse effect of noise and vibration in railroad cars. Further studies started in 1948, used EEG and EKG to determine the function of analyzers, thresholds of acoustic sensitivity and vestibular chronaxy and effects on the cardiovascular system; model vibratory platform was constructed. Characteristics of noise and vibration were divided into 3 groups according to noise and 2 according to vibratory parameters; these were determined for the various types of passenger coaches. (Author)
Edited machine translation of Gigiena Truda i Professionalnye Zabolevaniya (USSR), V11, N11, pp 58-60, 1967.

Volkov, AM
Wright-Patterson Air Force Base FTD-MT-24-358-68, Nov. 1968, 13 pp

ACKNOWLEDGMENT: NTIS (AD-685497)
PURCHASE FROM: NTIS Repr PC, Microfiche
AD-685497, DOTL NTIS

B7 037828
SIMPLE VIGILANCE AND DEADMAN DEVICE
Current requirements for checking the vigilance of the driver and safeguarding operation, if this falls below an accepted standard, make it clear that two safeguard functions are essential: to provide an effective deadman operation, and to check constantly that the driver is alert. Very recently a completely fresh design approach was made to the way the equipment can be made to fulfill the operating requirements and which lends itself to a much cheaper first cost, a very great reduction in maintenance, and is readily adaptable to fitting to locomotives without or with deadman equipment. The approach has been to provide a completely electronic unit incorporating relatively recently devised equipment, the metallised polycarbonate capacitor which has an infinitely small leakage characteristic and is used as the delay element, and the uni-junction transister which fires off the circuit operation when the voltage in the capacitor reaches a predetermined value. Incorporation of safety and vigilance cycles into the one control circuit provides a compact and straightforward arrangement which does not require the driver to choose between two courses of action to prevent a brake application once he hears the bell.

Railway Gazette Vol. 123 Aug. 1967, pp 626-628, 9 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-910)
DOTL RP

B7 039261
THE VISIBILITY AND AUDIBILITY OF TRAINS APPROACHING RAIL- HIGHWAY GRADE CROSSINGS
The study investigates devices and color schemes, proposed or in use on locomotives, which serve to make the train visible or audible to motorists approaching grade crossings. A color scheme using two contrasting colors, each color at least 3 1/2 x 5 feet in area, is recommended for visibility at 1000 feet. One color should be very bright, such as fluorescent or bright yellow. Two high-output xenon strobe lamps are recommended, one on each side of the cab roof, to flash alternately whenever the train is moving. At night, lighted panels are recommended as supplements to the strobe lamps. The sound level required to reliably alert a motorist was found to be 105 dB just outside the vehicle. In high speed encounters, present horns cannot reliably warn motorists early enough. A horn with enough output to be totally effective would not be an unacceptable nuisance. The report includes a bibliography and tables of required ranges. (Author)
See also Addendum Rept. dated Jul 71, PB-202 669.

Aurelius, JP Korobow, N
Systems Consultants, Incorporated Final Rpt May 1971, 163 pp

Contract DOT-FR-00006

ACKNOWLEDGMENT: NTIS (PB-202668)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-202668, DOTL NTIS

B7 039667
SELECTION TESTS FOR RAILWAY STAFF
The use of psychological tests for staff selection, in general, and for specific job requirements are described. Cited are their use by various National railways such as the French, Dutch, Swedish and U.S. to determine speed of reaction, intelligence, memory, visual and auditory acuity, as well as other factors affecting employee capability.

Railway Gazette Vol. 102 May 1956, pp 307-308

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1383)
DOTL RP

B7 040495
TRAFFIC-ORIENTED TRAINING FOR LOCOMOTIVE ENGINEERS
There is a need for improvement in the detail design of locomotives and their auxiliary equipment in order to enhance their performance in the various environments and conditions in which they operate. Many shortcomings in design only become apparent when the locomotive is actually at work in traffic and it is concluded that the young locomotive engineer destined to become a designer should undergo a planned period of induction to locomotive operation by riding with the driver working all types of trains at all hours and all seasons. The suggested areas of training include determination of trailing loads and point to point times, methods to avoid wheel burns, making enroute repair to loose or detached parts, use of hand brakes, use of speed indicating to loose or detached parts, use of hand brakes, use of speed indicating gear, fire hazards, use of warning devices, lay-out of the cab and instrument panel, use of the windscreen, use of route indicators, use of heating and ventilation systems, use of the driver's safety device, and re-railing locomotive.

Thorley, WGF (British Railways Board) *Institution of Locomotive Engineers Journal* Vol. 58 No. 324, Part 4, pp 305-384, 10 Fig, 29 Phot, 7 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1975)
DOTL RP

B7 041042
B&H SCHOOLS OFFERS ELECTRONIC TRAINING
Burlington Northern is encouraging its technicians to upgrade their skills to handle new, sophisticated controls involving solid-state electronics. The technicians, on a voluntary basis, are enrolling in the Bell & Howell Schools independent study course in electronics. B & H schools have resident educational facilities at eight locations. They provide a complete educational package from professional consulting on training, course selection, qualification testing, administration of educational programs, including progress reports to students and a national placement service.

Railway System Controls Vol. 2 No. 5, May 1971, pp 14-15, 2 Phot

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B7 041064
L&N TRAINS COMMUNICATIONS MEN
Louisville and Nashville has a training program for communications men. Most new men joining the communications department start with crews maintaining pole lines. L&N constructed a pole line for training. During the training period of about one month, the men play catch with a basketball while strapped to the poles. Such practice develop confidence and dexterity at heights. Train operations and safety are also reviewed for the men. They are encouraged to enroll for electronics correspondence courses.

Railway System Controls Vol. 1 No. 7, Oct. 1970, pp 15-16, 2 Phot

ACKNOWLEDGMENT: Railway System Controls
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B7 043284
HUMAN FACTORS SURVEY OF LOCOMOTIVE CABS
The purpose of the investigation was to review design of locomotive cabs from the human factors point of view. The following areas of human factors engineering are discussed: construction of cab interiors; design of controls and displays; atmospheric conditions in the cab; noise and vibration; seat design; physiology and vigilance of train driving. Discussion of each subject is divided into three sections: survey of relevant literature, conditions on domestic locomotives, and recommendations to improve present models and future design. (Author)

Jankovich, JP
Naval Ammunition Depot June 1972, 237 pp

ACKNOWLEDGMENT: NTIS (PB-213225 /)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-213225 /, DOTL NTIS

B7 043621
DESIGN AND CONSTRUCTION OF A PORTABLE OCULOMETER FOR USE IN TRANSPORTATION ORIENTED HUMAN FACTORS STUDIES
The report describes development of an instrument designed to acquire and process information about human visual performance. The instrument has the following features: It can be operated in a variety of transportation environments including simulators, cars, trucks, trains, and air traffic control stations; The visual performance measurements are made without alteration of the subjects's normal visual behavior; and The data can be presented to the experimenter as either a video picture of the scene with the fixation point superimposed, or as derived eye-motion parameters. (Author)

Davis, PW Lutz, JS Warner, A Iannini, AA
Transportation Systems Center Tech Rpt DOT-TSC-OST-71-13, Aug. 1971, 44 pp

ACKNOWLEDGMENT: NTIS (PB-213125)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-213125, DOTL NTIS

B7 043787
THE INCIDENCE OF DRUGS IN FATALLY INJURED DRIVERS
Methods for the collection of blood, urine, bile and alcohol washes of face and fingers from fatally injured drivers were developed. Specimens were collected from the Alcohol Safety Action Project areas. The samples were supplied by coroners and medical examiners from fatally injured drivers who were dead on arrival at the hospitals. Nine hundred and twenty-nine specimen collection kits were distributed to 44 different areas. Methods for analysis of blood, urine and bile for 44 commonly abused drugs were developed. These methods consisted of extraction of the fluids, followed by a qualitative thin-layer chromatographic screen. Alcohol washes of face and fingers were examined for evidence of marihuana. The analytical results indicated that 51% of the drivers had ingested alcohol and 33% of the drivers were legally drunk (alcohol content of blood greater than 0.15%). Twenty-four percent of the specimens examined evidenced the presence of drugs other than alcohol: 11% evidenced drugs and no alcohol; 13% evidenced drugs and alcohol. (Author)

Woodhouse, EJ
Midwest Research Institute, (MRI-3540-C) Final Rpt Sept. 1972, 77 pp

Contract DOT-HS-119-1-173

ACKNOWLEDGMENT: NTIS (PB-214390/7)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-214390/7, DOTL NTIS

B7 043793
HUMAN FACTORS CRITERIA FOR VEHICLE CONTROLS AND DISPLAYS
The study was directed toward developing valid criteria for the standardization of control and display location, coding, and operation in passenger cars, trucks, and buses. Five tasks were accomplished. Task 1 comprised an analysis of the commonality of control-display design arrangements in existing vehicles, and an assessment of the degree of the nonstandardization problems. Tasks 2 and 3 were directed toward developing criteria for C/D location and coding/operation respectively. Task 4 involved a study of 3 beam headlamp system control concepts. Task 5 comprised an experimental program to support Tasks 1, 2 and 3. (Author)
See also report dated Sep 72, PB-214 069.

Malone, TB Krumm, RL Shenk, S Kao, H
Essex Corporation Final Rpt Sept. 1972, 54 pp

Contract DOT-HS-120-1-174

ACKNOWLEDGMENT: NTIS (PB-214352/7)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-214352/7, DOTL NTIS

B7 043794
HUMAN FACTORS CRITERIA FOR VEHICLE CONTROLS AND DISPLAYS: APPENDIX A
The study was directed toward developing valid criteria for the standardization of control and display location, coding, and operation in passenger cars, trucks, and buses. Five tasks were accomplished. Task 1 comprised an analysis of the commonality of control-display design arrangements in existing vehicles, and an assessment of the degree of the nonstandardization problems. Tasks 2 and 3 were directed toward developing criteria for C/D location and coding/operation respectively. Task 4 involved a study of 3 beam headlamp system control concepts. Task 5 comprised an experimental program to support Tasks 1, 2 and 3. (Author)
See also report dated Sep 72, PB-214 067.

Malone, TB Krumm, RL Shenk, S Kao, H
Essex Corporation Final Rpt Sept. 1972, 204 pp

Contract DOT-HS-120-1-174

ACKNOWLEDGMENT: NTIS (PB-214066/3)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-214066/3, DOTL NTIS

B7 043795
HUMAN FACTORS CRITERIA FOR VEHICLE CONTROLS AND DISPLAYS: APPENDIX B
The steps followed in developing the standard C/D panels for each vehicle class are presented.
See also report dated Sep 72, PB-214 066 and PB-214 068.

Malone, TB Krumm, RL Shenk, S Kao, H
Essex Corporation Final Rpt Sept. 1972, 118 pp

Contract DOT-HS-120-1-174

ACKNOWLEDGMENT: NTIS (PB-214067/1)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-214067/1, DOTL NTIS

B7 043796
HUMAN FACTORS CRITERIA FOR VEHICLE CONTROLS AND DISPLAYS: APPENDIX C
Contents: Base line experiments; Comparisons of driver performance using alternative panels within vehicle classes; Analysis of driver performance across vehicle classes.
See also report dated Sep 72, PB-214 067, and PB-214 069.

Krumm, RL Malone, TB Kao, H Shenk, S
Essex Corporation Final Rpt Sept. 1972, 82 pp

Contract DOT-HS-120-1-174

ACKNOWLEDGMENT: NTIS (PB-214068/9)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-214068/9, DOTL NTIS

B7 043797
HUMAN FACTORS CRITERIA FOR VEHICLE CONTROLS AND DISPLAYS: APPENDIX D
A 3-beam headlight control study included concept development and experimental study.
See also report dated Sep 72, PB-214 068.

Krumm, RL Malone, TB Kao, H Shenk, S
Essex Corporation Final Rpt Sept. 1972, 22 pp

Contract DOT-HS-120-1-174

ACKNOWLEDGMENT: NTIS (PB-214069/7)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-214069/7, DOTL NTIS

B7 043998
DETECTION AND RECOGNITION OF COLORED SIGNAL LIGHTS
Two experiments were designed to determine effective colors for stimulus lights as measured by speed of detection and accuracy of identification. In addition, the nature of the interactions between stimulus color, background

color, and amount of ambient illumination was assessed. Responses to four stimulus lights (red, green, yellow, and white) were evaluated against four colored backgrounds (copper, tan, blue, and green) under two levels of ambient illumination. The overall ordering of stimulus colors as measured by speed of responding was, from fastest to slowest, red, green, yellow, and white. For errors in color naming, the order from least to most was green, red, white, and yellow. Detection and identification were more difficult under bright ambient illumination. The addition of an identification task added about 0.25 second to the response times for each color.

Reynolds, RE White, RM Hilgendorf, RL *Human Factors* Vol. 14 No. 3, June 1972, pp 227-236

PURCHASE FROM: Johns Hopkins Press Homewood Campus, Baltimore, Maryland, 21218 Repr PC

DOTL JC

B7 044050
SCIENTIFIC SELECTION AND STAFF CARE BRING PRODUCTIVITY PAY-OFF
As railways move towards less labour-intensive methods of working, the quality and efficiency of staff becomes of greater importance. Rhodesia Railways has achieved a significant improvement in productivity since introducing scientific staff selection and training methods designed to match aptitude and job as closely as possible.

Gardner, TW *Railway Gazette International* Vol. 128 No. 11, Nov. 1972, pp 411-413

ACKNOWLEDGMENT: British Railways Board
PURCHASE FROM: IPC Transport Press Repr PC

DOTL JC

B7 044266
OPERATING RULES--OBSOLETE OR OTHERWISE
A recent DOT report placed the 'human factors' or 'negligence of employees' as the cause of 27.1 percent of the train accidents in 1968. All of these accidents were due to rules violations of one sort or another. A tough policy on rules compliance is badly needed in the industry. The need for improved rules training is chronic. Employees required to operate over foreign line tracks must be qualified on foreign line rules. There are advantages to adopting a common rule book for all railroads. A disadvantage would be the high cost of changing signals to meet a common requirement. Acceptance would be difficult, since each railroad believes its own rules are the best for it. The committee feels that the present rules are not obsolete, but that they need to be streamlined to reflect the changes in operations and technology. The need for common rules is clear. The report concluded with the results of a survey on operating rules. Discussion of the committee report is presented on pages 60-75.

The 75th Annual Meeting of the American Association of Railroad Superintendents was held at Le Chateau Champlain, Montreal, Quebec Canada, June 15-17, 1971.

American Association of Railroad Superintendents Proceeding June 1971, pp 109-116

ACKNOWLEDGMENT: American Association of Railroad Superintendents
PURCHASE FROM: American Association of Railroad Superintendents 18154 Harwood Avenue, Homewood, Illinois, 60403 Repr PC

DOTL RP

B7 044309
SAFETY THROUGH TRAINING--A COMPUTERIZED LOCOMOTIVE AND TRAIN SIMULATOR
Safety is a major concern not only of everyone in the railroad industry in general, but of those of us responsible for the training of locomotive engineers in particular. Here, as in the acquisition of most skills, the familiar adage 'practice makes perfect' applies. For many decades, locomotive engineers acquired this practice by the familiar on-the-job training (OJT) method. The fireman or prospective locomotive engineer spent years following the procedure practiced by the engineer on numerous runs, perhaps even encountering an occasional emergency. A long period of OJT was necessary before the trainee became a qualified locomotive engineer. Recent advances in simulation technology, including the advent of high performance, low cost mini-computers, have permitted the design of simulators which can subject the trainee to a 'Real World' environment in a training simulator. Through sophisticated mathematical modeling techniques, it is now possible to generate all significant environmental cues with a high degree of fidelity, thereby subjecting the trainee to a synthetically generated and accurately controllable 'Total Environment'.

This paper was recommended by the IEEE Land Transportation Committee of the IEEE Industry Applications Society for presentation at the 1973 Joint ASME/IEEE Railroad Conference, St. Louis, Mo., April 11-12, 1973. The price is $1.35 for members.

Hazen, PL Booth, WC (Singer Company)
Institute of Electrical and Electronics Engineers Paper C73929-7-IA, Feb. 1973, 6 pp, 8 Fig

ACKNOWLEDGMENT: IEEE
PURCHASE FROM: IEEE Repr PC

B7 046211
BEHAVIORAL ENHANCEMENT
The report reviews research progress on motor vehicle operators and alcohol and their effects on highway safety.

Hurst, PM
Institute for Research Final Rpt Feb. 1973, 15 pp

Contract N00014-71-C-0219

ACKNOWLEDGMENT: NTIS (AD-758411)
PURCHASE FROM: NTIS Repr PC, Microfiche

AD-758411, DOTL NTIS

B7 046406
THE SANTA FE RAILWAY LOCOMOTIVE SIMULATOR AND CO-ORDINATED ENGINEER'S TRAINING PROGRAMME
The majority of American railroads today are facing a critical shortage in the supply of locomotive engineers. The elimination of the fireman's station from the cab of modern locomotives has deeply eroded the source from which railway companies drew potential engineers. A variety of on-the-job training programmes has been initiated among several railways in an effort to accelerate training processes and to reduce the period of indenture which for so many years represented a costly and time-consuming prerequisite to this vocation; but none have been so revolutionary as the training technique introduced with the advent of locomotive and train simulators. The Santa Fe Railway recently placed in service its first complete simulator, a mobile unit which, in support of an extensive training programme has produced exceptionally well-qualified engineers. The essential details of design and construction of the simulator and the more complex functions of the visual, motion and sound systems are presented in this paper. The effectiveness of the related simulator training exercises, and the classroom instructions are reviewed. Significant applications of train dynamics analyses revealed through computer interpolation of environmental conditions are discussed.

Ambrose, WG
American Society of Mechanical Engineers Paper 71-RR-3, Apr. 1971, 9 pp

ACKNOWLEDGMENT: British Railways (29020)
PURCHASE FROM: ASME Repr PC

DOTL TF5.A72 1971

B7 046416
BLOOD PRESSURE: NEGLECTED FACTOR IN SAFETY
This paper proposes that there is a curvilinear relationship between blood pressure and accident involvement (or accident potential), with undesirable conditions prevailing at both extremes of the blood-pressure scale. The diastolic index may be even more significant than the more commonly considered systolic level. This should be duly recognized in safety education and taken into account by driver licensing agencies.

Brody, L *Journal of Traffic Safety Education* Vol. 20 No. 1, Oct. 1972, pp 9-10

PURCHASE FROM: Highway Research Board 2101 Constitution Avenue, NW, Washington, D.C., 20418 Repr PC

B7 046418
VISUAL PERCEPTION AND HIGH-SPEED TRAINS
It seems certain that as railway speed is increased beyond the present general maximum of about 100 mph, traditional methods of train control, with a

driver responding manually at the controls to visual trackside signals, no longer provide essential safety levels. In this article a student of transport control ergonomics discusses some of the problems that need to be considered in designing the control systems of the developing high-speed ground transport vehicles.

Coombs, LFE *Modern Railways* Vol. 9 No. 291, Dec. 1972, 4 pp, 10 Phot

PURCHASE FROM: Allan (Ian) Limited Terminal House, Shepperton, Middlesex TW17 8AS, England Repr PC

DOTL JC

B7 046767
TRAINING LETTERS FOR M/W EMPLOYEES
Part III--Letters in this installment discuss the use of safety goggles, conserving rail anchors, preventing car rocking, keeping scrap cleaned up, placing signs and use of tie cars. This series consists of letters sent out from the office of C. E. Weller, chief engineer of the Rock Island. They go to the division superintendents, and sufficient copies are included so that the letters can be placed in the hands of division engineers, senior and general roadmasters, roadmasters, track supervisors and track inspectors. Part IV of the series will be published in the August issue.

Railway Track and Structures Vol. 69 No. 7, July 1973, 2 pp

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

B7 047471
SP DERAILMENT INVOLVES PC FUNCTION
After a runaway locomotive indicated what the Federal Railroad Administration has termed "serious deficiences in the capability of a PC system to function as intended under certain conditions," Southern Pacific, AAR, locomotive builders and air-brake manufacturers have mounted a nationwide program to assure that atuomatic power shutoff will take place in emergencies.

Railway Locomotives and Cars Vol. 176 No. 8, Sept. 1972, 1 pp

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

B7 048006
LOCOMOTIVE AND TRAIN SIMULATOR
Locomotive and train simulator is described which is a combination of advanced simulator technology that results in an effective training technique for developing the skills required by a locomotive engineman. The locomotive cab environment and forward view are simulated with a high degree of fidelity. The digital computer system provides the required synchronization, and allows wide parameter variation in the characteristics of the simulated train.
Presented at 1971-East Conference, September 14-17, 1971.

Woodhouse, HE (McDonnell Douglas Electronics Company); Lange, WF
Electro-Optical Systems Design Conference Proceeding Sept. 1971, pp 114-119

ACKNOWLEDGMENT: EI (EI 72 079921)
PURCHASE FROM: ESL Repr PC, Microfilm

B7 048017
TRAINING THE RAILWAY ENGINEER
The basic course of studies will be of one years specialised training in railway mechanical or railway electrical engineering to supplement the normal undergraduate studies of students having an honours engineering degree, and for this it will now be possible for the degree of M.Sc. to be awarded in appropriate circumstances. This would appear to meet the needs of most railway organizations in Great Britain and is in line with the views of the British Council for students from overseas.

Andrews, HI *Rail Engineering International* Vol. 3 No. 6, July 1973, pp 243-246

PURCHASE FROM: Broadfields (Technical Publishers) Limited Little Leighs, Chelmsford, Essex CM3 1PF, England Repr PC

DOTL JC

B7 050410
TRAINING LETTERS FOR M/W EMPLOYEES
About two years ago it became evident that the number of young men in the supervisory force of the Rock Island was growing. Some had five years or less of track experience. It was realized that a training program was needed not only to educate the trackmen and supervisors lacking experience but also to serve as a refresher course for the more experienced personnel. To assure having the type of training that was felt to be necessary, it was decided that the railroad would have to conduct this instruction itself. Another decision was that the training could best be handled by issuing a series of "track maintenance letters" in which the various maintenance matters that were considered basic and important would be discussed one at a time.

Railway Track and Structures pp 26-27

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

B7 050687
MAN-MACHINE SYSTEMS ENGINEERING IN FREIGHT SERVICE
In recent years, JNR has constructively advanced the automation and modernization of its enormous traffic operations, and as a consequence, human judegment, manual data processing and manual work are being replaced by a more reliable total system with speedy processing capacity. In order, however, to make efficient use of this total system, it must not only be dealt with as a computer-using system, but also as a large and complex man-machine system so that a high-level total transport system may be realized. For the modernization of freight service, JNR has begun with the automation of terminal yards, and in the Koriyama Marshalling Yard the controlling of freight car movement from hump to classification tracks and a part of the data processing are already automated. However, in order to promptly perform the enormous data processing and various changes of work schedule, it is further necessary to analyze the flow of all sorts of information and the framework of decision making in the light of the various modes of the system and to five an optimum assignment to man and machine. In constructing the control center of the Musashino Marshalling Yard, the most modern automated yard of JNR, studies were carried out based on the results obtained at the Koriyama Marshalling Yard and Shinkansen general control system. As a result, the information and decision-making systems of the new system and the characteristics of operations based on them were derived. Moreover, the requirements, concrete functions and role of the machines most closely connected to man at the control center were obtained, and in addition, an approach was made based on man-machine system engineering so that the criteria for the qualifications of the operators and the number of staff required (for normal and emergency time) can be determined. This paper deals with automation in JNR, giving some examples of the application of man-machine systems engineering, and tells of how the experience and method used therein were used to draw out the various data needed in planning the control center construction for the Musashino Marshalling Yard.

Iyama, Y (Japanese National Railways) *Rail International* No. 9, Sept. 1973, 3 pp

ACKNOWLEDGMENT: Rail International
PURCHASE FROM: International Railway Congress Association 17-21 rue de Louvrain, 1000 Brussels, Belgium Repr PC

DOTL JC

B7 050688
MAN-MACHINE INTERFACE PROBLEMS
Any interface problem between man and machine can affect the input and the resulting output. A key person in our elaborate railroad computer systems is the man at a remote yard or station reading a source document, converting the data into machine language and transmitting this data to a distant computer center that, in all probability, he has never seen. The terminal equipment he uses may be simple or complex. His attitudes, aptitudes, training, frustrations, environment and his supervisor's attitude

can affect the manner in which he operates this equipment, thereby affecting the accuracy of his input. Machine designers, systems analysts and railroad management who are aware of this human and knowledgeable of his problems are in a much better position to find solutions, resulting in a more efficient computer system.

Rees, WS (Penn Central Transportation Company) *Rail International* No. 9, Sept. 1973, 3 pp

ACKNOWLEDGMENT: Rail International
PURCHASE FROM: International Railway Congress Association 17-21 rue de Louvrain, 1000 Brussels, Belgium Repr PC

DOTL JC

B7 050732
HUMAN FORCE CONSIDERATIONS IN THE FAILURE OF POWER ASSISTED DEVICES
The study is concerned with determining the physical effort automobile drivers can exert on brake pedals and steering wheels when power assist systems have failed with the resultant data serving as a basis for motor vehicle standards development and compliance.

Pierce, BF Woodson, WE Selby, PH
Man Factors, Incorporated Final Rpt MFI-73-105, July 1973, 139 pp

Contract DOT-HS-230-2-396

ACKNOWLEDGMENT: NTIS (PB-222851/8)
PURCHASE FROM: NTIS Repr PC, Microfiche

PB-222851/8

B7 050744
HUMAN FACTORS COUNTERMEASURES TO IMPROVE HIGHWAY-RAILWAY INTERSECTION SAFETY
A field demonstration study in support of the evaluation of alternative railway-highway grade crossing accident countermeasures was conducted. Guidelines were provided for the development of countermeasure concepts. Investigations of the causative factors of accidents showed that maintenance of protective warning devices, driver attention and driver expectancy were precipitating and predisposing factors in accidents. An appraisal of inherent driver safety potential was made which included driver education and licensing, safety programs and law enforcement, attitude and habit components of railway-highway safety and psychophysiological capabilities and limitations. A broad base of data was obtained in a demonstration field study conducted in five states. (Modified author abstract)

Sanders, JHJ Kolsrud, GS Berger, WG
Biotechnology Incorporated Final Rpt July 1973, 230 pp

Contract DOT-HS-190-2-300

ACKNOWLEDGMENT: NTIS (PB-223416/9)
PURCHASE FROM: NTIS Repr PC, Microfiche

PB-223416/9

B7 050896
LAWS OF THE SIMPLE VISUAL REACTION TIME
Fourteen studies from the literature on the reaction time (RT) to a flash of light provided sufficient methodological detail and data to allow for a quantitative analysis of the effects of the following selected variables: luminance, duration, size of stimulus, response to onset versus termination of the signal, and monocular versus binocular viewing. Mathematical relationships were developed which can be used to predict binocular rts over a wide range of luminance, signal duration, and signal size. It was also shown that the product of rt and luminance may be used to represent a response criterion in the sense implied by the theory of signal detection as developed in recent latency models. The results were interpreted as suggesting two general energy processing activities--criterion development and an impulse "countdown"--going on in parallel which are in series with a sensory delay.

Teichner, WD Krebs, MJ *Psychological Review* Vol. 79 No. 4, July 1972, pp 344-358

PURCHASE FROM: American Psychological Association, Incorporated 1200 17th Street, NW, Washington, D.C., 20036 Repr PC

DOTL JC

B7 051908
WORK CONDITIONS AND EQUIPMENT DESIGN IN DIESEL LOCOMOTIVES: FEASIBILITY STUDY AND RECOMMENDATIONS
This report deals with a variety of problems associated with work conditions in locomotives. The purpose is to present guidelines for further recommendations concerning the design of a new cab and improvements for existing cabs. Observations were conducted on workers during long periods in their actual conditions on routes between Montreal and the West Coast. The authors have identified general psychological problems, and problems connected with the design of the cab.

Michaut, GME McGaughey, TP
Canadian Institute of Guided Ground Transport #72-11, July 1972

ACKNOWLEDGMENT: CIGGT
PURCHASE FROM: CIGGT Repr PC

B7 052512
AUTOMATIC WARNING OF TRACK MAINTENANCE GANGS. ENQUIRY INTO THE USE OF ACOUSTIC AND VISUAL WARNING DEVICES
This report contains the evaluation of the enquiries addressed to the Member Administrations of ORE concerning the state of progress of different acoustic and visual devices to warn track maintenance gangs. Most of the acoustic warning devices are air operated. In addition to the oral horns with a sound intensity of about 80 to 100 dB, which are still frequently used, warning devices operated by manual pumps with an air reservoir and those with compressed air containers are employed. The sound radiated by them varies between about 110 and 120 dB. The frequencies of the warning signals differ very much. A few Railway Administrations also use visual warning signals. These are either variations in the illumination of the working site or flashing lights. The report also includes conclusions referring to the need for further studies.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways A124/RP3/E, Apr. 1973, 36 pp, 2 App.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B7 052592
AUTOMATIC WARNING OF TRACK MAINTENANCE GANGS. THEORETICAL STUDY TO ASCERTAIN THE OPTIMUM ACOUSTIC WARNING SIGNALS IN THE PRESENCE OF SEVERE BACKGROUND NOISE
The report contains a description of a theoretical study concerning the complex psycho-acoustic and psychological aspects of signal perception when the signals are masked by interfering noise. The report also suggests what features appear to be the most favourable for acoustic warning signals, and makes proposals for the continuation of the study.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B124/RP 4/E, Apr. 1974, 30 pp, 2 Fig., 1 Tab.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B7 052647
AUTOMATIC WARNING OF TRACK MAINTENANCE GANGS. LABORATORY TESTS AND CONCLUSIONS CONCERNING THE CHOICE OF THE OPTIMUM ACOUSTIC SIGNALS FOR WARNING TRACK MAINTENANCE GANGS
The report describes laboratory tests carried out concerning the possibility of perceiving acoustic warning signals in the presence of severe background noise. Those tests have been carried out under simulated operating conditions (anechoic chamber, magnetic tape recordings of the noise produced by track maintenance machines) with a large number of combinations of the following factors: characteristics of the warning signals used (fundamental frequencies, types, wave shapes, modulation depths and frequencies, frequency spectra), type of background masking noise, auditory

qualities of test persons. The conclusion of the report mentions the characteristics which an acoustic signal should possess in order to offer the greatest efficiency as regards the intended object of this signal for the aural warning of maintenance gangs working on the track.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways A124/RP 5/E, Apr. 1974, 26 pp, Figs., 7 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B7 053751
MLW M420 HAS CN'S NEW CAB DESIGN
The major feature of the new design is the cab which is the product of a two-year development project of CN. The new locomotives have new safety factors and crew comfort features designed to improve the work environment of locomotive operators.

Railway Locomotives and Cars Vol. 147 No. 5, June 1973, 2 pp, Phots

PURCHASE FROM: XUM Repr PC

DOTL JC

B7 053818
LOCOMOTIVE SIMULATOR
Training of railroad engineers requires a development of high levels of skill and judgment, which cannot be learned in a classroom environment. It also requires a simulator support program of classroom instruction. Simulator capability for training is available through use of a solid state, high speed, general purpose digital computer. To build a simulator requires a detailed knowledge of electronics, hydraulic and mechanical engineering, systems analyses and integration, mathematical modelling, human factors design, training psychology, and environmental control. A train simulator consists of: (1) an exact reproduction of a locomotive cab with controls and fixtures; (2) an instructor station and console with gages duplicating those of engine console, indicator lights for monitoring operation, and switches for setting up and controlling the training events and runs; (3) a visual system, using a multiple of projectors; (4) a motion system; (5) a sound system; and (6) a computer system. Realistic simulation provides the maximum amount of engineer interest and motivation necessary to efficient learning and retention of skills, and provides high transfer of learning from simulator to real train operation. The digital computer is given information specifying the number and types of engines in consist, number of cars and weights, numerical data on track gradient, curves, speed limits, and milepost locations. During simulation, the computer calculates a complete force balance for each car, up to 200 cars in a train, and up to 164 separate values on each car ten times a second, and determines amount and direction of slack action, coupler force, locomotive tractive effort, braking effort, train speed, wheel action, effects of sand on adhesion, plus other effects a real train would experience. This computational ability provides the real time reaction which allows the trainee to obtain in a few weeks, experience under a wide variety of conditions, which would otherwise require years to acquire.

Presented at the Fourth International Symposium on Railroad Cybernetics, AAR/UIC/IRCA, 21-26 April 1974, Washington, D.C.

Culbertson, DL (Southern Pacific Transportation Company)
International Union of Railways Paper Apr. 1974, 3 pp

ACKNOWLEDGMENT: UIC
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr PC

DOTL RP

B7 053819
MAN-MACHINE SYSTEMS ENGINEERING IN FREIGHT SERVICE
In recent years, JNR has constructively advanced the automation and modernization of its enormous traffic operations, and as a consequence, human judgement, manual data processing and manual work are being replaced by a more reliable total system with speedy processing capacity. In order, however, to make efficient use of this total system, it must not only be dealt with as a computer-using system, but also as a large and complex man-machine system so that a high-level total transport system may be realized. For the modernization of freight service, JNR has begun with the automation of terminal yards, and in the Koriyama Marshalling Yard the controlling of freight car movement from hump to classification tracks and a part of the data processing are already automated. However, in order to promptly perform the enormous data processing and various changes of work schedule, it is further necessary to analyze the flow of all sorts of information and the framework of decision making in the light of the various modes of the system and to give an optimum assignment to man and machine. In constructing the control center of the Musashino Marshalling Yard, the most modern automated yard of JNR, studies were carried out based on the results obtained at the Koriyama Marshalling Yard and Shinkansen general control system. As a result, the information and decision-making systems of the new system and the characteristics of operations based on them were derived. Moreover, the requirements, concrete functions and role of the machines most closely connected to man at the control center were obtained, and in addition, an approach was made based on man-machine systems engineering so that the criteria for the qualifications of the operators and the number of staff required (for normal and emergency time) can be determined. This paper deals with automation in JNR, giving some examples of the application of man-machine systems engineering, and tells of how the experience and method used therein were used to draw out the various data needed in planning the control center construction for the Musashino Marshalling Yard.

Presented at the Fourth International Symposium on Railroad Cybernetics, AAR/UIC/IRCA, 21-26 April 1974, Washington, D.C.

Iiyama, Y (Japanese National Railways)
International Union of Railways Paper Apr. 1974, 5 pp

ACKNOWLEDGMENT: UIC
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr PC

DOTL RP

B7 053820
MAN-MACHINE INTERFACE PROBLEMS
Any interface problem between man and machine can affect the input and the resulting output. A key person in our elaborate railroad computer systems is the man at a remote yard or station reading a source document, converting the data into machine language and transmitting this data to a distant computer center that, in all probability, he has never seen. The terminal equipment he uses may be simple or complex. His attitudes, aptitudes, training, frustrations, environment and his supervisor's attitude can affect the manner in which he operates this equipment, thereby affecting the accuracy of his input. Machine designers, systems analysts and railroad management who are aware of this human and knowledgeable of his problems are in a much better position to find solutions, resulting in a more efficient computer system.

Presented at the Fourth International Symposium on Railroad Cybernetics, AAR/UIC/IRCA, 21-26 April 1974, Washington, D.C.

Rees, WS (Penn Central Transportation Company)
International Union of Railways Paper Apr. 1974, 3 pp

ACKNOWLEDGMENT: UIC
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr PC

DOTL RP

B7 053821
THE HUMAN PROBLEMS AND CHANGES IN MANAGEMENT TECHNIQUES INHERENT IN THE USE OF COMPUTERS FOR DECISION MAKING
Early applications of computers involved the mechanization of existing processes which were already well established and understood. The client had a clear understanding of the input, procedures and output involved and was able to provide a complete specification of his requirements. In recent years computers have been used more and more for applications in which the machine replaces human decisions by using various types of mathematical models. With these applications it is no longer easy to define the precise boundaries of the problem and in particular it becomes very difficult either for the client to express his decision criteria in appropriate terms or for the technician to explain the processes inherent in the model. Furthermore the power of modern computers is so great that their introduction to a particular problem area may so upset the balance of responsibility or span of control

that a major change in management structure is required. All these factors create problems of confidence and communication which must be given particular attention during the development stages of a project. This paper describes some of these problems with specific reference to computer projects developed for the planning of the freight and train movements activities of British Rail.

Presented at the Fourth International Symposium on Railroad Cybernetics, AAR/UIC/IRCA, 21-26 April 1974, Washington, D.C.

Alexander, NJB (British Railways)
International Union of Railways Paper Apr. 1974, 4 pp

ACKNOWLEDGMENT: UIC
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr PC

DOTL RP

B7 053822
DEVELOPMENT OF AN ADVANCED SIMULATOR FOR TRAINING OF LOCOMOTIVE CREWS

The paper presents a review of progress made in a development project directed to provide a fully realistic simulator for training locomotive crews. The evolutionary approach to equipment realizations is described. Features of a basic simulator and design objectives for a more complex simulator are outlined.

Presented at the Fourth International Symposium on Railroad Cybernetics, AAR/UIC/IRCA, 21-26 April 1974, Washington,

Wilson, JT (Canadian National Railways)
International Union of Railways Paper Apr. 1974, 4 pp, 2 Fig

ACKNOWLEDGMENT: UIC
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr PC

DOTL RP

B7 053823
THE MAN-MACHINE SYSTEM IN THE CONTROL OF TRANSPORT PROCESSES

Transport undertakings must, like all other commercial concerns, be organized in such a way that demand is met at minimum production cost by providing a service of quality. However, as they are public service undertakings in which the customer is directly involved in the production process, they must take special and more extensive measures to eliminate the element of risk in the transport process. This objective can be pursued by taking measures in the following spheres: (1) increase in reliability; (2) technical monitoring of failures; and (3) technical automation. In all, it can be stated that the quality of the solution to the task of safeguarding increases with the degree of automation applied to the safety system. The conditions for the safeguarding of transport processes merely serve to determine certain inviolate limits to the possibilities of movement in a transport network. There still remains a wide margin within which the actual optimization of production, i.e., the most profitable adaptation of the offered services to the demand, must be achieved. In solving the task of optimization, it is obviously necessary to select from among a multiplicity of possible solutions the one which meets a given criterion in the best possible way. It follows that the prospective results of a number of alternative decision options must be compared with each other. Depending on the nature of the task and on the speed at which a decision must be arrived at, the human brain can only deal with a very limited number of alternatives; on the other hand, relying on his knowledge of basic inter-relations and on his experience, the human decision-maker is able to eliminate from the outset a number of theoretically conceivable variants as being unsuitable. In contrast, electronic data processing plants are able to simulate in advance, at an extremely rapid speed, the consequences of certain decisions; but, especially in the case of transport optimization problems, the number of possible alternative decisions is so great that a sufficiently prompt decision cannot be obtained even with the aid of computers of the highest known capacity. While, in regard to the safeguarding of transport processes, it was possible to state that the basic task could best be solved by applying the highest possible degree of automation, it cannot be expected that the human operator can be completely replaced by the machine in the sphere of transport optimization.

Presented at the Fourth International Symposium on Railroad Cybernetics, AAR/UIC/IRCA, 21-26 April 1974, Washington, D.C. This paper was also published in the October 1973 issue of Rail International, which is available from E.S.L.

Pierick, K (Carolo-Wilhelmina Technical University)
International Union of Railways Paper Apr. 1974, 5 pp

ACKNOWLEDGMENT: UIC
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr PC

DOTL RP

B7 053824
RAILWAYMEN AND COMPUTERS: STUDY OF A SELECTION TEST FOR THE RECRUITMENT OF TERMINAL OPERATORS FROM WITHIN A RAILWAY NETWORK

Psychological research for determining the aptitudes required for certain work connected with information processing has been undertaken in numerous circles. In connection with the subject of Section IV of the Washington Symposium on "Human Aspects", the FS have carried out an experimental investigation associated with the study of certain mental functions such as intelligence, attention, memory and perfection, all of which are essential for the preparation of input data. The behaviour of a group of operators responsible for the transmission of input data has been studied, both from the point of view of their aptitudes and from the operational angle, with the conviction that an optimum man-machine relationship will still prove essential in a highly automated production system. The initial results of this investigation, which are limited for the time being to the work of card punching, demonstrate fully the value of extending the research to other work carried out by the staff at large electronic computer centers.

Presented at the Fourth International Symposium on Railroad Cybernetics, AAR/UIC/IRCA, 21-26 April 1974, Washington, D.C.

Monti, M (Italian State Railways)
International Union of Railways Paper Apr. 1974, 9 pp, 2 Fig, 3 Tab

ACKNOWLEDGMENT: UIC
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr PC

DOTL RP

B7 053825
HUMAN ASPECTS OF COMPUTER SYSTEMS

This paper draws from practical experience on British Railways. It discusses the more important human relations and people interface problems which have arisen with the development of computer systems in the Freight Traffic Field and refers to certain applications, including the American Southern Pacific TOPS, which have impacted significantly on attitudes and working relationships. It draws attention to the lesson learned from past shortcomings. Specific issues reviewed include the communication problem between Line Management and the Computer Specialist with suggestions for easement if not solution; the case for joint project management teams headed by the User Department; and the need to include Executive Management in training and education arrangements. Additionally some of the special problems relating to the recruitment, retention, and remuneration of computer personnel within the traditional framework of the highly formalized and unionized railway industry are discussed. Finally, the paper comments on the growing industrial relations influence on computer applications and concludes that future expansion is now more dependent on the solution of the human aspect problems rather than advancement in computer technology.

Presented at the Fourth International Symposium on Railroad Cybernetics, AAR/UIC/IRCA, 21-26 April 1974, Washington, D.C.

Urquhart, JB (British Railways)
International Union of Railways Paper Apr. 1974, 5 pp

ACKNOWLEDGMENT: UIC
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr PC

DOTL RP

B7 054317
GUIDELINES FOR WRITING RAILROAD OPERATING RULES

The report constitutes an aid to persons or groups who must create or revise railroad operation rules. It provides guidance for avoiding confusion, ambiguity and misconceptions in the wording of rules. Content, style and organization are discussed, with illustrations of both desirable and undersirable practices taken from current codes of operating rules.

Devoe, DB Story, AW
Transportation Systems Center, (FRA-RT-74-1) Tech Rpt DOT-TSC-FRA-73-7, July 1973, 27 pp

ACKNOWLEDGMENT: NTIS (PB-223733)
PURCHASE FROM: NTIS Repr PC
PB-223733, DOTL NTIS

B7 054596
TRAINING LOCOMOTIVE ENGINEERS
Canadian National opened in June 1972 its Engine Service Training Centre. The course at the training center covers eight weeks with a mid-term break of four days for the students. Students are selected from the ranks of conductors and yard foremen. The classroom training program covers four main areas: Rules and regulations, equipment function, both motive power and rolling stock, air and dynamic brakes, and train handling and track-train dynamics. Following graduation, the students with the assistance of master mechanics and regular locomotive engineers undertake the road part of the training program. While the staff at the Training Centre decides whether or not a student graduates from the Centre, it is a master mechanic who makes the final decision when he is qualified as an engineer. The training aides, such as a locomotive simulator are described in this paper.

Thirty-Seventh Annual Proceedings of the Railway Fuel and Operating Officers Association, 1973.

Cocquyt, MA (Canadian National Railways)
Railway Fuel and Operating Officers Association Proceeding 1973, 9 pp, Phots

PURCHASE FROM: Railway Fuel and Operating Officers Association 10414 South Wood Street, Chicago, Illinois, 60643 Repr PC
DOTL RP

B7 054597
LOCOMOTIVE ENGINEER MOTIVATION
Man's thinking is more or less guided or directed by three basic factors: Freedom from hunger, freedom from danger, and security. The locomotive engineer has these three factors. The question then is how to reach this man who has the basic needs of life? By applying the most powerful motivator in the world--usually, it is so personal, so closely identified with each person's ego that most people will not admit even having it or being motivated by it, but it is there, always. It is the need to feel important, and it is the most powerful motivation in the world. The motivation, the need to feel important, supplies the power, the drive, to do something outstanding.

Thirty-Seventh Annual Proceedings of the Railway Fuel and Operating Officers Association, 1973.

Ziegler, AB
Railway Fuel and Operating Officers Association Proceeding 1973, 4 pp

PURCHASE FROM: Railway Fuel and Operating Officers Association 10414 South Wood Street, Chicago, Illinois, 60643 Repr PC
DOTL RP

B7 054673
EMPLOYEE TRAINING
In a series of three articles the problems and goals of employee training are outlined. As a result of the major technological changes in railways it is much more important that employees receive training that will qualify them for the job. The articles outline some of the new approaches to training.

Railway Age Vol. 175 No. 4, Feb. 1974, pp 16-24

ACKNOWLEDGMENT: CNR
PURCHASE FROM: XUM Repr PC
DOTL JC

B7 054684
LEAD POISONING PERILS CREW RAZING EL
The men who are doing work as part of the demolition of the Third Evenue elevated line in the Bronx have run into a danger they had not anticipated--lead poisoning. As they burned through the huge beams coated with an 83-year accumulation of lead-containing paint, the workmen have been apparently inhaling large amounts of lead fumes.

Brody, J *New York Times* May 1974, p 33

PURCHASE FROM: New York Times Company 229 West 43rd Street, New York, New York, 10036 Repr PC
DOTL JC

B7 054693
EXAMINATION OF WORK-REST SCHEDULES OF RAILWAY LOCOMOTIVE OPERATORS
This research is a sequel of the study by G.M.E. Michant and T.P. McGauhey: work conditions and equipment design in diesel locomotives (CIGGT report, July 72) and attempts to collect further information on the lengths and distribution of work and rest periods in train drivers, with particular reference to biological rhythms such as sleep and disruptions in these rhythms. The data are gathered by means of the questionnaire method.

This study was jointly funded by Canadian National Railways, Canadian Ministry of Transport and Queen's University.

Wilde, GJ
Canadian Institute of Guided Ground Transport, (5.11.71)

ACKNOWLEDGMENT: Canadian Roads and Transportation Association
PURCHASE FROM: CIGGT Repr PC

B7 056950
RAILROAD ACCIDENT REPORT. REAR-END COLLISION OF TWO SOUTHERN PACIFIC TRANSPORTATION COMPANY FREIGHT TRAINS, INDIO CALIFORNIA, JUNE 25, 1973
The report describes and analyzes a rear-end collision between two Southern Pacific Transportation Company freight trains in the SP yard at Indio, California, on June 25, 1973. Extra 8992 West, after having entered the yard, struck the rear of Extra 8659 West, which was standing on the westbound main track. All five locomotive units of Extra 8992 West were destroyed, and 25 cars of the two colliding trains were derailed. The engineer and the front brakeman of Extra 8992 West were killed. Eight cars of a train on an adjacent track were also derailed. The National Transportation Safety Board determines that the probable cause of the accident was the failure of the crew of the Extra 8992 West to stop their train, which was being operated at an excessive speed by an engineer under the influence of alcohol. Contributing to this failure was the ineffectiveness of the Southern Pacific in assuring compliance with its operating rules and procedures which were specifically designed to prevent an accident if a crewmember failed to perform his duties.

Railroad Accident Report

National Transportation Safety Board, (SS-R-25) NTSB-RAR-74-1, Mar. 1974, 27p

ACKNOWLEDGMENT: NTIS (PB-231134/8)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-231134/8, DOTL NTIS

B7 057163
BIODYNAMICAL PROBLEMS RELATED TO TRANSPORTATION VEHICLES--DIGITAL SIMULATION OF OCCUPANTS
Several parallel efforts are underway to develop and use dynamic occupant simulation computer programs in automobile and aircraft crashworthiness research. This paper reports upon a study funded by the Office of Naval Research evaluating five well known occupant simulation programs. Evaluation factors include numerical integration techniques, mathematical accuracy, computing time, and occupant belt and seat modeling. Additional factors evaluated are graphical output quality, readability of output, usage of documentation, and coding quality. A set of program design specifications was developed concurrently which, if followed by current researchers, should eliminate most of the numerical and user-oriented problems encountered with current occupant simulation programs. Finally, a program structure which is designed for fast turnaround studies is described. The key element in this structure is on-line graphics, which provides a rapid visual summary of the completed results.

Presented at the Winter Annual Meeting of the American Society of Mechanical Engineers, Nov. 11-15, 1973, sponsored by the Applied Mechanics Division and the Automatic Controls Division. Papers presented at this meeting are compiled in "Surveys of Research in Transportation Technology", AMD-Vol. 5.

Karnes, RN Tocher, JL (Boeing Computer Services, Incorporated)
American Society of Mechanical Engineers 1973, pp 123-142, 7 Fig, 11 Ref

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL RP

B7 057164
BIOMECHANICS AND HUMAN IMPACT TOLERANCE
Human tolerance to impact is discussed with different degrees of trauma identified according to the Abbreviated Injury Scale (AIS). Quantitative values of human tolerance are presented in common engineering terms which permit logical safety system designs based upon the physical laws of mechanics. Tolerance levels for the head and chest in terms of acceleration in g units are used in examples to illustrate design techniques for establishing required deceleration distances. Analytical and graphical analyses are included. Injury criteria for interpreting injury potential from complex deceleration records are included.

Presented at the Winter Annual Meeting of the American Society of Mechanical Engineers, Nov. 11-15, 1973, sponsored by the Applied Mechanics Division and the Automatic Controls Division. Papers presented at this meeting are compiled in "Surveys of Research in Transportation Technology", AMD-Vol. 5.

Patrick, LM (Wayne State University)
American Society of Mechanical Engineers 1973, pp 109-122, 4 Fig, 54 Ref

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL RP

B7 057537
EVALUATION OF SAFETY IMPROVEMENTS AT HIGHWAY-RAILWAY GRADE CROSSINGS
In recognition that added effort must be placed on reducing the conflict at highway-railroad grade crossings, this research to evaluate means of supplying motorists with more credible and forceful information was developed. Many innovative active protection devices for grade crossings have been tried or proposed. Many such devices are reviewed with evaluations of their effectiveness, if any were available. The "Monon green light" signal, several of which are in Indiana, was field observed for effectiveness and recommendations are made for improvements. A study of speed profiles of vehicles approaching a crossing protected by a standard flashing light system is also reported. A photographic data collection system was developed which allowed determination of vehicle speed profiles, thus indicating driver reaction to the crossing condition. Speed profiles for nonactuated and actuated signal conditions are analyzed. It was determined that drivers approaching the crossing under progressively greater stimulus relative to an approaching train entered the approach at correspondingly slower speeds.

Conducted in cooperation with the U.S. Department of Transportation, Federal Highway Administration.

Butcher, TA
Purdue & Indiana State Highway Comm JHRP Intrm Rpt. JHRP-1-73, Feb. 1973, 138 pp, 27 Fig., 22 Tab., 61 Ref.

Contract HPR-1(10)Part 2

ACKNOWLEDGMENT: Purdue & Indiana State Highway Comm JHRP
PURCHASE FROM: Purdue & Indiana State Highway Comm JHRP Civil Engineering Building, Purdue University, West Layafette, Indiana, 47907 Repr. PC

B7 057648
ALCOHOL, DRUGS, AND DRIVING
The basic purpose of the Vermont Symposium was publication of the proceedings to incorporate the following specific aims: (1) Systematic, evaluative reviews of the eight major aspects of alcohol and drug problems related to highway safety, with each review written by a leading specialist in that aspect; (2) a synthesis of the edited transcriptions of the discussion periods that followed presentation of the summaries of each of the eight review papers; and (3) ratings of 176 key-word topics on three dimensions of alcohol, drug, and driving problems, i.e., the extent of present knowledge, the relative priorities for basic research in terms of informational yield, and the relative priorities for applied research in highway safety. The critical reviews consist of combinations of the following topics: Alcohol and/or drug influences upon driving-related behavior as studied in laboratory, simulator, and closed-course driving experiments; epidemiologic studies of the role of alcohol and/or drugs in highway crashes and citations; and research on countermeasures for alcohol and/or drug involved problems on the highway.

Perrine, MW
Psychological Research Foundation of Vermont, Inc Final Rpt. Mar. 1974, 394 pp

Contract DOT-HS-265-2-489

ACKNOWLEDGMENT: NTIS (PB-232111/5)
PURCHASE FROM: NTIS Repr. PC, Microfiche

PB-232111/5, DOTL NTIS

B7 057880
RAILROAD ACCIDENT REPORT: COLLISION OF MISSOURI PACIFIC RAILROAD COMPANY FREIGHT TRAIN EXTRA 615 SOUTH WITH A STANDING LOCOMOTIVE, COTULLA, TEXAS, DECEMBER 1, 1973
At 8:30 a.m., Saturday, December 1, 1973, Missouri Pacific Railroad Company freight train Extra 615 South (train DMX) entered Cotulla, Texas. Train DMX was traveling on a nonsignalized main track at a speed of 35 to 40 mph. Just after it passed over a grade crossing, the train was diverted through a switch onto an adjacent track where an unmanned locomotive, a caboose, and 11 cars were standing. Train DMX collided with the standing locomotive before any appreciable braking. The collision derailed all of the locomotive units and 29 railroad cars. Three crew-members who were riding in the lead locomotive unit of train DMX were killed. The National Transportation Safety Board determines that the probable cause of this accident was the establishment of a collision route for train DMX by the unauthorized operation of a switch by persons unknown. Contributing to the collision were railroad operating practices which authorize engineers to operate trains at speeds at which they could not stop short of a switch target which indicates the switch is improperly aligned. Contributing to the severity of the collision was the fact that the crewmembers of the locomotive of train DMX did not identify the open switch and apply the train's brakes soon enough to slow the train. The report contains recommendations to the Missouri Pacific Railroad Company and the Federal Railroad Administration.

Railroad Accident Report. This report contains Railroad Safety Recommendations R-74-22 through R-74-28.

National Transportation Safety Board, (SS-R-27) NTSB-RAR-74-3, June 1974, 36 pp, Figs., Phots., 3 App.

ACKNOWLEDGMENT: National Transportation Safety Board
PURCHASE FROM: NTIS Repr. PC

DOTL NTIS

B7 071612
RAILROAD/HIGHWAY ACCIDENT REPORT: ILLINOIS CENTRAL RAILROAD COMPANY TRAIN NO. 1 COLLISION WITH GASOLINE TANK TRUCK AT SOUTH SECOND STREET GRADE CROSSING, LODA, ILLINOIS, JANUARY 24, 1970
About 9:55 a.m., on January 24, 1970, Illinois Central Railroad southbound passenger train No. 1, moving at a speed of 79 miles per hour on track No. 1, struck a motortruck loaded with gasoline on the South Second street crossing in Loda, Illinois. The tank of the truck was split open, spilling the gasoline which exploded and caught fire. The burning gasoline covered the exterior of the locomotive unit and entered the control compartment through the nose door, damaged nose, and other openings. Three employees of the railroad, who were occupying the control compartment of the lead locomotive unit at the time of the accident, and the driver of the motortruck received fatal injuries from the burning gasoline. The National Transportation Safety Board determines that the probable cause of this accident was that the operator drove the gasoline-laden truck, without stopping, onto the tracks immediately in front of the approaching train, while the crossing warning device was indicating the train's approach.

National Transportation Safety Board NTSB-RHR-71-1, July 1971, 28 pp, Phots., Apps.

ACKNOWLEDGMENT: National Transportation Safety Board
PURCHASE FROM: NTIS Repr. PC, Microfiche

PB-202869, DOTL NTIS

B7 071746
RAILROAD ACCIDENT REPORT: ILLINOIS CENTRAL RAILROAD COMPANY AND INDIANA HARBOR BELT RAILROAD COMPANY COLLISION BETWEEN YARD TRAINS AT RIVERDALE, ILLINOIS ON SEPTEMBER 8, 1970
At 11:08 p.m. September 8, 1970, a collision occurred between Illinois Central (IC) Train 1218 and Indiana Harbor Belt (IHB) Train 8717 at Riverdale, Illinois. The collision of the two yard trains resulted in two fatalities and two serious injuries. Five cars and the caboose of the IC train were derailed and the locomotive cab of the IHB train was demolished. The IHB train was crossing over from an interchange track to an IC main track when the locomotive was struck by the unlighted caboose of the IC train. The IC locomotive was shoving 22 cars, and the caboose had passed a signal indicating "Restricted Proceed" 715 feet prior to impact. The safety Board determined that the accident resulted from the failure of the IC crewmembers to operate IC Train 1218 at a speed so as to be able to avoid the collision. Additional contributing factors included: (a) the failure of IC crewmembers to display a light and occupy a conspicuous position when shoving cars as required by rule; (b) the failure of the IC to provide additional protection when track changes initiated a permanent display of "Restricted Proceed" for the involved signal in 1969; and, (c) inadequacies in operating rules, practices, and personnel training. Contributing to the accident severity was the lack of crash protection provided the occupants of the IHB locomotive.

National Transportation Safety Board NTSB-RAR-71-3, Nov. 1971, 38 pp, Figs., Phots.

ACKNOWLEDGMENT: National Transportation Safety Board
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-206325, DOTL NTIS

B7 071750
RAILROAD ACCIDENT REPORT: SOUTHERN PACIFIC RAILROAD COMPANY FRUITRIDGE ROAD GRADE CROSSING SACRAMENTO, CALIFORNIA, FEBRUARY 22, 1067
On February 22, 1967 at 12:05 PM, a station wagon traveling east on Fruitridge Road in Sacramento, California collided with a Southern Pacific Company freight train traveling north at the intersections of the Southern Pacific railroad tracks and Fruitridge road. Immediately prior to and after the collision, the flashing lights and bells of the automatic railroad crossing warning devices were functioning properly. In addition, the engineer was sounding the locomotive's horn and bell in the prescribed manner, and the locomotive's regular and oscillating headlights were functioning. The station wagon was destroyed and the nine occupants killed. The train was not derailed nor was the train crew harmed and the lead locomotive suffered only minor damage. The probable cause of the accident was failure of the driver of the station wagon to stop his vehicle short of the grade crossing and to remain clear of the track as required by California State law.

National Transportation Safety Board Jan. 1968, 31 pp, 2 App.

ACKNOWLEDGMENT: National Transportation Safety Board
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-190216, DOTL NTIS

B7 071838
RAILROAD ACCIDENT REPORT: NEW YORK CENTRAL RAILROAD COMPANY TRAIN 1/NY-4 EXTRA 2020 EAST AND TRAIN ND-5 EXTRA 5305 WEST HEAD-ON COLLISION NEW YORK CITY, NEW YORK MAY 22, 1967
The accident occurred on the West 30th Street branch of the New York Central Railroad at approximately 147th Street, New York, New York, at about 9:55 A.M. on May 22, 1967. The collision occurred on Track No. 1, which was being used that morning for train movement in both directions due to repairs which were being conducted on main Track No. 2. Six train service employees were killed, and three train service employees were injured. Six locomotives and 11 cars were destroyed, one locomotive extensively damaged and five cars were also damaged. The probable cause of this accident was the failure of the operator at the 72nd Street Station (DO) to restrict train ND-5.

National Transportation Safety Board Jan. 1968, 37 pp, 1 Fig.

ACKNOWLEDGMENT: National Transportation Safety Board
PURCHASE FROM: NTIS Repr. PC
PB-190198, DOTL NTIS

B7 071965
AN ANALYSIS OF THE JOB OF RAILROAD TRAIN DISPATCHER
The report constitutes a detailed study of the job of railroad train dispatcher, conducted to provide a data base for the derivation of job knowledge, skills and training consonant with safe operations. Documentation was reviewed: specialists were consulted, and selected dispatching operations were observed in detail. The report describes the responsibilities and duties of train dispatchers, their workplaces and job aids, the principal functions they perform, and the records they must maintain. Special characteristics of the job, such as workload, stress, inadequacies in aids, and trends toward improvements are discussed, and estimates are made of the physical and psychological attributes, job knowledge and skills basic to safe operations and possible approaches to assurance of safety through selection, placement and training.

Devoe, DV
Transportation Systems Center, (DOT- TSC- FRA-73-13) Final Rpt FRA- ORD/D-74-37, Apr. 1974, 263 pp

ACKNOWLEDGMENT: FRA (PB-233 597/4)
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-233 597/4, DOTL NTIS

B7 071991
RAILROAD SAFETY PRACTICE [Eisenbahnsicherungswesen]
A brief survey is presented concerning the development of safety installations for railroads starting with mechanical devices and going on to electronic equipment. New application domains for electronic circuits and process computers are discussed. [German]

Ernst, H (Technische Hochschule, Switzerland) *Association Suisse des Electriciens Bulletin* Vol. 65 No. 5, 03

ACKNOWLEDGMENT: EI (EI 74 900407)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

B7 072729
PERSONAL SECURITY ON PUBLIC TRANSIT
While conventional modal choice models consider time and cost, safety has been largely ignored. This study examined the safety aspect of a public transit facility through user-perception survey. A bus and elevated line of the Chicago Transit Authority were chosen as the survey areas. It was found that the variable most frequently cited as decisive in using, or not using, the bus or elevated is freedom from personal attack or harassment. The users' perception of safety is examined. The study cites some shortcomings of the survey method and notes that system design should have a major role in persuading potential riders that safety is assured.

This paper is from Transportation in Focus, Proceedings of the Fifteenth Annual Meeting of the Transportation Research Forum, San Francisco, California, 10-12 October 1974.

Ferrari, ND Trentacosts, MF (New York State Department of Transportation)
Cross (Richard B) Company Proc Paper Vol. 15 No. 1, 1974, pp 214-223, 2 Fig., 8 Tab., Refs.

ACKNOWLEDGMENT: Transportation Research Forum
PURCHASE FROM: Vietsch (Grant C) 181 East Lake Shore Drive, Chicago, Illinois, 60611 Repr. PC
DOTL RP

B7 072730
MARKING AND LIGHTING FOR PASSENGER TRAIN VISIBILITY
This investigation was to evaluate various alternative marking designs that could enhance the visibility of the trailing ends of passenger trains. The goal was one overall design that would be optimum during all operating conditions and yet be economical to implement and maintain. For daytime visibility, it was found that coverage and contrast were most important, with fluorescent yellow-orange most effective. At night reflective white stripes and large red marker lights were desirable. The recommended pattern was an inverted V-pattern of the yellow-orange and white stripes and markers on both sides of the lower part of the car end.

This paper is from Transportation in Focus, Proceedings of the Fifteenth Annual Meeting of the Transportation Research Forum, San Francisco,

California, 10-12 October 1974.
Hovind, M (Illinois Department of Transportation)
Cross (Richard B) Company Proc Paper Vol. 15 No. 1, 1974, pp 177-186, 4 Fig., 6 Ref.

ACKNOWLEDGMENT: Transportation Research Forum
PURCHASE FROM: Vietsch (Grant C) 181 East Lake Shore Drive, Chicago, Illinois, 60611 Repr. PC
DOTL RP

B7 072859
HUMAN FACTORS IN SIGNALLING SYSTEMS: APPLICATIONS TO RAILWAY SIGNALLING
The author has made an in-depth study of the human factors involved in the design, construction and interpretation of signalling systems, and in particular analysis of errors, including controlled experimentation, the results being published in this book. The book belongs in the field of human factors engineering and applied and experimental psychology and will interest the signal engineer and others involved in rail safety, particularly in the design and application of the more complex systems.

Mashour, M
Wiley (John) and Sons, Incorporated Vol. 42 p

ACKNOWLEDGMENT: Modern Railroads
PURCHASE FROM: Wiley (John) and Sons, Incorporated 605 Third Avenue, New York, New York, 10016 Repr. PC

B7 080215
MASS TRANSIT TRAINING NEEDS. VOLUME I. EXECUTIVE SUMMARY
The report is the first of a five-volume series summarizing the findings, conclusions, and recommendations of a study of urban mass transit training needs. This study includes a detailed analysis of the training requirements; a discussion of the availability of training programs to meet the needs of the industry; an outline of supplementary material needed to bring training programs up to an acceptable standard; and proposals for programs to upgrade the standard of training as it currently exists. Specifically, this volume summarizes the results of an inquiry into industry needs for standardized programs regarding training of (1) bus operators, (2) bus operator instructors, (3) bus mechanics, (4) bus mechanic instructors, and (5) rapid transit rail car repairmen. Following a description of programs currently in use at transit properties, the general contents of the respective standardized programs are outlined, the role of the Federal government in funding is examined, alternative methods of delivering programs are discussed, and costs of development and demonstration are estimated.
Paper copy also available in set of 5 reports as PB-235 999-SET, PC$17.00.

Thrasher, EJ Wood, P
Mitre Corporation, Urban Mass Transportation Administration, (UM-TA-VA-06-0004) Tech. Rpt. MTR-6681-Vol-1, May 1974, 42 pp

Contract DOT-UT-10005

ACKNOWLEDGMENT: NTIS (PB-236000/6SL)
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-236000/6SL, DOTL NTIS

B7 080216
MASS TRANSIT TRAINING NEEDS. VOLUME II. HISTORY AND METHODOLOGY
The report is the second volume of a five-volume series summarizing the findings, conclusions, and recommendations of a study of urban mass transit training needs. This volume describes the history and methodology of the program. Statistics relating to transit industry training are derived.
Paper copy also available in set of 5 reports as PB-235 999-SET, PC$17.00.

Thrasher, EJ Wood, P
Mitre Corporation, Urban Mass Transportation Administration, (UM-TA-VA-06-0004) Tech. Rpt. MTR-6681-Vol-2, June 1974, 104 pp

Contract DOT-UT-10005

ACKNOWLEDGMENT: NTIS (PB-236001/4SL)
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-236001/4SL, DOTL NTIS

B7 080217
MASS TRANSIT TRAINING NEEDS. VOLUME V. RAILCAR REPAIRMAN TRAINING NEEDS
The report is the fifth of a five-volume series summarizing the findings, conclusions, and recommendations of a study of urban mass transit training needs. This volume is devoted to the railcar repairman. About half of the training is generalized enough to allow a standardized training course to be developed. An outline of such a course, and sources of training material which would be included are presented. One conclusion is that because of the financial difficulties of the mass transit industry, it is recommended that implementation be delayed until funds become available to cover the costs of training.
Paper copy also available in set of 5 reports as PB-235 999-SET, PC$17.00.

Wood, P
Mitre Corporation, Urban Mass Transportation Administration, (UM-TA-VA-06-0004) Tech. Rpt. MTR-6681-Vol-5, Aug. 1974, 53 pp

Contract DOT-UT-10005

ACKNOWLEDGMENT: NTIS (PB-236004/8SL)
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-236004/8SL, DOTL NTIS

B7 081203
AN EVALUATION OF FIVE RAILROAD ENGINE ALERTING AND WARNING LIGHT SYSTEMS
Five lighting systems proposed for improved other-vehicle operator approach warning alerting were evaluated in a simulated grade crossing decision paradigm. Additional evaluations were conducted on system conspicuousness. The systems, a Bicolor Radial Beacon, Slow-rate Strobe 2.5 flash per second (FPS), Fast-rate Strobe 1 FPS, truck clearance lights, and side mounted Flourescent Panels, were examined at 10, 20, 30 miles per hour under daylight and night conditions. Some advantage was found for the strobe systems and for the clearance lights as compared to the usual fixed locomotive headlight. Recommendations for further research were made. (Author)

Sanders, MS Aylworth, CE O'Benar, JD
Naval Ammunition Depot NAD-CR-RDTR-265, Feb. 1974, 81 pp

ACKNOWLEDGMENT: NTIS (AD-779878/8GA)
PURCHASE FROM: NTIS Repr. PC, Microfiche
AD-779878/8GA, DOTL NTIS

B7 081254
INFLUENCE OF AGE ON THE FREQUENCY OF PHYSICAL FAILURE OF STAFF EMPLOYED ON DB TRACTIVE STOCK
[Uber den Einfluss des Lebensalters auf die Haufigkeit von Fehlleistungen beim Triebfahrzeugpersonal der DB]
Recordings were made of 2,217 automatic brake applications in cases where the vigilance button for the distant signal in the warning position was not activated, and studies were carried out on the average frequency of release of the automatic acoustic warning signal (SIFA: Sicherheitsfahrschaltung) on 10 powered units during 1,424 running days. There was found to be no relationship between age and an increase in the frequency of human lapses. The maximum values reached show fluctuations of a certain importance at all age levels. Anticipated retirements could represent a selective effect; account is also taken, unofficially, of the age of drivers of powered units on drawing up the rosters.

Hildebrandt, G *International Archives of Occupational Health* Vol. 32 No. 1-2, 1974, pp 33-41, 2 Fig., 27 Ref.

ACKNOWLEDGMENT: International Railway Documentation, Selection of (UIC Serial No. 1102)
PURCHASE FROM: Springer Verlag 175 Fifth Avenue, New York, New York, 10010 Repr. PC
DOTL JC

B7 083926
COACH DESIGN FOR THE HELSINKI UNDERGROUND
After more than 20 years of planning, an underground system will be opened in Helsinki in 1978. In 1972, a short line was constructed, with six coaches for experiments. This article describes an analysis of these coaches from the

point of view of ergonomics. A travelling experiment was organized, designed to simulate the final travelling situation. After the experiment the subjects filled out a questionnaire. During the trip the behavior of the subjects and their moving in and out was observed by two TV recorders and two film cameras.

Saari, JT *Applied Ergonomics* Vol. 5 No. 3, Sept. 1974, pp 149-152

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: ESL Repr. PC, Microfilm

B7 083935
DRIVERS' CABS ARE BEING MODERNISED AND WILL BE WINDPROOF AND WARM
During the next few years the SJ will make large investments to improve the working environment for the locomotive drivers. By covering the piping of the cabs in plastics the draught will be eliminated and the working place will be more pleasant and easier to clean. Air-conditioning will be tested in some locomotives. The improvement of the working environment can in some cases cost up to 70,000 Skr per locomotive.

Lantz, S *Arbetsmiljo* No. 6, 1974, 13 pp

PURCHASE FROM: Foereningen Foer Arbetarskydd Kungsholms Hamrylan 3, S11220 Stockholm, Sweden Repr. PC

B7 090341
BART AND THE HANDICAPPED
A ten-year review of BART with regard to special facilities for the handicapped shows a gradual awareness of needs as citizen pressure has mounted. Special facilities for the visually and audibly disabled are not yet provided, and many elevators are awkwardly located for the physically handicapped. A study team in 1974 found many minor elevator operational problems, with an additional barrier for wheelchair users as the lack of level access to and egress from buses that transfer with BART. It is observed that new responsibility is now being taken to provide transportation for the handicapped and that BART has set a planning precedent.

Levine, R
Metropolitan Transportation Commission, Department of Transportation, Department of Housing and Urban Development, California University, Berkeley MTC-WP-17-1-75, Nov. 1974, 67 pp

Contract DOT-OS-38176

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-239211/6ST

B7 090522
RESULTS OF THE FIRST SEMI-ANNUAL QUALIFICATION TESTING OF DEVICES TO MEASURE BREATH ALCOHOL
Eight evidential breath testers were performance tested according to the Standard for Devices to Measure Breath Alcohol Federal Register, Vol 38, No. 212, November 5, 1973. In addition, a prototype breath tester not commercially available was tested. Test results are presented.

Flores, AL
Transportation Systems Center, National Highway Traffic Safety Administration Intrm Rpt. DOT-TSC-NHTSA-74-6, Jan. 1975, 24 pp

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-240104/0ST, DOTL NTIS

B7 090972
TASK ANALYSIS FOR THE JOBS OF TRAIN CONDUCTOR AND BRAKEMAN
The document describes the results of a research effort undertaken to detail the tasks of freight train conductors and brakemen. Included with text are detailed operational sequence diagrams for both conductor and brakeman.

Sanders, MS Jankovich, JJ Goodpaster, PR
Naval Ammunition Depot NAD-CR-RDTR-263, 235 pp

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
AD-A007528/3ST, DOTL NTIS

B7 091377
ANALYSIS OF HIGH RISK GROUPS FOR ALCOHOL COUNTERMEASURES
The study plan defines a number of high risk drinking driver groups, specifies variables to used in developing a predictive model of high risk drinking driving within these groups, and presents a design for a survey research operation which will discover these groups of high risk drinking drivers in the field, gather data on the relevant variables, and inductively develop best predicting equations from the data collected. Questionnaire forms are included, sampling plans and instructions, in preparation to begin Phase 2 of the research project, the conduct of the survey.
Also included report nos. DOT-HS-801 434 thru DOT-HS-801 435.

Wagner, MH Bigelow, JH Cobb, J Goldstein, L Kirkpatrick, RE Technical Research Associates, Incorporated, National Highway Traffic Safety Administration Final Rpt. Mar. 1975, 351p

Contract DOT-HS-4-00989

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-241567/7ST, DOTL NTIS

B7 092091
RAILROAD ACCIDENT REPORT: COLLISION OF ST. LOUIS-SAN FRANCISCO RAILWAY TRAINS 3210 AND 3211, MUSTANG, OKLAHOMA, SEPTEMBER 1, 1974
On September 1, 1974, at 1:44 to 1:46 p.m., the St. Louis-San Francisco Railway Company's eastbound freight train 3210 and westbound train 3211 collided head-on 1.7 miles west of Mustang, Oklahoma. The trains were scheduled to meet in Mustang. However, train 3211 passed Mustang ahead of schedule. As a result of the collision, 4 locomotive units were destroyed, 23 cars derailed, and hazardous materials caught fire in the wreckage. As a result of the fire, eight families were evacuated from their homes. A brakeman on train 3211 was killed, and the three other crewmembers of that train were injured seriously. The National Transportation Safety Board determines that the probable cause of this accident was the failure of the crew of train 3211 to take preventive action after the train passed Mustang ahead of schedule.

National Transportation Safety Board NTSB-RAR-75-6, May 1975, 25 pp

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-242771/4ST, DOTL NTIS

B7 092738
STANDARDIZATION OF CONTROLS FOR UNDERGROUND ELECTRIC FACE EQUIPMENT. APPENDIX 3. RAILED PERSONNEL CARRIERS
The appendix includes recommendations for the standardization of controls on railed personnel carriers and is intended to be used in conjunction with the Final Report (BuMines OFR 45(1)-75; PB-242 562). The primary purpose of the effort was to apply modern human engineering technology to reduce human error and accidents associated with the on-site operation of railed personnel carriers.
See also Appendix 2, PB-242 563.

Krause, JR Hedling, WG
Applied Science Associates, Incorporated, Bureau of Mines Res Rept. BuMines-OFR-45(4)-75, Dec. 1974, 34p

Contract H0230021

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-242565/0ST, DOTL NTIS

B7 092739
STANDARDIZATION OF CONTROLS FOR UNDERGROUND ELECTRIC FACE EQUIPMENT. APPENDIX 2. TROLLEY MINE LOCOMOTIVES
The appendix includes recommendations for the standardization of controls on trolley mine locomotives. It is intended to be used in conjunction with the Final Report (BuMines OFR 45(1)-75; PB-242 562). The primary purpose of the effort was to reduce human error and accidents associated with the on-site operation of trolley mine locomotives.

See also Appendix 1, PB-242 563 and Appendix 3, PB-242 565.
Krause, JR Hedling, WG
Applied Science Associates, Incorporated, Bureau of Mines Res. Rept. BuMines-OFR-45(3)-75, Dec. 1974, 32p

Contract H0230021

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-242564/3ST, DOTL NTIS

B7 094796
HEALTH HAZARD EVALUATION/TOXICITY DETERMINATION REPORT H.H.E. 74-28-212, WESTINGHOUSE AIR BRAKE COMPANY, WILMERDING, PENNSYLVANIA
NIOSH conducted a health hazard survey at a plant manufacturing railroad air brake and emergency braking systems. Environmental air samples were collected for cadmium, chromium, cyanides, nitric acid, and organic solvents. Medical histories were also reviewed and cutaneous examinations of exposed employees were performed. A chrome sore was observed on one worker and ten other workers were found to have various types of occupational dermatitis. It was concluded that the dermatitis cases were due to primary irritation to various chemicals, primarily lubricants. Airborne concentrations were judged to be not toxic to exposed employees.
See also PB-249 393.

Rosensteel, RE Lucas, JB
National Institute for Occupational Safety & Hlth Final Rpt. NOISH-TR-HHE-7428212, July 1975, 16 pp

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS
PB-249392/2ST, DOTL NTIS

B7 095224
ORGANIZATION OF A TRAINING CENTER FOR MAINTENANCE PERSONNEL
TABEC (Technical And Behavioral Education Center) was created in 1974 as a centralized training facility for Chicago Transit Authority maintenance personnel. The primary function at TABEC is to provide the training needed to enable maintenance personnel to efficiently and safely maintain all of CTA's equipment. Training includes both classroom and "on-the-job" instruction. This paper discusses the courses of job training that are handled at TABEC.
Contributed by the Rail Transportation Division of The American Society of Mechanical Engineers for presentation at the IEEE-ASME Joint Railroad Conference, San Francisco, California, April 15-17, 1975.

Bolech, J (Chicago Transit Authority)
American Society of Mechanical Engineers 75-RT-6, Apr. 1975, 4 pp

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL RP

B7 095232
NEW TRAIN-DYNAMICS SIMULATOR
A new approach to train-dynamics simulators has been developed by the Freight Master Company. Unlike units that are mock-ups of a locomotive cab similar to aircraft simulators, the new system uses a mini-computer and cathode ray tube to generate real-life conditions. The system might be further developed to be placed in a locomotive cab to aid the engineer in running his train more effectively. The Train Dynamics Analyzer, as it is called, uses a track profile and train consist data stored on magnetic tape. A locomotive control stand gives throttle action, braking, etc.

Progressive Railroading Vol. 18 No. 3, Mar. 1975, pp 39-40

ACKNOWLEDGMENT: CNR
PURCHASE FROM: Murphy-Richter Publishing Company 9 South Clinton Street, Chicago, Illinois, 60606 Repr. PC
DOTL JC

B7 095393
HERBICIDE EXPOSURE, MORTALITY AND TUMOR INCIDENCE, AN EPIDEMIOLOGICAL INVESTIGATION ON SWEDISH RAILWAY WORKERS
The investigation shows a slightly dose-dependent and significantly increased tumor incidence and mortality among workers exposed to amitrol (3-animo-1,2,4-triazole), whereas those exposed to phenoxy acids (2,4-dichlorophenoxyacetic acid = 2,4-D and 2,4,5- trichlorophenoxyacetic acid = 2,4,5-T) have about normal tumor incidence and mortality. Based on animal experiments, there is some evidence that amitrol may cause malignant tumors in different tissues, although tumors in the thyroid gland and the liver have been observed and discussed most frequently. Although the investigations may be criticized, the result, being in agreement with animal data, suggests precautions in using amitrol. [Finnish]
This paper was also published by Lakartidningen, Stockholm, Sweden, pp 2466-70, 1974.

Axelsson, O Sundell, L *Work, Environment, Health* 1974, pp 21-28, 15 Ref.

ACKNOWLEDGMENT: International Railway Documentation, Selection of
PURCHASE FROM: Occupational Health Foundation of Finland Haartmanink 1, SF-00290 Helsinki 29, Finland Repr. PC

B7 095625
INDIVIDUAL DIFFERENCES IN RESPONSE TO THE ENVIRONMENT
In assessing the effects of environmental stress three points are made. (1) Comfort and working efficiency cannot necessarily be equated. (2) The optimal experimental design for assessing individual differences differs fundamentaly from that required for establishing population means. Reliable individual differences will only be revealed by repeated measures of a given effect upon the same people and under the same conditions. (3) Regarding the assessment of what individuals find comfortable as regards temperature, or acceptable as regards noise, two difficulties are noted. (a) In terms of what they are prepared to do about it, individuals may differ in what they mean when they tick one of a number of terms indicating varying degrees of discomfort or annoyance. (b) Where an observer experiences a range of conditions he will tend to place the center point of the rating scale at the center of the range of conditions sampled. Over a group of observers this may bias the average comfort or acceptability vote away from its true point. The presentation of a standard followed by a single test condition will avoid difficulties due to range effects but may encounter others due to suggestion or contrast effects.

Wilkinson, RT (Medical Res Counc, Appl Psychol Unit, England) *Ergonomics* Vol. 17 No. 6, Nov. 1974, pp 745-756, 21 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B7 095626
COLD-INDUCED VASODILATATION ONSET AND MANUAL PERFORMANCE IN THE COLD
This study is an investigation of manual dexterity capabilities during whole-body cold exposure as a function of time to vasodilatation during local cooling. Thirty male subjects were divided into three equal groups on the basis of the time for a 3deg F (1.7deg C) rise in index finger temperature during immersion of the hand in 4.4deg C water: (450 sec group, 450-900 sec group, and)900 sec group. Subsequently, each subject was exposed to ambient temperatures of 15.6deg and-6.7deg C for three hours while performing a battery of six manual tasks bare-handed. Manual performance on all tasks was affected adversely at the-6.7deg C ambient and worsened with continued cold exposure. The drop in performance on three tasks involving skilled movements of the wrist and fingers was greatest for the 450 sec group. Within the limits of the present study, the early onset of vasodilatation in local cooling per se appears to be associated with initially superior performance and subsequently inferior performance on specific manual tasks with increasing durations of whole-body cold exposure.

Bensel, CK (Army Natick Laboratories); Lockhart, JM *Ergonomics* Vol. 17 No. 6, Nov. 1974, pp 717-730, 16 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm
DOLT JC

B7 095661
HUMAN FACTORS ANALYSIS OF THE DIESEL-ELECTRIC LOCOMOTIVE CAB
Using information collected over 6-1/2 years, a human factors analysis was completed of the diesel-electric locomotive cab. The analysis was directed towards displays, control design and arrangement, and environmental quality. Nineteen recommendations were provided for the modification of existing cabs and the design of new cabs to enable future locomotive crews to work more efficiently and safely in a more comfortable work environment.

Gamst, FC (Rice University, Houston) *Human Factors* Vol. 17 No. 2, Apr. 1975, pp 149-156, 1 Fig., 3 Ref.

ACKNOWLEDGMENT: Human Factors
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL RP

B7 095694
MOTION DISCOMFORT AND TRANSPORTATION GUIDEWAY FORM
A three-dimensional theory of motion discomfort is developed by defining scalar indices measuring discomfort due to acceleration and jerk. These indices are functions of effective acceleration and jerk vectors and their orientation to the preferred configuration of a subject. The optimal bank angle of a guideway is defined and shown to minimize acceleration discomfort. Isotropic approximations to the discomfort indices are proposed. Expressions for the indices are obtained in terms of the vehicle motion and guideway geometry. Detailed analyses of motion along optimally banked circular helical and three-dimensional spiral curves are presented. Motion with zero fore-aft thrust on a curve in a vertical plane is also detailed. The approach assumes a smooth guideway and so vibrational inputs are not included. The analysis should be followed up by an experimental program before it is taken too seriously in design.

Dais, JL Balachandra, M *Transportation Research* Vol. 8 No. 6, Dec. 1974, pp 523-531

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

B7 096631
STUDY OF THE TASKS, WORKING CONDITIONS AND REQUIREMENTS OF A CENTRALISED CONTROL POINT [Eine Untersuchung uber Aufgaben, Arbeitsbedingungen und Arbeitsanforderungen auf einer Fernsteuerzentrale]
From a central control point, two regulators govern a line 120 km long and 17 stations including train operations and locomotive allocation. Following an analysis of the tasks, working conditions and requirements at the control point's offices, taking into account recent results of work science, the author comes to certain conclusions about the construction and fitting of offices in such surroundings so that better conditions can be obtained in the future. [German]

Mrosek, U *Verkehrsmedizin und Ihre Grenzgebiete* Vol. 21 No. 8, 1974, pp 262-277, 10 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Transpress VEB Verlag Fuer Verkehrswesen Franzoesische Strasse 13/14, Berlin W8, East Germany Repr. PC

B7 096662
STATISTICS IN HUMAN ENGINEERING
This paper presents a discussion on the use and abuse of statistics in human engineering experiments. The topics briefly discussed include experimental design, statistical and practical significance, randomization and some aspects of the use of averages, distributions and correlation. A section is devoted to the reporting of experiments. Some notes about averaging of decibels and complex numbers are given in an appendix. /Author/TRRL/

Maslen, W
Royal Aircraft Establishment Tech. Memo EP548, July 1973, 35 pp, 4 Fig., 2 Tab., 19 Ref.

ACKNOWLEDGMENT: Transport and Road Research Laboratory (IRRD 211425S)
PURCHASE FROM: Royal Aircraft Establishment Farnborough, Hampshire, England Repr. PC

B7 096775
CONSPICUITY OF BEACONS FOR EMERGENCY VEHICLES
In a large field study red, orange, light blue and dark blue rotating and flashing beacons have been studied mainly from a peripheral conspicuity point of view. Some subjective evaluation has also been made. The results show that from a purely visual point of view the orange beacon is superior. The red beacon is inferior in nighttime conditions but good under bright daylight conditions which seem to be the worst from a safety point of view. The blue beacons are almost too good in nighttime conditions in the respect that they cause discomfort but they are poorly visible in bright daylight conditions. A light blue beacon improves visibility in daylight. Flashing light blue beacons are equally as conspicuous as rotating light blue beacons but cause more discomfort. /TRRL/

Rumar, K
Uppsala University R&D Rpt. Report 152, 1974, 44 pp, 4 Fig., 1 Tab., 11 Ref.

ACKNOWLEDGMENT: National Swedish Road & Traffic Research Institute (VTIN20019E), Transport and Road Research Laboratory (IRRD 212463)
PURCHASE FROM: Uppsala University P.O. Box 256, 75105 Uppsala, Sweden Repr. PC

B7 097251
TRAIN CONTROL, STRESS AND VIGILANCE
Modern railway operation, due to the control exerted on the man-machine-pathway combination is the safest form of transportation available. The vehicle pathway is continuously monitored and both front and rear end protection is provided to prevent collisions. Man although extremely versatile is known to be the weak link in the man machine system. Consequently, his duties need to be arranged to match his capabilities. An examination is made of human factor research, levels of arousal, driving efficiency and driver stress, fatigue, diurnal bodily rhythm and vigilance. Accident rates have been progressively reduced by various safeguards instituted to guard against human failure. Measurements of driver stress under various conditions of high speed train operation have been carried out and changes in stress in accordance with train speed, hours of duty, periods of rest, and day and night operation determined. There are a series of railway signalling and vigilance control devices which successively reduce the effect of the human element. These have further developed into semi-automatic and automatic train operation.
Paper presented at the 10th Annual Conference.

Cox, JJ
Ergonomics Society of Australia and New Zealand Nov. 1973, 22 pp

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: Ergonomics Society of Australia and New Zealand Repr. PC

B7 097604
CONTACT LENSES AND DRIVERS [Kontaktlinsen und Kraftfahrer]
The advantages of adhesive lenses for correcting errors of refraction have to be set against the disadvantages, particularly for drivers. Restrictions of the field of vision are possible because of the optical structure of the edge zones and the firly thick lacrimal film. Alterations in field of vision can be balanced out with use. Special contact lens shapes have to be used under certain conditions in order to achieve good visual acuity. Vision in darkness and dusk is usually impaired by adhesive lenses, night myopia increases, and increased formation of scattered light and over-sensitivity to light lead to greater dazzle. Dark adaptation may be considerably impaired by dark adhesive lenses. After the contact lenses have been removed unclear vision often occurs for up to 21 days, and this is not compensated for by the immediate wearing of spectacles. Smaller lenses are best in this respect. These again cause noticeable formation of scattered light. A questionnaire study of wearers of contact lenses showed that judgment of distance was mostly much better with contact lenses. The greater field of vision was regarded as particularly favourable. /TRRL/ [German]

Stone, J *Augenoptik* Vol. 89 No. 2/3, 1972, 4 pp, 5 Fig., 18 Ref.

ACKNOWLEDGMENT: Transport and Road Research Laboratory (IRRD 301752)
PURCHASE FROM: VER Verlag Technik Oranienburger Strasse 13/14, 102 Berlin, East Germany

B7 097605
DIABETES AND DRIVING APTITUDE [Diabets und Fahrtuechtigkeit]
Despite the frequency of diabetes mellitus, the sugar disease and its complications and the side effects associated with its treatment only rarely affects driving aptitude. There is no call for a general ban on driving for diabetics, and discrimination against them on the roads has to be avoided. Diabetics involved in accidents have to be judged individually. There are guidelines on this published by the German government. The author discusses aspects of civil law involved in the judgment of diabetics. /TRRL/ [German]

Petzoldt, R *Arzt und Auto* Vol. 48 No. 10, Oct. 1972, pp 13-15, 28 Ref.

ACKNOWLEDGMENT: Transport and Road Research Laboratory (IRRD 301754)
PURCHASE FROM: Kraftfahrverband Deutscher Aerzte eV (KVDA) Frankfurt am Main, West Germany

B7 098678
RAILROAD ACCIDENT REPORT: COLLISION OF PENN CENTRAL FREIGHT TRAIN OV-8 WITH AN OPEN DRAWBRIDGE, CLEVELAND, OHIO, MAY 8, 1974
On May 8, 1974, Penn Central freight train OV-8 collided with the counterweight of a lift-span drawbridge on the Cuyahoga River at Cleveland, Ohio. Shortly before the collision, the eastbound train had been traveling at 33 mph on a main track equipped with automatic block signals when the DB operator contacted the traincrew and advised them that the route was clear ahead. Then, the operator remembered that a boat had been awaiting passage and, without informing the traincrew, he opened the bridge. The train passed the red home signal of the DB interlocking without braking and struck the counterweight of the open bridge about 600 feet beyond the signal. The two crewmembers in the lead locomotive unit died as a result of crash injuries. The National Transportation Safety Board determines that the probable cause of this accident was the failure of the locomotive crewmembers to obey a wayside signal indication to stop and the concurrent opening of the drawbridge by the DB operator after he had advised the oncoming traincrew by radio that the route was clear. Contributing to the accident was the absence of specific rules that either prohibited such a radio message or described the circumstances under which such a radio transmittal could be accepted as an operational control.
This report contains Safety Recommendations R-75-11 through R-75-15.

National Transportation Safety Board NTSB-RAR-75-3, SS-R-29, Mar. 1975, 29 pp, Figs., 2 App.

ACKNOWLEDGMENT: National Transportation Safety Board, NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-242430/7ST, DOTL NTIS

B7 099353
PROPOSED QUALIFICATION REQUIREMENTS FOR SELECTED RAILROAD JOBS
This report proposes minimum, safety-related knowledge, performance and training requirements for the jobs of railroad engineer, conductor, brakeman and train dispatcher. Analyses performed were primarily based upon job and task analytic documentation already in existence, and were critically reviewed by government and civilian railroad specialists. Recommendations are also offered for the conduct of job training and for techniques to measure and evaluate job knowledge and performance.
This report was sponsored by US DOT, Federal Railroad Administration's Office of Research and Development.

Hale, A Jacobs, HH
Dunlap and Associates, Incorporated, (DOT-TSC-FRA-75-8) Final Rpt. FRA-OR&D-75-44, May 1975, 130 pp, 1 Fig., Tabs., 3 App.

Contract DOT-TSC-736

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-244090/AS, DOTL NTIS

B7 099360
FIELD EVALUATION OF LOCOMOTIVE CONSPICUITY LIGHTS
Flashing xenon strobe lamps were installed on locomotives in revenue service as a means of alerting motorists to the hazards they are approaching at a rail-highway grade crossing. Effectiveness of these lights in attracting motorists' attention was evaluated. The reactions of both motorists and locomotive crews to the use of strobe lights were also evaluated. Field observations, interviews, and experiments confirmed the attention-getting value of locomotive-mounted strobe lights used in revenue service to alert motorists and suggested operational procedures and device specifications that are the subject of a separate application guideline report. Experimentation and observation of the strobe lights under railroad operating conditions verified that these lights do not interfere with perception of trackside signals or with normal motorist and crew operations. The work reported in this document supports a technical recommendation favoring use of strobe lights on more extensive research tests in railroad operational service.
The project was sponsored by US DOT, Federal Railroad Administration's Office of Research and Development.

Devoe, DB Abernethy, C
Transportation Systems Center, (DOT-TSC-FRA-74-11) Final Rpt. FRA-OR&D-75-54, May 1975, 66 pp, Figs., Tabs.

ACKNOWLEDGMENT: FRA, NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-244532/8ST, DOTL NTIS

B7 099708
HUMAN INFORMATION PROCESSING UNDER VARYING TASK DEMAND
Experiments on the rate of human information transmission show that the relationship between performance and demand depends upon time history of demand; beyond overload, performance does not recover at the expected rate as demand is reduced. The resulting 'hysteresis' effect increases after moderate doses of alcohol. Some implications of these results in real-life situations are discussed. (A) /TRRL/

Cumming, RW (Monash University, Australia); Croft, PG (New South Wales Dept of Motor Transport, Australia) *Ergonomics* Vol. 16 No. 5, 1973, pp 581-586, 4 Fig., 9 Ref.

ACKNOWLEDGMENT: Transport and Road Research Laboratory (IRRD 211949)
PURCHASE FROM: ESL Repr. PC, icrofilm
DOTL JC

B7 099709
SAFETY PSYCHOLOGY: A REVIEW OF THE LITERATURE
This paper reviews the major concepts and trends in safety psychology under four headings: (1) personal factors affecting the causation of accidents; (2) environmental factors affecting accident causation; (3) theories in safety psychology; (4) research problems in safety psychology. The most important conclusion reached, is that safety psychology lacks a theoretical framework which is necessary for both predicting accidents before they occur and as a cohesive force for drawing together the immense amount of information that is available in the field of safety. (A) /TRRL/

Dunn, J
Aston University, England R&D Rept. AP #35, 1971, 34 pp, Refs.

ACKNOWLEDGMENT: Transport and Road Research Laboratory (IRRD 211978)
PURCHASE FROM: Aston University, England Department of Applied Psychology, Birmingham B4 7ET, England Repr. PC

B7 099762
VOCATIONAL APTITUDE TESTING--A CONTRIBUTION TO OPERATING SAFETY [Eignungstests--ein Beitrag Zur Betriebssicherheit]
Vocation aptitude testing should conform to scientific quality criteria and be practically put to the test to check its validity. The author describes the methods of the particular tests and their effectiveness for increasing operating safety. [German]

Dvorak, H *Die Bundesbahn* Vol. 50 No. 12, 1974, pp 943-945

ACKNOWLEDGMENT: International Railway Documentation, Selection of PURCHASE FROM: Hestra[Verlag Holzhofallee 33, 61 Darmstadt, West Germany Repr. PC

B7 099833
BETTER PERFORMANCE TODAY
Despite a downturn in traffic, the potential for improving operating results still exists. Santa Fe's vice president, operations, calls Santa Fe's people crucial in such efforts and says motivation and training are crucial. Computerized monitoring of train performance following a rationalization of freight train schedules was instituted. Close control over switching costs has also been instituted. The railroad has also taken a close look at supervision of its freight offices and yard offices, instituting standardized procedures vital in introducing machine accounting. Training programs for the new approach involve subject matter rather than job functions.

Cena, L (Santa-Fe Railway) *Progressive Railroading* Vol. 18 No. 7, July 1975, 5 pp, 5 Phot.

PURCHASE FROM: Murphy-Richter Publishing Company 9 South Clinton Street, Chicago, Illinois, 60606 Repr. PC
DOTL JC

B7 125893
HUMAN FACTORS IN RAILROAD OPERATIONS: ACTIVITIES IN FISCAL YEAR 1973
This is an interim report covering human factors services rendered by TSC to the FRA under the project: "Human Factors in Railroad Operations," during fiscal year 1973. It reviews all activities briefly and contains more detailed reports on a research plan for use with a locomotive cab simulator, a training survey, studies of train handling, and fault-tree analysis of railroad accident data.

Devoe, D Feehrer, CE Hill, JH Sussman, ED
Transportation Systems Center, Federal Railroad Administration, (DOT-TSC-FRA-73-11) Tech. Rpt. FRA-OR&D-74-32, Feb. 1974, 114 pp, Figs., Tabs., 3 App.

ACKNOWLEDGMENT: FRA, NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-244540/1ST, DOTL NTIS

B7 126419
HUMAN CRITERIA IN THE DESIGN AND ARRANGEMENT OF CONTROL ELEMENTS
This article examines some important factors that should be considered in the design and arrangement of control elements from the standpoint of human engineering. The need for ready identification of individual control elements is stressed, and several possibilities for differentiation between control knobs--based on variation of the shape, size, color, texture, position and operating method--are described. The basis for the coding of control elements in either of these ways is human sensibility. Finally, hand controls and foot controls are discussed in terms of selection, best positioning and arrangement.

Shan, HS (Roorkee University, India) *Machinery and Production Engineering* Vol. 126 No. 3258, May 1975, pp 455-459, 7 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

B7 127005
ACUTE MYOCARDIAL INFARCTUS AMONG CSD RAILWAYMEN [Akutni infarkt myokardu u zeleznicaru]
The analyses were based on 1971 data. The average age of railwaymen examined was 52.2 years. The survey reveals the importance of preventive examinations. The main criteria for deciding on return to active duty are: the seriousness of the illness and the type of job done by the staff concerned. As regards the resumption of work, the age criterion is of secondary importance. [Czech]

Sramek, J *Zeleznicni Zdravotnictvi* Vol. 18 No. 1, 1974, pp 3-30

PURCHASE FROM: Zeleznicni Zdravotnictvi Prague, Czechoslovakia

B7 127007
THE DB'S OPTICAL WARNING SYSTEM FOR PERMANENT WAY MAINTENANCE GANGS [Die optische Rottenwarnanlage der DB]
The use of audible warning signals to gangs working on the line causes much disturbance for people living near the railway, especially at night. The DB has tried to replace audible warnings by optical signals for work on the permanent way at night. The principle is that at the arrival of the train, the lighting intensity at the worksite is varied according to the two frequencies used by the DB to show the track on which the train is arriving. On engines with autonomous lighting, electronic flash-devices are used to warn the gangs. Finally, the author stresses that the present warning system depending on a look-out man, as used by the DB, is unsatisfactory from the safety point of view. Only automatically operated equipment could meet safety requirements. Moreover, this optical warning device saves manpower, as the look-out man is not required. [German]

Koerber, H *Eisenbahningenieur* Vol. 26 No. 3, Mar. 1975, pp 89-90, 3 Fig.

ACKNOWLEDGMENT: International Railway Documentation, Selection of PURCHASE FROM: Dr Arthur Tetzlaff-Verlag Niddastrasse 64, Frankfurt am Main, West Germany Repr. PC

B7 127715
TRACK TRAIN DYNAMICS. GUIDELINES FOR: TRAIN HANDLING, TRAIN MAKEUP, TRACK & STRUCTURES, ENGINEER EDUCATION
This manual was prepared as an immediate aid in improving freight train performance. It has five sections: Definitions and Functions of Equipment; Train Handling; Train Makeup; Track and Structure; Engineer Education. These results are based on parametric study using validated analytical models.

A Government-Industry Research Program on Track Train Dynamics. Requests for this publication should be directed to J.G. Britton, Director of Operations, AAR. This is a 2 volume set.

Association of American Railroads AAR-R153, 1973, 33 pp, Figs.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B7 127720
CAREER DEVELOPMENT OF RAILROAD OPERATING CRAFT EMPLOYEES
This paper investigates the career paths of railroad operating employees (trainmen) from pre-employment to employment, to post-employment (retirement). Its purpose is to determine how a person comes initially to the operating craft; once working, to see how a person's career develops over his period employment (normally more than 30 years); and to consider his retirement. Using a modified version of Schein's career development model, the career of railroad employees is analyzed. A framework is provided within which to analyze forces that are acting to modify and change the current career development procedures.

This paper is from the Proceedings of the 16th Annual Joint Meeting of the Canadian Transportation Research Forum and the Transportation Research Forum, 3-5 November 1975, Toronto, Canada. Complete Volume $20.00.

Potratz, JT (Massachusetts Institute of Technology)
Cross (Richard B) Company Vol. 16 No. 1, 1975, pp 348-358, 5 Tab., 18 Ref.

PURCHASE FROM: Vietsch (Grant C) 181 East Lake Shore Drive, Chicago, Illinois, 60611

B7 127832
HUMAN FACTORS ANALYSIS OF THE DIESEL-ELECTRIC LOCOMOTIVE CAB
Using information collected over 6 1/2 years, a human factors analysis was completed of the diesel-electric locomotive cab. The analysis was directed towards displays, control design and arrangement, and environmental quality. Nineteen recommendations were provided for the modification of existing cabs and the design of new cabs to enable future locomotive crews to work more efficiently and safely in a more comfortable work environment.

This article was published in Human Factors, Vol 17, No. 2, pp 149-156,1

Figure, April 1975.
Gamst, FC
Rice University Apr. 1975, 7 pp

Grant NSF GS 3040

PURCHASE FROM: Johns Hopkins Press Homewood Campus, Baltimore, Maryland, 21218 Repr. PC

B7 127833
THE DIESEL-ELECTRIC LOCOMOTIVE AS A WORK ENVIRONMENT: A STUDY IN APPLIED ANTHROPOLOGY
Human factors in the diesel-electric locomotive is the subject of a study in applied ethnology and applied physical anthropology. Working from the viewpoint of locomotive crew members, the study's principal objective is to aid in designing locomotives that will enable crews to work efficiently and safely. Thirty recommendations are made to this end. After a discussion of applied anthropology, general characteristics of present-day locomotives and operations of the crew in the locomotive are covered. Recommendations and background information are presented in the following areas: (1) arrangements of cab displays of warning devices and mechanical indicators, (2) arrangement and design of controls, (3) locomotive structure, (4) impacts, (5) exterior signaling for the locomotive, and (6) vibration on the locomotive.

Published as part of "Studies in Cultural Anthropology," Rice University Studies, Vol 61, No. 2, pp 37-78, 8 Figures, Spring 1975.

Gamst, FC
Rice University Aug. 1975, 41 pp

Grant NSF GS 3040

PURCHASE FROM: Rice Campus Store P.O. Box 1892, Houston, Texas, 77001 Orig. PC

B7 128191
TROUBLE SHOOTING QUICKENER (TSQ) FOR SHINKANSEN
With extension of the Shin Kansen to Hakata in 1975, the line is now 1,000 km long and 2,100 cars are needed for the operation. Since this is the trunkline of JNR, its operation is characterized by high speed and heavy density. A malfunction on a single car can affect not only the entire Shin Kansen but also connecting services. Intended as a trainer for drivers, this electric railcar simulator was installed in Shin Osaka in 1974. The cab controls and the air conditioning controls are faithfully reproduced. Pantograph and underfloor brake equipment are installed on separate racks. Operators learn to operate under the prevailing Automatic Train Control signals and speed indications. Malfunction indications are coordinated with trouble shooting.

Okuda, D *Japanese Railway Engineering* Vol. 15 No. 3/4, 1974, pp 28-30, 2 Fig., 2 Phot.

PURCHASE FROM: Japan Railway Engineers' Association 2-5-18 Otemachi, Chyoda-ku, Tokyo, Japan Repr. PC

DOTL JC

B7 130670
RAILROAD ACCIDENT REPORT: REAR END COLLISION OF TWO TEXAS AND PACIFIC RAILWAY COMPANY FREIGHT TRAINS, MEEKER, LOUISIANA, MAY 30, 1975
About 8:52 a.m. on May 30, 1975, a Texas and Pacific Railway Company freight train, Extra 3311 West, passed an "approach" signal and a "low" signal and collided with the rear of train Extra 551 West, which has stopped on the main track in Meeker, Louisiana. The 4 locomotive units and the first 10 cars of Extra 3311 West and the last 5 cars and the caboose of the standing train were derailed and damaged. The engineer and the front brakeman of Extra 3311 West and the conductor of Extra 551 West were killed. The National Transportation Safety Board determines that the probable cause of the collision was the failure of the engineer of Extra 3311 West, while operating the train in violation of a "low" signal indication, to perceive the train ahead in time to prevent a collision. A cause of the severity of the collision was the subnormal braking capability of a significant number of cars. As a result of this investigation, five recommendations concerning use of radio, backup control system, "Stop and Proceed" procedure and enforcement of braking system regulations have been addressed to the Federal Railroad Administration.

National Transportation Safety Board NTSB-RAR-75-9, 1975, 23 pp, 1 Fig., 2 App.

ACKNOWLEDGMENT: National Transportation Safety Board
PURCHASE FROM: NTIS Repr. PC, Microfiche

DOTL NTIS

B7 131655
RAILROAD ACCIDENT REPORT: PENN CENTRAL TRANSPORTATION COMPANY, TRAIN COLLISIONS, LEETONIA, OHIO, JUNE 6, 1975
About 11i00 p.m. on June 6, 1975, three freight trains of the Penn Central Transportation Company (PC) were involved in a collision near Leetonia, Ohio. Extra 6330 West collided with the rear of standing Extra 2278 West. Immediately thereafter, Extra 6259 East, which was on an adjacent track, struck the wrecked cars from the other two trains. One employee was killed and seven others were injured. Property damage amounted to about $1.25 million. The National Transportation Safety Board determines that the probable cause of this accident was the failure of the engineer and brakeman to assure the operation of the train at a speed slow enough to stop it within the visibility range. This violated the resitrcted speed rule required by the signal indication. Recommendations were made concerning operating rules and the use of radios.

National Transportation Safety Board NTSB-RAR-76-2, Feb. 1976, 28 pp

ACKNOWLEDGMENT: National Transportation Safety Board
PURCHASE FROM: NTIS Repr. PC, Microfiche

DOTL NTIS

B7 131656
RAILROAD ACCIDENT REPORT REAR END COLLISION OF AN ALASKA RAILROAD FREIGHT TRAIN WITH A PASSENGER TRAINî NEAR HURRICANEî ALASKAî JULY 5, 1975
About 3i46 p.m. on July 5, 1975, an Alaska Railroad freight train, Extra 1502 South, collided with the rear of passenger train No. 5, which had stopped south of Hurricane, Alaska, to permit the passengers on the train to view Mt. McKinley. All cars of the passenger train and the first four locomotive units of the freight train were derailed. Sixty-two persons were injured and one of the injured subsequently died. The National Transportation Safety Board determines that the probable cause of the accident was the failure of the engineer of Extra 1502 South to operate the braking system on the locomotive properly and the failures of both trancrews to comply with railroad operating rules. As a result of its investigation, the Safety Board made three recommendations to the Federal Railroad Administration concerning improvement and compliance with operating rules and a modification of locomotive brake valves.

National Transportation Safety Board NTSB-RAR-76-3, Feb. 1976, 24 pp

ACKNOWLEDGMENT: National Transportation Safety Board
PURCHASE FROM: NTIS Repr. PC, Microfiche

DOTL NTIS

B7 134602
TASK ANALYSIS FOR THE JOBS OF FREIGHT TRAIN CONDUCTOR AND BRAKEMAN
This document describes the results of a research effort undertaken to detail the tasks of freight train conductors and brakemen. Included with text are detailed operational sequence diagrams for both conductor and brakeman. This task analysis is subsequent to a similar study conducted by McDonnell Douglas describing the tasks of freight train engineers.

Sanders, MS Jankovich, JP
Naval Ammunition Depot, (DOT-TSC-FRA-75-10) Final Rpt. FRA-OR&D 75-69, May 1975, 236 pp

Contract RDTR 263

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS

AD-A007528, DOTL NTIS, DOTL RF

B8 033073
BRAKING SYSTEM OF THE HIGH-SPEED TRAIN-QUARTERLY REPORT-1966
The results of running tests carried out in the last fiscal year 1963 to approximately 1964 with the revised prototype and production type C-train, proved that such problems as insufficient braking force and failure of the electric brake, etc., were almost solved. Problems as slippage, heat crack or deformation of the brake disc were not sufficiently solved, and characteristic tests of the anti-skid device and tracing study of the growth of cracks in the brake disc were performed.

Nakane, Y (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 7 No. 1, Mar. 1966, pp48-50

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-009)
DOTL RP

B8 033096
TRAIN SAFETY CONTROL SYSTEM (REPORT 2)
When a train safety control system is newly installed in a certain section of railway line, the first problem is to choose the most suitable system for the section in full consideration of its traffic condition, peculiarities and operation system adopted there. Next it is important to organize the working of the system so well that the highest degree of safety may be secured. The present study purports to make investigations of train safety control system, to define the basic requirements of the system on the basis of probability theory, and ultimately to facilitate selection of it.

Ishiai, M (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 1 No. 4, Dec. 1960, pp40-45

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-033)
DOTL RP

B8 033098
LABORATORY TEST OF THE REMODELLED K-1 TRIPLE VALVE FOR FREIGHT CARS
Test was conducted in 1958 on a freight train equipped with a K-1 triple valve without the conventional brake cylinder choke for the purpose of speed-up of freight train operation. Results suggested the necessity of improvement on the brake apparatus and the car-end buffer, because undesirable impacts occasionally occurred.

Kito, K (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 1 No. 4, Dec. 1960, p76

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-035)
DOTL RP

B8 033099
ROLLING STOCK FOR HIGH-SPEED OPERATION
Discussion of factors to be considered in the design of rolling stock for high speed operation. Factors in the design to rolling stock includes: gauge, outside forms as related to streamlining, carriage structure, locomotion systems, braking systems.

Miki, T (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. .I. Apr. 1960, pp7-12

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-036)
DOTL RP

B8 033102
BRAKING SYSTEM FOR THE HIGH SPEED TRAIN-QUATERLY REPORT-APRIL, 1964
Discusses the problems of braking systems for high speed trains. Includes consideration of factors related such as: limits of adhesion, brake types such as disc, wheel tread, materials for brakes, electric brakes and aerodynamic spoilers.

Kano, M (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. .I. Apr. 1960, pp66-71

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-040)
DOTL RP

B8 033103
EXPERIMENTAL RESULTS FOR TEMPERATURE RISE OF RAIL WHEN APPLYING EDDY CURRENT RAIL BRAKE (NO. 2)
A fundamental test for eddy-current rail brake, brake coils in four types were measured for temperature rise in rail and temperature distribution when brake force and train operation interval were varied. Results of measurements are summarized.

Sookawa, H Saito, T Shimizu, K (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 11 No. 1, Mar. 1970, pp40-41

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-041)
DOTL RP

B8 033106
RUNNING TEST OF THE TIRE-CLEANING DEVICE ON THE SHIN KANSEN VEHICLES
A running test was carried out about the new type tire-cleaning device equipped with grindstone shoe for the purpose of preventing the wheel-slip during braking time. The object of this test was to grasp its real conditions on the vehicles as well as to investigate its effect in the prevention of the wheel slip.

Maruyama, H Ohyama, T Satoh, K (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 11 No. 2, June 1970, p118

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-045)
DOTL RP

B8 033107
STANDING TEST OF EDDY CURRENT RAIL BRAKE SET TO A NEW TEST ELECTRIC CAR
To strengthen the braking force of the car at higher speed newly developed eddy current rail brakes (ECB) were tested in standing conditions with use of a new test electric car. Following items were studied in the test. (a) flux intensity of pole, (b) vertical displacement of exciting ECB, (c) displacement and strain of track and turnout, (d) distribution and effect of flux near ECB, (e) magnetization of rail.

Sookawa, H Sato, Y Itakura, E (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 11 No. 3, Sept. 1970, pp149-152

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-046)
DOTL RP

B8 033108
ON THE THERMAL EFFECT OF TREAD BRAKING UPON CAR WHEELS
Some effects of tread braking with composite brake shoe upon solid wheels were studied by a full-size brake testing machine. The temperature rise, the temperature distribution in the wheel, and the friction coefficient of brake shoe were measured during drag or stop brakes. The residual stresses set up in wheels after the brake applications in different conditions were also studied, and some clear differences were observed between the states of residual stress in the wheel drag braked and the one repeatedly stop braked.

Hirooka, T Teramura, H Saito, T (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 11 No. 3, Sept. 1970, pp160-162

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-047)
DOTL RP

B8 033112
DEVELOPMENT OF HIGH PERFORMANCE AIR BRAKE SYSTEM
Increase of train speed and train length requires the air brake control system to be of much quicker propagation. In order to meet this requirement, a new pressure control valve has been developed in JNR. This report deals with the theory on pressure wave propagation in the brake pipe, gives a brief explanation of the new valve and the road test results in both passenger and freight trains.

Nomura, Y Matsui, S Takami, H (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 12 No. 1, Mar. 1971, pp41-49

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-051)
DOTL RP

B8 033113
ROAD TEST FOR THE MEASURE OF SKID PREVENTION ON SHIN KANSEN CARS--MEASUREMENT TEST OF ADHESION FORCE UPON BRAKING
For the purpose of studying the limit of adhesion between rail and wheel upon braking, the measured results of adhesion force on SHIN KANSEN electric railcars, under the condition of watering, in both short and longer period tests are described in this report. Actual state of adhesion on cars in service were clarified such as follows: (1) adhesion force has difference of significance each by speed and by day of testing, even though the test conditions are seemingly same, and (2) the relation between mean adhesion force and skidding risk is to be known.

Wada, H Ohbu, T (Japanese National Railways) *Railway Technical Research Institute* Vol. 12 No. 1, Mar. 1971, pp49-51

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-052)
DOTL RP

B8 033131
BRAKING SYSTEM FOR HIGH SPEED TRAIN-QUARTERLY REPORT-NOVEMBER, 1961
Article discusses the various types of brakes to be used on the New Takaido Trunk Line. Comparison of various friction materials brake types, control of braking power and the limit of adhesion are subtopics which are discussed in detail.

Kano, M (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. .I. Nov. 1961, p27

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-071)
DOTL RP

B8 033136
EXPERIMENTAL RESULTS FOR TEMPERATURE RISE OF RAIL WHEN APPLYING AN EDDY CURRENT RAIL BRAKE
The eddy current rail brake operates without friction between rails and wheels of vehicle. This brake system can be used on a conventional railway as well as on a high speed railway. The brake force is obtained by converting the kinetic energy of the vehicle into heat energy in the rail, the temperature of the rail will be raised. Since the rail is essential equipment for operating railway vehicles, the temperature rise of rail is a very important factor as to whether or not this brake system can be used.

Soogawa, H Saito, T Shimizu, K (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 10 No. 1, Mar. 1969, pp58-59

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-076)
DOTL RP

B8 033172
EXPERIMENT ON ADHESION IN BRAKING BY ADHESION TESTING MACHINE
Adhesion between the rail and wheel of rolling stock is known as a complex phenomenon influenced by many factors. In order to increase available adhesion value, it is necessary to study the factors. Modeling procedure on an adhesion testing machine is suitable for the purpose at it simplifies the conditional factors. The experiment reported here is aimed to have insight for fundamental factors, through qualitative analysis of the sliding and re-adhesion process in braking.

Idemura, K Wada, H (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 9 No. 2, June 1968

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-126)
DOTL RP

B8 033173
RUNNING TEST FOR THE STUDY OF COMPOSITION BRAKE BLOCKS
The study of composition brake blocks has been advanced in JNR to obtain better brake efficiency for the operation of high speed train. As a part of its study a car running test at Sanyo line (the rail condition is straight and flat) was carried out using the composition brake blocks specially made for trial. Since a part of the brake equipment was provisional in this test, brake cylinder pressure rose slowly and idling time was 0.7 to 1.2 sec longer than usual. If it is possible to shorten the idling time by any brake equipment up to that of the emergency brake, the brake distance will be shortened within 600 m at the initial brake speed 120 km/h. In this case the variance of brake distance may be involved in it.

Wada, H (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 9 No. 2, June 1968, p122

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-127)
DOTL RP

B8 033197
BRAKING SHOCK TEST OF PASSENGER-AND FREIGHT-CARS MIXED TRAIN
According to the existing regulation on train operation of the Japanese National Railways, cut-off of the supplementary auxiliary air reservoirs of passenger cars is required in a mixed composition of train, when six or more freight cars are included in the train, in order to alleviate the difference of brake effects. The present test was planned for examining the effect on train impact of application of emergency brake under the condition of the supplementary reservoir included or excluded in the operation, and for exploring the possibility of modernizing the regulations.

Nomura, Y Kikuchi, K Matsui, S (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 5 No. 2, June 1964, pp43-44

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-154)
DOTL RP

B8 033236
THE DIGITAL TYPE SLIP DETECTOR
Article discusses the system used on the new Tokaido line electric cars to minimize wheel slip when the brakes are applied. This wheel slip detector is designed to release brakes when any one axle exceeds 20-30 percent of the train velocity. A block diagram of the system is included.

Obu, T Wada, H (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 9 No. 4, Dec. 1968, pp245-246

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-182)
DOTL RP

B8 033256
BRAKING SYSTEM FOR HIGH-SPEED TRAIN-QUARTERLY REPORT-1966
After completion of prototype train for trunk line operation, operation tests were performed to provide data for comparison with lab data for comparison of brake operation. Generally operation was satisfactory but problems still remain to be solved before final design of rolling stock. These include wheel flat, heat crack-deformation of brake disc, better lining material and failure of electrodynamic brake.

Nakane, Y (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. .I. Oct. 1963, pp28-36

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-205)
DOTL RP

B8 033263
BRAKING SYSTEM FOR HIGH SPEED TRAIN-QUARTERLY REPORT-NOVEMBER, 1962
An experiment of adhesion limit continued from the preceding year, basic research on the disc brake and the performance test of the air brake equipment which was tentatively manufactured in the middle of this year. Adhesion Limit and Anti-Skid Devices; Disc Brake; Air Brake System.

Kano, M (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. .I. Nov. 1962, pp23-25

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-213)
DOTL RP

B8 033270
THE ELECTRO-PNEUMATIC BRAKE FOR RAILWAY ROLLING STOCK
Article compares the "standard" single pipe air brake with several modified forms which use electric control. Including the Achard, Carpenter, Lipkowsky and the Chapsal. The advantages of electrical control are named and discussed. Conclusions are that the air brake with electrically controlled valves is the best system and the advantages are named.

Laplaiche, M (French National Railways) *Rail International* Nov. 1963, pp751-702, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-221)
DOTL RP

B8 033271
LATEST DEVELOPMENTS IN THE BRAKING OF RAILWAY ROLLING STOCK (SYSTEMS, CONTROL, TYPES OF EQUIPMENT, MATERIALS USED...)
Since the increase in speed, length and weight of trains continues to increase, the development of braking systems becomes more and more important. Recommendations considered the utilization of braking force within the limits of wheel adhesion, trains exceeding 120 km/h should use anti-skid systems, non-metallic discs or brake shoes are recommended for high speed operations, the development of electropneumatic controls should be further developed as should continuing research into the development of disc and rail brakes.

Kazarinov, VM (Ministry of Communications, USSR) *Rail International* 1962, pp836-861

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-222)
DOTL RP

B8 033272
SAFETY AND AUTOMATION ON ELECTRIC AND DIESEL MOTOR POWER UNITS
Application of automation techniques in the driving of power units (locomotives and motorcoaches), automatic starting, control of the spinning and skidding of the wheels, automatic transmission of the signal indications and automatic stopping: vigilance and dead-man's devices; application of electronics.

Neruez, J (Belgian National Railways) *Rail International* 1962, pp37-63

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-223)
DOTL RP

B8 033337
BRAKING SYSTEM FOR HIGH-SPEED TRAIN-QUARTERLY REPORT-1964
From the results of running tests carried out with the prototype car train in the last year (1962 to approximately 1963) on the test track section, several problems were pointed out to be solved or improved for maximum safety and better traffic service, such as insufficient braking force, failure of electric brake, wheel slip and heat crack or deformation of brake disc. To certify the practical effects of these revised designs in the course of manufacturing of the mass production type cars, several kinds of running tests were carried out using prototype cars, about the modified circuit of electric brake, plans to eliminate the flat of wheel tread, improvement of brake disc and certification of the supposition running resistance formula.

Nakane, Y (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. .I. Sept. 1964, pp26-33

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-288)
DOTL RP

B8 033342
THE RATIO ALARM SYSTEM OF THE WESTERN PACIFIC HOT BOX DETECTOR PROGRAM
Describes the development of the Ratio Alarm system to detect overheating or distressed journals of hot-boxes. Uses a ratio between temperatures at hot end and cold end of the axle. A fixed percentage between the two journals is used. A signal at the scanner is set off, a tape in the dispatcher's office is also marked, which permits an override of the system if the dispatcher feels that the alarm can be ignored.

Unpublished paper presented for Signal and Communications Engineers.

McNeill, BL (Western Pacific Railroad) Vol. pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-295)
DOTL RP

B8 033369
THE DEVELOPMENT OF SPECIAL SIGNALLING FOR HIGH-SPEED OPERATION ON EXISTING LINES
It is important to develop signal systems when train speeds exceed 160 km/h. Such factors as stopping distance at such speeds preclude the use of the system used in the noraml automation block section. At higher speeds, the warning distance may reach 2 or 3 blocks. One solution is to develop a 3 aspect signaling system which covers 3 blocks with signals fed through cables laid along the track.

Michaux, J (French National Railways) *French Railway Techniques* No. 4, 1969, pp213-222, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-323)
DOTL RP

B8 033370
PROGRAMME FOR TECHNICAL RESEARCH INTO VERY HIGH SPEEDS
A study of the areas which need to be researched for very high speed (up to 300 km/h) operation. The S.N.C.F. program of research for such operation is listed, stability, aerodynamics and train resistance, braking, adhesion, running gear, safety equipment, infra-structure, traction systems and collection are each discussed in detail. The problems, and possible solutions are also considered individually.

Tessier, M Mignot, C (French National Railways) *French Railway Techniques* No. 1, No. 1, 1970, pp1-13, 2 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-324)
DOTL RP

B8 033372
DEVELOPMENTS IN BRAKING SYSTEMS FOR EXPRESS TRAINS TO MEET THE DEMANDS OF INCREASING OPERATING SPEEDS
Increase in the speed of trains poses numerous problems, amongst which those concerned with braking are becoming more and more important. Speeds of the order of 200 km/h at the price of relatively inconsiderable modification to the signalling to retain conventional solutions for the rolling stock, such as the cast iron brake block. In the very high-speed field, 250 to 300 km/h on specially constructed new lines. It becomes necessary to resort to combined systems amongst which may be other types of frictional brake.

Laplaiche, M (French National Railways) *French Railway Techniques* No. 2, 1970, pp51-66, 2 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-326)
DOTL RP

B8 033374
REPORT ON SOME RECENT TESTS BY THE "DIVISION DES ESSAIS DE MATERIEL OF THE S.N.C.F. 1. RAILWAY DYNAMICS SECTION (S.D.F.) 2. BRAKE TESTING SECTION (S.E.F.) 3. VITRY-SUR-SEINE TESTING STATION (S.E.V.)
Report of French rail technology including tests of braking and effects on vehicle stability, stability of an experimental gas turbine, locomotives with rubber block suspension. The second section deals with testing of braking systems of passenger and freight units. The last section reports testing of a modified suspension system, air suspension and an Eddy Current Brake.

French Railway Techniques No. 3, 1970, pp105-115

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-329)
DOTL RP

B8 033380
RAILWAY BRAKE. POSSIBILITIES OF INCREASING ITS POWER AND THEIR CONSEQUENTIAL EFFECTS
Overview of the conditions which make rail the economical transport in Europe. Recognizes the need to increase speed of passenger and freight trains to answer the increased demands. Discusses the need to develop more

efficient braking systems to permit this increase in train speeds. Suggests modifications of disc brakes, airbrakes and magnetic brakes operating with anti-skid devices to achieve increased rail speeds.

Moller, E *Rail International* July 1961, pp501-524, 8 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-338)
DOTL RP

B8 033387
THE PROBLEMS ARISING WHEN BRAKING AT PRESENT DAY SPEEDS
Discusses the basic law of braking and the ways in which it is accomplished. Further the Bozic, Knorr, Oerlikon and F.S. brake regulators, Type "M" Anti-Slip systems are discussed. The modes of operation, advantages and disadvantages are discussed also. Finally, the problems of braking systems and some of the forms suggested for high speed operation are compared.

Svagel, J (Yugoslavian Railways) *Rail International* Vol. 37 No. 7, July 1960, p569

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-347)
DOTL RP

B8 033391
DERIVATION OF INITIAL SPEEDS AND STOPPING DISTANCES FROM DECELERATION/TIME CURVES
Brake testing involves the measurement of deceleration. This can be obtained by direct means or by calculation knowing the initial speed, stopping distance, and stopping time. The method to be described involving the use of a recording decelerometer and stopwatch only gives a full assessment of the braking performance, and since no electrical or mechanical connection with the test vehicle is required has the obvious advantage of permitting tests on any brake at any time without previous preparation. Success of the method has been proved over a number of train tests where independent measurements of speed and distance have been available.

Law, J *Rail International* Vol. 38 No. 7, July 1961, pp449-453

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-352)
DOTL RP

B8 033401
HIGH SPEED RUNNING AND TRAIN SPEED CONTROL
Conventional on-tread braking equipment and operation is used up to 160 km/h (100 mph), and is based on the best possible use of available adhesion during braking. The available adhesion has restricted the average possible deceleration to 1 m/sec square (3.27 ft/sec square). Having established the minimum safe stopping distance to be within three blocks, the signaling was adapted to this operation, and cab signals were designed to give the engine men specific limits of operation.

Plaiche, M (French National Railways) *French Railway Techniques* No. 2, 1966, pp59-65

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-362)
DOTL RP

B8 033420
JNR IMPROVING METHODS OF SUPPRESSING TRAIN OPERATION ACCIDENTS
Discusses the increase of railroad accidents, the contributory factors and steps which are being taken to eliminate them. Includes the prevention of grade crossing accidents by reducing the numbers, erection of warning devices, automatic train stop system, automatic signal and relay interlock plus devices to cut off power to catenary lines when an obstruction is present.

Akashi, T (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 6 No. 2, June 1965, pp10-12

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-384)
DOTL RP

B8 033439
DISC BRAKES FOR RAILWAY VEHICLES AND THEIR LININGS
Discussion of the use of disc brakes for railroad use. A comparison of disc brakes and shoes brakes. A study of the various materials used in the construction of each and the respective advantages of disc vs shoe types is included. Recommendations in the solution of materials for the best performing disc brake are also included.

Sauthoff, F Schmidt, E (German Federal Railways) *Rail International* Vol. 38 No. 3, Mar. 1961, pp159-188, 17 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-405)
DOTL RP

B8 037205
EFFECTS ON TRAIN OPERATION OF MIXED CONSISTS OF ON-TREAD AND DISC BRAKED ROLLING STOCK--PART I [DAS ZUSAMMENWIRKEN VON VKOTZ-UND SCHEIBENGEBREMSTEN FAHRZEUGEN IN EISENBAHNZUGEN]
This article deals with the problem of attaining uniform braking power for service, sustained grade and emergency braking on mixed consists of equipment with disc and on-tread brakes. Formulae are developed and charts show the relative proportioning of braking power arrived at between disc and on-tread braked cars. The conclusions reached show that this proportioning of braking power on such mixed consists can provide up to 30 minutes of sustained braking without any difficulties for all types of braking requirements. [German]

Schmuecker, B Kolbeck, E *Eisenbahntechnische Rundschau* No. 4, Apr. 1967, pp 104-112, 4 Fig, 5 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-466)
DOTL RP

B8 037206
MINIMUM TRAIN HEADWAYS ON RAPID TRANSIT RAILWAYS WITH ADVANCED TRAIN CONTROL AND CONVENTIONAL SIGNALLING [DIE DICHTESTE ZUGFOLGE AUF STADTSCHNELLBAHNEN BEI NEUZEITLICHER ZUGSTEUERUNG UND BEI HERKOMMLICHER SIGNALISIERUNG]
This article deals with the problems of rapid transit to and from cities, both urban and interurban systems. It describes investigations into the extent to which theoretical train spacing employing "running with elastic vision" can be achieved with various signal and train-control systems. An ideal system based on headways equal to braking distance and a developed practicable system are compared with four conventional signal systems with long and short protected sections and up to three permissive follow-on signals. The comparison, supported by fully developed formulae and diagrams, shows that the time spacing between trains with a refined fixed signalling system with three follow-up signals and immediate speed control is only a few seconds longer than the practicable train control with cab signals for train spacing equal to the braking distance. With the use of more powerful locomotives, and an acceptable slight increase in journey times, the proposed 90 second interval between trains appears to be a reasonable prospect even with trains of 200 meters length. [German]

Lueddecke, C *Eisenbahntechnische Rundschau* No. 1,2, Jan. 1968, pp 29-54, 14 Fig, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-467)
DOTL RP

B8 037207
CONTINUOUS AUTOMATIC TRAIN CONTROL FOR SAFETY AND CONTROL OF RAPID TRANSIT RAILWAYS [LINIENZUGBEEINFLUSSUNG ALS MITTEL ZUR SICHERUNG UND STEUERUNG VON STADTSCHNELLBAHNEN]
The emphasis on speed with safety is a necessary consideration in the planning of any railway signaling system. This article describes a system such as used with the operation of the 200 km/h passenger trains on the German Railways. The prerequisite emphasized for properly functioning signal systems is the interdependence existing between train spacing, train length, length of the protected sections and the speed over the route. A further development of the signal system described, where command information is constantly being imparted to the train through a special communications line, is the possibility of programmed automatic operation of these trains. [German]

Koehler, EJ Kupper, D *Eisenbahntechnische Rundschau* No. 1,2, Jan. 1968, pp 15-17, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-468)
DOTL RP

B8 037233
DERAILMENT AT COTON HILL
The running away and consequent derailment of a goods train on January 11, 1965, was ascribed to driver failure to observe the instructions for descent of an incline (falling 1 in 100). The leading 22 wagons were equipped with vacuum brakes and weighed 245 tons. The other 24 wagons and brakevan were unbraked and weighed 530 tons. The 2,750 hp type 4 C-C Brush-Sulzer locomotive weighed 114 tons and was equipped with vacuum/air brake equipment. As a precautionary measure to eliminate the possibility of a complete failure of the locomotive air brakes, it was recommended that the pipe connection between the vacuum train pipe and the triple valves be duplicated as the locomotives go into shops for overhaul.

Robertson, JRH (Ministry of Transport, England) *Railway Gazette* Vol. 122 Mar. 1966, pp 207

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-928)
DOTL RP

B8 037237
DERAILMENT OF GOODS TRAIN
On September 10, 1963, the Up Dover Marine continental depot train consisting of 24 loaded continental ferry vans and a bogie brakevan weighing about 618 tons, became derailed on curved track. It was drawn by a Bo-Bo 2,500 hp electric locomotive and travelling at about 60 mile/h at the time of derailment in a valley where a long steep falling gradient changed to a steep rising gradient. The train first parted between the first and second van, but the brakes were not automatically applied on the engine. It was assumed for lack of evidence of materials failure that the parting and derailment were caused by variations in cant which helped an oscillation to develop in the play between the bodies and axles. The failure to automatically apply the engine brakes when the vacuum was severed was traced to a systems design deficiency in the air-vacuum isolating valve. It was agreed that the addition of a magnet valve connected so it was energized when the exhauster switch was at "off" and de-energized when at "on" would correct this braking system deficiency.

Reed, WP (Ministry of Transport, England) *Railway Gazette* Vol. 120 Aug. 1964, p 658

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-933)
DOTL RP

B8 037243
INDUCTIVE TRAIN COMMUNICATION TRIALS
This survey describes British Railways field experiments on a continuous cab signalling system for speed control and position monitoring. In this system, cables are laid between the rails using a small motorized trolly. Although technical feasibility was demonstrated, little progress was made with the engineering of the system. Problems yet to be solved include physical damage to the cables by platelayers and other workers and the design of a memory device for the locomotive since the cables cannot be continued through points.

Railway Gazette Vol. 121 Nov. 1965, pp 900-901, 1 Fig, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-939)
DOTL RP

B8 037252
RECENT TRENDS IN BRAKING PRACTICE
Developments in brake types and methods of control effected over the past few years are surveyed. Under the stresses imposed by new high speed (200 km/h) and heavy (up to 8500 hp) trains, tyred wheels have not demonstrated the necessary reliability and monoblock wheels do not withstand the braking heat. Disc brakes with grey cast-iron have shown promise on streamlined trains. Flat wagons are under construction in Germany wherein the disc brake is being incorporated in the wheel assembly. In Belgium and Germany successive, short interval applications of air-operated disc brakes followed by electric resistance brakes are being used on moderate speed (120 km/h) passenger trains. British Railsway liner trains have been equipped with monobloc wheels in which the wheel center forms the brake disc; however, some trouble has been encountered within the past two years speed-controlled air-electromagnetic brakes have enabled much greater deceleration on Rheingold trains (1000 m for 160 km/h) than wheel-and-rail adhesion systems permit. Track speeds of 200 km/h are possible using disc-magnetic rail systems, and the recommended 1-1/4-in. through brake pipe and double-pipe air brake system might provide the control and protection needed at this velocity.

Railway Gazette Vol. 121 June 1965, pp 498-499, 2 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-948)

B8 037257
INNOVATIONS IN CONTINENTAL BRAKING PRACTICE
The article describes the addition of a quick-action valve to the "U" graduated-release distributor as designed by the Italian Westinghouse company of Turin (Westinghouse Freni e Segnali, Cia). The quick-action feature is the distributor proper gives a rapid drop in brake-pipe pressure all down the train for emergency application, ensuring that brakes apply fully almost in accordance with the timing of the distributor. For example, on a 20-coach train travelling at 140 km/h the stopping distance without quick-action was 940 meters. With quick-action, the stopping distance was 850 meters. A comment is made to the effect that if improvements in service braking and flexibility in release are to be made, the only logical way of achieving this is to incorporate "e.p. control" (electro-pneumatic control).

Railway Gazette Vol. 118 Apr. 1963, 3 pp, 3 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-964)
DOTL RP

B8 037259
CONTROL OF RAILWAY BRAKES BY ELECTRICITY
This article surveys the field of electro-pneumatic braking systems as applied to suburban and high speed services, to ensure rapid and simultaneous operation. Consideration is given to brake systems, brake equipment (including valves and (controllers), control systems, and the future development of electro-pneumatic control by extension to main line trains. The latter may be either by providing a straight airbrake in parallel with the existing pneumatic arrangement, with control either on timing or by a code arrangement, or by using the electric control to synchronize brake pipe reduction and recharge down a train, hence reducing the time lag to apply and release the brakes.

Railway Gazette Vol. 118 Apr. 1963, pp 416-418, 3 Fig, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-966)
DOTL RP

B8 037292
A NEW BRAKE TESTING MACHINE
The Inertia Machine Mark V, which can be used for recording deceleration, torque, and friction surface temperature in one operation, is described and illustrated. The machine is capable of dealing with any of the shoe or disc brakes used on railcars, and it should eventually deal in a similar manner with brake blocks for actual wheel rim braking. The design, generally, resembles a fully floating back axle, the motor taking the place of the differential gear, and the flywheels replacing the road wheels. The brake units are mounted on a shaft coupled to a torque recording gear carried in headstocks, which may be retracted axially to remove the brake units from their drums. The machine is a double-ended one to allow two brakes to be tested simultaneously, alternately, or individually. The flywheel specifications, torque recording system, and pyrometer are briefly described.

Railway Gazette Vol. 84 June 1946, pp 684-685, 2 Fig, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1155)
DOTL RP

B8 037299
THE BRAKING OF RAILWAY VEHICLES
The factors affecting the stopping distance of freight trains are: increased length of trains; increased speed; and increased ratio of gross weight to tare. To secure 40 lb per sq. in. brake cylinder pressure on the rear car of 35-, 50-, and 70-car trains required 6.5, 10.5, and 20 sec, respectively. Increasing the

maximum speed of freight trains from 30 to 40 mph almost doubled the stopping distance. To reduce the effect of increasing the ratio of gross weight to tare two methods are suggested: 1) application of an emergency feature whereby air is dumped from the brake pipe to the atmosphere at each equipment causing rapid buildup of brake cylinder pressure, or 2) empty and load brakes procedure, by which the braking power of the loaded vehicle is increased substantially over that of the empty vehicle. The tests were conducted in Australia. Discussion of high-braking forces for high-speed passenger trains focuses on both U.S. and European efforts. Data are presented on the Zephyr showing the relationsip of different braking ratios on stopping distances.

White, J *Railway Gazette* Vol. 85 Dec. 1946, pp 114-716, 3 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1162)
DOTL RP

B8 037419
NEW BRAKE SHOE CUTS STOPPING TIME, REDUCES WEAR AND SPARKING
A new brake shoe completely interchangeable with the standard metal shoe promises better train control, increased life and almost total spark suppression. Key to the breakthrough is an alloy of iron which exhibits a vastly different metallurgical structure from that of a standard shoe. The Samson shoe reduced stopping distance 32 percent and confirmed the improvement in train handling. The Samson retained the favorable friction characteristics of the standard metal shoe at static breakaway and low speed. Comparative sparking under drag braking conditions tested with cheese cloth placed in the trajectory of sparks leaving the wheel. At 45 mph, sparks from the standard metal shoe ignited the cheesecloth in seven minutes; Samson caused no fire.

Modern Railroads May 1971, pp 49-52, 1 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-882)
DOTL RP

B8 037432
NEW CONCEPT IN BRAKES FOR BART CARS
Automatic control blends dynamic and hydraulic disc brakes for a smooth, fast non-slide stop with use of electro-hydraulic disc brakes. These operate under solid-state automatic control, which blends the hydraulic disc brake into the dynamic braking of the motors. An advantage of hydraulic brakes in their quick-acting ability to respond to the electro-hydraulic controls which detect skids and momentarily ease braking. The hydraulic disc brake linings will last 20 to 25 runs; however, when working with dynamic braking, the linings normally last longer.

Myers, ET *Modern Railroads* Dec. 1970, 1 p, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-883)
DOTL RP

B8 037469
AIR-BRAKE DEVELOPMENTS ON JAPANESE RAILWAYS
Application of self-lapping brake for the locomotive as well as the train and use of brake diaphragms in place of cylinders are discussed. The D.E. 10 General-Purpose C-B diesel-hydraulic locomotive brake system is described in some detail. The use of diaphragms instead of cylinders to operate the brake obviates air leaks, reduces linkage to a minimum, and hence lubrication, and also the need to adjust the linkage to take up brake-wear.

Kondo, K (Japanese National Railways) *Railway Gazette* Vol. 124 July 1968, pp 347-549, 4 Fig, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-819)
DOTL RP

B8 037478
COLLISION AT ST. ANNE'S PARK
A collision between two passenger trains in the Western Region of British Railways was the direct result of irregular block working on the part of the signalman at Bristol East Depot Main Line. This accident would not have occurred if full block controls including one acceptance control had been installed on the down line. This control requires the berth train circuit at the outermost stop signal to have been occupied and cleared before a second line clear can be given.

Railway Gazette Vol. 124 May 1968, p 353

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-825)
DOTL RP

B8 037586
EFFECTS ON TRAIN OPERATION OF MIXED CONSISTS OF ON-TREAD AND DISC BRAKED ROLLING STOCK-PART II
This article deals with this problem of mixed braking systems under conditions of very frequent stopping at short intervals. Formulae are developed for these conditions and charts show the results and comparisons with half, service and emergency braking from various speeds, and the heating effect on treads and wheel plates and brake discs. It is shown that mixed system braking is possible under all these conditions without overstressing the brake discs through over-heating, and that cars with different systems can be accepted in German passenger trains from other countries without affecting the operations adversely.

Schmucker, B Kolbeck, E *Eisenbahntechnische Rundschau* Vol. 16 No. 5, May 1967, pp 177-187, 9 Fig, 1 Tab, 5 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-469)
DOTL RP

B8 037590
SIGNAL TRANSMISSION FOR HIGH SPEED OPERATIONS OF 200 KM/H ON THE GERMAN RAILWAYS
For speeds of 200 KM/H improvements in braking power was not sufficient to enable stopping within a required distance. A more sophisticated system using an electronic control system was designed, which displays to the engineering the following: the permitted speed goal, the distance ahead for which the goal speed pertains up to 5000 meters, speed changes depending on conditions, and the actual speed of operation. If deceleration, in response to predicted conditions ahead, is not actuated by the engineer, the control system activates emergency brakes. A full description of this system is illustrated with diagrams and charts.

Luetgert, R *Eisenbahntechnische Rundschau* Vol. 15 No. 3, Mar. 1966, pp 69-75, 6 Fig, 6 Phot, 17 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-474)
DOTL RP

B8 037606
A METHOD FOR DETERMINING A UNIVERSAL BRAKE PIPE PRESSURE
The Central Air Brake Club proposes a method for determining a Universal Brake Pipe Pressure; taking into consideration grade braking, stopping requirements on grades, plus limitations of the shoes and wheels. The fundamental consideration is: any car should have a braking system which will allow it to safely negotiate any downgrade fully loaded, whether as a single car or in a train of similar cars with air brakes alone. An important corollary is that sufficient brake shoe friction material will always be available until the bottom of the grade or next available shoe replacement point is reached. Another corollary is that the braking duty must not be such that wheels are overworked and overheated. Finally, it must be decided what constitutes an adequate margin of retarding force above grade balancing for satisfactory stopping ability. To arrive at this, the stopping distance requirement on the grade must be known. If the grade is block signaled, this is fairly easy to determine. If the track is not block signaled, the most critical stopping requirement must be found. This might be an entrance to a yard, curve, an interlocking, unloading dock, or tipple, etc. There are two primary factors speed and weight.

pp 26-39, 1 Fig, 4 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-505)
DOTL RP

B8 037613
OPERATING TRAINS ON ELECTRIC VISION--WHY AND HOW?
The author presents the signalling system of today as an example of the way in which much of the present state of the art of the railways reflects the developments from past methods and states of the art. New techniques have been superimposed onto the old, without changing the fundamental principles. A new system is envisioned where the operations would be through constantly moving blocks, with a predetermined time interval

controlling the movement of the trains. This system is described in considerable detail, as also its advantages in congested train conditions. Complete safety of operations, including the absolute protection at railroad crossings at grade, and protection to maintenance of way workers, as well as supervision of compliance with speed restrictions, are included in the functions of this system. Economic considerations are also dealt with. The characteristics and simplicity of this system makes it suitable for application to all transportation systems, including urban rapid transit.

Lagershausen, H *Eisenbahntechnische Rundschau* Vol. 14 No. 6, June 1965, pp 221-238, 9 Fig, 6 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-514)
DOTL RP

B8 037614
USE OF COMMUNICATIONS TECHNIQUES IN A FUTURE TRAIN AND LINE SYSTEM

The task of communications techniques is not only the transmission of information from one source to the user, but also the processing of this information according to scheduled programs. In transportation safety, the initial information in the form of an oral instruction or a programmed coded order must be transmitted to the vehicle and received by it. From the communications standpoint, it is necessary to differentiate between, (1) one-way transmission from train to track or from track to train, and (2) two-way transmission between track and train. In one-way transmission from train to track, direct current circuits are generally used, together with axle counters. Two-way communication between track and train can be accomplished by superimposing both transmission directions onto a closed circuit. The planning of a linear safety system begins with the desired speed-related headway interval. Three safety systems are described and the economics of expenditures on train and track are discussed with particular reference to the wide variety of signalling tasks on the one hand, and the relationship between the length of line and the quantity of rolling stock on the other. The article describes a digital system, with specially simple vehicle equipment, designed for underground railways.

Fricke, H Form, P *Eisenbahntechnische Rundschau* Vol. 14 No. 6, June 1965, pp 140-262, 35 Fig, 8 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-515)
DOTL RP

B8 037624
ADVANTAGES OF HYDRAULIC BUFFERS

The hydraulic buffer automatically produces a steady retarding force of such a value that, whatever the speed of impact, the wagon is brought to rest as the buffer-stroke is completed. These buffers also produce a very low recoil. Hydraulic buffers make it possible for the safe speed of impact, to be raised from something over 4 mph to nearly 10 mph. Present-day marshalling yards already work with impact speeds of 10-12 mph and a survey carried out at one hump yard showed that 4 percent of impacts were at speeds of more than 10 mph. Hydraulic buffers also have a part to play in the reduction of shock in trains fitted with continuous brakes.

Railway Gazette Vol. 106 Feb. 1957, pp 180-181

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-526)
DOTL RP

B8 037633
PROTOTYPE AUTOMATIC COUPLER FOR BRITISH RAILWAYS

The prototype A.S.F./v automatic coupler was designed for use on high-speed freight trains. The unit is one of the first to be equipped with either an automatic vacuum or air connector. The present prototype of the coupler is designed to take a drawbar pull of 40,000 lb. but it will be tested with a load of 140 tons giving a safety factor of approximately eight to one. This second prototype has, a greater range of buffer height and incorporates the hydraulic draft gear as an alternative to the rubber gear fitted to the first unit.

Railway Gazette Vol. 106 May 1957, pp 625-628, 1 Fig, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-535)
DOTL RP

B8 037671
DISC BRAKES IN THE U.S.A.

In 1948 the Union Pacific Railraod decided to use disc brakes in new stock. When the first disc-braked cars were put in service, they were mixed with cars equipped with clasp brakes. Trains composed exclusively of cars with disc brakes were assembled. The results have been a reduction in noise and in jolting when trains are being stopped. Thermal cracking of wheel tires has been virtually eliminated. Certain interesting cost figures have been got out comparing the use of clasp and disc brakes on one of the trains over a 12-month period. The cast-iron tread shoes of the clasp brakes required renewal after every round trip of 4,598 miles, 73 changes of shoes thus being made during the year; the disc brake shoes ran an average of 90,000 miles each, and so required an average of 3.73 changes only. Over a full year, the renewals of short clasp brakes cost a total of $48,865.60 and of the long type $65,045.26, whereas the corresponding expenditure for Budd disc brake renewals was $7,221.48.

Railway Gazette Vol. 108 June 1958, pp 677-678

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-584)
DOTL RP

B8 037676
FRICTION MATERIALS FOR RAILWAY BRAKING

The Ferodo composition brake block is compared to cast iron brake blocks. The braking characteristics are shown for the average of 20 stops using emergency brake applications of a train travelling 50 mph. The deceleration time for the Ferodo brake was greater than the cast iron brake, but the stopping distance was less. A composition brake block is less abrasive to the wheel than a cast iron block, and the product of wear less harmful. Although the Ferodo block still wears more rapidly than the wheel, its life has been found to be equal to as many as five cast iron blocks in some instances. Flange profiles are shown comparing the two types of brake blocks as to flange wear.

Pritchard, C (Ferodo Limited) *Railway Gazette* Vol. 108 Feb. 1958, pp 250-252, 3 Fig, 3 Phot, 3 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-589)
DOTL RP

B8 037726
AUTOMATIC DIESEL LOCOMOTIVE OPERATIONS ON THE L&N

The drawbar pull on the longer and heavier trains has prompted several railroads to look into different types of operations using automatically controlled locomotives to relieve the drawbar tension. The L&N used a General Railway Signal (GRS) control system with an L&N Unit No. 830, 1500 horsepower EMD F7A locomotive for demonstration. The basis for the GRS control system is a force-velocity determinant, a product of which is correlated to demand horsepower. The parameters are derived by strain gauges on the coupler shank to define the force, and an axle-drive alternator for defining velocity. L&N's experiences with this prototype system are comprehensively reviewed.

Holderfield, HC (Louisville & Nashville Railroad)
Symington Wayne Corporation Tech Proc Sept. 1965, pp 58-63, 4 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-727)
DOTL RP

B8 037742
SIMULATION OF OPTIMUM TRAIN OPERATION

The author discusses the concept and development of computer simulation models to study vital issues and policies which would affect the entire railroad network. The issues for which it is hoped models can be developed, include train lengths, scheduling and blocking.

Eberhardt, JS (Burlington Lines) *Engineering and Operations Interface* Tech Proc Sept. 1967, pp 18-22, 10 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-741)
DOTL RP

B8 037750
ELECTRONIC SURVEILLANCE AND CONTROL SYSTEM FOR ADVANCED TRAIN OPERATION
The "ESACS" concept started as a relatively small advancement in the form of an improvement in automatic couplers. Some means of reducing the complexity of the electric couplers of the MU car type was needed. It became apparent that once a communication means with the capacity to handle hundreds of bits of information in either direction was installed on a train, so as to connect all cars, a great many things could be achieved in the form of surveillance and control with benefits in operation, car utilization, lading damage control, safety and performance. Efforts at developing this system are presented.

Cope, GW *Engineering and Operations Interface* Tech Proc Sept. 1967, pp 59-68, 13 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-749)
DOTL RP

B8 037767
A NEW BRAKE SYSTEM FOR DIESEL LOCOMOTIVES
The vacuum brake system is particularly suitable for diesel locomotives where the problem of finding room for orthodox brake cylinders is difficult. It is designed to give augmented locomotive brake power by taking advantage of an increase of cylinder vacuum at the moment of brake application without interference with the normal working vacuum throughout the train. A two-pipe driver's valve is used, which isolates the exhauster side of the system before admitting air to the train pipe. Both vertical and horizontal types are available with pull or push action. The new cylinders are so designed that the driver can manipulate the brakes separately on locomotive and train, or both simultaneously.

Railway Gazette Vol. 103 Aug. 1955, pp 243, 2 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-777)
DOTL RP

B8 037775
ELECTRONIC CONTROL OF SPIN AND SLIDE
Viewed as control problems wheel-spin and wheel-slide are identical. Therefore a common electronic detection circuit can be used to trigger electrical and mechanical corrective devices such as air-brake dump valves. Rapid restoration of traction or braking torque as the wheel recovers can be achieved electronically by a flywheel circuit which anticipates slightly the return to full adhesion. A block diagram of the system is shown.

Crawford, KDE (Westinghouse Brake & Signal Co. Ltd.) *Railway Gazette International* Apr. 1971, pp 140-142, 2 Fig, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-787)
DOTL RP

B8 037783
CONFINES OF BRAKING--1
Factors reducing braking rates below the limit imposed by adhesion between wheel and rail are discussed. Braking efficiency can be related to adhesion, but only when the braking is straight line from moment of application to standstill. This is never so in practice, and the braking efficiency can therefore be considered only as an average ratio, and not the adhesion value which is the limit in maximum braking. No braking starts at the maximum rate instantaneously, nor does it usually carry on to a stop at the maximum rate. The reasons are regard for passenger comfort and the speed of equipment response. Manufacturing inaccuracies and maintenance problems which cause differences in brake cylinder air pressure are mentioned.

Broadbent, HR *Railway Gazette* Vol. 97 Oct. 1952, pp 488-489, 5 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-798)
DOTL RP

B8 037784
CONFINES OF BRAKING--2
Characteristics in service of electro-pneumatic brakes and calculation of brake rigging efficiency are discussed. If I.P. feed valves are used, a variation in setting can also produce variations in the rate of rise of brake cylinder air. Differences in brake cylinder stroke can also cause considerable variations in rates of rise. A record of an emergency stop is shown where the brake cylinder air has been controlled by a retarder, blow-down valve, and additional relay vent valve. The restrictions which can cause variations in rate of feed through triple valves appear with an E.P. brake in other places, in, for instance, the variation in lift of an application valve.

Broadbent, HR *Railway Gazette* Vol. 97 Nov. 1952, pp 514-515, 4 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-799)
DOTL RP

B8 037785
CONFINES OF BRAKING--3
The factors considered are the brake block itself, and the various conditions of control between wheel tire and block. The variations in braking which occur through the mutual contact of wheel tire and block are as follows: variation of the coefficient of friction of a brake block with speed; block friction and applied force, block friction and tire temperature; block friction and weather; and effect of wheel diameter with drum, disc, and dynamic braking. These effects are briefly described.

Broadbent, HR *Railway Gazette* Vol. 97 Nov. 1952, pp 546-547, 3 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-800)
DOTL RP

B8 037786
CONFINES OF BRAKING--4
Braking force can be no higher than the co-efficient of friction between wheel and rail will allow. Various factors affecting the friction between the wheels and rail are discussed, such as, variation in passenger loading, weight transfer, deposits on the rail, effect of speed, mutual wheel/rail contact, gradients, winds, and frictional resistance of the train.

Broadbent, HR *Railway Gazette* Vol. 97 Nov. 1952, pp 570-571, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-801)
DOTL RP

B8 037787
CONFINES OF BRAKING--5
This article discusses the economics of brake systems, especially that extras costs in changes should bring about greater safety, train handling improvement and easier maintenance. Factors of higher speeds, increased loading as reflected in higher air pressure requirements, problems of brake block and wheel temperatures, as well as increased stresses in the components are considered. Increased wear in brake blocks and wheels can result either in higher costs or spatial limitations for the hardware necessary to perform the tasks.

Broadbent, HR *Railway Gazette* Vol. 97 Dec. 1952, p 627

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-802)
DOTL RP

B8 037798
HYDRODYNAMIC BRAKES ON DIESEL-HYDRAULICS
The hydrodynamic brake, which has been applied to diesel electric locomotives, also has been applied to small rail car transmission and gas turbine trains in Europe. The cooling equipment of diesel power plants is not present in gas turbine but with the use of oil air cooling equipment modified for the hydrodynamic brake, the braking power is equivalent to that developed by the turbine.

Railway Gazette Vol. 126 Mar. 1970, pp 172-175, 4 Fig, 4 Tab, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-839)
DOTL RP

B8 037799
BRAKES FOR HIGH SPEED TRAINS
The article gives the background in need for improved brake blocks for trains when speed exceeds 160 km/h. The traditional cast iron block is reliable and simple but the material creates problems at higher speeds. The major problem in selecting braking systems is complicated by the dependence upon adhesion which decreases with speed increase. Cast iron brakes are not suitable for high speed operation therefore either composition blocks or disc brakes are more effective on nonpowered axles as is the rheostatic brake for powered axles.

Wise, S (British Railways Board) *Railway Gazette* Vol. 126 Mar. 1970, pp 169-171, 1 Tab, 3 Phot, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-840)
DOTL RP

B8 037828
SIMPLE VIGILANCE AND DEADMAN DEVICE
Current requirements for checking the vigilance of the driver and safeguarding operation, if this falls below an accepted standard, make it clear that two safeguard functions are essential: to provide an effective deadman operation, and to check constantly that the driver is alert. Very recently a completely fresh design approach was made to the way the equipment can be made to fulfill the operating requirements and which lends itself to a much cheaper first cost, a very great reduction in maintenance, and is readily adaptable to fitting to locomotives without or with deadman equipment. The approach has been to provide a completely electronic unit incorporating relatively recently devised equipment, the metallised polycarbonate capacitor which has an infinitely small leakage characteristic and is used as the delay element, and the uni-junction transister which fires off the circuit operation when the voltage in the capacitor reaches a predetermined value. Incorporation of safety and vigilance cycles into the one control circuit provides a compact and straightforward arrangement which does not require the driver to choose between two courses of action to prevent a brake application once he hears the bell.

Railway Gazette Vol. 123 Aug. 1967, pp 626-628, 9 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-910)
DOTL RP

B8 037831
ITALIAN U-TYPE AIR-BRAKE DISTRIBUTOR
Thousands of Italian Westinghouse brake distributors of U and U-R types are now in use on the Italian State Railways (F.S.) and other systems. An advantage of the basic U distributor is the time delay of 30 sec in the re-opening of the control reservoir after the end of a brake release. This permits the re-charging of the system in full release position of the brake valve for a longer time than permitted by other distributors. It also provides a positive security against exhaustion of the brake. The U-R distributor is in use only on passenger stock, for it is only in these vehicles that the brake cylinder filling time need be as low as 4 to 5 sec.

Railway Gazette Vol. 123 Feb. 1967, pp 110-111, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-915)
DOTL RP

B8 037835
HYDRODYNAMIC BRAKING FOR LOCOMOTIVES
Dynamic braking has one feature in common with the normal air or vacuum brakes. The limit of its force is dependent on the adhesion between a steel wheel and a steel rail. However, with dynamic braking there is no possibility of slide; over-braking dynamically produces a reverse slip, which is much less damaging to wheels, rails and braking elements. A very detailed description of this type of brake is provided, covering such topics as cooling factors, braking efforts and ranges, decelerating characteristics, driving technique and air control.

Railway Gazette Vol. 122 Oct. 1966, pp 837-42, 8 Fig, 1 Tab, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-919)
DOTL RP

B8 037851
AUTOMATIC COUPLERS AND COMPRESSED-AIR BRAKES
The article deals with automatic couplers and compressed-air brakes. Inherent advantages are cited for automatic couplers along with refinements for the future automatic coupler. The Unicupler (developed for the Russian S.A. 3 type) and the Fischer coupler designs are discussed as examples of couplers meeting U.I.C. the International Union of Railways specifications. Coupling problems are considered and the importance of practical testing and experimentation stressed. Air brakes, electrically-controlled brakes, and coupling connections are commented on relative to coupler design considerations. Finally, capital expenditure is discussed along with economics affected.

Bulleid, OVS *Railway Gazette* Vol. 118 Apr. 1963, pp 469-472, 2 Tab, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-963)
DOTL RP

B8 037857
AUTOMATIC REGULATION OF TRAIN SPEED
Successful trials on the Belgian National Railways of an inductive control system are reported. Signal aspects are displayed in the driving cab. Transmission of information from the track to the locomotive is carried out by a pair of inductors between the rails, each of which contains a coil of litz wire tuned by a capacitor. Beneath the locomotive there are two detectors. The input and output of a wide-band amplifier are connected to the loops. The effect of an inductor on the track beneath a detector is to couple the two loops by a link having a resonant frequency between 50 and 100 kc/s, and the amplifier will then generate a signal of the same frequency as the inductor. Inductors may be tuned to 15 different frequencies in this range so that a large variety of information can be transmitted to the locomotive as compared with electro-magnetic systems.

Railway Gazette Vol. 121 Mar. 1965, 4 pp, 3 Fig, 7 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-993)
DOTL RP

B8 037860
BRAKING OF HEAVY TRAINS
Trends in dealing with formations up to 14,000-tons with proposals for 22,000-tons freight and mineral trains are discussed. Air braking as applied to very heavy and very long trains is of two types. On the Vitoria a Minas line in Brazil the specifications are all based on AAR practice. For the proposed 22,000-ton trains of the future, the present idea is to insert a special brake van with diesel-powered compressors and other air-brake details to which more rapid filling at the back end of the train after the full release, which is all that is possible with direct-release brakes. All the other examples quoted have graduated-release brakes of Knorr KE type, because only with an inexhaustible graduated application and graduated-release brake is it possible to have full control over a train at all times.

Railway Gazette Vol. 121 Apr. 1965, p 275

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-996)
DOTL RP

B8 037866
FREIGHT CAR BRAKE RIGGINGS
The design of the rigging influences the maximum brake effect, and the stretching and deformation of the brake rods, levers, and associated parts unfavourably influence the piston travel. The U.S. type of freight car bogie truck, due to its two independent side frames, has a great disadvantage regarding braking technique. On European cars, clasp brakes are used, whereby the axle is not influenced by the brake shoe thrust. The problem of play in joints in the single show type of brake is illustrated. The clasp brake system and a diagram of the eccentric force by rods from the body in the U.S. type bogie are also shown.

Rihosek, J *Railway Gazette* Vol. 71 Sept. 1939, pp 319-320, 3 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1047)
DOTL RP

B8 037876
RAIL BRAKES FOR SHUNTING YARDS
The Marchais brake is hydraulically operated, and the braking effort is made proportional to the weight of the cars. The construction, principles of action and control system for the Marchais rail brake are shown. This braking system has been installed at the Rennes yard of the French National Railways.

Railway Gazette Vol. 76 Apr. 1942, p 432, 3 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1056)
DOTL RP

B8 037915
NEW DEVELOPMENTS IN AIR BRAKES
The article surveys a number of recent improvements in brake equipment and associated pneumatic controls. The D22 special control valve design differs from the "universal" control valve in that the air is governed by a relay valve. A device called the Decelostat momentarily reduces braking force on slippery wheels permitting them to return to train speed. Hot-box detectors utilizing the Wheatstone bridge principle provide warning when overheating is imminent. A new type of driver's brake valve (No. 24) incorporates five sections to suit various requirements for freight and passenger service. A new variable-load brake has been designed for light-weight wagons. A brake-cylinder release valve device isolates reservoirs and vents the brake cylinder when the "bleed" valve is pulled, thus permitting the shunter to pass from one vehicle to the next without waiting.

Stewart, CD (Westinghouse Air Brake Company) *Railway Gazette* Vol. 87 Aug. 1947, pp 126-127, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1107)
DOTL RP

B8 037920
THE WESTINGHOUSE EMPTY AND LOAD BRAKE
This article contains excerpts from a technical paper on specially designed compressed-air brakes. The Westinghouse company devised this system in which the simple "straight" air brake is superimposed on the automatic air brake, which thereupon functions as an emergency brake. This arrangement has the advantage of retaining the automatic brake in fully-charged condition, ready for use if needed, so that there is no danger of a train getting out of control. Methods of arranging the brake components on freight and on passenger vehicles are given in the original paper.

Fawcett, B *Railway Gazette* Vol. 87 Sept. 1947, p 312

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1112)
DOTL RP

B8 037922
THE PROPORTIONING OF BRAKE BLOCKS
Excerpts are presented from an article dealing with the temperature effects produced between two sliding bodies. The investigation had two main aspects: first, the development of a satisfactory method of measuring the surface temperatures and, second, the application of this method to actual railway brake blocks in a full-scale series of tests. In applying the apparatus to the measurement of surface temperatures of a railway tyre, the aim of the experiment was to correlate the results obtained with three variables: speed, block pressure, and contact area. It was found that in all the tests contact area was very small and moved along longitudinal strips parallel to the width of the block. Working on the assumption that contact area should be a function of block material and block pressure, and should thus vary with the ratio of block length to block width, the authors began the most striking part of their research. A block was progressively shortened to give three-quarters, one-half, and one-quarter the original area. Blocks of type 1 and type 2 were used, as well as cast iron, at initial speeds of 60 and 30 m.p.h. and a brake block pressure of 1,240 lb. The result was an astonishing decrease of temperature maxima for both the non-metallic blocks, although there was no such decrease in the cast-iron blocks. Contact areas in the nonmetallic blocks now covered the full tyre width, instead of being confined to narrow longitudinal strips. Measurements of wear show that the normal and half-blocks wear at exactly the same rate. Since cracking of the tyre is known to arise from the true heat spots, it can be taken that by reducing brake block areas from the present standard size, in the case on non-metallic materials, the liability to the formation of cracks is minimized and the life of tyres can thus be greatly increased.

Parker, RC Marshall, PR (Ferodo Limited) *Railway Gazette* Vol. 87 Nov. 1947, pp 546-547

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1114)
DOTL RP

B8 037931
RHEOSTATIC AND REGENERATIVE BRAKING--1
A five-part series is presented that discussed various aspects of rheostatic and regenerative braking. Information is included on main lines with long and steep gradients, equipment for three-phase and single-phase systems, applications with compounds and series d.c. motors, principles of the metadyne for motor control and regeneration, and, the acceptance of regenerated power at substations with rotary and static rectifying equipment. This document, 1125, contains the complete series of articles and this subject, beginning on April 23, 1948, p. 488 of the Railway Gazette, and continuing through the June 18, (p. 716) September 10, (p 296) December 3, (p. 636) and December 31 issues.

Prigmore, BJ *Railway Gazette* Vol. 88 1948, 6 pp, 11 Fig, 1 Phot, 16 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1125)
DOTL RP

B8 037961
MINISTRY OF TRANSPORT ACCIDENT REPORT
An accident which occurred in Glasgow on November 14, 1951 is reported. The train went out of control on a down gradient, which averages 1 in 43, and collided with eleven empty passenger cars travelling through a scissors crossover. There were several injuries and extensive damage. The runaway was due to vacuum brake failure. Details of the investigation are reported.

Langley, CA (Ministry of Transport, England) *Railway Gazette* Vol. 97 Aug. 1952, pp 191-192, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1267)
DOTL RP

B8 037970
PROBLEMS IN RUNNING BRAKED AND UNBRAKED TRAINS
Acknowledgment is made of a paper presented at a technical meeting in 1944 on brake equipment and tests. This is an account of the highly specialized equipment that was developed by the Westinghouse Brake and Signal Co., Ltd., to provide a complete braking installation capable of dealing with every kind of service demand.

Railway Gazette Vol. 80 June 1944, pp 588-589

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1303)
DOTL RP

B8 037988
FACING POINT LOCKING
A paper by O.S. Nock on facing point protection presented to the Institute of Railway Signal Engineers on Feb. 4, 1959, is summarized. The question how far one should go in applying supplementary precautions against irregular movement of power points by using local track locking and/or revised circuit arrangements, designed to give greater security against the effect of faults, is discussed. It is determined that facing points must be made as safe as the latest techniques can make them.

Nock, OS *Railway Gazette* Vol. 110 Feb. 1959, p 176

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1408)
DOTL RP

B8 037992
FRICTIONAL BRAKING BUFFER STOPS
Braking buffer stops with fractional retarding action, widely used on the Continent, have been tested in South Wales. There are three principle types of Rawie buffer stop in use but each can be modified or supplemented by altering or adding components, as conditions may render advisable. The simplest is the rail brake design. In this, friction grips, or clamps, provided with bronze inserts, are bolted to the rail head in such a manner as to give the desired brake power in tons.

Railway Gazette Vol. 110 Apr. 1959, pp 479-480, 3 Tab, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1412)
DOTL RP

B8 039203
DEVELOPMENT OF NONFRICTION BRAKING SYSTEMS FOR HIGH SPEED TRAINS
Performance potential and approximate cost estimate for three nonfriction braking systems are obtained. The systems are: the air retarder, the hydraulic retarder, and aerodynamic braking. It is shown that the air retarder and the hydraulic retarder have potential to develop full braking deceleration in a

speed range from 250 MPH to 25 MPH. Because of its advantage over the hydraulic retarder in system weight, simplicity and cost, it is recommended that development of the air retarder be undertaken. Aerodynamic braking deceleration is highly dependent on projected braking area. Maximum frontal envelope considered was car frontal area plus an area enclosed by car width and extending three ft. above the roof. For this area, most of the energy of a 250 MPH train can be absorbed by aerodynamic braking. At speeds below 100 MPH (very approximately) aerodynamic braking must be supplemented by friction braking to obtain sufficient deceleration rates. Existing aerodynamic test data for longitudinally spaced braking surfaces are not sufficient to obtain accurate predictions of the friction braking crossover point and the aerodynamic braking deceleration rate. Therefore a wind tunnel test program is recommended. The report includes an extensive bibliography and references covering related aerodynamic material. (Author)

Cassidy, RJ Pleuthner, RL Schenkel, FK
Cornell Aeronautical Laboratory Final Rpt CAL-YM-2811-K-3, Apr. 1970, 204 pp

Contract DOT-FR-9-0040

ACKNOWLEDGMENT: NTIS (PB-192454)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-192454, DOTL NTIS

B8 039305
DETECTORS FOR ACCIDENT PREVENTION
For dragging equipment detection, a series of brittle, cast-iron loops are mounted between and outside the rails, just below standard clearnace for rolling stock. Hanging parts break one or more of the detector loops and these being connected in a detector circuit de-energise a relay and operate warning devices. A device that automatically detects broken wheel flanges as well as wheels that are loose on the axle, while wagons are in motion, is described. The hot box detector has proved that the principles employed have been most successful in detecting hot axleboxes. The equipment was designed by a firm who are manufacturers of infra-red control systems.

Railway Gazette Vol. 111 Oct. 1959, pp 241-242, 1 Fig, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1421)
DOTL RP

B8 039313
MOTIVE POWER FOR HIGH SPEEDS
This article traces the growth of high speed operation engineering and planning on the German Railways from 1903. Projected plans call for even heavier and higher speed units of motive power, with 25 ton axle load and capable of 300 km/h. Further developments are in progress in motive power elements, as the asynchronous motor drive. Similar progress is evidenced in the application of computer techniques to train control and operation. The demands for faster travel speeds are being constantly considered by the German Federal Railway.

Kuckuck, R Niekamp, K (Hauptverwaltung der Deutschen Bundesbahn)
Die Bundesbahn No. 7/8, July 1971, pp 339-343, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1429)
DOTL RP

B8 039319
FIRST MAIN-LINE DIESEL-HYDRAULIC LOCOMOTIVE FOR BRITISH RAILWAYS
The first diesel-hydraulic main-line locomotive ordered under the British Railways modernization plan has been completed. The power rating is 2,000 hp and the wheel arrangement A1A-A1A incorporates two 12 cylinder diesel engines each set to 1,100 hp. The engines, transmissions, trucks, brake system, and drive controls are described. Exterior dimensions ares hown. Safety features include warning lights provided at each engine position and a general warning light which shows the driver if a fault has developed. Failure of air pressure or vacuum prevents the engine being used to drive the locomotive.

Railway Gazette Vol. 108 Feb. 1958, pp 221-223, 1 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1481)
DOTL RP

B8 039343
UTILIZATION OF ENERGY LOST IN BRAKING [ISPOLZOVANIE ENERGII, POGASHAEMOI V TORMOZAKY]
The paper describes a 'recuperative' brake system, so-called because energy derived from braking is retained to assist subsequent acceleration. Such a device lends itself well to vehicles making frequent stops and starts like buses. In a test vehicle using a recuperative brake system, acceleration to 19 miles per hour was achieved with only half the fuel normally required. (Author)

Trans. of Avtomobilni Transport (USSR) n7 p35-36 1971, by Trombley.

Atoyan, K Gulia, N Vfelesyana, L Nagornysk, G
Army Foreign Science and Technology Center, (FSTC-T7023012301) FSTC-HT-23-968-72, Apr. 1972, 9p

ACKNOWLEDGMENT: NTIS (AD-745798)
PURCHASE FROM: NTIS Repr PC, Microfiche
AD-745798, DOTL NTIS

B8 039406
STUDY OF LIGHTER BRAKE SLIPPER
This document discusses the need for new materials to be used in the construction of brake slippers. The use of epoxy and fiberglass has not been successful in prototype construction. Future design should also include the incorporation of light, resistant steel and composites used in brake shoes.

Question D91. Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Report ORE Pub-23,29, 4 pp, 3 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-655)
DOTL RP

B8 039412
COMPOSITION BRAKE BLOCKS
The research question is a determination of the limits of brake heeating applied to wheelsets with shrunk on tires. The limits were determined by measuring the time of constant braking before the tire loosened on the wheel. As a result, the shrinkage allowance for shrunk on wheels should be placed at a high value and brake blocks used with such wheels should be selected for good thermal conductivity.

Question B64. Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways No. 29, ORE Pub-29, July 1969, pp 13-15, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-661)
DOTL RP

B8 039414
TRANSMISSION OF INFORMATION THROUGH THE AUTOMATIC COUPLER
This report discusses future developments in automatic coupling and uncoupling of trains. With the advent of fully automatic couplers, it is hoped that the following will be possible: the automatic connection of air pipes for controlling and operating brakes; a collector line connection to transmit electrical current to heat cars and to feed other electrical units; the connection of a central-current supply line to transmit central orders, for data transmission-reception and for train separation signals; and connection of a line for currents carrying data between the locomotive and train.

Question A103. Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways ORE Pub-28, Jan. 1969, pp 31-32

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-663)
DOTL RP

B8 039438
INSTRUCTIONS FOR DYNAMIC BRAKING WITH DIESEL UNITS HAVING 6-WHEEL TRUCKS TO AVOID DERAILMENTS
This document consists of operational instructions for operation of dynamic brakes for diesel locomotives. Included are instructions for the placement of units which do not have alignment control couplers and the maximum number of locomotive units or traction motors in any consist. As a result of these instructions, no derailments have occurred which are attributed to the use of dynamic braking.

Unpublished Report.
Hastings, DC
Seaboard Coast Line Railroad Dec. 1970, 3 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-692)
DOTL RP

B8 039462
A GENERALIZED SPECIFICATION FOR COMPOSITION BRAKE BLOCKS FOR RAILWAY VEHICLES
The braking of railway vehicles may be improved technically and economically by a direct replacement of cast iron brake blocks by blocks of a composite material of the correct design and functional characteristic. Numerous available composite materials can introduce large savings due to their good wearing properties when compared to cast iron. As a result of excessive heat dissipation rates and thermal shock, rolling stock wheel treads can be seriously overstressed at the higher operating speeds by blocks of incorrect friction characteristic and physical design. This paper deals with the definition of the physical requirements related to the design of composition brake blocks for railway vehicles, and motivates a generalized specification for the performance characteristic.

Barnard, JH *Rail International* Oct. 1970, pp 694-703, 3 Fig, 2 Tab, 4 Phot, 6 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-757)
DOTL RP

B8 039470
DETONATOR OF OPTIMUM AUDIBILITY AND SAFETY
This report is the result of an ORE inquiry into the uses of detonators as signalling devices. Other types of devices are suggested which could replace or supplement detonators. The report concludes by suggesting that torches should be used which burn long enough and bright enough to be seen while other means of protection can be explored.

Question B63 Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Report ORE Pub-21, July 1965, p 24

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-789)
DOTL RP

B8 039475
ADHESION AND FRICTION IN RAIL TRACTION
For dry rails, a coefficient of adhesion of 0.25 may be assumed for speeds up to 40-50 m.p.h. At higher speeds, however, there is less information to draw on. Above the 40-50 m.p.h. range, the dependence of adhesion on speed introduces a bend into the curve connecting speed and power output. For wet rails, the coefficient of adhesion is reduced to about 0.6 of the value determined for dry rails. Of the many variables encountered in brake-block friction, there is abundant evidence of the dependence of coefficient of friction on speed and brake-block pressure. Substances should be saught for blocks for which the coefficient of friction is less affected by speed than in the case of cast iron; the effect would be to allow acceptable braking distances without having to use high braking ratios, so that a reduction in the weight of brake gear could be contemplated.

Koffman, J *Railway Gazette* Vol. 89 Oct. 1948, p 484

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-807)
DOTL RP

B8 039482
LOAD-COMPENSATING FREIGHT BRAKES
A variable-capacity brake is required, which automatically compensates for increase in loading. This new equipment uses a double brake-cylinder arrangement to provide a maximum braking force of 60 percent for the empty vehicle, a maximum braking force for fully loaded vehicle, of 20-30 percent, and some intermediate figure for vehicles partly loaded. The mechanism for setting the car braking ratio must be automatic. Setting must take place when the car is stationary. On the engine manual adjustment is needed, as there is no simple means for registering on the locomotive the load of the cars.

Stewart, CD (Westinghouse Air Brake Company) *Railway Gazette* Vol. 82 May 1945, p 513

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-814)
DOTL RP

B8 039494
WARNING DEVICES OTHER THAN DETONATORS
Luminous torches for signalling used in Europe and Japan were tested as a part of the task of Specialist Commitee B92. Work is now directed toward warning devices with a range of 2-3 km. A Hertzian torch, which is a transmitter, would emit radio warning signals to a receiving device to be installed in every motive power unit. Another solution would be the installation of transmission and reception devices on the motive power units, connected by inductive coupling through conductors along the railway track. This method is especially advantageous in tunnnels and hilly terrain. Cost comparisons are being made.

Question B92. Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways ORE Pub-24, Jan. 1967, p 45

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-959)
DOTL RP

B8 039510
AUTOMATIC-PNEUMATIC COUPLING FOR INCREASED UTILIZATION
The Automatic Pneumatic Coupling System design by Dresser Transportation Equipment is described and illustrated. The system consists of a train line connector for making the physical connection between car ends; valves to control the air; and, a means to initiate the coupling and intentional uncoupling of air and to sense unintentional uncoupling. The system is compatible with knuckle couplers already in service. Field tests were scheduled for 1970.

Technical Proceedings from 1969 Railroad Engineering Conference.

Punwani, SK
Dresser Transportation Equipment Division Tech Proc Sept. 1969, pp 56-59, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1012)
DOTL RP

B8 039517
DEVELOPMENT IN FULLY AUTOMATIC COUPLERS AND POTENTIAL ON AUTOMATED FREIGHT TRAINS
The automatic coupling system developed by Symington Wayne for subway and rapid transit cars is illustrated and described. This equipment manufacturer is now considering the design of an automatic coupling system for freight trains.

Technical Proceedings from 1964 Railroad Engineering Conference.

Cope, GW
Symington Wayne Corporation Tech Proc Sept. 1964, pp 24-30, 1 Fig, 9 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1029)
DOTL RP

B8 039539
THE AUTOMATIC COUPLER
The conversion of existing cars to automatic couplers is discussed. The various operations for replacing the couplers are shown. A brief report is made on the testing of 300 of the couplers. Five series of tests were made in the climatization chamber of the Vienna Arsenal Federal Research Institute. Field tests were also conducted under severe climatic conditions. The pipe joints were not capable of coping with the extremely low temperatures. A 100-axle freight train was tested during the summer, to determine the effects of longitudinal play between the couplers on ride quality. Four cars in the middle of the train derailed during emergency braking from 10 km/h.

Question B51. Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways ORE Pub-25, July 1967, pp 15-18, 7 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1120)
DOTL RP

B8 039590
DYNAMIC BRAKING
In the light of 60-70 percent brake wear reduction by the use of dynamic braking with American diesel-electric locomotives, it was recommended that dynamic braking systems be considered for the British railways: electric-some form of power brakes; steam-Riggenbach brakes, diesel- exhaust brake on railcars plus dynamic brakes on locomotives, gas-turbine-feed current to dynamic and thence to brake compressor, and turbo-mechanical-brake compressor driven by separate turbine on hot side of power turbine.

Railway Gazette Vol. 95 Sept. 1951, p 311

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1238)
DOTL RP

B8 039631
CONTINUOUS MEASUREMENT AND CONTROL OF THE SPEED OF WAGONS SHUNTED OVER HUMPS
The classical automatic marshalling yard with retarders, weigh rails, wagon rollability measurement, doppler radar speed measurement computers, etc. falls short of what is required. Six new systems being developed in Europe are briefly described. These systems will be evaluated by comparing the following quantities: installation costs, system capacity, annual maintenance costs, and shortcomings.
Question D74.

International Union of Railways ORE Publ 23, July 1966, pp 18-19, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1318)
DOTL RP

B8 039651
SPACE-INTERVAL DRIVER'S VIGILANCE DEVICE
The Swiss-developed safety control apparatus operates on a distance interval, and therefore gives the same factor of safety irrespective of the locomotive speed, whereas the more common system based on a time interval does not achieve this feature. The effect of the new apparatus is basically the same as the previous systems, i.e., following the incapacity for duty of the driver, a warning is sounded in the cab and if no action is taken by the driver the traction motors are switched off and the brakes applied. A diagram showing the mechanical and electrical circuits of the safety device is given. Also shown is part of a diagram of the run-down on the safety apparatus expressed in locomotive miles travelled.

Railway Gazette Vol. 103 Sept. 1955, pp 333-334, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1347)
DOTL RP

B8 039669
BRAKING PRACTICE AND DEVELOPMENTS
The article describes features which are standardized and in widespread use by British Railways and certain designs still under investigation. The object was to provide a picture of developments taking place in the country for the non-expert in matters of braking. Elementary considerations of energy absorbtion and the forces acting on a wheel during braking, followed by a concise statement of the limiting factors involved are considered.

Railway Gazette Vol. 112 Jan. 1960, pp 96-97

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1385)
DOTL RP

B8 039798
AUTOMATIC CHECK SYSTEM OF THE MOBILE STATION FOR THE NEW TOKAIDO RADIO TELEPHONE
The concept of developing automatic inspecting equipment and method devised to automate the check-up of the radio stations are described. Features of layout of equipment mounted on a train for the train radio telephony of the New Tokaido Line and outline diagram of automatic check-up device for mobile station.

Baba, T *Japanese Railway Engineering* Vol. 12 No. 1, 1971, pp 13-18

ACKNOWLEDGMENT: EI (EI 72 50728)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

B8 039856
SIGNALS AND OPERATING RULES AS CASUAL FACTORS IN TRAIN ACCIDENTS
Railroad signal systems, even though performing as designed, do not compensate for human failure and prevent accidents. Many collisions attributable to negligence of employees result from lack of compliance with operating rules which do not relate compatibly with the signal systems. A relationship is developed between signal systems, operating rules, and the human element that is responsive to both. Specific cases are cited in which the discrepancies are exposed and examined within the context of the foregoing. Recommendations are directed to the Federal Railroad Administration that they take steps under the increased scope of authority of the Federal Railroad Safety Act of 1970, to develop a comprehensive program for future requirements in signal systems and operating rules that will reduce or eliminate the present ambiguities and lax, ill-defined operating rules.

National Transportation Safety Board Spec Study NTSB-RSS-71-3, Dec. 1971, 16p

ACKNOWLEDGMENT: NTIS (PB-206407)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-206407, DOTL NTIS

B8 039916
ELECTRONIC SURVEILLANCE AND CONTROL SYSTEM
This article discusses the application of the ESACS system to train operation. The system is a technique for encoding or connecting analog or switch position data over two wires to a second location where the data is decoded and displayed. The elements of the system, costs, and maintenance are described as well as the benefits.
Proceedings of 1968 Railroad Engineering Conference.

Spaulding GB *Car Design Inputs* Proceeding Sept. 1968, pp 39-42, 5 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1022)

B8 039928
AN UNUSUAL AMERICAN ACCIDENT
The highlights of a train accident which occurred at Washington Union Station are reported. This train the "Federal" express composed of 16 coaches, entered the station out of control and collided with the buffer-stops at 35 mph. As a result, the train broke through into the main concourse of the station, demolishing the stationmaster's office and a bookstall, and was prevented from continuing into the main waiting room only by the collapse of the concourse floor. The accident was caused by the angle cock of the compressed air brake connection between the third and fourth coaches having been turned almost completely off.

Railway Gazette Vol. 98 Apr. 1953, p 389, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1181)
DOTL RP

B8 039946
ELECTRO-PNEUMATIC BRAKE
The article compares two forms of the electro-pneumatic brake in laboratory tests and in field tests. The two forms of braking system consist of the automatic system with 2 brake pipes; and the direct acting system with a single 1-1/4 inch brake pipe. Tests showed both systems were equal in operation, but the direct system requires a circuit check for safe operation whereas the indirect is not dependent upon electronics but brake pipe pressure. Findings show both systems superior in operational ease to the pneumatic system in use.
Question B 83 Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Rpt ORE Publ No. 21,26, 4 pp, 2 Fig, 1 Phot, 2 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1324)
DOTL RP

B8 039953
BRITISH RAILWAYS DECISION ON BRAKES
After extensive research and practical trials the British Transport Commission adopted as standard the vacuum type of automatic brake. Although the time needed to couple up and to create the vacuum will mean that a made-up

train will stand longer in the yard than with the present standard coupling for goods vehicles, this disadvantage is believed to be more than offset by the faster running time which will result from fitting throughout. The substitution, by new construction and conversion, of a fully-braked fleet of wagons will enable freight trains to run at maximum speeds of up to 60 mph. The higher average speeds of train movement will lead to reduction of about 2,000 locomotives and will enable the total wagon stock to be reduced.

Railway Gazette Vol. 104 Apr. 1956, pp 152-153

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1362)
DOTL RP

B8 039957
SPEED AND BRAKE APPLICATION RECORDER
A speed and brake application recorder, the R 1038 tachograph has been designed for records of speed and brake application against a distance base in the critical period immediately preceding any accident or incident in which locomotives or railcars may be involved. A self-erasing recording disc provides, on a large scale, records of speed and brake applications against a distance base of 1,820, 910, or 450 yd. only, all records previous to the selected distance being automatically erased. The disc may be removed to provide evidence and a spare disc fitted without upsetting the calibration in any way.

Railway Gazette Vol. 104 June 1956, pp 475-476, 1 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1368)
DOTL RP

B8 039959
BRAKING SYSTEMS
After discussing the advantages and disadvantages of the vacuum and the air brake it is concluded that they balance, except the delay of release with the vacuum. Members of the brake industry have undertaken much research into the vacuum brake, and in its latest form, with improved brake cylinders and valves. There seems little doubt that for all freight trains of the length likely to be practicable in this country, taking into consideration yard capacity and loading gauge, it answers well. The faster running possible with a fitted train will more than recoup the greater time required for starting by the vacuum brake.

Railway Gazette Vol. 105 July 1956, p 4

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1370)
DOTL RP

B8 039965
DUAL AIR BRAKE SYSTEM
The Westinghouse Brake and Signal Company, Ltd. has developed a simple dual brake system, which is claimed to represent an advancement in modern vehicle braking technique. The provision of independence peneumatic storage and control for front and rear brake systems ensures that, in the event of any part of one system being rendered inoperative, braking is obtained from the unaffected system. A typical layout is shown in which a common air compressor, controlled by a single unloader and safety valve, supplies air to two main reservoirs; each of these provides independent, air storage for one part of the dual system, and is isolated from the other by inclusion of check valves in the supply from the compressor. The supply and release of air from the reservoirs to the piston type brake cylinders' or diaphragm brake chambers is by means of a lightweight dual control valve.

Railway Gazette Vol. 105 Nov. 1956, p 555 1 Fi, g, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1376)
DOTL RP

B8 039991
LATERAL FORCES ON TRACK AND EQUIPMENT DUE TO DYNAMIC BRAKING ON THE SOUTHERN PACIFIC LINES
This report embraces a description and analysis of data secured during the operation of regular scheduled freight trains on the Southern Pacific Company between Roseville, California and Sparks, Nevada. The purpose of the investigation was to determine the coupler forces and resulting lateral forces exerted on the rails by the passage of an 85 ft. car coupled to a short car in a train with the locomotive using dynamic braking while operating on steep grades and curves up to 10 deg. During the investigation, data were secured on coupler and car angles, lateral and vertical truck forces and longitudinal acceleration of the 85 ft. car with the train operating at various speeds. The analysis of data contained in this report may be summarized as follows: 1. The steady or longitudinal coupler forces for both pull and push conditions, as expected, are in proportion to the weight of that portion of the train behind the point of measurement. The compressive coupler forces were reduced considerably when the train air line pressure was reduced with the locomotive under dynamic braking on the descending grades. 2. The coupler angles are in direct proportion to the track curvature with the values obtained under the pulling condition slightly greater than those under the pushing condition. 3. The data indicate there is a linear relationship between the track curvature or coupler angle and the lateral truck forces acting on the rail. 4. The occurrence of slack action was rather infrequent due to the long and almost continuous grades for but some coupler forces as large as 90,000 lb were obtained by an application of the dynamic brakes which permitted the slack to run-in. 5. The sprung weight of the 85 ft. car was subjected to longitudinal accelerations as large as 2.2 g but there does not appear to be any direct relationship between the direction and magnitude of this acceleration with respect to the direction and magnitude of the slack action coupler force.

Schinke Aggarwal
Association of American Railroads Technical Center ER-69, Oct. 1966, 30 pp, 9 Fig, 4 Tab, 3 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1456)
DOTL RP

B8 040006
MATERIAL CHARACTERISTICS OF RAILWAY BRAKE DISCS OF VARIOUS IRON-CARBON ALLOYS
The results are described of tests and investigations carried out in the Research Station of the Bergische Steel Industry in Remscheid, on various iron-carbon and steel alloy materials for use in disc brakes on railway vehicles. While chrome-molybdenum steel alloy castings showed some desirable characteristics under repeated heatings, the pearlitic cast iron with lamellar graphitic inclusions showed greater resistance to fine hair line cracking. The group of malleable, ductile and pearlitic cast irons appeared to develop relatively few cracks, up to 6 mm depth and widely dispersed, while the cast steels with no or little alloys sustained many short cracks only 1.2 mm deep. There remains the need for further research for combinations of materials that will withstand better the high and repeated high temperature shocks to which brake discs are subjected. [German]

Zeuner, H *Eisenbahntechnische Rundschau* Vol. 13 No. 7,8, Aug. 1964, pp 349-354, 10 Fig, 1 Tab, 12 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1489)
DOTL RP

B8 040008
REPORT OF BOARD OF INQUIRY ON ACCIDENT AT COLISEUM STATION, BAY AREA RAPID TRANSIT DISTRICT, SAN FRANCISCO, CALIFORNIA
The accident occurred during test operations at the Coliseum Station on November 2, 1971, when a BART vehicle travelling about 25 MPH, collided with the rear car of a parked BART train. The train operator was injured. The accident, which occurred in manual mode, underscores the wisdom of the early planning decisions to design the BART system on the most fully automatic basis possible. Such a collision will be very unlikely once the automatic system is in operation because of the basic fail-safe design. Despite the speed of impact, there was little damage beyond the bulk heads of the attendant's compartments in the impacting cars. The accident was attributed to human failure to apply the brakes in sufficient time or at a sufficient rate to effect the stop.

Stokes, BR
Bay Area Rapid Transit District 19 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1491)
DOTL RP

B8 040010
THE RAIL MOTOR-BRAKE
Achieving train speeds of 300 to 400 KMH are discussed. Over 200 km/h no conventional technical solution is suitable as to the fundamental aspects

of traction, and mainly the braking. The rail would become an integral part of the electric motor, propulsion and braking systems regenerating linearly, rapidly and indefinitely under the field part of the motor, of which it becomes, electrically, the armature. The motor or braking effort, the system being reversible, hence are produced between the rail head, wherein flows induced currents producing the effort. A magnetic core, provided with windings, constitutes this part of the motor which provides the inductor field necessary for propulsion, asynchronous sliding field, by its feed with variable frequency, polyphase, alternating current. This motive power unit would employ classical railway, yet would be independent of traction adhesion and braking limits.

French Rail News No. 4, 1968, pp 58-59, 1 Fig, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1493)
DOTL RP

B8 040014
THE EVOLUTION OF BRAKING FOR FAST TRAINS IN RELATION TO THE RISE IN SPEED

The cast iron brake block can be retained up to 200 km/h by a suitable arrangement of the signalling. In the field of the very high speeds, 250/300 km/h, it is necessary to resort to the combined systems. The test results of the electromagnetic brake up to 270 kmh are shown. Due to the frequent need for braking in high speed travel electrical control of braking will necessarily replace air brakes. A combined disc-cast iron block brake system was tested at 250 km/h and results are discussed. Hydraulic brakes and Foucault current brakes are considered.

French Rail News Vol. 2 1970, pp 22-24, 5 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1497)
DOTL RP

B8 040019
OPERATING CONDITIONS OF TURBINE ENGINE: CONTROL, REGULATION, PROTECTION

Systems for adapting an aircraft-type turbine engine to the Very High Speed Set are discussed. The design of the regulating and driving assemblies are to be as simple as practicable. The regulating system for the gas turbine and the fuel supply system are illustrated. The fault indicator signals and the fire detection and extinction methods are described.

Amet (French National Railways) *French Railway Techniques* No. 2, 1967, pp 91-96, 6 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1502)
DOTL RP

B8 040025
INFLUENCE OF TRAIN HANDLING ON DERAILMENT TENDENCY

Test runs were made with an instrumented 4-axle EMD model GP-35 locomotive and a 50-ft. box car as base test units. Subsequent tests were made with 6-axle EMD model SD-45 locomotive and a 50-ft. box car and tests were then made between Los Angeles and Pine Bluff with the EMD Model SD-45 and an 85-ft. TFC flat car. Dynamic brake tests were run using the instrumented EMD SD-45 unit and the SP dynamometer car. A comparison of results of these tests with those from AAR tests in 1966 shows much higher buff force was attained in current tests than with the three Alco 623 locomotives. There were a number of occasions where steady state L/V ratio approached or exceeded 0.82 which predicts impending wheel lift. Although maintenance of alignment control features on locomotive couplers will serve to prevent excessive lateral force and rail climbing by diesel locomotives, the increase in dynamic braking power above that afforded by 24 axles does not appear feasible on mountain grades. As a result of several derailments of unexplained cause, a task force investigate the dynamic forces exerted by locomotive and freight car wheels against the rail.

Wagner, TB (Southern Pacific Company) Conf Paper 9 pp, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1508)
DOTL RP

B8 040035
SIGNALLING ON A MODERN RAILWAY SYSTEM

Signalling techniques on the railways have progressed through the manual block system to the Centralized Traffic Control, where the movement of trains is controlled from a central headquarters, with the track display of a district and the appertaining switch and signal actuating equipment located in the usual desk arrangement, observed and operated manually. Interlocking of crossings at grade are included in this system. The longer braking distances resulting from the 200 km/h and more operation presently necessitate modification of this system to include continuous automatic train control, which can be projected ultimately to automatic train operation and travelling on instrument vision. This article describes the use of computers for this type of control of trains. The computers are presently used for indirect control of train movements through existing signal equipment. The problems of extending this system to direct control of train movements are under consideration. The question whether the direct control of trains is possible or economical without local interlocking frames is at present unresolved. [German]

Ernst, W *Eisenbahntechnische Rundschau* Vol. 20 No. 1,2, Feb. 1971, pp 21-27, 7 Phot, 9 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1518)
DOTL RP

B8 040050
A COMPUTER SIMULATION OF CTC RAILROAD OPERATIONS

A computer program is shown for determining the most economic number and locations of signalled sidings which will adequately handle the current and anticipated traffic. The computer technique enables the Transportation Department to evaluate various siding configurations easily and quickly and to compare alternatives quantitatively.

Hudson, CJ (Canadian National Railways)
American Society of Mechanical Engineers 8 pp, 7 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1533)
DOTL RP

B8 040053
PERFORMANCE OF FREIGHT CAR BRAKE REGULATORS DURING STATIC AND DYNAMIC CONDITIONS

The continued observation of improper brake piston travel on freight cars equipped with automatic brake regulators prompted an investigation of factors affecting the operation of these devices. Tests made statically and dynamically showed a marked difference in performance of regulators. The factors surrounding this problem and the effect on train braking are discussed. Selected for the test were representative cars of a large group of covered hopper cars. These 2929 cu ft 100-ton cars are virtually identical, having 12 in. by 10 in. brake cylinders, cast iron shoes and four types of brake regulators. Conclusions would include: brake regulators do not adjust for false or running piston travel, improvements of rigging efficiency will yield more uniform piston travel, lower leverage ratios make piston travel variation less susceptible to rigging dynamics and stretch; piston travel increases with speed of train regardless of cylinder pressures; vibration or impacts caused by rough track or train slack action appear to have no effect on operation of the brake regulator after the unit locks up and although greater than nominal piston travel occurs on cars at speed, the brakes still retain effective stopping ability.

Mc Lean, LA Mims, WE (Seaboard Coast Line Railroad)
American Society of Mechanical Engineers Conf Paper 68-WA/RR-4, Dec. 1968, 16 pp, 12 Fig, 2 Phot, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1536)
DOTL RP

B8 040054
DEVELOPMENT OF HYDROPNEUMATIC BRAKING SYSTEM FOR RAIL VEHICLES

The operation of a hydropneumatic booster with two-stage pressure development and automatic double-acting slack adjustment features two distinct types of brake cylinders including a mechanical locking safety feature, and hand-brake controls to allow manual pressurization of the system and control of the mechanical cylinder locks is described. Production of the three types of hardware followed the study for a brake system that would solve the problems of larger and heavier cars, longer and faster trains, and rising maintenance costs. The various features of the brake system are illustrated. The results of limited testing are reported.

Contributed by the Railroad Division of the ASME at the Winter Annual

Meeting November 16-20, 1969 Los Angeles California
Engle, TH (New York Air Brake Company)
American Society of Mechanical Engineers Conf Paper 69-WA/RR8, Nov. 1969, 12 pp, 16 Fig, 12 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1537)
DOTL RP

B8 040055
BRAKING HIGH-SPEED FREIGHT TRAINS AND EFFECTS ON RAILROAD CAPACITY

The effect of improving freight train braking levels is to increase railroad capacity by allowing higher speeds with heavier cars within present or specific signal spacings. Freight train braking abilities can be improved 20 to 30 percent by equipping cars with WABCOPAC truck-contained foundation brake equipment and by converting existing cars to the use of COBRA high-friction composition brake shoes. Combining these two improvements give improved train braking abilities from 30 to 50 percent which will allow speeds to be increased from approximately 10 to 20 mph within existing signal spacings. Establishing a basically higher loaded-car braking level some 50-70 percent higher than the existing minimum with a load-sensitive brake equipment would allow raising the maximum speed, based on braking considerations only, close to 100 mph within signal spacing now suitable for 65 to 70 mph. Freight train braking abilities can be improved 10 to 30 percent by adding modern-design continuous quick service valves to all freight cars.

Contributed by the Railroad Division of the ASME at the Winter Annual Meeting and Energy Systems Exposition Pittsburgh Pennsylvania, November 12-17, 1967

Blaine, DG (Westinghouse Air Brake Company)
American Society of Mechanical Engineers Conf Paper 67-WA/RR-7, Nov. 1967, 16 pp, 14 Fig, 4 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1538)
DOTL RP

B8 040083
CARRIAGE AND RAILCAR BOGIES: THEIR DESIGN AND DEVELOPMENT–IV

Design factors considered in this part include brake ratios; axle fatigue; adhesion, and P.D. More effective braking will require ratios 1:1.5 to 2.2 of the tare weight, cut back to 0.8 at lower speeds. A routine method of axle fatigue calculation indicating the influence of such design variables as fillet radii, type of vehicle, speeds, whether four-wheeler or bogie, and so on, relating to dynamic load allowance and other factors is long overdue. Adhesion improvement through truck linkage to the body at low level requires care that bogie pitching will not cause high stress peaks at the kingpin or cause intense shuttle of the body.

Koffman, JL (British Railways) *Railway Gazette* Vol. 115 Aug. 1961, pp 216-218, 4 Fig, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1579)
DOTL RP

B8 040130
DERAILMENT DETECTION SYSTEM

The application of a Servo Rail Detector to cars which carry hazardous materials will cause the brakes to be applied immediately if any of the wheels of the car become derailed. This will bring the train to a stop and greatly reduce the possibility of a catastrophic accident. Each truck of a car has a sensor mounted near each wheel. The sensors are narrower than the width of the wheel. A nickel cadmium battery and wheel-driven alternator provide power for the system. The system will not interfere with or be interfered by signal or communications systems. It will operate over a temperature range of-40 degrees to 160 degrees F., and will operate for 7 days on battery power without car moving.

Company Report

Ray, RL Lockwood, RA
Servo Corporation of America SCA-P6411, 7 pp, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1630)
DOTL RP

B8 040131
SERVO RAIL DETECTIVE-DERAILMENT DETECTION SYSTEM

This proposal for the development of a derailment detection system was submitted to the Chicago Transit Authority. The planned system meets an urgent need for a reliable, low-cost derailment detection system for rapid transit service. The general operating characteristics of the proposed system are described.

Company Report

Weinstein, M Westover, T
Servo Corporation of America SCA-P-6249-1R, June 1969, 20 pp, 3 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1631)
DOTL RP

B8 040141
THE PROBLEMS OF TRACKWAY AND SIGNAL TECHNIQUES FOR RAIL

The problems relating to high speed travel are outlined. For speeds up to 250 km/h, the conventional form of track structure, with ties on the ballasted road bed, will suffice, using the presently available equipment and motive power systems. The following improvements in the present rail permanent way are suggested for attaining the full benefit in travel time reduction from the high speed operation: strengthening the present track structure system; improving the soil foundation under the track structure; improving the track with consideration for the centrifugal forces of vehicles on curves; elimination of close track spacing; elimination of railway road crossings; and equipping the high speed sections with continuous train control. [German]

Kuemmell, KF *Eisenbahntechnische Rundschau* Vol. 17 N No. 2, Dec. 1968, pp 506-512, 3 Fig, 1 Tab, 6 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1641)
DOTL RP

B8 040147
SAFETY AND RELIABILITY OF COMPUTER-CONTROLLED RAILWAY OPERATION

The application of computer techniques to the problem of handling train movements is discussed. All phases of such a system and its workability are investigated for safety and reliability. The chances of an erroneous output from the computer that could affect a train movement are computed to be extremely small. The duplex computer system provides a method of safeguarding against a failure in the output. The conclusions reached in all questions relating to this possible means of controlling train operations gives the go ahead for computer-controlled railway train operation. [German]

Delpy, A Suwe, KH (Bundesbahn-Zentralamt, Minden) *Eisenbahntechnische Rundschau* Vol. 18 No. 10, Oct. 1969, pp 386-395, 8 Fig, 14 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1646)
DOTL RP

B8 040148
STUDIES ON INTERVAL DISTANCE BRAKING WITH PRIMARY AND SECONDARY RETARDERS IN THE HUMP INSTALLATIONS IN TRAIN YARDS

One important problem of the automation of train hump yards is the automatic control of the speed of all cars in the distribution track zone between the hump and the last of the distribution switches. The results of the studies of this problem are described, which the Swiss Federal Railways researched with the aid of their Computer-Program. The basic observations of the free-running of cars in the distribution zone were considered, which required the distinction between "free-rollers" and "hard-rollers". To equalize this situation, the "hard-rollers" required acceleration and the "free-rollers" required deceleration or braking. In addition, the basic considerations of braking in the distribution zone required studies to attain the desired speed interval braking of the various types of rolling cars. A detailed description of the programmed braking is given, as well as its application to these hump yard operations. [German]

Koenig, H (Bauabteilung der Generaldirektion derr SBB) *Eisenbahntechnische Rundschau* Vol. 19 N No. -2, Feb. 1970, pp 13-20, 3 Fig, 2 Tab, 6 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1648)
DOTL RP

B8 040156
THE EFFECT OF BRAKE SHOE ACTION ON THERMAL CRACKING AND ON FAILURE OF WROUGHT STEEL RAILWAY CAR WHEELS
Laboratory test were made on 369 wrought steel railway car wheels. Two types of tests were performed: the wheels were stopped from high speed by using high brake shoe pressure, and the wheels were tested under long-continued applications of the brake shoes. The stop tests were intended to produce thermal cracks in the wheel treads. The long-continued brake shoe applications were intended to produce fractures through the rims and plates of the wheels. In both types of tests the conditions imposed on the wheels were more severe than the wheels should receive in normal railway operation. The studies of the effect of carbon content of the wheel material, various methods of heat treatment, and changes in wheel design, together with a qualitative analysis of the stresses developed in the wheels are presented.

Wetenkamp, HR Sidebottom, OM Schrader, HJ
Illinois University No. 387, Bulletin Series 387, 101 pp, 18 Fig, 25 Tab, 24 Phot, 2 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1674)
DOTL RP

B8 040192
SD-45 LOCOMOTIVE DYNAMIC BRAKE TRAIN HANDLING TESTS ON PENNSYLVANIA RAILROAD
Because of a major derailment near Johnstown, Pa., a series of dynamics brake handling tests were conducted between Harrisburgh and Pittsburgh, on severe grades and curves. The trains in which the test unit and the adjacent long overhang boxcar operated were varied in nature, ranging from tonnage trains while operating in a two-unit consist to trailer trains and PR trains in four-and eight-unit consists. In general, with the loaded long overhang boxcar leading the train, the records indicate that at no time did the danger of derailing due to drawbar forces exist. No instances in the entire test program exhibited lateral force levels which would be of concern with respect to derailment. The boxcar was loaded with freight during all of the tests.

Klinke, WR Buesing, EJ
General Motors Corporation Test Rpt 898-68-132, Aug. 1967, 76 pp, 39 Fig, 1 Tab, 8 Phot, 7 Ref, 2 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1627)
DOTL RP

B8 040205
THE CONTRIBUTION OF SIGNALLING TECHNIQUES
Since the braking distance for the 200 Km/h trains is 2200 m for emergency and 3500 m for service brake applications, additional changes in signalling systems are necessary. The lengthening of the signal blocks is neither appropriate nor desirable to accommodate all kinds of trains. The alternate was the development of the continuous train control system. The effective distance between blocks is lengthened for the high speed trains, by changing the intervening blocks to display caution, whereby the affected train must reduce its speed to 160 Km/h. The control system provides automatic control of the high speed train by binary coded information which is transmitted through a separate signal communication line to the locomotive. Signal messages can be transmitted over the same frequency back to the control headquarters. The technical processes of this interchange of information and the manner of control of the train through the programmed cab signals and information and the automatic operation of the locomotive controls are described in detail. [German]

Koeth, W Wolf, O (Bundesbahnzentralamt Munchen) *Eisenbahntechnische Rundschall* Vol. 17 No. 12, Dec. 1968, pp 533-539, 8 Fig, 1 Tab, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1664)
DOTL RP

B8 040212
REPORT OF COMMITTEE ON BRAKES AND BRAKE EQUIPMENT
A total of 21 agenda items and 5 exhibits are published as part of this Annual Report to the committee members. Topics include brake cylinders, hoses, and shoes, hand brakes, brake-testing racks, valves, and a braking ratio for frieght cars.

Association of American Railroads Annual Rpt CIRCULAR NO DV-1749, May 1971, pp 25, 4 Fig, 8 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1675)
DOTL RP

B8 040228
DISTANCE FOR BRAKE RECOVERY OF WET AND ICED SHOES
Four types of brake shoes were tested with clasp brakes and a standard Cobra Shoe was tested in a single brake. The shoes tested with the clasp brakes were: standard Cobra, special Cobra V-132-B, standard Comet, and standard metal. The results are presented graphically.

Erie Mining Company Feb. 1960, 2 pp, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1692)
DOTL RP

B8 040236
STATIC HOLDING FORCE-COMPOSITION VS IRON BRAKE SHOES
The brake cylinder pressure is plotted versus the drawbar pull for composition shoes and cast iron shoes. Clasp brakes were used.

Abex Corporation 1 pp, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1700)
DOTL RP

B8 040247
BRAKING OF HIGH SPEED PASSENGER TRAINS
It was concluded from a study of braking practices on high speed passenger trains that a rather serious situation prevails relating to the braking; there are disturbing situations prevailing regarding: (a) Combinations of high speed and pressures; (b) Brake-shoe efficiency and endurance; (c) Stress and temperature created in shoes and wheels; (d) Design of brake-shoe rigging best adapted to such service; (e) Braking ratios and brake-shoe pressures.
Only conclusions page present. Confidential Report.

Association of American Railroads AAR MR-7, Feb. 1936, 2 pp, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1711)
DOTL RP

B8 040248
ROAD TESTS WITH TYPE AB FREIGHT BRAKE EQUIPMENT--CHAPTER VII GENERAL SUMMARY AND CONCLUSIONS
Demonstration tests of the "AB" freight brake equipment are summarized. This series of tests was made for the purpose of (1) checking the operation of the new "AB" equipment with the operation of the "FC-3A" equipment as developed during the American Railway Association tests on the Southern Pacific Lines in Oregon; (2) investigation the operation of the new "AB" equipment with trains containing both empty and loaded cars; (3) investigating the effect of the "AB" equipment when operated in trains composed of both "AB" and "K" equipments, and (4) determining whether the "AB" equipment would meet road conditions safely in service. Sixty-one tests consisting of 234 trials were made during the demonstration tests. The different types of trains tested included "AB" equipment trains of all empty cars, mixed loaded and empty car trains, all loaded car trains, and also mixed "K" and "AB" equipment trains of all empty cars. In conclusion it may be stated that the "AB" equipment would meet road conditions safely in service.

Association of American Railroads Rpt AAR MR-193, 4 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1712)
DOTL RP

B8 040309
USE OF DYNAMIC BRAKES
Instructions are given to update previous methods for use of dynamic brakes, handling engines dead in tow, making up of multiple engine consists and backing up and pusher movements.
Unpublished Communications.

Hastings, DC Dec. 1970, 3 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1790)
DOTL RP

B8 040320
LOCOMOTIVE WHEEL-TO-RAIL TRACTION
It is shown (on the basis of laboratory data) that the low values of locomotive wheel-to-rail traction caused by contaminants can be increased and stabilized under both driving and braking conditions by the application of a high-frequency (HF) induction-coupled air plasma torch to each rail ahead of the lead drive wheel. Descriptions are given of experiments to investigate friction effects of RF ionized gases, corona discharge, an acetylene torch, a do argon plasma torch, and an HF induction-coupled air plasma torch. The plasma torch has given a two to three-fold friction increase under laboratory conditions, even with oiled surfaces.

Albachten, HT (Stanford Research Institute)
American Society of Mechanical Engineers Nov. 1966, 9 pp, 6 Fig, 5 Tab, 6 Phot, 11 Ref, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1824)
DOTL RP

B8 040399
BRAKE-SHOES MADE FROM SYNTHETIC MATERIALS--REPORT OF ENQUIRY
An enquiry was made to member organizations to gather information on the interest in and experience with the use of non-metallic brake blocks for railway brakes. Information was also sought from the literature on this subject. The interest in non-metallic brake blocks is very great, and it seems that there introduction may result in economical advantages, no steps of any importance have so far been taken for the drawing-up, on an international level, of specifications for these brake blocks. Only a few organizations have gained sufficient experience of many years standing or have introduced these brake blocks on any appreciable scale.

Summary and conclusions. Question B64 Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Feb. 1963, 3 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1862)
DOTL RP

B8 040400
COMPOSITION BRAKE BLOCKS--COMPARATIVE TESTS ON THE TESTING PLANT
This report contains the results of braking tests from speeds of up to 160 km/h to a stop, and continuous braking tests at about 60 km/h. These were made employing 15 different existing types of composition brake blocks, on the brake block testing plant of the SNCF. The various types of brake blocks investigated had coefficients of friction remarkably similar both in character and magnitude. At the moment of coming to rest, the percentage increases in the instantaneous coefficient of friction is up to one tenth of that when braking is affected with cast iron blocks.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Intrm Rpt. B64/RP 1/E, June 1965, 16 pp, 7 Fig., Tabs., Apps.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1863)
PURCHASE FROM: UIC Repr. PC
DOTL RP

B8 040401
COMPOSITION BRAKE BLOCKS--INTERACTION BETWEEN COMPOSITION BRAKE BLOCKS AND WHEELS
The service tests with various makes of K-block on the Berliner S-Bahn are described. The object of the tests was to study the interaction of the two friction elements, block/wheel. Although a strong tendency for the formation of cracks in wheel tires had occasionally been observed with K-blocks, in the service tests such a tendency could not be detected. All the stages of grooving and follow-wear were present on the tires. Similar phenomena had been observed by the SNCF on suburban services. Experience gained by the DB showed that some difficulty arose due to metallic particles sometimes becoming embedded in the braking surface of the block. K-blocks were used extensively on the London Transport Underground lines. Thermal cracking, tire spalling and wear constituted a special problem on the frequently-stopping motor coaches with heavily-loaded small diameter wheels, running in tube tunnels. The performance of a K-block depended on various parameters: characteristics of the block and of the wheel steel, application conditions, service conditions, weather, and shape of block. The development of a universal K-block would be difficult.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Intrm Rpt. B64/RP 2/E, Mar. 1967, 62 pp, Figs., Phots., 8 App.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1864)
PURCHASE FROM: UIC Repr. PC
DOTL RP

B8 040402
COMPOSITION BRAKE-BLOCKS-EFFECTS ON ADHESION
The effects of composition brake blocks on adhesion were investigated by the DB. The measurements were analyzed statistically and the results plotted in the form of curves. Generally, lower adhesion values were ascertained when braking with K blocks than when using cast-iron blocks. As such an effect is only acceptable if it is small, severe testing is, in this respect, considered to be necessary when submitting K blocks to acceptance tests.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B64/RP 3/E, Nov. 1967, 14 pp, 32 Fig., 55 Ref.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1865)
PURCHASE FROM: UIC Repr. PC
DOTL RP

B8 040403
COMPOSITION BRAKE-BLOCKS-EFFECTS OF HUMIDITY ON BRAKING
Tests carried out by the SNCF, to determine the effects of humidity on braking; were made with 20 different types of existing composition brake-block. On the test rig at Vitry, braking tests were made from speeds of up to 160 km/h to a stop, and continuous braking tests were made with single cars at about 60 km/h. In service, fly-shunting tests at speeds of up to 140 km/h were made. The brake-block wear was not measured during the tests on wet rails. The similarity of the curves obtained with the different makes of block on dry wheels was not repeated on wet wheels. It would seem that not all the blocks have been designed and manufactured with the same object of obtaining satisfactory performances under wet conditions.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B64/RP 4/E, Apr. 1968, 16 pp, Figs., Tabs., Phots.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1866)
PURCHASE FROM: UIC Repr. PC
DOTL RP

B8 040405
COMPOSITION BRAKE-BLOCKS. EFFECTS OF ICE AND SNOW
The effect of winter conditions on the braking distance proved to be considerable. Using the results of all the tests undertaken in winter with composition brake-shoes it was calculated that the braking distances in winter were on average 36% longer than in summer. The great amount of humidity due to the melting of the snow and the ice probably contributed considerably to the increase in the braking distances. With one type of composition brake-shoes, the braking distances were, on the whole, shorter in the winter tests than in the summer tests. This might have been due to the effect of the temperature on the coefficient of friction with these types of brake-shoes. The braking distances obtained with the low-friction brake-shoes were in certain instances more than 100% longer than those obtained during the summer tests, because of the effect of the snow and ice adhering to the blocks. Since only a small number of preliminary-braking tests were carried out it is not possible to deduce from the results any valid conclusions concerning the effect of preliminary braking.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B64/RP 7/E, Apr. 1970, 12 pp, 38 Fig., 3 App.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1868)
PURCHASE FROM: UIC Repr. PC
DOTL RP

B8 040478
COMMUNICATION DEVELOPMENTS IN THE RAILWAY INDUSTRY
Communications systems in use in 1969 by Dutch, German, Swiss, French, and British railways are discussed. British systems favor inductive and direct contact systems, whereby the other railways studied preferred radio communication. Radio offers the greater amount of flexibility, which makes it attractive for a transportation system.

O'Farrell, MA (London Transport Board) *Railway Division Journal* Vol. 1 No. t 2, 1970, pp 148-172, 13 Fig, 9 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1952)
DOTL RP

B8 040487
AUTOMATIC TRAIN OPERATION ON LONDON TRANSPORT RAILWAYS
The paper reviews some experiences with the original trains and equipment and describes changes incorporated in the Victoria Line equipment. London Transport expects to obtain the following advantages and benefits from their system of automatic train operation: regularity of service due to the consistent driving technique; minimizing of energy consumption; proper observations of speed restrictions; possibility of making up time and closing up the service by selective elimination of coasting; opportunity of introducing one-man operation.

Maxwell, WW Ware, DK (London Transport Railways) *Institution of Locomotive Engineers Journal* Vol. 56 No. 6, Paper No. 686, pp 593-612, 7 Fig, 4 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1961)
DOTL RP

B8 040488
THE CHANGEOVER FROM VACUUM TO AIR BRAKES ON BRITISH RAILWAYS
Vacuum and air brake characteristics are compared, both for passenger and freight trains. Propagation rates are examined. Other topic include: brake release characteristics; brake pipe leakage, air brake development outside England, UIC conditions for braking, and features of graduated release distributors on modern air brakes.

Roberts, HP (British Railways Board) *Institution of Locomotive Engineers Journal* Vol. 56 No. 1, Paper No. 678, pp 8-36, 14 Fig, 1 Tab, 4 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1965)
DOTL RP

B8 040492
DEVELOPMENT OF THE DISC BRAKE WITH PARTICULAR REFERENCE TO BRITISH RAILWAYS APPLICATION
The development of disc brakes for passenger vehicles for British Railways is reviewed. In the last year a brake has been developed for service up to 125 mph incorporating wheel cheek discs and lightweight cylinders. A 12-car train has now been built and is also fitted with a new design of electronic Wheel Slide Prevention equipment. This is completely self-contained in two units, one fitted to the axlebox and containing the sensing and control modules, the other comprising a pneumatic valve fitting in the adjacent bogie pipe work. No external electrical supply is needed and no wiring is used other than a flexible cable joining the two units. Design trends are now towards one cylinder for each brake. To reduce costs, light pressed steel cylinders, mass produced for road vehicles are being introduced. This paper describes in some detail the design and operation of some disc brake installations within the period 1954-1968.

Tompkin, JB (Railway Products, Gibling Limited) *Institution of Locomotive Engineers Journal* Vol. 59 No. 1, Paper No. 714, pp 84-117, 31 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1972)
DOTL RP

B8 040497
AUTOMATIC WHEELSLIP CONTROL
The principles involved in wheelslip control are outlined and then are applied to control for diesel-electric and electric locomotives. The voltage distribution across the motors during wheelslip is shown, as are the dynamic adhesion characteristics according to the hook up of the motors. Proper use of automatic wheelslip control devices permit a locomotive to be worked right up to the limit of adhesion.

Lucas, HW Wojtas, B *Institution of Locomotive Engineers Journal* Vol. 56 No. 313, Part 5, pp 442-495, 26 Fig, 8 Ref, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1981)
DOTL RP

B8 040504
RHEOSTATIC BRAKING WITHOUT MOTORING ALL AXLES
The power circuits for the system are shown. The detailed sequence of events during a stop using rheostatic braking is as follows: A command is received to brake at one of the specified rates (1.5, 2.1, or 2.6 mph p.s.), both electro-pneumatic and rheostatic brake circuits are energized. When a rheostatic braking current has been established on every equipment on the train a change-over relay is energized and this releases the air brakes on all cars. The rheostatic braking continues to build up through the operation of a camshaft switching unit, which reduces progressively the degree of field divert until it is checked by the operation of the rheostatic current limit relay (RCLR) when the current value is reached which represents the maximum which can reasonably be permitted under tare conditions. The performance is shown which was obtained with the equipment in terms of percentage of train energy dissipated rheostatically for various speeds of entry and various rates of retardation. The degree of success which is achieved with this scheme will be revealed by the extent to which wheel wear is reduced.

Manser, AW (London Transport Board) *Institution of Locomotive Engineers Journal* Vol. 55 No. 303, Part 1, pp 18-58, 12 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1991)
DOTL RP

B8 040506
COMPOSITION BRAKE BLOCKS AND TYRES
This paper describes some of the problem which have arisen from the use of composition brake blocks in the past. For at least two of these, wet stopping performance and thermal cracking, there is now an understanding of the problem and possible solutions. Present-day production has also resulted in blocks free from the other difficulties. Other methods of avoiding the dangers associated with thermal cracking have been indicated: these involve moving away from the classic wheel and tire arrangement and the materials which have persisted for many years.

Wise, S Lewis, GR *Railway Division Journal* Vol. 1 Part 4, 1970, pp 386-443, 5 Fig, 4 Tab, 7 Phot, 13 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1993)
DOTL RP

B8 040508
A METHOD FOR ESTIMATING BRAKING DISTANCES
This method allows for a time delay in the development of full brake power after a brake application has been initiated at the driver's cab, by taking note of the actual pattern of this development during this period. Thereafter, the distance traversed with full brake power before coming to a stop can be computed. Allowance has also been made of the brake power development characteristics of the motive power units. The method is suitable for application to all brake systems, compressed air standard AVB, and AVB with Quick Application valves--in fact, for any system where the brake power development curves can be established.

Singh, A (Ministry of Railways, India) *Institution of Locomotive Engineers Journal* Vol. 57 No. 317, Part 3, pp 251-278, 14 Fig, 2 Tab, 1 Phot, 12 Ref, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1999)
DOTL RP

B8 040540
MODERN DEVELOPMENTS IN WHEELSLIP CONTROL ON ELECTRIC LOCOMOTIVES
The reasons for wheelslip are discussed indicating what happens when it does occur on different types of locomotive and under different circumstances, and what action can be taken to correct it. The coefficient of friction is shown versus slip speed and the probably maximum useful adhesion is shown for various speeds on wet and dry rail. The natural and slipping characteristics of a number of motors shows why some locomotives are less steady on their feet than others. Wheelslip results in loss of tractive effort and at a standstill or at low speeds can cause wheel burns. Ways of avoiding wheelslip by correcting weight transfer problems, by controlling the acceleration cycle with small notches in the contactors and by limiting the tractive effect. When slip is detected, one of the following actions is recommended: reduction of tractive effort, applications of sand, light application of air brakes, and armature shunting.

Scott, M *Institution of Locomotive Engineers Journal* Vol. 59 No. 328, Part 2, pp 182-190, 5 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1997)
DOTL RP

B8 040545
VACUUM BRAKING OF HEAVY FREIGHT TRAINS ON THE BROAD GAUGE, INDIAN RAILWAYS
Indian Railways are the largest system using vacuum brakes. Braking distances for 2200 ton trains are shown. Clasp brakes improved the coefficient of friction; the shoe pressure and friction are plotted as a function of speed. The initial developments comprising emply-load change-over devices, slack adjusters, clasp brakes, etc., have made possible the running of 3,200 ton trains without increasing braking distances over those obtaining with 2,200 ton four-wheeler trains. With the rapidly increasing transportation requirements, running of 4,500 ton trains is an immediate necessity. Improvements under consideration to permit 4500 ton trains include, modified cages, direct admission valves, and 80 mm train-pipe. Incorporation of the developments now under study, such as higher brake ratios, improved rigging, composition brake shoes, etc., will enable the vacuum brake to meet the future transportation requirements of 6,000 to 7,000 ton trains at higher speeds.

Mohan, C (Research Designs and Standards Organization, India) *Institution of Locomotive Engineers Journal* Vol. 54 No. 300, Part 4, pp 328-365, 17 Fig, 5 Tab, 13 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2005)
DOTL RP

B8 040779
SIGNALLING FOR HIGH SPEED TRAINS
In this paper the author has tried to analyze the signaling problems of high-speed operation, and to bring them into perspective. The paper discusses the limitations of contemporary modern signaling when applied to higher speeds and the principles upon which an acceptable solution might be based. Speeds higher than 100 mph bring other problems than signaling, notably those of line capacity, track maintenance, and automatic train control. It was claimed that signaling requirements for speeds of 100 to 125 mph and 100 to 150 mph are different. In one case existing signaling can be modified to achieve desired safety requirements, and in the other a new and additional system must be considered.

Tyler, JFH (British Railways Board) *Railway Division Journal* Vol. 1 No. t 3, 1970, pp 297-322, 9 Fig, 1 Tab, 2 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2111)
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B8 040780
AIR BRAKE EQUIPMENT: PERFORMANCE AND MAINTENANCE
This paper discusses some of the more troublesome problems that have been experienced together with the remedies and maintenance procedures adopted to overcome them on air brake equipment. These problems relate to (1) teething troubles which require modifications to equipment, (2) training of both the operating and maintenance staff, (3) having to maintain a more sophisticated system of braking which has tight operating tolerances, and (4) operating two completely different systems during the transition period. In conclusion it is important to emphasize that the two-pipe air brake system as adopted by British Railways for locomotive-hauled trains, is considered to give the best performance that can be obtained from a purely pneumatic system, being second only to the electro-pneumatic brake such as is used on electric multiple units.

Wilson, SH *Railway Division Journal* Vol. 1 No. t 3, 1970, pp 322-348, 5 Fig, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1944)
DOTL RP

B8 040829
DISCUSSION ON "THE ENGINEERING ASPECTS OF HIGH-SPEED TRAINS" (1) MOTIVE POWER; (2) PASSENGER ROLLING STOCK; (3) BRAKING AND SIGNALLING; (4) PERMANENT WAY
This paper surveys the engineering aspects of high-speed trains in terms of motive power, passenger rolling stock, braking and signaling, and permanent way. In developing high-speed trains there is clearly a need to examine all aspects of vehicle performance on the track, and also a need to subject every item of traction equipment to the closest secrutiny to ensure that it is suitable for onerous high-speed duties. The car of the future will probably be lower and smoother, and with smaller windows than present-day cars. It will be pressurized and adjacent body ends will be closer to incorporate peripheral coupling and improve passenger access. It will also cost more. A basic consideration in obtaining the best brake performance of high-speed trains is the maximum braking retardation. When high retardations are used and as the maximum speed of trains increases from about 100 mph to 120 mph (or even 150 mph) two problems of braking which become increasingly important are adhesion and heat dissipation. Both necessitate modifications to present braking practice when higher speed stops are to be made. It is generally agreed that at high speeds some form of cab signaling is essential, and systems in use vary from the relatively simple A.W.S. as used in this country to apparatus which starts, controls, and stops the train automatically. There is every justification to believe that, from the point of construction, modern track would be quite suitable for speeds up to 160 mph--possibly more--where it is straight or flat-curved.

Sharp, E Thring, JF Peacock, DW Loach, JC *Institution of Locomotive Engineers Journal* Vol. 56 No. t 2, pp 196-219, 9 Fig, 1 Tab, 1 Phot, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1963)

B8 040831
STUDY OF FRICTIONAL CHARACTERISTICS OF COMPOSITION COMPARED TO CAST IRON BRAKE SHOES
An investigation was made to study the braking characteristics of various types of brake shoes on switching locomotives. This work was conducted on the Seaboard Coast Line Railroad at Waycross, Georgia, in 1968. The field work was supplemented with laboratory work conducted at the AAR Research Department on the brake shoe dynamometer machine. The frictional effect of breakaway resistance of wheels was also studied by the use of this machine. It was concluded that: 1. Braking force developed by the brake system is dependent upon the fundamentals of friction of the brake shoe on the wheel and pressure applied on the shoe. 2. The stopping distances are independent of the type brake shoe or whether single or clasp brakes are used, provided that proper coefficient of friction of brake shoes and brake shoe pressure are used in the design. 3. Brake shoe pressures that develop restraining forces greater than can be withstood by the wheel-rail contact will result in the tendency to reduce braking effort and cause slid flat wheels. 4. The coefficient of friction values for the cast iron shoe compared with the composition shoes are sufficiently similar to permit use of either type of shoe provided proper brake cylinder pressure is maintained and suitable lever ratios are used in the design.

Britton, JC Knoblock, OW
Association of American Railroads Res Rpt AAR MR-448, Apr. 1968, 50 pp, 12 Fig, 5 Tab, 18 Phot, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2026)
DOTL RP

B8 040993
MICROWAVE NETWORK IS VITAL TO IC'S TELEPROCESSING SYSTEM
Illinois Central's 900 mile microwave system between Chicago and New Orleans serves their MAIN Teleprocessing System, serves their centralized dispatching from Chicago, and provides voice communications for their telephone system. Information from 27 hotbox detectors is sent to MAIN over the microwave system, and MAIN has two way radio communication with train crews as an integral part of the communications capability. Information from Automatic Car Identification installations is transmitted over the microwave system. Hot standby/space diversity is used for path protection. All microwave stations have an eight hour backup battery plant. GTE Lenkurt provided engineering, microwave equipment, and acted as prime contractor for the towers.

Taylor, JC (Illinois Central Gulf Railroad) *Railway System Controls* Vol. 6 No. 7, July 1972, pp 6-8, 2 Phot

ACKNOWLEDGMENT: Railway System Controls
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B8 040994
LATEST SIGNAL TECHNIQUES LET RAILROADS DECREASE JOINT USAGE
This article presents the results of a survey of new methods and equipment used to reduce the number of insulated joints in service. The survey covered: brands of insulated joints, circuits and equipment for rail-highway grade crossing protection, where can insulated joints be eliminated and where must they be retained, and other related areas.

Railway System Controls Vol. 3 No. 7, July 1972, pp 9-10, 1 Tab

ACKNOWLEDGMENT: Railway System Controls
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B8 040995
FCC GRANTS PETITION ON TONE MODULATION
The Federal Communications Commission granted an AAR petition to permit tone modulation on a secondary basis to voice operations on railroad frequencies in the 160 MHz band and on certain 450 MHz band frequencies for remote control of locomotives and cab indicators. The FCC also agreed to permit use of two pairs of frequencies in the 450-460 MHz band, now reserved for slave locomotive control, for the additional functions requested. The FCC amended frequency tolerance rules to permit use of mobile transmitting equipment as base stations on two frequency pairs in railroad yards and terminals. The FCC denied the request to permit use of two splinter frequencies of 157.450 and 159.480 MHz for control of slave locomotives.

Railway System Controls Vol. 3 No. 7, July 1972, pp 11-12, 1 Tab

ACKNOWLEDGMENT: Railway System Controls
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B8 040999
RAILROAD FAX USAGE HAS GROWN
This article summarizes the replies of thirteen railroads to a survey of railroad usage of facsimilie transmission. Southern Railway's LDX system, with 38 locations transmitting to Atlanta, is the largest installation. Fax usage on the thirteen railroads includes both short distance yard and terminal applications and long distance inter-city applications. Information transmitted includes passenger reservations, switch lists, work orders, waybills, car inventories, train lists, office memos, and general operating information.

Railway System Controls Vol. 3 No. 6, June 1972, pp 8-12, 11 Fig

ACKNOWLEDGMENT: Railway System Controls
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B8 041004
SAFETY BOARD ASKS FRA TO WRITE RADIO RULES
The National Transportation Safety recommends that the Federal Railroad Administration: 1) Issues as soon as possible regulations to provide for the use of radio in railroad operations. These regulations should include the traditional safeguards found in existing railroads operating rules where they apply to train movements. It is further recommended that, in drafting such regulations, consideration be given to the principles and procedures for radio used by military and civilian aviation authorities. 2) Review and revise as necessary its accident reporting requirements and investigation procedures to insure that all facets of the involvement of radio or the absence of radio are determined and reported.

This article is a reprint of National Transportation Safety Board's Safety recommendations No. R-72-9 and R-72-10, released May 17, 1972.

Railway System Controls Vol. 3 No. 6, June 1972, p 25

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B8 041006
RADIO NETWORK BLANKET LIRR
Long Island Rail Road recently put in operation what is probably one of the most extensive VHF radio communications systems on any commuter line. The new network is made up of four VHF radio communications systems, costing about $800,000. The four, each complete and distinct, operate in the 160 MHz band and are used as follows: 1) Police department--all vehicles, walkie-talkies and pocket-pagers. 2) Maintenance of Way No. 1--communications, electric traction, substations and signals. 3) Maintenance of Way No. 2--track, structures, bridges, buildings and miscellany. 4) Train to Wayside--diesel locomotives, electric trains, both communicating direct to wayside towers and/or the movement bureau at Jamaica station.

Railway System Controls Vol. 3 No. 5, May 1972, pp 16-17, 6 Phot

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B8 041009
SAFETY BOARD MAKES SUGGESTIONS FOR SIGNAL SYSTEMS AND RULES
In this report, the primary areas discussed are existing systems, their relationship to operating rules, and, the remedies available under the Federal Railroad Safety Act of 1970.

This report is the full text of the National Transportation Safety Board report No. NTSB-RSS-71-3, adopted December 2, 1971 as a result of the special study "Signals and Operating Rules as Causal Factors in Train Accidents".

Railway System Controls Vol. 3 No. 4, Apr. 1972, pp 15-21

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B8 041012
CP HAS PROCESS CONTROL AT ALYTH
Canadian Pacific has modernized the old Alyth Yard to the standards of today. The new yard has a sustainable throughput of 3,000 cars per day and incorporates the greatest number of automation features to date in one yard. Located at the junction of four main lines, Alyth Yard is the keystone of CP operations in the west. The problem is to keep everyone informed of factors affecting their work, and the objective is to supply each yard supervisor with the information he needs. Two Honeywell DDP-516 process control computers with associated peripherals provide process control, data processing, and back-up protection. The punched card format used is the same as that at the central computer system in Montreal. Seven cathode ray tubes with keyboards are used for input-output devices, and printers are used for hard copy. Complete data on every car in the yard is available in the computers. Ten Automatic Car Identification scanners will be used, eight at yard entrances, one at an interchange, and one on the hump approach track. Computer enhancement of the ACI data will be performed.

Railway System Controls Vol. 3 No. 3, Mar. 1972, pp 11-16, 1 Fig, 5 Phot

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B8 041014
INDUCTIVE CIRCUIT WORKS AT CROSSINGS
The MIPCO inductive track circuit (ITC) is for use in "dead" section protection. The high-frequency inductive track circuit (ITC-HF) operates at frequencies in the range of 55 to 160 KHz for track length of 4 to 600 ft with shunting sensitivity generally above one ohm. The track is terminated with low impedance at both ends, either or both of which may be an uninsulated rail of a crossing frog (dead section) and serves as a single-turn secondary of the transmitting circuit connected to a single-turn primary of the receiving circuit.

Essentially full text of paper delivered at Communication and Signal Section, AAR, annual meeting October 6, 1971 at Bal Harbour, Fla.

Crofts, GB (Marquardt Industrial Products Company) *Railway System Controls* Vol. 3 No. 3, Mar. 1972, pp 28-29, 3 Fig, 1 Phot

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B8 041024
LI ACHIEVES RADIO AND POWER CONTROL
The Long Island Rail Road has 119 miles of electrified territory including 83 substations under centralized control from its Jamaica headquarters. Also LI's four VHF radio systems are now operational, providing communications for railroad police, maintenance of way personnel, and train-to-wayside for operating crews and supervisors.

Railway System Controls Vol. 2 No. 12, Dec. 1971, pp 20-21, 1 Phot

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B8 041027
SIGNAL RULES MAY BE CHANGED
The Federal Railroad Administration has proposed revisions to the rules, standards, and instructions for the installation, inspection, maintenance and repair of signal systems, devices, and appliances. The proposed revisions were sent to the Association of American Railroads and to the Brotherhood of Railway Signalmen. The article presents the FRA proposals, the AAR comments, and the B of RS comments. The article is continued in subsequent issues.

Continuation of this article appear in Railway System Controls, Vol 3 No. 1 pp 22-28 and Vol 2 No. 12, pp 24-30, 33.

Railway System Controls Vol. 2 No. 11, Nov. 1971, 12 pp

ACKNOWLEDGMENT: Railway System Controls
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B8 041029
AAR DATA PROGRAMS MOVE AHEAD
Railroad cooperation working through the Association of American Railroads is moving ahead on three fronts. AAR's Tele-Rail Automated Information Network is in its second year of operation. In the planning area, AAR's network model and train performance calculator are now available. These planning tools are computer programs designed to help railroads predetermine the effects of proposed changes in operations.

Railway System Controls Vol. 2 No. 10, Oct. 1971, pp 20-22, 2 Tab, 1 Phot

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B8 041034
VHF RADIO COVERAGE TESTED
With the increasing use of unit trains, and longer freight trains, the use of remotely-controlled helper, or slave locomotives, placed toward the rear of these long trains has become quite commonplace. Controls from the lead unit, and indication or status responses from the slave unit are sent between units using VHF radio. Continuity of radio service is essential for satisfactory slave locomotive operation. Several railroads have made radio propagation tests to determine the extent of radio coverage along lines where such slave locomotive operations take place. These tests and the results are described in this article.

Railway System Controls Vol. 2 No. 8, Aug. 1971, pp 8-15, 5 Fig, 5 Tab

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DOTL JC

B8 041036
PCM USED FOR REMOTE CONTROLS
The General Electric pulse code modulated PCM radio remote control system is designed to meet the complete requirements for remote operation of mining, industrial and railroad locomotives by an operator who is up to 2,000 ft from the unit. Up to 30 locomotives, with 15 commands to each, can be controlled from separate transmitters operating on a single licensed frequency. A self synchronous feature of the system insures reliability of transmissions to the locomotives. The equipment operates in the 72-76 MHz or 150-174 MHz frequency range and meets all FCC requirements for permanent licensing, including the 0.5 watt transmitter output maximum.

Vandervort, TL (General Electric Company) *Railway System Controls* Vol. 2 No. 8, Aug. 1971, pp 20-25, 5 Fig, 4 Phot

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B8 041039
SIGNALING HIGHLIGHTS MEETING
This article presents subjects discussed at the ASME/IEEE April 1971 Railroad Conference, principally a cybernetic system to improve line capacity and the impact of electrification on signaling and communications. An analysis of electrical noise currents in the running rails included: noise currents produced by conventional switched resistor and new chopper propulsion systems, currents produced by substation power systems incorporating rotary convertors and mercury and silicon controlled rectifiers. The best potential for electrification in North America is some 20,000 miles of track averaging over 40 trains per day. One thousand amperes flowing in the catenary with a deep ground return will induce about 500 to 700 volts per mile in parallel signal and communications lines at the usual locations. A completely new signaling system may cost less than a retrofit. Development of a cybernetic system to improve line capacity was reported by the French National Railroads for a route on which freight, passenger, and commuter trains all converge on two tracks. The cybernetic system consists of three subsystems: signaling and routes, traction control on commuter trains,and dispatching.

Railway System Controls Vol. 2 No. 6, June 1971, pp 17-19, 1 Fig, 2 Phot

ACKNOWLEDGMENT: Railway System Controls
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B8 041043
HOW GTE INFORMATION SYSTEMS AIDS RAILROADS
Railroads have failed to meet the fifth deadline for equipping all cars used in interchange with Automatic Car Identification labels. Some railroads are reluctant to spend money to label cars when the railroad has no ACI scanners. Other railroads are reluctant to spend money for scanners when the cars are not all labeled. GTE Information Systems has made economic and operational analyses of ACI in these areas: terminal analysis procedure, ACI checking of pullout in a hump yard, ACI checking of inbound and outbound consists, ACI site survey worksheet, communications criteria for ACI. The ACI checking of pullout in a hump yard indicates a return of from 48 to 145 percent. Checking the inbound and outbound consists indicates a return of 29 percent. Copies of the reports are available to railroads.

Railway System Controls Vol. 2 No. 5, May 1971, pp 15-16, 2 Phot

ACKNOWLEDGMENT: Railway System Controls
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B8 041048
RADIO IS KEY LINK IN CONTROLLING SWITCHES AT COPPER MINE

Frequent relocations of tracks, heavy traffic 24 hr daily, plus possible damage from debris resulting from blasting, are but three factors making radio control of power switches practical at Bingham Canyon open-pit copper mine, in Utah. Moving trackage is common at Bingham Canyon. It takes approximately two tons of waste or overburden and one ton of ore to produce 14 lb of pure copper. Thus, there is a continuous excavating to step-back the mine, which requires moving trackage to the newly opened mining areas. Controls and indications of the signals and power switches in the mine are sent to and from control panels via radio, eliminating the need for a pole line or cable communications.

Railway System Controls Vol. 2 No. 3, Mar. 1971, pp 10-12, 6 Phot

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B8 041058
RADIO CONTROLLED UNITS HELP STEEL COMPANY

Locomotives and self-propelled scrap vehicles are remotely controlled via radio at the Burns Harbor plant of Bethlehem Steel Corporation in northern Indiana. Remote control equipment and systems including the retarders at the Burns Harbor plant were designed and furnished by the General Railway Signal Company. The GRS radio remote control system is capable of controlling as many as 128 vehicles, each up to 16 commands, simultaneously on the same radio frequency, without interference. Transmitting range is kept down to approximately half a mile to further minimize interference. The 154 MHz signal is transmitted in the form of random pulses, at the rate of one pulse during each 100 millisecond period of time. This technique practically eliminates the possibility of two simultaneously-transmitted pulses blocking one another.

Railway System Controls Vol. 1 No. 9, Dec. 1970, pp 19-21, 5 Phot

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B8 041059
HVDC TRANSMISSION MAY CAUSE INTERFERENCE TO COMMUNICATIONS CIRCUITS

A high-voltage direct current transmission line, constructed in the western United States, operates at 800,000 volts and carries 1800 amperes current. Tests made on the 853-mile line indicate that serious interference does exist in the portion of the spectrum 3 KHz to 150 KHz. In the portion between 3 KHz and 124 KHz, the converter/inverter stations were generating noise of considerable magnitude into railroads' communication facilities. Very little effect was noted from those frequencies above 124 KHz. Further, little effect was noted in the frequency range 0 KHz to 3 KHz. Railroad communication facilities using superimposed carrier techniques normally operate in the range 4 to 150 KHz; therefore the noise being generated by the Celilo converter/inverter station falls directly within the operating range of the railroad's carrier derived communications systems. The carrier systems affected are utilized for voice transmission, dispatchers' telephones, for analog data, i.e., hotbox detectors and other systems of this type and digital data, i.e., teleprinter circuits, centralized train control coding equipment and systems of this type.

This paper was presented at the 10th Annual Meeting, Communication & Signal Section, AAR, San Francisco, California, September 17, 1970.

Robertson, HM (Union Pacific Railroad) *Railway System Controls* Vol. 1 No. 9, Dec. 1970, pp 28-37, 17 Fig

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B8 041062
WHAT IS TRAIN-STOP

Experience indicates that in recent years railroads may be stopping too many trains for suspected hot boxes. Two railroads, Southern and Norfolk & Western, have examined the situation. Their findings are that many trains having roller-bearing equipped cars are being stopped because the journals are running at above normal temperatures. Also, the train crew which makes the judgement in the field takes the safest course of action, that is set the suspected car rather than take the chance of having a bearing fail with possible resultant derailment. Over lubrication appears to be one possible cause of these bearings to run at elevated temperatures which actuates hot box detectors. Improved journal bearing maintenance practices may reduce abnormal running bearings and decrease the number of train stops.

This article contains the abstracts of two papers presented at the recent annual meeting of the Communication & Signal Section, AAR.

Pace, NC (Southern Railway); Hesser, JM (Norfolk and Western Railway) *Railway System Controls* Vol. 1 No. 8, Nov. 1970, pp 22-27, 3 Fig

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B8 041064
L&N TRAINS COMMUNICATIONS MEN

Louisville and Nashville has a training program for communications men. Most new men joining the communications department start with crews maintaining pole lines. L&N constructed a pole line for training. During the training period of about one month, the men play catch with a basketball while strapped to the poles. Such practice develop confidence and dexterity at heights. Train operations and safety are also reviewed for the men. They are encouraged to enroll for electronics correspondence courses.

Railway System Controls Vol. 1 No. 7, Oct. 1970, pp 15-16, 2 Phot

ACKNOWLEDGMENT: Railway System Controls
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B8 041067
MICROWAVE USES PCM

In the railroad industry, communications have been strained to stay one step ahead of rolling-stock technology. Railroad technology is becoming increasingly dependent on the computer. The communication systems must be optimized in such a way that they will not choke on the vast amount of information that has to be handled every day of the year. And an effective, economical system must handle both voice communication and data efficiently. Canadian Marconi has developed a new microwave (PCM) system-MCS6900-which meets these objectives and is presented here.

Hagger, TR (Canadian Marconi Company) *Railway System Controls* Vol. 1 No. 6, Sept. 1970, pp 21-23, 4 Fig, 1 Phot

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B8 041071
TRANSIT COMMUNICATIONS HAS RADIO, INTERCOMS

Comfort and convenience are now considered important along with the physical act of transportation. Hence, dissemination of information about operations, especially helpful when delays occur, plays a key role in today's transit systems. Improved operations control result from extensive use of instant two-way communication between dispatchers, train operators, conductors and law enforcement personnel. Three basic communications systems are being employed by transit authorities and commuter railroads, namely two-way radio, intercommunications and public address systems. In some cases, it is possible to combine these three systems employing much common equipment. However, some communications experts prefer to keep the radio system separate from PA and intercom equipment. Failure of a common unit shared by radio, PA or intercom systems might cause one or more systems to become inoperable. Radio is commonly used for train-to-wayside communications between train crews and operating officials and law enforcement personnel so that failure of the radio equipment

could be critical. However, intercoms and PA systems are often combined, using much common equipment.

Schwendeman, RJ (Motorola, Incorporated) *Railway System Controls* Vol. 1 No. 5, Aug. 1970, 7 pp, 12 Fig

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

B8 041078
SANTA FE FINDS A BETTER WAY FOR COMMUNICATIONS MAINTENANCE
Specifications for a field input/output terminal have been developed by the Systems & Data Communications committee of the Data Systems Division, AAR: General; 1.0 Basic Terminal; 2.0 Optional Building Blocks; 3.0 I/O Devices; 4.0 Environment; 5.0 Maintenance and Reliability. shops located at 38 strategic points along the railroad. Financial aid is available for job-oriented correspondence courses, and men have been sent to manufacturers' schools. A wide range of testing equipment is available. Electronic Technicians have the use of Carryall type vehicles. Edge punched cards are used for maintaining records on radio equipment.

Railway System Controls Vol. 1 No. 4, July 1970, pp 18-23, 1 Fig, 5 Phot

ACKNOWLEDGMENT: Railway System Controls
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

B8 041079
BART CONTROLS "DRY RUN" TESTED
BART is the world's first completely automated rail transit system in the world. This concept of automated train control combines all functions required to operate trains without human intervention: regulation of individual train movement from starting to stopping; determination of the routes the trains will take; and control of scheduling to keep trains spaced for optimum station services.

Railway System Controls Vol. 1 No. 2, May 1970, pp 13-17, 3 Fig, 2 Phot

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

B8 041080
AUTOMATIC TRAIN STOPPING HAS BEEN DEVELOPED FOR RAPID TRANSIT
Precision stopping equipment has become a requirement for most modern rapid transit systems for two reasons. First, modern systems require air-conditioned platforms for passenger comfort requiring stops with very tight tolerances which will permit the vehicle door to line up with the platform doors. Secondly, if the position of the train can be specified accurately, the passengers can station themselves along the platform and save time and confusion. This article describes a system developed for BART trains. The automatic stopping feature is also used by the Port Authority Transit Corporation on its trains operating between Philadelphia, Pennsylvania and Lindenwold, New Jersey.

Thorne-Booth, GM Kalra, RPS (Westinghouse Electric Corporation) *Railway System Controls* Vol. 1 No. 2, May 1970, pp 18-20, 5 Fig, 1 Phot

ACKNOWLEDGMENT: Railway System Controls
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

B8 041084
IC MOVES CONTROLS TO HQ FOR EFFICIENCY
Illinois Central Railroad is now reaping the benefits of three years of intense planning (1964067) and three years of installation work on their $15.5 million management information system. The microwave system is the central nervous system for the whole railroad. Key to the success is centralization where management and supervision are located and computer power sufficient to handle all data flowing into the headquarters. A detailed description of the microwave system and a map are included.

Railway System Controls Vol. 1 No. 1, Apr. 1970, pp 13-17, 1 Fig, 3 Phot

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

B8 041085
TRACK CIRCUIT SHUNTING TESTED ON ELECTRIFIED SUBURBAN LINE
Following reports from several Australian State Railways that unsafe track circuit switch failures had increased with the general introduction of synthetic resin brake shoes, a series of comparative tests, under controlled conditions, have been carried out on various types of rolling stock and rail surfaces on the Victorian system. Tests conducted under the most adverse conditions indicate that wheel-to-rail resistance was generally up to ten times greater for cars fitted with synthetic resin brake shoes than those fitted with cast iron brake shoes. One of the conditions encountered is that of rail film caused by rainy or humid weather. One result of the tests was that wheels fitted with cast iron brake shoes had superior film penetration and rail cleaning action to those fitted with synthetic brake shoes. In one series of tests conducted on equivalent type of rail surfaces, wheel-to-rail contact resistance was 0.138 ohms for trailer wheels with synthetic resin brake shoes and 0.0145 ohms for wheels with cast iron brake shoes. A description of how the track circuit switch tests were carreid out, methods of upgrading track circuits to handle lightweight trains fitted with synthetic resin brake shoes, and an explanation for the defective switching sometimes experienced with lightweight passenger vehicles on branch lines are included.

Cox, JJ (Victorian Railways) *Railway System Controls* Vol. 1 No. 1, Apr. 1970, pp 18-23, 3 Fig

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

B8 041088
C&S SECTION OUTLINES SIGNAL PRINCIPLES
A committee on interlocking, traffic control and block signals has developed basic principles for electronic controls for signal systems which are presented here.

Railway Signaling and Communications Vol. 63 No. 3, Mar. 1970, p 18, 1 Phot

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

B8 041089
ADVANCING TECHNOLOGY CAN AID SIGNAL DESIGN
Communication and Signal Section AAR report entitled "Signals Principles Defined" contains recommendations for the design of vital equipment which are not sufficiently complete or inclusive to provide adequate safety consistent with the traditional concept of fail safety. At least, the following modifications should be made to the guidelines as they presently stand: 1) Provide for the use of "vital" resistors, "vital" transformers and other vital elements which can be constructed to have a known unidirectional mode of failure; 2) Require safety under all the independent correlated and combinational modes of failure as necessary to eliminate all hazardous effects of failures; 3) Suggest construction techniques available for achieving safety, to be used as a guide rather than a specification.

Hoyler, RC (Westinghouse Electric Corporation) *Railway Signaling and Communications* Vol. 63 No. 3, Mar. 1970, P 19, 1 Phot

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

B8 041091
RAPID TRANSIT TRAINS RUN AUTOMATICALLY TO SERVE PHILADELPHIA AREA
To handle upwards of 30,000 commuters daily, a Philadelphia area transit line has found that automatic train operation and centralized control provide a successful operation. Port Authority Transit Corp., operates a 14.5-mile, double-track line from 16th and Locust Streets in down town Philadelphia to Lindenwold, N.J., via Camden. PATCO runs expresses mixed with locals during rush hours to provide headways down to three minutes. An attendant

operates door controls and "Start" button to start the train. After the "start" button is pressed (with doors closed-an interlock prevents starting with doors open), the train runs automatically to the next station where it is brought to a stop near the center of the platform. Supervisory control of ten interlockings, the power system for traction current and three communications systems are all controlled from Center Tower at Broadway, Camden. To communicate with passengers in stations, a public address system was provided. Also tied in with the Trainphone radio system on trains, announcements can be made to passengers riding the trains. Dispatcher-to-train attendants' communication is carried out via the Trainphone radio system. An automatic dial telephone system provides service between Center Tower, all power substations, passenger stations and repair shops.

Railway Signaling and Communications Vol. 63 No. 3, Mar. 1970, pp 24-29, 6 Fig, 2 Phot

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

B8 041094
D&RGW HAS DISPATCHER-CONTROL OF RADIO STATIONS OVER ENTIRE SYSTEM

To keep everyone informed about train movements, reliable and complete communications coverage is necessary. Denver & Rio Grande Western has achieved such communications coverage via its recently completed dispatcher-controlled, base-radio station program. Radio coverage provides two-way communications between dispatchers and personnel on rolling stock on main and branch lines, totaling some 1300 miles. Also, personnel in radio-equipped vehicles on adjacent highways can talk to or be called by dispatchers. By use of special tones, men in the field can alert the dispatcher to the fact that they wish to talk to him. A special muting device enables the dispatcher to have "peace and quiet" for planning moves, yet a light and bell will call his attention to a call from the field. This muting feature enables D&RGW to conserve radio frequencies in that only one frequency can serve for both end-to-end and train-to-wayside service. Dispatchers at Denver, Grand Junction and Salt Lake City can cover the entire system.

Railway Signaling and Communications Vol. 63 No. 2, Feb. 1970, pp 26-29, 4 Fig, 4 Phot

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

B8 041126
COMMUNICATIONS VITAL TO CTC

There is a well established trend in railroading toward consolidation and centralization of CTC and other control Systems. A centralized traffic control protection system has been developed which may be used over any voice frequency or high frequency facility suitable for data or telegraph transmission. It employs full-duplex tone channelizing equipment. Redundant transmission is used to provide reliability. An alternative using dialup can be provided.

Arnold, BL (GTE Lenkurt, Incorporated) *Railway System Controls* Vol. 3 No. 12, Dec. 1972, 9 pp, 4 Fig, 1 Phot

ACKNOWLEDGMENT: Railway System Controls
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

B8 041128
BN BURIES FIVE CONTROL CABLES

Burlington Northern has used a cable-laying machine to bury signaling and communications cables. Six cables were buried five feet deep along seven miles of main line. Five cables were buried along three miles of branch line. Static wire and cables were buried in 3,000 to 5,000 foot lengths. High voltage power lines parallel to the tracks were interfering with the railroad signals and communications. The ac induction into the tracks was dangerous. On the first pass, the cables are buried in the trench cut by the plow. Work train speed is one mile per hour. Plow operator and workmen on the reel car had radio contact with the locomotive engineer.

Railway System Controls Vol. 3 No. 12, Dec. 1972, pp 24-25, 5 Phot

ACKNOWLEDGMENT: Railway System Controls
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

B8 041129
KCS EXTENDS REMOTE CONTROLLED LOCOMOTIVE OPERATION AND CTC

By the end of 1972, Kansas City Southern will have 11 sets of remote locomotive control equipment installed in its units. Synchronous power to the rear permits slashing drawbar and knuckle failures 50% compared with all power at the head end. Location of rear consists must be varied depending on loading, train length, and weather. With remote control locomotives in the train, there is a reduction in slack action, faster charging of the brake pipe at terminals, an improvement in starting, and a reduction in sticking brakes. Since braking response is improved, train speeds can be increased. Splitting power reduces the potential for derailing long cars, and reduces wheel and flange wear. The characteristics of handling short trains are imparted to the longest. Heavier trains can be moved over the ruling grades.

Railway System Controls Vol. 3 No. 12, Dec. 1972, pp 28-29, 3 Phot

ACKNOWLEDGMENT: Railway System Controls
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

B8 041135
WASHINGTON SUBWAY AUTOMATES

The Washington Metro will be an automated transit system. Train operation will be automatic, but an attendent will be on board. Maximum speed will be 75 mph, with headways as close as 90 seconds. The control system, to be supplied by General Railway Signal Company, will consist of three control subsystems and a computerized central control facility. The subsystems are: automatic train protection, automatic train supervision, and automatic train operation. This article presents information on these subsystems, and includes block diagrams and illustrative diagrams. Train Detection, Automatic Speed Commands, Metro-Link Hardware, Flyby Receivers and Transmitters, and the Door Operating system are discussed. Also discussed are Dispatching of Trains, Interlockings, and the No-Break Power Supply.

Railway System Controls Vol. 3 No. 8, Aug. 1972, 6 pp, 5 Fig

ACKNOWLEDGMENT: Railway System Controls
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

B8 041311
SAFETY APPLIANCES AND POWER BRAKES

This current compilation of standards established for cars and locomotives by Federal regulation is a successor to the ICC's Safety Appliance Standards, last published in 1946, and to the Power Brake Law pamphlet, issued in 1958. It incorporates requirements for today's rolling stock, including tank cars without underframes, hi-cube box cars and cars of special design.

This book was published by the Bureau of Railroad Safety, Federal Railroad Administration and announced in Railway Locomotives and Cars, V145, N9, September 1971.

Government Printing Office

ACKNOWLEDGMENT: Railway Locomotives and Cars
PURCHASE FROM: Government Printing Office Superintendent of Documents, Washington, D.C., 20402 Repr PC

B8 041610
ELECTRICATION--ITS EFFECT ON SIGNALING AND COMMUNICATIONS

Electrification of a railroad generally involves costly changes to the signaling and communications facilities. Electrification provides significant benefits to the railroads and to the public. Power circuits will produce extraneous voltages and currents in communication circuits, caused by magnetic induction, electric induction, ground potential conduction, or accidental connection. Rails are grounded through ballast, and part of the return

current flows through the ground. One means of reducing the induced voltages over long distances is the three-wire system using autotransformers and a negative feeder. Fault currents can cause high induced voltages and currents. Unless preventive steps are taken, hazards can exist for personnel and equipment. Electification will generally be applied to high density lines which already have extensive communications and signaling facilities. Installation will have to be accomplished under traffic without disruption of traffic. The challenge is to make the changes to signaling and communications add to the benefits rather than just to the costs. Several diagrams are included illustrating the induction effects.

This paper was presented at the Tenth Annual Meeting of the Communication and Signal Section of the Association of American Railroads, San Francisco, California, September 15-17, 1970.

Stinson, GE (Westinghouse Air Brake Company)
Association of American Railroads Technical Center Proceeding Sept. 1970, pp 554-568

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr PC
DOTL RP

B8 041620
A PRESCRIPTION FOR BART
As the result of a sequence of mishaps and incidents occurring in the automated operation of the Bay Area Rapid Transit (BART) system since partial revenue service was inaugurated last September 11, considerable skepticism has been expressed by many sources as to the safety of this ultrasophisticated mass-transit system. These critical evaluations led to the empaneling of a select three-man committee to report on the safety of the BART ATC system. In brief, the panel did not find the system's present mode of operation unsafe, but said the present system would not provide adequate passenger safety under full-scale operation, and recommended modifications and redesign to correct the deficiencies.

Friedlander, GD
Institute of Electrical and Electronics Engineers Vol. 10 No. 4, Apr. 1973, pp 40-44

ACKNOWLEDGMENT: IEEE Spectrum
PURCHASE FROM: IEEE Repr PC
DOTL JC

B8 041623
BART'S HARDWARE--FROM BOLTS TO COMPUTERS
In 1965 BART began the Mt. Diablo Test Track. Three laboratory cars were built and used to test new technology. The testing program included reduction of sound and vibration, propulsion equipment and power supply, transit vehicle trucks, automatic train operation, rails and rail support, and aerial structures, tubes, and tunnels. Five propulsion system were tested, and dc chopper control was selected. The Rohr built transit cars, 250 of them, feature cantilever seat construction, noise suppression, air conditioning, and glare free lighting. The car trucks are equipped with derail detectors connected into the automatic train operation system. On aerial structures and in tunnels, rail is fastened directly to the concrete slab or tunnel invert. For the Berkeley Hills tunnel, which crosses the Hayward Fault, rails were mounted on timber ties to permit speedy realignment. The Trans Bay Tube contains both horizontal and vertical curvature. Fifty-seven prefabricated sections were floated into position, then sunk. The Trans Bay Tube terminates in a ventilation building at each end. Cathodic protection is used. Welded rail was used, and the second pour technique for concrete. BART purchases power at 34.5 kvac. This power system has seven sections. An I section steel third rail provides strength and the top running surface for overrunning pickup shoes. Aluminum inserts carry the current. A J shaped cover protects against accidental contact. Automatic train operation handles speed regulation, programmed station stops, and train door operation. Line supervision provides best possible service schedules. Train protection maintains the safety of the operation.

This article is the third of a series on BART. Refer to RRIS #041625 Section 23 for a note on special availability.

Friedlander, GD *IEEE Spectrum* Vol. 9 No. 10, Oct. 1972, pp 60-72, 18 Fig

ACKNOWLEDGMENT: IEEE Spectrum
PURCHASE FROM: IEEE Repr PC
DOTL JC

B8 041624
MORE BART HARDWARE
BART's central control at Lake Merritt is the nerve center for its communications network. More than 300 discrete channels and four radio channels are used. Wireline carrier uses a double sideband suppressed carrier AM modem that can carry 24 channels over two pairs of wires. BART uses a PBX dial system leased from the telephone company. However, for wayside maintenance use, there is a separate maintenance telephone throughout the entire BART system. Emergency phones are located along the route. BART has a fully automatic fare collection system. A ticket console produces a magnetic card ticket with the amount the passenger wishes to purchase. Upon entering a station, a ticket console encodes entry data. Upon departure from the passenger's final station, the gate console deducts the proper amount and recodes the balance. For exact fare remaining, the console captures the ticket. For insufficient fare, the ticket is rejected and a lighted display directs the passenger to the Addfare machine. Subway construction near Civic Center required working well below the water table. A wall was constructed down to an impervious layer of soil by a special technique. Land beneath aerial structures has been made into Linear Parks.

This article is the fourth of a series on BART. Refer to RRIS #041625 Section 23 for a note on special availability.

Friedlander, GD *IEEE Spectrum* Vol. 9 No. 11, Nov. 1972, pp 41, 6 Fig

ACKNOWLEDGMENT: IEEE Spectrum
PURCHASE FROM: IEEE Repr PC
DOTL JC

B8 041626
RAILROAD OPERATION AND RAILWAY SIGNALING
The basic text which explains the relationship between train operation and railway signaling is now available in reprint form. The text is in the form of questions and answers so that the reader may know the objective of the information given, and to place emphasis upon the "why" and "how" of railway signaling and railroad operation. Topics covered include fixed signals, block signaling, interlockings, centralized traffic control, cab signals and highway grade crossing protection.

This is a reprint of the 1953 edition. The price for 1 to 9 copies is $5.95 each, and for 10 or more it is $5.00 each.

Phillips, EJ, Jr
Simmons-Boardman Publishing Corporation

ACKNOWLEDGMENT: Railway System Controls
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL TF 617.P45

B8 041646
AUTOMATIC CONTROL OF MOTION AND BRAKING OF MOTOR VEHICLES AND AUTOMATION OF DRIVING PROCESSES IN RAILROADS [AUTOMATISCHE FAHR-UND BREMSSTEUERUNG DER TRIEBFAHRZEUGE UND AUTOMATISERUNG VON BETRIEBSVORGAENGEN IN ZUEGEN]
The functions of automatic control of motion and braking are discussed, such as selection of dominant control criteria, speed control as well as control of traction and of braking force. [German]

Lehmann, S *Elektrische Bahnen* Vol. 43 No. 2, Feb. 1972, pp 33-38

ACKNOWLEDGMENT: EI (EI 73 017373)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

B8 041659
TELECOMMUNICATION SYSTEMS IN RELATION TO 50 HZ A.C. ELECTRIC TRACTION
Current methods for reducing the effects of inductive interference in lineside telecommunication cables on railroads, electrified at industrial frequency, are summarized. The methods employed by British Railways for calculating

induced longtudinal voltages in cables are outlined, together with standard calculated values in tabular form. The degree of electromagnetic shielding which can be obtained by the use of high-conductivity cable sheaths and steel-tape armoring is illustrated. The effects of the method of traction-current control in motive-power units, with respect to the generation of noise in cables, are discussed.

Tierney, JR (British Railways Board); Gross, BH *Institution of Electrical Engineers, Proceedings* Vol. 119 No. 4, Apr. 1972, pp 441-455

ACKNOWLEDGMENT: EI (EI 73 015056)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B8 041670
BRAKE RIGGING EFFICIENCY OF RAILWAY FREIGHT CARS
The dynamic brake rigging efficiency of freight cars, investigated by using a computer to analyze test track data, is compared with static brake rigging efficiencies. Computer simulations of constant grade braking are performed.

This paper was presented at the ASME Winter Annual Meeting, November 28-December 2, 1971. The notification of this paper appeared in Mechanical Engineering.

Carman, RW (Southern Railway)
American Society of Mechanical Engineers 71-WA/RT-2, 1971

ACKNOWLEDGMENT: Mechanical Engineering
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL TF5.A72 1971

B8 041671
NONFRICTION BRAKING METHODS FOR RAILWAY VEHICLES
Performance potential and approximate cost estimates are presented for three nonfriction braking systems: air retarder, hydraulic retarder, and aerodynamic braking. It is shown that the air and the hydraulic retarders have potential to develop full braking deceleration in a speed range from 250 to 25 mph. Because of the air retarder's potential advantages in system weight, simplicity and cost, prototype development of the retarder is indicated. Aerodynamic braking deceleration is highly dependent on the cumulative effect of longitudinally spaced braking surfaces. Further wind tunnel testing is required for complete evaluation.

This paper was presented at the ASME Winter Annual Meeting, November 28-December 2, 1971. The notification of this paper appeared in Mechanical Engineering.

Cassidy, RJ (Cornell Aeronautical Laboratory)
American Society of Mechanical Engineers 71-WA/RT-3, 1971

ACKNOWLEDGMENT: Mechanical Engineering
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL TF5.A72 1971

B8 041677
BRAKE-SYSTEM OPERATION AND TESTING PROCEDURES AND THEIR EFFECTS ON TRAIN PERFORMANCE
In the past 90 years, a number of train brake-system inspection and testing procedures have evolved to meet the requirements at various stages of railroad development in North America. From an engineering basis, the authors view the major procedures used today and examine their effects on train handling and stopping ability.

This paper was presented at the ASME Winter Annual Meeting, November 28-December 2, 1971. The notification of this paper appeared in Mechanical Engineering.

Blaine, DG (Westinghouse Air Brake Company); Hengel, MF (Missouri Pacific Railroad)
American Society of Mechanical Engineers 71-WA/RT-9, 1971

ACKNOWLEDGMENT: Mechanical Engineering
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL TF5.A72 1971

B8 041993
ELECTRIFICATION: ITS EFFECT ON SIGNALING AND COMMUNICATIONS
When an operating railroad is electrified, the propulsion power may produce effects on the signaling and communication facilities which require conversion for compatibility. This paper suggests a systems approach to electrification, on the basis that proper coordination of propulsion power with signaling and communication facilities can materially improve the return on investment for electrification.

Staples, CE (Westinghouse Air Brake Company) *IEEE Transactions on Industry & Genrl Applications* Vol. IA-8 No. 4, July 1972

ACKNOWLEDGMENT: EI (EI 72 064353)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B8 043019
TWO-FREQUENCY COMBINATION TYPE AF TRACK CIRCUIT
It is shown that in the thyristor phase controlled car placed in practical service on the a-c electrified lines, higher harmonics are involved than in the conventional rectifier type cars and in consequence the existing amplitude-modulated AF track circuit is liable to make false action. A novel AF track circuit free from the interference of such high harmonics was developed.

Ito, K Kiyosawa, S *Railway Technical Research Institute* Vol. 12 No. 2, June 1972, pp 89-91

ACKNOWLEDGMENT: EI (EI 72 24036)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B8 043021
HOW TO APPLY SURGE PROTECTION DEVICES
Nature of over-voltage transients is examined for design and construction of transistorized devices to be used to provide control and communication functions necessary to modern railroading.

Kahl, FA *Railway Signaling and Communications* Vol. 61 No. 10, Oct. 1968, p 24

ACKNOWLEDGMENT: EI (EI 69 07626)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B8 043522
BRAKE SHOES
Performance characteristic curves on the Samson brake shoe as well as general background information are the subjects of an eight-page booklet.

The announcement of this publication appears in Railway Locomotives and Cars, January 1973, Volume 147 Number 1.

Abex Corporation Booklet 8 pp

ACKNOWLEDGMENT: Railway Locomotives and Cars
PURCHASE FROM: Abex Corporation Valley Road, Mahwah, New Jersey, 07430 Repr PC

B8 043535
RAILROAD DATA BOOK
A Railroad Radio Data Book provides information on more than 8,350 active stations authorized by the FCC in the railroad radio service. The directory alphabetically lists all carriers using radio, and gives locations of transmitters, call signs, specific frequencies authorized, plus the number of mobiles, bases and other types of stations authorized. Also included, in another portion of the book, is similar information for licensees in the motor carrier radio service.

The announcement for this book appeared in Railway System Controls, September 1971. Monthly updates of this publication are $5.00 each.

Arcata Communications Information

ACKNOWLEDGMENT: Railway System Controls
PURCHASE FROM: Arcata Communications Information 665 National Press Building, Washington, D.C., 20004 Orig PC

B8 043538
BIGGER BUGS IN BART?
Six months in partial service have raised questions about BART's automation and its safety features. On October 2, 1972 a computer-controlled BART train overshot the Fremont station and plunged the lead car onto a

sand bank. The cause was a malfunction of a crystal oscillator on board the lead car. This article reviews some of the problems that have occurred, and summarizes some of the reports that have been released. A report by State Legislative Analyst Alan Post has two principal stipulations: (1) that BART's service began without adequate checks and with train control deficiencies, and (2) that BART was overcharged for the system engineering and construction-management services. Post's report explains that the low-power circuit in the tracks may not detect a train under certain conditions. BART has run 28 million passenger miles in automatic mode with manual block as backup for train separation. Present operations, according to BART, are fully automatic more than 95% of the time. A report by Battelle Institute concluded that under normal conditions the system appears to operate in a manner that is not unsafe; under conditions of single malfunctions no clearly defined unsafe operating condition was identified, and that the operating safety of the vehicle system depends on redundant rather than fail-safe circuits. The article also presents some of the reactions of the consultants and of the supplier of the automatic control system. The article notes that off-the-shelf mechanical wheel scrubbers may solve the train detection problem. The article concludes with some findings of a blue ribbon panel.

Friedlander, GD *IEEE Spectrum* Mar. 1973, pp 32-37

ACKNOWLEDGMENT: IEEE Spectrum
PURCHASE FROM: IEEE Repr PC

DOTL JC

B8 043595
INDUCTIVE COORDINATION GETS SYSTEMS APPROACH
To help solve the problems of inductive interference that might result when a high-voltage power line is constructed along a railroad right-of-way, Northern States Power Co. used the system approach. When NSP was about to build an 11-mile parallel of high-voltage transmission lines along Burlington Northern lines in Minnesota, the approach taken was to determine correct solutions for the problems that the induced voltages might cause. Subjects considered high-speed protective relaying, protection for signal and communications circuits, and grounding, among others.

This article is essentially the full text of a paper delivered at the Communications and Signal Section, AAR, 1972 annual meeting.

Judkins, RE Thorson, JM, Jr (Northern States Power Company) *Railway System Controls* Vol. 4 N2 Feb. 1973, 16 pp, 4 Fig, 2 Tab, 1 Phot

ACKNOWLEDGMENT: Railway System Controls
PURCHASE FROM: Simmons-Boardman Publishing Company 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

B8 043793
HUMAN FACTORS CRITERIA FOR VEHICLE CONTROLS AND DISPLAYS
The study was directed toward developing valid criteria for the standardization of control and display location, coding, and operation in passenger cars, trucks, and buses. Five tasks were accomplished. Task 1 comprised an analysis of the commonality of control-display design arrangements in existing vehicles, and an assessment of the degree of the nonstandardization problems. Tasks 2 and 3 were directed toward developing criteria for C/D location and coding/operation respectively. Task 4 involved a study of 3 beam headlamp system control concepts. Task 5 comprised an experimental program to support Tasks 1, 2 and 3. (Author)

See also report dated Sep 72, PB-214 069.

Malone, TB Krumm, RL Shenk, S Kao, H
Essex Corporation Final Rpt Sept. 1972, 54 pp

Contract DOT-HS-120-1-174

ACKNOWLEDGMENT: NTIS (PB-214352/7)
PURCHASE FROM: NTIS Repr PC, Microfiche

PB-214352/7, DOTL NTIS

B8 043794
HUMAN FACTORS CRITERIA FOR VEHICLE CONTROLS AND DISPLAYS: APPENDIX A
The study was directed toward developing valid criteria for the standardization of control and display location, coding, and operation in passenger cars, trucks, and buses. Five tasks were accomplished. Task 1 comprised an analysis of the commonality of control-display design arrangements in existing vehicles, and an assessment of the degree of the nonstandardization problems. Tasks 2 and 3 were directed toward developing criteria for C/D location and coding/operation respectively. Task 4 involved a study of 3 beam headlamp system control concepts. Task 5 comprised an experimental program to support Tasks 1, 2 and 3. (Author)

See also report dated Sep 72, PB-214 067.

Malone, TB Krumm, RL Shenk, S Kao, H
Essex Corporation Final Rpt Sept. 1972, 204 pp

Contract DOT-HS-120-1-174

ACKNOWLEDGMENT: NTIS (PB-214066/3)
PURCHASE FROM: NTIS Repr PC, Microfiche

PB-214066/3, DOTL NTIS

B8 043795
HUMAN FACTORS CRITERIA FOR VEHICLE CONTROLS AND DISPLAYS: APPENDIX B
The steps followed in developing the standard C/D panels for each vehicle class are presented.

See also report dated Sep 72, PB-214 066 and PB-214 068.

Malone, TB Krumm, RL Shenk, S Kao, H
Essex Corporation Final Rpt Sept. 1972, 118 pp

Contract DOT-HS-120-1-174

ACKNOWLEDGMENT: NTIS (PB-214067/1)
PURCHASE FROM: NTIS Repr PC, Microfiche

PB-214067/1, DOTL NTIS

B8 043796
HUMAN FACTORS CRITERIA FOR VEHICLE CONTROLS AND DISPLAYS: APPENDIX C
Contents: Base line experiments; Comparisons of driver performance using alternative panels within vehicle classes; Analysis of driver performance across vehicle classes.

See also report dated Sep 72, PB-214 067, and PB-214 069.

Krumm, RL Malone, TB Kao, H Shenk, S
Essex Corporation Final Rpt Sept. 1972, 82 pp

Contract DOT-HS-120-1-174

ACKNOWLEDGMENT: NTIS (PB-214068/9)
PURCHASE FROM: NTIS Repr PC, Microfiche

PB-214068/9, DOTL NTIS

B8 043797
HUMAN FACTORS CRITERIA FOR VEHICLE CONTROLS AND DISPLAYS: APPENDIX D
A 3-beam headlight control study included concept development and experimental study.

See also report dated Sep 72, PB-214 068.

Krumm, RL Malone, TB Kao, H Shenk, S
Essex Corporation Final Rpt Sept. 1972, 22 pp

Contract DOT-HS-120-1-174

ACKNOWLEDGMENT: NTIS (PB-214069/7)
PURCHASE FROM: NTIS Repr PC, Microfiche

PB-214069/7, DOTL NTIS

B8 043998
DETECTION AND RECOGNITION OF COLORED SIGNAL LIGHTS
Two experiments were designed to determine effective colors for stimulus lights as measured by speed of detection and accuracy of identification. In addition, the nature of the interactions between stimulus color, background color, and amount of ambient illumination was assessed. Responses to four stimulus lights (red, green, yellow, and white) were evaluated against four colored backgrounds (copper, tan, blue, and green) under two levels of ambient illumination. The overall ordering of stimulus colors as measured by speed of responding was, from fastest to slowest, red, green, yellow, and

white. For errors in color naming, the order from least to most was green, red, white, and yellow. Detection and identification were more difficult under bright ambient illumination. The addition of an identification task added about 0.25 second to the response times for each color.

Reynolds, RE White, RM Hilgendorf, RL *Human Factors* Vol. 14 No. 3, June 1972, pp 227-236

PURCHASE FROM: Johns Hopkins Press Homewood Campus, Baltimore, Maryland, 21218 Repr PC

DOTL JC

B8 044016
EXPANDING ROLE OF THE TRAIN DESCRIBER
The train describer provides a base on which a complex network of reporting and control systems may be erected. Computer-controlled train describers now being installed between Weaver Junction and Glasgow will output selected operating data automatically, and the computer may be interrogated direct without disturbing the signalman. Simple routing decisions in accordance with priority rules are within the capacity of the equipment being installed.

Tyler, JFH *Railway Gazette International* Vol. 128 No. 1, Jan. 1972, pp 9-12

ACKNOWLEDGMENT: British Railways Board
PURCHASE FROM: IPC Transport Press Repr PC

DOTL JC

B8 044045
WASHINGTON OPTS FOR STAND-ALONE AUTOMATION
While including all the features which make BART the first fully automated transit operation, Washington metro has specified stand-alone capability in its signalling and train regulation systems so as to allow manual operation of the full scheduled service in the event of a computer or communication failure.

Railway Gazette International Vol. 128 No. 8, Aug. 1972, pp 298-302

ACKNOWLEDGMENT: British Railways Board
PURCHASE FROM: IPC Transport Press Repr PC

DOTL JC

B8 044052
A SCHEME FOR INSTALLING C.T.C. ON THE CHEAP
Centralised traffic control is almost invariably introduced in under-developed countries to increase the capacity of busy sections of line. Indeed, the associated reduction in station staff can be an embarrassment rather than an advantage where high unemployment is a problem. David Thornber points out that c.t.c. can be introduced at perhaps one-fifth of the present cost if it is regarded only as a better means of communication between the controller and signalmen, while still achieving the desired increase in line capacity.

Thornber, D *Railway Gazette International* Vol. 128 No. 11, Nov. 1972, pp 416-419

ACKNOWLEDGMENT: British Railways Board
PURCHASE FROM: IPC Transport Press Repr PC

DOTL JC

B8 044201
TWO-WAY RADIO COMMUNICATION MASS TRANSPORTATION DEMONSTRATION PROJECT
Existing equipment prior to the demonstration required that train crews descend to the tracks to report trouble, while police had to rely on conventional telephones available only in station clerks' booths. A variety of alternative mobile systems and components were considered, including train-to-wayside intercom systems currently used in Chicago, Toronto, and London. These proved too limited in scope for the complex New York City subway network. A portable, transistorized transmitter/receiver was judged ideal, particularly for the policemen who required compact, durable equipment. The engineering, operation, and maintenance of the selected system is documented. The improved communications were evaluated primarily in terms of reduced train delays and police reaction time. The latter was demonstrated to be particularly effective. Message delays between police dispatchers and transit patrollmen were reduced by 99%, and the ratio between crimes and arrests improved by 8% during daylight hours and rose to 95% at night. Overall operational efficiency also showed substantial improvement. The average number of train delays per month decreased 41%, and the average duration of such delays decreased 9% in the test area as compared with the system as a whole. Ridership within the test area was also shown to increase during the demonstration. It is concluded that overall, the project was successful enough to warrant the use of two-way radio equipment throughout the New York subway system. Appendices deal with capital and overhead costs for the project, and requirements for extension of the system to other divisions of the subway network.

New York City Transit Authority, (Ny-mtd-8)

ACKNOWLEDGMENT: UMTA
PURCHASE FROM: NTIS Repr PC, Microfiche

PB-177048, DOTL NTIS

B8 044204
DIGITAL-VOICE OVERLAY FOR LAND MOBILE COMMUNICATIONS
The technical feasibility of alternative means of multiplexing data and voice transmissions in a vehicle location and communications system is treated. Multiplexing refers to the sharing of a transmitter, a receiver, and a radio frequency channel by different users. Two multiplexing techniques are discussed: "time division" methods (tdm), in which each broadcaster is given a particular time slot during which he may transmit data and all other users remain silent; and frequency slot separated by guard bands to minimize cross-channel effects. Because tdm technology cannot easily or economically handle both voice and digital transmissions, the report focuses on fdm applications. Fdm systems necessarily employ equipment to modulate voice and data inputs in order to channel them into their appropriate slots. Considerations in applying channel modulation in location and communications systems are (1) frequency modulation, which is standard for land mobile services but requires potentially undesirable bandwidth occupancy requirements; (2) amplitude modulation, which suffers potential fading and drifting problems; (3) frequency shift keying; (4) phase-shift keying; and (5) on-off keying. Bandwidth requirements and data rate capability are discussed with reference to alternative fdm applications. Trade-offs in voice-data multiplex are considered in terms of power requirements for switching between voice and digital transmissions in the same frequency subchannel. Baseband spectrum occupancy, power requirements, and on operational considerations are also examined. The report concludes with a brief discussion of federal communications regulations that apply to implementation.

Scales, WC
IIT Research Institute, (Md-mtd-4) Nov. 1970

ACKNOWLEDGMENT: UMTA
PURCHASE FROM: NTIS Repr PC, Microfiche

PB-202025, DOTL NTIS

B8 044274
COMPUTER SIMULATION OF RAIL VEHICLE BRAKING PERFORMANCE
The ability to predict rail vehicle braking performance has been of vital interest to the railroads and railway brake equipment suppliers. A computer program developed to simulate rail vehicle braking performance provides a practical and efficient method of calculating braking performance and permits study and analysis of all elements of braking. For background information this paper briefly reviews the factors that affect braking performance, provides information on how the data for evaluating these factors was obtained, and describes the logic used in devising the computer program. The accuracy of the program is demonstrated by comparing calculated test results with actual field test and dynamometer test data. The potential usage of the program for the analysis of rail vehicle braking is described in general terms.

Contributed by the Rail Transportation Division of ASME for presentation at the Winter Annual Meeting, New York, New York, November 26-30, 1972.

Hart, JE Grejda, FJ (COBRA Shoe Engineering)
American Society of Mechanical Engineers Paper 72-WA/RT-5, July 1972, 11 pp, 10 Fig

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL RP

B8 044312
USE OF MINICOMPUTERS IN CTC OPERATION

This paper is organized into four divisions such that each division is an attempt to answer one of four questions. The four questions are: (1) What is computerized cTc? (2) How does computerized cTc function? (3) What need does computerized cTc fill? and (4) To what will the acceptance of computerized cTc lead: what may be the time frame? Centralized Traffic Control (cTc) is a method for controlling the traffic on a railroad system from a central location. The application of cTc has generally been restricted to main line operation between distant points so that railroad lines covering hundreds of miles are controlled over a telemetry system from a single location. The cTc system may therefore be considered in three parts; that is, the field circuits or field stations, the communications circuit or circuits which link the field to the single central location (office), and the central location or office itself. Computerized cTc is an office device which interfaces to the communications circuits to interrogate the status of the field locations and control these field locations. As computerized cTc is presently viewed by General Railway Signal, the computerization of the office need have no immediate impact on any existing field circuit design.

This paper was recommended by the IEEE Land Transportation Committee of the IEEE Industry Applications Society for presentation at the 1973 Joint ASME/IEEE Railroad Conference, St. Louis, Mo., April 11-12, 1973. The price is $1.35 for members.

Marsh, DB (General Railway Signal Company)
Institute of Electrical and Electronics Engineers Paper C73926-3-IA, Jan. 1973, 8 pp, 13 Fig

ACKNOWLEDGMENT: IEEE
PURCHASE FROM: IEEE Repr PC

B8 044566
CAR AND LOCOMOTIVE ORDERS AND SIGNALING STATISTICS

The statistics are for 1972 and cover: Freight-train car orders; Locomotive orders; Locomotive orders-Foreign; Freight-trains car orders-Canada; Locomotive orders-Canadian domestic; Freight-train car orders-Canadian Foreign; Railroad signaling installed in 1972; and Railroad communications installed in 1972.

Railway Age Vol. 174 No. 2, Jan. 1973, pp 82-88

ACKNOWLEDGMENT: Railway Age
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B8 046072
SURGE PROTECTION FOR SOLID STATE RAILROAD SIGNAL EQUIPMENT

Railroad signaling and communications equipment must operate under conditions that causes electrical surges. The problem of surge protection has been solved for conventional devices, and is now being solved for solid state devices. Electrical surges can be caused by lightning discharges, by power system switching and fault surges, and by the space charge associated with a cloud. Solid state devices are generally subject to damage by breakdown in the reverse direction. Protection problems can be grouped into three general areas: (1) AC power lines, (2) battery power supplies, and (3) information circuits of AC or modulated DC. The report describes the approaches taken for each of the three areas. Various methods of protection are explained and are illustrated with circuit diagrams.

Safetran Systems Corporation June 1971, 21 pp

ACKNOWLEDGMENT: Safetran Systems Corporation
PURCHASE FROM: Safetran Systems Corporation Railroad Accessories Company Division, Minneapolis, Minnesota, 55421 Repr PC
DOTL RP

B8 046308
ELECTRIFICATION HAS IMPACT ON SIGNALING

Electrification with its parallel power lines can interfere with signal systems. The effects of earth voltage gradients can cause foreign current to flow in track circuits. Electrostatic and electromagnetic induction due to inductive coupling exists between the power lines, track circuits and open wire C&S lines. Accidental contact between phase wires of the power line and some part of the signal system cause interference to the latter.

Railway System Controls Vol. 4 No. 5, May 1973, 2 pp

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B8 046323
MODERNIZATION OF SIGNALING MAINTENANCE

The mode of signaling maintenance presently being promoted which is claimed to be the most effective one, aims at preventing a fault in the facilities and assuring high efficiency in their operation. It is natural that even if JNR developments in equipment maintenance follow the same course as in general industries, the maintenance of signaling facilities in JNR is characterized by the early introduction (about 50 years ago) of the idea of "preventive maintenance." Preventive maintenance as contrasted to "break-down maintenance," means that, through periodic inspection, signs of functional deterioration in the equipment are detected early and the necessary steps are taken to restore its function and thereby maintain the functional integrity of the equipment. Thus, a progressive step was taken in this direction and since 1965, what might be called "corrective maintenance" has been positively introduced. More recently, another approach is being promoted in addition to the above-mentioned corrective maintenance approach; namely, the so-called "maintenance-free" principle: that is, the idea of securing the individual reliability of each component in a piece of equipment and improving the overall reliability of the unit as a whole.

Kataoka, A (Japanese National Railways) *Japanese Railway Engineering* Vol. 14 No. 1, 1973, 4 pp

PURCHASE FROM: Japan Railway Engineers' Association 2-5-18 Otemachi, Chiyoda-ku, Tokyo, Japan Repr PC
DOTL JC

B8 046356
RESIGNALLING THE MAIN LINE TO GLASGOW

By mid-summer most of the 366-km Weaver Junction to Glasgow section of BR's West Coast main line now being electrified will be controlled from four new signalboxes at Warrington, Preston, Carlisle and Motherwell.

Railway Gazette International Vol. 129 No. 3, Mar. 1973, pp 110-112, 1 Fig, 1 Tab, 3 Phot

PURCHASE FROM: IPC Transport Press Repr PC
DOTL JC

B8 046394
CONTINUOUS-ACCESS GUIDED COMMUNICATION (CAGC) FOR GROUND-TRANSPORTATION SYSTEMS

Electromagnetic open-guiding structures, or surface waveguides, for continuous-access guided communication (CAGC) and obstacle detection ("guided radar"), are described for use in ground transportation, such as railways, highways, and more advanced guided systems. The experimental and theoretical work at Queen's University on surface-wave devices and their application to obstacle detection are reviewed in detail. It is concluded that there is considerable promise in these techniques and that obstacle detection, in particular, deserves much more attention than it appears to have received.

Special issue on ground transportation for the eighties.

Beal, JC Josiak, J Mahmoud, SF Rawat, V (Queen's University) *Institute of Electrical and Electronics Engrs Proc* Vol. 61 No. 5, May 1973, pp 562-568, 30 Ref.

ACKNOWLEDGMENT: IEEE
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B8 046415
ALTERNATIVE SYSTEMS FOR RAPID-TRANSIT PROPULSION AND ELECTRICAL BRAKING

The need for rapid transit is stimulating further development in the technology and equipment for propulsion and electrical braking. Although the traditional cam-controller equipment is being improved, control systems

based on thyristors have some advantages over it, achieved at a cost in weight and complexity of the control equipment. The thyristor approaches overcome 2 basic problems of cam-controller equipment: the need for continual maintenance on the cam switch contacts and the power losses incurred when voltage is controlled by resistors.

Krings, BJ *Westinghouse Engineer* Vol. 33 No. 2, Mar. 1973, pp 34-41

PURCHASE FROM: Highway Research Board 2101 Constitution Avenue, NW, Washington, D.C., 20418 Repr PC

DOTL JC

B8 046426
RAILROAD SIGNALING TECHNOLOGY: A NEW APPROACH
The ever increasing volume of rail traffic demands an increase in capacity, which can only be met with higher traffic speeds and greater traffic density. Traffic control is essentially vehicle and track control and should therefore be automated to meet the demand. Control technologies using special circuit elements should not be employed. The aim should be to use standard, universally applicable circuit elements, as for example, large scale integrated circuits. Failure should be detected and corrected by software techniques tht ensure the fail-safe principle. Modified and improved existing systems using these techniques should be constructed on a building block principle and capable of change and expansion to enable any future system modification to be integrated.

Jakob, W (Standard Elektrik Lorenz) *Electrical Communication* Vol. 47 No. 4, 1972, pp 271-274

ACKNOWLEDGMENT: EI (EI 73 015176)
PURCHASE FROM: ESL Repr PC, Microfilm

B8 046689
AUTOMATION IN RAILWAY TRAFFIC CONTROL
The aim of railway traffic control is safety of operation coupled with maximum traffic density. The use of track circuits, automatic train control, centralized train control and the mechanised hump yard for marshalling trains is described. This control in addition to enhancing the safety of operation, produces considerable economics and large increases in revenue but its wholesale application is restricted by the lack of trained technicians. The author concludes that this deficiency requires a vast investment in staff training.

Husemeyer, NS *Certificated Engineer* Vol. 45 No. 4, Apr. 1972, pp 302-307

ACKNOWLEDGMENT: EI (EI 73 024706)
PURCHASE FROM: Institution of Certificated Mech and Elec Engrs P.O. Box 3361, Johannesburg, South Africa Repr PC

B8 046692
DEISGN TECHNIQUES FOR AUTOMATIC TRAIN CONTROL
It is shown how automated control and communication systems presently available provide safe and efficient train operation. System requirements, control implementation, and design techniques are discussed.

Hoyler, RC *Westinghouse Engineer* Vol. 32 No. 4, July 1972, 23 pp

ACKNOWLEDGMENT: EI (EI 73 034812)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B8 046715
ABC'S OF AIR BRAKES
Three volumes dealing with the fundamentals of air brake design, construction and operation of car air brakes, and locomotive brake devices. They include detailed diagrams and descriptions of the equipment, quizzes for home study, and an Air Brake dictionary. The second two volumes are Vol II "Car Air Brakes" and Vol III "Locomotive Air Brakes".

Drennan, CM
Simmons-Boardman Publishing Corporation Book

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Orig PC

DOTL 625.25 D772.C

B8 046746
AUTOMATIC DRIVE AND BRAKE CONTROL OF THE MULTIPLE-UNIT TRAIN TYPE 420 OF THE WEST GERMAN RAILROAD SYSTEM, AEG DESIGN [DIE AUTOMATISCHE FAHR-UND BREMSSTEUERUNG DES TRIEBZUGS 420 DER DEUTSCHEN BUNDESBAHN, BAUART AEG]
Features of the urban rapid transit system in the metropolitan area of Munich, West Germany are reported. The trains are equipped with modern control circuitry incorporating thyristors. The utilization of speed control equipment relieves the conductor from routine operations. Results of experimental performance are discussed. [German]

Mueller, HJ Zimmer, R *Elektrische Bahnen* Vol. 43 No. 7, July 1972, pp 158-163

ACKNOWLEDGMENT: EI (EI 73 027926)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B8 046769
COMPUTER-BASED TRAIN DESCRIBER COMMISSIONED ON BR WEST COAST MAIN LINE
Warrington power signal box commissioned in September bringing into operation Westinghouse train describer indicating up to 210 train positions on signal panel diagrams, the computers of which teleprint train counting, information to Station Managers etc, and could be linked into route-setting and ATC. Twin computers and other safeguards incorporated to provide automatic back-up in case of failure.

Rail Engineering International Vol. 3 No. 1, Jan. 1973, 5 pp, 3 Fig

PURCHASE FROM: Broadfields (Technical Publishers) Limited Little Leighs, Chelmsford, Essex CM3 1PF, England Repr PC

DOTL JC

B8 046812
INCORPORATING MINICOMPUTERS IN CENTRALISED TRAFFIC CONTROL
Minicomputers can be introduced into existing systems using the carrier and site instalations already operating and readily facilitate control offices being set up because of its ability to handle increased information and throw it up on two-stage screens with full site detail.

Marsh, DB *Rail Engineering International* Vol. 3 No. 3, Mar. 1973, 6 pp, 14 Fig

PURCHASE FROM: Broadfields (Technical Publishers) Limited Little Leighs, Chelmsford, Essex CM3 1PF, England Repr PC

DOTL JC

B8 046907
AUTOMATIC DRIVE AND BRAKE CONTROL FOR THE INTERCITY MULTIPLE-UNIT TRAIN, TYPE ET 403 [DIE AUTOMATISCHE FAHR-UND BREMSSTEUERUNG FUER DEN INTER-CITYTRIEBZUG ET 403]
A thyristor control system is described. It is reported that trains incorporating this system showed that every cutoff speed could be maintained within plus minus 0.25 km/hr and a target braking accuracy of plus minus 0.25 m was achieved. It was possible to relieve the conductor from performing manual operations to a considerable extent. [German]

Lichtenstein, L *Elektrische Bahnen* Vol. 43 No. 7, July 1972, pp 167-172

ACKNOWLEDGMENT: EI (EI 73 027928)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B8 046910
ORE LOOKS AT E.P. BRAKES FOR LONG FREIGHT TRAINS
A program of tests has established the superiority of the two-pipe automatic e.p. brake over the direct-acting type for use with automatic couplers.

Roberts, HP (British Railways) *Railway Gazette International* Vol. 128 No. 6, June 1972, pp 225-228

ACKNOWLEDGMENT: EI (EI 73 027263)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B8 046911
PRINCIPLES OF DYNAMIC TRANSPORTATION PERTAINING TO AUTOMATIC DRIVE AND BRAKE CONTROL [FAHRDYNAMISCHE GESICHTSPUNKTE ZUR AUTOMATISCHEN FAHR-UND BREMSSTEUERUNG]
The importance of the braking curve for automatic drive and brake control is discussed. An analysis is presented which correlates braking time and distance for given braking characteristics. The properties of the pneumatic brake are considered. Economic aspects are dealt with. [German]

Blueck, H *Elektrische Bahnen* Vol. 43 No. 7, July 1972, pp 147-152

ACKNOWLEDGMENT: EI (EI 73 027924)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

B8 046938
SURFACE WAVE CORRIDORS. COMMUNICATIONS FOR HIGH SPEED GROUND TRANSPORTATION SYSTEMS
A surface wave travels around a single conductor within a space of limited radius. Its low loss and broad bandwidth permit this line to replace coaxial cable and microwave relays for CATV and power distribution. The surface wave field can be extended to envelop a railroad track or a highway, and act as a continuous sensor for trains or vehicular traffic, and when surrounding a security area, to pinpoint an intruder. Essentially non-radiating, a number of surface wave corridors could coexist side by side, without interfering with each other or with the public wave spectrum.
Presented at the IEEE International Conference on Communication, Boulder, Colorado, June 9-11, 1969, Session 23.

Hafner, T (Surface Conduction, Incorporated)
Institution of Electrical Engineers Conf Rec , Session 23, June 1969, pp 7-12

ACKNOWLEDGMENT: EI (EI 72 47115)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

B8 046960
DEVELOPMENT TRENDS AND PERFORMANCE EXAMPLES OF THE AUTOMATIC DRIVE AND BRAKE CONTROL AT THE BROWN-BOVERI COMPANY [ENTWICKLUNGSTENDENZEN UND AUSFUEHRUNGSBEISPIELE DER AUTOMATISCHEN FAHR-UND BREMSSTEURUNG IM BROWN-BOVERI-KONZERN]
Problems associated with the automatic drive and brake control are discussed. Examples described include the speed control of a switch engine, automatic operation of an industrial railroad, control of a locomotive for an express train in West Germany, control of a motor car of the Swiss railroad system, and control of a train type 420 of the West German railroads. [German]

Eikermann, J *Elektrische Bahnen* Vol. 43 No. 7, July 1972, pp 152-158

ACKNOWLEDGMENT: EI (EI 73 027925)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

B8 046962
DRIVE AND BRAKE CONTROL OF THE LOCOMOTIVE TYPE E 103 [DIE FAHR-UND BREMSSTEUERUNG DER LOKOMOTIVE E 103]
In 1965 the West German Railroad System put into operation four locomotives, type E102, having a maximum speed of 200 km/hr. Some modifications in these locomotives are reported which were incorporated as a result of operational experience. [German]

Assmus, A *Elektrische Bahnen* Vol. 43 No. 7, July 1972, pp 163-167

ACKNOWLEDGMENT: EI (EI 73 027927)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

B8 046988
S&C CAN LIVE WITH 50KV, 60 HZ AC
Signal and communications facilities can be converted for satisfactory operation in electrified territory on railroads. There is no simple formula for determining conversion costs. Studies have indicated a variety of costs ranging from a low of $9,000 per track mile to a high of $30,000 per track mile. The type of signal and communications facilities in the existing railroad plant determine to a large extent the cost of making them compatible with electrified operations. Techniques for conversion are now known and proved feasible.

Railway System Controls Vol. 4 No. N7, July 1973, 2 pp

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B8 046989
FCC-RAILROAD STATUS OUTLINED BY THOMAS
The current status (April 15, 1973) of railroad activities with the Federal Communications Commission was the subject of recent talks by L. R. Thomas, general superintendent communications and signals, Santa Fe. Thomas spoke at two sectional meetings of the Communication & Signal Sectioon, AAR, at Arlington, Texas on April 24 and at Baltimore, Md. on May 17.

Thomas, LR *Railway System Controls* Vol. 4 No. N7, July 1973, 1 pp

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B8 046990
INTERCONNECTION IS VITAL TO RAILROADS
Railroads are vitally concerned with interconnection of their communications facilities with those of the public telephone network. At present, the Federal Communications Commission is looking into the matter. Generally, the telephone companies desire to install their own protective devices at the interface of customer-owned facilities and those of the phone companies. Railroads which have the expertise and ability to interconnect their own communications networks without harm to the public systems do not want to have this additional expense. Working with the AAR Communication & Signal Section, railroads can report on their experiences and problems in the interconnection field.

Railway System Controls Vol. 4 No. N7, July 1973, 3 pp

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

B8 047384
VIEWING OF RAILWAY FLASHING LIGHT SIGNALS
An attempt is made to bridge the gap existing between theoretical knowledge and published material on the one hand, and the practical application to an efficient outdoor flashing light warning system for railway purposes, on the other. The relative effectiveness of flashing light highway crossing signals under the full range of environmental conditions likely to be experienced in service is determined by many diverse factors, the principal ones being contrast brightness, apparent brightness magnitude, intensity of light output, signal colour, alignment and focusing of lights, and signal range. An examination is made of the above items and conclusions are drawn as to the minimum standards necessary for optimum viewing.
Perception and Application of Flashing Lights, International Symposium, 19-22 April 1971.

Cox, JJ (Victorian Railways)
Imperial College pp 189-207, 14 Ref

ACKNOWLEDGMENT: EI (EI 73 024032)
PURCHASE FROM: ESL Repr PC, Microfilm

B8 047468
SAMSON GIVES NEW LOOK TO METAL-SHOE BRAKING
For a month railroads have had the authority to replace conventional metal brake shoes on foreign freight cars with a new high-phosphorus shoe, billing owners for the 20% higher price which this product involves. In the wake of AAR conditional approval, the Mechanical Division Committee on Brakes and Brake Equipment is working on a specification for the new "high-phos" shoe, now designated AAR-1B.

Railway Locomotives and Cars Vol. 146 No. 8, Sept. 1972, pp 47-48

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

B8 047476
ELECTRIC BRAKING-PART 1: MULTIPLE UNITS
Braking is simply a means of converting energy from one form into another. The moving train has kinetic energy which can be calculated. If the train slows down for any reason, its kinetic energy must be converted into some other kind of energy. If a simple mechanical brake is used, the energy appears as heat; similarly, if the vehicle is coasting to a lower speed, heat appears in the bearings as a result of friction. If an electric brake is used, electricity is the new form of energy. This article is the first of two dealing with electric brakes on railways; it deals mainly with electric braking on multiple-unit trains.

Scott, M *Modern Railways* Vol. 30 No. 299, Aug. 1973, pp 318-321, 3 Fig, 4 Phot

ACKNOWLEDGMENT: Modern Railways
PURCHASE FROM: XUM Repr PC

DOTL JC

B8 047478
BRAKING THE SNCF'S TURBOTRAINS
Starting with more or less standard electro-pneumatic tread brakes on the 160 km/h ETG series, French Railways progressed through disc and hydraulic brakes on the 200 km/h RTG to a complex system with four inter-dependent components on the 300 km/h TGV.001 experimental turbotrain. The combination of light axleload with high speed that is a feature of gas turbine traction creates unique problems in braking, even though SNCF is prepared to modify its signalling to provide greater stopping distances.

Dubois, C (Cie des Freins et Signaux Westinghouse) *Railway Gazette International* Vol. 129 No. 2, Feb. 1973, 4 pp

PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B8 047479
IMPROVED BRAKING RAISES BR'S INTER-CITY SPEEDS
From 1975 onwards, British Rail's 125 mile/h diesel-powered train sets will give a 25 percent increase in top speed on non-electrified routes without alteration to the existing signalling. This has required a careful appraisal of existing braking technology to ensure consistent stopping within the distance now required by 100 mile/h locomotive-hauled trains.

Roberts, HP (British Railways) *Railway Gazette International* Vol. 129 No. 2, Feb. 1973, 3 pp

PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B8 047480
HYDROKINETIC BRAKES TO STOP THE APT
Hydraulic brake dynamometers have a long history, but the principle has rarely been applied to traction except as a by-product of hydraulic power transmission. The brake developed for BR's Advanced Passenger Train uses cast aluminium vanes inside a thin-walled tubular axle of large diameter to convert kinetic energy into heat by churning water, which is then cooled in external radiators after the stop has been completed.

Shore, AGL (British Railways Research Department) *Railway Gazette International* Vol. 129 No. 2, Feb. 1973, 3 pp

PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B8 047505
AUTOMATIC RUNNING AND BRAKING CONTROL. A MODULE FOR MODERN MOTIVE POWER SYSTEMS [AUTOMATISCHE FAHR-BREMS-STEUERUNG, EIN BAUSTEIN MODERNER TRIEBFAHRZEUGTECHNIK]
Automatic running and braking control forms the link between continuous automatic train running control and the vehicle controls. It contains a closed-loop speed control system with a supplementary device for automatic running and braking. Since it relieves the driver of routine tasks of speed adjustment and instrument reading, it enables him to devote more attention to the line ahead. A description is given of the input variables, the mode of operation and construction. [German]
Special Issue, Bahntechnik.

Lichtenstein, L *Siemens Review* Vol. 45 1971, pp 89-92

ACKNOWLEDGMENT: EI (EI 73 027038)
PURCHASE FROM: ESL Repr PC, Microfilm

B8 047506
INSTALLATIONS FOR SUPERVISION AND CONTROL OF THE SUBURBAN RAPID TRANSIT OPERATION IN MUNICH [ANLAGEN ZUM UEBERWACHEN UND STEUERN DES S-BAHN-BETRIGBS IN MUENCHEN]
Suburban rapid transit in the Munich area is being developed as a system distinct from the ordinary railroad and subway systems. Development laws and progress, including the use of all-relay central interlockings, the automatic blocking, continuous automatic train control with cab signals and data processing installations are described. Requirements for supervision and control tasks of central control offices using data transmission channels are discussed. In the first stage, the overall rail traffic will be covered according to type, time and location in five areas of supervision. [German]
Special Issue, Bahntechnik.

Schmidt, J *Siemens Review* Vol. 45 1971, pp 93-96

ACKNOWLEDGMENT: EI (EI 73 027039)
PURCHASE FROM: ESL Repr PC, Microfilm

B8 047507
ELECTRONIC REMOTE CONTROL SYSTEM DUS 600 FOR RAILROAD SIGNALING INSTALLATIONS [ELEKTRUNISCHES FERNWIRKSYSTEM DUS 600 ZUM FERNSTEUERN UND FERNUEBERWACHEN VON EISENBAHNSIGNALANLAGEN]
The remote control system DUS 600 replaces with its computer for data processing the hitherto usual central remote control devices. It corresponds to the signaling and operating requirements of the railway signaling technique. To each station--according to the number of installed information--a certain area is assigned. A continuous interrogation of indications is guaranteed by a cyclic repetition. An order determined in the computer system of the central control offices is transmitted by two separate channels to the station. The transmission of orders and indications is secured with the minimum hamming-distance d = 4. [German]
Special Issue, Bahntechnik.

Krug, A *Siemens Review* Vol. 45 1971, pp 97-100

ACKNOWLEDGMENT: EI (EI 73 027040)
PURCHASE FROM: ESL Repr PC, Microfilm

B8 047509
REMOTE CONTROL OF SHUNTING LOCOMOTIVES [FERNSTEUERUNG VON RANGIERLOKOMOTIVEN]
Remote control of shunting locomotives with the aid of continuous automatic train running control is described. Safety is ensured by protection loops at danger points and automatic braking on the occurrence of irregularities. The control can be incorporated directly into process control systems. VHF radio control from small portable units offers advantages for industrial railway operation where large areas may have to be covered but traffic density is low. [German]
Special Issue, Bahntechnik.

Hoppelshaeuser, F *Siemens Review* Vol. 45 1971, pp 110-113

ACKNOWLEDGMENT: EI (EI 73 027042)
PURCHASE FROM: ESL Repr PC, Microfilm

B8 047510
AUTOMATIC INTERNAL TRAIN CONTROL [AUTOMATION IM ZUGE]
Central buffer couplings have provided an important prerequisite for automatic control within a train unit. Equipment is described for transmitting commands from the locomotive to the cars and signals or commands from the cars to the locomotive or to other cars. Time-division multiplexing with length-modulated pulse trains is employed. [German]

Special Issue, Bahntechnik.
Allmendinger, AD *Siemens Review* Vol. 45 1971, pp 114-116

ACKNOWLEDGMENT: EI (EI 73 027043)
PURCHASE FROM: ESL Repr PC, Microfilm

B8 047517
HIGH-CAPACITY BRAKING RESISTORS FOR ELECTRIC LOCOMOTIVES [HOCHBELASTBARE BREMSWIDERSTANDSGERAETE FUER ELEKTRISCHE LOKOMOTIVEN]
The electrical braking capacities required for modern locomotives cannot be handled by the resistors of conventional design. It was therefore necessary to develop new braking resistors with approximately the same dimensions but twice the capacity. This has been achieved by providing gill-like slots in the resistance strips. Guidelines and mathematical relationships are given for the optimum design of resistors of this type. [German]
Special Issue, Bahntechnik.

Czerny, J Loos, R *Siemens Review* Vol. 45 1971, pp 140-143

ACKNOWLEDGMENT: EI (EI 73 027051)
PURCHASE FROM: ESL Repr PC, Microfilm

B8 047520
DC/DC CONVERTER FOR THE ELECTRICAL BRAKING SYSTEM OF LOCOMOTIVE E103 OF THE GERMAN FEDERAL RAILWAYS [GLEICHSTROMUMRICHTER FUER DIE ELEKTRISCHE BREMSE DER SERIENLOKOMOTIVE E 103]
To enable the traction motors to form the excitation power from their own braking power a d.c./d.c. converter is employed. This consists of an inverter and a rectifier. The inverter, which is connected in a controlled bridge arrangement with four main thyristors, two turn-off thyristors and load-dependent charging of the turn-off capacitors, can hanlde an unusually large input voltage range from 50 tp 550 V. An uncontrolled rectifier in single-phase bridge connection is arraged on the output side of the inverter. [German]
Special Issue, Bahntechnik.

Seidl, G *Siemens Review* Vol. 45 1971, pp 150-153

ACKNOWLEDGMENT: EI (EI 73 02754)
PURCHASE FROM: ESL Repr PC, Microfilm

B8 047522
AUDIO-FREQUENCY TRACK CIRCUITS FOR CHECKING OF TRACK SECTIONS [TONFREQUENZ-GLEISSTROMKREISE ZUM UEBERWACHEIV VON GLEISABSCHNITTEN]
Track circuits provide the information about the vacancy and occupancy state of line tracks, station tracks and points. Track circuits up to now were operated by direct or alternate voltage and required the division of the track into sections insultated from each other. By application of audiofrequencies, such a separation is unnecessary; the section ends form electrical separating bonds deriving from electrical separating bonds deriving from a connection of rail joints and condensers under utilization of the inductive resistance of the rails. The shorter length of the audiofrequency track circuits compared with the conventional ones permits their use on outer suburban railways or for special tasks on long distance railways. [German]
Special Issue, Bahntechnik.

Dickschen, A *Siemens Review* Vol. 45 1971, pp 161-164

ACKNOWLEDGMENT: EI (EI 73 927056)
PURCHASE FROM: ESL Repr PC, Microfilm

B8 047523
ELECTRONIC AXLE COUNTING FOR CHECKING OF TRACK SECTIONS [ELEKTRONISCHE ACHSZAEHLUNG ZUM UEBERWACHEN VON GLEISABSCHNITTEN]
Axle counting installations continuously provide informations on the vacancy or occupancy condition of station and line tracks. The counting pulse generated at the ends of a track section, due to passing wheels, are processed in a counting device, which gives the clear indication with safety in the case of equality of axles counted-in and out. Furthermore, with the use of axle indication points, beside the track clear indication, the axle number sum of a train can be utilized for the disposition of railway wagons. Axle indication points indicate whether a train has departed in its whole length and whether axles have been attached or detached. [German]
32 Z C Z CA Z
Special Issue, Bahntechnik.

Dampke, G *Siemens Review* Vol. 45 1971, pp 164-167

ACKNOWLEDGMENT: EI (EI 73 027057)
PURCHASE FROM: ESL Repr PC, Microfilm

B8 047530
CENTRAL TRAFFIC CONTROL OFFICES FOR LONG-DISTANCE AND OUTER SUBURBAN TRAFFIC [BETRIEBSLEITZENTRALEN FUER DEN FERN-UND NAHVERKEHR]
Pushbutton Interlockings, Centralized Control Boxes and Central Control Offices are the characteristics of the modern signaling technique for all railway systems. Central control offices with data processing installations check and control the operation aiming at the automation up to the centers of the interlocking areas. For checking, location and time recognition are necessary as a disposition basis, for which data display units and printers as well as a computer-controlled language output are employed. A special position is hereby taken by the outer suburban traffic, in which the point is close density of trains, punctuality and quick disposition. Here, the checking and connection of operation auxiliary equipment, as well as the coordination with other transport operators are to be solved. [German]

Schmidt, JJ *Siemens Review* Vol. 45 1971

NL

ACKNOWLEDGMENT: EI (EI 73 027036)
PURCHASE FROM: ESL Repr PC, Microfilm

B8 047800
DISC BRAKES : CONTRIBUTION TO THE STUDY OF THEIR RATIONAL USE ON RAILWAY VEHICLES [LE FREIN A DISQUES CONTRIBUTION A L'ETUDE DE SON UTILIZATION RATIONELLE SUR LES VEHICULES FERROVIAIRES]
Braking problems have become more complicated with highspeed running and, in solving them, greater consideration must be given to the inherent characteristics of disc brakes which are quite different from those of conventional brakes with cast-iron blocks. Initially, disc brakes are generally more expensive to install than shoe brakes but under actual operating conditions they can be more economical provided the discs last sufficiently long and the quality of the linings is good. The study of the basic phenomena which distinguish the operation of this brake system has been undertaken at the international level by the UIC Braking Sub-Committee. The article draws attention to the importance of the assembly of the discs and their mechanical arrangement which must allow for the expansion caused by heating when the brakes are applied. The work carried out includes the determination, on the brake testing plant at Vitry, of the maximum performance obtainable both for holding braking and braking to a stop, with given axle loads, average decelerations and speeds. A further study, based initially on theoretical calculations and the use of a computer, has shown the importance of the average diameter of the disc on the performance obtainable. The study also includes the examination of the adhesion conditions that are feasible on polluted rail, compared with brakes with cast-iron blocks. An effective solution has been proposed for curing the adhesion defects noted with disc brakes in the case of high performances. The study has also highlighted the importance of the linings on the performance that can be obtained with disc brakes, and how this performance can drop in the case of exceptional weather conditions (snow and low temperatures). Line tests, under difficult winter conditions, have enabled these phenomena to be determined with precision. [French]

Lapaiche, H *Revue Generale des Chemins de Fer* July 1972

ACKNOWLEDGMENT: UIC
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B8 047811
DEVELOPMENT OF LOCAL SIGNAL BOXES ON THE PARIS UNDERGROUND [L'EVOLUTION DES POSTES DE MANOEUVRE LOCAUX DU "METRO" URBAIN DE PARIS]
The authors (respectively Chief Engineer at the Electric Equipment Department and Chief Divisional Engineers at the Research Department of the RATP) explain the nature of the two types of shunting carried out in the Underground: a) ordinary: change of tracks at termini and stabling of trains; b) exceptional: change of tracks on the line and change of lines. They give historical details of earlier systems and describe the characteristics of the boxes used, whose efficiency is measured by their speed of action and their degree of automation and which incorporate two distinct techniques: one traditional for safety requirements, the other industrial for associated functions to simplify operations. The first all-relay boxes were installed in 1940; a new type of box known as the PEX (box recently been opened and the article gives its main characteristics. [French]

Majou, J Mez, H Besacier, G *Revue Generale des Chemins de Fer* Oct. 1972, p 640

ACKNOWLEDGMENT: UIC
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B8 047812
SIGNAL BOXES DEVELOPMENT AND CURRENT TRENDS [LES POSTES DE SIGNALISATION-EVOLUTION ET TENDANCES ACTUELLES]
The development of signal boxes on the SNCF has been directed mainly to concentration and extension of the area controlled by each box. In the circumstances, mechanical and electro-mechanical boxes have been practically eliminated. "All-relay" electric boxes have reached a satisfactory stage of technological development in the form of PRS-NS1 boxes. Certain variants of the conventional PRS box are however of special interest. The main variant is the PRGS or the Simplified Geographical All-Relay Box. This is an adaptation to SNCF requirements of boxes with a geographical structure and an "entry-exit" pubh-button table, as used by several European railways. The PRGS boxes are not equipped for pre-setting which is no disadvantage for the applications planned, i.e. for medium-sized stations, and consequently they represent an appreciable saving. Another variant is the "turn-push" handle type of box. The handles may be "individual" ones and form the basis of the PRMI which is replacing the PELI: track handle boxes can also be built especially for controlling the head of a set of service sidings. From the technological aspect, NS1 relays are being introduced at the same time as static components which seem to be very suitable for PRGS boxes. [French]

Weber, O Huet, J *Revue Generale des Chemins de Fer* Oct. 1972, p 633

ACKNOWLEDGMENT: UIC
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B8 047818
THE COMPOSITION SHOE CONTRIBUTION TO MODERN RAILROAD SERVICE
Something over ten years ago an intensive investigation was started to determine the specification for the ideal friction material for tread brake shoes to be used in railroad service. The general conclusions of this research were: 1. The coefficient of friction of the material should be uniform through out the speed range but with a slightly rising characteristic to substantially match the wheel-rail adhesion as the speed reduces. 2. Brake shoes made of such material should have a service life which would make the economics of its use highly attractive. 3. The friction material should have a higher coefficient of friction than conventionally employed to make possible greater simplification of control equipment and brake rigging. 4. The friction material must operate compatibly with existing wheels to improve wheel performance and economics. 5. Reliable braking performance must be assured under all normal operating conditions, including wet weather. Shortly after the above period, Westinghouse Air Brake Company, working with John-Manville Corporation, began their search for composition friction materials which would possess the foregoing characteristics to the greatest extent possible. Approximately four years ago, a modern composition shoe, called the COBRA shoe was offered for commercial use. There are now over 80 million vehicle miles of service experience with the shoe. Considerable pertinent data have been gathered with respect to its characteristics and performance.

Railroad Friction Products Corporation RFP-110, 17 pp, 14 Fig

ACKNOWLEDGMENT: Railroad Friction Products Corporation
PURCHASE FROM: Railroad Friction Products Corporation Wilmerding, Pennsylvania, Repr PC

DOTL RP

B8 047819
THE COBRA SHOE IN LOCOMOTIVE SERVICE
The braking forces when COBRA shoes are applied to a locomotive must be less then when metal shoes are used, since the COBRA shoe has a higher coefficient of friction. The spread between the coefficients of friction of COBRA and metal shoes increases as the speed increases; therefore, the nominal operating speed must be taken into account when COBRA shoes are applied. For this reason, the amount of braking force varies with type of service and with the brake system. One amount of force is used for the independent brake system which is normally used in low speed switching service. A different amount of force is used for the automatic brake system which is sused at the higher speeds encountered in road service. With this in mind, the tabulation lists the general recommended braking ratios for application of CoBRA shoes to locomotives.

Railroad Friction Products Corporation RFP-112, June 1972, 21 pp, 3 Fig

ACKNOWLEDGMENT: Railroad Friction Products Corporation
PURCHASE FROM: Railroad Friction Products Corporation Wilmerding, Pennsylvania, Repr PC

DOTL RP

B8 047820
WABCOPAC BRAKE ASSEMBLY TODAY-DESIGN AND PERFORMANCE
The WABCOPAC brake assembly has now been in service for approximately 12 years with over 120,000 cars presently equipped. Most of these cars are of the high utilization, high capacity types. As occurs with any equipment offered for general interchange service, many evolutionary improvements have been made over this 12-year period. Some were made as a result of changing operating requirements, others because of the extensive service experience reflecting all types of operating and environmental conditions. This paper will discuss the design improvements incorporated into the WABCOPAC brake assembly over this period, the test criteria used to evaluate the effectiveness of these changes, and the improved braking performance that the WABCOPAC brake assembly is presently providing.
Presented at the Air Brake Association Annual Meeting, Sept. 14, 1970.

Wilson, RL
Westinghouse Air Brake Company 23 pp, 8 Fig

ACKNOWLEDGMENT: Westinghouse Air Brake Company
PURCHASE FROM: Westinghouse Air Brake Company Wilmerding, Pennsylvania, Repr PC

DOTL RP

B8 047821
BRAKE SHOE PERFORMANCE ON 100 TON FREIGHT CARS
The braking performance of 100-ton cars should be viewed from the ability to provide a braking level or stopping capability no less favorable than lighter weight cars. Such a performance level can not be matched by 100-ton cars with cast metal shoes at a reasonable braking ratio. However the performance criteria for COBRA shoes on 100-ton cars is to provide a stopping ability, at minimum, on less favorable than a 50-ton car with cast metal shoes. This has obvious benefits in the areas of signal spacing, high speed consideration, etc. With this stopping ability however the most advantageous maintenance and economic relationships available should be realized. With the number of existing 100-ton cars with metal shoes presently in service, together with the majority of new 100-ton cars having COBRA shoes, it has been possible to accurately measure the economic and braking performance relationships between the two brake shoe concepts. The information contained in this presentation provides a summary of data in both of these areas.

Railroad Friction Products Corporation RFP-111, Feb. 1969, 14 pp, 4 Fig, 2 Tab

ACKNOWLEDGMENT: Railroad Friction Products Corporation
PURCHASE FROM: Railroad Friction Products Corporation Wilmerding, Pennsylvania, Repr PC

DOTL RP

B8 047822
CONVERTING FREIGHT CARS TO COBRA SHOES BY MEANS OF A 7 1/2 INCH CONVERSION KIT IN A 10 INCH AB BRAKE CYLINDER
A simple method to obtain the benefits of COBRA shoes on existing 50 and 70-ton freight cars equipped with cast metal brake shoes is to use the 7-1/2" brake cylinder conversion kit in the AB-10" brake cylinder. This presentation illustrates the upgraded braking performance and the resulting brake shoe and wheel savings when such cars are converted to COBRA shoes by this means. This conversion is also a simple solution to the problem of meeting the recommended braking ratio level on rebuilt cars affected by the 5% increase in gross rail load limit.

Westinghouse Air Brake Company 27 pp, 8 Fig, 3 Tab

ACKNOWLEDGMENT: Westinghouse Air Brake Company
PURCHASE FROM: Westinghouse Air Brake Company Wilmerding, Pennsylvania, Repr PC

DOTL RP

B8 047823
UPGRADED TRAIN BRAKE PERFORMANCE RESULTING FROM 1972 BRAKING RATIO DEFINITIONS
Braking ration in its specific terminology is merely an expression of the percentage of car weight which is translatable to total brake shoe force. In the past few years the AAR has systematically addressed their attention to recognizing and establishing some degree of limits on several of the variables which effect brake performance. With the advent of composition brake shoes, a performance specification was adopted which, in effect, set acceptable maximum and minimum friction levels for this type of brake shoe in both "stop" type braking and continous horsepower or grade braking. Essentially this redefinition of braking ratio eliminated the rigging loss variable as a factor influencing brake performance.
Presented at the Air Brake Association Annual Meeting, Chicago, Ill., Sept. 19, 1972.

Janke, JC
Westinghouse Air Brake Company 19 pp, 9 Fig., 1 Tab.

ACKNOWLEDGMENT: Westinghouse Air Brake Company
PURCHASE FROM: Westinghouse Air Brake Company Wilmerding, Pennsylvania, Repr PC

DOTL RP

B8 047883
TRAIN CONTROL SYSTEMS FOR THE AUTOMATION OF RAIL TRAFFIC [ZUGBEEINFLUSSUNGSSYSTEME ZUR AUTOMATION DES SCHIENENVERKEHRS]
The development of optical signaling systems for train control is discussed, along with various systems of linear control. Specific problems pertaining to the West German Railroad System are considered. [German]

Gruenewald, H Krauss, HJ *Elektrische Bahnen* Vol. 44 No. 4, Apr. 1973, pp 83-92, 14 Ref

ACKNOWLEDGMENT: EI (EI 73 041299)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B8 047889
RAILWAY SIGNALLING DEVELOPMENT
Review of the use of power operated and color light signaling includes track circuits on electrified railways, control circuits, cabling and relays, relay interlocking and control panels, remote control systems, direct wire system, time dividion multiplex systems, frequency division multiplex systems, and track to train communication.

Foster, GI (General Electric Company, General Signal Limited) *Railway Engineering Journal* Vol. 2 No. 3, May 1973, pp 6-15

ACKNOWLEDGMENT: EI (EI 73 041471)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B8 047916
USE AND DEVELOPMENT OF ELECTRONICS IN LOCOMOTIVE CONTROL SYSTEMS
British Railways and manufacturers' points of view in introducing electronics into locomotive control systems are discussed.

Bradley, RM Wilson, RM *Railway Engineering Journal* Vol. 2 No. 2, Mar. 1973, pp 44-52

ACKNOWLEDGMENT: EI (EI 73 031067)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B8 047929
EFFECTS OF NEW FREIGHT CAR TECHNOLOGY ON THE SWITCHING PROCESS
New developments, such as remote uncoupling, automatic coupling of air and electric circuits, electric braking systems, braking by wayside systems, etc., are reviewed. Projected advantages are improved yard classification of trains, easier switching, simplified brake bleeding, quicker coupling and uncoupling and improved track usage.

Ditmeyer, SR (Federal Railroad Administration); Lang, AS *Railway Management Review* Vol. 72 No. 2, 1972, pp A59-A71

ACKNOWLEDGMENT: EI (EI 73 036295)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B8 048025
CONTINUOUS LAYING-IN OF BURIED CABLES BY A CABLE-LAYING TRAIN USING THE TRENCHLESS METHOD
Totally self-contained mobile cable-laying train developed by Balfour Kilpatrick using simultaneous entrenchment to obviate cable, becoming lost or damaged by preliminary laying out ahead of final installation.

Rail Engineering International Vol. 3 No. 6, July 1973, pp 278-280, 4 Fig

PURCHASE FROM: Broadfields (Technical Publishers) Limited Little Leighs, Chelmsford, Essex CM3 1PF, England Repr PC

DOTL JC

B8 048153
RADAR MAKES FAULT-FINDING FAST
Southern Railway has shortened the time required to locate and clear troubles in their communications and signaling cables. The time saving has been made possible by the use of several Radar Cable Test Sets.

Railway System Controls Vol. 4 No. 9, Sept. 1973, pp 20-21, 3 Fig

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

B8 048221
AS BR ANGLO-SCOTTISH ELECTRIFICATION REACHES PRESTON, SIGNALLING AND TRACTION MODERNISATION NEAR FRUITION
230 ac locomotives comprising 35 new 147 refurbished and 48 as-built units present a resourceful outcome of modern thinking, as does the establishing of only four control areas to operate over 400 route-miles fully covered by comprehensive telecommunication network, colour-light signalling, route-relay interlocking, computerized train reporting and describing, and hotbox-detection network.

Rail Engineering International Vol. 3 No. 7, Sept. 1973, 4 pp, 3 Fig, 1 Phot

PURCHASE FROM: Broadfields (Technical Publishers) Limited Little Leighs, Chelmsford, Essex CM3 1PF, England Repr PC

DOTL JC

B8 048286
C&S TREND IS TOWARD SIMPLER, STURDIER MORE RELIABLE EQUIPMENT
One strong trend in the communications and signal equipment area is development of products that not only provide greater reliability, longer life and greater capacity but also cost less to install, operate and maintain. The

increased productivity potential lies in a railroad's ability to make use of more communications and signal equipment, with a given manpower requirement, than was possible in former years, especially before the advent of integrated circuits and other solid-state electronics techniques.

Railway Age Vol. 174 No. 17, Sept. 1973, 3 pp, 10 Phot

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

B8 050031
TRAIN CONTROL AND SIGNALLING METHODS FOR SAFE HIGH-SPEED RUNNING
Recent developments in signaling practice and equipment on British railroads are reviewed. Alternative forms of remote control systems, train describers, relay development, train control and rapid transit trends are described.

Barker, PJ (General Electric Company) *Journal of Science and Technology* Vol. 39 No. 2, 1972, pp 70-75

ACKNOWLEDGMENT: EI (EI 73 044058)
PURCHASE FROM: ESL Repr PC, Microfilm

B8 050032
RECORDING OF CONTROLS ON THE WORKING OF BRAKES ON RAILROAD VEHICLES [CONTROLLI DI FUNZIONAMENTO DELLE APPARECCHIATURE DEL FRENO PNEUMATICO DIE ROTABILI]
The problem of systematic control of the working of brakes is considered. A special bogie created for this purpose in 1934 has been improved and equipped with an arrangement for automatic and continuous recording of control results. Information is given on the 1970 experimental control device and of the two models in operation since 1971, designed by the author. [Italian]

Greco, A *Ingegneria Ferroviaria* No. 1, Jan. 1973, pp 13-25

ACKNOWLEDGMENT: EI (EI 73 045869)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B8 050033
USE OF HIGH-FREQUENCY TELEPHONE SYSTEMS AND IN PARTICULAR 120-CHANNEL SYSTEM IN THE RAILROAD TELECOMMUNICATION NETWORK [L'IMPIEGO DI SISTEMI TELEFONICI IN A.F. ED IN PARTICOLARE DEI SISTEMI A 120 CANALI NELLA RETE DI TELECOMUNICAZIONE FERROVIARIA]
The use of high-frequency telephone system is well-adapted to the requirements of the railway telecommunications network. Alongside the traditional systems of 12-channel capacity and those by means of co-axial cable, the Italian State Railroad has introduced a 120-channel system to be used on a symmetrical cable. After mentioning some solutions adopted to solve questions arising from the characteristics of railway cables, a resume is given of the salient characteristics of the system together with some test results. A conclusion is made by expressing the opinion that the equipment adopted satisfies railway requirements. [Italian]

Lega, L Cremascoli, P *Ingegneria Ferroviaria* No. 1, Jan. 1973, pp 3-12

ACKNOWLEDGMENT: EI (EI 73 045868)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B8 050084
INDUCTIVE SIGNALLING FOR SPEED RESTRICTIONS ON THE GERMAN FEDERAL RAILWAY
With the advent of higher speeds, the DB has adapted its inductive signalling and train control to ensure reduction of speed over restricted lengths even if the driver fails to slow down.

Railway Gazette International Vol. 128 No. 12, Dec. 1972, pp 465-466

ACKNOWLEDGMENT: British Railways (29098)
PURCHASE FROM: IPC Transport Press Repr PC

DOTL JC

B8 050098
NEW MACHINE TESTS BRAKES AT HIGH SPEED
A high speed railway brake test dynamometer to further research into development of tread and disc brake composition materials has been developed by a British company, Trist, Draper. The machine was built to Trist, draper design by Benrath Machine Tools, Manchester. Commissioned in January this year, its first programme will be to complete evaluation of a new, conformable block material for use on suburban multiple unit railway stock at speeds of up to 160 km/h and axle loads of up to 12 tons.

International Railway Journal Vol. 13 No. 5, May 1973, pp 38

ACKNOWLEDGMENT: British Railways (29490)
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

B8 050132
FREIGHT TRAIN BRAKING LEVEL
It is the purpose of this paper to present some data and thoughts that might help in establishing braking levels for freight cars and trains to meet future requirements. It is apparent that conditions have changed materially since the 1930 freight car braking level requirements were brought up to date in 1956 to be not less than 18% on the load limit and not more than 80% on the lightweight.
Presented at The Air Brake Association Annual Meeting October 1, 1968.

Kirk, WB
Westinghouse Air Brake Company Oct. 1968, 22 pp, 14 Fig, Tabs

PURCHASE FROM: Westinghouse Air Brake Company 1200 18th Street, Washington, D.C., 20036 Repr PC

DOTL RP

B8 050417
THE SUPER 70'S
Four billion dollars will be spent for cummunication, data processing and signaling in the seventies. Planned expenditures in these three sectors are given.

Railway System Controls Vol. 4 N Mar. 1973, 7 pp

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

B8 050419
TRAIN DETECTION PROBLEM STILL PLAGUES BART
Engineers at the Bay Area Rapid Transit (BART) District are exploring new solutions to the train detection problem delaying the service through the transbay tube to San Francisco, now scheduled for May 1974 (ENR 8/30 p. 14). The California Public Utilities Commission (PUC), which will not allow BART to route trains to and from Oakland through the tube until the problem is solved, has concluded that the wheel scrubbers installed last spring are not a cure.

Engineering News-Record Vol. 191 No. 5, Oct. 1973, 1 pp

PURCHASE FROM: McGraw-Hill, Incorporated 1221 Avenue of the Americas, New York, New York, 10020 Repr PC

DOTL JC

B8 050538
BART TIGHTENS SAFETY ON CONTROLS
The San Francisco Bay Area Rapid Transit (BART) District has installed electronic recorders on its trains to check on the contorl system in response to a report that claims the system does not consistently detect all trains on the 39 miles of track that are now open.

Hammond, DG *Engineering News-Record* Vol. 190 No. 8, Feb. 1973, 1 pp

PURCHASE FROM: McGraw-Hill, Incorporated 221 Avenue of the Americas, New York, New York, 10020 Repr PC

DOTL JC

B8 050587
THE BREAKING, BRAKE-RELEASE, AND STARTING PROBLEM OF LONG TRAINS WITH CENTER-BUFFER COUPLINGS [DAS BREMS-, LOSE-UND ANFAHRPROBLEM VON LANGEN ZUGEN MIT MITTELPUFFERKUPPLUNGEN]
A complete equation of the problem, taking into account: 1) the tractive effort of the locomotive; 2) the vehicle masses; 3) their resistance to forward running; 4) the braking effort, the speed of propagation of the brake wave, the length of time necessary in order to release the brakes; and 5) the elastic, non-linear, characteristics of the couplings. A description is given of the programming of the mathematical model, together with a comparison, in the diagrams, between the calculated results, and those measured during tests. [German]

Reich, O Reick, KD *Hochschule f Verkehrs F List Wissenschraft Zeitsch* No. 3, 1972, 16 pp, Figs, 5 Ref

ACKNOWLEDGMENT: International Railway Documentation
PURCHASE FROM: International Union of Railways, BDC 14 rue Jean Rey, 75015 Paris, France Repr PC

902

B8 050590
THE SWISS FEDERAL RAILWAYS' SWISS EXPRESS COACHES WITH TILTING EQUIPMENT [DER SUISSE-EXPRESS-WAGEN MIT QUERNEIGE-EINRICHTUNG DER SCHWEIZERISCHEN BUNDESBAHNEN]
These coaches have an aluminum body, are air-conditioned, and are designed for a maximum speed of 140 km/h. Gangway connections, without doors, are provided between the coaches, as well as UIC type automatic centre buffer, couplings. The 728 SIG-A type bogies are provided with body tilting equipment, which is operated by means of one electromotor per bogie, over a guide rail. Guidance is effected by means of centrifugal equipment. The coaches are equipped with a combined disc-block brake, the discs providing 75%, and the brake-blocks 25%, of the brake power. [German]

Lack, H Schaffner, A Meyer, W *Glasers Annalen ZEV* No. 1, 1973, 9 pp, 14 Fig

ACKNOWLEDGMENT: International Railway Documentation
PURCHASE FROM: International Union of Railways, BDC 14 rue Jean Rey, 75015 Paris, France Repr PC

911, DOTL JC

B8 050604
INCREASED STOPPING DISTANCES DUE TO ICE ON BRAKE BLOCKS
A theory is proposed which predicts increased stopping distances due to ice on brake blocks by assuming that an initial low brake friction is maintained until the ice layer is melted by frictional heating. The friction then becomes that of the dry block. Reasonable agreement is obtained with Winter stopping distances published by O.R.E. which reveal that all types of block, including cast iron, are similary affected by pre-formed ice layers.

Pritchard, C Tanvir, MA (British Railways) *Rail International* No. 7, July 1973, pp 802-806, 1 Fig, 1 Tab, 7 Ref

ACKNOWLEDGMENT: International Railway Congress Association
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B8 050618
ELECTRIC BRAKING, PART 2: LOCOMOTIVES
While, for multiple units the emphasis with braking is usually on stopping the train, for locomotives it is more usual to want to use the electric brake to hold a steady speed, supplementing this with air (or vacuum) to bring the train to a stop. Locomotives fitted with dynamic brake are therefore usually found on railway systems with long grades. The basic problems for multiple unit and locomotives are the same (slow-speed fade-out matching regenerated energy to the receptivity of the supply) but they have differing degrees of urgency for the two types of vehicle. Again, for locomotives, both rheostatic and regenerative brakes are available and either can be operated alone or blended with air/vacuum.

Electric Braking, Part 1, dealing with braking of multiple units, was published in Modern Railways, August 1973.

Scott, M *Modern Railways* Vol. 30 No. 302, Jan. 1973, pp 442-444, 2 Fig, 7 Phot

PURCHASE FROM: Allan (Ian) Limited Terminal House, Shepperton TW17 8AS, Middlesex, England Repr PC

DOTL JC

B8 050640
AUTOMATION IN THE SUBURBS: OPERATION, SIGNALLING, DRIVING AIDS AND TRAFFIC CONTROL
In this article, the authors, who are senior officials at the SNCF responsible respectively for cybernetics matters at the Transport Management and the Research Department, explain the objectives sought by automation when it is particularly desirable as is the case for very dense suburban traffic varying from day to day and from hour to hour, and which can have a detrimental effect on main line traffic. They give details of the essential operational functions that must be carried out, the need to rectify as possible any incidents which may occur so that normal running can be resumed, how driving and other railway staff are involved, the systems in operation and the results obtained. They place special emphasis on the importance of strict traffic monitoring and control, especially in suburban areas, which, by employing a sophisticated driving programme (acceleration or deceleration) depending on the actual or predicted line occupation, enable more trains to be worked through during a given period of time. [French]

Meyer, JL Andouin, J *Revue Generale des Chemins de Fer* Apr. 1973, pp 256-265, 7 Fig

ACKNOWLEDGMENT: French National Railways
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B8 050675
PRESENT KNOWLEDGE OF ADHESION AND ITS UTILISATION
The phenomenon of adhesion has since become the vital problem, representing the principal limitation to the increase in the magnitude of the tractive and braking forces at low speed as well as at medium speed. Scope and nature of the investigations concerning adhesion and its utilization have obviously developed in parallel to the importance attached to the problem itself. During the last decades, research on the subject of adhesion has not only developed considerably but its nature has also undergone a remarkable development. These different research programmes have already enabled several countries to achieve substantial improvements in the values of the adhesion coefficient which were applied in connection with the calculation of maximum train loads.

Verbeeck, H *Rail International* No. 6, June 1973, 34 pp, 27 Fig, 53 Ref

ACKNOWLEDGMENT: Rail International
PURCHASE FROM: International Railway Congress Association 17-21 rue de Louvrain, 1000 Brussels, Belgium Repr PC

DOTL JC

B8 050730
INVESTIGATION OF VOLTAGE TRANSIENTS AND SPIKES IN DIRECT CURRENT RAPID TRANSIT SYSTEMS
Voltage transients and spikes have been investigated on five existing rail rapid transit systems to define the power environment in which new rail transit cars might be expected to operate. A final report describes and evaluates observed third-rail shoe transient and spike voltages, measured in subway installations in Philadelphia, New York City, Boston, Cleveland, and Chicago during rush and non-rush hours. It condenses these data into curves which may be used as the basis of a general performance specification. The underlying theory as well as special test equipment used during the field test activity is described in detail, together with a special computer program required for test data evaluation. The results obtained may be applied to future subway car speed control systems using static power conversion.

Boeing Company Final Rpt DI74-10017-1, June 1973, 256 pp

Contract DOT-UT-10007

ACKNOWLEDGMENT: NTIS (PB-222698/3)
PURCHASE FROM: NTIS Repr PC, Microfiche

PB-222698/3

B8 050886
BRITISH RAILWAYS WEST COAST ROUTE RESIGNALLING
The Weaver Junction to Kirkpatrick resignalling scheme comprises three signalling control centres which between them cover 466 route kilometres. In addition to interlockings in each of the control centres, electronic remote control equipment cover 27 satellite interlockings and the train descriptions for the entrance-exit type control panels are also presented electronically.

Rail Engineering International Vol. 3 No. 8, Oct. 1973, pp 355-364, Phots

ACKNOWLEDGMENT: Rail Engineering International
PURCHASE FROM: Broadfields (Technical Publishers) Limited Little Leighs, Chelmsford, Essex CM3 1PF, England Repr PC
DOTL JC

B8 050887
INTRODUCTION BY NETHERLANDS RAILWAYS OF COMPUTERISED AUTOMATIC ROUTE-CONTROL AT TWO MAIN CENTRES
Real-time computer system developed by GRS being incorporated into existing control networks at Amsterdam and Utrecht to obtain maximum controllability of intensive services.

DeHeer, JJ (Nederlandse Spoorwegen) *Rail Engineering International* Vol. 3 No. 8, Oct. 1973, pp 367-373, 9 Fig

ACKNOWLEDGMENT: Rail Engineering International
PURCHASE FROM: Broadfields (Technical Publishers) Limited Little Leighs, Chelmsford, Essex CM3 1PF, England Repr PC
DOTL JC

B8 050890
SWISS FEDERAL RAILWAYS PERPETUATE MODERN CONVENTIONAL ELECTRIC-TRACTION TECHNIQUES FOR ITS LATEST 8,000 KW LOCOMOTIVES
Class Re6/6 Bo-Bo-Bo 120-tonne electric locomotives developed for 800-tonne trains over the Gotthard route using a conventional frame design after trials with prototypes incorporating both jointed and full length underframes and superstructures. Conclusions on signal/telecommunication interference protection currently assessed in respect to thyristor control and considered to outweigh advantages achieved due to long-term immunisation programme involved.

Meyer, K (Swiss Federal Railways) *Rail Engineering International* Vol. 3 No. 8, Oct. 1973, pp 385-392, 13 Fig

ACKNOWLEDGMENT: Rail Engineering International
PURCHASE FROM: Broadfields (Technical Publishers) Limited Little Leighs, Chelmsford, Essex CM3 1PF, England Repr PC
DOTL JC

B8 051313
AUTOMATIC TRAIN OPERATION
This selective bibliography covers 75 articles on automatic train control, many of them in journals and from reports not covered by RRIS. The articles are from the middle sixties to the early seventies, and most are from European or Japanese sources.

International Union of Railways, BD Sept. 1973, 41 pp

PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr PC
DOTL RP

B8 051314
AUTOMATION OF MOTIVE POWER UNITS AS REGARDS THE CONSTRUCTION OF ELECTRIC LOCOMOTIVES
The author shows the reasons for which the railways are particularly suitable for automation, from both a technical and an economic point of view, and then examines automatic train running control, continuous automatic control and cab signals, and automatic running and braking control, describing, as an example, the DB's type 103 high-speed locomotive and its equipment. He also describes the experiments carried out on series 110 300 and 110 299 locomotives, as well as on locomotive 112 270, equipped for braking to a stop, and refers to the ultimate object of research, which should result in the rationalization, as well as in an improvement and speeding-up, of the whole process of transport.

Gierth, E *International Railway Congress Assn Monthly Bull* Vol. 6 No. 6-7, June 1969, 35 pp, 11 Ref

ACKNOWLEDGMENT: UIC
PURCHASE FROM: International Railway Congress Association 17-21 rue de Louvrain, 1000 Brussels, Belgium Repr PC
DOTL JC

B8 051315
RECENT DEVELOPMENTS IN THE REGULATION OF THE MOVEMENT OF TRAINS
The above article deals with the studies which are now being carried out on British Railway with the object of improving the flow of traffic. A description is given of the necessary equipment, which is now being perfected, for the creation of a system of communications enabling permanent bilateral communications to be established, as well as a more material link for the tramsission of data between the control centres and the moving trains, and a special computer is being constructed which, when placed on the train, will constantly keep the driver informed of the maximum speed to be observed. It should be noted that the control centres will not transmit information concerning safety, so that, even in the case of breakdown, it will be possible for the trains to continue to run in complete security. A computer, known as a "safety computer" will record, on punched cards, the safety details relating specifically to a train, and will process them with the help of the information obtained from the track.

Alston, LL *International Railway Congress Assn Monthly Bull* Vol. 6 No. 1, Jan. 1969, 19 pp, 16 Fig, 7 Ref

ACKNOWLEDGMENT: UIC
PURCHASE FROM: International Railway Congress Association 17-21 rue de Louvrain, 1000 Brussels, Belgium Repr PC
DOTL JC

B8 051317
CYBERNETIC OPERATION OF RAILWAY TRAFFIC
This is a statement of the BR's future prospects about automatic train operation and lines control. The principles of "module operation" achieving exact functions are given.

Alston, LL Davies, D *Rail International* Sept. 1970, 4 pp, 5 Ref

ACKNOWLEDGMENT: UIC
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

B8 051319
BAY AREA TRANSIT SYSTEM WILL HAVE AUTOMATED CENTRAL CONTROL
The above article contains details of the BART central control system, together with a brief description of the network. The system will comprise a central unit ensuring optimum working, and local units carrying out vital operation. The central unit has no control over the local units, except in the case of certain of their non-vital operations, such as the length of stops. The article contains a reproduction of the diagram of the central unit, as well as details of the characteristics of its different parts, and an explanation of its method of operation and functions.

Gibson, TR *Westinghouse Engineer* Vol. 30 N Mar. 1970, 4 pp, 4 Fig

ACKNOWLEDGMENT: UIC
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B8 051320
AUTOMATIC CONTROL OF TRAIN MOVEMENT ON A RAPID TRANSPORT SYSTEM FOR LONDON
The paper covers system arrangements for the automatic operation of the Victoria Line, and explains the part played by the programme machines for signaling associated with automatic train operation and its cybernetic application for management control. The paper also covers the communication system employed.

Hadaway, HW *Rail International* Sept. 1970, 6 pp, 4 Fig

ACKNOWLEDGMENT: UIC
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

B8 051321
DEVELOPMENTS IN TRAIN CONTROL ON BRITISH RAILWAYS
After commenting briefly on the equipment available up to 1970, the authors provide a description of the Southern Region Automatic Warning Systems (STRAWS), which is used on the line between Totton and Bournemouth. This installation is to be improved by means of the following additional equipment; (1) automatic speed control with an integrated programme on the motive-power unit; (2) introduction of a central cabin for the control of programme alternations; (3) marshalling and running control of trains in the event of delay. This equipment has been designed in such a way as to remain compatible with the later development of train control by means of a central computer. Provision has been made for two types of equipment--that which is directly concerned with operating safety, and that which is independent of it. During 1972, an automatic installation for bringing a train alongside a platform by means of centralized control will be tested at Glasgow Central Station. It comprises a computer with store which optimises the use of the 13 tracks in accordance with the schedules of the trains running through a 6-track bottleneck at the entrance to the station.

Alston, LL Birkey, JW *Rail Engineering International* Nov. 1971, 8 pp, 10 Fig, 4 Ref

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Broadfields (Technical Publishers) Limited Little Leighs, Chelmsford, Essex CM3 1PF, England Repr PC
DOTL JC

B8 051323
PERFORMANCE TEST OF AN AUTOMATIC TRAIN POSITIONED STOP SYSTEM
The author shows the lay-outs provided on a vehicle incorporated in a train, as well as between the tracks on the Shin-Kansen line, in order to ensure that trains stop at a given point in Kyoto station. The installation operates at an approach speed of 70 km/h using multiplex equipment, with transmission and reception of signals on 72 KHz. The conventional train equipment has not been altered--the brakes are operated by this equipment, and by the control device, which receives the signals in accordance with the running speeds and the distance to the stopping point. The stopping distance is adjusted to some 0.05 m. As this technique has now been perfected, its practical application is expected very soon.

Kambe, T Saruya, T *Railway Technical Research Institute* Quart Rpt No. 3, 1971, 2 pp

ACKNOWLEDGMENT: UIC
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

B8 051328
CAROL AUTOMATIC RAILWAY DOUBLES ITS CAPACITY
Completion of double-tracking coupled with improvements to catenary and signaling have almost doubled the capacity of the Carol Lake automatic railway in Labrador. There is now enough rolling stock for seven 20-wagon trains to be in circulation on the 10 km line simultaneously, raising the daily capacity from 85,000 long tons of crude iron ore to 140,000 tons.

Smart, CK (Iron Ore Company of Canada) *Railway Gazette International* Vol. 129 No. 11, Nov. 1973, pp 434-437

ACKNOWLEDGMENT: Railway Gazette International
PURCHASE FROM: IPC Transport Press Repr PC
DOTL JC

B8 051381
SIGNALLING AND COMMUNICATIONS FOR KOREA'S FIRST ELECTRIFIED LINES
This article describes the protection provided for signaling and communications facilities when the line was electrified.

Railway Gazette International Vol. 129 No. 12, Dec. 1973, p 472, 1 Fig

PURCHASE FROM: IPC Transport Press Repr PC
DOTL JC

B8 051408
THE WASHINGTON METRO AUTOMATIC TRAIN SUPERVISION SYSTEM
The Washington Metro will be operated as a fully automated rapid transit system. Normal system operation will be controlled by the Automatic Train Control System which is comprised of the Automatic Train Protection, Operation and Supervision subsystems. This paper is divided into two parts: Part I provides an overview of system operation, including the role played by each of the subsystems in providing control of train separation and train speed, route security, control of acceleration and station stopping, and maintenance of schedules through computer-directed performance level and dwell adjustments. Part II provides a detailed description of the Automatic Train Supervision system and the methods employed by the computer software to exercise supervisory control of the system. The major programs and the software-hardware interface which provide the supervisory functions for train and terminal operations are described. A discussion of the strategies employed during major service disruptions closes the paper.

Hillman, HD (Gibbs and Hill, Incorporated); Cerbins, OH (TRW Systems Group)
American Society of Mechanical Engineers Paper 73-ICT-79, Sept. 1973

ACKNOWLEDGMENT: ASME Journal of Mechanical Engineering
PURCHASE FROM: ESL Repr PC, Microfilm

B8 051528
TELECOMMUNICATIONS RESEARCH IN THE UNITED STATES AND SELECTED FOREIGN COUNTRIES: A PRELIMINARY SURVEY
A preliminary investigation has been carried out on the command and control of rail transportation, both in the U.S. and overseas. An overriding consideration of rail transportation is safety, both for reasons of preservation of human life and for the high cost of a failure in potential damage to property. As such, railway signaling has evolved not only in a "fail-safe" mode, but in one where innovation must pass a series of slowly ascending levels of trial before being generally accepted in the industry. The second consideration is that of low R&D funding levels. In recent years gross investment in rail transportation has been low as the high technology fields of air and space have preoccupied governments.
Report to NSF by Panel on Telecommunications Research, Committee on Telecommunications, NRC.

National Academy of Engineering Vol. 2 June 1973

Contract NSF H-1221

PURCHASE FROM: NTIS Repr PC, Microfiche
PB-222082, DOTL NTIS

B8 051558
TRACK CIRCUITS FOR MODERN RAPID TRANSIT SYSTEMS
Track circuits have been used in American Railroads for over a hundred years. Although the basic idea (use of rails as part of detection circuit) remains the same, changes in implementation have been made constantly to meet new requirements and to take advantage of advances in technology. In modern rapid transit applications track circuits must meet certain requirements in performing their function of train detection and broken rail protection. The track circuits must operate reliably without insulating joints and with lightweight cars using disk brakes. As modern rapid transit systems use chopper controlled propulsion systems the track circuits have to be designed for operation without interference from chopper harmonics. Track circuits without insulating joints result in problems which must be solved for safe and reliable operation.
Contributed by the Intersociety Committee on Transportation for presentation at the Intersociety Conference on Transportation, Denver, Colo., Sept. 23-27, 1973.

Kalra, P (Bechtel Corporation)
American Society of Mechanical Engineers Paper 73-ICT-62, Sept. 1973, 8 pp, 9 Fig, 3 Ref

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL RP

B8 051905
BIBLIOGRAPHY ON RAILWAY SIGNALLING 1960-1972
The purpose of this study was to examine present-day railway signalling systems with a view to formulating recommendations for improved signalling on Canadian railways. Such recommendations were to be made on the basis of increasing efficiency and/or safety and reducing maintenance and operating costs. The present bibliography list reference published during the period of 1960 to the present, with an emphasis on references after 1965. No attempt has been made to list all titles available during this period. However, where possible representative titles of those subject areas considered relevant to advanced railway signalling systems have been included.

Mackay, NAM Martin, BD
Canadian Institute of Guided Ground Transport #73-9

ACKNOWLEDGMENT: CIGGT
PURCHASE FROM: CIGGT Repr PC

B8 051946
THE AUTOMATIC DIGITAL COMPUTER CONTROL OF VEHICLES IN RAPID TRANSIT SYSTEMS FOR URBAN TRANSPORTATION
This paper considers the problem of controlling vehicles in a rapid transit system using an on-line digital computer. Vehicle speeds and spacings are obtained periodically and are used by the control computer to calculate the required driving or braking forces for the next time period. A largely non-mathematical description is given of multivariable control methods which allow rapid transit schemes to operate efficiently for any number of vehicles with maximum capacity consistent with safety requirements and comfort. Difficulties which arise because of uncertainties in data in practical cases due to measurement errors, interference, or malfunction are alleviated by the control method and produce no significant deterioration in system performance. Consideration is given to non-linearities, merging, starting, etc., which are inherent in any overall scheme. Practicality is borne in mind throughout the description.

Proceedings of the Symposium on Rapid Transit Vehicles for City Services 22-23 April 1971. Arranged by the Automobile Division of the Institute of Mechanical Engineers.

Anderson, JH (Waterloo University); Powner, ET (Manchester University Institute of Science & Tech); Bergman, N (Waterloo University) *Institution of Mechanical Engineers Proceedings* Vol. 184 No. t3S, 1970, 7 Fig, 13 Ref

ACKNOWLEDGMENT: Institution of Mechanical Engineers
PURCHASE FROM: Institution of Mechanical Engineers 1 Birdcage Walk, Westminster, London SW1, England Repr PC
DOTL TJ1.15

B8 051958
EVOLVING MODERN SIGNALLING TO MEET LOCAL NEEDS
Because few foreign suppliers can offer equipment that fully meets operating needs, signalling techniques can make progress in a developing country only if a strong indigenous base exists for system design. Each country has its own maintenance and reliability problems, best solved by local engineers.

Joseph, CM (Indian Railways) *Developing Railways* 1974, 4 pp, 1 Fig., 5 Phot.

ACKNOWLEDGMENT: Developing Railways
PURCHASE FROM: IPC Transport Press Repr PC
DOTL JC

B8 051968
TECHNICAL PROBLEMS CONCERNING HIGH-SPEED TRANSPORT [TECHNISCHE PROBLEME DES SCHNELLVERKEHRS]
Based on the operating programme, and the problems of high-speed rail transport, details are shown of high-speed passenger coaches, and goods wagons. Solutions to tractive and braking problems are then discussed. Details are also shown of the effects of high-speeds on the layout, and deformation, of the track. Based on the terms "dependability" and "security", a description is given of a data-processing system. Finally, the authors deal with the necessity of research and development. [German]

Rahn, T Althammer, K Bischofberger, G Zeilhofer, M *Glasers Annalen ZEV* No. 2/3, 1973, 9 pp, 15 Fig, 3 Ref

ACKNOWLEDGMENT: UIC (996)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

B8 051969
THE REACTIONS ON THE SYSTEM OF SECTOR CONTROLLED THYRISTOR VEHICLES [NETZRUCKWIRKUNGEN SEKTORGESTEUERTER THYRISTORFAHRZEUGE]
In order to improve the power factor, and to reduce the electro-magnetic effect on the environment, in the case of thyristor motive-power units, a contribution is made by the new blow-out, thyristor current-rectifier, contact, particularly as an unsymmetric, semi-controlled, singlephase bridge. The method of operation is shown by means of model experiments, and a brief report is given concerning tests carried out on a series 420 German Federal Railway motive-power unit. [German]

Forster, J *Glasers Annalen ZEV* No. 2/3, 1973, 10 pp, 20 Fig, 11 Ref

ACKNOWLEDGMENT: UIC (1048)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

B8 051970
THE ELECTRO-MAGNETIC EFFECT ON THE ENVIRONMENT OF THYRISTOR VEHICLES [ELEKTROMAGNETISCHE UMWELTBEEINFLUESSUNG DURCH THYRISTORFAHRZEUGE]
The effect on the environment of electro-magnetic forces, to which electric motive-power units, with thyristor control, give rise, is discussed in broad outline. In this connection, details are shown both of the causes, and of several possibilities of reducing, or preventing them. [German]

Buckel, R *Glasers Annalen ZEV* No. 2/3, 1973, 9 pp, 11 Fig, 3 Ref

ACKNOWLEDGMENT: UIC (1045)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

B8 052080
CONTINUOUS AUTOMATIC TRAIN CONTROL ON MUNICH S-BAHN
The German Federal Railway has already introduced continuous ATC on some of its main lines, but the greater traffic density on its Munich S-bahn network has justified the cost of a more sophisticated version known as LZB 110, which comes into limited operation next month. Dipl.-Ing. E. J. Kohler of Siemens describes how this system will ultimately replace colourlight signalling, which would remain in a standby capacity.

Kohler, EJ *Railway Gazette International* Vol. 130 No. 1, Jan. 1974, 3 pp, 2 Phot., 3 Ref.

ACKNOWLEDGMENT: Railway Gazette International
PURCHASE FROM: IPC Transport Press Repr PC
DOTL JC

B8 052101
THE DISC BRAKE. A CONTRIBUTION TOWARDS THE STUDY OF ITS RATIONAL USE ON RAIL VEHICLES
From the point of view of their conventional methods of production, and given the same wheel diameters, the disc brake enables, in the case of braking to a stop, a greater amount of energy to be dissipated than does a cast-iron brake block. There exists, therefore, a field, which is that of high speeds and heavy axle loads, in which the use of the disc brake is more appropriate than of the brake block. It is, however, difficult to define where precisely the limits of this field lay, as they also depend, in fact, on the braking performance, i.e. the average rate of deceleration required and, therefore, on the signalling system used. The brake lining pads play an outstanding part. The results which can be expected from a disc brake depend, in the first place, on the lining pads, which should be capable of satisfactory performance, both when the temperature is high, and under special atmospheric conditions (low temperatures, and considerable humidity).

Laplaiche, M (French National Railways) *French Railway Techniques* No. 3, 1973, 16 pp, 17 Fig, 4 Phot

PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B8 052119

BRAKING MOVEMENT OF TRANSPORT VEHICLES WITH HYDRAULIC RETARDATION [DVIZHENIE TRANSPORTNYKH SREDSTV V TORMOZNOM REZHIME S GIDROZAMEDLENIEM]

Conditions of hydraulic braking are given in the form of mathematical dependence formulas. Base equations of motion in the braking mode of operation and of speed change during the period of braking are presented. Conditions are defined for the absence of wheel sliding, formulas are given for determining the path and time of braking in different conditions. Dependence relations are given determining the necessary hydraulic counter-pressures. Results of this work can be utilized for designing hydraulic braking systems for mine cars railroad rolling stock, automobiles and other types of transport. [Russian]

Uzhanov, AY Sorokin, LA *Izvestiia Vysshikh Uchebnykh Zavedenii, Gornyi Zhu* No. 6, 1973

ACKNOWLEDGMENT: EI (EIX731203904)
PURCHASE FROM: ESL Repr PC, Microfilm

B8 052505

APPLICATION OF THYRISTORS IN RAILWAY TECHNOLOGY: CONSEQUENCES AND REMEDIES. INVESTIGATIONS ON A.C. MOTIVE POWER UNITS WITH SEVERAL THYRISTOR CIRCUITS (TESTS AND RESULTS OBTAINED FROM THE BLS-LOCOMOTIVE RE4/4 NO. 161)

This report concerns the tests undertaken with the BLS-Locomotive Re 4/4 161 fitted with several thyristor circuits. The object of the tests was to clarify the changes in the power factor and the harmonic wave content-the latter in view of its effects on signalling and telecommunication installations-resulting from the increased number of inverter steps and the limitation of the firing angle of the thyristor bridges to 35 degrees. The tests conducted have shown that in the case of thyristor-controlled motive power units, a multi-step control of the voltage regulation leads to a reduction of the harmonics of the line current and to an improvement in the power factor during acceleration and running below full power. The limitation of the firing angle of the thyristor bridges of 35 degrees, considered in its entirety, does not bring any advantages however.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways A122/RP6/E, Apr. 1973, 27 pp, 11 Fig., 5 Tab., 3 App.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B8 052506

APPLICATION OF THYRISTORS IN RAILWAY TECHNOLOGY: CONSEQUENCES AND REMEDIES. TESTS WITH A STATIC FREQUENCY CONVERTER FOR 50-16 2/3 HZ

The Swedish State Railways (SJ) have conducted several comparative measurements on the Moholm-Skovde line, using a prototype of a static frequency converter (power 6 MVA) During the tests the equivalent disturbing currents and the weighted longitudinal e.m.f. induced in telecommunication circuits were measured; for these tests, the test line was fed through the static converter or through rotary converters. When the feeding took place through the static converter, the levels of the disturbing current in the overhead contact system and the induced weighted longitudinal e.m.f. were raised. However, a lowering of the levels measured may be expected, after the filter for the static converter has been modified. On the three-phase side there are no adverse effects, as long as the power of the static converter is very small in comparison with the short-circuit power of the high voltage network. The SJ have ordered, for two sub-stations, two static converters each with a power of 15 MVA each.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways A122/RP8/E, Apr. 1973, 14 pp, 7 Fig., 1 Tab.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B8 052514

APPLICATION OF THYRISTORS IN RAILWAY TECHNOLOGY: CONSEQUENCES AND REMEDIES. CHOPPER CONTROL SYSTEMS

Within the scope of studies concerning possible interference induced in signalling and telecommunication installations caused by chopper-controlled motive power units, the Committee thought it useful to make a comparison between the various control systems. The present report contains a comparison of the control of choppers by varying the pulse frequency or pulse duration and it describes several possible solutions during the starting process. With a view to the high powers usually installed in motive power units, and, above all, with a view to the signalling and telecommunication installations on the railway administrations, the application of choppers operating at fixed frequencies is considered desirable.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways A122/RP 7/E, Apr. 1973, 28 pp, 5 Fig., Refs., 3 App.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B8 052526

ELASTIC SYSTEMS FOR TRACTION AND SHOCK GEAR (SIDE BUFFERS AND CENTRE BUFFERS). THEORETICAL STUDIES OF THE DEVELOPMENT OF LONGITUDINAL FORCES IN GOODS TRAINS EQUIPPED WITH CONVENTIONAL ELASTIC ELEMENTS (FORCE A FUNCTION OF STROKE ONLY)

The influence of the characteristics of the elastic elements on the occurrence, on the development (in time and space) and on the value of the longitudinal forces in trains has been examined for several variants of spring-mass systems. Examination of the braking process has shown that the longitudinal force can be considered as being composed of a "rigid" component, an "elastic" component and a "coefficent of friction" component. With a suitable spring stiffness, combined with a brake-cylinder filling time adjusted accordingly, a "sub-critical development of the longitudinal forces"-and thus a substantial reduction in the values of the maximum longitudinal forces-can be achieved. The development of the longitudinal forces during gradual braking and during starting is also dealt with. The validity of the mathematical model has been confirmed on the basis of the results obtained during tests with actual trains. Future running trials can thus be restricted to an absolute minimum. Finally, the report indicates the optimum spring characteristics for permitting a "sub-critical development of the longitudinal forces" to be obtained during braking.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B36/RP 9/E, Apr. 1972, 124 pp, 47 Fig., Tabs., 7 App.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B8 052531

APPLICATION OF THYRISTORS IN RAILWAY TECHNOLOGY: CONSEQUENCES AND REMEDIES. STUDIES AND RESULTS OF INTERFERENCE CAUSED BY THYRISTOR LOCOMOTIVES WORKING ON 25 KV, 50 AND 60 HZ

This report covers essentially the results of the different tests carried out by the SNCF with thyristor locomoitve BB 15000 and by the MAV with two prototype thyristor locomotives types V 43 and V 42. The purpose of the SNCF tests was (a) to compare the different thyristor arrangements and (b) to determine the effect of the BB 15000 thyristor arrangement on the various types of SNCF track circuits. The object of the MAV measurements was to ascertain, in addition to the effects on track circuits, the interference currents, so as to be able to conclude, at a later date, the effects on telecommunication circuits. The report also contains the results of measurements taken with the type 181 thyristor locomotive belonging to the DB and

with a thyristor locomotive belonging to the South Korean Railways (KNR).

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways A122/RP 11/E, Oct. 1974, 38 pp, 25 Fig., 3 Ref., 1 App.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B8 052532
APPLICATION OF THYRISTORS IN RAILWAY TECHNOLOGY: CONSEQUENCES AND REMEDIES. STUDY OF THE EFFECT OF INTERFERENCE ON TRACK CIRCUITS

This report contains a general equivalent circuit model valid for all track circuits and permitting analysis of the distribution of the interference produced in the different elements of the circuit model (which also constitute the different elements of the track circuit). These elements are studied from the point of view of their structure, in taking as a basis the theory of circuits and lines, as well as from the point of view of the penetration mechanism of which each of these is subjected. A list of electrical quantities of the track circuit is established, for which it is advisable to fix limits (criteria). The results of the evaluation of a questionnaire relating to track circuits are given, which permit a preliminary general idea to be gained of the types of installations which are affected by interference and those which are not. Finally, several practical measures taken so far for protecting track circuits against the harmful effects of interference are mentioned.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways A122/RP 9/E, Oct. 1973, 42 pp, Figs., Tabs., 2 App.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B8 052558
APPLICATION OF THYRISTORS IN RAILWAY TECHNOLOGY: CONSEQUENCES AND REMEDIES. STUDIES OF A.C. THYRISTOR LOCOMOTIVES FOR 15 KV 16 2/3 CYCLES AND THE EFFECT ON 100 HZ TRACK-CIRCUIT INSTALLATIONS (TESTS WITH OBB LOCOMOTIVE 1043)

The Austrian Railways have carried out extensive tests with 1043 class locomotives and ascertained the effect of a defect in the firing angle on the operating safety of track circuits working at 100 Hz. This report describes the measures which have been taken (a) on the locomotive and (b) on three different types of track-circuit installations to ensure that operation is not affected as a result of the running of thyristor locomotives either with single or double heading of trains.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways A122/RP 13/E, Apr. 1974, 30 pp, 22 Fig., 2 Tab., 1 App.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B8 052560
APPLICATION OF THYRISTORS IN RAILWAY TECHNOLOGY: CONSEQUENCES AND REMEDIES. INVESTIGATION OF TRACTIVE UNITS EQUIPPED WITH CHOPPERS--TEST WITH SEVERAL RAILCARS ON THE 3 KV D.C. SYSTEM OF THE SNCB

This report contains the account of various measurements carried out by the SNCB with one and also with several coupled chopper-equipped railcars in service to determine the repercussions on various equipment of permanent installations. Evaluation of the tests has shown that, taking into account the conditions encountered on the system of the SNCB, the operation of chopper-equipped railcars does not give rise to unacceptable interference in signalling circuits. Furthermore, it does not appear that telephone and data transmission circuits are significantly affected by these units, in comparison with conventional units. The report also includes a theoretical study for calculating the amplitude of the most important harmonics.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways A122/RP 10/E, Oct. 1973, 37 pp, 21 Fig., 17 Tab., 2 App.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B8 052562
USE OF ELECTRONIC COMPONENTS IN SIGNALLING. NON-ELECTRICAL ENVIRONMENT IN THE CASE OF ELECTRONIC SIGNALLING SYSTEMS

The report describes the non-electrical environment which needs to be taken into account when planning railway safety installations containing electronic components. Explanations cover the following effects: air pressure variations, chemical effects, water, humidity, temperature effects, mechanical stresses, and a combination of environmental effects in relation to the four ways in which safety installations may be accommodated: closed rooms, capsulated outdoor installations, lineside equipment, tractive units and other vehicles. The tabulation of the values which are typical of the parameters of the non-electrical environment completes the report.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways A118/RP 4/E, Apr. 1974, 31 pp, 4 Tab., 4 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B8 052568
OPERATING PRINCIPLES ENABLING A SINGLE TRACK TO BE USED IN EITHER RUNNING DIRECTION OVER A SECTION OF DOUBLE TRACK

Over a line with double track, it may be necessary to make arrangements for trains to run temporarily in both directions over a single track, the other track being unusable due to repairs, a traffic incident, an obstacle, etc.; this happens more and more due to modern methods of maintaining the track and catenaries, which require such long periods of work that it is generally not possible to do them without transfering the running of a certain number of trains to the other track. This document sets out the measures taken by certain UIC Member Railways (SNCF, BR, CFF, DB, DSB, FS, NS, OBB, PKP, RENFE, SJ, SNCB) in order to reduce delays due to the running of trains in the wrong direction, without endangering safety of operation.

International Union of Railways, BD DOC 29, Jan. 1972, 12 pp

ACKNOWLEDGMENT: UIC
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr. PC

DOTL RP

B8 052574
REDUCTION OF MANUAL CALCULATIONS WHEN INVESTIGATING THE ADVANTAGES OF USING ELECTRIC AND HYDRODYNAMIC BRAKES

Simulation of train movements with the aid of an electronic data processing equipment, taking into consideration operating and economic factors, is used by the German Federal Railway to produce an economically optimum design of electric and hydrodynamic brakes. The resulting great quantity of data is handled by means of three data processing programs: (1) train movement calculation program; (2) brake system calculation program; and (3) program to ascertain the economy of brake systems. The programs are supplemented by manual evaluations.

This paper was presented at the Third ORE Colloquium held in Amsterdam, May 8th to 10th 1973, and its Summary is contained in the Colloquium report #AZ40/RP 5/E; See RRIS #052511. Restrictions on the use of this document are contained in the explanatory material.

Kraus, GD
International Union of Railways June 1973

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B8 052575
STUDY OF THE LATERAL STABILITY OF A BOGIE
This study permits a mathematical model to be found representing the movements of free bogie supporting a given load and running on a straight track of good quality. Starting from this model, it is possible to show the influence of the principal structural-design features of a bogie on its critical speed, namely: (1) characteristics of the connections between bogie-frame and axles; (2) bogie wheelbase: (3) sprung mass: and (4) equivalent conicity characterising the geometry of the contact between rail and wheel. This study has permitted the optimization of the choice of constructional characteristics of the bogies of the SNCF TGV 001 trainset.

This paper was presented at the Third ORE Colloquium held in Amsterdam, May 8th to 10th 1973, and its Summary is contained in the Colloquium report #AZ40/RP 5/E; See RRIS #052511. Restrictions on the use of this document are contained in the explanatory material.

Joly, R
International Union of Railways June 1973

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B8 052580
SIMULATION OF THE LOCOMOTIVE RUNNING DIAGRAM
The basis of the program is a simulation model. The object of our investigation is to establish a program by means of which we are able to produce locomotive running diagrams on the computer within a relatively short time. In the case of inexact groups of trains to be routed, and for waiting times between two trains which exceed a given time interval, the program constructs suitable individual locomotive runs. Critical cases in the locomotive running diagram which require human decisions are indicated by the computer. These decisions modify the inputs of the program. With these modified inputs, the process for establishing the working diagram must be repeated. The optimum criterion is the minimum time for the realization of the produced diagram. The basis of the model is a graphical structure. The points of this structure signify the arrival of trains for subsequent routing to their destination stations. In this structure, a "hamiltonian way" must be determined which satisfies the optimum criterion and all the conditions which are necessary for achieving the diagram. This process is accomplished by means of a combinative method. The program produces different variants of the diagram satisfying the indicated conditions. From these variants, the optimum solution is determined and the calculation of the indices of the diagram are carried out. Finally, the process outputs are printed.

This paper was presented at the Third ORE Colloquium held in Amsterdam, May 8th to 10th 1973, and its Summary is contained in the Colloquium report #AZ40/RP 5/E; See RRIS #052511. Restrictions on the use of this document are contained in the explanatory material.

Csikos, M
International Union of Railways June 1973

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B8 052595
PROGRAMME OF TESTS ON THE BRAKE RIG. DESCRIPTION OF VIENNA ARSENAL BRAKE TEST RIG AND CALIBRATION TESTS ON LINE
The report contains a technical description of the Vienna Arsenal Brake Test Rig and its associated instrumentation. The tests made on the line during the winter of 1972/73 to establish the mechanical conditions in the brake equipment and the climatic conditions near the bogies are summarised. The relationship between weather conditions (quantity of snow, temperature, humidity, etc.) and brake performance (stopping distance, etc.) is demonstrated. The tests are fully described in Appendices 1, 2 and 3.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B132/RP 1/E, Apr. 1974, 26 pp, Figs., Tabs., 3 App.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B8 052598
ELECTRONIC TEST INSTALLATION (VIENNA-ARSENAL). TESTS MADE BY THE ELECTRONIC TEST INSTALLATION DURING THE TIME FROM SEPTEMBER 1, 1971 TO AUGUST 31, 1972
This is the fifth annual report of the electronic test installation (formerly installation for testing data transmission equipment), erected and operated in Vienna jointly by the Office for Research and Experiments (ORE) of the International Union of Railways (UIC) and the Austrian Federal Research and Test Institute. In the course of the financial year, one modem for a modulation rate of 600/1200 bauds was tested. As a result of this, the number of modem types entered in the comparative table and in the comparative curves has risen to 16. This report also contains the results of measuring the interference on the telephone circuits of the NS, UBB, and FS due to thyristor-controlled electric locomotives. In addition, the report contains CCITT documents on recommendations for testing modems, the tests being based on the design of the installations for testing data transmission equipment at Vienna Arsenal.

This is a confidential report available only to the Member Administrations of ORE. Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways AZ32/RP 5/E, Nov. 1973, Figs., Tabs., 1 App.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B8 052604
BRAKE PADS FOR DISC BRAKES AND COMPOSITION BRAKE BLOCKS. DEVELOPMENT OF PHYSICAL-MECHANICAL AND CHEMICAL-ANALYTICAL TEST PROCEDURES FOR ACCEPTANCE TESTING AND QUALITY CONTROL OF BRAKE PADS
Provisional specifications for the acceptance testing of disc brake pads have been compiled in B 126/RP 1. For the final version of this document, further tests need to be carried out. Some of these, covering physical, mechanical and chemical properties of pad "composition" materials are described in the present report. Considerable variations in property levels due to material heterogeneity have been noted. The application of a number of the test methods studied as quality control and acceptance testing techniques seems quite feasible. Further experimental work will be required before correlation between the properties studied and the braking performance of "composition" materials is possible.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B126/RP 2/E, Oct. 1974, 16 pp, Figs., Tabs.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B8 052611
A COMPUTER-BASED SYSTEM FOR INTERLOCKING CONTROL
In the Amsterdam and Utrecht stations, a computer system will be used as a means to control local and remote interlockings. This will include such functions as train identification (using scheduled train sequences), train describer (on standard peripheral crt devices), train route optimization (including conflict resolution in case of slight disturbances), route control, control of platform indicators, train reporting, statistics, field control of a part of shunting movements, and man-machine communications. After some introductory remarks, the paper describes design philosophy, system configuration (including interface equipment) and in a more detailed manner the software for route optimization and conflict resolution.

A summary contained in ORE report #AZ40/RP 6/E, RRIS #052600, Section 17, RRIS Bulletin 7502. Restrictions on the use of this document are contained in the explanatory material.

Weidema, J
International Union of Railways Sept. 1974, 3 pp

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B8 052615
AUTOMATIC ROUTE SETTING BY TRAIN NUMBER EVALUATION
Automatic setting of train movements at junctions requires routing criteria. For this purpose the train number which includes the train destination and the route to it is well adapted. A limited capacity computer is especially suited for evaluation of the train number and the resulting route setting. SBB will use the reconstruction of the track system in Zurich Oerlikon station, an important junction, to install an automatic train routing system with a processor. INTEGRA AG has in this connection developed a simulation program for a PDP 8e computer which, in off-line operation, permits the simulation of all technical and operating conditions which need to be allowed for. Every train entering the control area is guided over a predetermined route to its destination without being diverted and, in accordance with the criterion of "first come-first served" decision principle, without considering any priorities. This type of automatic train routing provides an economical and flexible solution which will enable even more complicated decision algorithms to be performed when the time comes.

A summary contained in ORE report #AZ40/RP 6/E, RRIS #052600, Section 17, RRIS Bulletin 7502. Restrictions on the use of this document are contained in the explanatory material.

Stalder, O
International Union of Railways Sept. 1974, 3 pp

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B8 052616
COMPARISON OF DECISION ALGORITHMS FOR SOLVING INCOMPATIBLE TRAFFIC SITUATIONS BY MEANS OF SIMULATION
Train control decisions on the sequence of trains in cases of conflict in traffic are now being taken over by machine (e.g. process computers) from man (e.g. traffic controller). This means that considerations extend to more complex decision algorithms, which for time reasons were unable to be used by man. These new decision making rules can in certain circumstances bring important advantages in traffic and train working. The choice of the most suitable decision algorithm is to be made from case to case according to predetermined criteria. Such comparison requires model testing and hence simulation on a large electronic computer. With this in mind the SBB has applied the "small junction" simulation model, which is written in Simula I for the Univac 1108, and conclusive results were obtained. The SBB is currently working on a second generation simulation model, which will make it possible to extend the comparison of decision algorithms to large junctions and is written in Simula 67 for processing on the CDC computer.

A summary contained in ORE report #AZ40/RP 6/E, RRIS #052600, Section 17, RRIS Bulletin 7502. Restrictions on the use of this document are contained in the explanatory material.

Stahli, S
International Union of Railways Sept. 1974, 4 pp

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B8 052617
THE IDENTIFICATION AND CORRECTION OF CONFLICTS IN TRAIN RUNNING CONTROL
An on-line decision making program run off on a process computer for space and time reasons cannot in all cases produce optimum decisions. The intention is to solve satisfactorily as high as possible a percentage of conflict situations encountered by the application of simple and manageable decision making rules. In the remaining decisions to be taken by the controller he is assisted by computer prepared decision aids in the form of tables and graphs. The program described here consists of several modules, the first of which relates to a route traffic control system intended to be further developed parallel to practical testing. The control process is initiated in cycles and when special events occur (e.g. track closure). After each start, the timetables are generally compiled in advance for all trains, covering almost the next half hour (block sections and occupation times). The controller is advised of all conflict situations and how they can be corrected. Decisions by the controller override computer decisions.

A summary contained in ORE report #AZ40/RP 6/E, RRIS #052600, Section 17, RRIS Bulletin 7502. Restrictions on the use of this document are contained in the explanatory material.

Schenk, O
International Union of Railways Sept. 1974, 3 pp

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B8 052618
COMPILATION OF WORKING TIMETABLES FOR TEMPORARY SINGLE-TRACK WORKING; WAYS OF CONTROLLING TRAIN RUNNING
The German Federal Railway has developed a program for determining the effect of temporary single-track working on the theoretical timetable for a double-track line. The program does not just fix the train sequence in the temporary single-track section by train classes, but also takes into account permissible train delays, for which allowance is made depending on the priority of the train. The article gives an account of the structure of the program and the method used to determine the train sequence in the section with temporary single-track working.

A summary contained in ORE report #AZ40/RP 6/E, RRIS #052600, Section 17, RRIS Bulletin 7502. Restrictions on the use of this document are contained in the explanatory material.

Roth, P
International Union of Railways Sept. 1974, 3 pp

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B8 052619
COMPUTER CALCULATION OF TYPICAL TRAIN RUNS AND APPLICATION OF SIGNAL POSITIONING FOR TRAIN HEADWAYS
Train movement simulation program permitting the elaboration (and plotting) of typical runs and the calculation of stopping distances and safety intervals. This program offers the possibility of optimizing the running speed for obtaining a given interval (at present with moving and variable block section) and a signal interpositioning (in the course of study-application to a signalling system adapted to the automatic pilot working of trains on the PARIS urban network).

A summary contained in ORE report #AZ40/RP 6/E, RRIS #052600, Section 17, RRIS Bulletin 7502. Restrictions on the use of this document are contained in the explanatory material.

Perrin, J Cervoni, G
International Union of Railways Sept. 1974, 3 pp

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B8 052621
SIMULATION MODEL FOR THE STUDY OF TRAIN RUNNING
The author describes a simulation model applicable to the case of a line equipped with automatic block the "exit-from-line" of which gives multi-directional access. The model is constructed in modular form and is of the type with variable time increment (simulation in the form of separate distinct events). The model is well-suited for studying the stability of a train running schedule during peak hours, as a function of the signalling installation. It permits the sensitivity of the train schedules to different parameters to be determined: length of block sections, speed restriction zones, characteristics of the rolling stock, closure time of signal controlled from end of line. etc.

A summary contained in ORE report #AZ40/RP 6/E, RRIS #052600, Section 17, RRIS Bulletin 7502. Restrictions on the use of this document are contained in the explanatory material.

Martens, P
International Union of Railways Sept. 1974, 3 pp

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B8 052622
COMPUTER BASED TRAIN CONTROL SYSTEMS ON LONDON TRANSPORT
The paper describes both present computer controlled railway signalling on London Transports Railways, and the proposed installation of a centralized computer control system for two deep tube lines. In addition to the control functions, the paper also briefly describes the information which will be available from the computer system, and the means of entering time table and crew schedule information into the computers.

A summary contained in ORE report #AZ40/RP 6/E, RRIS #052600, Section 17, RRIS Bulletin 7502. Restrictions on the use of this document are contained in the explanatory material.

Hadaway, HW
International Union of Railways Sept. 1974, 5 pp

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B8 052623
DETERMINATION OF THE HIGHEST-DENSITY RUNNING SCHEDULE ON AN ARBITRARY LINE TIME-SHARING PROGRAM
To be able to determine the theoretical validity of a given line equipment it is essential to be able to measure this validity in terms of operation i.e. in terms of running schedule flexibility. In this connection, the maximum number of trains which it is possible to run can be considered as a sufficiently valid and selective criterion for being applied a priori to a more complete and finer study. The simplicity of application, through the combined technique of Branch and Bound, makes it an ideal tool for determining the most advantageous running schedules on an arbitrary line.

A summary contained in ORE report #AZ40/RP 6/E, RRIS #052600, Section 17, RRIS Bulletin 7502. Restrictions on the use of this document are contained in the explanatory material.

Gatez, JL
International Union of Railways Sept. 1974, 3 pp

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B8 052625
RAILWAY AREA SIMULATION: AN AID TO TRAIN CONTROL
The paper describes a computer-based model of a railway network developed by the BR R&D Division. This model was designed to permit the evaluation of advanced train control strategies without resorting to practical tests on the real railways. Comprehensive facilities are provided by the simulator to handle the many complex facets of railway operation. The simulator has been used by BR to study train control strategies. It has also been employed to evaluate train service plans and line capacities, particularly for services of high density which demand running at close headways.

A summary contained in ORE report #AZ40/RP 6/E, RRIS #052600, Section 17, RRIS Bulletin 7502. Restrictions on the use of this document are contained in the explanatory material.

Breen, RC Stewart, JM
International Union of Railways Sept. 1974, 2 pp

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B8 052626
A REAL-TIME COMPUTER SYSTEM TO AID TRAIN REGULATION AT GLASGOW CENTRAL STATION
The paper describes a real-time computer system to assist in the control of trains at a busy terminal station. It is scheduled to be installed in the Signalling Centre at Glasgow on the Scottish Region of British Railways in 1974. The computer system will process data on trains received from the Train Describer and signalling staff, in conjunction with the timetable data. Replatforming and scheduling algorithms can make recommendations, in real-time on changes to the timetable to avoid potential operating problems due to out-of-course running. Information on the planned working and computed recommendations are presented to the signalling staff on three video displays.

A summary contained in ORE report #AZ40/RP 6/E, RRIS #052600, Section 17, RRIS Bulletin 7502. Restrictions on the use of this document are contained in the explanatory material.

Annis, AJ Brook, GD
International Union of Railways Sept. 1974, 3 pp

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B8 052627
STUDIES IN CONNECTION WITH THE LAYOUT AND OPERATION OF FIXED INSTALLATIONS FOR WRONG-TRACK RUNNING
This report deals with the elaboration of new methods applicable to studies in connection with the layout of fixed installations for wrong-track running and the operation of lines equipped with such installations. Three models have been developed. The first is designed for analyzing a priori the best layout of fixed installations for wrong-track running and the influence of the parameters involved. It has permitted a number of general results to be obtained with regard to the number of fixed installations for wrong-track running, the number of trains to be run in 'groups", etc. The second model is devoted to the pre-planning of the train running diagram, when single-track working is required as a result, for example, of work planned in advance; this running diagram is designed to approximate as closely as possible the normal train running graph for double-track working. The object of the third model is to organize the train traffic in real time in such that the delay incurred by the trains is reduced to the minimum on a line where, as a result of an incident, a fixed installation for wrong-track running must be unexpectedly placed in service. The first model is a theoretical one where certain simplifying hypotheses have been used. The last two models take the case of the Channel Tunnel (1970 or 1971 hypotheses) by way of concrete example.

A summary contained in ORE report #AZ40/RP 6/E, RRIS #052600, Section 17, RRIS Bulletin 7502. Restrictions on the use of this document are contained in the explanatory material.

Auclair, JP
International Union of Railways Sept. 1974, 5 pp

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B8 052639
SIMPLIFIED VARIANTS OF THE LINEAR TRAIN CONTROL SYSTEM. INTERFACE CONDITIONS OF THE INTEGRATED SYSTEM. SIMPLIFIED VARIANTS OF THE INTEGRATED LINEAR TRAIN CONTROL SYSTEM
In this report, the interface conditions of the integrated system are introduced in the form of a UIC Leaflet (Appendix 5). Furthermore, the possibilities of simplifying the integrated system of linear train control are described allowing for the following items: technical feasibility; performance of the simplified solution; evaluation of possible savings with respect to the full integrated system. Special attention was given to the question of interpenetration (compatibility) and possible expansion to the full integrated system. Four variants are recommended in this report for use on the systems of the administrations according to their particular requirements.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways S1005/RP 1/E, Oct. 1974, 25 pp, Figs., Tabs., Apps.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B8 052652
BRAKING AND ACCELERATION FORCES ON BRIDGES. BRAKING TESTS ON STRAIGHT TRACK WITH A LONG TRAIN
The tests were designed to establish whether some reduction of peak braking effort might be obtained due to propagation time in a long train. Performed, more expediently on plain line with a train of oil tank wagons, some advantage for long bridges was proved, particularly with loose coupling. The tests serve to explain how, in a long train of 20 wagons, the resultant frictional coefficient falls below the value of 0.15 of the individual wagons. For economy they were performed in a station track at Reichertshofen with full and with shortened train, and with both close and loose coupling.

Restrictions on the use of this document are contained in the explanatory material.

D101/RP 7/E 7504 Apr. 1975, 24 pp, 7 Fig.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B8 052659
APPLICATION OF THYRISTORS IN RAILWAY TECHNOLOGY: CONSEQUENCES AND REMEDIES. PROGRESS OF WORK AND SUMMARY OF RESULTS RELATING TO INTERFERENCE FROM THYRISTOR CONTROL SYSTEMS
This report gives a brief account, referring to each individual point of the working programme, of the current state of work concerning the use of thyristors in railway engineering and the influence factors so far discovered and investigated, including the effect on information transmission installations. So far as possible, conclusions of general validity are given based on the results outlined in reports A 122/RP 14 which, however, relate to conditions on individual railway administrations. For more detailed information, attention is drawn to the summary in the appendix of the reports compiled by the Committee and other publications generally available.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways A122/RP 16/E, Oct. 1974, 22 pp, 18 Ref., 2 App.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B8 052660
APPLICATION OF THYRISTORS IN RAILWAY TECHNOLOGY: CONSEQUENCES AND REMEDIES. INVESTIGATION OF INTERFERENCE IN TRACK CIRCUITS FROM STATIC CONVERTERS USED FOR ELECTRIC PASSENGER TRAIN HEATING
The present report gives an account of tests made by the German Federal Railways (DB) on the Jugoslav Railways (JZ) route system with the object of investigating whether static converters for 1000 V, 16-2/3 Hz heating supply systems cause interference in track circuits. Measurements were obtained with 6 different single-rail insulated track circuits (a.c. and d.c.) under different earthed rail conditions. In every case and even under the most adverse conditions, which would in practice only rarely be met, misfunctioning of track circuits did not occur. Under certain circumstances described in more detail in the report it may become necessary to use a fundamental frequency of 22 Hz (A) instead of 16-2/3 Hz.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways A122/RP 18/E, Apr. 1975, 30 pp, 20 Fig., 8 Tab.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B8 052683
CONSTRUCTIONAL ARRANGEMENTS FOR IMPROVING THE RIDING STABILITY AND THE GUIDING QUALITY OF ELECTRIC AND DIESEL LOCOMOTIVES AND VEHICLES. MEASUREMENTS OF THE FORCES EXERTED ON THE RAILS BY VARIOUS TYPES OF MOTIVE POWER UINTS (MEASURED IN A CURVE OF 300M RADIUS AT GIORNICO)
In 1955 the CFF decided to intitiate investigations in order to determine by means of experiments the extent of the wear to which the track would be subjected in a curve of 300 m radius by the then newly developed locomtive types of the series Ac 4/4 (BoBo) and Ae 6/6 (CoCo). The measuring rail working according to the Schlumpf system was used as measuring apparatus. The results of these measurements have shown that the modern bogie locomotives subject the track to less wear at the same speed (BoBo) or to hardly any heavier wear (CoCo) than the rigid frame locomotives of not so recent date. Following the tests which had been made at the suggestion of the Working Group "Measurements on the track" of the B 10 Specialists Committee, for the comparison between three different measuring methods (see B 10 RP 4), arose the possibility of repeating the tests made in 1955. The measuring rail was again used as measuring apparatus, as it had been done for the tests made in 1957, but the tests included a larger number of locomotive types and a considerable versine error was intentionally arranged in the test track. The tests made in 1957 have confirmed the fundamental results of 1955, moreover they have shown that 1) a transverse coupling between the bogies and 2) the lateral movement of the rubber cushioned leading axles of the CoCo locomotives considerably reduce the forces exerted on the track.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B10/RP 5/E, Nov. 1960, 18 pp, Figs., Apps.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC

DOTL RP

B8 052722
WARNING DEVICES USING RADIO. ENQUIRY REPORT: RADIO WARNING OF ONE TRAIN BY ANOTHER, EITHER DIRECT OR THROUGH A FIXED OR MOBILE RADIO ON THE TRACK, AND RADIO WARNING OF A TRAIN BY MEANS OF A FIXED OR MOBILE RADIO ON THE TRACK
The problem of the warning of trains by radio in cases of danger has been entered in the ORE programme of work as Question A 99. This report contains an introduction and a copy of the questionnaire sent out, and also a summary of the replies from 21 administrations. The general observations and the documents provided by the administrations have also been incorporated.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways A99/RP 1/E, Oct. 1968, 51 pp, Figs., Tabs.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

B8 053739
ANALYSIS OF DISTORTION CHARACTERS IN TRANSMISSION OF BASEBAND CODE AND ITS APPLICATIONS
The present situation of a baseband code transmission in a cable line is reviewed, and its trend in the future is taken into consideration with some expectations, then it is noticed that the qualities of the code, expecially the distortion character, have to be studied. The calculation method for the distortion degree has been derived from the step response function of a cable circuit. Applying the method to practical problems in lines of JNR's systems, the distortion characters have been evaluated. A quite simple method for improving the character also has been studied, and its application to pratical usages is illustrated.

Takahashi, K *Railway Technical Research Institute*Quart Rpt Vol. 14 No. 4, 1973, 7 pp, 13 Fig

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

B8 053742
BRAKING PERFORMANCE OF FREIGHT TRAIN--BRAKING RATIO AND BRAKING DISTANCE

The braking distance of trains on JNR's narrow gauge lines is stipulated in a regulation as to be within 600m in any case. This must be a primary consideration in designing either vehicles or ground facilities. In order to have more traffic available, train speed must be increased and each train must be composed much longer. These are contradictory requirements for freight trains with conventional air brake equipment. These circumstances brought the study on this theme. This paper deals with (1) the survey of actual trains on their consist, their loading conditions and so on, (2) method of simulation for making up train consist, and (3) the result obtained therefrom.

Takami, H Iwase, Y *Railway Technical Research Institute* Quart Rpt Vol. 14 No. 4, 1973, 2 pp, 5 Fig

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

B8 053770
FRISCO'S TRAIN MEET CALCULATOR

Traditionally, the Frisco and many other railroads have determined the location and length of passing tracks by rather unsophisticated means, usually based on intuition and experience. This computer simulation model offers the ability to weigh alternatives and to predict the probable consequences of decisions more precisely in the operations planning of a single-track railroad concerning (a) operating policy and procedures, and (b) physical plant. It is run on an IBM 360/50 and contains all of the dispatching logic deemed necessary. The model permits running trains on schedule, if desired, but all runs to date have made maximum use of the randomization of events based on history. These include (but are not limited to) train generation, departure times, delays (all types), and length of delay (if incurred) for each segment of track. The ability to isolate delays by type and measure their effects on a system by type has proved to be a valuable tool. This simulation effort was conceived, designed and developed entirely by Frisco Railway personnel beginning in mid-1970. The program was validated to the complete satisfaction of both line and staff operating personnel in early 1972. Since that time it has been used continuously and all decisions concerning passing track placement and lengthening, train schedules, priorities, and power and train configurations are based on analysis of the output.

Presented at Fourth International Symposium on Railroad Cybernetics, AAR/UIC/IRCA, 21-26 April 1974, Washington, D.C. This paper was also published in the October 1973 issue of Rail International, which is available from E.S.L.

Thomas, LA (St Louis-San Francisco Railway Company)
International Union of Railways Paper Apr. 1974, 4 pp

ACKNOWLEDGMENT: UIC
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr PC
DOTL RP

B8 053773
AN OPTIMIZING NETWORK MODEL FOR THE CANADIAN RAILWAYS

A network model of the mainline operation of a railroad has been developed. This model predicts the optimal routing of traffic and the congestion at each yard and over each track section in the model. Input to the model is the required origin-destination flow of railcars, together with a set of physical parameters which describe each yard and the connecting track sections. Time delays in the yards are derived from queueing models of the actual system. Also, an expression has been developed which describes the over-the-road running time as a function of the traffic intensities. Output of the model gives details of the flow pattern that minimize the total car-hours required to accomplish all desired origin-destination movements, together with the delays encountered at each yard, and running times over each road section. The concept of the model is described, the component parts of this model are explained, and some potential applications in transport planning are indicated.

Presented at Fourth International Symposium on Railroad Cybernetics, AAR/UIC/IRCA, 21-26 April 1974, Washington, D.C. This paper was also published in the November-December, 1973 issue of Rail International, which is available from E.S.L.

Peterson, ER Fullerton, HV (Queen's University)
International Union of Railways Paper Apr. 1974, 6 pp, 2 Fig, 9 Ref

ACKNOWLEDGMENT: UIC
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr PC
DOTL RP

B8 053774
A MINI-NETWORK COMPUTER SIMULATION MODEL FOR RAILROAD PLANNING

Operating management of a large railroad must frequently deal with problems which effect major segments of the railroad or possibly even the entire railway system. These types of problems include train scheduling, routing, major track and signal improvements, as well as changes in operating policies. The Chessie System has developed the Mini-Network Model as a tool for aiding management in evaluating the impact of these types of problems and the effect of proposed solutions on operations. The Mini-Network Model is a computer simulation model which has the ability to duplicate over-the-road train operations on single and multiple track territories. The modifier, Mini, is used because, unlike other network models, simulation is performed at the train rather than the car level. When required for the specific application, yard and terminal functions can also be simulated. On single track territory, the model will arrange meets and passes with due consideration given to train priorities, track occupancy and trackwork configurations. The major application of the model has been in preparing for the federal (USA) 12-hours of service law. Under this rule, train crews cannot exceed 12 hours on continuous duty between call and relieve times, which represents a change from the 14 hours previously permitted. The model was used on certain regions of the Chessie System to project what will happen under the new law if schedules and facilities remain unchanged. The effect of proposed additional main tracks, yard improvements, and schedule changes to relieve the operating difficulties imposed by the constraint on crew service hours were also simulated. The end product was a recommendation for train schedule revisions providing satisfactory operations under the new law. The model has also been used to aid in the scheduling of a new train service over an already busy territory and it is currently proposed to use the model in studying the effects of single tracking of a multiple main track territory.

Presented at Fourth International Symposium on Railroad Cybernetics, AAR/UIC/IRCA, 21-26 April 1974, Washington, D.C. This paper was also published in the November-December, 1973 issue of Rail International, which is available from E.S.L.

Drucker, RW Jewell, BL Borden, RP (Chessie System)
International Union of Railways Paper Apr. 1974, 5 pp, 2 Fig

ACKNOWLEDGMENT: UIC
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr PC
DOTL RP

B8 053818
LOCOMOTIVE SIMULATOR

Training of railroad engineers requires a development of high levels of skill and judgment, which cannot be learned in a classroom environment. It also requires a simulator support program of classroom instruction. Simulator capability for training is available through use of a solid state, high speed, general purpose digital computer. To build a simulator requires a detailed knowledge of electronics, hydraulic and mechanical engineering, systems analyses and integration, mathematical modelling, human factors design, training psychology, and environmental control. A train simulator consists of: (1) an exact reproduction of a locomotive cab with controls and fixtures; (2) an instructor station and console with gages duplicating those of engine console, indicator lights for monitoring operation, and switches for setting up and controlling the training events and runs; (3) a visual system, using a multiple of projectors; (4) a motion system; (5) a sound system; and (6) a computer system. Realistic simulation provides the maximum amount of

engineer interest and motivation necessary to efficient learning and retention of skills, and provides high transfer of learning from simulator to real train operation. The digital computer is given information specifying the number and types of engines in consist, number of cars and weights, numerical data on track gradient, curves, speed limits, and milepost locations. During simulation, the computer calculates a complete force balance for each car, up to 200 cars in a train, and up to 164 separate values on each car ten times a second, and determines amount and direction of slack action, coupler force, locomotive tractive effort, braking effort, train speed, wheel action, effects of sand on adhesion, plus other effects a real train would experience. This computational ability provides the real time reaction which allows the trainee to obtain in a few weeks, experience under a wide variety of conditions, which would otherwise require years to acquire.

Presented at the Fourth International Symposium on Railroad Cybernetics, AAR/UIC/IRCA, 21-26 April 1974, Washington, D.C.

Culbertson, DL (Southern Pacific Transportation Company)
International Union of Railways Paper Apr. 1974, 3 pp

ACKNOWLEDGMENT: UIC
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr PC

DOTL RP

B8 053827
APPLICATION OF THYRISTORS IN RAILWAY TECHNOLOGY: CONSEQUENCES AND REMEDIES. 1. TESTS TO COMPARE THYRISTOR-CONTROLLED TRACTIVE UNITS FOR 16-2/3 HZ ON THE SAME TEST TRACK

A comparison of the measured results which had been obtained from tests made with thyristor-controlled locomotives of about the same type showed variations in the interfering currents measured by some railway administrations (DB and SJ) which could not be explained as having been caused only by the connection for feeding the overhead contact system. After an adjusted measuring technique had not produced appreciable changes, it was held that the type and magnitude of the supplying overhead contact systems and high voltage systems exerted a certain effect on the interfering current.

Rail International Report No. 2, ORE A 122/RP4, Feb. 1973, 1 p

ACKNOWLEDGMENT: Rail International
PURCHASE FROM: International Railway Congress Association 17-21 rue de Louvrain, 1000 Brussels, Belgium Repr PC

DOTL JC

B8 053828
APPLICATION OF THYRISTORS IN RAILWAY TECHNOLOGY: CONSEQUENCES AND REMEDIES. 2. ADDITION OF PSOPHOMETRICALLY WEIGHTED INTERFERING CURRENTS PRODUCED BY SEVERAL THYRISTOR-CONTROLLED A.C. TRACTIVE UNITS

Simultaneous running of several tractive units gives rise to severe variations in the composition of the interfering currents since the different harmonics which are dependent on the characteristics of the tractive units, the control and the conditions of the system change continuously their phase relationship to one another and also to fundamental frequency.

Rail International Report No. 2, ORE 122/RP5, Feb. 1973, 1 p

ACKNOWLEDGMENT: Rail International
PURCHASE FROM: International Railway Congress Association 17-21 rue de Louvrain, 1000 Brussels, Belgium Repr PC

DOTL JC

B8 053862
AXLE COUNTERS DEFINE BLOCK SECTIONS IN ELECTRIFIED TERRITORY

Indian Railways has installed electronic axle counters in a section of railway line having 25 kv, 50 Hz electric traction. The railway had the requirement of increasing capacity on the double-track Grand Chord line from Mughalsarai to Asansol which carries a major portion of the country's vital coal traffic. Due to hilly terrain, construction of a third main track would have been difficult and costly. Steel ties are used extensively because wood ties are in short supply. Hence track circuiting on an extensive scale is difficult. It was decided to provide electronic axle counters for splitting up some of the block sections with intermediate signaling and thereby reducing headway between trains.

Gupta, KK (Indian Northern Railway) *Railway System Controls* Vol. 4 No. 11, Nov. 1973, 5 pp, 11 Fig

ACKNOWLEDGMENT: Railway System Controls
PURCHASE FROM: XUM Repr PC

DOTL JC

B8 053865
REFINEMENTS IN SURGE PROTECTION

Surges from lightning and power sources have long been a problem for people working with electronic equipment on the railroads. Many approaches to the problem have been taken and all of the solutions found have been quite adequate for protecting the traditional equipment of the past. Today, new surge protection is being developed to protect the solid state components in much of the equipment being used in signaling and communications.

Railway System Controls Vol. 5 No. 3, Mar. 1974, 3 pp, 2 Fig

ACKNOWLEDGMENT: Railway System Controls
PURCHASE FROM: XUM Repr PC

DOTL JC

B8 053869
EFFECT ON THE SYSTEM OF A.C. LOCOMOTIVES REGULATED BY THE ASSEMBLY IN STAGES OF THYRISTOR BRIDGES CONNECTED IN SERIES [NETZVERHALTEN VON WECHSELSTROM-TRIEBFAHRZEUGEN MIT MEHRFACH-FOLGESTEUERUNGEN IM STROMICHTERSPARSCHALTUNG]

A report submitted at the 14th meeting dealing with "Modern railway stock", held in Graz. The assembly in question was designed by Brown Boveri, in order to: 1. Suppress, in the supply system, the high-frequency harmonics, as well as their induced effects causing interference on the lines carrying weak current. 2. Suppress the low-frequency harmonics capable of having an effect on the track circuits. 3. Improve the power factor. This assembly was tested on an RC 4/4 locomotive No. 161. The report contains a theory covering this assembly, as well as details, set out in the very numerous diagrams, of the results obtained during tests, and conclusions concerning the conditions under which the desired effects can be obtained. [German]

Winter, P *Glasers Annalen ZEV* No. 2-3, 1973, 10 pp, Figs, 6 Ref

ACKNOWLEDGMENT: UIC (1187)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B8 053874
BRAKE BLOCK SHOE MADE OF COMPOSITE MATERIALS

The final report consists of a summary, in which the different partial problems are shown, as they exist at the beginning of 1972. In addition to a brief outline of the work carried out previously, the report contains a more detailed description of a number of more recent studies (comparative bench tests, effect of composite brake block shoes on adhesion, and chemical and physical alterations to the friction surfaces of brake block shoes made of composite materials, and the wheels). In addition to the considerable information obtained concerning brake block shoes, the positive advantages include the use--although, of course, to a provisionally limited extent--of brake block shoes made of composite materials, ensuring advantages from the point of view of profitability and the braking technique. Finally, there is also shown, as one result, a proposal concerning a provisional specification for approval, which takes into account the existing stage of developments. The negative side includes the defects and disadvantages which still affect composite brake block shoes, and which must be taken into account, as they are capable of restricting the latters' use and profitability. Amongst the problems which are still in suspense, the most important are those concerning adhesion between wheel and rail, metal inclusions, and the effect of atmospheric conditions (particularly in winter), and, they are, therefore, problems which affect braking efficiency. The Committee leaves it to braking experts on the different railways to decide themselves, on the basis of the information obtained and placed at their disposal, whether to make use of composite brake block shoes.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B64/RP10, Oct. 1972, 169 pp, 17 Fig, 56 Tab, 2 Ref

ACKNOWLEDGMENT: UIC (1175)
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr PC

48M1

B8 053886
HOW TO OBTAIN BETTER TRANSMISSION FROM CABLE
With considerable interest in communications, especially with increasing demands for data transmission facilities, railroads are looking with greater intensity at the possibilities of using cable systems. The following article from TELEPHONY describes the basics of cable pressurization and how it can reduce or avoid service interruptions. Some of the advantages of cable pressurization are: 1) Positive internal dry gas pressure prevents moisture or damp air from entering sheath openings, and the resulting dryness helps minimize electrical leaks and noise, prevents cross talk and guards against complete loss of the cable's transmission capabilities. 2) Even in PIC cable, pressurization prevents serious transmission loss and facilitates locating leaks or breaks. 3) Maintenance costs are reduced greatly.

Skahan, PJ (Sola Basic Industries) *Railway System Controls* Vol. 4 No. 11, Nov. 1973, 3 pp, 2 Phot

ACKNOWLEDGMENT: Railway System Controls
PURCHASE FROM: XUM Repr PC

DOTL JC

B8 053982
THE DEVELOPMENT OF RAILWAY BRAKES
This article traces the development of railway braking systems from the earliest mechanical brakes through the development of air brakes.
Note: Part 2 of this article appeared in the March 1973 issue.

Marsh, GH Sharp, AC *Railway Engineering Journal* Vol. 2 No. 1, Jan. 1973, 8 pp, 11 Fig

PURCHASE FROM: Institution of Mechanical Engineers 1 Birdcage Walk, Westminster, London SW1, England Repr PC

DOTL JC

B8 054015
IMPROVEMENTS IN THE DESIGN OF AIR BRAKE CONTROL VALVES
The paper traces the development of the air brake control valve from its earliest ancestor, the original triple valve invented by George Westinghouse, up until the present day. Emphasis is placed on the way in which constructional techniques evolved, developments on both sides of the Atlantic being considered. The desire for improved performance, reduced costs and an extended maintenance period is shown to be the driving force towards change, which is inevitable once the required skills and techniques become available. The authors show how worthwhile improvements are still feasible and introduce a new design of control valve based on constructional techniques intended to realize these.
Contributed by the Rail Transportation Division of The American Society of Mechanical Engineers for presentation at the ASME-IEEE Joint Railroad Conference, Pittsburgh, Pa., April 3-4, 1974

Moore, IG Wickham, DJ (Westinghouse Brake and Signal Company, Limited)
American Society of Mechanical Engineers ASME #74-RT-3, Dec. 1973, 9 pp, 8 Fig

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL RP

B8 054130
ANALYTICAL APPROACH TO RAILWAY SIGNAL BLOCK DESIGN
Originally intended for rapid transit systems, it is also applicable to any rail system where high-speed, short-headway characteristics are required to maintain a smooth and efficient flow of passengers of goods. Analytical techniques are used to select system speed commands using a cost-benefit analysis; to determine the speed-location operating profile; to locate signal block boundaries; and to determine signal logic. Four computer programs are used to calculate station dwell times, to simulate train performance, to calculate safe braking distance, and to determine headway. These programs determine the highest feasible speeds, consistent with civil design restrictions, at which trains can travel while at design headways. The algorithm for block layout then ensures that the minimum number of blocks will be used to provide the design headway subject to all system limitations. Program inputs include car characteristics and track profile, user demand statistics, and the design headway.

Weiss, DM Fialkoff, DR *ASCE Journal of Transportation Engineering* Proc Paper Vol. 100 No. TE1, #10369, Feb. 1974, 13 pp

ACKNOWLEDGMENT: ASCE
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B8 054142
NATIONAL CAR INFORMATION AND CONTROL SYSTEM. REPORT OF THE TASK FORCE AND STEERING COMMITTEE
This extensive report investigated the need for a national car information and control system. The report gives the scope of the study, the benefits to be realized from such a system, and lays out the basic requirements of the system. Subcommittee reports included are: Car Service, Data Input, Automatic Car Identification, Communications, and Computer Systems. This report led to the expansion of TRAIN to TRAIN II.

Association of American Railroads Apr. 1972

PURCHASE FROM: AAR Repr PC

B8 054283
AUTOMATIC TRAIN CONTROL FOR MADRID METRO
Automatic train protection and operating system by Westinghouse Brake & Signal in conjunction with Dimetal S.A. is being installed on Lines 1 to 5 and new lines 6 and 7. A.T.P. is coded carrier signal system and A.T.O. is signals sensed by bogie-mounted coils giving stopping distance, gradient and coasting orders.

Rail Engineering International Vol. 4 No. 2, Feb. 1974, p 70, 1 Fig

ACKNOWLEDGMENT: Rail Engineering International
PURCHASE FROM: Broadfields (Technical Publishers) Limited Little Leighs, Chelmsford, Essex CM3 1PF, England Repr PC

DOTL JC

B8 054306
WANTED: NEW STANDARDS FOR AFO
With the advent of AFO track circuits many problems have been presented since impedance is the primary attenuating factor, not resistance. With a given shunt, the resistance will remain constant, but as the audio frequency goes up, the impedance goes up, thus less attenuation. If the standard .06 ohm shunt is used for aligning AFO track circuits, the impedance is affected by frequency, track conditions and ballast conditions. This spring General Railway Signal Co. will start an extensive project to compile the information needed for developing new standards and new equipment which will make the alignment of AFO track circuits more accurate.

Railway System Controls Vol. 5 No. 4, Apr. 1974, 8 pp, 12 Fig

ACKNOWLEDGMENT: Railway System Controls
PURCHASE FROM: XUM Repr PC

DOTL JC

B8 054326
MEASUREMENTS AND ANALYSIS OF 115 KV POWER LINE NOISE AND ITS EFFECT ON PUEBLO TEST SITE RADIO LINKS
Noise measurements were made for 115 KV power lines near the frequencies 166, 217 and 406.8 MHz with a receiver bandwidth of 1 MHz. The measurements consisted of counting the numbers of pulses per minute at preset threshold values and RMS. The variations of the noise level vs the lateral distance from the power line were also measured. The worst noise level,-40 dBm, was observed at 217 MHz under a noisy power line. The results of these measurements show that, under normal conditions, power line noise will not have significant effects on the radio links at the Pueblo Test Site.

Buck, RE Esposito, RE Gagnon, R Leonard, ET Yoh, P
Transportation Systems Center, (FRA-RT-73-36) Tech Rpt DOT-TSC-FRA-72-5, May 1972, 43 pp

Contract T-RR-204

ACKNOWLEDGMENT: NTIS (PB-222410)
PURCHASE FROM: NTIS Repr PC
PB-222410, DOTL NTIS

B8 054334
SIGNALLING AND TELECOMMUNICATIONS WORKS ON THE EUSTON MAIN LINE ELECTRIFICATION
The basic requirements of the signalling and telecommunications scheme are presented in this paper. Details of maximum speed of various types of trains, average headway, desirability for consistency of aspects, all necessitated the provision of four-aspect colour-light signalling with continuous track circuiting. Originally, power signal boxes with limited range were programmed, but economic conditions necessitated reconsideration for some electromechanical boxes. Difficulties arising in the manning of the signal boxes later caused replanning for power signal boxes throughout with much longer sections controlled from each box following technical developments. Particulars are given of the telecommunications requirements in principle. The planning of the signalling and telecommunications schemes are dealt with in some detail with special reference to the various factors to be met. Sections of the paper deal with design factors and equipment both for signalling and telecommunications with special reference to the methods which had to be adopted to give immunization against inductive effects from the 25 000 V 50 c/s traction system. Particular reference is also made to the instances where other electrical factors had to be met. Developments which occurred during the progress of the scheme are detailed and their effect on the original design is mentioned. The planning and execution of the installation work and the testing and commissioning are described, with some reference to the maintenance of the works. At the end of the paper reference is made to present-day experiences and some remarks are presented about the future.

Proceedings of a Technical Conference sponsored jointly by the British Railways Board and the Institutions of Civil, Mechanical, Electrical, Locomotive and Railway Signal Engineers, 25-26 October 1966.

Brentnall, EG (British Railways Board)
Institution of Mechanical Engineers Vol. 181 No. t3F, 1967, pp 65-86, 24 Fig

ACKNOWLEDGMENT: Institution of Mechanical Engineers
PURCHASE FROM: Institution of Mechanical Engineers 1 Birdcage Walk, Westminster, London SW1, England Repr PC
DOTL TJ1.I5

B8 054358
POWER, SIGNAL, AND ROLLING STOCK RAPID TRANSIT CAR EQUIPMENT
This paper provides maps showing the areas and routes presently served and those to be extended in the future by the Massachusetts Bay Transportation Authority; historical background of the Authority, the present and proposed traction power facilities; the present and proposed signal facilities; and the present and proposed electrical equipment on rapid transit cars. The MBTA presently operates 102 route miles of Tunnel, Subway, Elevated, and Surface Grade Rapid Transit Train (R.T.L.) Service, and has under construction and scheduled plans for an additional 82 route miles of Modern Type R.T.L. Train Service, mostly at Surface Grade and in existing railroad rights-of-way.

O'Neil, JA Smith, EH Walsh, RF (Massachusetts Bay Transportation Authority)
Institution of Electrical Engineers Conf Pub #50, 1968, 17 pp

ACKNOWLEDGMENT: Institution of Electrical Engineers
PURCHASE FROM: Institution of Electrical Engineers Savoy Place, London WC2R 0BL, England Repr PC
DOTL TF858.A4C67 Pt1

B8 054373
EXPERIENCE WITH THE AUTOMATIC DRIVING OF TRAINS ON THE PARIS METRO
This paper discusses the automatic train operation on the Paris Metro. The design of the equipment and the experience with its use are covered.

Guieysse, L (Regie Autonome des Transports Parisiens)
Institution of Electrical Engineers Conf Pub #50, 1968, 12 pp, 6 Fig

PURCHASE FROM: Institution of Electrical Engineers Savoy Place, London WC2R 0BL, England Repr PC
DOTL TF858.A4C67 Pt1

B8 054374
THE ELECTRICAL EQUIPMENT OF LINES N.1 AND N.2 OF THE MILAN METROPOLITAN RAILWAY
This paper provides general information on the electrical equipment used by the Milan Metro lines. Coverage includes power supply and power collection, signaling and train control, communications, and auxiliary equipment. A description of the rolling stock is also presented.

Cirenei, M (Milan, City of, Italy)
Institution of Electrical Engineers Conf Pub #50, 1968, 19 pp, 4 Fig, Refs

PURCHASE FROM: Institution of Electrical Engineers Savoy Place, London WC2R 0BL, England Repr PC
DOTL TF858.A4C67 Pt1

B8 054595
VOICE TRAIN CONTROL SYSTEMS
The Voice Train Control System is made practical by the continuing advancement of communications technology. The telegraph made Train Orders practical and code lines made Train Control System practical. Mobile Radio and recent advances in electronics make Voice Train Control System possible. Voice Train Control System is described at length in this very complete paper.

Thirty-Seventh Annual Proceedings of the Railway Fuel and Operating Officers Association, 1973.

Priddy, RH Johnson, HC (Chessie System); Boyd, RK (TRW Systems)
Railway Fuel and Operating Officers Association Proceeding 1973, 15 pp, 1 Fig

PURCHASE FROM: Railway Fuel and Operating Officers Association 10414 South Wood Street, Chicago, Illinois, 60643 Repr PC
DOTL RP

B8 054598
TRAIN BRAKE SYSTEMS APPLICATION AND RELEASE
Unusual and unpredictable braking actions were reported by engine men around 1970 on Canadian Railways. The problems coincided with changes in train consists that now include a greater number of 70 and 100-ton cars. The ratio of horsepower to locomotive weight had increased to the point where the independent brake was no longer capable of holding trains on grades while the train was being recharged. These problems are outlined in detail and general recommendations to prevent unusual braking are given.

Thirty-Seventh Annual Proceedings of the Railway Fuel and Operating Officers Association, 1973.

Peterson, JH (Westinghouse Air Brake Company)
Railway Fuel and Operating Officers Association Proceeding 1973, 23 pp, Figs

PURCHASE FROM: Railway Fuel and Operating Officers Association 10414 South Wood Street, Chicago, Illinois, 60643 Repr PC
DOTL RP

B8 054601
USE OF RADIO FOR TRAIN DISPATCHING
The Florida East Coast Railway placed a 71 mile section of non-block, single track territory, under a manual block system of operation. Since then train operations have been controlled by radio communications between the train dispatcher and the engineer.

Thirty-Seventh Annual Proceedings of the Railway Fuel and Operating Officers Association, 1973.

Vlasin, BD (Florida East Coast Railway)
Railway Fuel and Operating Officers Association Proceeding 1973, 6 pp

PURCHASE FROM: Railway Fuel and Operating Officers Association 10414 South Wood Street, Chicago, Illinois, 60643 Repr PC
DOTL RP

B8 054636
AUTOMATIC ANALYSIS OF BRAKE TESTS
The authors, who are Inspecteurs at the SNCF Rolling Stock and Research Departments, explain in this article the method adopted to determine the braking performance of modern highspeed trains (TGV 001), i.e., the distance needed to bring the train to a halt from various speeds with all the brakes in operation, then with all or part of each braking system isolated. This method is possible because the results of the tests are analysed by computer, and details are given of the programme and the principles on which it operates. The results are printed out directly and form an extremely useful catalogue with which all the brake equipment and the performance of future tractive stock can be defined with precision. [French]

Merle, A Foureys, J *Revue Generale des Chemins de Fer* Vol. 93 Jan. 1974, pp 26-32

ACKNOWLEDGMENT: British Railways (30112)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B8 054691
DESIGN AND OPERATION OF REMOTE-CONTROLLED LOCOMOTIVES IN FREIGHT TRAINS
In the territory in which Canadian Pacific uses radio-controlled remote locomotives, the maximum train tonnage over the ruling grade has been raised from 7500 to 12,300 long tons and the time for the 2250 km (1400 mile) round trip of a coal train reduced from six to three days. In this paper the function of the radio control equipment is outlined briefly, the placement of remote locomotives in trains is described and, through examples of mishaps to trains, the correct methods of train handling in critical situations are discussed.

Parker, CW (Canadian National Railways) *Railway Engineering Journal* Vol. 3 No. 1, Jan. 1974, pp 29-38, 24 Fig.

ACKNOWLEDGMENT: Railway Engineering Journal
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B8 054793
COMBINED REGENERATIVE AND RHEOSTATIC BRAKE ON ELECTRIC RAILCARS POWERED BY DIRECT CURRENT [GEMISCHTE NUTZ--UND WIDERSTANDSBREMSE BEI GLEICHSTROMTRIEBFAHRZEUGEN]
Most rectifier-type sub-stations feeding catenaries are fitted with values that can allow current flow in both directions. This is impossible in a system with three-phase current. When catenary absorption capacity is variable, regenerative and rheostatic braking should be possible with electric brakes. In a braking situation the first step consists of increasing the braking current supply through a direct current converter; then this current is fed into the system by a diode for as long as the system can absorb it. If the circuit system does not require any power, there is a brake thyristor to activate and maintain a braking resistance right up until the end of the direct-current converter cycle. [German]

Loderer, P *Elektrische Bahnen* Vol. 44 No. 8, 1973, 5 pp, 9 Fig, 2 Ref

ACKNOWLEDGMENT: UIC (91)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B8 054795
TRAIN MONITORING BY RADIO [DER ZUGBAHNFUNK]
Tests on the Lubeck-Puttgarden line have shown that on-train radio is subject to more interference from the catenary when the 160 MHz frequency is used as opposed to the 460 MHz wavelength adopted by the International Union of Railways. If the future development of traffic over the main trunk routes is to be more profitable, it is essential to introduce ground-to-train radio communications. The article also explains the structure of radio installations on board trains. [German]

Rossberg, RR *Europaverkehr* No. 3, 1973, 4 pp, 4 Fig, 3 Ref

ACKNOWLEDGMENT: UIC (83)
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr PC

83

B8 054942
AUDIO RESPONSE UNIT
This is an explanation of several voice out-put units. First, human voice out-put mechanism is described. Then, various interpretations of voice are shown, thereby several voice out-put units are considered by tracing the mechanism and the physical phenomena of voice. Audio response units by record editing type are actually used today in a few systems. Concerning voice composing types a device made by partial autocorrelation method seems to be the most hopeful.

Kimura, Y *Railway Technical Research Institute* Quart Rpt Vol. 15 No. 1, Mar. 1974, pp 1-7, 17 Fig, 10 Ref

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B8 054950
DATA CONVERSION OF BRAKING SPEED
Recently, in JNR, most trunk lines are heavily congested with scheduled trains and it is gradually becoming difficult for a test train to be additionally planned, if sticking to the condition of test section to be level and straight. This study was made to find out the way to convert the data of train speed, measured in any section with grades or curves included, into that to be expected for train on a level and straight section. The conversion in opposite direction is considered too.

Takami, H Iwase, Y *Railway Technical Research Institute* Quart Rpt Vol. 15 No. 1, Mar. 1974, 2 pp

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B8 056745
REGENERATIVE BRAKING EQUIPMENT FOR CLASS RE 6/6 LOCOMOTIVES OF SWISS FEDERAL RAILWAYS
The advantages of electric braking are listed as are the advantages of regenerative type braking when compared to rheostatic type for ac traction vehicles. An advance in capacitor technology has made feasible the resonance excitation system for a locomotive employing six single-phase ac motors. All six traction motor fields of these locomotives can be connected in series, thus dispensing with the excitation transformer.

Schacher, R *Brown Boveri Review* Vol. 60 No. 12, Dec. 1973

ACKNOWLEDGMENT: EI (EIX740504764)
PURCHASE FROM: ESL Repr PC, Microfilm

B8 056747
THYRISTOR-CONTROLLED RHEOSTATIC BRAKING FOR THE SERIES 1042 LOCOMOTIVES OF AUSTRIAN FEDERAL RAILWAYS (OBB)
Over 100 series 1042 locomotives of the Austrian Federal Railways are equipped with thyristor-controlled rheostatic braking which provides virtually constant braking effort over a wide speed range. Features of the equipment include simplicity and reliability.

Albrecht, W *Brown Boveri Review* Vol. 60 No. 12, Dec. 1973

ACKNOWLEDGMENT: EI (EIX740504767)
PURCHASE FROM: ESL Repr PC, Microfilm

B8 056748
LOCALIZED FEEDBACK CONTROLS FOR MULTI-LOCOMOTIVE POWERED TRAINS
A model for the longitudinal dynamics of a multi-locomotive powered train is developed. Using this model the theory of the LQG (Linear-Quadratic-Gaussian) problem is applied to the problem of minimizing coupler forces in the train consist while maintaining a practical schedule velocity. The controllers developed are easily realized and in one form provide commands for throttle setting changes to a human operator. Experimental results are presented for a 62 car consist traversing a severe grade with locomotives placed at the front, middle and end of the consist. For these experiments the controllers developed were found to meet the system specifications.
Presented at the IEEE Conf on Decis and Control, Incl Symp on Adapt.

Peppard, LE McLane, PJ Sundareswaran, KK
Institute of Electrical and Electronics Engineers 5 Ref

ACKNOWLEDGMENT: EI (EIX740502704)
PURCHASE FROM: ESL Repr PC, Microfilm

B8 056782
DATA-TRANSMISSION CHARACTERISTICS OF RAILWAY TRACK
Command data may be transmitted to a train by using the track as an inductive link. Measurements of the transmission characteristics of the track are presented. A method is presented for reducing signal attenuation that uses capacitors connected between the rails.

Mellitt, B (Birmingham University) *Electronic Letters* Vol. 9 No. 23, Nov. 1973

ACKNOWLEDGMENT: EI (EIX740204137)
PURCHASE FROM: ESL Repr PC, Microfilm

B8 056789
ELECTRO-MAGNETIC COMPATIBILITY DESIGN FOR RAPID TRANSIT SYSTEMS
Design criteria and techniques used to minimize the interference levels between the communication and signal channels for control of rapid transit vehicles and other working systems (such as propulsion, power system, auxiliaries, etc.) or the environment, are analyzed in this paper. The particular system under consideration utilizes a higher frequency band to allow a wide separation from signal to noise, but below 10 KHz and at low power level so that it does not require special license to operate. In addition, the use of FSK and the well known features of signal capture as developed in fm systems, are used to further increase the EMC of the overall system. The techniques presented in this paper have been successfully implemented in various transit systems which are presently in operation.

Presented at the IEEE International Electromagn Compat Symp Rec, New York, N.Y.

Barpal, IR
Institute of Electrical and Electronics Engineers

ACKNOWLEDGMENT: EI (EIX740102349)
PURCHASE FROM: ESL Repr PC, Microfilm

B8 056790
ELECTROMAGNETIC COMPATIBILITY BETWEEN THRYSITOR-CHOPPER CONTROLLED CARS AND ELECTRIC FIXED INSTALLATIONS IN TOKYO SUBWAYS
When commercial operation was initiated between Ayase and Kasumigaseki stations on the Chiyoda Line (Tokyo) in March, 1971, the Teito Rapid Transit Authority put into service 130 chopper-controlled cars made up of thirteen 10-car trains. In February 1972, 60 chopper-controlled cars were put into service. Compared with conventional rheostat-controlled cars, chopper-controlled cars offer improved riding comfort, reduced electric power consumption, and low temperature rise in subway tunnels. However, the thyristor-chopper control generated ripple currents in the trolley wires and rails causing problems with the signaling and communication installations. Analytical studies and tests provided a solution to these problems by employing such measures as filtering and adopting a 660 Hz chopper frequency. As a result of the tests, compatibility between chopper-controlled cars and electric fixed installations was established

Presented at the IEEE International Electromagn Compat Symp Rec, New York, N.Y.

Yukawa, R
Institute of Electrical and Electronics Engineers

ACKNOWLEDGMENT: EI (EIX740102348)
PURCHASE FROM: ESL Repr PC, Microfilm

B8 056791
ELECTROMAGNETIC COMPATIBILITY BETWEEN ELECTRIC TRACTION SYSTEM AND SIGNALLING AND TELECOMMUNICATIONS AT THE SWEDISH RAILWAYS
When 16 2/3 Hz electric traction systems were developed in the twenties, comprehensive research was undertaken concerning the interference produced in telecommunication circuits. To solve the problem, modifications were made to both the traction system and the telecommunication lines. With the introduction in 1967 of thyristor controlled locomotives and motor coaches, extensive investigations were made of disturbances in signaling and telecommunication circuits. During 1971-1972, a prototype static frequency converter for transforming utility-supplied three-phase 50 Hz power to single-phase 16 2/3 Hz power was tested to investigate harmonic disturbances and to determine ways of reducing the disturbance. Finally, techniques have been developed for reducing interference of railway telecommunication and signaling circuits resulting from exposure to induction and earth potentials from power lines and plants.

Presented at the IEEE International Electromagn Compat Symp Rec, New York, N.Y.

Svensson, S
Institute of Electrical and Electronics Engineers

ACKNOWLEDGMENT: EI (EIX740102345)
PURCHASE FROM: ESL Repr PC, Microfilm

B8 056798
INTERFERENCE TO TELECOMMUNICATION INSTALLATIONS BY RAPID TRANSIT SYSTEMS
Power conversion by means of semiconductor elements, i. e. the use of thyristors in traction systems operating with dc or ac has resulted in new electromagnetic compatibility problems. While it has hitherto been possible to control the interference to telecommunication installations caused by the fundamental frequency and harmonics of the traction current without great difficulties, the growing number of harmonics may call for special measures to be taken. In addition, traction currents are also increasing due to the demand for higher acceleration and speed of trains, particularly of rapid transit systems in densely populated areas-a demand which can particularly be met by the thyristor technique. This paper examines the electromagnetic compatibility problem from both the viewpoint of the Railways and the telecommunication authorities. Moreover, measures for keeping the interference within tolerable limits are indicated.

Presented at the IEEE International Electromagn Compat Symp Rec, New York, N.Y.

Buckel, R Riedel, HA
Institute of Electrical and Electronics Engineers

ACKNOWLEDGMENT: EI (EIX740102347)
PURCHASE FROM: ESL Repr PC, Microfilm

B8 056810
RAILWAY RE-SIGNALLING FOR ELECTRIFICATION
Railroad signalling principles are outlined. Contract work carried out is reported for British Railways Scottish Region in re-signalling 90 miles of the West Coast Main Line between Carlisle and Glasgow Central, in preparation for the introduction in 1974 of electric traction on the 25 kv overhead system.

Goldsbrough, JV (GEG-General Signal Limited) *Journal of Science and Technology* Vol. 40 No. 3, 1973

ACKNOWLEDGMENT: EI (EIX740304256)
PURCHASE FROM: ESL Repr PC, Microfilm

B8 056814
SELF-COMMUTATED RECTIFIER TO IMPROVE LINE CONDITIONS
When thyristor rectifiers are used for electric drives, reactive power is produced with fundamental and harmonic frequencies. Especially in single-phase traction lines, with their low short-circuit power, a technical solution of this problem, applicable mainly to thyristor-driven rail cars and locomotives, had to be found. In this paper, the sector-control system of a self-commutated unsymmetrical bridge is described. In the unsymmetrical half-controlled bridge connection, the two thyristors can be quenched by adding a self-commutating device. This attachment (supplement) can be applied to the single bridge or to two bridges in series (sector control). By using this self-commutating attachment, it is possible to shift the fundamental of the current to a leading angle with respect to the voltage.

Zander, H (Telefunken) *Institution of Electrical Engineers, Proceedings* Vol. 120 No. 9, Sept. 1973

ACKNOWLEDGMENT: EI (EIX740100145)
PURCHASE FROM: ESL Repr PC, Microfilm

B8 056823
SYSTEMS OF COMMUNICATION BETWEEN TRACK AND TRAINS ON PARIS SUBWAYS [LES SYSTEMES DE TRANSMISSION ENTRE LA VOIE ET LES TRAINS DU METRO DE PARIS]
The first transmission devices used in the past to transmit signals between the tracks and the trains are briefly recalled. With a view to increasing the traffic and improving the control and ease of train driving, new transmission systems have been introduced. In the case of the Paris Metro network, 14 transmission systems are currently in use. They are briefly described. [French]

Besacier, G *Automatisme* Vol. 18 No. 10, Oct. 1973

ACKNOWLEDGMENT: EI (EIX740205696)
PURCHASE FROM: ESL Repr PC, Microfilm

B8 056825
TELEPHONE EQUIPMENT IN THE MUNICH SUBWAY
Author describes the most important telephone equipment of the latest state of the art as used for the operational systems of the Munich subway in West Germany.

Hilscher, G *Reports on Telephone Engineering* Vol. 8 No. 4, July 1973

ACKNOWLEDGMENT: EI (EIX740103050)
PURCHASE FROM: ESL Repr PC, Microfilm

B8 056837
REQUIREMENT AND IMPLEMENTATION OF REGENERATIVE TRAIN CONTROL
Advances beyond the state of the art are desired for car performance, reliability of scheduled service and passenger comfort. The train propulsion and control system constitutes a major element affecting such requirements as car configuration, acceleration and braking, jerk rate, efficiency, maintainability, initial and operating cost, etc. This paper discusses the requirements imposed on an optimized propulsion system for this type of service. These requirements are then implemented by utilizing an advanced concept regenerative drive coupled to a dc shunt or series motor. A generalized approach is evolved. It is shown that close analogy exists between ac and dc systems intended to fulfill the same requirements. The paper thus projects the philosophy that advanced concepts and improved performance are not synonymous, as is often assumed, with the exercise of varying the method of implementation. It concludes by showing that the stress should be on the mating of the system elements to the source of supply and the car and on the method and techniques of exploiting their inherent characteristics advantageously. The discussions and arguments are supported by suitable signal flow diagrams, block diagrams and schematics.
Ind Appl Soc, Annual Meeting, 8th Conf Rec.

Berman, B Gelb, G
Institute of Electrical and Electronics Engineers Paper

ACKNOWLEDGMENT: EI (EIX740303826)
PURCHASE FROM: ESL Repr PC, Microfilm

B8 056853
DISK ASSIST, THE SIMULTANEOUS USE OF TREAD AND DISK BRAKES
The combination of on-tread and disk braking is an excellent method to obtain the advantages of each kind of braking and to minimize the disadvantages. There is a real need for combination braking on rapid transit cars and many freight cars. Results of in-service performance of a test car are given.

Archibald, RH (Westinghouse Air Brake Company); Cabble, GM
American Society of Mechanical Engineers Paper 73-WA/RT-11, Nov. 1973

ACKNOWLEDGMENT: EI (EIX740104848)
PURCHASE FROM: ESL Repr PC, Microfilm

B8 056957
LOW SENSITIVITY DESIGN OF OPTIMAL FEEDBACK SYSTEMS FOR LONGITUDINAL CONTROL OF AUTOMATED TRANSIT VEHICLES
Many new urban transportation systems involve the use of automatically controlled vehicles. Some new systems, such as personal rapid transit (PRT) and dual mode, are characterized by small automated transit vehicles traveling on exclusive guideways. The number of passengers per vehicles is small, and short headways are necessary for high capacity. A versatile, efficient, and safe control system is needed to maintain proper spacing between vehicles without causing passenger discomfort. The report is devoted to the design of a longitudinal control system using modern control technology. A detailed mathematical model of the longitudinal motion of automated transit vehicles in an external-reference system is presented.

Yang, SC
Minnesota University, Minneapolis July 1973, 159p

ACKNOWLEDGMENT: NTIS (PB-231441/7)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-231441/7, DOTL NTIS

B8 057173
CONTINGENCIES IN THE DESIGN OF THE AUDIO TRACK-CIRCUIT
Problems exist with little used track due to dirty surface conditions leading to development of unbalanced track-circuits raising inter rail-relay drop out voltage. Factors include track-circuit lengths, adjustments to obtain constant lengths of pre-shunt and extended-shunt distance, effect of ballast resistance and its measurement. Little data is published on shunting characteristics, ionization voltage and relevance of the AAR standard minimum shunt in relation to audio-frequency.

Frielinghaus, KH (General Railway Signal Company) *Rail Engineering International* Vol. 4 No. 4, May 1974, pp 182-188, 12 Fig

ACKNOWLEDGMENT: Rail Engineering International
PURCHASE FROM: Broadfields (Technical Publishers) Limited Little Leighs, Chelmsford, Essex CM3 1PF, England Repr. PC
DOTL JC

B8 057175
INFORMING THE DRIVER OF BRAKE-PIPE FLOW AND LEAKAGE PARAMETERS
It is important that drivers receive ready information on air brake performance when effecting routine test and ensuring breakway, and that brake equipment faults and emergency applications made in the train be identified quickly. Westinghouse Brake & Signal has developed a new simple air-flow measuring device which can be mounted directly on the main reservoir supply to the brake valve.

Wickham, DJ (Westinghouse Brake and Signal Company, Limited) *Rail Engineering International* Vol. 4 No. 4, May 1974, pp 194-197, 2 Fig

ACKNOWLEDGMENT: Rail Engineering International
PURCHASE FROM: Broadfields (Technical Publishers) Limited Little Leighs, Chelmsford, Essex CM3 1PF, England Repr. PC
DOTL JC

B8 057177
WARNING STAFF AT WORK ON THE TRACK BY RADIO-TELEMETRY LINK
The Alexander Early Warning System comprising a rail-affixed detector which transmits its warning by radio link up to three miles distant to the "lookout" man is described. A device which overcomes problems of impaired visibility and obstructed vision.

Rail Engineering International Vol. 4 No. 4, May 1974, pp 189-190, 3 Phot.

ACKNOWLEDGMENT: Rail Engineering International
PURCHASE FROM: Broadfields (Technical Publishers) Limited Little Leighs, Chelmsford, Essex CM3 1PF, England Repr. PC
DOTL JC

B8 057179
RE-SIGNALLING THE SCOTTISH SECTION OF THE ELECTRIFIED BR WEST-COAST MAIN LINE TO GLASGOW
Remodelling the 90-route miles north of Carlisle over Beattock summit embraced power-signalling with remote control from only two signal-centre control panels and incorporated computer-based train-describers. This comprehensive scheme exploits to the full the electrification of this severely-graded main line to Scotland.

Goldsbrough, JV *Rail Engineering International* Vol. 4 No. 4, May 1974, pp 174-181, Figs., Phots.

ACKNOWLEDGMENT: Rail Engineering International
PURCHASE FROM: Broadfields (Technical Publishers) Limited Little Leighs, Chelmsford, Essex CM3 1PF, England Repr. PC

DOTL JC

B8 057430
SP MAKES REMOTE AIR BRAKE TESTS
Southern Pacific has incorporated its new remote-controlled Terminal Air Brake Test System. Once the head end of the train is coupled to the brake test system, an automated panel, operated by the lead carman in the Trim Tower, is programmed to perform the charging-reducing of the brakepipe and leakage air tests. Automatic testing procedure is described.

Railway Locomotives and Cars Vol. 148 No. 3, Mar. 1974

ACKNOWLEDGMENT: EI (EIX740601962)
PURCHASE FROM: XUM Repr. PC

DOTL JC

B8 057502
GERMANY AUTOMATES ITS RAILS
This article bites off a chunk of German Federal Railway (DB), suburban commuter lines (S-Bahnen), and urban mass-transit systems (U-Bahnen) technology that is so complex that it is difficult for the reader to understand in an article of limited length--unless it is somewhat "digested" in content. Therefore, presented here is a broad-brush overview of the railway signaling techniques, track-to-train communications, and safety systems that have evolved in the Federal Republic since the end of World War II.

Friedlander, GD *IEEE Spectrum* Vol. 11 No. 7, July 1974, pp 73-77, 5 Fig.

ACKNOWLEDGMENT: IEEE
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

B8 057529
ON THE REGENERATIVE BRAKING OF DC MOTORS WITH AC SUPPLY
A new method is described in which the DC motor may regenerate power effectively to AC supply. The principle is similar to that with a DC chopper for regeneration of the power from DC motor to DC supply. In this new method, however, thyristor switches synchronizing to the AC supply are used instead of a DC chopper. The principle and the power calculations as well as experimental results are presented. From theoretical and experimental considerations it is clarified that there exist suitable trigger angles in the thyristor of the synchronizing switches.

Makino, T Harada, K *IEEE Transactions on Industry Applications* Vol. 1A10 No. 1, Jan. 1974, pp 123-127

ACKNOWLEDGMENT: IEEE Transactions on Industry Applications
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

B8 071820
RECIPROCATING COMPRESSORS AND VACUUM EXHAUSTERS FOR RAIL TRACTION VEHICLES
Compressors and vacuum exhausters are essential components of the brake equipment on rail vehicles. Reliability and space-saving design are the main features of the machines described in this article. These are built in various sizes, with motor drives for electric traction vehicles and mechanical drives for diesel locomotives.

Moser, R Sigg, M *Brown Boveri Review* Vol. 61 No. 2-3, Mar. 1974

ACKNOWLEDGMENT: EI (EI 74 705595)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B8 071985
RE-SIGNALLING THE SCOTTISH SECTION OF THE ELECTRIFIED BR WEST-COAST MAIN LINE TO GLASGOW
Power signaling with remote controls from only two signal-center control panels and incorporating computer-based train describers, is used to monitor 90 miles of track. Power supplies for signaling are generally derived from public sources at 415 V, three-phase, four-wire. The remote control system is fully transistorized and mounted on printed circuit boards. These controls and indications are all simple two-state conditions and scanning is at the rate of 750 bit/sec.

Goldsbrough, JV *Rail Engineering International* Vol. 4 No. 4, May 1974

ACKNOWLEDGMENT: EI (EIX740902332)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B8 071987
TELECOMMUNICATION CABLE LINK OF THE SOUTH AFRICAN RAILWAYS BETWEEN JOHANNESBURG AND CAPE TOWN
The cable link running along the permanent way between Johannesburg and Cape Town was placed in service for the South African Railways. The makeup of the cables used, the mode of operation of the link, and the projection of the route are described. A brief account is also given of the importance of this Siemens-built link for the operation of the South African Railways. Besides being Africa's so far longest coaxial cable link, its technology is rated as the most advanced in the world.

Beck, K Desi, DG *Siemens Review* Vol. 41 No. 4, Apr. 1974

ACKNOWLEDGMENT: EI (EIX740901873)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

B8 072492
SYSTEMS PARAMETERS AND THEIR AFFECT ON AUTOMATIC TRAIN CONTROL SYSTEM DEVELOPMENT
In order for an Automatic Train Control System to function within the total complex of a rapid transit system, the ATC designer must be aware of and make adjustment and allowance for the various other elements of the system which can place restrictions on the ATC design and operation. These and other system parameters take on many shapes and forms and in many cases are not as apparent as some of the parameters. Changing any of the critical systems characteristics can have far reaching effects on the total system.
This paper was presented at the Ninth Annual Meeting of the IEEE Industry Applications Society, Pittsburgh, Pennsylvania, 7-10 October 1974.

Swithers, FG (De Leuw, Cather and Company)
Institute of Electrical and Electronics Engineers, (74 CHO 833-41A) Proceeding Part 1, 1974, pp 516-519

ACKNOWLEDGMENT: IEEE
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL RP

B8 072494
OCCUPANCY DETECTION TECHNIQUES FOR TRANSIT SYSTEMS
Occupancy detection in a transit system which does not use a pair of rails for shunting can be accomplished by a continual "check-in/check-out" process for each train as it moves about the system. With this process, each train in the system indicates track occupancy by transmitting signals to wayside antennas which extend the length of each block. Once received for a particular block, this occupancy signal sets a latched, positively reset relay or solid-state memory, which will provide an occupancy indication for that block until the train establishes occupancy in the next block. The occupancy information for each track is processed through a series of vital safety checks. These checks monitor possible emergency conditions and provide the appropriate alarms to the speed encoding subsystem and other subsystems. By using the appropriate hardware to implement these principles, this

subsystem has been made failsafe. The failsafe operation of this subsystem depends upon the specific hardware component choices such as vital relays, failsafe and gate, etc., and on proper system-level design criteria. In addition, this type of logic can be used in a system which does employ shunting of the rails for occupancy detection in order to provide redundancy for increasing the margin of safety.

This paper was presented at the Ninth Annual Meeting of the IEEE Industry Applications Society, Pittsburgh, Pennsylvania, 7-10 October 1974.

Barpal, IR (Westinghouse Electric Corporation)
Institute of Electrical and Electronics Engineers, (74 CHO 833-41A) Proceeding Part 1, 1974, pp 319-322, 1 Fig.

ACKNOWLEDGMENT: IEEE
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL RP

B8 072559
SAFETY AND AUTOMATIC TRAIN CONTROL FOR RAIL RAPID TRANSIT SYSTEMS

The anticipated construction and expansion of rail rapid transit systems in the United States over the next 10-15 years implies major capital expenditures. A significant level of automation in train control is likely to be central to these systems. The potential safety problems associated with various implementation alternatives, several possible levels of automation, and uncertainty in the corresponding proper role of the human operator raise issues requiring timely resolution. This report describes the state-of-the-art in rail rapid transit system automatic train control, assesses the safety related interrelations between the train control system, functions of the human operator and other portions of the total system, and makes recommendations, based on current experience, to aid the process of planning, funding approval, design, implementation, test, safety certification and operation of new systems or modifications of existing systems. The Study suggests that the Federal Government develop safety criteria by which to evaluate future proposals and establish guidelines for safety certification procedures. It also concludes that knowledgeable application of system engineering skills and advanced development program techniques together as a process, are probably more important to achieving a successful new rail rapid transit system than are individual design decisions or application of advanced technology.

Pawlak, RJ Colella, AM Knable, N Robichaud, RH Sussman, ED
Transportation Systems Center, (OE404-R4602) Final Rpt. DOT-TSC-OST-74-4, July 1974, 278 pp

ACKNOWLEDGMENT: TSC
PURCHASE FROM: NTIS Repr. PC
PB-235/492/6 st, DOTL NTIS, DOTL HE18.5 A35 74-4

B8 072660
AUTOMATION AND CONTROL IN TRANSPORT

This book provides a highly technical, sophisticated engineering treatment of transport control systems, with considerable attention to railroad signaling and control systems. The book also covers interlocking and classification yards. Automatic Train Control and locomotive control systems are also covered, as are braking systems and guidance systems. The book also covers highway control systems and advanced systems such as air cushion vehicles and the linear induction motor. Numerous references to other works are given.

Barwell, FT (Swansea University College, England)
Pergamon Press 257 pp, Figs., Phots., Refs.

PURCHASE FROM: Pergamon Press, Incorporated Maxwell House, Fairview Park, Elmsford, New York, 10523 Repr. PC

DOTL TA1230.B28

B8 072678
A SURVEY OF RAILWAY SIGNALING AND CONTROL

Railway signaling originated from the basic needs of safety, but its development has permitted the exploitation of wider facilities, in the form of considerable economics and increased efficiency, coupled with the attainment of higher speeds and improved control. It is closely supported by telecommunications techniques, both in ancillary functions and in characteristic railway communication networks, using land and radio transmission media. Signaling is based on the principle of "fail-safe" and complete reliability; at first it was effected by mechanical means, but subsequently supported and replaced by electrical means, the latter method proving itself by means of specialized application and method, to be the most suitable for the very exacting performance demanded. The introduction and improvement of electronics is now playing an increasing part in the operation of railways, and holds much promise for greater application in the future, having under its wing not only control and peripheral installations as they are known today, but also new capabilities in the form of revenue collection, data handling, and streamlined administration. The recent trend is toward automation, to which railway systems are particularly adaptable, but there are still many unsolved problems. In signaling and communications, managements have not only the best possible insurance policy, but an indispensable tool for commercial viability; these two assets will play a large and vital role in the imminent transport explosion of the future.

Cunliffe, JP (Harris (Frederic R), Incorporated) *Institute of Electrical and Electronics Engrs Proc* Vol. 56 No. 4, Apr. 1968, pp 653-674, 10 Fig., 11 Ref.

ACKNOWLEDGMENT: Institute of Electrical and Electronics Engrs Proc
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

B8 072785
INTERFERENCE IN RAILROAD ELECTRIFICATION

In the electrification of any railroad, the design engineer is faced with many problems related to proper operation of communication and railroad signal systems. The factors cited above are dominant and, because they are interrelated, support the obvious conclusions of basing the design of electrification on a systems approach.

Robertson, HM (Association of American Railroads)
National Telecommunications Conference Cong. Rec. Vol. 2 Proc. Paper #25c, 1973, 3 pp, 22 Ref.

TOTAL FUNDS: $200,000,000

ACKNOWLEDGMENT: EI
PURCHASE FROM: IEEE Repr. PC

B8 072859
HUMAN FACTORS IN SIGNALLING SYSTEMS: APPLICATIONS TO RAILWAY SIGNALLING

The author has made an in-depth study of the human factors involved in the design, construction and interpretation of signalling systems, and in particular analysis of errors, including controlled experimentation, the results being published in this book. The book belongs in the field of human factors engineering and applied and experimental psychology and will interest the signal engineer and others involved in rail safety, particularly in the design and application of the more complex systems.

Mashour, M
Wiley (John) and Sons, Incorporated Vol. 42 p

ACKNOWLEDGMENT: Modern Railroads
PURCHASE FROM: Wiley (John) and Sons, Incorporated 605 Third Avenue, New York, New York, 10016 Repr. PC

B8 072962
TRANSPORTATION NETWORK ANALYSIS-SYSTEM AND TERMINAL

Eleven addresses, followed by discussions, given at the meeting, held in April, 1969, of the RSMA, on the general subject of the application of systems analysis, the theory of graphs, and the computerisation theory of communications, to transport problems. The above brochure contains a list of the 50 previous publications of the RSMA which appeared between 1955 and 1969. The following are some of the most characteristic of the subjects dealt with:--W.P. Allmann. Foreword. The fundamental transport problem: way and works, rolling stock, methods of operating, its importance, methods of study--mathematical models, simulation, adaptation of the problem to the possibilities of computers.--A. Dooharian. Communication and control in an operational analysis. Connections between a national defence strategy and the transport problem.--W.H. Turner. Economics of the configurations of chain systems and the problem of point-to-point communications. A parallel

between the the problem of the telephone system and that of the transport system.--R.S. Farnsworth. Optimised system of land and sea transport. Linear programming of the transport of a product to the ports in the United States, and from there to destinations inside the country. Study of the breaking down of a problem which is too large to be dealt with as a whole.--G.J. Ahrenholz. Systems analysis applied to operations in a sea port. Details of the TRANSIM model and application in a military port to the enbarkment of an infantry division.--D.J. Collins. The individual control of wagons, the basis for the efficient operation of a railway system. Details of the model used on the Canadian National.--E.C. Dwyer. Relations between the running of marshalling yards and headquarters. Elaboration of a complete railway operating system.--H.N. Shycon. The distribution system. Research into an optimum distribution strategy, taking into account marketing, selling points and the geographical situation of the producers, by means of computer simulation.

Railway Systems and Management Association Oct. 1969, 100 pp

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Railway Systems and Management Association 181 East Lake Shore Drive, Chicago, Illinois, 60611 Repr. PC

B8 072966
ONE RADIO CHANNEL CAN CONTROL MANY VEHICLES
The author shows the manner in which the development of the binary system and the corresponding coding enables the points, and locomotives, or other vehicles, to be remote controlled by means of one radio channel. He describes the layout and operation of such a control, whose transmitting equipment is situated at a fixed or movable point, and the receiving equipment on a vehicle.

Shook, CG *Railway Signaling and Communications* Nov. 1963, pp 26-40, 6 Fig.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: ESL Repr. PC, Microfilm

B8 072969
HOW TO CONTROL HUMP LOCOMOTIVES
After having drawn attention to the advantages of the control of the speed of the above locomotives, particularly from the point of view of rapid marshalling, the author describes the equipment and method of operation of a number of remote-control systems used by the railways in the United States.

Stipancic, C *Railway Signaling and Communications* Aug. 1969, pp 26-28, 2 Fig.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B8 072988
A NEW BRAKE-REVERSING TRANSMISSION FOR SHUNTING WORK
Locomotives used in shunting operations require 1) power acceleration with smooth stepless development of tractive effort, 2) steady change of load and speed, 3) rapid reversing, 4) uniformly high braking effort without wearing parts, 5) easy control and operation, and 6) simple and rugged design to ensure trouble-free running. AEG (Allegemeine Electricitaers Gesellschaft) has developed the Ser 311-Fottinger transmission. Characteristics include: power up to 280 HP; compact design; high turbine moment is obtained when starting; the torque converter gives smooth acceleration, adjusting automatically to the load; friction-disc reversing clutches are made of non-wearing sinter-bronze and steel; and most importantly, it can be reversed while the locomotive is still moving. In fact, it is possible to reverse at speeds of up to half maximum. The Sar 320 has also been developed by AEG for use on multiple-unit stock for medium and long distance services, consisting of up to 6 or 8 cars. It uses force locking reverse clutches. The arrangement is advantageous on extensive railway systems with long intervals between stations. It permits the use of very simple transmissions with a minimum of control equipment.

Eisenbahntechnische Rundschau No. 11, Dec. 1969, pp 20-22, 2 Fig.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Hestra-Verlag Hernichel und Dr. Strauss, 61 Darmstadt, West Germany Repr. PC

B8 080083
ELECTRIC VEHICLES AND POWER SUPPLIES FOR HIGH-SPEED RAIL TRAFFIC [Elektrische Fahrzeuge und Energieversorgung fuer Schienenschnellverkehr]
This article describes rail dynamics at high speeds and the bearing these have on the design, power, running gear and brakes of electric traction stock. The increased powers required for high-speed vehicles are examined, and the necessary changes in the overhead contact line with respect to elasticity and conductance described. [German]

Bauermeister, K *Eisenbahntechnische Rundschau* Vol. 23 No. 9, Sept. 1974, pp 335-339, 2 Fig.

ACKNOWLEDGMENT: Eisenbahntechnische Rundschau
PURCHASE FROM: Hestra-Verlag Hernichel und Dr. Strauss, Darmstadt, West Germany Repr. PC
DOTL JC

B8 080090
BIT ERROR RATE AND CROSSTALK DISTURBANCE IN TRANSMISSION OF BASEBAND SIGNAL CODES
First, a structure of occurring error codes caused by pulsive noises in transmission of baseband signal codes is analyzed theoretically, and then confirmed by experiments using various noise patterns, as regard several parameters affecting the error rates. Examples of the rates measured in J.N.R.'s lines are shown, and a predicting method for the rates as well as application to practical lines are illustrated. Next, as for crosstalk disturbances, formulae derived analytically from the step response function of the line are presented, expressing spectra of the crosstalk wave. Applying this to comparatively short lines, the disturbances in lines practically used, such as low speed telegraph and the C.T.C. system's 2400 bauds are evaluated, and for the future, sending power levels of high speed lines are discussed relating with the error rates.

Takahashi, K *Railway Technical Research Institute* Quart Rpt. Vol. 15 No. 3, Sept. 1974, pp 137-143, 8 Fig., 2 Tab.

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Ken-yusha 1-45-6, Hikari-cho, Kokubunji, Tokyo, Japan Repr. PC
DOTL JC

B8 080121
RELIABILITY EVALUATION OF A BRAKE PIPE FLOW INDICATOR FOR USE WITH REMOTE CONTROL LOCOMOTIVE EQUIPMENT
The test data presented in this report show that the Type "B" Brake Pipe Flow Indicator is mechanically capable of operating one million cycles under laboratory conditions without failure or loss of sensitivity. Under prolonged exposure to high temperatures the diaphragm showed some effects of heat aging which is to be expected with molded rubber products not specifically synthesized to withstand high temperature environments. The apparatus developed for the cycling tests was realistic in terms of simulating a number of significant operating parameters of a flow meter used on locomotives in service. It appears therefore that the flow rater as used for a control function in remote-controlled locomotives is functionally adequate and no special precautions need be considered in relation to normally testing and maintaining this part.
Sponsored by the Ad Hoc Committee on Remote Controlled Locomotive Unit Power.

Association of American Railroads Technical Center, (69-R-6) Proj. Rpt. R-108, Mar. 1971, 11 pp, 3 Tab.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B8 080254
DETECTION OF TRACK GUIDED GROUND VEHICLES USING THE TRACK AS AN ELECTROMAGNETIC SURFACE WAVEGUIDE
The importance of vehicle detection and communication in mass transportation systems is discussed along with the advantages of track guided systems and the use of automation. Present and proposed methods of tracked vehicle detection are reviewed. An innovative method is proposed for detecting or communicating with tracked vehicles in which the track is used as an open waveguide. The characteristics of a rail as a communication channel are determined and suggestions for analyzing other parts of the system are discussed. A method of analyzing wavelengths of arbitrary shape and consisting of glossy materials was required. The problem of distinguishing the desired modes from non-physical spurious and other modes is discussed and the complete set of programs is listed and described. History, definitions, and applications of electromagnetic surface waves are reviewed and behavior of two types of surface waves are presented.

McAulay, AD
Carnegie-Mellon University, Urban Mass Transportation Administration, (UMTA-PA-11-007) PRI-74-103, CMUTRI-TP-73-17, Dec. 1973, 193 pp

ACKNOWLEDGMENT: NTIS (PB-235727/5)
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-235727/5, DOTL NTIS

B8 080341
TRAIN TRACK DYNAMICS-GUIDELINES FOR: TRAIN HANDLING, TRAIN AND STRUCTURE, ENGINEER EDUCATION
The abstract of guidelines taken from Track Train Dynamics Manual indicates factors in four areas which are important in improving the performance of freight trains.
An RPI-AAR cooperative program. See 080130.

Association of American Railroads Technical Center, (R-153) R-122(73T 0252), 1973, 83 pp, 29 Fig.

ACKNOWLEDGMENT: Association of American Railroads Research Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

B8 080350
RADIO COMMUNICATIONS EQUIPMENT FOR THE SOCIETE DES CHEMINS DE FER VICNAUS DU ZAIRE (CVZ)
The radio communications system for the new railway line between Akeli and Bumba of the Chemins de fer Vicinaux du Zaire commenced operation in December 1972. The backbone of the installation is a 400 MHz directional radio link. The control center is at Aketi, from which every station and locomotive on the 185 km long railway line can be reached. The radio communications system eliminates complex signal equipment and ensures reliable train services.

Hefti, E *Brown Boveri Review* Vol. 61 No. 6, June 1974, pp 279-281

ACKNOWLEDGMENT: EI (EI 74 080399)
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B8 080355
LIMIT CAPABILITIES OF COMBINED BRAKING SYSTEMS [Leistungsgrenzen Kombinierter Bremssysteme]
The article deals with brake systems of high-speed trains, the main attention focussing on braking to complete stop. Assuming low axle drive masses, it is shown that safe braking from speeds up to 350 km/hr, is possible by means of different combined brake systems. In this connection, the eddy-current brake is of particular importance for attaining short stopping distances. [German]

Saumweber, E *Glasers Annalen ZEV* Vol. 98 No. 7-8, July 1974, pp 259-265, 9 Ref.

ACKNOWLEDGMENT: EI (EI 74 080397)
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B8 083046
MOPAC CONTROL SYSTEM SPEEDS INVENTORY AND MOVEMENT
The Transportation Control System project of the Missouri Pacific is now controlling car, train and terminal operations with computer-based techniques. Data on inventories and movements of cars on the entire system are maintained in the computer at MP's St. Louis headquaters. At the yard level, MP has developed a standardized Yard and Terminal Subsystem (YATS) which ties in with the overall TCS network. YATS has produced substantial improvement in yards, more than enough to offset the cost of computerizing car information and processing at the individual yard level. Some data is processed on minicomputer subsystems at individual yards.

Railway System Controls Vol. 5 No. 10, Dec. 1974, pp 16-18, 3 Phot.

PURCHASE FROM: XUM Repr. PC
DOTL JC

B8 084727
MEASUREMENTS OF LEAKY COAXIAL CABLES AND POSSIBLE APPLICATIONS TO TRAIN COMMUNICATION
The electrical and radiation properties of the Radiax have been measured. The main results are: i) the surface wave exists, ii) the radial radiation follows $1/r^2$ relation for frequency below 190 MHz and $1/r$ relation for frequency near 400 MHz, iii) the transverse radiation pattern is nearly omnidirectional, iv) the coherent band-width is on the order of 3 MHz and the operating frequency range is several hundred megahertz; and v) better coupling efficiency is observed at lower frequency. Possible applications for railroad communication are discussed.

Yoh, P Esposito, R Gagnon, R Kodis, RD
Transportation Systems Center, (DOT-TSC-FRA-73-15) Final Rpt. FRA-ORD&D-74-43, May 1974, 90 pp, 57 Fig., 4 Tab.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche
DOTL TF23.U68A34, DOTL NTIS

B8 084925
NEW DIMENSION IN CTC
Computer, solid state electronics and cathode ray tube displays are adding new dimensions to centralized traffic control. A new concept called "area dispatching" allows the dispatcher to visualize the interaction between events over a much larger area. Computer systems have now been developed to handle entire "meets" and to select routes through large terminal areas.

Progressive Railroading Vol. 17 No. 9, Sept. 1974, pp 70-72

ACKNOWLEDGMENT: CNR
PURCHASE FROM: Murphy-Richter Publishing Company 9 South Clinton Street, Chicago, Illinois, 60606 Repr. PC
DOTL JC

B8 092738
STANDARDIZATION OF CONTROLS FOR UNDERGROUND ELECTRIC FACE EQUIPMENT. APPENDIX 3. RAILED PERSONNEL CARRIERS
The appendix includes recommendations for the standardization of controls on railed personnel carriers and is intended to be used in conjunction with the Final Report (BuMines OFR 45(1)-75; PB-242 562). The primary purpose of the effort was to apply modern human engineering technology to reduce human error and accidents associated with the on-site operation of railed personnel carriers.
See also Appendix 2, PB-242 563.

Krause, JR Hedling, WG
Applied Science Associates, Incorporated, Bureau of Mines Res Rept. BuMines-OFR-45(4)-75, Dec. 1974, 34p

Contract H0230021

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-242565/0ST, DOTL NTIS

B8 092739
STANDARDIZATION OF CONTROLS FOR UNDERGROUND ELECTRIC FACE EQUIPMENT. APPENDIX 2. TROLLEY MINE LOCOMOTIVES
The appendix includes recommendations for the standardization of controls on trolley mine locomotives. It is intended to be used in conjunction with the Final Report (BuMines OFR 45(1)-75; PB-242 562). The primary purpose of the effort was to reduce human error and accidents associated with the on-site operation of trolley mine locomotives.
See also Appendix 1, PB-242 563 and Appendix 3, PB-242 565.

Krause, JR Hedling, WG
Applied Science Associates, Incorporated, Bureau of Mines Res. Rept. BuMines-OFR-45(3)-75, Dec. 1974, 32p

Contract H0230021

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-242564/3ST, DOTL NTIS

B8 093378
NORTHEAST CORRIDOR HIGH SPEED RAIL PASSENGER SERVICE IMPROVEMENT PROJECT. TASK 4A. SIGNALING AND COMMUNICATIONS
The report includes description of the present signal systems, recommendations and description of the changes required to support high-speed passenger service, and corresponding cost estimates for the Northeast Corridor (Washington, D.C. to Boston, Massachusetts). Recommendations and descriptions cover the areas of proposed signal systems, track circuit requirements, impedance bonds, hazard protection devices, control systems, communications systems, training devices, installation schedule, and estimates of costs to procure and install such systems. Typical construction and installation specifications are included as an appendix.
See also report dated Apr 75, PB-243 419.

Williams, J Pipas, G
Bechtel Corporation, Federal Railroad Administration Final Rpt. FRA/ONECD-75/4A, Sept. 1975, 110 pp

Contract DOT-FR-40027

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Micfofiche
PB-245956/8ST, DOTL NTIS

B8 093563
OPERATION OF HIGH SPEED PASSENGER TRAINS IN RAIL FREIGHT CORRIDORS
A preliminary examination of the problems associated with mixed-traffic operations-conventional freight and high speed passenger trains-is presented. Approaches based upon a modest upgrading of existing signal systems are described. Potential costs to the operating railroads, impact on railroad efficiency, and safety of passengers and train crews are considered. Special attention is given to analysis of stopping distance for various conditions and rolling stock. Basic conclusions are that speeds above 125 MPH are likely to require substantial signal system modification and that freight service capacity will be severely degraded by large numbers of HSPT's; further analysis is required to determine well-founded control-system guidelines.

Abbott, RK
Transportation Systems Center, Federal Railroad Administration Final Rpt. DOT-TSC-FHA-75-14, FRA/ORD-76-07, Sept. 1975, 82 pp

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-247055/7ST, DOTL/NTIS

B8 095226
HOT SPOT HEATING BY COMPOSITION SHOES
It is generally understood that uneven heating of the tread of a wheel during braking is possible. A method has been devised to measure the intensity and frequency of hot spots on the wheel tread surface. After a description of the measurement apparatus and technique, results of a study of hot spots during constant speed brake applications with single composition shoes are presented. Possible lowering of the hot spot level by increasing the conformability of the brake shoe is studied by cutting one slot across each pad of a brake shoe. This method of hot spot study may be useful for future analysis and improvement of brake shoes.
Contributed by the Rail Transportation Division of The American Society of Mechanical Engineers for presentation at the IEEE-ASME Joint Railroad Conference, San Francisco, California, April 15-17, 1975.

Wetenkamp, HR Kipp, RM (Illinois University, Urbana)
American Society of Mechanical Engineers 75-RT-2, Apr. 1975, 5 pp, 7 Fig., 1 Tab., 12 Ref.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL RP

B8 095230
COMBINATION FRICTION BRAKING SYSTEMS FOR FREIGHT CARS
The improvement in railroad capacity requires among other things, the ability to safely increase speeds on significant downgrades. A means of doing this by way of a combination of on tread and off tread brakes is shown along with dynamometer data to support the method both technically and economically. An historical review of the need for supplementary braking is also included.
Contributed by the Rail Transportation Division of The American Society of Mechanical Engineers for presentation at the IEEE-ASME Joint Railroad Conference, San Francisco, California, April 15-17, 1975.

Blaine, DG Cabble, GM Grejda, FJ (Westinghouse Air Brake Company)
American Society of Mechanical Engineers 75-RT-11, Apr. 1975, 16 pp, 30 Fig., 3 Tab., 8 Ref.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL RP

B8 095373
REMOTE CONTROL AND TRANSMISSION OF DATA BY RADIO [Funkferasteuerung mit Datenuebertragung]
This appliance makes possible the remote control of 10 shunting locomotives through one radio channel. The device operates on a selective call system and the transmission data on a simplex channel in the 160 or 460 MHz frequency bands, with a data transmission speed of 2,400 Bands. A self-check code ensures correct transmission from the transmitter to the vehicle. Repetition by the vehicle is unnecessary because of the inherent safety of the system. The radius of action of the installation is 600 m. In the case of breakdown in the transmitter or the vehicle device, as well as in the case of a severance of communication, the "emergency stop" process will be triggered off, and this can only be cancelled by special instruction.

Escher, R *Technische Mitteilungen AEG-Telefunken* Vol. 64 No. 4, 1974, pp 129-131, 2 Fig.

ACKNOWLEDGMENT: International Railway Documentation, Selection of
PURCHASE FROM: Allgemeina Elektricitaets Gesellschaft-Telefunken Hohenzollerndamn 150, Berlin 33, West Germany Repr. PC

B8 095629
CONTRIBUTION TO THE INVESTIGATION OF COMPATIBILITY OF THYRISTOR-CONTROLLED DC RAIL MOTOR CARS WITH SIGNAL AND TELECOMMUNICATION EQUIPMENT [Beitrag zur Untersuchung der Kompatibilitaet von Thyristorgesteuerten Gleichstrom-Triebfahrzeugen mit den Signal-und Fernmeldeeinrichtungen]
It is shown how distortion effects in the thyristor control circuitry can be drastically reduced or completely eliminated by the proper selection of components. The use of dc circuits, operating in the audio-frequency region, appears to be best for train protection. [German]

Wagner, R (Schweiz Lokomotiv und Maschinenfabv, Switzerland) *Elektrische Bahnen* Vol. 45 No. 9, Sept. 1974, pp 198-204, 7 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTl JC

B8 095630
MEAN SPEED OF BRAKING THE TRACTION VEHICLE [Die Mittlere Geschwindigkeit beim Bremsen eines Triebfahrzeuges]
The characteristic data, such as traveling time, traveling speed, are obtained by solving the d'Alembert basic equation. The calculation of the braking procedure has so far been based on a mean speed corresponding to half the braking speed. In this paper the corrected mean speed is computed under consideration of the nonlinear motional resistance. [German]

Sliwa, H *Glasers Annalen ZEV* Vol. 98 No. 12, Dec. 1974, pp 414-416, 3 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B8 095631
RADIO TECHNOLOGY FOR RAILROADS WITH INSUFFICIENTLY DEVELOPED SIGNALING AND TELECOMMUNICATION SYSTEM [Funktechnik fuer Bahnen mit Wenig Ausgebautem Signal-und Fernmeldesystem]
In the case of railroads with low traffic density and simple operating conditions, the use of radio equipment will result in a considerably higher flexibility of operations and in a higher profit-earning capacity of the transport undertaking. This requires in the first place the setting up of a radio network with fixed stations and radio link systems. Such a system is described in more detail. [German]

Fischer, K (Telefunken, Germany) *Glasers Annalen ZEV* Vol. 98 No. 12, Dec. 1974, 5 pp, 16 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B8 095632
TELECOMMUNICATION FOR BRITISH RAIL
The principal object of the National Telecommunications Plan (NTP), a railway-owned and maintained telecommunication network, is to provide an automatic extension-to-extension trunk-dialing telephone network between all business centers on the railway, as well as a good base for data-transmission services. The trunk cable network connecting the business centers is installed in lineside routes. It has sufficient bandwidth capacity to serve all telephone traffic as well as for an automatic switched teleprinter network. It also provides for all the expected requirements for low-,medium-and high-speed data transmission for purposes like the total operations processing system (TOPS) and seat reservation systems, etc.

Boura, J (British Railways) *Electronics and Power* Vol. 20 No. 9, May 1974, pp 360-363

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

B8 095657
THE LIMITATIONS OF THE BRAKING POWER OF COMBINED BRAKE SYSTEMS [Leistungsgrenzen kombinierter bremssysteme]
The author explains the brake systems of high speed trains and describes braking to a stop in detail. He then discusses the limitations of the braking power of brakes and explains the problem of the coefficient of adhesion, as well as suitable combinations of brakes. Providing that each bogie is loaded at 12 tonnes per axle, various combined brake systems can be used for speeds of up to 350 km/h. Electromagnetic eddy-current brakes are very important for braking over short distances. [German]
This paper was presented at the 15th Colloquium on Railway Rolling Stock, Graz, 10 April 1974.

Saumweber, E *Glasers Annalen ZEV* Vol. 98 No. 7-8, July 1974, pp 259-265, 17 Fig., 2 Tab., 9 Ref.

ACKNOWLEDGMENT: International Railway Documentation, Selection of
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B8 095867
DYNAMIC BRAKING
The kinetic energy of rapid transit trains that is normally dissipated as heat during braking can be converted to potential energy. The use of a flywheel energy storage system is an old idea that has recently been revived. A competitive idea being advanced is the thyristor inverter-recuperative system. While extensive operational experience is not yet available for either, both are currently being tested. The flywheel system is being tested on the New York Transit Authority and the regenerative system on the Sao Paulo, Brazil, Metro. It appears that the regenerative system is more efficient and requires less maintenance, thereby justifying the additional capital investment.

Kalra, P (Bechtel Corporation) *IEEE Spectrum* Vol. 12 No. 5, May 1975, pp 63-66, 4 Fig., Refs.

PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B8 096547
TELE-INFORMATION TECHNIQUES FOR AN INTEGRATED DATA TRANSMISSION NETWORK OF THE EUROPEAN RAILWAYS
Particular importance must be attached to the continually progressing advance of automation. Railway operation calls for the processing of frequently recurring data which must be exchanged and processed within a short period of time. For this purpose, modern electronic data processing plants with their rapid and reliable processing methods provide an optimum solution for the continuing process of introducing cybernetics into railway operation. Within the framework of the ever closer European co-operation, the need for the co-ordination of all these systems into a single integrated international system has become more amd more evident. The international network stems from the integration of the different national systems; this gives a brief description of their characteristics.

Tosi, E *Rail International* Vol. 6 No. 2, Feb. 1975, pp 127-132, 8 Fig.

PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B8 096557
ELECTRIC BRAKING IS ESSENTIAL: HISTORY AND ADVANTAGES OF ELECTRIC BRAKING: TECHNOLOGY AND PERFORMANCE
In the first article, the author, who is Rolling Stock Manager of the SNCF, explains the functioning of electric braking, its development and how it is employed. He lists its various advantages and states that electric brakes are essential for speeds above 180 km/h. High-speed running experiments have therefore produced a new technology in this field. The author refers to the economic benefits of this braking system and concludes by describing the developments which, by employing electronic power-control systems, have led to present applications. In the second article, the author, who is Head of the Electronics Division at the SNCF Rolling Department, gives details of the SNCF electric motive power fleet fitted with electric brakes, which are essential for high-speed running. The characteristics and operation of electric braking equipment are described on the most modern direct-current, single-phase and dual-current locomotives (CC 6500, BB 7200 BB 15000 and BB 22200 series), as well as on the experimental high-speed Z 7100 railcar. The locomotives have two different electric brake systems (one for normal braking, the other for emergency braking); the railcar is provided with an eddy-current linear brake system. [French]

Bouley, J Cossie, A *Revue Generale des Chemins de Fer* Vol. 93 Dec. 1974, pp 713-723

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B8 096579
ELECTRICAL NOISE: GET IT OUT OF THE SIGNAL PLANT
The growing use of delicate, sensitive and sophisticated interference-susceptible electronic apparatus in signal and communications applications has produced operating and maintenance problems. The inherently low power and voltage levels prevailing in communications installations have forced communications engineers to develop methods for solving the problem. This article discusses primarily problems and solutions for phenomena such as false operation of computer-controlled devices, erroneous indications and spurious occurences of other types in signal systems.

Pace, NCJ *Railway System Controls* Vol. 6 No. 4, Apr. 1975, p 24, 5 Fig.

PURCHASE FROM: XUM Repr. PC

DOTL JC

B8 096601
LATEST DEVELOPMENTS IN RAILROAD TELECOMMUNICATIONS [Les telecommunications au chemin de fer. Tendances nouvelles]
The author mentions the salient points of recent developments in telecommunications equipment and the Railroads contribution to the progress achieved. The scope of the article is limited to the developments in conventional electronic telephone switch gear. Examples of the latest French National Railroad standard equipment; electronic manual switching, and spatial automatic telephone dialing systems are given. [French]

Gourdon, C *Revue Generale des Chemins de Fer* Vol. 93 Dec. 1974, pp 745-756

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

B8 096622
REGENERATIVE BRAKING FOR RAIL VEHICLES. AN OVERALL VIEW [Nutzbremsung bei Schierenfahrzeugen Eine Uebersicht]
By means of thyristor rectifiers and electronic regulator devices, the old problem of regenerating the braking energy of rail vehicles has been solved and, at the same time, full safety in use in assured. Conventional solutions in the past did not provide a fast enough reaction speed to protect the devices against the harmful effects of excessive voltages and currents. Furthermore, electronic solutions give better performance and results. The article deals with the principles of regenerative braking with separate excitation and self-excitation for direct and alternating current engines. [German]

Scholtis, G *Elektronik* Vol. 22 No. 11, 1973, pp 383-386, 16 Fig.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: ESL Repr. PC, Microfilm

B8 096631
STUDY OF THE TASKS, WORKING CONDITIONS AND REQUIREMENTS OF A CENTRALISED CONTROL POINT [Eine Untersuchung uber Aufgaben, Arbeitsbedingungen und Arbeitsanforderungen auf einer Fernsteuerzentrale]
From a central control point, two regulators govern a line 120 km long and 17 stations including train operations and locomotive allocation. Following an analysis of the tasks, working conditions and requirements at the control point's offices, taking into account recent results of work science, the author comes to certain conclusions about the construction and fitting of offices in such surroundings so that better conditions can be obtained in the future. [German]

Mrosek, U *Verkehrsmedizin und Ihre Grenzgebiete* Vol. 21 No. 8, 1974, pp 262-277, 10 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Transpress VEB Verlag Fuer Verkehrswesen Franzoesische Strasse 13/14, Berlin W8, East Germany Repr. PC

B8 097251
TRAIN CONTROL, STRESS AND VIGILANCE
Modern railway operation, due to the control exerted on the man-machine-pathway combination is the safest form of transportation available. The vehicle pathway is continuously monitored and both front and rear end protection is provided to prevent collisions. Man although extremely versatile is known to be the weak link in the man machine system. Consequently, his duties need to be arranged to match his capabilities. An examination is made of human factor research, levels of arousal, driving efficiency and driver stress, fatigue, diurnal bodily rhythm and vigilance. Accident rates have been progressively reduced by various safeguards instituted to guard against human failure. Measurements of driver stress under various conditions of high speed train operation have been carried out and changes in stress in accordance with train speed, hours of duty, periods of rest, and day and night operation determined. There are a series of railway signalling and vigilance control devices which successively reduce the effect of the human element. These have further developed into semi-automatic and automatic train operation.
Paper presented at the 10th Annual Conference.

Cox, JJ
Ergonomics Society of Australia and New Zealand Nov. 1973, 22 pp

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: Ergonomics Society of Australia and New Zealand Repr. PC

B8 097266
IMPROVED SPEED MONITORING WITH AUTOMATIC TRAIN CONTROL [Ausbau der Geschwindigkeitsueberwachung bei der induktiven Zugbeeinflussung]
Existing automatic train control (A.T.C.) is to be augmented with intermittent monitoring to ensure correct train braking. A.T.C. equipment is described. By adding an electronic braking-distance monitor, it is possible to have distant-dependent, continuous speed control after application of 1,000 or 500 Hz induction so that the train is braked automatically every time the permitted speed is exceeded. [German]

Prechel, H *Eisenbahntechnische Rundschau* Vol. 24 Apr. 1975, pp 123-128, Figs., Tabs.

ACKNOWLEDGMENT: Eisenbahntechnische Rundschau
PURCHASE FROM: Hestra[Verlag Holzhofallee 33, 61 Darmstadt, West Germany Repr. PC

DOTL JC

B8 098066
SELTRAC OPERATING CONTROL SYSTEM FOR LOCAL TRANSPORT [Die Betriebsablaufsteuerung SELTRAC fuer Nahverkehrssysteme]
The SELTRAC (registered trademark) operating control system has been developed by SEL for tracked urban transport applications such as underground and rapid transit railways and also large cabin systems. The modular hardware and software allows the degree and extent of system automation to be extended step by step as required. Full automation can be achieved in several stages, starting from a purely monitoring system. Described here are the basic operating concept, operating sequences and possible alternatives, also vehicle distribution in the network and planning of the running schedules. Even with a high degree of automation a central controller is required, and his workplace and scope for action are described. In conclusion there is a description of the layout and function of a SELTRAC demonstration system. [German]

Dobler, KU *Eisenbahntechnische Rundschau* Vol. 24 May 1975, pp 181-186, 5 Fig.

ACKNOWLEDGMENT: Eisenbahntechnische Rundschau
PURCHASE FROM: Hestra[Verlag Holzhofallee 33, 61 Darmstadt, West Germany Repr. PC

B8 098760
EMERGENCY BRAKE APPLICATION
The file name is REEBA. A computer program which models an emergency brake application of railroad trains. The input consists of: the locomotive and train consist, grade or location of train, the initial speed and train handling information. The output provides: the stopping distance and time, if an intratrain collision would take place, if the train would separate, and the approximate coupler forces developed during the application.

Tallen, SM
Atchison, Topeka and Santa Fe Railway No Date

ACKNOWLEDGMENT: AREA (AREA 09-02-005)
PURCHASE FROM: Atchison, Topeka and Santa Fe Railway 9th and Jackson Streets, Information Systems Department, Topeka, Kansas, 66628

B8 098771
MICROWAVE DESIGN CALCULATIONS
Computer program: ENMICRW. Microwave program performs path calculations necessary for the proper design of a microwave system. This program takes the same approach as used by the Federal Communications

Commission and should give results identical to that program. The method used is an adaptation from the "Inverse Position Computation" set out on Page 14 of "Special Publication No. 8", Coast and Geodetic Survey: Formulas and Tables for the Computation of Geodetic Positions. This method takes into account the oblateness of the earth, and therefore gives more precise values than an uncorrected great-circle calculation method. Inputs: Inputs for this program are as follows: (1) Latitude and longitude for the sites. (2) Waveguide length for the sites. (3) Antenna dish size for the sites. (4) Transmitter power in DBM. (5) Transmitter frequency for the sites. (6) Receiver detection threshold. (7) Distance from one site other than midpoint, where fresnel is to be calculated. Outputs: The outputs from this program are as follows: (1) Printed outputs of the latitudes and longitudes that were specified between individual hops. (2) Azimuth from Site 1 to Site 2. (3) Azimuth from Site 2 to Site 1. (4) Distance from Site 1 to Site 2 expressed in feet and miles. (5) Freespace loss. (6) Waveguide loss. (7) Total path loss in DB. (8) Total gain in DB. (9) Net path loss in DB. (10) Median received signal in DB. (11) Carrier/Noise Ratio in DB. (12) Fade margin to 52 DBA per channel. (13) Fresnel at the midpoint.

Robinson, RE
Atchison, Topeka and Santa Fe Railway 1972

ACKNOWLEDGMENT: AREA (AREA 11-01-001)
PURCHASE FROM: Atchison, Topeka and Santa Fe Railway 9th and Jackson Streets, Information Systems Department, Topeka, Kansas, 66628

B8 099848
TRAIN DISPATCHING SIMULATION MODEL USER'S MANUAL
This report documents the use of the Train Dispatching Simulation (TDS) model developed for FRA under this contract. The model is programmed in PL/I for use on an IBM/360 or IBM/370. The general operation of the model is described. The necessary job control language to access and use the model is given. Model input conventions and requirements are described in detail for application of the model to conventional or hypothetical rail lines. Interpretations of error messages are provided and suggestions for effective use of the model are included. Finally, a case study application of the model illustration and application of the model to an existing line.

This report is a result of the study entitled "Parametric Analysis of Railway Line Capacity" RRIS #21A 058275 in Bulletin 7501. Final report, FRA-OPPD-75-1, was issued August 1975.

Prokopy, JC
Peat, Marwick, Mitchell and Company Final Rpt: DOT-FR-4-5014-1, Mar. 1975, 61 pp

Contract DOT-FR-4-5014

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC

DOTL NTIS

B8 125793
ELECTROMAGNETIC EDDY CURRENT BRAKE (SNCF TRIALS)
In order to avoid the dependence of braking effect on the adhesion of the wheels to the rails, experiments have been carried out by the SNCF (French National Railways) on two designs of electromagnetic brakes acting by inducing eddy currents in the rail. The tests were made on an experimental high-speed vehicle drawn by a locomotive at speeds up to 250 km/hr. Fitted to the frame of a long- wheelbase truck, each "shoe" is approximately 2 m long and contains up to 9 poles. The mean air gap is 7 mm, and the pole faces are 78 mm wide, which is 6 mm wider than the railhead of the U80 60 kg/m rail often used for high speeds as continuously welded rail, and 13 mm wider than the more common U36 50 kg/m rail. A retarding force of 1400 daN has been obtained with the new brake at an acceptable electric power demand. Tests indicated that switch points and rail joints did not present a hazard, and that heating of the rails was slight. Remaining problems to be investigated and directions of further research are indicated.

Pouillet, P (French National Railways) *French Railway Techniques* Vol. 17 No. 3, 1974, pp 98-105

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

B8 125842
RADIO INTERFERENCE PROBLEMS IN ELECTRIC TRACTION [Problem Zaklocen Radioelektrycznych w Trakcji Elektrycznej]
The sources of the radioelectric interference are outlined. Means for interference suppression are discussed. The question whether suppression devices should be applied to individual items of equipment or to such complete functional units as substations, network, rolling stock, etc., is considered. The standard specification PN-73/E-05108 is criticized. [Polish]

Nasilowski, J (Institute Elektrotech, Poland) *Przeglad Elektrotechniczny* Vol. 51 No. 2, Feb. 1975, pp 78-79, 8 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

B8 125864
THE USE OF SIMULATION TO DETERMINE THE CAPACITY OF SINGLE-TRACK RAILWAY LINES
The assessment of various upgrading alternatives is presented here in terms of the capacity of the line. Several definitions of single-track line capacity are given; the capacity definition based on weighted delay computations and differentiated by train class is shown to be a promising approach. However, more research is needed into the ways of determining the weighting factors and delay costs of various classes of trains.

Walker, AEG Jones, JCM *Transport Economics and Operational Analysis* No. 1, Mar. 1975, pp 1-13

ACKNOWLEDGMENT: British Railways

B8 126419
HUMAN CRITERIA IN THE DESIGN AND ARRANGEMENT OF CONTROL ELEMENTS
This article examines some important factors that should be considered in the design and arrangement of control elements from the standpoint of human engineering. The need for ready identification of individual control elements is stressed, and several possibilities for differentiation between control knobs--based on variation of the shape, size, color, texture, position and operating method--are described. The basis for the coding of control elements in either of these ways is human sensibility. Finally, hand controls and foot controls are discussed in terms of selection, best positioning and arrangement.

Shan, HS (Roorkee University, India) *Machinery and Production Engineering* Vol. 126 No. 3258, May 1975, pp 455-459, 7 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

B8 126453
PROTOTYPE THYRISTOR-CONTROLLED BR CLASS 87 25 KV INTRODUCED AND TRIALS START TO EVALUATE INFLUENCE ON SIGNALLING AND COMMUNICATIONS
Stepless power control produced by solid-state propulsion systems has advantages from performance and weight saving aspects but can cause telecommunications problems because of electrical interference. Predecessor locomotives of this same general design have normal tap changer control of acceleration; British Railways elected to build a prototype locomotive with thyristor power conditioning system so that aspects such as power factor and general harmonics might be investigated. Previous BR experience with thyristors had been on multiple-unit trains; this installation represents a significantly higher power level.

Rail Engineering International Vol. 5 No. 4, June 1975, pp 151-153, 3 Fig., 1 Phot.

PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

B8 126454
SWISS FEDERAL RAILWAYS NEW COMMUTER 15-KV MULTIPLE-UNIT PROTOTYPE SETS IN LIGHT ALLOY WITH THYRISTOR CONTROL
To obtain greater versatility, lightweight trainsets were selected for pre-production service evaluation. Two power cars were incorporated in three-or four-car sets to determine acceptable power demand consistent with

good acceleration. Thyristor controls are seen as having several advantages in suburban operation, but problems of electrical interference with communications and signal cables are special problems.

Winter, P *Rail Engineering International* Vol. 5 No. 4, June 1975, pp 144-150, 11 Fig.

PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

B8 126981
GREATER SAFETY THROUGH LINEAR CONTROL OF TRAINS
[Securite accrue par le controle lineaire des trains]
A short description of the integrated transmission system designed by the ORE. The tests were begun on the Lavorgo-Bodio (St-Gothard) line, with RE 4/4 II type locomotives. Further tests are planned on the Turgi-Coblenz section with one of the new RABDe 8/16 type suburban trainsets. The system as a whole will be thoroughly tested between now and 1977, so that large-scale production can be begun at that date. [French]
Also published in German.

Winter, P *CFF-Staff Bulletin* Vol. 52 No. 4, 1975, pp 64-67, 4 Fig.

ACKNOWLEDGMENT: International Railway Documentation, Selection of
PURCHASE FROM: CFF-Staff Bulletin Berne, Switzerland Repr. PC

B8 127637
AUTOMATIC TRAIN CONTROL AND COMMUNICATIONS FOR WASHINGTON METRO
The automatic train control and the communication systems for the Washington Metro rail are outlined.

Greenway, JP (Washington Metropolitan Area Transit Authority); Sheldon, RH *Communications Society Newsletter* Vol. 12 No. 6, Nov. 1974, 9 pp, 11 Fig.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

B8 127841
THE S.N.C.F. CENTRAL SIGNALLING AND TELECOMMUNICATIONS LABORATORY
The author, Head of Section at the S.N.C.F. Equipment Department, relates the history of this laboratory since it was built by the former Northern Railway. He describes its present arrangement and states its purpose which is not research but essentially the verification of equipment, tests, investigations. This work is in principle confined to S.N.C.F. signalling and telecommunications equipment. Activities have been grouped as a result of the reform of S.N.C.F. structures. The author then describes the laboratory equipment and its use as regards electronics, photometry, relays, track circuit testing with simulators (high speed, information), and the testing of telecommunications and electronic equipment, computer functioning, etc. He then gives facts about the laboratory's mobile equipment which enables readings to be taken at any point in the installations, in particular 10 testing coaches, a power coach taking current directly from the 1,500 V supply, and an experimental railcar. [French]

Kieffer, A *Revue Generale des Chemins de Fer* Vol. 94 July 1975, pp 476-484

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

B8 131042
LIGHTNING AND ITS EFFECTS ON RAILROAD SIGNAL CIRCUITS
This study discusses the occurrence of lightning, its effects on railroad signal equipment, and protection of such equipment from lightning damage, with special attention to known protective techniques which are employed in a variety of situations in the power, communications, and railroad industries. A brief review is offered of the causes of lightning and other surges, followed by an extensive treatment of the means by which lightning and power-line transients induce surges and over-voltages in signalling circuits. Specific topics include the effects of the direct stroke current, the collapsing electric field when the stroke occurs, inductive coupling, and the effects of ground

currents in the earth. A survey of protective devices and techniques currently in use for specific types of equipment is presented, including categorization of arrestors by type and application. Preferred lightning protection practices in railroad signalling are examined and related to practices in other fields. The problem of lightning protection is addressed from an overall systems viewpoint, encompassing development and testing of protective systems and design of systems, so that they can more easily be protected. Recommendations for future research are made.

Lowell Technological Institute is under contract to Transportation Systems Center.

Holmstrom, FR
Lowell Technological Institute Research Foundation, (DOT-TSC-FRA-75-21) Final Rpt. FRA-OR&D-76-129, Dec. 1975, 106 pp, 16 Fig.

Contract DOT-TSC-589

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-250621/AS, DOTL NTIS

B8 131281
THE INFLUENCE OF TRACK CIRCUIT PARAMETER VARIATION ON MAXIMUM PERMISSIBLE LENGTH
In an article published in Rail International in June 1974. this author described a method for determining the maximum length and optimum terminal impedance for track circuits which are compatible with the system and the parameters defined in that paper. These parameters were assumed to be constant. This second article is a study of the influence of parameter variations on the maximum permissible length of circuits. The author discusses line resistance, line inductivity and terminal resistance to signals.

Iancu, OD *Rail International* Vol. 7 No. 1, Jan. 1976, pp 39-43, 1 Tab., 5 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B8 133570
MEASURING DEVICES OF TESTING CAR FOR SIGNAL APPARATUS
The measuring devices used for testing the wayside signal equipment of Japanese National Railways are described. All these are mounted on the high-speed inspection cars used on the New Tokaido line and on the conventional network. The functions checked are the ground coil for the automatic train stop device, the detector circuits used for grade crossing protection devices, and the regular track circuits. An elapsed distance system is also used for correlating measurements on the digital output tape. A computerized system is under study.

Kurotori, S *Railway Technical Research Institute* Quart. Rpt Vol. 16 No. 4, Dec. 1975, pp 189-190, 4 Fig.

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Ken-yusha 1-45-6, Hikari-cho, Kokubunji, Tokyo, Japan
DOTL JC

B8 135181
METHOD OF PROGRAM SYNTHESIS FOR FAILSAFE INTERLOCKING DEVICE IN RAILWAY SIGNALLING
The functions are analyzed of conventional interlocking relay devices used for train control. It is indicated which parts should be designed on the failsafe basis. A method is also proposed for synthesizing a failsafe logic system which is fed with non-failsafe inputs. A universal digital computer program using an interlocking matrix is proposed for the failsafe logic system. The effectiveness of the proposed method has been confirmed by field tests and 20,000-hour test operations.

Okumura, I (Japanese National Railways) *Electrical Engineering in Japan* Vol. 94 No. 6, Nov. 1974, pp 96-102, 4 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

B8 135185
NONSYMMETRIC, CROSSED BRAKING CIRCUIT

[Unsymmetrische Gekreuzte Bremsschaltung]

One method of measuring the actual speed of vehicles in local traffic consists of measuring the revolutions of a driving axle where no slip occurs. The braking moment of this axle must be smaller than that of the remaining driving axles. In the crossed braking circuit, a motor with reduced excitation is used. The relationship between the braking forces of both motors as a function of speed is analyzed. [German]

Sliwa, H *Elektrische Bahnen* Vol. 46 No. 6, June 1975, pp 147-150, 3 Ref.

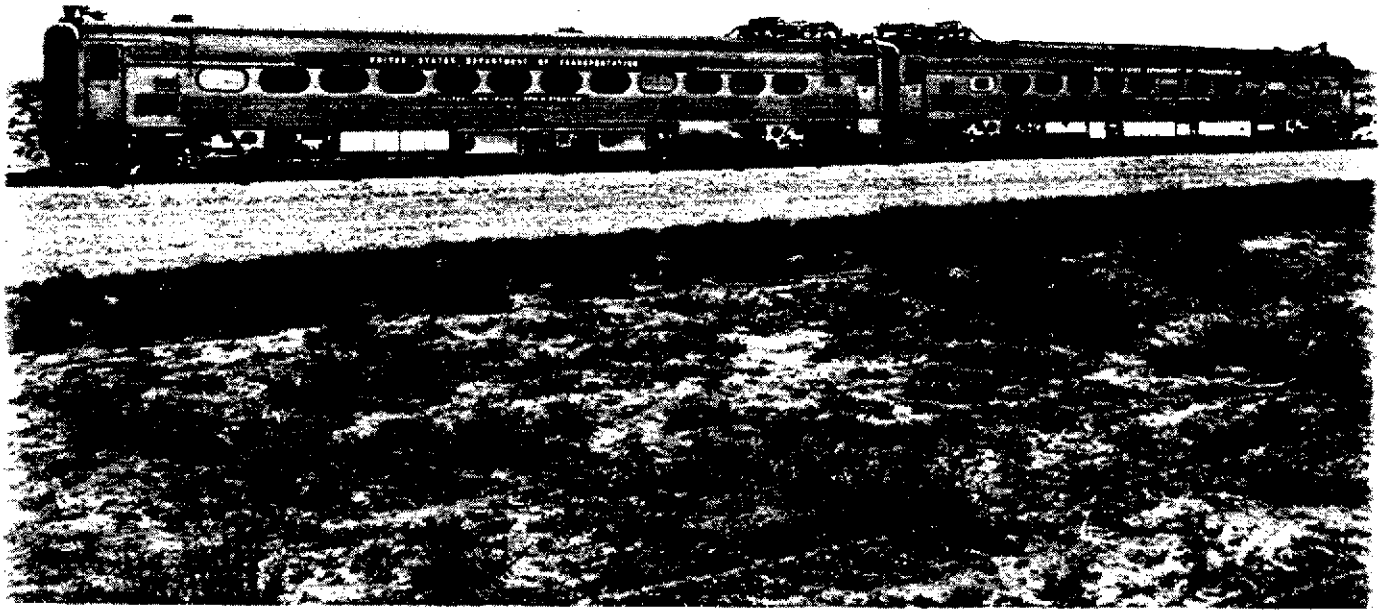
ACKNOWLEDGMENT: Nebraska University, Lincoln
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

B8 135195
LONGITUDINAL TRACK TO VEHICLE COMMUNICATIONS

Two systems of track-train communications are among those being developed in the United Kingdom for use on train control projects. These are inductive loop communication at low frequencies and communication at radio frequencies using radiating cable. This paper outlines the salient features of the inductive loop system including the method of transmission, system security and special features and details the transmission principles and techniques, choice of frequency and possible applications for radiating cable.

Hutchings, BW (British Railways Board); Cree, DJ
Institution of Electrical Engineers No. 117, 1974, pp 153-169

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC



IMPROVED INSPECTION, DETECTION, AND TESTING RESEARCH

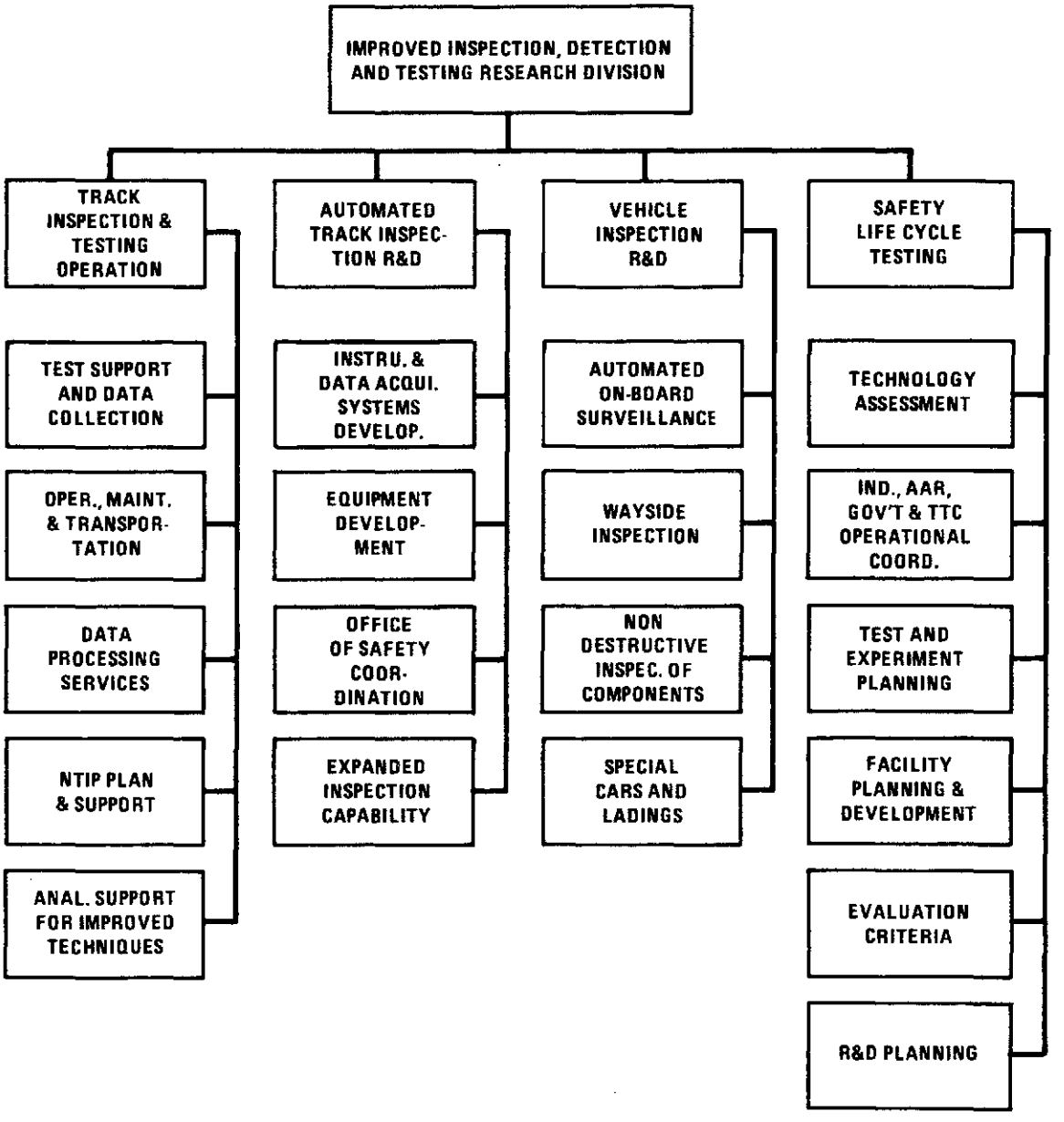
Research in the Improved Inspection, Detection, and Testing Research Division is conducted under four program areas: (a) track inspection and testing operations, (b) automated track inspection, (c) vehicle inspection, and (d) safety life-cycle testing.

The track inspection and testing operations program provides the services (personnel and equipment) and basic technical support for several FRA research and safety related programs. The automated track inspection program (ATIP) provides the FRA Office of Safety with track monitoring capabilities, such as the track inspection vehicles and their associated equipment. The program also assists the railroad industry in establishing track maintenance priorities and in developing new maintenance procedures. In the automated track inspection research and development, both track inspection and data acquisition technology and equipment are developed and refined. Research is conducted to improve speed, sensitivity, and accuracy of rail flaw detection and track geometry systems and to extend the mobile inspection capabilities to include assessements such as rail wear, track impedance, and crosstie condition.

In the vehicle inspection program, systems are being tested for an effective on-board monitoring capability for individual cars and for wayside surveillance stations to detect abnormal car behavior in trains.

Under the safety life-cycle program, the methodology to test the safe performance of rail systems during their entire life spans is being developed. The Facility for Accelerated Service Testing (FAST) at Pueblo, Colorado, provides an ideal environment for component life-cycle evaluation.

Figure 6. Organization of the Improved Inspection, Detection, and Testing Research Division.



Abstracts of Reports and Journal Articles

C1 033078
DATA HANDLING MACHINE FOR THE NO. 2 TRACK INSPECTION CAR OF THE NEW TOKAIDO LINE
To make some maintenance plans from the results of measurement of track irregularities, some statistical treatment of data becomes necessary. For this purpose a high performance electronic data handling machine was installed to the No. 1 track inspection car of the new Tokaido Line. In the case of periodical maintenance of the No. 1 track inspection car, the No. 2 inspection car is to be used.

Nakamura, I Wada, K (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 7 No. 3, Sept. 1966, pp47-50, 5 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-014)
DOTL RP

C1 033116
DEVELOPMENT AND USE OF A TRACK QUALITY INDEX
Discusses the factors used to make up the track quality index. These are the items which are measured by the Southern Railway's track inspection car. The factors measured include gauge, twist, surface, superelevation, and alignment. The measurement of these factors is an aid in scheduling and controlling track maintenance.

Crane, LS Sullivan, JH Kaelin, CR (Southern Railway) *American Society of Mechanical Engineers Trans* Jan. 1969, pp1-10

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-055)
DOTL RP

C1 033121
COLLECTION OF PRIVATE MEMORANDA ON DERAILMENT
A series of derailment reports discusses the contributing factors which caused derailment. These factors include unique qualities of hopper cars and their tendency to rock at certain speeds, track irregularities, uneven loading of a flat car in conjunction with rail which has excessive wear.
Private Communication

22pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-060)
DOTL RP

C1 033167
INTEGRAL TYPE MEASURING EQUIPMENT FOR SUPERELEVATION
In measuring superelevation with track inspection car a gyrostabilizer is generally used. The gyrostabilizer is considerably expensive and needs electric power source. So, for a simple mechanical type track inspection car, it is difficult to mount a measuring equipment for superelevation using a gyrostabilizer. A new mechanical integral type measuring equipment which enables measuring the superelevation from twist of track has been made. The equipment needs no source of electric power. The frequency characteristics of the equipment is fairy good for ordinary superelevation, the accuray of mechanical parts being about 10 percent.

Kishimoto, S Takeshita, K (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 8 No. 4, Dec. 1967, pp221-225, 2 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-121)
DOTL RP

C1 033214
QUALITY OF RAILS AND MEANS OF GUARANTEEING IT. TESTS WITH APPARATUS FOR THE CONTINUOUS EXAMINATION OF RAILS IN THE TRACK
Report discusses the use of high speed rail inspection equipment, the ways in which joint operation of such vehicles would be practical. The amount of track to be inspected, the frequency of inspection and geographic considerations are determinants of the practicality of joint ownership and operation. Also a comparison of the Teledetector, the Spema, and the DB ultra-sonic rail fault coach is made over identical track. A discussion of rail flaws and their classification is included.
Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways D45/RP 6/E, Oct. 1963, 16 pp, 1 Fig., 4 Tab., 2 App.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-172)
PURCHASE FROM: UIC Repr. PC
DOTL RP

C1 033215
QUALITY OF RAILS AND MEANS OF GUARANTEEING IT; EXAMINATION OF THOMAS STEEL RAILS OF THE THIRD SERIES OF TESTS BY MEANS OF THE RALUS ULTRASONIC PROCEDURE; DOCUMENTARY REPORTS OF IRSID AND BAM
The investigation of the quality of steel rails and the means of guaranteeing it has been entrusted to the D 45 Specialists Committee at the request of the 7th UIC Commission. Two series of tests have already been made within the scope of this work. A third series of tests was then carried out on rails having shown a 'good' performance in the track and on those having shown a 'bad' performance, these performances being defined beforehand according to some accurate criteria. The definition tests and the special tests on the Thomas steel rails of this series have been dealt with in Interim Report No. 9. As many as possible of the Thomas steel rail samples of the third series of test have been examined by means of the RALUS ultrasonic equipment, developed by IRSID and designed for the automatic industrial ultrasonic inspection of the rail head. The results of this examination have been dealt with in this report (RP 10), which also contains a documentary report by

IRSID on the RALUS method and one by BAM on the investigation of rails for non-metallic inclusions.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways D45/RP 10/E, Nov. 1967, 23 pp, Figs., Tabs.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-173)
PURCHASE FROM: UIC Repr. PC

DOTL RP

C1 033252
ON THE ULTRASONIC RAIL INSPECTION CAR

Seventy percent of rail failures are located in the joint areas starting from the bolt hole, but these defects could not be found out by the electro-magnetic method. The new ultrasonic rail flaw detector car was designed and manufactured by the Railway Technical Research Institute, Japanese National Railways. Results of the tests are summarized as follows: (1) up to a test speed of 35 km/h records are satisfactory, (2) at a higher speed than that the recording of joint areas becomes unreliable, (3) jumping tendency of probe was avoided by elongation of shoes and water supply devices, (4) a revolving type searching unit has been manufactured and a test is now continuously being carried out.

Nakamura, R Tsuchidana, T (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 4 No. 3, Sept. 1963, pp53-55

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-200)

DOTL RP

C1 033258
RELATION BETWEEN SUPERELEVATION AND CAR ROLLING

Springs and links between car body and axles can be thought as a mechanical filter to isolate the car body from axle motion (except axle revolution). Then the problem to know the relation between track irregularity and car vibration is the problem to know the characteristics of this filter. there are three methods to study the characteristics. The first method is to calculate the characteristics theoretically from the parts constants. The second method is to know the characteristics by measuring the output of filter for special input. The third method is to determine the characteristics by analyzing the input-output relations for normal operation. No special equipment except measuring instruments is needed. Second, the effect of random noise can be cancelled out by statistical treatment of data. An application of this method is described.

Nakamura, I (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 3 No. 1, Mar. 1962, pp17-20

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-207)

DOTL RP

C1 033259
NEW SHAPE OF TRANSITION CURVE IN HIGH-SPEED RAILWAY TRACK AND ITS ALIGNING

The quantity called "Track Irregularities" is usually used as basic data and technical inferences are made from it. From the view-point of safety and comfort of traveling, we are requested to decrease the track irregularity especially with regard to high speed railway track. Must first of all grasp the essential meaning of "Track Irregularity" and consequently the next two quantities clearly: (i) difference between geometrically practicable shape and the actual shape of railway track. (ii) difference between physically rational shape and geometrically practicable shape of railway track. These two items are almost self-evident for the straight railway track, but for the curved railway track, especially transition curve, there are many problems yet to be solved.

Taya, T (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 3 No. 2, June 1962, pp38-45

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-208)

DOTL RP

C1 033273
ADAPTATION OF THE METHODS OF LAYING, ALIGNING AND MAINTAINING THE PERMANENT WAY TO CARRY TRAFFIC AT VERY HIGH SPEEDS (120 KM/H AND MORE): A) ON THE STRAIGHT: B) ON CURVES: SO FAR AS THEY AFFECT SAFETY AND TAKING INTO ACCOUNT THE TYPE OF ROLLING STOCK USED

The following topics are discussed: effects of rolling stock on track, layout of lines; points and crossings, loading gauges; distances between running lines, equipment, ballast and track renewal of high speed lines, and finally safety of trains, staff and inspection processes of high speed lines. Appendices include answers related to railway technology from responding members.

Thille, M (French National Railways) *Rail International* Vol. 39 No. 4, 1962, pp492-725

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-224)

DOTL RP

C1 033288
STRUCTURAL CLEARANCE MEASURING CAR WITH SCANNING CAMERA
The Structural Clearance System consists of a rail-highway station wagon equipped with special optical devices that will record minimum clearance data on structures photographically. The clearance data on the obstruction contours are read directly from the exposed negative by means of a special film reader on a calibrated grid scale. Indexing marks on the grid scale permit precise alignment of the negative, providing data accuracies to within 1/2 inch. Actual tests on the Norfolk and Western Railway Company property were not successful, with many difficulties having been encountered. No worth while data could be gathered and the equipment was returned to the manufacturer.
Letter correspondence, File NIWRR.

Norfolk and Western Railway 1970, 21pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-241)
DOTL RP

C1 033292
ACCOUSTIC EMISSION TECHNIQUE FOR THE DETECTION OF FLAWS IN RAIL WELDS
An acoustic emission technique of testing for flaws in welded rail was conducted in June and July of 1969 at the Bellevue, Ohio, rail welding plant and at the Roanoke, Va., gas welding plant. Several welds by thermite, gas and electric welding processes were prepared for these tests under controlled conditions, with several samples of each process having artificially induced or included defects. This technique is entirely non-destructive and is accomplished immediately after welding so authoritative corrective action can be taken. Correlation was found between poor welds and high AE activity and good welds and lower AE activity. It appears that innovations and refinements will be required to obtain a practical "black box" of this type suitable for use on the railroads.
Company report.

Norfolk and Western Railway SCE 1188, SCE 155, July 1969, 4pp.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-245)
DOTL RP

C1 033315
STRESS MEASUREMENTS IN THE WEB OF RAIL ON THE DENVER AND RIO GRANDE WESTERN
Progress on stress measurement in rail located in curved and tangent situations was measured, and reported. The vertical web stresses under different locomotives is included, and the varying speeds are listed. A comparison of stresses between 112 lb and 115 lb rail as well as 112 lb and 131 lb rail is included in the discussion.

Magee, GM Cress, EE (Association of American Railroads) *AREA Bulletin* Vol. 44 1943

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-269)
DOTL RP

C1 033317
INVESTIGATE CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL SURFACES FOR THE PURPOSE OF DEVELOPING MEASURES FOR THEIR PREVENTION
This subcommittee began its investigation with a field inspection on two heavy coal carrying railroads where the rail conditions are unusually severe. Committee has taken up its assignment under the three topical headings: shelling, head cracks and flaking, rating them as to relative importance in the order named. Flaking is not as serious as shelling or head checking as a cause of failures in rails. Seven rail flaws are illustrated.

Hewes, FS Armstrong, SE Barnes, WC *AREA Bulletin* Vol. 44 1945, pp597-610

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-271)
DOTL RP

C1 033324
SEVENTH PROGRESS REPORT OF THE JOINT INVESTIGATION OF FISSURES IN RAILROAD RAILS
The development of detector cars made possible the detection of many fissures before rail fracture had occurred, but it did not touch the problem of prevention of fissures. A "rolling-load" testing machine was designed and built which subjected a specimen of rail to repeated cycles of wheel load and bending moment. Before testing in this machine an etch test to detect the presence of shatter cracks was made on the rail from which the specimen was cut. Rolling-load tests showed the following results: Only shatter-cracked rails developed fissures, but not all shatter-cracked rails developed fissures. It is the complex stresses directly under a wheel load which cause cracks to develop into fissures. Bending moment tends to cause fissures to take a transverse direction, and accelerates their spread. No greater wheel load was required to start a fissure in a heavy rail than in a lighter rail. The minimum wheel load which started a fissure in the rolling-load tests was 40,000 lb. The wheel load necessary to start a fissure, the theoretical shearing stress in the zone where shatter cracks are located, the fatigue strength of rail steel, and the weakening effect of minute cracks (shown by fatigue tests of specimens) form a coherent picture of the mechanism of fissure formation and spread. The solution of the problem of preventing shatter cracks in rails was attacked by making tests of specimens from rails cooled in air and also controlled cooled. A large amount of study has been given to the problem of finding a nondestructive test which could be used to detect shatter cracks in new rails. Shatter cracks are so minute that changes, due to these shatter cracks, in properties or structure of metal around them, are masked by other variations in the metal. Unfinished work of the investigation relating to fissures includes formulation of proposed standards for control cooling of rails and for bend tests for acceptance of rails. Numerous photographs detail rail defects of the type described.

Moore, HF (Illinois University) *AREA Bulletin* Vol. 42 1941, pp681-751, 15 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-275)
DOTL RP

C1 033348
MAXIMUM VALUE OF TRACK IRREGULARITY
To know maximum values of track irregularities in a certain length of track is necessary for those who maintain track for the safety of traffic and for those who are in charge of maintenance of way. States of track irregularities are represented by the following indexes: P: Index of track irregularity (probability exceeding plus or minus 3 mm) m: Mean value of track irregularities sampled at random sigma: Standard deviation of track irregularities sampled at random. If the mutal relation between the maximum value of irregularity and the irregularity index is ascertained, it will be very useful.

Hiroi, I (Japanese National Railways) *Permanent Way* Vol. 5 No. 3, No. 16, Sept. 1962, pp16-24

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-301)
DOTL RP

C1 033349
DYNAMIC EFFECT OF A FLAT WHEEL ON TRACK DEFORMATION
A series of riding tests was made to clarify dynamic effects of wheels (whose treads were set with flat spots) on the rolling stock as well as on the track at various speeds up to 200 km/h on the test run section of the New Tokaido Truck Line on December 7-11, 1963. In the present report, major test results concerning track deformation are outlined. Shock values resulting from rail bending stress and pressure between rail and sleeper grow rapidly with train speed, showing the peak at 20 to approximately 30 km/h, and thereafter up to 100 km/h, they gradually decrease.

Satoh, Y (Japanese National Railways) *Permanent Way* Vol. 7 No. 1, No. 22, Mar. 1964, pp14-22

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-303)
DOTL RP

C1 033354
ON THE RELATION BETWEEN SUPERELEVATION AND CAR ROLLING
Springs and links between the car body and axles can be thought as a mechanical filter to isolate the car body from axle motion (except axle revolution). To know the relation between track irregularity and car vibration is the problem to know the characteristics of this filter. Method is to know the characteristics by analysing the input-output relations for normal operation. Application of this method is introduced in the following section.

Nakamura, I (Japanese National Railways) *Permanent Way* Vol. 5 No. 1, No. 14, Mar. 1962, pp10-16, 5 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-308)
DOTL RP

C1 033357
HOW TO PREVENT RAIL FAILURES WHICH CAUSE TRAFFIC DISTURBANCE
Discusses the types of rail failure and the causes. Includes tables which illustrate various types of failure, the frequency and month by month break down of failure. Conclusions include recommendations for rail inspection and means to control the quality of rail steel to minimize break down.

Ito, A Kurihara, R (Japanese National Railways) *Permanent Way* Vol. 8 No. 2, No. 27, pp1-16, 2 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-311)
DOTL RP

C1 033365
IMPROVING THE RUNNING QUALITIES OF THE COACHES TO BE INCLUDED IN HIGH SPEED LUXURY TRAINS--MODERN BOGIES--POSSIBLE TECHNICAL EVOLUTION
Discusses the needs of bogie design when rolling stock speeds reach 200 km/h. Suggested areas include relationship of connections between axles, bogie frames and coach bodies; tire profile for stability of 250 km/h speeds; vertical suspension systems for light weight coaches, reduction of unsprung weight, use of rubber in suspension systems. Finally, the problems of running coaches on lines with superelevated curves where problems exist in retaining a level coach interior.

Robert, J (French National Railways) *French Railway Techniques* No. 2, 1968, pp97-122

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-319)
DOTL RP

C1 033415
DERAILMENT TEST WITH EXPERIMENT TRACK
Outline of the derailment test on the experiment track was conducted there. We expect to make, from next year on, experiments with practicable and likely irregularities attached to rolling stock and track, and experiments with a train of rolling stock instead of single car. It is hoped that the causes of derailment will be fairly clarified, and more effective preventive measures will be worked out through the future tests, thereby paving the way for a derailment theory.

Oki, H (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 8 No. 4, Dec. 1967, pp14-17

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-378)
DOTL RP

C1 033377
THE "RALUS" METHOD FOR RAIL INSPECTION BY MEANS OF ULTRASONIC PROBE
Shrinkage of a rail is not due to vertical wear but to diverse cause divided into two main categories:--Defects in rail fabrication;--Shrinkage due to use, for example the lateral wear at chamfer, or damage to the surface by slipping. Though the diminution of shrinkages in the second category is the affair of the user, the first category concerns the rail makers and the S.N.C.F. jointly. The study and development of the RALUS method provide an efficient means of checking the metallurgical quality of rails. A tool which will enable it to follow up the quality of production and to detect any anomalies before rails are laid on the track.

French Rail News No. 1, 1970, pp9-10

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-333)
DOTL RP

C1 033417
HIGH SPEED TRACK INSPECTION CAR
The high speed track inspection car serves to check efficiently the important factors of track condition such as track irregularity under train load, train vibration etc. It is effectively utilized to perform periodic track inspection based on JNR maintenance rules, as well as other testing and research; the maximum measuring speed is 120 km/h on the narrow-gauge lines and 160 km/h on the New Tokaido Line.

Hiroi, I (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 7 No. 4, Dec. 1966, pp40-41

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-380)
DOTL RP

C1 033421
DATA HANDLING OF HIGH-SPEED TRACK INSPECTION CAR
Measurement records made from the high-speed track inspection car are for two purposes, one of them is to defect and locate large track irregularities for preparation of the data necessary for spot maintenance. The other purpose is to give an overall information on the track irregularities found within a certain distance, as this helps service and maintenance planning. For the second purpose, however, records must be sorted, classified and processed statistically. The machine operation shows more stability than that of manual work and this is because the machine has no personal error. The machine has been employed officially since April 1961 and the inspection data over 40,000 km throughout Japan has been already handled. Therefore savings of man-power, cost and time to date have been very large.

Nakamura, I (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 4 No. 3, Sept. 1963, pp37-38

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-385)
DOTL RP

C1 033428
MECHANIZED MAINTENANCE OF TRACK ON THE JNR
The Japanese National Railways are making continuous efforts to mechanize track maintenance work in line with the policy towards general modernization of operation. Emphasis is laid on the wider employment of small-sized equipment which will allow a train to pass or which can easily be taken out of the track when a train is coming. So-called overall track renewal using heavy equipment is carried out where an interval of 3 or 4 hours is available between midnight and 4 o'clock in the morning as in the case of the electric multiple unit train lines in and around Tokyo and Osaka. This method is also used on some trunk lines, such as the Tokaido Line in cases where sufficient work time is available by blocking one side of the double track. Outlined are the principal kinds of maintenance work in which such equipment is used, and the measuring devices.

Ijichi, K (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 1 No. 4, Sept. 1960, pp24-26

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-392)
DOTL RP

C1 033446
DETERMINING THE INCREASE IN BALLAST DENSITY UNDER TRAFFIC BY MEANS OF THE GAMMA ABSORPTION METHOD
The increase of running speeds on main lines to 140 km/h or 160 km/h and the increase of axle loads of motive power units and goods wagons, the question has been studied for some years whether the undoubtedly higher maintenance cost to be incurred for the permanent way could be reduced by special measures. The mechanical compaction of ballast between sleepers will repay after 2-1/2 years because the extension of the interval between track overhauls will also entail a reduction in the number of tamping machines required.

Birmann, F Cabos, P (German Federal Railways) *Rail International* Mar. 1967, pp229-249, 9 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-414)
DOTL RP

C1 033723
DEFORMATION OF RAILWAY TRACK UNDER HIGH-SPEED TRAIN--MEASUREMENTS ON THE TEST-RUN SECTION OF THE NEW TOKAIDO LINE
In designing the new Tokaido line, many tests through actual operations of trains at high speed were conducted in parallel with model experiments, laboratory tests and theoretical analyses. Major items of measurement on the ground were rail deflections, rail stress, stress on fastening device, track vibration acceleration and sleeper stress. Major measured items on the car were wheel side thrust, wheel load, bogie stress, car body vibration, axle box vibration and similar forces.

Satoh, Y Toyoda, M (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 7 No. 2, June 1966, pp20-23

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-003)
DOTL RP

C1 033732
TESTS ON THE TRACK ON THE RIDING STABILITY AND THE GUIDING QUALITY OF VEHICLES BY MEANS OF A SPECIAL VEHICLE-RESULTS OF THE FIRST TRACK TESTS
The report gives an account of the results of the tests made with the experimental bogie described in a previous report. The first part of the report supplies data relating to four series of tests during which the various parameters of the bogie (lateral play between axle-box and axle, axle load) and also the riding speed were successively varied. These tests have made it possible to establish conclusions relating to the wave-length of the hunting movement, the amplitude of the transverse movements of the bogie and the maximum transverse forces occurring between bogie and axles. The second part of the report supplies data relating to the tests during which the wheelbase of the test bogie was varied. The data obtained have permitted the establishment of some conclusions relating to the wave-length of the hunting movement, the transverse displacement of the bogie frame, the maximum angle of rotation of the bogie and the transverse forces. The third part of the report contains an account of the results obtained during the tests, the object of which was to study the same magntiudes as those prevailing during the previous tests, the wheel tyres of the test bogie having however been machined in accordance with the wear profile "Muller No. 2". All the tests were made on one and the same section, this being in an excellent state of repair and having a relatively constant gauge and chiefly consisting of straight track.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B52/RP 2/E, June 1963, 36 pp, 35 Fig., 2 Tab.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-159)
PURCHASE FROM: UIC Repr. PC
DOTL RP

C1 033735
MEMORANDUM DESCRIPTION OF DERAILMENT
A memorandum discussing a derailment includes the vehicles involved (4 diesel locomotives, 112 loaded and unloaded freight cars) and the probable causes of the derailment. The scene of the accident is described, list of possible causes, with each discussed in detail. Causes are not clearcut, but probably the rolling of an empty car, the wheel of one track on that car hitting a rail joint on the outer rail of a curve, the upward force from car roll, the bad joint caused the wheel to run over the rail causing the derailment. It is suggested that differences in rail height at joints be limited to 1/16 in. and rail wear be limited so that wheel flanges will not be raised by joint bars when hit by wheels with worn treads.

Unpublished data.

Magee, GM
Association of American Railroads May 1968, 8pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-190)
DOTL RP

C1 033846
TRACK TEST EQUIPMENT FOR EVALUATION OF ROAD BED IRREGULARITIES
The Norfolk and Western Railway Company has been investigating various methods of evaluation of track irregularities. The R-S Three Way Ride Recorder records accelerations in 2 or 3 directions as required, such as vertical and lateral accelerations, whereby riding qualities of cars may be compared to evaluate the track structure. The Tracon system for track analysis is an electronic track inspection system which measures and digitalizes the dynamic cross level variations of a track structure. There are three possible multiples of cross level variations that may be measured. This system can be applied to any car and is designed to operate at any speed above 35 mph. In addition, consideration has also been given to a computerized method road bed evaluation through measurements and simulation of "rock and roll" of a car. This problem is continuing under study.

Unpublished communications.

Norfolk and Western Railway 48pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-293)
DOTL RP

C1 033854
TRACK GEOMETRY AND DESIGN OF THE PERMANENT WAY OF HIGH-SPEED LINES
The increase in maximum speed envisaged by many railway administrations makes exacting demands on the permanent way. In the following, the resulting problems associated with the railway track are discussed mainly on the basis of theoretical considerations and on the strength of the results of experimental research carried out by the German Federal Railway (D.B.) at speeds of 200 km/h. The resulting conclusions are also applied to even higher speeds. Comparisons are made with similar developments abroad.

Birmann, F (German Federal Railways) *Rail International* June 1969, pp393-428, 34 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-349)
DOTL RP

C1 033860
EXPERIMENTAL RESEARCH ON THE EFFECT OF VEHICLES ON RAILWAY TRACK AT HIGH RUNNING SPEEDS
The methods adopted by the Soviet railways for testing the effect of ultra-high-speed vehicles on the track are primarily designed for fixing safe speed limits for vehicles. These conditions are determined by different

criteria and characteristics; the determination is based on the evaluation of extensive statistical data obtained by measurements on the track and on the vehicles.

Verigo, MF (Ministry of Communications, USSR) *Rail International* Jan. 1968, pp39-70

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-412)
DOTL RP

C1 033861
"HIGH-SPEEDS" SYMPOSIUM
Theoretical and experimental solutions of track problems for high speeds, especially in regard to the design of curves and transition curves, track laying and maintenance tolerances as well as dynamic stability. Conclusions are given as regards the design of tracks and points.

Birmann, F (German Federal Railway) *Rail International* Apr. 1968, pp391-460

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-413)
DOTL RP

C1 037213
LATERAL DYNAMICS OF RAILWAY VEHICLES
The fundamentals of lateral dynamics theory of railway vehicles is reviewed. Numerous topics are presented, including: stable running theory, longitudinal creep, forward speeds, sinusoidal path, forces acting, hunting, conditons for stability, critical speeds, profiled wheels, suspension, coned and profiled wheels, wear of trends, vehicle design, and track geometry.

Wickens, AH (British Railways Research Department) *Railway Gazette* Vol. 121 Dec. 1965, pp 987-990, 4 Fig, 2 Phos, 14 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-633)
DOTL RP

C1 037230
STATISTICAL CONTROL OF TRACK MAINTENANCE
The subject of this paper concerns a method of control of maintenance of track making use of statistics and probability theory. The control of track maintenance should be handled on the basis of probability or statistics, while observing the phenomena from the rules of mechanics. A few examples of statistical treatment are given.

Onogi, J *Railway Technical Research Institute* Vol. 1 No. 3, June 1960, pp 3-5, 4 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-651)
DOTL RP

C1 037247
RAIL FAILURE DETECTION IN THE UNITED STATES
The major components of inductance, residual magnetic, and ultrasonic instruments for detection of flaws in rails are described. The Association of American Railroads report for 1964 correlated the drastic reduction in service failures due to transverse defects with the success in controlled cooling of the rails during manufacture, although the number of failures detected using the above NDT methods remained fairly constant. It was concluded that the $400,000 cost of the flaw detection services was well worth while in the USA, but could not be justified in the United Kingdom due to the use of different steel for the rails.

Railway Gazette Vol. 121 Aug. 1965, pp 665-666, 1 Fig, 4 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-943)
DOTL RP

C1 037248
TRAINING IN THE ULTRASONIC DETECTION OF FLAWS
Special training courses have been instituted at Derby for British Railways staff in ultrasonic detection of flaws and arc welding of metals. The ultrasonic school consists of a three week course for operators and an appreciation course of four days for supervisory staff. Student operators spend 12 days on practical training and three days in lectures on acoustic principles. Audiovisual aids and experimental demonstrations are used during the instruction. The welding school runs appreciation courses lasting five days, which qualifies the students to inspect and accept welded fabrications for the British Railways Board.

Railway Gazette Vol. 121 Aug. 1965, p 627, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-944)
DOTL RP

C1 037287
TRUE GAUGE IN STRAIGHT TRACK
The permissible amount of slack gauge in straight track in relation to the lateral oscillation or nosing of locomotives is considered. S or slack gauge, for any one locomotive and type of track will vary inversely as the square of the speed. Mathematical derivations for engineering physics aspects of the problem are given.

Inglis, RA *Railway Gazette* Vol. 82 May 1945, p 445, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1138)
DOTL RP

C1 037415
ULTRASONIC CAR WORKS AT 25 MPH
British Rail's detector car uses ultrasonic methods to detect and record hidden rail flaws while running at speeds up to 25 mph. The train can test up to 100 miles a shift--means that entire main routes can be ultrasonically tested in a matter of a few days. The train's rail scanning probes are carried on a trolley mounted between the running wheels of the equipment car. For scanning the rails the trolley is lowered to run on its own wheels, allowing the probes to slide along the surface of the running rails on a thin film of water. Using the principle of reflection of high frequency sound, the probes inspect the running rails for minute cracks and internal flaws Signals from the probes are relayed to monitoring devices on the train and then recorded on film. At the end of each day's testing, the film is sent to an evaluation center near Paddington station, London, where a team of evaluators examines it and reports any signals that indicate a possible rail deflect.

Modern Railroads July 1971, p 48, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-500)
DOTL RP

C1 037420
PURPOSES AND REQUIREMENTS OF TRACK INSPECTION AND MEASUREMENT
This is the first part of a two-part study prompted by recent interest in automated inspection devices and systems. This first portion, deals with the general questions about inspection such as why is track inspected, what is being looked for, when and how often inspection should be done rather than how it should be done. The first is as a fundamental guide to procedures and purposes of inspection, and for an examination of what may or may not be wrong about the way inspection is now being performed. The track materials inspection should include: the load bearing function of the track; the effects of loading on deformation and rupture and wear and abrasion, and on fatigue; and the environmental effects. The present inspection methods are given for rail, cross ties, switches, turnouts, crossings, and ballast.

Way, GH
Chesapeake and Ohio Railway Tech Rpt 71-103, Feb. 1971, 74 pp, 3 Fig, 3 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-485)
DOTL RP

C1 037443
GERMAN FEDERAL RAILWAY EXPERIMENTS WITH CONCRETE TRACK BEDS
If sleepers and ballast prove inadequate for speeds over 200 km/h, some form of structural support for the track will be necessary. Because of the vibrations induced by high speed trains and the need to maintain the line and level of track within closer limits, the upper speed limit for sleeper track may be regarded as 260 km/h. Three types of track and three types of fastenings are examined. Comparative stresses in the ground under concrete bed track and conventional sleeper track in ballast are shown.

Birmann, F (German Federal Railways) *Railway Gazette* Vol. 125 Apr. 1969, pp 308-310, 3 Fig, 6 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-850)
DOTL RP

C1 037444
ONE-MAN PORTABLE MITSUBISHI TRANSISTORIZED CRACKMETER
Mitsubishi's Type CM-2 all-transistorized crackmeter is designed to be handled easily by one operator. Providing both visual and aural confirmation of defects at rail joints, it can pinpoint flaws without removal of the fishplates. Ammeter registration of approaching trains is an added safety

feature. It can be used on rails of different widths by a simple screw adjustment.

Railway Gazette Vol. 125 May 1969, p 24, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-851)
DOTL RP

C1 037455
RAIL DEFECT TESTING IN THE UNITED STATES

Over 130,000 miles of track are tested annually in USA by the Sperry fleet of 25 self-propelled test cars. A new and highly efficient ultrasonic detection system was developed which is capable of finding most cracks and flaws in the joint area. Details are reported. As part of its service Sperry Rail Service has compiled and published a comprehensive manual of rail defects, covering subjects from history and methods of rail manufacture to causes of rail defects and classifications of every known rail defect. This Rail Defect Manual is furnished free to any railway.

Railway Gazette Vol. 125 Mar. 1969, pp 180-184, 4 Fig, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-865)
DOTL RP

C1 037457
ULTRASONIC RAIL TESTING AT THE ROLLING MILL

Studies have shown that fatigue defects which appear in rails in the track can always be traced back to segregations in the metal, inclusions or micro-cracks. Metallographic tests which show up these defects are lengthy, costly and must inevitably be restricted in scope because they involve destruction of the specimen tested. Consequently, it was necessary to find a non-destructive method of detecting these defects by sounding the whole length of the rail head. The ultrasonic method using echoes was chosen by SNCF and ORE. The Ralus equipment was designed to detect heteorogeneities which are particularly harmful to the performance of the rail in the track: non-metallic inclusions and flakes located in the critical zone of the rail-head where most fatigue defects originate. Studies have shown that the Ralus testing method does give a reasonable indication as to the quality of the rails.

Railway Gazette Vol. 124 Oct. 1968, p 752, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-873)
DOTL RP

C1 037467
TRACK GEOMETRY AND PERMANENT WAY CONSTRUCTION FOR HIGH SPEED LINES [GLEISGEOMETRIE UND KONSTRUKTION DES OBERBAUES VON SCHNELLFAHRSTRECKEN]

This article discussed the heavier demands imposed on the track structure by the maximum operating speeds on railways. The problems are presented and considered as determined by both theoretical studies and the results of field tests of 200 Km/h operations consideration of the line construction and the alignment, superelevation and transition run-offs on curves is shown by actual data and charts, including theoretical studies of speeds up to 400 Km/h. The stability of the track structure, horizontally and longitudinally, under different axle loads and spacings are considered, and the relations thereto of rail strength, type of fastening, the ballast bed and the underneath soil foundation. Switch, turnout and frog designs are dealt with: This article gives a comprehensive, detailed study of the requirements for track geometry and construction for high speed operations. [German]

Birmann, F (Bundesbahndirektion, Nurnberg) *Eisenbahntechnische Rundschau* Vol. 17 No. 12, Dec. 1968, pp 513-532, 24 Fig, 4 Tab, 6 Phot, 34 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-572)
DOTL RP

C1 037594
SERIAL MEASUREMENTS ON RAIL TO DETERMINE WHEEL LATERAL FORCES

The rail-head bending procedure is described for measuring the loading on the rail due to the lateral forces of the wheels of motive power and freight cars for various conditions of track curvature and speed ranges up to 200 km/h. Comparisons are given for the lateral and vertical loads imposed by the different wheel and axle arrangements of this equipment at various speeds and of the stress effects on the rail. Charts show these relations, and the relations of the lateral forces to the curve radii. The side wear or abrasion of the rails is also shown in mm(super 2) per million gross tons rolling over the rail in relation to the curve radii.

Birmann, F Eisenmann, J *Eisenbahntechnische Rundschau* Vol. 15 No. 5, May 1966, pp 155-164, 19 Fig, 1 Tab, 1 Phot, 10 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-479)
DOTL RP

C1 037598
LATERAL RAIL FORCES DUE TO VARIOUS LOCOMOTIVE AND TRAIN CONSISTS

A series of tests was performed to determine the lateral forces developed by various types of locomotives and train consists. Analysis of the data indicates that no excessive lateral forces were developed by any of the test consists. The maximum average force, 7,400 pounds was developed by the T.P.F.C. freight. The effect of roadway irregularities on lateral forces generated by normal consists remains largely unknown. Based on the results of this test series, it is concluded that light locomotive, passenger and freght consists generate relatively low lateral force on good roadway. There is a slight reduction in maximum lateral forces as training tonnage is increased. A study of the available research literature on the forces required to overturn rail shows that the maximum pressures measured were about 30% of the forces theoretically needed.

Luebke, RW

Chesapeake and Ohio Railway, Baltimore and Ohio Railroad Test Rpt Apr. 1967, 14 pp, 8 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-484)
DOTL RP

C1 037618
ULTRASONIC TESTING OF RAIL--EXPERIENCE AND IMPROVEMENTS

The author discusses improvements in the methods of ultrasonic testing of rail for defects and flaws on the German Federated Railways, giving details of the present state of the art in the new test equipment, and reviewing the knowledge accumulated. Possible improvements in the testing techniques are discussed, including the need for doubling, at least, the speed presently required for this testing of rails.

Egelkraut, K *Eisenbahntechnische Rundschau* Vol. 14 No. 1-2, Jan. 1965, pp 49-59, 15 Fig, 11 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-519)
DOTL RP

C1 037634
SELF-PROPELLED TRACK RECORDER

A track recording trolley, is being used by the civil engineering department, Eastern Region, for detecting and recording track irregularities. It is self-propelled, weighs some eight tons, and is powered by a 65-hp petrol engine. As the vehicle travels along the track a series of probes and wheel flanges in contact with the rail surfaces communicate any irregularities to the recording table by means of wire cables and mechanical linkage. Records obtained include gauge variation, superelevation, and alignment. Speeds during recording are up to 20 mph, but up to 50 mph can be attained when not recording. A crew of five is carried.

Railway Gazette Vol. 106 June 1957, p 688, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-536)
DOTL RP

C1 037647
SYSTEMATIC DETECTION OF RAIL DEFECTS IN U.S.A.

The Missouri Pacific Lines have increased the daily mileage of a Sperry detector car from 21.1 to 30.0, and its annual mileage from 6,188 to 9,074. Annual examinations are made of 55 percent, or 4211 track miles, of the total rail system. Rail inspection statistics are given for the years 1931 to 1939, including: transverse fissures detected; longitudinal fissures detected; other defects; total defective rails; and average defects per track mile.

Railway Gazette Vol. 76 Jan. 1942, pp 159,166, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-550)
DOTL RP

C1 037683
FURTHER THREE-DIMENSIONAL PHOTOELASTIC STUDIES OF STRESSES IN RAIL HEAD DUE TO WHEEL CONTACT PRESSURE
A transparent model of a rail head about two-thirds scale was constructed and tested. The model testing showed that the three principal stresses are compressive immediately under the wheel, but as we go away from the wheel both to the right and to the left, all these compressive stresses become tensile. The main difficulty in this study was not studying the stresses in the model of the rail head or the rail, but rather from the difficulties of interpreting the meaning of the stresses in relation to shelly rail failures, or failures in general.

Frocht, MM (Illinois Institute of Technology) *AREA Bulletin* Vol. 60 1959, pp 1167-70

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-597)
DOTL RP

C1 037686
MEASUREMENT OF RAIL HEAD WEAR
A novel method of rail wear measurement is being used on the London Midland and Scottish Railway in order to compare rails of special composition or rails which have been specially treated to increase resistance to wear. The apparatus is simple, and consists of a jig formed to the contour of the part of the rail to be measured, and a dial gauge reading to 0.5 in. by 0.001 in. graduations. The actual gauging can be done at the rate of about one minute per section.

Railway Gazette Vol. 73 Aug. 1940, p 228, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-600)
DOTL RP

C1 037709
CONTROL OF TRACK IRREGULARITIES IN JNR
The existing rules in Japan regulating track irregularities are given. Inspection cars and techniques used for examining track are described. Recommendations are made for revisions of track irregularities limits considering their effect on safe operation, riding quality, and economic aspects.

Ban, Y (Japanese National Railways) *Japanese National Railways* Vol. 4 No. 4, Dec. 1963, pp 30-32, 2 Tab, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-627)
DOTL RP

C1 037732
CAR ROLL AND WHEEL LIFT TESTS ON SIMULATED SERVICE TRACK: TEST CONDITIONS AND RESULTS AT PRR ALTOONA TEST SITE
The class H-43, 100-ton hopper car began derailing at increasing rates beginning in the Spring of 1964 as more and more of these cars were placed in service. It was decided to set up a test track to simulate the rock-off phenomena and determine what modifications could be made to the car to reduce wheel lift and car roll. All cars were tested first on a tangent track with rails shimmed 3/4" to produce an 1-1/2" total change in cross level at each 39-ft. joint over a distance of ten rail lengths at speeds in the range of ten miles per hour to 22 miles per hour at approximately one mile per hour increments or until the critical speed was exceeded. The cars were then tested on a 3 degree curve having a 4-1/2" super-elevation with an 1-1/2" change in cross level superimposed at each joint over a distance of six rail lengths. Speeds on the 3 degree curve did not exceed 15 miles per hour. After testing, it was decided to adopt the following truck modifications:--1. Replace the 2-1/2" travel springs with 3-11/16" travel springs. 2. Add two friction snubbers to each spring group to absorb energy input into the spring group: 3. Move the side bearings in from 50" centers to 46" centers. 4. Machine the bolster gibs to permit more bolster lateral freedom. Even though a truck modification eliminate wheel lift on the test track, it was not certain just how close the wheel is to becoming unloaded.

Bertram, LW (Pennsylvania Railroad) *Engineering Exchange Forum* Tech Proc Sept. 1966, pp 23-27

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-734)
DOTL RP

C1 037759
COMPREHENSIVE TRACK MAINTENANCE SYSTEM
Railway engineers aim to achieve as economically as possible a long-life track and a stable relationship with the vehicles running over it at high speed. Flaw detection and track laying and cleaning equipment is described. Ballast site rehabilitation, track material renewal, and track lifting lining and tamping procedures are discussed.

Genton, D *Railway Gazette* Vol. 126 June 1970, pp 465-467, 1 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-769)
DOTL RP

C1 037778
ULTRASONIC RAIL TESTER
This sturdy lightweight rail tester has been designed to inspect rails automatically for bold hold cracks, wheel burns, "snowflakes," shatter cracks and other separations in the head and web. Pointwork and welded rail joints can also be examined manually. The assembly moves easily along a rail and test speeds of 80 ft/min are easily accomplished by skilled operators. The device is pictured.

Railway Gazette Vol. 126 Jan. 1970, p 35, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-793)
DOTL RP

C1 037780
SIMPLIFIED RIDE INDEX MEASUREMENT
This portable instrument will provide a continuous meter indication of the ride index of the vehicle in which it is placed. The meter uses a variable inductance accelerometer as an acceleration element. The meter is placed on the floor of the vehicle and the plane of measurement selected, either vertical or horizontal. The ride quality is shown directly on the meter scale as a continuous reading.

Railway Gazette International Jan. 1971, p 35, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-795)
DOTL RP

C1 037781
INSPECTION AND MAINTENANCE ON A HIGH SPEED RAILWAY
Despite consistent operation at 200 km/h, cars on the Tokaido Shin Kansen now cost less to maintain on a distance-run basis than JNR's 3-ft 6-in gauge electric railcar fleet which is limited to 120 km/h. As a result of a review of maintenance procedures for rolling stock and fixed equipment, the labor force now used to maintain 515 km will be redeployed in 1972 to cover the 165-km San-yo extension as well. Periodic inspection and maintenance routines are given and failures of electrical equipment over a five year period are itemized.

Railway Gazette International Jan. 1971, pp 22-24, 2 Fig, 3 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-796)
DOTL RP

C1 037794
ULTRASONIC FLAW DETECTION TRAIN ON THE DB
The German Federal Railway utilizes a two car set of railway vehicles which make graphic recordings of rail flaws. These flaws are detected by an ultrasonic detector which records the type of flaw, the size, and its relative position in the rail. Oblique and transverse flaws are also detected by the system. The vehicles may be operated at a speed of 10 km/h upwards, with a speed of 40 km/h as normal.

Railway Gazette Vol. 124 No. 1, Jan. 1968, pp 29-32, 1 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-835)
DOTL RP

C1 037850
CROSS-SECTIONS BY PHOTOGRAMMETRY
When exceptional loads have to be conveyed by rail, measurements must be made along the route to determine by how much the normal loading gauge may be infringed. The Swiss Federal Railways has devised a method based on stereoscopic photography and has built a special measuring vehicle that houses the appropriate equipment. Stereo photographs coupled with a special viewing attachment permit the recording of continuous profiles as a cross-sectional diagram. The vehicle is equipped with a dark room to provide immediate on site inspection of exposures. An electric tractor is used to take the vehicle to site and also provides a 220V supply for the spotlight, heating, and charging of the car-lighting batteries. In transit speeds up to 56 mph are permitted. While operating, the speed is limited to 18 mph.

Railway Gazette Vol. 118 June 1963, p 723, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-962)
DOTL RP

C1 037852
RAIL CURVE CALCULATOR
The Matisa Multi-Station Curve Calculator functions according to the simple three point principle of curve correction. By using the calculator, an alignment may be set up in the form of a versine diagram and modified or corrected at will without calculation or possibility of error. The slews necessary for the realignment are automatically registered at each point. The unit has 30 indicators with which to set up the versine diagram, on graduated scales of 250-mm length. The operator can couple together two or more calculator units, and thereby use 60 or more versine stations, according to the length of the alignment. The unit can be supplied with a tracing equipment, which makes it possible to trace a record on paper of the original versine diagrams, the corrected diagram, the slews and any other desired information; for example, a cant diagram.

Railway Gazette Vol. 117 Oct. 1962, p 487, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-986)
DOTL RP

C1 037863
MEASURED SHOVEL PACKING
The packing of the track by the L.M.S.R. method of shovel packing is accomplished in three stages. First, low places on the rail are measured by means of slighting boards; secondly, the depth of any voids there may be between the underside of the sleepers and the ballast when the track is unloaded is recorded on a series of Abtus voidmeters; and thirdly, the requisite amount of chippings, determined by the two measurements, is spread under the sleepers. These stages are described in detail and photographers show the use of the sighting board, voidmeters installed on the track, and the spreading of clippings under the sleepers.

Railway Gazette Vol. 70 Feb. 1939, pp 180-182, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1044)
DOTL RP

C1 037872
RECENT PROGRESS IN RAIL FISSURE DETECTION
The experience with Sperry detector cars during 10 years of service in the U.S. is reported. Changes in the design of the car to increase sensitivity and reliability are reported. The rails are pre-energized by a magnetic flux, followed by the magnetic flux from the search unit. The searching unit has four-coils which are staggered rather than in line. The Type 80 modification is described which contains special amplifiers and recording pens to differentiate defects of certain types. During 5 years of experience 40 percent of the defects detected were transverse or compound fissures, 40 percent were vertical split heads, 15 percent were horizontal split heads, and 5 percent were miscellaneous defects. Five hundred miles of fissure-containing rails have been removed during the last 10 years after detection with Sperry detector cars.

Railway Gazette Vol. 75 Aug. 1941, pp 216-17

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1053)
DOTL RP

C1 037879
RAILWAY ENGINEERING AND RADIOGRAPHY
When X-rays penetrate a substance opaque to visible light they are partly transmitted, partly absorbed, and partly reflected or scattered, the amount of each depends on the substance and its thickness. Substances of high density and atomic weight usually absorb X-rays to a much greater extent than those of light weight, for the latter tend to scatter the rays rather than absorb them. An outline arrangement for taking a radiograph is shown. In welds, unsoundness of the weld metal, imperfect penetration of the weld head and cracks in both bead and parent plate may be sought for. In castings, any such defects as porosity, draws and hot tears are likely to be revealed. Radiographs are shown of various welded and cast specimens.

Knights, ED *Railway Gazette* Vol. 77 Oct. 1942, pp 348-50, 1 Fig, 12 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1060)
DOTL RP

C1 037904
OVERHEAD LINE EQUIPMENT INSPECTION VEHICLE
A diesel-driven vehicle for overhead line inspection is described. Of steel construction, the interior provides space for eight men and necessary working equipment. Drive is from either end with speed options of 1.5, 5.6, 9.8, 14.8, and 23.1 mph. A hydraulically operated tower is housed in a well in the vehicle body. Windows are set at 45 degrees to permit inspection from inside the vehicle. Accessory lighting is provided by two separate battery-operated 24 volt circuits.

Railway Gazette Vol. 93 Dec. 1950, pp 489-92, 4 Fig, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1095)
DOTL RP

C1 037909
TRACK DEFECTS REVEALED BY MAGNETIC TESTS
Notes are given on experience gained on the Denver and Rio Grande Western Railroad in the Magnaflux method of inspecting rails, fishplates, welded joints, track tools, and chains.

McBrian, R (Denver and Rio Grande Western Railroad) *Railway Gazette* Vol. 86 May 1947, p 502

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-100)
DOTL RP

C1 037924
INSPECTION CARS AND GANG TROLLIES
The wide range of motor inspection cars and gang trollies manufactured by D. Wickham and Co., Ltd., are described. Nine models are pictured. One out of four variations of the type 40, 6 to 9 person car is shown, as is the new type 30. Also shown are the flyweight, one-man trolley; the one-man, light-weight type 8B; the type 18A gang trolley; the heavy-duty type 18A; the 5-ton loader version of the type 18A; the covered version of the type 18A; and the medium-duty type 17A gang trolley. The power unit in each type of vehicle is described.

Railway Gazette Vol. 87 Dec. 1947, 3 pp, 9 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1116)
DOTL RP

C1 037941
TRACK INSPECTION ON THE L.N.E.R.
A system of assessing numerically the condition of track is briefly described. Track is evaluated for 10 different characteristics and awarded a maximum of 100 points for each. A perfect score is 1000--average scores on the L.N.E.R range from 650 to 950. Uniformity of assessment is essential: to this end the judgment of individuals of considerable experience of the system was pooled and a small nucleus was formed which trained others, who again became apostles to spread over a widening field the level of uniform discrimination.

Railway Gazette Vol. 82 July 1945, p 10, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1140)
DOTL RP

C1 037971
TRACK TESTS ON THE ILLINOIS CENTRAL RR
This article describes a number of tests conducted on the Illinois Central. One test was conducted to determine whether the removal of the mill scale from the rail ends and fishing surfaces of the plates would reduce the initial rate of bolt tension loss or have beneficial effects on fishplate wear. Insulated joints were also tested. Tests were also carried out with various types of bearing plates in an attempt to eliminate the cutting of soft wooden sleepers by such plates. To prevent creep, 14 rail anchors of different types were fitted per rail length, and in addition 12 rail clips to the rail length were used. Eight different arrangements of the anchors were installed. Various kinds of sleepers and ballast were also tested.

Railway Gazette Vol. 81 July 1944, p 11, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1304)
DOTL RP

C1 039120
RAILROAD RESEARCH FIELD TESTING PROGRAM
The primary purpose of this project is to assist in defining the operational characteristics and constraints of conventional rail systems at speeds of the order of 150 miles per hour. Four electric, multiple-unit commuter-type cars, modified to facilitate instrumentation and to achieve full-power balancing

speed in excess of 150 miles per hour, were built and heavily instrumented. High-speed tests are being conducted on an improved 21 mile section of the Penn-Central Railroad between Trenton and New Brunswick, New Jersey, and track geometry measurements reflecting track conditions are being made between Washington, D. C., and Boston. Of particular interest are the evaluation of ride quality, truck and suspension performance and vibration, track geometry measurements, pantograph performance, catenary profile and dynamic response, track-roadbed characteristics, and interaction between trains. An initial part of the original contract was the formulation of a general purpose mathematical model of car motion suitable for evaluating the performance of new or proposed vehicles or vehicle components in response to rail excitation at high speeds. The parameters and characteristics of the research cars and statistics of track geometry are being used to validate the mathematical model with actual measurements. This dynamic railcar simulation program will be the subject of a separate comprehensive report. The purpose of this report is to present in summary form the progress achieved thus far on this program.

Hurley, FJ Goeser, JN Koch, BR McConnell, PJ
Melpar, Incorporated Progress Rpt No. 1, Dec. 1968, 215 pp

Contract C-111-66

ACKNOWLEDGMENT: NTIS (PB-182470)
PURCHASE FROM: NTIS Repr PC, Microfiche

PB-182470, DOTL NTIS

C1 039233
STUDIES FOR RAIL VEHICLE TRACK STRUCTURES
Conventional (tie-type) and non-conventional rail vehicle track structures were studied, with the restriction that standard gauge and rail-head contour be used. Computer programs were developed and used to analyze track response to both static and dynamic vehicle loading. The models of conventional track were validated by track, and on the Penn-Central high-speed track near Bowie, Maryland. The DOT research cars were used to obtain a series of controlled-speed passes at speeds up to 125 mph. Track response under Metroliner and regular freight traffic was also recorded, both at a joint and away from a joint. The measurements showed the lack of consistency of track characteristics at different locations and at different times, and indicated the computer results to be as accurate as the degree to which track parameters could be defined. The predicted presence of individual pressure pulses for individual axles on trucks with wheelbases exceeding 6' was verified by measured subgrade pressures 3' beneath the tie base, at speeds up to 125 mph. A major philosophy in the development of improved track structures was to reduce the magnitude and number of pressure cycles transmitted into the roadbed, with the number of cycles reduced by using beam and slab type rail supports having substantial longitudinal bending stiffness. Following the analysis, performance specifications were written for rail fasteners and three types of reinforced concrete structures recommended for further evaluation in field tests: cast-in-place slab, cast-in-place twin beams, and precast twin beams. (Author)

Meacham, HC Prause, RH Ahlbeck, DR Kasuba, JA
Battelle Memorial Institute Final Rpt Apr. 1970, 208 pp

Contract DOT-FR-9-0021

ACKNOWLEDGMENT: NTIS (PB-194139)
PURCHASE FROM: NTIS Repr PC, Microfiche

PB-194139, DOTL NTIS

C1 039265
SYSTEM INSTRUMENTATION MANUAL. DOT TEST TRAIN PROGRAM
The report describes current instrumentation installed aboard the Department of Transportation Test Train. The instrumentation is designed to gather research data on various rail research projects. The major discussion in this report covers the Track Geometry System aboard the test train, and the operation and calibration of this system. (Author)

Gerhardt, CL May, JT
ENSCO, Incorporated Annual Rpt Jan. 1971, 176 pp

ACKNOWLEDGMENT: NTIS (PB-203110)
PURCHASE FROM: NTIS Repr PC, Microfiche

PB-203110, DOTL NTIS

C1 039309
CIVIL ENGINEERING MAINTENANCE WORK
Regular examination is the basis of railway civil engineering maintenance work, ranging from daily examination of passenger-carrying lines to underwater examination of the piers or abutments of a bridge at 20-year or longer intervals. The Matisa track-recording self-propelling trolley unit, introduced during the last two years, enables reliable records of cross level, track curvature and track gauge to be obtained at a running speed of about 20 mph. Examination of rails with manually-applied ultrasonic-type flaw probes was introduced in 1954. A special rail-mounted adaption of the principals and mechanism of the Simon hoist has been developed to provide better means of regular examination of high masonry vaiducts. At the end of 1958, only two major equipment developments were being pursued. First, a prototype "on track" self-propelling machine was under construction. This is designed to excavate track ballast from outside the ends of sleepers, and screen it, and replace the clean ballast. Secondly, a design of a type of low-loading lorry with both pneumatic-tired road wheels and steel flanged tired wheels is being developed.

Railway Gazette Vol. 111 Nov. 1959, pp 475-476

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1425)

DOTL RP

C1 039403
TRACON-A NEW SYSTEM FOR TRACK ANALYSIS
The article discusses an electronic track inspection system which is designed to give management rapid information on track condition. The system can be attached to almost any passenger car without any modifications. It measures dynamic cross level at speeds above 35 mph. This concept was not expected to be an accurate defect detection and locating system, but is meant for rapid statistical analysis of track conditions for the allocation of maintenance funds.

22nd Annual ISA Conference and Exhibit, September 11-14, 1967, Chicago, Illinois.

Lombaroo, LR (New York Central Railway)
Instrument Society of America Conf Paper 23-1-T1D-67, Sept. 1967, 6 pp, 7 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-652)

DOTL RP

C1 039437
INVESTIGATION OF LATERAL STRENGTH OF RAIL FASTENINGS ON TOKAIDO TRUNK LINE BETWEEN FUJIEDA AND SHIMADA BY LATERAL FORCE TESTING CAR
As a result of tests by the JNR lateral testing car, several types of rail fasteners were designed. Statistical prediction gave a stress variation of 3 to 6t. All designs were designed to withstand a lateral force of 3t and will not easily fail at stresses of 6t. The strongest fasteners utilizes polyurethane gage blocks. Weaknesses of design and materials in the order fasteners tested are also discussed and compared.

Minemura, Y Ichikawa, S (Niigata Railway Administration, Japan)
Railway Technical Research Institute Vol. 5 No. 2, June 1964, pp 50-53, 5 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-691)

DOTL RP

C1 039451
ELEVENTH PROGRESS REPORT OF THE ROLLING-LOAD TESTS OF JOINT BARS
This report discusses the test program of rolling load tests of joint bars using 3-33 inch stroke rolling machines. The results of the tests of joint bars, which were heat treated and tempered are given. Hardness tests of the bars are included as well as the rolling load tests. Test results of 132 RE leadfree bars (oil quenched) averaged 573,100 cycles before failure which started at a rail end. Tests of 132 RE leadfree bars (water quenched) averaged 365,300 cycles. 4 bars failed, 2 from the top, 2 from the base.

Jensen, RS (Illinois University) *AREA Bulletin* Vol. 54 1953

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-708)

DOTL RP

C1 039453
"TRACON" CROSSLEVEL MEASURING SYSTEM
Tracon is an electronic track inspection system that will rapidly provide management with information on track conditions. This patented system can be installed on almost any passenger car and will operate at speeds above 35 mph. The system utilizes solid-state integrated circuits to measure

dynamic cross-level under load at track speed. Operation characteristics, cost, and installation costs are presented.

Cleveland Technical Center, Incorporated Comp Rpt 3 pp, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-710)
DOTL RP

C1 039456
COUNTING TRACK DEFECTS
This article discusses the development of a system for the New York Central Railroad to measure track irregularities, which uses crosslevel as the parameter of measurement. The readout is given in digital form at the end of any geographic unit desired. Crosslevel limits have not yet been determined. Further improvements include the addition of horizontal and vertical accelerometers to record dynamic action.

Railway Track and Structures Apr. 1966, pp 30-31, 4 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-713)
DOTL RP

C1 039471
PULSATOR TESTS WITH ELASTIC RAIL SPIKES
The article is concerned with a testing program of double and single-shank elastic rail spikes. The tests used these spikes with rail of various widths and heights with inclined loading. Rail was placed on timber cross ties or with steel base plates between the rail and ties. Results of the tests are compared on the basis of vertical and horizontal loading, in terms of laboratory and equivalent track tons translated into tons per day over a period of years to show the resulting permanent gauge widening with the fastening/rail/tie combinations.

Birman, F (German Federal Railway Directorate) *Railway Gazette* Vol. 126 Apr. 1970, pp 271-272, 2 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-791)
DOTL RP

C1 039495
TEST OF LATERAL FORCES REQUIRED TO SPREAD 133 LB MAIN LINE RAIL UNDER VARIOUS LOADS STATICALLY IMPOSED
To determine the lateral force required to spread or overturn the 133 lb. rail on the main line under static vertical load conditions, vertical loading was imposed by a freight car of known weight standing on the track with axle center-line of one pair of wheels in the vertical plane through the line of force of the jack. The curve showing the lateral forces required to spread the rail under vertical loading statically imposed is shown.

Flebbe, PE (Union Pacific Railroad)
Union Pacific Railroad Test Rpt July 1969, 1 pp, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-987)
DOTL RP

C1 039528
PERMANENT WAY TESTS AND PRACTICE ON THE L.M.S.R.--I
Track realignments necessary to accommodate the Coronation Scot, a 90 mph passenger train, are described. A total of 269 curves were eased for a single track mileage of 244. A test using various fastenings is described. Ten track locations, where lateral stress was high and traffic load varied, were selected. The test results are tabulated.

Wallace, WK *Railway Gazette* Vol. 77 Oct. 1942, pp 420-421, 2 Tab, 6 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1040)
DOTL RP

C1 039529
PERMANENT WAY TESTS AND PRACTICE ON THE L.M.S.R.--II
Joints in tunnel track, experience with continuous welded rail, use of short fishplates, experience with Douglas fir cross ties, and tests using flat-bottom rail are described. These early tests with welded rail indicated that reduced maintenance costs could not offset the added initial costs.

Wallace, WK *Railway Gazette* Vol. 77 Nov. 1942, pp 489-490, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1041)
DOTL RP

C1 039549
THE ULTRASONEL FLAW DETECTOR
The Ultrasonel instrument of Trevor-Johnstone Company for detection of flaws in locomotive frames and thin plates by measuring the intensity of ultrasonic waves is described. The Ultrasonel will detect either internal or surface defects. The internal defects may be revealed by either transparency or echo methods as may be convenient, whereas the surface flaws are detected by inclining the feelers at an angle to the surface. The feelers are set at an angle to the surface so that the ultrasonic waves move along the surface without penetrating the test material.

Railway Gazette Vol. 99 July 1953, pp 17-18, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1188)
DOTL RP

C1 039602
GAUGING THE USEFUL LIFE OF RAILS
A device for determining the useful life of a rail is described. This particular instrument requires no attachment to the rail as do many other devices. The weight of the rail is read directly on a single scale. Also, a cross-section of the worn rail can be produced.

Railway Gazette Vol. 96 Apr. 1952, p 375, 1 Fig, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1254)
DOTL RP

C1 039614
RAIL-END DEFECTS
Of all steel rail defects, probably the most difficult to detect are those which occur at the rail-ends and are concealed by the fishplates. The major cause is the pounding and vibration to which rail-ends are subject because of the gap between the rails over which the rolling load must pass. This may encourage the development of corrosion fatigue cracks from any sharp edges, such as those of the fishbold holes or in the fishing angles of the rails, which stresses are concentrated. In the course of ordinary inspection, the only way to discover whether or not a rail is cracked at the end is to take off the fishplates but this is a costly operation from the labour point of view. In the United States certain railways are now supplementing the regular patrolling of their tracks with Sperry or other detector cars by supersonic testing of rail-ends. One of the problems arising from such inspections has been to decide at what stage of development a crack becomes sufficiently serious to demand the removal of the rail from the track. To remove all rails in which small cracks are found would appear to be an unjustifiable costly proceeding. The present practice of classifying the cracks and removing from the track only rails that have cracks of over a certain length, would appear to be reasonably safe, and far less costly than the indiscriminate removal of all rails show ing the slightest sign of cracking.

Railway Gazette Vol. 97 Aug. 1952, pp 199-200

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1268)
DOTL RP

C1 039627
A NEW FATIGUE DEFECT IN RAILS
The shelling defect has been most commonly encountered in the 131-lb standard flat-bottom section, though it has been reported in some degree in all sections from 100 lb. upwards. The first manifestation of the trouble is the appearance, on the running surface of the rail near the running edge of dark spots, which indicate the presence of horizontal planes of separation of the steel within the rail-head; these may occur at a number of different levels in the same rail. The shelling is the result of wheel action on the rail causing failure of the metal, either by direct stress exceeding the elastic limit, or by loss of ductility which is the outcome of constant reversals of stress. Factors which may influence the relative severity of the shelling are the inclination of the rail, the superelevation, the bearing pressure exerted by the wheels, the radius connecting the flanges and the treads of the wheels, and the radius of the gauge corner of the railhead.

Railway Gazette Vol. 79 July 1943, p 38

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1283)
DOTL RP

C1 039636
RAIL WEB FAILURES
Out of 30,881 failures of new rails in U.S.A. tracks in 1942-51, and removed during that period because of defects, 13,554, or 44 percent, were web failures. The great majority of the latter were failures within the area of the rail joint. Laboratory and track tests showed that many web failures could be explained by corrosion-fatigue but not by corrosion alone. Various factors increase the web stresses at rail ends. One is poor or irregular fit of fishplates; loose or worn fishplates or loose fishbolts have a bad effect, as they are liable to cause greater impacts to develop under the rolling load. Excessive gaps at the rail-joints or battered rail ends similarly tend to increased impacts.

Code, CJ (Pennsylvania Railroad) *Railway Gazette* Vol. 102 Feb. 1955, p 162

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1332)
DOTL RP

C1 039692
TESTS OF BOLTED AND BONDED RAIL JOINTS
The report discusses a comparative study of bolted and bonded rail joints. All joints were on 133 lb. rail; the bolted joints used Huck high strength fasteners, while the bonded joints used high strength fasteners with different structural adhesives. Results of the tests showed the bonded joint is a satisfactory alternative to thermite welding. However, installation requires high temperatures to assure curing of the adhesives.
Unpublished Report.

Brown, RM
Union Pacific Railroad 1 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1471)
DOTL RP

C1 039697
GP-7 LOCOMOTIVE WHEEL TO RAIL LATERAL LOADING TEST ON ILLINOIS CENTRAL RAILROAD
The report is based upon testing conducted by EMD to determine causes of derailments which involved GP-9 locomotives. The EMD Test Car was used to determine wheel loading levels for the GP-9 locomotive to determine wheel loading at the derailment sites. The test train from which data for this report was obtained represented a typical freight train operating in normal service through the areas where previous derailments occurred. The loads measured between wheel and rail during the testing were substantially below levels which are normally considered necessary to cause derailment by wheel climbing rail, rail turn-over, or shift of entire track structure. The maximum steady state net lateral load measured on the guiding wheel was 13,200 lbs. which represents 41.2% of the nominal wheel vertical load. Accompanying this load was a 5,400 lb. axle lateral load which represented 8.5% of the nominal axle vertical load. The above loads were measured in a 6-1/2 inch curve. Threshold tendency of wheel climbing rail is generally expected when net lateral force on guiding wheel is 90 to 100% wheel vertical load. Rail turnover demands that total lateral load compared to total vertical load on an entire rail length unsupported, or practically unsupported, by adjacent lengths gives a ratio great enough to cause the load resultant to fall outside of the base of the rail. Dynamic instanteous peak loads which are of very short duration resulting from sudden rail irregularities (joints) are not believed to affect wheel climbing rail or rail turn-over. Train speed did not significantly change steady state forces in a particular curve. However, increased speed did significantly change the level of dynamic loading as much as 200%.

Klinke, WR
General Motors Corporation Tech Rpt 119, Mar. 1965, 49 pp, 33 Fig, 18 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1477)
DOTL RP

C1 039800
ULTRASONIC TESTS ON RAILS IN SITU WITH ELECTRO-MAGNETIC AND ACOUSTIC TRANSDUCERS
Article describes an ultrasonic contactless testing equipment used for detecting defects in rails. System uses ultrasonic oscillations produced by electromagnetic-acoustic transducer. Mechanical details of the assembly are described, as well as block diagram of electric circuitry.

Vlassov, VV Lonchak, VA Glukhov, NA Invanov, LV Runov, NN
Russian Ultrasonics Vol. 1 No. 3, July 1971, pp 178-84, 4 Ref

ACKNOWLEDGMENT: EI (EI 72 52091)
PURCHASE FROM: ESL Repr PC, Microfilm

C1 039933
PENNSYLVANIA RAILROAD CLEARANCE CAR
The Pennsylvania Railroad has introduced a specially designed car for the measurement of track clearnace. It is usually made up into a short train consisting of a locomotive, the clearance car, and a crew coach. The car has now been in service for three years. Aluminum rods, 3 ft. long, and steel tipped, project from the sides and roof of the car in the form of an arch. As the train moves slowly towards a structure to be measured the rods are brushed backwards by contact to conform to the contours of the structure. The rods, 126 in number, are each capable of giving readings to 1/8 in. Graphs show the profile and clearance of the structure measured. The clearance car can cover an average of 100 miles of track each day. The time taken for measurement is about five minutes for a bridge and 30 minutes for a tunnel a mile long.

Railway Gazette Vol. 100 Apr. 1954, p 386, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1210)
DOTL RP

C1 039949
TRACK TESTS AT WOOD GREEN
This appendix taken from an unidentified report, describes a test conducted between London and Edinburgh on a section of track which was causing maintenance problems due to soil instability. The following measurements were taken through the use of pressure transducers: (1) transverse distribution of vertical stress beneath a test sleeper, (2) vertical stresses on the rail to sleeper reaction axis beneath both rails of the adjacent sleepers, (3) transverse horizontal stresses beneath the test sleepers, and (4) longitudinal horizontal stresses acting across the rail to sleeper axis. As a supplement to the stresses, induced by traffic, the in situ changes in the density and moisture content of the track foundation was determined by means of radioactive probes. This was done to check the behavior of the individual layers of the ballast, the blanketing layer just down and the formation under traffic loads. Findings are presented graphically.

53pp, 38 Fig, 11 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1330)
DOTL RP

C1 039982
MEASUREMENT OF LATERAL STRENGTH OF RAILWAY TRACK BY "LATERAL STRENGTH TESTING CAR" (1ST REPORT) MECHANISM OF TESTING CAR
The "Lateral Strength Testing Car" represents a two-axle bogie car additionally attached with a one-axle testing truck which carries a mechanism, which applies a vertical and a lateral load to the center axle, a mechanism which lifts the said testing truck above the rails and an oscillograph for recording the vertical and lateral loads. The car answers the questions: How much lateral load can the track withstand? and under what conditions and in what process a derailment of a car takes place? Procedures for measuring these quantities are provided.

Tanahashi, H *Railway Technical Research Institute* Vol. 4 No. 2, June 1963, pp 46-48, 4 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1447)
DOTL RP

C1 039988
TRACK SURFACE AND CAR DERAILMENTS
Tests under laboratory conditions to determine the effect of warped track surface as a cause of derailment of freight cars and the flange pressure required to turn the trucks under freight cars have led to certain conclusions contrary to the accepted beliefs of many competent engineers and railroad officers. Among the definite conclusions indicated by these tests may be mentioned the following: That a rigid and a flexible track are equally effective in resisting a tendency to derailment caused by warped track surface; that center-plate resistance plays little part in the total resistance

which must be overcome in turning trucks on curves, and that grease lubrication of center plates has no appreciable effect on truck turning resistance. It is interesting to note that, in general derailment occurred with less depression than super elevation of the outer rail. In general, it is evident that side-bearing clearance is the most important single factor, so far as the car is concerned, affecting derailments caused by warped track surface, and it is evident that flexibility of car structures plays no small part in keeping cars on the track where side-bearing clearance is small or altogether absent.

Railway Age Vol. 85 No. 17, Oct. 1928, p 794

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1453)
DOTL RP

C1 039990
INVESTIGATION TO DETERMINE THE CAUSE OF "SUDDEN" WIDE GAGE ON THE DELAWARE AND HUDSON RAILROAD

The purpose of this investigation was to determine the cause of this "sudden" gage widening. It would appear that this gage widening would most probably be caused by a jackknifing condition. This investigation measured the jackknifing forces developed under heavy pushing. The first part of the investigation was made on a 3 deg curve. A special test train was used consisting of a number of diesel units in dynamic braking and 15 loaded hopper cars, including one 100 ton car, to provide the pushing resistance at one end, an 89 ft. TTX flat car and short hopper in the middle and the pushing diesel units under test at the other end. Four special ties and eight roller bearing tie plates were installed near the middle of the 3 deg curve to measure and record the lateral forces exerted by the equipment on both inner and outer rails. Strain gages were placed on the rail webs to measure the vertical wheel loads. The lateral displacement between the first and second diesel units and the total locomoitve drawbar force were also measured. The investigation did not result in finding any clear cut and specific answer as to the cause of the occurrences of "sudden" wide gage. However, it appears most likely that the occurrences were due to lateral forces exerted against the outer rail as a result of locomotive jackknifing under dynamic braking.

Sckinke, R Akalin, MT
Association of American Railroads Technical Center Test Rpt Oct. 1966, 44 pp, 21 Fig, 9 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1455)
DOTL RP

C1 040094
MECHANICAL LINING OF TRACK

This article describes the Plasser and Theurer Limited mechanical equipment and procedures for alignment of track. Over 100 of these machines are in use in Britain, Germany, Austria, the United States and other countries, and are being used on bull-head as well as flat-bottom rail.

Schubert, E (Austrian Federal Railways) *Railway Gazette* Vol. 121 Aug. 1965, pp 617-619, 5 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1590)
DOTL RP

C1 040112
COMPUTERIZED DATA PROCESSING OF TRACK GEOMETRY RECORDING

The British Railways system of automatic assessment of the records produced by track-condition recording cars is described. The mechanical movements of the pens of the recording trolley are converted to electric pulses, which are measured on a floating datum in the case of the versines and twist. All measurement and evaluation is electronic and in no way impairs the production of the standard track-record graph. All the information on the print-out and the date of the recording are reproduced on a punched tape which is subsequently processed by a central computer to produce future work programmes for tamping and lining machines. This is done by extrapolating the trend of deterioration revealed by the fault counts to predict the content and order of priority of future maintenance work loads on the tracks.

Coombs, DH (British Railways Board) *Railway Gazette* Vol. 122 July 1966, pp 560-562, 3 Fig, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1608)
DOTL RP

C1 040120
RELATION BETWEEN TRACK IRREGULARITIES UNDER TRAIN LOADS AND NO LOAD

Track irregularities were measured under train load conditions using a new high speed inspection car, Maya 341. The sizes of the irregularities were compared with the sizes measured under no load conditions with a light weight, Yoshiike type, inspection car. A unique rule connecting measurement under load versus no load conditions could not be formulated. Relationships are established for load versus no load conditions in a mathematical model.

Ikemori, M *Railway Technical Research Institute* Vol. 4 N2 June 1963, pp 48-50, 4 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1616)
DOTL RP

C1 040122
DYNAMICS OF RAIL FAILURES IN THE TRACK

The propagation conditions of the following defects were studied: transverse cracks in the head; horizontal cracks in the head; and starcracking at fish-bolt holes. The main object was to attempt to determine the length of time after the appearance of detection of the failures during which the rails could be left in the track before dangerous failure became imminent. Laboratory tests failed to determine this time factor. Field test results from the Paris suburban railway are briefly described for the three types of defects. Laboratory measurement of transverse defects showed the electric method gave more accurate results than the ultrasonic method using pulse echoes.
Question D88

International Union of Railways Rpt ORE PU-25, July 1967, pp 33-35

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1618)
DOTL RP

C1 040159
THE USES OF TRACK INSPECTION INFORMATION IN RAILWAY ENGINEERING

Track inspection techniques are described. The purposes of the inspection is to develop a maintenance program; detect emergency track defects; evaluate methods, machines and material; and control work quality. Emphasis is placed on the analysis of data collected during the inspection.

Way, GH *AREA Bulletin* Vol. 71 1970, pp 767-774, 6 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-491)
DOTL RP

C1 040161
DIGITAL PROCESSING OF TRACK GEOMETRY DATA FOR MAINTENANCE PLANNING

The concepts for data processing described in this paper and the resulting preferred formats for the presentation of track geometry data resulted from discussions with knowledgeable people within the railroad industry. Data on 450 miles of track geometry are recorded by the test cars in less than 8 hours. The analog chart data is then scrutinized and edited. Within 48 hours after the test run, the digital gage printout and the annotated charts are ready for review by the maintenance engineer. By use of digital computer processing, a vast amount of track data can be collected and reduced into meaningful form quickly and efficiently. The Gage Data Reduction Program is a tool actively providing maintenance engineers and key management personnel with information to direct the planning of maintenance-of-way activities. The crosslevel program, presently under development, will be providing information on another key track parameter.

Woll, TP (Federal Railroad Administration) *AREA Bulletin* Vol. 71 1970, pp 785-797, 8 Fig, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-493)
DOTL RP

C1 040165
ENGINEERING TRACK RECORDER CAR

The Canadian National Railways have developed a track recorder car which measures and records condition of track. Track measuring and recording equipment has been installed in a converted passenger car which is equipped with two six-wheel trucks. This car is capable of testing track when operated

within the speed range of 20 mph to 100 mph. This car is equipped to measure and record the surface conditions of each rail, cross level and gauge. Photographs show the instrument panel and the equipment installation. Sample output is illustrated.

AREA Bulletin Vol. 71 1969, pp 161-169, 8 Fig, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-497)
DOTL RP

C1 040179
STUDY OF RAIL FAULTS IN THE TRACK--STANDARD RAIL FAILURE STATISTICS 1965 RAIL FRACTURES CAUSING DERAILMENTS

This report provides an account of rail failures for 1965 compiled by nineteen Administrations. The report also includes a study on broken rails having caused derailments. A primary distribution of the failures bases on their location is failures at rail-ends, failures away from rail-ends, and butt-weld failures. The principle rail defects classified according to their cause are failures attributable to manufacturing defects, failures attributable to service, failures which may be attributed either to manufacturing defects or to service, and failures due to butt-welding or thermit-welding and rebuilding of surfaces.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Final Rpt. D88/RP 5/E, Apr. 1968, 15 pp, Figs., Apps.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1547)
PURCHASE FROM: UIC Repr. PC
DOTL RP

C1 040188
INSTRUCTION GOVERNING THE SUPERELEVATION OF OUTER RAIL AND THE SPEED OF TRAINS ON CURVES

This specification for operations practice provides four superelevation tables: Table A gives the equilibrium elevation for various speeds on curves at which the overturning forces are balanced by the superelevation. Table B gives the speed at which conventional passenger equipment will ride comfortably around a curve. Three additional inches of superelevation would be required for balance of overturning forces. Table C gives a modified speed which may be authorized for freight trains. The superelevation is between equilibrium and comfortable. Table D gives a maximum theoretically safe speed assuming a center of gravity at 98 inches above the rails. This table is not to be used for elevating track. It is for information only. Change in superelevation will follow the alignment spiral where possible. The rate of change of superelevation should not exceed 1/2" in 31' for speeds up to 50 mph or 3/8" in 31' for speeds over 50 mph.

Baltimore and Ohio Railroad, Chesapeake and Ohio Railway Engr Rpt BULLETIN NO R-13, Apr. 1970, pp 8

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1556)
DOTL RP

C1 040258
BATTER TEST OF 151 LB. R.E. RAIL

This report covers a test of 151 lb. R.E. rail in which the base and lower portion of the web at the rail ends is cut square while the head and upper portion of the web is mitred, the change in angle of cut taking place about the center of height of web. The mitre makes an angle of 60 degrees with the line of track. For the purpose of test the above rails were laid on the Pittsburgh Division in No. 1 Eastward Freight Track east and west of Ardara on April 27, 1935. For comparison, 67, 131 lb. X-Rails with ordinary square ends were laid at same time adjacent and west of the mitred rails on the same track. After one night's traffic had passed over the rail initial measurements of rail and batter were taken. It was concluded that insofar as rail end batter there is no advantage in the use of mitred end rails over ordinary square cut end rails as determined by batter measurements over a period of one year and-1/2 months service in heavy tonnage freight track.

Graham, FM
Penn Central Transportation Company Test No. 240, June 1937, 5 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1723)
DOTL RP

C1 040260
FINAL REPORT ON 131 LB., R.E. FERRO-TITANIUM RAIL TESTS NOS. 253 AND 300 CONDUCTED ON THE ALTONNA AND COLUMBUS DISTRICTS

It was the purpose of the tests to determine to what extent rail with ferro-titanium added would alleviate the presence of shatter cracks with ultimate formation of detail fractures or other kinds of failures. Also, to obtain information as to the service quality of the above rail by means of observations and measurements of wear and rail end batter. The ferro-titanium rail used in Tests Nos. 253 and 300 was rolled under standard specification C.E. 35-(b). It was concluded that there is no overall advantage, either in reduction of head wear or rail end batter, in the addition of ferro-titanium to rail steel. Shatter cracks have been eliminated in rail of normal composition by control cooling. There is no necessity for using rails of special composition for this purpose. While the reduction in flaking, often associated with the formation of shelly spots, was not marked, there may be justification in considering titanium along with higher silicon contact as an alloying element intended to reduce shelling. It is recommended that in the study of rail chemical composition intended to reduce shelling, consideration be given to titanium.

Unpublished Correspondence.

Code, CJ
Penn Central Company Final Rpt Test Nos. 253, 300, Jan. 1956, 9 pp, 6 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1725)
DOTL RP

C1 040271
COMMENTS ON PENNSYLVANIA RAILROAD ELECTRIC LOCOMOTIVE TRACK TESTS CONDUCTED BETWEEN 1930 AND 1938

These are the first tests in which a section of track was equipped with special ties with means of measuring the maximum lateral force exerted outwardly on the rail by an electric locomotive on a test run. The tests were quite extensive with respect to instrumentation and also the number of run made with various types of locomotives. The section of test track consisted of steel ties spaced on 43 inch centers. The applied loads would be considerably different than on wood ties placed on 20 inch centers. A loaded profile of the right rail and left rail on the tangent track test section 440 ft. long including 128 test ties was intentionally made with variations in cross level in order to develop the performance of locomotives under unusually large variations in track cross level for very high speed running. The second phase of the tests included the use of weight bars equipped with magnetic strain gages to measure the lateral force exerted by the axle against the locomotive frame. These tests are of limited value to diesel locomotives and freight car equipment now in service.

Unpublished Report.

Magee, GM
Penn Central Transportation Company Nov. 1971, 31 pp, 11 Fig, 7 Tab, 8 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1740)
DOTL RP

C1 040272
TEST 431--RAIL MODIFICATION

The test comprised modified rails applied on high side of 6 deg 00' curve in heavy tonnage territory. For the test rails 131 lb. No. 1 quality, open hearth high carbon steel were furnished. Performance of the rails in track was followed during 2 years service by occasional inspections, measurements of rail wear, and rail end batter. Carnegie rails with 10" head radius were heavily flaked but no shelling was evident, whereas, the Bethlehem rails with 14" head radius were shelling.

Gressitt, JL (Pennsylvania Railroad)
Penn Central Company Test Rpt Test 431, Feb. 1950, 3 pp, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1741)
DOTL RP

C1 040273
STRESS CORROSION OF RAIL WEB STEEL (STATIC)

The test included six rail joint segments containing one bolt hole with a bolt inserted to make the joint. It also included twenty steel specimens taken

from rail steel which were subjected to static bending stresses. The twenty corrosion test specimens were tested after nearly twelve and one half years of exposure to the elements. The joint segments were tested approximately one month later. All of the test specimens were cleaned throughly and examined in the laboratory by Magnaflux and Magnaglow methods for the presence of corrosion cracks. While there was considerable pitting to be found, the laboratory examination disclosed no cracks in any of the specimens. This test shows that static stress combined with corrosion has little or no effect upon the development of cracks in rail web steel.

Code, CJ (Pennsylvania Railroad)
Penn Central Transportation Company Test Rpt Test 475, Nov. 1960, 16 pp, 2 Fig, 1 Tab, 9 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1742)
DOTL RP

C1 040278
DETERMINATION OF PLASTIC FLOW IN RAIL HEAD
The purpose of the test was to determine the amount of plastic flow which takes place in the gauge corner of a rail on the high side of a curve under conditions which produce shelling. The rails were laid on the Bolivar Curve. At this location the track was laid with 140-lb., 1948 rail, which in August 1953, was showing flaking and light shelling. This is a 4-degree curve with 4-inches superelevation, authorized speed 45-mph, and carries moderate to heavy eastward freight traffic. Records kept in connection with another test indicate a tonnage of approximately 29,000,000 gross tons annually. The three test rails were installed August 17, 1953. Inspection September 12, 1955, showed light flaking on all three rails. On the high rail of curves there is a flow of metal at the top gauge corner of the rail toward the gauge side. This flow of metal extends to a depth of 1/4-inch to 3/8-inch below the rail surface. The magnitude of deformation is positive evidence of shear stresses well beyond the yield point of the steel.

Code, CJ
Penn Central Transportation Company Test No. 591, Aug. 1971, 19 pp, 5 Fig, 1 Tab, 7 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1751)
DOTL RP

C1 040279
RAIL WEB STRESSES IN HIGH SPEED TERRITORY
The purpose of the present test was to determine if possible the cause of frequent split web failures in the joint on 131-lb. RE rail on the Fort Wayne Division, and in 152-lb. PS rail on the New York Division. Web failures in 131-lb. and 152-lb. rail on the Fort Wayne and New York Divisions are adequately explained by the corrosion fatigue theory. The ocassional bolt hole failures in 133, 140, and 155-lb. rail are not readily explained. A 50% allowance for impact is justifiable based on measured wheel loads. Application of reformed bars changes stress distribution in the rail web and in many cases increases web stresses, accelerating rail web failure. Loose bolts and increase in rail end gaps increase rail web stress. The results of this test emphasize the need for protection of rail steel against corrosion, for maintaining standard bolt tension, a good fit between bars and rail, and good surface through joints.

Code, CJ
Penn Central Transportation Company Test Rpt Test No. 597, June 1960, 6 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1752)
DOTL RP

C1 040281
ALLOY STEEL RAIL (CHROME-VANADIUM OR "CV")
The CV rail was laid in October 1953, in connection with regular rail renewals. The location was selected because it was one where moderate shelling had developed in the previous 131-lb. rail over a period of about 11 years. A total of 47 CV rails were laid--16 on the low side and 31 on the high side of the curve. Measurements of gauge superelevation, ordinates and rail head wear were made. A final inspection of CV rail was made on October 29, 1959, at which time 30 CV rails remained in track. There was no indication of shelling, although, some flaking was noted on the CV rail, and there was no indication of rail and defects. The results of this test have shown the CV alloy steel of the composition used to be unreliable. Its good wearing qualities and superior resistance to shelling are over-shadowed by its poor resistance to impact.

Code, CJ
Penn Central Transportation Company Test Rpt Test No. 645, Jan. 1960, 23 pp, 3 Fig, 1 Tab, 15 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1754)
DOTL RP

C1 040290
APPLICATION OF AMERICAN CURVE LINING CORPORATION CROSS LEVEL INDICATOR TO TRACK PATROL CAR
The cross level indicator is rectangular, eleven inches long, ten inches high and two inches deep. The dial opening is about ten inches long and four inches wide. The dial scale is graduated to read cross level in inches, from zero at the center of the dial to eight inches at the extreme ends of the dial. The indicator is geared to and actuated by a pendulum which is dampened with oil. The instrument had an accumulative error of 3/64 of an inch for every inch of superelevation reading on the dial. The indicator did not always return to zero when the instrument was returned to level. This unit is very sensitive to vibrations. To date the results of this test indicate that this unit is unsatisfactory. The present instrument should be retained for trial application to a separate unit to be propelled by hand or track car.

Code, CJ
Penn Central Transportation Company Test Rpt Test No. 729, Apr. 1959, 3 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1763)
DOTL RP

C1 040295
RELATIVE HAZARD INVOLVED IN WEB CRACKS OF VARYING LENGTH DETECTED BY AUDIGAGE
For testing, eight rails having web cracks from 0.25 to 9 inches in length along the centerline of the web were prepared by joining them with a pair of reformed joint bars, to a sound rail end of the same section, making a combined specimen somewhat over six feet in length with a joint at the center. These specimens were placed under the million pound machine with supports 60-inches apart, the joint at the center, and the load applied at the extreme end of the sound rail at the center of the joint. The loading was increased until ultimate failure in the rail end was obvious. Two rails with cracks through the bolt hole were also tested. On the first series of tests, except for one rail which had a nine inch crack, the load had to be carried beyond that which gives a bending moment corresponding to what can be expected in track. In the second set of tests rail loading caused the cracks to lengthen. It is still recommended that rails with cracks over 5 inch in length be removed as is required by Audigage testing procedure.

Code, CJ
Penn Central Transportation Company Test Rpt Test No. 784, Nov. 1962, 6 pp, 1 Fig, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1768)
DOTL RP

C1 040299
CHARTS OF SELECTED TEST RUNS ON AAR TEST CURVE ON LOUISVILLE AND NASHVILLE RR
Lateral acceleration and roll angle are shown for test runs on the AAR test track. Three and six inch elevations, and 0.5, 0.25, and 0.34 inch shims were used. The vehicles had 2.5 or 3.7 inch springs, and in one test, volute snubbers and widened gibs. Wheel lifts were recorded.
Unpublished Data.

Association of American Railroads Technical Center 8 pp, 8 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1772)
DOTL RP

C1 040334
A METHOD FOR RELATING TEST TRACK DATA TO THE REAL WORLD
The purpose of this discussion is (a) to develop a method by which test track data can be related directly to any railroad's rock and roll problem, and (b) to provide a means for objectively evaluating the railroad's requirements for

100,000 in-lb to unload the wheels of a high cube car and create a potential derailment condition. The rate of energy buildup on the number of joints required to unload the wheels defines the car's susceptability to derailment. The rate of energy buildup also allows test track data to be related to the real world. By determining the distribution of low joints in the curved territory over which the equipment must operate, and the relative probability of derailment thus generated, the test track data can be used to objectively evaluate the needs of any railroad for rock and roll devices.

Luebke, RW (Chesapeake and Ohio Railway) *ASME Journal of Engineering for Industry* Nov. 1968, pp 736-740, 5 Fig, 3 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1484)
DOTL RP

C1 040339
COMPUTERIZATION OF HIGH AND WIDE CLEARANCES
The clearance problem considered is limited to dimensional restrictions to movement. Weight distribution and axle-load restrictions are ignored. The operations of a typical railroad Clearance Bureau are outlined and the phases which would be simplified by the use of a computer are identified. Several photoelectric detector installations for measuring the clearance are photographed. The functions of the Mechanical and Engineering Departments regarding clearances are briefly described. The SCOPE car used to collect information for updating clearance records is shown and described. The flow chart of the digital computer program is illustrated.

Laden, HN (Chesapeake and Ohio Railway) *AREA Bulletin* Vol. 69 1968, pp 814-830, 1 Fig, 11 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1737)
DOTL RP

C1 040345
MEASUREMENTS OF VERTICAL AND LATERAL FORCES ON BOTH RAILS OF A SIX-DEGREE REVERSE CURVE UNDER DIFFERENT TYPES OF SIX-AXLE AND FOUR-AXLE DIESEL LOCOMOTIVES
An investigation was conducted on a 6 deg. reversed curve with 150 ft. spirals and practically no tangent between them. The track was instrumented at two locations, one on each of the spirals near the juncture with the 6 deg. curve. Vertical and lateral wheel loads were measured for each passing wheel of the locomotives on both rails. Four classes of locomotive were included in the tests having six wheel trucks as well as locomotives having four wheel trucks. The lateral force exerted against the high rail increases with speed; is relatively low for the freight diesel locomotives with four axles and the passenger diesel locomotives with six axles; and is appreciably higher for the two types of freight locomotives with the trimount trucks.

Magee, GM
Association of American Railroads Mar. 1967, 27 pp, 24 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1774)
DOTL RP

C1 040378
DYNAMIC MEASUREMENT OF RAIL PROFILE AND RELATED LOCOMOTIVE TRUCK MOTIONS
The profile of the railroad track on which a railway vehicle operates represents an input into the vehicle. This input is due to vertical and lateral rail irregularities and can cause dynamic loads that result in excessive damage or wear and tear on vehicle components and on the track itself. In order to study the dynamic operation of rail vehicles, it is necessary to know the profile of the track on which they operate. Since the unloaded profile of the rail can vary significantly from the loaded condition, it is the loaded-rail profile that must be known. This paper presents a method developed by the authors' company for the rapid measurement of the loaded-rail profile and includes some typical rail profiles and related truck motions resulting from these profiles. The instrumentation resulting from this work appears to have immediate application in day-to-day railroad operation and in high-speed rail transportation studies.

Contributed by the Railroad Division of the ASME for presentation at the 9th Joint ASME-IEEE Railroad Conference, San Francisco, California, May 4-6, 1966.

Spangler, EB Marta, HA (General Motors Corporation)
American Society of Mechanical Engineers Paper 66-RR-1, May 1966, 9 pp, 12 Fig, 3 Phot, 18 Ref, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1828)
DOTL RP

C1 040379
HIGH-SPEED RESEARCH TRAIN INSTRUMENTATION
The material presented in this paper will describe the basic instrumentation packages currently used in high-speed rail research. The instrumentation for the test and research program was subdivided into four separate packages, viz., body suspension (or ride quality), catenary-pantograph, track geometry, and track and roadbed dynamics. The task was to provide the necessary instrumentation for measurements, tests, and studies into the behavior and dynamic performances of rail vehicles, catenary, and supporting track structures at speeds up to 160 mph. The program was to be composed of four distinct but interrelated parts: (1) instrumentation, (2) computer programming, (3) data collection, reduction and interpretation, and (4) analysis and simulation. This presentation is concerned primarily with instrumentation. As a result of this program track geometry can now be determined at speeds in excess of 150 mph. Cross level, gauge, profile, alignment, warp, and rate of change of gauge can be measured at high speeds by using non-contract sensors.

Koch, BR (Transportation Systems Center)
Melpar Incorporated Tech Paper PRC 68-2

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1829)
DOTL RP

C1 040398
DYNAMIC MEASUREMENT OF ABSOLUTE TRACK PROPERTIES
A transducer developed to mount on the truck of a standard railway coach is the basis of a special track evaluation car. The practical application of this facility to track maintenance is described. Rail profiles are shown of track of good, intermediate, and poor quality. The SR and cross level values are shown in the figures.

Contributed by the Railroad Division of the ASME for presentation at the IEEE-ASME Joint Railroad Conference April 15-16; 1969, Montreal Quebec, Canada

Cass, R Berthiaume, PP Kalita, RE St. Louis, L (Canadian National Railways)
American Society of Mechanical Engineers Conf Paper 69-RR-6, Apr. 1969, 7 pp, 13 Fig, 3 Phot, 2 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1861)
DOTL RP

C1 040413
QUALITY OF RAILS AND MEANS OF GUARANTEEING IT--FALLING WEIGHT TESTS AND DEFINITION TESTS (1ST AND 2ND SERIES OF TESTS)
The main object of these tests--was to define and to standardize the conditions of use of the falling weight tests laid-down in UIC Leaflets 860-1-0 and 860-2-0, for the acceptance of rails of current quality and rails of nontreated steel of a quality resistant to wear. It was concluded that a falling weight test, irrespective of its type, is not representative of the fatigue behavior of rails in the track, but it was considered advisable to retain for the time being, such a test on complete pieces of rail, to make it possible to detect and eliminate brittle rails with a large degree of probable success and to maintain each rail production within a truly characteristic and correct scatter range.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Intrm Rpt. D45/RP 5/E, Apr. 1963, 35 pp, Figs., Apps.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1876)
PURCHASE FROM: UIC Repr. PC
DOTL RP

C1 040418
PROBLEMS OF INTERACTION OF VEHICLES AND TRACK--WORN PROFILES OF RAIL HEADS AND WHEEL TYRES

As a result of a large number of tests it has been proved that service wear on wheel tires and rail heads leads to definite profiles. These worn profiles are to a large degree independent of the initial profiles of tires and rail heads. In the worn condition the profiles maintain their form and are not subject to any further change. The worn profiles are characterized by good mutual conformity and thus by little increase in wear. The worn profile of tires results in a shortening of the wave length of the periodical wheel set motions (hunting) in the track clearance. It was concluded that to wear new profiles of rail heads and tires should be adapted as much as possible to the worn profile. The use of special wheel tire profiles promise no lasting influence on the riding quality of vehicles. Therefore other design measures on the vehicles should be preferred to control the hunting motion.

Question C9 Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Interim Report No. 6, Oct. 1962, 2 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1881)
DOTL RP

C1 040426
ROLLING-LOAD AND SLOW-BEND TEST RESULTS OF BUTT-WELDED RAIL JOINTS

In the period from October 1, 1965, to October 1,1966, sixteen rolling load tests and six slow bend tests were conducted on butt-welded rail joints at the Association of American Railroads Research Center. The joints were made by the thermite (Thermex Metallurgical, Exomet and Orgotherm), submerged-arc and oxyacetylene pressure-butt-welding process. The rolling-load tests were made on a 12-in-stroke rolling-load machine. Welded specimens were tested for various reasons including: (1) to determine the quality of the submerged-arc-welded rail joints, (2) to evaluate 115-lb thermite welded rail joints made by the Exomet process, (3) to determine the seriousness of making butt welds from rails with hairline cracks of (pipe) in the web. (4) to investigate the possible detrimental effects of a collar that was not removed from an Orgotherm thermite welded rail joint. The slow bend tests were made with the rail resting on supports 4 ft. apart and loaded at 2 points, one on each side of and 6 in. from the weld. These tests were made with the rail base down, thereby subjecting the head to a compressive stress and the base to a tension stress. For satisfactory service performance a minimum of 1.5 in. of deflection and 140,000 psi modulus of rupture are being used as tentative criteria for oxyacetylene and electric-flash pressure butt welds. A summary of the slow bend test results is provided.

AREA Bulletin Vol. 68 Bulletin 605, Feb. 1967, pp 383-396, 16 Fig, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1891)
DOTL RP

C1 040428
RAIL FAILURE STATISTICS COVERING (A) ALL FAILURES, (B) TRANSVERSE FISSURES, (C) PERFORMANCE OF CONTROL-COOLED RAIL

These statistics are based on the rail failures reported to December 31, 1965, and are submitted as information. They include the service and detected failures reported by 45 railroads on all of their main-track milage, which constitutes approximately 90 percent of the main track of Class 1 Railroads in the United States. The accompanying tables and diagrams indicate the extent of control of the transverse fissure problem that has been obtained by the use of control-cooled rail and detector car testing, give data on the quality of each year's rollings for the various mills, and show the types of failures that are occurring on the various railroads as related to the mill producing the rail. Also included are data reported on all failures in rail of all ages and sections.

AREA Bulletin Vol. 68 Bulletin 605, Feb. 1967, pp 418-436, 10 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1893)
DOTL RP

C1 040431
METALLURGICAL EXAMINATION OF FOUR ELECTRIC-FLASH BUTT WELD SERVICE FAILURES SUBMITTED BY THE FLORIDA EAST COAST RAILWAY

An investigation was made to determine the cause of four electric-flash butt welded rail joint service failures. These four failures are representative of a group of 13 or more failures that occurred in a short period after laying. From the results of this investigation it is believed that these failures are not related to the quality of the rails or the soundness of the welds. It was later disclosed that the rail ends were cropped with a petrogen torch prior to welding. Information was also received that the time between cutting and welding could range from a few days to several weeks. It is possible that incipient cracks formed during cropping of rail ends. Once these incipient cracks have formed, further development of the crack can occur on reheating, such as during the welding operation. A second possible cause for these failures is that the amount of rail cropped from the ends of these secondhand rails was insufficient to remove bolt-hole cracks that extend back into the web. From this investigation it is believed that these failures can be attributed to (1) cutting the rail ends with a petrogen torch, (2) incomplete removal of existing bolt-hole cracks, or a combination of both these factors.

AREA Bulletin Vol. 68 Bulletin 605, Feb. 1967, pp 460-462, 4 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1896)
DOTL RP

C1 040432
SHELLY RAIL INVESTIGATION, ROLLING-LOAD AND SLOW-BEND TEST RESULTS

Two methods presently employed for improving shelling resistance is the addition of alloying elements and the heat treating of rail. The rolling-load tests in a cradle-type machine are designed to evaluate these methods of improving the resistance to shelling. Rolling-load test results obtained from these cradle-type machines for the period between October 1, 1965, and October 1, 1966, are shown. The S-13 series were initiated to compare the effects of welding prior to flame hardening and flame hardening prior to welding. The electric-flash butt welds were made from secondhand 132-lb HF rail and flame hardened by the Hammon process. Specimens S-13A and S-13C failed after being subjected to 389,800 and 656,900 cycles, respectively. As a result of this performance, rolling-load tests were conducted on welded joints made from 132-lb HF secondhand rail having no flame hardening applied. These joints, S-13E and S-13J, shelled after being subjected to 1,088,000 and 1,163,000 cycles, respectively. Rails flame hardened by the Linde process developed shells after being subjected to 1,254,400 and 844,900 cycles in the cradle-type rolling-load machine. During this period there were no slow-bend tests.

AREA Bulletin Vol. 68 Bulletin 605, Feb. 1967, pp 477-487, 3 Fig, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1897)
DOTL RP

C1 040441
DERAILMENT OF A FREIGHT CAR LOADED WITH LUMBER ATTRIBUTED TO TRACK IRREGULARITIES

The examination of freight cars carrying lumber is reported following their derailment on June 6, 1968. The train was travelling at 52 mph over track having alternating differentials in crosslevel in a few rail lengths. Vertical acceleration coupled with a car with a fairly high center of gravity is believed responsible for the derailment.

Angold, JA (Atchison, Topeka and Santa Fe Railway) July 1968, 3 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1907)
DOTL RP

C1 040443
DERAILMENT OF A PASSENGER TRAIN CONSISTING OF A DIESEL LOCOMOTIVE WITH SIX-WHEEL TRUCKS, A BAGGAGE CAR, AND A COACH

Three letters discuss the derailment of June 7, 1968. A sketch of the derailment area and photographs of sections of the track involved are included. This derailment is characteristic of a number of derailments that have occurred on curves at or near permissible speed of passenger trains having locomotives with six-wheel trucks, derailment apparently occurring

first of the rear truck of the locomotive unit or the lead truck of the baggage car following. In each case the high rail of the curve was overturned. A high ratio of L/V is required to overtrun a rail and it is unlikely that this high a L/V ratio would be developed in track unless there is some unusual condition such as a jack-knifing of couplers between cars, an unloading of the lead wheel of the truck on the high rail, or some severe wedging action of the truck between rails due to a malfunction of the truck components.
Letter Correspondence.

Angold, JA (Atchison, Topkea and Santa Fe Railway); Stuppi, FN 14 pp, 1 Fig, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1909)
DOTL RP

C1 040445
TEST TO DETERMINE VERTICAL AND LATERAL FORCES IMPARTED TO THE RAIL BY A TYPE U28CG GENERAL ELECTRIC LOCOMOTIVE, SANTA FE CLASS 350
The test runs were made using a train consisting of two lightweight chair cars and three baggage cars and a locomotive of two units, one having the instrumented truck. Tests were run at speeds up to 90 mph on dry rail and moderate temperature. The test results show lateral forces of substantial magnitude being exerted on the rails, an occasional one having a finite duration of ten feet. They also show vertical wheel loads of low value in some locations. The test results indicate it is possible for these two conditions to occur simultaneously on two or three adjacent wheels of a truck and produce an effective L/V ratio of sufficient magnitude to overturn the rail.

Angold, JA
Atchison, Topeka and Santa Fe Railway Test Rpt Aug. 1969, 37 pp, 17 Fig, 3 Tab, 2 Phot, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1911)
DOTL RP

C1 040447
DERAILMENT DATA
A series of derailments are discussed. The majority of the derailments involve a loaded car connected at one or both ends with a cushion underframe car. A test plan is suggested to simulate the derailments by using a loaded hopper car and an adjoining box car with cushioned underframe containing instruments trucks. The instruments would measure lateral and vertical forces exerted on curves similar to the derailment sites.
Derailments described in BCL-1914, Letter Correspondence.

Magee, GM
Association of American Railroads Feb. 1968, 5 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1913)
DOTL RP

C1 040450
DERAILMENT ON REVERSE CURVE
Four data sheets concern derailments on reverse curves and turnouts. The derailment on the reverse curve involved a hopper car, loaded with bulk clay, which climbed the high rail at 15 mph. The Santa Fe rules for laying and maintaining turnouts are given. One derailment at a No. 8 turnout involved splitting a switch by entering the turnout at 18 mph, proscribed speed was 10 mph. Crosslevel information is given for a derailment at the point of a frog.
See also BCL-1913 and BCL-1914, Unpublished Data.

Magee, GM
Association of American Railroads Oct. 1971, 4 pp, 1 Fig, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1916)
DOTL RP

C1 040454
DERAILMENT REPORT
A collection of 23 derailment reports is presented. Track condition, type of train, speed, causes and comments are recorded for each incident. Only freight train derailments are examined. Rails that are heat-treated, have a variance in chemical
Unpublished Data.

Magee, GM 7111-7112 45 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1920)
DOTL RP

C1 040455
DERAILMENT DATA
A total of 88 freight-train derailment reports is presented. Type of consist, track conditions, train speed and nature and cause of accident are reported.
Unpublished Data.

89 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1921)
DOTL RP

C1 040457
RESULTS OF ROLLING-LOAD TESTS OF BUTT WELDED RAIL JOINTS
Between October 1, 1967 and September 30, 1968 fifteen butt welded rail joints were tested on the rolling-load machines at the AAR. The rails were tested to a maximum of 2,000,000 cycles, or to failure, of repeated loading. The rolling-load tests are tabulated. For the failed rails the damage points are shown.

AREA Bulletin Vol. 70 No. 619, Feb. 1969, pp 699-711, 1 Fig, 1 Tab, 10 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1923)
DOTL RP

C1 040472
RESULTS OF ROLLING-LOAD AND SLOW-BEND TESTS OF BUTT WELDED RAIL JOINTS
In the period between October 1, 1966 and October 1, 1967, 22 rolling-load tests were conducted on butt welded rail joints but no slow-bend tests were conducted. These butt welded rail joints were made by the oxyacetylene and electric flash butt welding process. The rolling-load tests were made on a 12-in-stroke rolling-load machine. Investigation 214 (samples A through F) was conducted to determine the seriousness of hairline cracks (segregation and pipe) on oxyacetylene pressure butt weld quality. Five of the six joints with stood 2,000,000 cycles of repeated loadings without failure, which is considered a run-out, and one joint (214E) failed after 897,100 cycles. A macroscopic examination made on transverse sections cut from the end of each rail prior to welding indicates that this failure originated from a fishtail. Investigation 220 (samples A through F) is a continuation of the problem presented in investigation 214 but was conducted to determine the effects of hairline cracks on joints from rails of heavier sections. It was found that fatigue of the failed specimens originated in the fillet between the head and web and can be attributed to a shear drag introduced while removing the weld upset. Investigation 226 (samples A and B) was conducted to evaluate two electric flash butt welded joints from which the upset metal had been ground from the top and sides of the head and bottom and sides of the base but not removed from the web. An examination of the fracture surface to determine the fracture mechanics indicates that this failure originated in the fillets between the web and upset metal. Investigation 230 (samples A and B) was conduced to evaluate oxyacetylene pressure butt welded joints made with a new type of welding head. Joint 230A failed after 33,500 cycles of repeated loading and joint 230B withstood the 2,000,000 cycle minimum requirement without failure. This failure can be attributed to the lack of fusion at the weld interface.

AREA Bulletin Vol. 69 Bulletin 612, Feb. 1968, pp 589-597, 11 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1938)
DOTL RP

C1 040474
INVESTIGATION OF FAILURES IN CONTROL-COOLED RAIL
In the period between October 1, 1966 and October 1, 1967 there were seven failures in control-cooled rail, three service and four detected, investigated by the metallurgical laboratory of the AAR. Investigations 132-10A and B involved two rail specimens both having a detected transverse discontinuity in the head. These transverse discontinuities were detected by a detector car. Rail specimen 132-10A was identified as a 100-lb RE. This failure should be classified as a transverse fissure from hot torn steel. Rail specimen 132-10B was identified as a 132-lb RE. This failure should be classified as a detailed fracture from a shell. Investigations 132-12A and B involved two

rail specimens both having a detected internal imperfection in the web. These internal imperfections were detected by a detector car and a hand test. Both rail specimens were identified as 132-lb RE. It was noted that both these rails have a pipe, and a non-metallic entrapment (slag) commonly associated with pipe, in the web. Investigation 135-16 involved a rail that failed in service. This rail was identified as a 112-lb RE. A photograph of the fractured faces showed a fatigue ring development. This fatigue ring development (detail fracture) started from a longitudinal separation close to the running surface of the rail head, then turned downward to form a transverse separation at a right angle to the running surface. This failure should be classified as a detail fracture from a shell. Investigation 135-28 involved a service failure that resulted from a derailment. This rail was identified as a 112-lb RE. This failure was caused by an impact force of unusually high magnitude that is believed to have been the result of a derailment. Investigation 135-29 involved a rail that failed in service. This rail was identified as a 115-lb RE. This failure was attributed to the presence of a base seam in conjunction with a high impact loading at subzero temperatures.

AREA Bulletin Vol. 69 Bulletin 612, Feb. 1968, pp 620-631, 19 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1940)
DOTL RP

C1 040502
ULTRASONIC TESTING OF RAILWAY COMPONENTS

Ultrasonic testing has expanded to the stage where it is a vitally important inspection method for two major railway components, axles and rails. It is likely that the use of the method will extend in many other fields. The success with which ultrasonic testing is now practiced is dependent upon three factors. They are: a thorough understanding of the type and position of flaws likely to occur in the component and the significance of flaw size; a sound knowledge of the principles underlying the use of ultrasonics for this purpose; and, a testing organization which can put sound techniques, well-trained men, and well-maintained instruments of the right type to work.

Wise, S (British Railways Board) *Institution of Locomotive Engineers Journal* Vol. 58 No. 321, Part 1, pp 77-110, 12 Fig, 8 Phot, 4 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1989)
DOTL RP

C1 040510
TWO-VIBRATOR TYPE SEARCHING UNIT AND ITS APPLICATION TO ULTRASONIC FLAW DETECTOR

In order to detect flaws located closely near surface in a metal material using a ultrasonic flaw detector, a two-vibrator type searching unit was invented. One of the two vibrators is a transmitter and the other a receiver. This unit can be used to inspect Thermit welded part of rails. Two-vibrator type searching unit is applied to an audigauge type flaw detector for use in rails. The unit can detect big flaws if they exist more than 1 to 5 mm apart from surface. In case of small flaws, they can be detected if their distances from surface are more than 5 mm.

Mano, K *Railway Technical Research Institute* Vol. 3 No. 4, Dec. 1962, pp 11-13, 2 Fig, 7 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2016)
DOTL RP

C1 040511
REPEATED SHOCK TEST OF RAILWAY TRACK

By means of a repeated shock tester for track, the dynamic properties are studied of the test track. Test tracks were selected one on a wooden tie section and the other on a concrete tie section. There were laid 50 kg PS rails, wooden ties without tie-plates or pre-stressed concrete ties with a spacing of 60 cm. Ballast was crushed stone with a depth of 25 cm and a shoulder width of 35 cm. Before every test the ballast was tamped. To know the pressure on rails, bending stress was measured. Displacement of rail depression was calculated on the data of measurements by the velocity vibrometer. Dynamic force upon rails was calculated on the data of rail bending stress. This force exceeds the centrifugal force under 1400 to 1900 rpm and this is considered to be caused through resonance.

Satoh, Y Hirata, G *Railway Technical Research Institute* Vol. 4 No. 2, June 1963, pp 42-45, 6 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2017)
DOTL RP

C1 040524
RAIL FAILURE STATISTICS COVERING (A) ALL FAILURES, (B) TRANSVERSE FISSURES, (C) PERFORMANCE OF CONTROL-COOLED RAIL

These statistics are based on the rail failures reported to December 31, 1961, and are submitted as information. They include the service and detected failures reported by 50 railroads on all of their main-track mileage which constitute approximately 90 percent of the main track in the United States and Canada. The accompanying tables and diagrams indicate the extent of control of the transverse fissure problem that has been obtained by the use of control-cooled rail and detector car testing, give data on the quality of each year's rollings for the various mills, and show the types of failures that are occurring on the various railroads as related to the mill producing the rail.

Faries, DT Kannowski, K (Association of American Railroads) *AREA Bulletin* Vol. 64 No. 577, Feb. 1963, pp 500-508, 4 Fig, 14 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1951)
DOTL RP

C1 040561
MEASURING ACCURACY OF MECHANICAL TYPE TRACK INSPECTION CAR

Mechanical type track inspection car YA210 has a measuring chord length 4.6m, its measuring accuracy being 19%. The accuracy has been improved to 12% by means of softer restoring springs. YA210 may be used up to the speed of 72km/h. There are prospects of constructing a mechanical type track inspection car with a measuring accuracy 10% and a measuring chord length 10 m. The new mechanical type track inspection car will have an integral type measuring equipment for superelevation of track, and a mechanical type automatic data processing equipment.

Kishimoto, S Takeshita, K *Railway Technical Research Institute* Vol. 9 No. 2, June 1968, pp 113-117, 6 Fig, 2 Tab, 3 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2024)
DOTL RP

C1 040566
TESTS TO DETERMINE THE EFFECT OF REMOVING THE BULGE FROM THE BOTTOM OF THE RAIL BASE ON THE STRENGTH OF ACETYLENE PRESSURE BUTT WELDS

Eight specimens were welded from 3-ft lengths sawed from two 115 RE Inland rails, and welded in the normal fashion. On four of the specimens the bulge was left on the base and on four of the specimens the bulge was ground off. A ninth specimen was cut from a 78-ft length from a previous welding run leaving the bulge on the base. Slow bend tests were made. There was considerable variation in the maximum load before fracture and especially in the energy for fracture. Observation of the fractured surfaces showed smooth areas predominately in the base and web indicating that full fusion had not been obtained in the welding process. The results obtained in the drop tests showed the same lack of complete fusion in the appearance of the fractured area. It is concluded that there is no significant difference in the strength of the weld whether or not the bulge on the base of acetylene pressure welds is removed by grinding or left on as has been the past practice.

Kannowski, K (Association of American Railroads) *AREA Bulletin* Vol. 61 No. 556, Feb. 1960, pp 898-904, 2 Tab, 7 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2045)
DOTL RP

C1 040575
RAIL FAILURES STATISTICS, COVERING (A) ALL FAILURES; (B) TRANSVERSE FISSURES; (C) PERFORMANCE OF CONTROL-COOLED RAIL

These statistics are based on the rail failures reported to December 31, 1958. They include the service and detected failures reported by 59 railroads on all of their main-track mileage. The tables and diagrams indicate that extent of control of the transverse-fissure problem that has been obtained by the use of control-cooled rail and detector-car testing, give data on the quality of each year's rollings for the various mills, and show the types of failures that are occurring on the various railroads as related to the mill producing the rail.

Code, CJ *AREA Bulletin* Vol. 61 No. 556, 1960, pp 845-866, 4 Fig, 8 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2054)
DOTL RP

C1 040577
ROLLING-LOAD-TEST RESULTS OF WELDED ENGINE-WHEEL BURNS ON RAIL SUPPLIED BY THE SEABOARD AIR LINE RAILROAD

The oxyacetylene-welding method is the standard procedure for repairing wheel burns. Two welds of this type were prepared as controls. Eight engine-wheel burns were then welded by means of the electric-arc method. The first six welds were made on 115-lb RE rail and the last four welds were made on 132-lb RE rail. In this type of test 2,000,000 cycles without failure are considered a run-out. All of the welds were checked ultrasonically for defects. The oxyacetylene welds had the best results, in that one ran to 2,000,000 cycles without a failure and the other ran to 589,000 cycles, failing from a detected inclusion. The electric-arc welds failed prematurely at 49,000 to 159,000 cycles. The microscipic examination of fractures revealed taht a sharp line of demarcation between the weld metal and rail metal existed as well as very fine porosity on the interface. This porosity in all of the electric-arc welds was the cause of the failure. The microsocpic porosity in the interface could not be detected ultrasonically whereas the indication of the inclusion was very definite.

AREA Bulletin Vol. 61 No. 556, 1960, pp 891-896, 2 Tab, 8 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2056)
DOTL RP

C1 040583
REPORT ON PENNSYLVANIA RAILROAD M. OF W. TEST NO. 591, DETERMINATION OF PLASTIC FLOW IN RAIL HEAD

On the high rail of curves there is a flow of metal at the top gauge corner of the rail toward the gauge side. This flow of metal extends to a depth of 1/4 in. to 3/8 in. below the rail surface. The flow of metal toward the gate side extends back to the edge of the center arc and beyond, probably to the center of the rail head. The magnitude of deformation is positive evidence of shear stresses well beyond the yield point of the steel. This condition was demonstrated on the high rail of a 4-deg curve under moderately heavy freight traffic after 75,000,000 gross tons. This was at a location of moderate shelling on previous rail. Only light flaking had developed in the test rail at the time of removal.

AREA Bulletin Vol. 59 No. 542, Feb. 1958, pp 962-975, 4 Fig, 1 Tab, 16 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2062)
DOTL RP

C1 040781
TESTS OF ELECTRIC FLASH BUTT-WELDED RAILS

This paper describes rolling-load tests and physical tests of specimens of 131 and 130-lb electric flash butt-welded rails which were undertaken to determine if stress relief treatment would be necessary. The 131-lb. rail was set up for rolling-load tests of weld 73 in. in a 33-in. stroke rolling-load machine. The second rolling-load test was made on weld 52 in the 131-lb. rail, which was supplied with all the flash metal ground off except under the rail base. 1. The first two-rolling load tests that failed at a bolt hole and stress raiser on the rail webs emphasize the damaging effects of such conditions. 2. The rolling-load tests which ran over 2,000,000 cycles with 60,000-lb. wheel load without failure, are considered very satisfactory for welded rails. 3. The bend tests of 132-lb rails gave higher tests than unwelded 131-lb. rails, and as high as any previously tested rail welds. 4. Some of the physical tests indicate that the welds which were not stress relieved were slightly stronger than the stress relieved welds. However, the difference is negligible and no conclusions on this subject should be based on tests of only two welds.

Cramer, RE Jensen, RS (Illinois University) *AREA Bulletin* Vol. 55 1954, pp 684-694, 2 Tab, 12 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2077)
DOTL RP

C1 040793
TRACK ANALYSIS

In the present paper an attempt has been made to create the physical based for an objective assessment of the quality of railway track. For this purpose, the damage occasioned by faults in the geometric position of the track has been reduced to the universally applicable notion of 'detrimental energy' which is, in its turn, based on the detrimental integral exclusively derived from the geometry of the track. The definition of these novel notions is made possible by classifying the faults as subcritical, critical or super-critical depending on the period length of the oscillations caused by them. This leads to a coherent evaluation system which is largely founded on physical facts, lends itself to automation by means of modern computers, and furnishes directly applicable data not only for short-term maintenance programmes (marking of danger spots) but also for long-term renewal programmes (quality assessment of entire sections of track). The necessary computing techniques are outlined in their logical set-up.

Translated from Glasers Annalen, Zeitschrift fur Eisenbahnwesen und Verkehrstecknik, Feb. 1967.

Erismann, T (Amsler (Alfred J) and Company) *Rail International* pp 571-592, 8 Fig, 18 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2036)
DOTL RP

C1 040821
SUPERSONIC INSPECTION FOR DEFECTS IN RAIL ENDS

Statistical data on rail defects found in 1951 by use of the Audigage flaw detector and the ultrasonic detector car are reported. Pennsylvania Railroad located 3400 defects in joints and 417 defective rails at highway crossings. Photographs of the detectors and some defective rails are shown.

Code, CJ (Pennsylvania Railroad) *AREA Bulletin* Vol. 53 1952, pp 1151-58, 10 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2092)
DOTL RP

C1 041672
MEASUREMENT AND ANALYSIS OF WHEEL-RAIL FORCES

Described is a method used to continuously measure, record, and analyze the lateral and vertical forces between wheels and rails of several types of railroad freight cars under a variety of car and track conditions. The method, using analog-to-digital conversion and computerized data handling, has produced results relating to a multitude of car and track behavior subject areas. Especially important is the definition, development, and verification of performance "signatures" which are generated in a unique and characteristic manner by each car in negotiating a given curve. The finding of such "signatures" to be completely reproducible and yet sensitive enough to change with relatively minor track or car component variations, i.e., modifications, supports the belief that these techniques can be applied beyond pure experimental scopes into routine (a) trackside inspection of cars in passing trains; (b) mechanized track inspection; and (c) truck design evaluation.

This paper was presented at the ASME Winter Annual Meeting, November 28-December 2, 1971. The notification of this paper appeared in Mechanical Engineering.

Peterson, LA (Bessemer and Lake Erie Railroad); Freeman, WH (Quebec Cartier Mining Company Railroad); Wandrisco, JM (United States Steel Corporation)
American Society of Mechanical Engineers 71-WA/RT-4, 1971

ACKNOWLEDGMENT: Mechanical Engineering
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL TF5.A72 1971

C1 043614
A RAIL REVIEWAL PROBLEM

Two alternative solutions are proposed for an unexpected rail trouble: laying a new track or reducing speed and intensifying inspection over the present one. The problem must be solved quickly because of material and service ordering. Cash inflows and outflows are analyzed and compared; and the figures favor a new rail. Next, a negotiating process takes place between financing people and engineering and operating people. The new rail is agreed upon and the decision is executed immediately.

Bardwell, RO (Regency Income, Incorporated); Love, JB
Railway Systems and Management Association Feb. 1969, pp 55-61, 4 Tab, 1 App

ACKNOWLEDGMENT: Railway Systems and Management Association
PURCHASE FROM: Railway Systems and Management Association 163 East Walton Street, Chicago, Illinois, 60611 Repr PC

C1 044005
MAINTENANCE OF WAY AND THE INFORMATION EXPLOSION
Maintenance of way activities have traditionally been subjected to budget restrictions, in part because it has been difficult to document and quantify the real cost of deferred track maintenance. Southern is using the computer to produce studies and reports on maintenance of way programs. The key elements are a group of data bases or master files containing essential information. Probably the most important is the Track Characteristic Master. Southern's Research C r R-1 provides key information on track conditions. A second file contains all pertinent details on derailments. Correlation of the derailment file with the track characteristic master produced a sensitivity index of defect types as a predictor of derailments. Southern is completing a System-wide anchor and double spiking program with standards based on traffic density, degree of curvature, and grade. The best way to determine when rail should be relaid and when track should be retied and surfaced is by measuring rail and track condition. R-1 car findings cause adjustment in maintenance schedules. Southern is pursuing an equally aggressive role with respect to rail defects and rail failures. The most recent addition to the data bases is the bridge file. Track programs have been correlated for efficiency.

Cary, AM (Southern Railway) *Progressive Railroading* Vol. 16 No. 2, Mar. 1973, pp 31-36, 2 Fig, 3 Phot

ACKNOWLEDGMENT: Progressive Railroading
PURCHASE FROM: Murphy-Richter Publishing Company 9 South Clinton Street, Chicago, Illinois, 60606 Repr PC

DOTL JC

C1 044281
TECHNICAL STUDIES TO EVALUATE THE INFLUENCE OF OPERATIONAL FACTORS ON TRACK LOADING
This paper describes briefly theoretical and physical investigations which have recently been performed by Canadian National Railways. The objective of investigations has been to establish means of reducing the probability of train derailment. While the scope of the derailment study is indicated, two efforts have been singled out for more detailed description. The first effort was directed to determine through computer simulation and analysis programs the lateral loading on curved track which can result from longitudinal train action forces. The second effort to be reviewed was directed to determine, through field measurement, actual lateral tieplate loads on curved track imposed by various vehicle types.

Contributed by the Rail Transportation Division of ASME for presentation at the Winter Annual Meeting, New York, New York, November 26-30, 1972.

Scott, JF Belevins, WG Wilson, JT (Canadian National Railways)
American Society of Mechanical Engineers Paper 72-WA/RT-11, Nov. 1972, 11 pp, 14 Ref

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL RP

C1 044310
DATA ACQUISITION FOR AUTOMATED TRACK INSPECTION
The purpose of this paper is to describe the use of a mini-computer in an integrated track inspection program. The basic elements of such a program include the measuring vehicle, data reduction process, and presentation of data to the various management levels. The paper describes such a system which has been in use on the Southern Railway over five years, and points out desirable changes, problems and economics.

This paper was recommended by the IEEE Land Transportation Committee of the IEEE Industry Applications Society for presentation at the 1973 Joint ASME/IEEE Railroad Conference, St. Louis, Mo., April 11-12, 1973. The price is $1.35 for members.

Sullivan, JH (Southern Railway)
Institute of Electrical and Electronics Engineers Paper C73922-2-IA, Jan. 1973, 8 pp, 10 Fig

ACKNOWLEDGMENT: IEEE
PURCHASE FROM: IEEE Repr PC

C1 044439
MECHANIZED TRACK INSPECTION: WHERE IT IS TODAY, WHERE IS IT HEADING?
Technology is available for mechanizing track inspection, but traditional methods are waging a stubborn battle against the new techniques which have been accepted in varying degrees on some roads but rejected on others. However, a significant point is the fact that no railroad after having acquired a track recorder, ever abandoned the idea later. The C&O/B&O, the Southern, the Canadian National, the Chicago and North Western, the Louisville and Nashville have track inspection cars which are described in this article. At least two track-measuring cars of European origin are now commercially available, the Matisa (Tamper) Trackfax car and the latest, the Plasser EM-50 Track Recording Car which has been in operaton on the Union Pacific. The technology of track-measurement and data processing has been brought to a high level of sophistication in the track-recording cars developed for the Department of Transportation. Known as "Rail Research Track and Vehicle Response Measuring Cars", these are self-propelled cars designed for operation in electrified territory, but operated also on portions of a number of roads and in more or less regular use for track-measurement in the Northeast Corridor.

Railway Track and Structures Vol. 69 No. 3, Mar. 1973, 4 pp, 8 Phot

ACKNOWLEDGMENT: Railway Track and Structures
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

C1 046320
MAINTENANCE OF TRACK ON SHINKANSEN
This article discusses the train operation, track construction, quality standards, and maintenance program of the high speed railway in Japan. Train vibrations are related to track conditions. Use of Track Inspection Car to measure track quality is discussed. Maintenance operations are carried out at night when no trains are running.

Fukusawa, Y *Japanese Railway Engineering* Vol. 14 No. 1, 1973, pp 3-7

PURCHASE FROM: Japan Railway Engineers' Association 2-5-18 Otemachi, Chiyoda-ku, Tokyo, Japan Repr PC

DOTL JC

C1 046362
DETECTING THE PROPAGATION OF KIDNEY-SHAPED FATIGUE FLAWS IN RAIL HEADS ON THE LINES OF THE HUNGARIAN STATE RAILWAYS
The author discusses the cause and propagation of kidney-shaped fatigue flaws in the rail head as well as the measures designed to prevent fractures. The main purpose is the description of the functional relationship between the propagation of the fatigue flaw and the traffic load. The formation of flakes in the rail material, the hardness of the rail head and the notch effect set up in the rail head by internal flaws are discussed. It is found that the propagation of the flaws is jointly caused by a number of processes such as microinclusions, oscillatory movements of dislocations, high stresses in the rail head, etc. The positions of the initial centres have been investigated by examining and measuring several fractures. Methods for calculating the height of the fissure and its inclination towards the vertical are developed. An analysis is made of the development of fatigue flaws as a function of the traffic load, and the existing relationship is established by an equation. In determining the effective cross-sectional area of the rail, the wear of the rail is also taken into account and added to the area of the fatigue flaw. After an analysis of the permissible threshold values, certain specifications are suggested, and the size of the flaw area in percent of the total cross-sectional area of the rail head is indicated with the aid of nomographs. In addition to the manual examinations, the introduction of ultrasonic high-speed testing vehicles is urgently recommended. In modern railway operation, ultrasonic testing is the most suitable method of detecting dangerous flaws; but the influence of human subjectivity in evaluating the results must be eliminated by using modern computers.

Kecskes, OS *Rail International* Vol. 3 No. 9, Sept. 1972, pp 493-506, 12 Fig, 14 Ref

PURCHASE FROM: International Railway Congress Association 17-21 rue de Louvrain, 1000 Brussels, Belgium Repr PC

DOTL JC

C1 046913
ON THE SOUTHERN TRACK INSPECTION, MECHANIZED, AUTOMATED, COMPUTERIZED
It is shown how track-measuring car, put into service by Southern, produces printouts showing defects that need immediate attention and an index of condition for each mile of track covered. The system has objectives to detect and locate any condition requiring correction and to establish a numerical rating which would afford a comparison of the relative quality of each mile segment of track on the system.

Railway Track and Structures Vol. 67 No. 3, Mar. 1971, pp 18-21

ACKNOWLEDGMENT: EI (EI 73 79921)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

C1 046914
COMPUTERIZED TRACK MAINTENANCE. OUTLINE OF A PLAN THAT GOES ALL THE WAY
The possibility of raising track-work planning and execution to a highly proficient level by combining mechanical track measurement and electronic data processing in such a way as to exercise total control over mechanized field operations is suggested.

Railway Track and Structures Vol. 67 No. 3, Mar. 1971, pp 22-24

ACKNOWLEDGMENT: EI (EI73 79927)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

C1 046953
DYNAMIC BEHAVIOR OF SHIN-KANSEN SLAB TRACK--TESTING RESULTS OF 951 MODEL TEST CAR
Slab track has been carried on research since 1965 by the Railway Technical Research Institute, JNR. This slab track is laid for test in many places and to be fully used for the future Shinkansen, Okayama-Hakata, Tokyo-Mori-oka and other railway tracks. This present report shows test results of dynamic behavior of Shinkansen slab track under high speed, max. 260 km/h. The test results confirmed that slab track has sufficient efficiency and is also safe.

Ikemori, M Higuchi, Y Sakamoto, S *Railway Technical Research Institute* Quart Rpt Vol. 14 No. 2, 131, 1972, June 1973, pp 85-87, 7 Fig, 1 Tab, 2 Ref

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: IPC (America), Incorporated 205 East 42nd Street, New York, New York, 10017 Repr PC

DOTL JC

C1 047969
C & NW IS NOW ABLE TO TELL MORE ABOUT TRACK AND CAR RIDE
The Chicago & North Western and Gulton Industries have jointly developed an electronic system called a Dynamic Track Analyzer. The system measures track deviations in cross level and alignment and then relates their combined effect upon the car's rock and roll action. It consists of rate gyroscopes to give measurements, a solid state analog computer along with a digital computer and a data processor to analyze the information, plus a printer to record all the pertinent data. The dynamic Track Analyzer has a pick-up device that is mounted on one of the axles of the car's rear truck. It includes two gyroscopes, one sensitive to the roll axis and the other to the turn axis. Tranducers convert the gyro measurements to signals. The analyzer system's speedometer pick-up is mounted on a different axle of the same truck and on the same side as the transducer housing. Another gyroscope within the computer cabinet measures spirals and curbes. The track geometry defects that are detected are divided into three classes; minimums, subcritical defects, and critical defects. The analyzer has proved to be an invaluable aid in picking out track areas that may be conductive to rock and roll derailments of a covered hopper car.

Railway Locomotives and Cars Vol. 146 No. 1, Jan. 1972, pp 14-16
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

C1 048240
TECHNICAL STUDIES TO EVALUATE THE INFLUENCE OF OPERATIONAL FACTORS ON TRACK LOADING
This paper describes briefly theoretical and physical investigations which have recently been performed by Canadian National Railways. The objective of investigations has been to establish means of reducing the probability of train derailment. While the scope of the derailment study is indicated, two efforts have been singled out for more detailed description. The first effort was directed to determine through computer simulation and analysis programs the lateral loading on curved track which can result from longitudinal train action forces. The second effort to be reviewed was directed to determine, through field measurement, actual lateral tieplate loads on curved track imposed by various vehicle types.

Scott, JF Blevins, WG Wilson, JT
American Society of Mechanical Engineers Paper #72-WA/RT-11, Nov. 1972, 11 pp

ACKNOWLEDGMENT: British Railways (29375)
PURCHASE FROM: ESL Repr PC, Microfilm

C1 050072
EFFECT OF FLAT WHEELS ON TRACK AND EQUIPMENT
Although old, this work is generally considered to be an excellent reference on this subject. The report describes the Test Apparatus and the Tests, presents the results of the tests, and presents some conclusions from the tests. The conclusions cover the effect of train speed, the effect of flat spot length, the effect of wheel load, and the impact force of a flat spot; and recommend guidelines for removing wheels from service and for running cars with flat wheels to terminals for service.

Association of American Railroads Technical Center May 1951, 81 pp, 27 Fig, 3 Tab, 9 Ref

ACKNOWLEDGMENT: Association of American Railroads Research Center (f4196)
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr PC

DOTL RP

C1 050363
MAGNETIC INSPECTION AND THE DYE PENETRANT TECHNIQUE AS AIDS FOR CONFIRMING RAIL DEFECTS
Two alternative methods which can be used as an aid to the Pulse-Echo method of rail testing are described. Magnetic crack detection and dye penetrant testing produce a visual picture of the surface defect which contains all the relevant information except that of relating to the actual depth of the crack.

Banks, J *Permanent Way Institution, Journ & Rpt of Proceed* Proceeding Vol. 91 No. t1, 1973, pp 33-39, 3 Fig

PURCHASE FROM: Derry and Sons, Limited Canal Street, Nottingham, England Repr PC

DOTL JC

C1 050367
C & NW PINPOINTS ITS DERAILMENT PROBLEMS
Chicago & North Western is taking an electronic approach to the prevention of derailments by determining the precise locations where track conditions are conducive to rock-and-roll wheel uplift. The system measures track deviations in cross level and alignment and relates their combined effect in producing rock-and-roll action that will cause a car's wheels to lift from the rail at a critical speed. Pick-up device includes two gyroscopes, one sensitive to the roll axis of the axle and the other to the turn axis. Both are in fixed position with respect to the axle.
See also Railway Track Structures, Vol. 67, No. 11, Nov. 1971, pp 22-24.

Railway Age Vol. 171 No. 9, Nov. 1971, 2 pp

ACKNOWLEDGMENT: EI (EI 72 34131)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

C1 050368
EFFECT OF TRACK GEOMETRY ON RIDE QUALITY
Track measuring cars provide an indication of what is off-standard in a section of track but give little indication of which variables are the most crucial to the production of a good ride. An approach which is being employed in an attemtp to bridge the gap between the track geometry and the quality of ride obtained on a given track section is described. Some preliminary results and conclusions are presented.

Ullman, KB (Department of Transportation); O'Sullivan, WB *IEEE Transactions on Industry & Genrl Applications* Vol. IGA-7, No. 6, pp 755-759

ACKNOWLEDGMENT: EI (EI 72 33184)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

C1 050373
DEVICE MEASURES TRACK-CENTER DISTANCES
Apparatus described was used for checking track centers on 120 mi between main tracks and 30 mi between main and side tracks in test. Truck is propelled by the outrigger pipes, but sliding frame permits it to move laterally so connecting cable actuates a transducer. Output voltage from potentiometric displacement transducer is fed into a recording voltmeter to produce a continuous tape for reading.

Railway Track and Structures Vol. 67 No. 9, Sept. 1917, pp 24-25

ACKNOWLEDGMENT: EI (EI 72 23287)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

C1 050473
USING FERROPROBES FOR TESTING THE RAILS OF ELECTROMAGNETIC WAGON/DEFECTOSCOPES
The parameters of the cores of a ferroprobe for operation of a high-speed rail defectoscope in relative strong fields are calculated by an approximate method. The possibility of using ferroprobes to indicate defects by high-speed electromagnetic nondestructive testing of railroad rails for low traveling speed is shown.

Shcherbinia, VA (All-Union Scientific Res Inst for Railw Transport); Valasov, VV Dovnar, DP *Soviet Journal of Nondestructive Testing* Vol. 8 No. 6, Nov. 1972, pp 641-647, 15 Ref

ACKNOWLEDGMENT: EI (EI 73 050854)
PURCHASE FROM: ESL Repr PC, Microfilm

C1 051346
M/W PROBE NUMBER 1--THE UNION PACIFIC
Six related articles, all dealing with the Maintenance of Way Practices on the Union Pacific Railroad, are presented. Subjects covered included track standards, welded rail, organization of M/W gangs, the Track Recorder Car, and bridges.

Railway Track and Structures Vol. 69 No. 6, June 1973, 18 pp

PURCHASE FROM: XUM Repr PC

DOTL JC

C1 051535
A TRACK CURVATURE MEASURING SYSTEM AND ITS APPLICATION
A track curvature measuring system has been designed and installed in the Department of Transportation's rail test car by ENSCO, Inc. The system employs an inertial rate-of-turn gyroscope to measure the yaw rate of the car, an axle-driven tachometer to measure speed, and velocity transducers to measure the relative motions between the car and the trucks. An analog circuit receives these inputs and performs the curvature computation. The system is capable of making continuous curvature measurement at any speed greater than 3 mph at either direction of travel. The system performance and various applications of the data are demonstrated. Schemes for detecting undesirable superelevation and curvature mismatches are discussed.

Contributed by the Intersociety Committee on Transportation for presentation at the Intersociety Conference on Transportation, Denver, Colo., Sept. 23-27, 1973.

MacIntyre, SA May, JT (ENSCO, Incorporated)
American Society of Mechanical Engineers Paper 73-ICT-110, Sept. 1973, 8 pp, 11 Fig

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL RP

C1 051536
APPLICATION OF GUIDEWAY ROUGHNESS POWER SPECTRAL DENSITY AS A MANAGEMENT TOOL
Ground surface vehicles such as trucks or railway cars can be considered as mechanical systems suspended on vibrating wheels. The source of vibrational energy is the roughness in the roadway or the guideway. A portion of the vibrational energy is transmitted through the vehicle suspension system and to the passengers or lading inside the vehicle. The magnitude of the transmitted energy and its frequency content depend on the roughness of the surface, the speed of the vehicle, and the mechanical characteristics of the suspension system. If the roads and guideways are categorized by the Power Spectral Density (PSD) of their surface roughness, the amount of vibrational energy can be predicted if the speed and the characteristics of the vehicle suspension system are known. Conversely, if a safe limit of the vibration has been established for a particular lading, management can render a cost effective decision on guideway maintenance, speed practices, and vehicle design from knowledge of the PSD characteristics of a proposed route.

Contributed by the Intersociety Committee on Transportation for presentation at the Intersociety Conference on Transportation, Denver, Colo., Sept. 23-27, 1973.

Corbin, JC Yang, TL (ENSCO, Incorporated)
American Society of Mechanical Engineers Paper 73-ICT-114, Sept. 1973, 8 pp, 3 Fig, 11 Ref

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL RP

C1 052253
JOINT BARS-DESIGN SPECIFICATIONS AND SERVICE TESTS INCLUDING INSULATED JOINTS AND COMPROMISE JOINTS
Various tests and application procedures of joints are discussed. Insulated joints, glued joints, web-contact joint bars, Huck fasteners, and joints with structural adhesives are studied in service tests, both in the laboratory and in field installations. The field installations are varied in location. Static stresses in rail and dynamic stresses in rail joint are studied in connection with field installations Huck fasteners. Among the conclusions are: 1)service tests of redesigned vulcabond insulated joints showed much chipping and flaking off; 2) Huck fasteners on polyurethane insulated joints were in satisfactory condition after two to twelve months installation; 3) Huck fasteners in standard head-free toeless angle bars would not satisfactorily restrain rail movement.

AREA Bulletin Proceeding Vol. 73 N No. 36, Feb. 1972, pp 312-337, 2 Fig, 7 Tab, 22 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C1 052285
RESULTS OF ROLLING LOAD AND SLOW-BEND TESTS OF BUTT-WELDED RAIL JOINTS
Results of 13 rolling-load and 13 slow-bend tests of butt-welded rail joints are described. The butt welded rail joints are made by the thermit (Exomet and Orgotherm process), the electric-flash and the oxyacetylene pressure butt-welding processes, and are submitted for testing to evaluate the various welding methods. Rolling-load tests are made on either use 12 in. or the 33 in. stroke rolling-load machine; slow-bend tests are made on supports 4 ft. apart with a two-point loading 6 in. on each side of the weld. Results of rolling load tests indicate that with the thermit weld orgotherm process and the thermit weld type from Exomet, Inc. a rail broke, but otherwise no failures occurred in butt-welded rail joints. Results of slow-bend tests indicate that a rail broke in each test situation, but that there was good structure in Southern Railroad's Thermit Weld (Orgotherm) specimen.

AREA Bulletin Proceeding Vol. 67 N No. 98, Feb. 1966, pp 428-436, 2 Fig, 2 Tab, 4 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C1 052287
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
Causes of shelly spots and head checks in rail are explored and methods for their prevention are presented. Heat-treated-rail and alloy rail service test installations are inspected on curves with shelly histories, and laboratory investigations of shelly rail involving rolling-load and slow-bend tests are also made. Service test installations on the Great Northern Railway of rails rolled from continuously cast blooms, fully heat-treated rails, Columbium-treated rail, and Curve-master rail, were inspected, and contour tracings of the rail inspected were made. Service test installations on curves are designed to study both resistance to wear and flow and resistance to shelling. Two methods presently employed in improving these properties are the addition of alloying elements and heat treating. The addition of certain alloying elements improves resistance to wear and flow but does not necessarily improve resistance to shelling. The use of other alloying elements may improve both of these properties. It is shown that rail if properly heat treated, will be improved in both of these properties. If improperly heat treated, the results are detrimental rather than beneficial.

AREA Bulletin Proceeding Vol. 67 N No. 98, Feb. 1966, pp 493-508, 4 Fig, 3 Tab, 12 Phot, 2 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C1 052294
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
Causes of shelly spots and head checks in rail are determined, and methods for their prevention are discussed. Two phases of the investigation include the inspection of heat treated and alloy rail service test installations on curves with shelly histories and the laboratory investigations of shelly rail involving rolling-load and slow-bend tests. The usual service test inspections are made of the fully heat-treated and alloy rail installations to corroborate the observations of previous years. Investigations featured include the service test installation of induction-hardened rail on the Great Northern Railway and on the Norfolk and Western Railway and the test installation to compare high-carbon rail with blue-end rail on the Pennsylvania Railroad. New developments in induction and flame hardening of rails to increase their resistance to shelling are also reported.

AREA Bulletin Proceeding Vol. 66 N No. 91, Feb. 1965, pp 479-493, 1 Fig, 2 Tab, 6 Phot, 2 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C1 052300
LENGTH OF RAILWAY TRANSITION SPIRAL-ANALYSIS AND RUNNING TESTS
Report and analysis is made of length of railway transition spiral, to provide more information on fundamental factors related to the design of the spiral easement curves and the levels of acceleration suitable for the requisite comfort on diesel locomotive and modern passenger rail cars. Previous work and history are reviewed, and the problem is analyzed. Other topics considered include test procedures and instrumentation, passenger ride comfort, lateral forces on leading locomotive trucks, and effects of track variations. It is noted that reported results confirm British ride comfort results, despite more scatter in the plots of the current study here.

AREA Bulletin Proceeding Vol. 65 N No. 80, Oct. 1963, pp 91-129, 13 Fig, 8 Tab, 8 Phot, 20 Ref

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C1 052316
RAIL SLIPPAGE TESTS-CONCRETE TIES
Tests are conducted to determine rail slippage for concrete ties, using the fastenings to check the slippage resistance anticipated in the design calculations. Test procedure is described and results are presented. It is noted that the values of rail slippage resistance for the AAR design clips for the Type E tie are generally more than the 2000 lb minimum for 5000 lb bolt tension, except those with vibration, which are only about 1000 lb. It is concluded that the measurements of rail slippage resistance obtained agrees reasonably well with those anticipated in the design of the fastening for the AAR Type E prestressed concrete tie. It is believed that a range of bolt tension between 10,000 and 5000 lb should be maintained with AAR clips until such time as service experience indicates that a change in these limits is warranted.
This article is an abstract of report no. ER-22.

AREA Bulletin Proceeding Vol. 64 N No. 73, Oct. 1962, pp 39-45, 2 Tab, 6 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C1 052319
RAIL WEAR TESTS ON THE ST. LOUIS-SAN FRANCISCO RAILWAY
Two curves on the St. Louis-San Francisco Railway were selected for rail wear tests. The section having a slightly lower rate of wear in past service was not lubricated. The other curve had a "Meco" single rail lubrication using graphite grease at the far end of its two curves. The effectiveness of the lubrication was gaged by taking rail profiles at various intervals of time. These profiles show the amount of steel worn from the heads of the rail gage. Elevation and curvature of the high rail were measured at each point where a profile was taken. Seven sets of profiles were taken of the rails undergoing the tests. The profiles show significantly less wear on the curve with the track lubricator than on the curve with no lubrication. The effectiveness of molybdenum-disulphide was tested as a rail lubricant. Its application showed less wear rate. These service tests definitely show that track lubricators are effective and can double the life of the outer rail in the presence of heavy sanding.

AREA Bulletin Proceeding Vol. 63 N No. 66, Oct. 1961, pp 17-25, 4 Fig, 1 Tab

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C1 052326
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL: METHODS FOR THEIR PREVENTION
This report is presented in two appendices. Appendix 8-a covers the inspection of service tests of fully heat-treated and alloy rail installations. There are five tests of fully heat-treated rail, three of high-silicon rail, one of chrome-vanadium, and one of columbium-treated rail. The heat treatment in some locations has shown considerable value in extending rail life under shelly conditions and in resisting head flow on the low side of curves. The high silicon and low-alloy rails show a resistance to wear and shelling. The chrome-vanadium rail shows excellent performance. Appendix 8-b covers 1) rolling-load tests to produce shelling in high-silicon chrome-vanadium rail, columbium-treated rails, basic-oxygen standard carbon rails and flame-hardened rails; and 2) end-quench hardenability curves determining the quenching characteristics of some of the low-alloy rail steels. High-silicon chrome-vanadium rails rated high in rolling-load tests. End-quench hardenability curves are given for four rail steels to furnish information on the quenching characteristics of low-alloy rail steels.

AREA Bulletin Proceeding Vol. 63 N No. 70, Feb. 1962, pp 532-552, 2 Fig, 11 Tab, 12 Phot, 2 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C1 052333
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
This informational progress report is contained in two appendices. Appendix 8-a covers inspections of service tests of heat-treated and alloy-rail installations at 11 locations. There were five tests of heat-treated rail, three of high-silicon rail, and three of chrome-vanadium alloy rail. Heat-treated rail continues to show decided increased life over standard rail. Use of heat-treated rail on the low side of curves has increased life of rail 5 to 8 times, and on high sides 1 1/2 to 4 times. High-silicon rails have shown greater resistance to the detrimental effects of heavy wheel loads on the low

side of curves than standard rails. Chrome-vanadium alloy rails show greater resistance to wear than standard rails. However, in this test the chrome-vanadium alloy steel of the composition used was unreliable. Appendix 8-b covers rolling-load tests to produce shelling in 136-lb high-silicon vanadium rails, failed shelly rails from service, and rolling-load tests to produce detail fractures from shelling. Results of tests of 115-lb columbian rail and tests of 133-lb rail single flame hardened by the Union Pacific Railroad are also reported.

AREA Bulletin Proceeding Vol. 62 N No. 63, Feb. 1961, pp 622-634, 1 Tab, 5 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C1 052352
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
Most of the information in this report on causes of shelly spots and head checks in rail is contained in the two appendices. Appendix 8a covers inspections of service test of heat-treated and alloy steel rail installations at five locations. There are three tests of heat-treated rail and two of high-silicon rail. Heat-treated rail in tests on the Norfolk & Western Railway continues to show increased life over standard rail. High-silicon have shown greater resistance to the detrimental effects of heavy wheel loads in the low side of curves than standard rails. Appendix 8b contains studies done at the University of Illinois. Three rolling-load tests to produce shelling in high-silicon rails, standard carbon-steel rails and 50-kg rails induction hardened in Japan are presented and discussed. Two rolling-load tests on a high-silicon rail ran 1,944,400 and 1,480,000 cycles. A standard-carbon-steel rail gave unusually long tests of 4,347,000 and 4,371,000 cycles. These specimens deformed considerably before the shelling cracks were visible on the side of the headrail. Two induction-hardened 50-kg rails from Japan gave rolling-load tests of 577,400 and 718,300 cycles.

AREA Bulletin Proceeding Vol. 61 1960, pp 869-881, 1 Tab, 4 Phot, 2 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C1 052374
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
Causes of shelly spots and head checks in rail are discussed, and methods for their prevention are recommended. Topics considered include six tests of heat-treated rail, a final report of service tests of 155-lb rail on the Pennsylvania RR laid on the high side of a 6-deg curve, a University of Illinois study of rolling tests, investigation into the significance of the hydrogen level in rail steel, and report on a three-dimensional photoelastic investigation to study the internal stresses within the rail head due to wheel contact pressures.

AREA Bulletin Proceeding Vol. 60 1959, pp 917-969, 19 Fig, 4 Tab, 19 Phot, 10 Ref

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C1 052398
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS OF THEIR PREVENTION
Causes of shelly spots and head checks in rail are discussed, and methods for their prevention are recommended. Research conducted by the research staff of the Engineering Division of AAR and by the University of Illinois is reported. Inspections of service tests of heat-treated and alloy rail are made at nine locations, including five tests of heat-treated rail, two of chrome vanadium alloy, and two of high-silicon rail. The final report of heat-treated rails on the Norfolk & Western Railway reveals a very definite advantage of heat-treated rail over standard control-cooled rail, with rail life increased by 2 1/2 times in the case of shelling. Economic advantage of heat-treated rail involves a rail life 4 1/2 times that of standard rail. University of Illinois reports results of mechanical and rolling-load tests to produce shelling failure and details fractures and tests of six rails which developed detail fractures in service.

AREA Bulletin Proceeding Vol. 58 1957, pp 1026-10, 3 Fig, 4 Tab, 13 Phot, 1 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C1 052403
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL METHODS FOR THEIR PREVENTION
Continuing investigations confirmed that heat-treated or alloy rails were effective in extending the service interval before gage corner shelling occurs in track. A description and summary of eight test installations of heat-treated and alloy rails in areas of high shelling was presented. Appendix 8-a presented the progress of shelly rail studies. Rolling-load tests of high-silicon rails and one chrome-vanadium rail were performed. Shelly rail failures from service were examined and rolling-load tests to produce detail fractures in the laboratory were performed. Detail fractures from shelling in European rails were discussed. High-silicon rails gave rolling-load tests 50 to 100 percent better than standard carbon-steel rails before developing shelling failures. Three tests of a chrome-vanadium alloy rail gave two tests over 5,000,000 cycles and one test of 1,846,000 cycles. Rolling-load tests of high-silicon rails to develop detail fractures from shelling produce failures similar to those produced in track.

AREA Bulletin Proceeding Vol. 57 1956, pp 830-857, 5 Fig, 3 Tab, 20 Phot, 1 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C1 052406
CURVE WEAR WITH DIESEL LOCOMOTIVES ON THE BESSEMER AND LAKE ERIE RAILROAD
A series of test runs were made to obtain definite information on the amount of rail curve wear produced by diesel locomotives relative to that produced by the remainder of the train. A second series of tests was made for the purpose of relating the effectiveness of flange oilers on the locomotive and rail lubricators in the track in controlling the amount of curve wear. Instrumentation consisted of a box to catch metal abraided by diesel units from the track and a motion picture camera to photograph the passing wheel flange on the high rail. The tests show that although the rate of rail and wheel wear with a diesel unit is greater than for a heavily loaded freight car, the greater amount of rail wear is due to the train rather than the diesel units. Rail and wheel flange wear on curved track can be practically eliminated by lubrication with either flange oilers on the diesel units or rail lubricators in track, or a combination of the two.

AREA Bulletin Proceeding Vol. 56 1955, pp 269-281, 1 Fig, 2 Tab, 9 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C1 052410
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
Progress in the continuing study of the causes of shelly spots and head checks was reported. The performances of various installations of heat-treated and alloy-steel rail have been tabulated. Appendix 8-a presented rolling-load tests of heat-treated chrome-vanadium rail, high-silicon rails, and 140-lb. chrome-vanadium alloy rail. Examination of shelly rails from service and rolling-load tests to produce detail fractures in the laboratory were discussed. One specimen of chrome-vanadium rail, heat-treated to 490 Brinell hardness, ran 21 million cycles in a rolling-load test. Ten specimens of high-silicon rails averaged 2,307,000 cycles in rolling-load tests. Two specimens of 140-lb. chrome-vanadium alloy rail averaged 3,625,000 rolling-load cycles. Photographs of one shelling crack in a service rail indicate the crack started at a segregation streak in the rail. All rolling-load tests to produce shelling indicate that rails with higher hardness, with corresponding increase in mechanical strength, give longer laboratory rolling-load tests.

AREA Bulletin Proceeding Vol. 56 1955, pp 951-959, 2 Tab, 3 Phot, 1 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C1 052418
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
Five service tests of rail are discussed. There are four of heat-treated rail and one of alloy rail. In the progressive study of shelly rail rolling-load tests of flame-hardened rails, high-silicon rails, and electric furnace steel rails were performed. Examination of shelly rails from service was performed. Rolling-load tests to produce detail fractures were done. The rolling-load tests indicate that stronger rail steel should give longer life before shelling develops in service. Study and testing on simulated rails indicated that plastic deformation is the major factor in shelly failure. Design changes and metallurgical changes to limit plastic deformation would improve rail life. Use of lower wheel loads, larger wheels and higher strength material is indicated. A photoelastic study of the stresses in a model of a railhead utilizing developments in three dimensional photoelasticity for a better understanding of rail shelling was presented. Plastic models of the prototype were thinly sliced and the data obtained were subjected to a field of polarized light. Processing the data was done by the shear difference method. Principal stresses and maximum shears were studied through loading tests. Principal stresses and maximum shears were found in the transverse section of the rail under the center of the wheel.

AREA Bulletin Proceeding Vol. 55 1954, pp 828-897, 27 Fig, 5 Tab, 14 Phot, 4 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C1 052426
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
A summary of the performance of heat-treated rail at five installations is presented. Results of rolling-load tests for each installation was presented. The progress on shelly rail studies was presented. Rolling-load rests on heat-treated rail, three experimentally flame-hardened rails and commercially flame-hardened rails were performed. Rolling-load tests to develop detail fractures and stress relaxation tests were made. The tests of the experimentally flame-hardened rails did not compare favorably with tests of heat-treated or alloy rail. Progress in the studies of stress relaxation in rail steel and deformational behavior of rails is reported. Bending fatigue tests of rail steel specimens were run to investigate whether a subcritical thermal treatment might heal progressive fatigue damage. No beneficial effect was noted. The mechanisms involved in rolling-load failures were then studied by work with low-carbon steels sensitive to the Fry "strain-etch" technique and with silver chloride which has optical properties and metal-like mechanical behavior. More work will be done with these two materials.

AREA Bulletin Proceeding Vol. 54 1953, 14 pp, 2 Tab, 4 Phot, 2 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C1 052434
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
A summary of the performance of five test installations of heat-treated rail was presented. Appendix 9-a presented the progress of shelly rail studies at the University of Illinois. Repeat cradle type rolling-load tests on two specimens of manganese chrome, vanadium alloy rail indicated that these rails may be several times as good as standard carbon steel rails. A test of 115-lb heat-treated standard carbon rail indicated that this type was as good as the manganese, chrome, vanadium alloy steel of the heat-treated standard carbon steel rails. An electron micrograph of nickel alloy steel showed detail in fine pearlite structure which was not revealed by a light microscope. Appendix 9-b presented a summary of progress on the investigation of stress relaxation in rail steel. The work was in two areas: 1) Relaxation of stresses in small bar specimens was studied as a function of time and temperature, and 2) rolling-load fatigue tests on small systems. Specimens cut from the top section of the rail were tested and results indicated possibly larger values of relaxation in percent of applied stress than for other specimens. Rolling-load fatigue tests produced failures that require further investigation of the effect of alleviation of damage by stress relaxing heat-treatment.

AREA Bulletin Proceeding Vol. 53 1952, pp 899-920, 2 Fig, 2 Tab, 12 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C1 052440
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
A summary of the performance of heat-treated rail in two test installations was presented. Progress on shelly rail studies at the University of Illinois was presented in appendix 10-a. Rolling-load tests of heat-treated rails, flame-hardened rails, alloy rails and headfree rails were performed. Laboratory examination of detail fractures from shelling was performed. Design and construction of a new cradle-type rolling machine was discussed. A description of the technique used to produce electron micrographs at 35,000X magnification was given. Rolling load tests continued on 132-lb heat-treated rail revealed that yield strength was increased 65 percent, tensile strength 31 percent, elongation 18 percent, reduction of area 100 percent, and endurance limit 40 percent. Results of rolling-load tests on seven rails flame-hardened different amounts on the rail treads showed four specimens failed by head and web separation cracks, and three failed by shelling. Rolling-load and physical tests on two specimens of alloy rail steel showed that these rails have physical properties which compare closely with those of heat-treated rails. Examinations of seven detail fractures from shelling revealed that the shelling cracks started longitudinally in the steel and then turned into transverse detailed fractures.

AREA Bulletin Proceeding Vol. 52 1951, pp 661-679, 1 Tab, 12 Phot, 1 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C1 052447
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
Progress on the continuous study of shelly spots and head checks in rail was presented. Heat-treated rail tests indicate that its use extended the life of a rail before gage corner shelling occured. Appendix 10-a described studies at the University of Illinois where examinations of shelly rails from service and laboratory tests to produce shelling were performed. It was observed that the black shelly spots developed by two processes. Two rolling-load test on an alloy rail were high. Examination of the failed specimen revealed non-metallic inclusions. Rolling-load tests on heat-treated rail specimens of standard chemical analysis compared with non-heat-treated companions revealed that heat-treated specimens gave 3 to 4 times the performance of the non-heat-treated specimens. Appendix 10-b presented a summary report on the examination of rails containing detail fractures found by detector cars. The purpose was to determine if the chemistry, mechanical properties, or structures of detail fracture rails varied from those of random rails. The average chemical analyses and mechanical properties of 44 rails having detail fractures and 26 random rails were so nearly the same that no distinction between the two groups was possible. The mechanical tests included hardness, tensile properties, and impact properties. Examination of deep etched structures and microstructures of detail fracture rails indicated that the steel used was of relatively good quality.

AREA Bulletin Proceeding Vol. 51 1950, pp 595-620, 4 Fig, 4 Tab, 16 Phot, 2 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C1 052457
TEST RESULTS ON RELATION OF IMPACT TO SPEED
Test results on relation of impact to speed are reported to support the proposed Article 107 of the Rules for Rating Existing Iron and Steel Bridges. It is noted that a study of short span steel bridges 20 to 40 ft. long and deck plate girder spans 40 to 130 ft. long subjected to live loads with or without hammer blow indicates that the reduction of impact as a result of speed should occur at 40 mph or less, rather than synchronous speed or less as was proposed in 1947 for spans longer than 50 ft. The value of 40 mph was selected as the maximum practical speed where allowable reduction in impact might be permitted since rolling equipment without hammer blow has no synchronous speed. It is noted that some values of total impact on truss spans approximately 120-150 ft. long, subjected to equipment with hammer blow, receive more impact than is provided by Article 206 of the Specifications for Steel Railway Bridges. The character of the reduction equation for truss spans subjected to rolling equipment with hammer blow is consistent with the data.

AREA Bulletin Proceeding Vol. 50 1949, pp 432-443, 9 Fig, 1 Tab

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C1 052460
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-MEASURES FOR THEIR PREVENTION
Causes of shelly spots and head checks in rail are reported and measures for their prevention are recommended. Reports of four study groups are presented. It is noted that no definite relationships or trends exist in the relationship between chemistry and shelling, or curvature, elevations, speeds, and grades. It is found that transposing shelly high rails to the low rail, if done in time, is worthwhile. Rail slow-cold worked under traffic in nonshelling locations and relaid in shelling locations possesses very little, if any, greater resistance to shelling than ordinary rail. Studies of high carbon rail indicate that it will retard but not eliminate shelling and that it has a tendency to head check and this in turn causes gage corner flaking or minute shelling. A seven-year summary report of shelly rail investigation at the University of Illinois is presented. Also presented is a summary report on the examination of 300 shelled spots selected from the track of 11 major roads, indicating that the shelled spots were predominantly of surface origin.

AREA Bulletin Proceeding Vol. 50 1949, pp 534-557, 3 Fig, 2 Tab, 16 Phot, 2 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C1 052468
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL SURFACES-DEVELOP MEASURES FOR THEIR PREVENTION
Causes of shelly spots and head checks in rail surfaces are investigated, and preventative measures are recommended. It is found that no definite relationship exists between chemistry and shelling, and no definite trend regarding curvature, elevations, speeds and grades. Transposing shelly high rails to the low rail, if done in time, is worthwhile. Rail slow-cold worked under traffic in non-shelling locations and relaid in shelling locations possesses little resistance to shelling compared to ordinary rail. It is also found that high carbon rail does not eliminate shelling but retards it more than ordinary carbon rail; however, the high carbon rail tends to head check and in turn cause gage corner flaking or minute shelling. Reports are submitted by the Norfolk & Western, Pennsylvania, Duluth, Missabe & Iron Range, and Chesapeake & Ohio Railroads.

AREA Bulletin Proceeding Vol. 49 1948, pp 434-463, 10 Fig, 5 Tab, 19 Phot, 3 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C1 052469
FOURTEENTH PROGRESS REPORT OF THE COOPERATIVE INVESTIGATION OF FAILURES IN RAILROAD RAILS IN SERVICE AND THEIR PREVENTION
Report is made of the cooperative investigation of failures in railroad rails in service and their prevention. Careful examination of transverse fissures is made. Laboratory rolling-load tests are studied to find a type of rail steel to resist shelling failures which occur in rails on curves. Work on end-hardened rails is continuing. Failed rail conditions are summarized and illustrated.

Conducted by the Engineering Experiment Station, University of Illinois in cooperation with the Association of American Railroads and the American Iron and Steel Institute.

Cramer, RE (Illinois University, Urbana) *AREA Bulletin* Proceeding Vol. 49 1948, pp 490-495, 3 Tab, 3 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C1 052470
INVESTIGATE CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL SURFACES FOR THE PURPOSE OF DEVELOPING MEASURES FOR THEIR PREVENTION
Causes of shelly spots and head checks in rail surfaces are investigated, and preventative measures are presented. Topics discussed include mill chemistry records; curvature tabulation, elevation, speeds, and grades; effect of rail lubricators, transposing rails, slow cold rolling; field tests of special rails; experience of roads having these defects; radius of gage corners of rail, tread of wheels, radius between flange and tread of wheels; relationship between wear of rail and wheel; bearing pressure of wheel on rail; cant of rail; superelevation of rail on curves; examination of service rail failures caused by these defects; rolling-load tests to produce these effects under laboratory conditions; resistance of rail steel of various composition to the development of these defects under laboratory conditions; resistance of different heat treatments of rails to the development of these defects under laboratory conditions. Progress is made but no definite solution has been found.

AREA Bulletin Proceeding Vol. 46 1945, pp 643-659, 6 Fig, 3 Tab, 6 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C1 052471
INVESTIGATE CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL SURFACES FOR THE PURPOSE OF DEVELOPING MEASURES FOR THEIR PREVENTION
Causes of shelly spots and head checks in rail surfaces are investigated to develop measures for their prevention. Topics discussed include study of rail steel compositions, heat treatments, wheel and rail contacts and pressures, mill practices, and consideration of larger diameter wheels or lighter loads on the wheels. It is cautioned that new chemistry or heat treatment may induce other types of defects or excessive expense. Study of shelling reveals no definite trend or definite conclusions. It is noted that the control cooled process will not prevent shelling. Rolling load machines and tests are discussed.

AREA Bulletin Proceeding Vol. 45 1944, pp 446-469, 14 Fig, 1 Tab, 9 Phot, 2 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C1 052472
INVESTIGATE CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL SURFACES FOR THE PURPOSE OF DEVELOPING MEASURES FOR THEIR PREVENTION
The investigation into the causes of shelly spots and head checks in rail surfaces was presented. A definition and description of shelly spots, the most serious type of rail damage, was presented. The division of the work of this subcommittee was described. Appendix A presented the shelly rail studies conducted at the University of Illinois. Laboratory studies of failed shelly rails concluded that shelling appears to be the result of cold working of the rail steel by "line contact" with car wheels. The presence of imperfections accelerated the formation of cracks. Laboratory rolling-load tests to produce shelling were performed. Different rail steel compositions were studied through rolling-load tests. The Brinell hardness of the wheel path after rolling was measured. Full sections specimens of heat-treated carbon rail were tested under rolling-load. No conclusions were reached.

AREA Bulletin Proceeding Vol. 44 1943, pp 597-610, 3 Fig, 12 Phot, 1 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C1 052473
NINTH PROGRESS REPORT OF THE JOINT INVESTIGATION OF FISSURES IN RAILROAD RAILS
The information in this report of the joint investigation of fissures in rails was contained in five sections. Field tests for batter of end-hardened rails in service on the Chesapeake and Ohio Railway were performed. The summary of the batter values was tabulated. Rail ends with large cracks had approximately three times the batter of uncracked ends. Examination of end-hardened rails from the C and O test track in Carey, Ohio revealed that most damage, weeping cracks and flow of the metal over the ends and sideways, produced batter and drooping of the rail ends. Tests of mill cooling containers for rails were discussed. Examination of control-cooled and Brunorized rails which failed in service revealed that none of the control-cooled rails contained shatter cracks, but did have transverse fissures from blow holes and welded spots, horizontal split heads, detailed fractures from engine wheel burn, fatigue failures starting in the web, and detailed fractures from shelly spots. The Brunorized rails had developed transverse fissures from shatter cracks as nuclei. A comparison of drop and bend tests was summarized.

Conducted by the Engineering Experiment Station, University of Illinois in cooperation with the Association of American Railroads and the Rail Manufacturers' Technical Committee.

Moore, HF Alleman, NJ Cramer, RE Jensen, RS (Illinois University, Urbana) *AREA Bulletin* Proceeding Vol. 44 1943, pp 611-621, 9 Fig, 2 Tab, 1 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C1 052534
UNCONVENTIONAL TRACKS. LABORATORY AND SITE MEASUREMENTS OF STIFFNESS AND DAMPING OF SELECTIVE TYPES OF DIRECT FIXING FOR TRACKS WITHOUT BALLAST

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways D87/RP 8/E, Apr. 1973

C1 052564
TEST TRACK AT RADCLIFFE-ON-TRENT. CONSTRUCTION AND RUNNING EXPERIENCE

This description of experience with various types of ballastless track using in situ concrete slab indicates some of the practical aspects of installation and the standards of accuracy obtained. Most of the test lengths have shown no significant deterioration in four years of service carrying normal traffic.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways D87/RP 7/E, Oct. 1973, 18 pp, 7 Fig., 12 Tab.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

C1 052661
CONSTRUCTIONAL ARRANGEMENTS FOR IMPROVING THE RIDING STABILITY AND GUIDING QUALITY OF ELECTRIC AND DIESEL LOCOMOTIVES AND VEHICLES. SUMMARY OF TEST RESULTS AND VEHICLE DESIGN RECOMMENDATIONS

During the investigations and studies relating to the riding stability and guiding quality of tractive units, various data have been collected which have enabled constructional recommendations to be elaborated. These have been grouped together in such a way that it will be possible to choose, from among these recommendations, those which are apt to reduce the forces between wheel and rail to the greatest possible extent, while a good riding stability of the tractive unit is still ensured.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B10/RP 15/E, Oct. 1974, 59 pp, Figs., 25 Ref., 2 App.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

C1 054011
STATISTICAL CHARACTERIZATIONS OF RAILWAY TRACK BEHAVIOR

Absolute space curve data of railway track, representing the vertical and lateral perturbations of both running rails, was collected and analyzed. A variety of track is studied, including high speed versus yard, bolted versus continuous welded rail (CWR), and old versus new construction. Analytical techniques include Signal Averaging, Analysis of Variances, and Correlation analysis. As a result, it is concluded that railway track is characterized by a pure Markovian process, a periodic process, and a periodically modulated random process.

A paper recommended by the IEEE Land Transportation Committee of the IEEE Industry Applications Society for presentation at the 1974 Joint ASME/IEEE Railroad Conference, Pittsburgh, Pa., April 2-4, 1974.

Corbin, JC (ENSCO, Incorporated)
Institute of Electrical and Electronics Engineers Dec. 1973, 15 pp, 18 Fig, 13 Ref

ACKNOWLEDGMENT: IEEE
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL RP

C1 054339
INERTIAL PROFILOMETER AS A RAIL SURFACE MEASURING INSTRUMENT

A pair of profilometers, modified from the original design of the Electro-Motive Division of General Motors, has been built and installed on the Department of Transportation rail test car by ENSCO, Inc. The inertial profilometer system is capable of accurately measuring variations in rail surfaces of both short wavelength (a few feet) and long wavelength (a few hundred feet). In addition to its application in vehicle-dynamic simulation, the measured inertial profile can be used as a data base for extracting mid-chord (or other types of relative profile measurement) at any selected chord length. Field and laboratory tests have been conducted to evaluate the performance of the profilometers. The laboratory tests consisted of shake table tests to measure the amplitude and phase response within the frequency range of interest. These results correspond closely to the theoretical frequency response. Extensive field tests were performed on tangent, spiral, and curved track. Both manual stringline and DOT mid-chord system measurements were made on the same sections of track. The results show good agreement between the profilometer data and the accurate stringline measurements.

Contributed by the Intersociety Committee on Transportation for presentation at the Intersociety Conference on Transportation, Denver, Colo., Sept. 23-27, 1973.

Rudd, TJ Brandenburg, EL (ENSCO, Incorporated)
American Society of Mechanical Engineers 73-ICT-102, July 1973, 9 pp, 15 Fig

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL RP

C1 054781
IMPROVEMENTS OF MAINTENANCE CRITERIA COVERING THE RUNNING GEAR OF SHIN-KANSEN RAILCARS BY MEASURING THE TRANSVERSAL ACCELERATIONS OF THE BODY [SHIN-KANSEN DENSHA SOKO KANRI SHIRYO SEIDO UO KOJO NI KANSURU KENKYU]

Osaka engine shed officials measure, under 200 km/h on line conditions, the body accelerations of Shin-Kansen railcars each time the wheels are re-profiled (every 70,000 km). Following these measurements, an index is calculated in accordance with an empirical formula that is a linear combination of the acceleration occurrence frequencies classified by section (linear combination of the values of the acceleration distribution analysis). Bogie overhaul is scheduled in accordance with the value of this index. In applying this method, the JNR encountered difficulties due to the effect of 3 factors on transversal accelerations: the state of the track, the speed (the index is very sensitive to speed variations of only a few km/h), weather conditions (transversal stability is distinctly improved in rainy weather). The article describes how corrective laws were worked out to eliminate the effect of the first 2 factors. For the 3rd factor, it was decided to limit measurements to periods of wet weather. [Japanese]

Tanida, I *Denkisha No Kagaku/Railway Electric Rolling Stocks* Vol. 26 No. 6, 1973, 5 pp, 8 Fig

ACKNOWLEDGMENT: UIC (95)
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr PC

95

C1 056803
METHOD DEVELOPMENT FOR THE SYSTEMATIC INSPECTION AND PREVENTIVE MAINTENANCE OF RAILROAD NETWORK OF INDUSTRIAL AND TERMINAL RAILROADS [ZUR SYSTEM-ENTWICKLUNG FUER DIE PLANMAESSIGE UEBERWACHUNG UND VORBEUGENDE INSTANDHALTUNG DER GLEISNETZE VON WERKS-UND ANSCHLUSSBAHNEN]
It is stressed that a fully expanded operational system for the maintenance of industrial railroad networks could become one of the examples for the setup of corresponding organizational closed-loop control systems for the more complex conditions in the field of machinery. [German]

Hoehn, P Merten, R Warlich, R *Glasers Annalen ZEV* Vol. 97 No. 7-8, Aug. 1973, 9 Ref

ACKNOWLEDGMENT: EI (EIX740100234)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

C1 056847
MAGNETIC PARTICLE AND DYE PENETRANT TECHNIQUES AS AIDS TO THE NDT OF RAILS
A description of the methods of magnetic particle testing, magnetic ink inspection and dye penetrant tests in revealing accurately the extent of thermal cracking in the head of a severely wheelburnt rail, whether of the continuous or isolated type of burn and the examination of the running face of Thermit welded rails for surface cracking. A description is given of the use of ultrasonic methods of rail testing with these visual picture methods as a supporting aid.

Banks, J *British Journal of Non-Destructive Testing* Vol. 15 No. 6, Nov. 1973

ACKNOWLEDGMENT: EI (EIX740300900)
PURCHASE FROM: ESL Repr PC, Microfilm

C1 057180
PHOTOGRAPHIC RECORDING OF STRUCTURE GAUGE FOR OUT-OF-GAUGE LOADS
Checking for infringement of structure-gauge by out-of-gauge transports on Netherlands Railways using a track-mounted pointer and trace-board has given place to a camera recording technique whereby lineside structures are photographed and annotated with a grid carrying both the load and the structure profiles. Great speed of information collection and evaluation is thus achieved with consequent cut in track occupation time.

Dekker, HAL (Netherlands Railways) *Rail Engineering International* Vol. 4 No. 4, May 1974, pp 169-172, Phots.

ACKNOWLEDGMENT: Rail Engineering International
PURCHASE FROM: Broadfields (Technical Publishers) Limited Little Leighs, Chelmsford, Essex CM3 1PF, England Repr. PC

DOTL JC

C1 057461
RAIL STRESS DUE TO LOADING AND ROUTE PROPERTIES [Beanspruchung der Schiene durch die Belastung und die Gegebenheiten des Fahrweges]
The authors report on extensive measurements of transverse forces with test wheelsets against the background of steadily higher loading as a result of heavier and faster trains. These results are placed in relation to stationary measurements of transverse forces, stresses and track subsidence, and from this deductions are made with respect to the design of permanent way and vehicles. [German]

Birmann, F Herbst, W (Berlin Technische Universitaet) *Eisenbahntechnische Rundschau* Vol. 23 No. 3, Mar. 1974, pp 104-112, Figs., 18 Ref.

ACKNOWLEDGMENT: Eisenbahntechnische Rundschau
PURCHASE FROM: Hestra-Verlag Hernichel und Dr. Strauss, Darmstadt, West Germany Repr. PC

DOTL JC

C1 057674
DOT TEST TRAIN PROGRAM SYSTEM INSTRUMENTATION MANUAL. FOURTH EDITION
This report describes current instrumentation installed aboard the Federal Railroad Administration Test Cars. The instrumentation is designed to gather research data on various rail research projects. The major discussion in this report covers the Track Geometry System aboard the test train, and the operation and calibration of this system.
See also RRIS #039279, PB-209709 and RRIS #039265. This document supersedes PB-203110 and AD-748286.

Anderson, L Kolczynski, N
ENSCO, Incorporated Annual Rpt DOT-FR-72-21, Dec. 1972, 194 pp, Figs.

Contract DOT-FR-20032

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC

PB-239462/5ST, DOTL NTIS

C1 071962
AN ANALYSIS OF TRACK PARAMETER HETEROGENEITY AS A COMPLEMENT TO GEOMETRICAL METHODS OF TRACK CONDITION RATING
Subject of the paper is methods used for track heterogeneity analysis. They are concerned with selected geometrical and structural parameters as well as with a synthetical track condition rating using track geometry cars. Results of UIC 60 track heterogeneity investigations are quoted.

Baluch, H (Institute of Railway Research, Poland) *Rail International* No. 7-8, July 1974, pp 537-546, 8 Fig., 4 Tab., 6 Ref.

ACKNOWLEDGMENT: Rail International
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

C1 072450
NUMERICAL PROCESSING OF MEASUREMENT DATA TO MEET FEDERAL TRACK STANDARDS
U.S. railways face a heavy program of track renewal and maintenance following application of government standards to all lines from October 1973. Operators must now insure that Federal requirements for different speed classifications are complied with says M. Robert Rousse, honorary chief engineer of French National Railways, who explains how recording cars equipped for numerical processing of geometric data are being used for programming the work needed to keep permanent way within the new limits.

Rousse, R (French National Railways) *Railway Gazette International* Vol. 130 No. 9, Sept. 1974, pp 345-349, 3 Fig., 1 Phot., 3 Ref.

PURCHASE FROM: XUM Repr. PC

DOTL JC

C1 072658
RAILROAD ACCIDENTS AND NONDESTRUCTIVE INSPECTION
Railroad accident data published annually by the Office of Safety in the Federal Railroad Administration are analyzed to indicate the most severe causes of railroad accidents. The severity is judged by viewing both the frequency of accidents and the dollar damage per accident. Most of the components or conditions in the groups found to be severe accident causes are amenable to non-destructive inspection. An analysis shows the maximum benefits of an extensive non-destructive inspection program to appear in the wheel and axle category followed in order by track geometric and dynamic conditions and rails and joints. A review is provided for non-destructive inspection methods in current railroad use and potentially useful for the future.
This paper was contributed by the Rail Transportation Divison of ASME for presentation at the winter Annual Meeting, 17-22 November 1974, New York, New York.

Bray, DE (Oklahoma University)
American Society of Mechanical Engineers No. 74-WA/RT-4, June 1974, 15 pp, 3 Fig., 6 Tab., 59 Ref., 2 App.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ASME Repr. PC

DOTL RP

C1 072797
FATIGUE-WEAR TESTING OF RAILS UNDER ROLLING LOAD
The fatigue-wear endurance model tests conducted on surface hardened and untreated low-carbon rails, as well as the test results, are presented. Both the wear and fatigue load resistance of the surface hardened rails surmounted those of the untreated rails.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Toth, L *Acta Technica* Vol. 70 No. 3-4, 1971, pp 445-457

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: ESL Repr. PC, Microfilm

C1 072800
INVESTIGATION OF THE FORMATION OF CORRUGATIONS IN RAILS ON SELECTED TEST TRACKS UNDER CONDITIONS OF ORDINARY TRAFFIC
This is an evaluation of a large amount of data collected on two tracks since 1951 and 1958, respectively. Emphasis was on determining the behavior of different steels as a function of composition, melting practice, and treatment after rolling. Examples of findings are that increasing tensile strength and nitrogen content increase corrugations, increasing Mn and Si decrease the defect. [German]

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Spieker, W Koehler, H Kuehlmeyer, M *Stahl und Eisen* Vol. 91 No. 26, Dec. 1971, pp 1470-87

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: ESL Repr. PC, Microfilm

C1 072813
ULTRASONIC 'EYES' ABOARD BRITISH TESTING TRAIN LOCATE RAIL DEFECTS
Ultrasonic "eyes" capable of detecting and recording hidden flaws in railroad tracks have been placed in use in Great Britain aboard a new rail testing train which travels as it works at speeds up to 25 mph. This paper reports the technique.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Materials Evaluation Vol. 39 No. 6, June 1971, pp 16A-18A

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: ESL Repr. PC, Microfilm

C1 072815
TRACKING DOWN JOINT-AREA RAIL DEFECTS
Now by using hand-held testing devices Santa Fe is testing joint-bar areas with ultrasonic devices for detecting bolthole cracks and head-and-web separations. A mirror is used to reflect light into joint gap to reveal presence of defects. Stepped-up method of joint-area inspection has produced big increase in detected defects.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Railway Track and Structures Vol. 66 No. 7, July 1970, pp 21-23

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: XUM Repr. PC

C1 072816
COMPUTER SPOTS RAIL DEFECTS FAST
Survey of applications of computer complex in the computerizing of rail-defect information developed by a fleet of rail detector cars and a variety of portable ultrasonic testing instruments. A monthly printout from Penn Central computer shows rail defects found by special cars and ultrasonic devices. Computer data is also shown to be useful in programming rail renewals.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.
Railway Age Vol. 169 No. 1, July 1970, pp 32-33

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: XUM Repr. PC

C1 072817
SIGNIFICANCE OF A DETECTION OF DEFECTS IN RAILS
The articles describe the principal types of defects which may be found in rails, and indicates those which are inherent in the manufacturing processes and those which arise as a result of service loads. The principles of resonance and pulse-echo ultrasonic flaw detection as applied to rails are given, and the current ultrasonic testing practice at the British Railway is described.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Johnson, PC Wise, S *Non-Destructive Testing* Vol. 3 N Apr. 1970, pp 111-116

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: ESL Repr. PC, Microfilm

C1 072818
DETECTION OF BASE SEAMS IN INLAID RAILS
A description of a test apparatus that has made possible the detection of rolling mill defects in the seams, located at the base of new rails, installed less than 2 yrs is presented. A semi-automated ultrasonic rail test car, operated at 5 km/hr, is demonstrated.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Veniza, GE *Intl Conf on Nondestructive Testing, 6th Proc* Vol. 3 Session H, Rept. 4, 1970, pp 37-46

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: Society for Nondestructive Testing 704 47th Street, Los Alamos, New Mexico, 87544 Repr. PC

C1 072831
SCANNING ELECTRON MICROSCOPY OF EARTHQUAKE--INDUCED RAIL FRACTURES
This investigation has as its purpose a somewhat systematic scanning electron fractography study of railroad-rail fracture resulting from stresses induced by earth movements associated with an earthquake measuring 6.6 on the Richter scale which struck the Los Angeles, California area on February 9, 1971, having a primary shock duration ranging from 1 to 2 min.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Murr, LE Hodgkin, NM Lowe, BV (University of Southern California) *Metallography* Vol. 4 No. 6, Dec. 1971, pp 477-486

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: ESL Repr. PC, Microfilm

C1 072850
QUANTIFIED GEOMETRIC STATE OF RAILROAD TRACKS
[L'Etat geometrique quantifie]
General principles and methods of statistical analysis of railway track displacements adopted by the Swiss railways are given. The tracks are automatically tested by means of a track inspection car equipped with an analyzer. Statistical properties of discrete data distribution, and the algorithm of the analysis are discussed. Graphs are presented illustrating the analytical results of the track inspection. [French]

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Juillerat, T Rivier, R *Bulletin Technique de la Suisse Romande* Vol. 97 No. 5, Mar. 1971, pp 55-63

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: ESL Repr. PC, Microfilm

C1 080284
SUMMARY OF HEAT-TREATED AND ALLOY RAIL SERVICE TEST INSTALLATIONS ON CURVES WITH SHELLY HISTORIES--1972
The AAR, in its program of Rail Research, has a project of field inspection and analysis of those rails that continue in service which show some potential for improvement in performance. The field inspections are carried out as a cooperative effort of the American Railway Engineering Association (AREA) Rail Committee, the American Iron and Steel Institute (AISI), and the AAR Research and Test Department. This report is a summary of results of the August and September 1972 inspections of seven field test installations of High-Silicon, Curvemaster, Fully Heat-Treated and Columbium Treated Rails.
An RPI-AAR Cooperative Project.

Schoeneberg, KW
Association of American Railroads Technical Center, (R009) Res. Rpt. R-121, Apr. 1973, 59 pp, 28 Fig.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

C1 080772
TRAIN HANDLING AND OVERTURNED RAIL
The Canadian Pacific Railway recently used the EMD's dynamometer car to explore the problem of harmonic roll and over-turned rail. The problem is particularly bad in the Rockies. The tests indicated several methods by which train handling procedures could be improved to reduce the chance of a derailment.

Progressive Railroading Vol. 17 No. 8, Aug. 1974, pp 33-34

ACKNOWLEDGMENT: CNR
PURCHASE FROM: Murphy-Richter Publishing Company 9 South Clinton Street, Chicago, Illinois, 60606 Repr. PC
DOTL JC

C1 080789
NW EMPHASIZES STRONG TRACK, WELL MAINTAINED
Norfolk & Western is committed to a policy of having strong track handled by a well-equipped maintenance organization which is adequately supplied with replacement materials. This article discusses various facets of the road's track programs and the maintenance groups which do the work. There has been great emphasis on mechanization. One result is a maintenance expense per thousand gross ton miles which is among the lowest in the U.S.

Dick, MH *Railway Age* Vol. 175 No. 21, Nov. 1974, pp 24-26, 3 Phot.

PURCHASE FROM: XUM Repr. PC
DOTL JC

C1 081382
COMPUTERIZED SUPERVISION OF TRACK MAINTENANCE
Japanese National Railways has computerized the planning of the maintenance of its 26,000 km of main lines, 13,000 km of sidings, and 70,000 switches. JNR has programmed the replacement of 2,000 km of rail yearly. For each individual turnout, data is stored on the parts involved, on the results of annual inspections, and on the speed and volume of movements. Initially tie condition has involved the almost 38 million wood ties on JNR but the growing number of prestressed concrete ties are to be included in the future. Seven high-speed track inspection cars are being fitted to provide input for a maintenance planning system. While problems remain, computerization of maintenance equipment control, track improvement planning and track work estimates are being made.

Inoue, T (Japanese National Railways) *Japanese Railway Engineering* Vol. 15 No. 1, 1974, pp 9-13, 5 Fig.

PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

C1 083026
TRACK GEOMETRY MEASUREMENTS AND DATA PROCESSING DEVELOPMENTS IN THE RAIL RESEARCH PROGRAM
This report summarizes the FRA-sponsored Rail Research Program, and outlines many of the problems presently encountered by the railroad industry in providing safe, high-speed transportation; and illustrates the vital role of cost-effective maintenance planning. This report was originally presented at the IEEE/ASME Joint Railroad Conference in St. Louis, Missouri, in April 1973. The FRA Test Cars are described, with emphasis placed on the ability of the cars to measure all parameters of track geometry at high speed. Examples are included of the various types of computer-generated reports which are designed specifically for personnel who are responsible for maintenance planning and operations. The information in this report is intended for use by a general audience who desires a comprehensive nontechnical summary of the operation and application of the FRA Test Cars, related instrumentation and data processing operations.
This project is sponsored by the Federal Railroad Administration, Department of Transportation.

From, L
ENSCO, Incorporated, (DOT-FR-74-2Z) Tech. Sum. FRA-ORD&D-75-14, Oct. 1974, 29 pp, 20 Fig.

Contract DOT-FR-20032

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-239463/AS, DOTL NTIS

C1 083027
DEVELOPMENT OF AN INERTIAL PROFILOMETER
The information in this report covers the design, fabrication and testing of an inertial profilometer system, developed for use on the FRA Test Cars. The profilometer is used to measure rail profile at high speeds, relative to an inertial reference. Design details and analysis of the profilometer are covered, and comparisons are made between profilometer measurements, mid-chord measurements, and manual measurements made with stringline and roll-ordinator devices, to show the relative accuracy of the profilometer measurements. The inertial profilometer offers several advantages over the currently-used mid-chord syystem. Accuracy of the profilometer has proven to be quite good. Operation of the profilometer is not degraded by inclement weather, and system components are not subject to damage by protruding objects in close proximity to the rail being measured.

Brandenburg, EL Rudd, TJ
ENSCO, Incorporated, (DOT-FR-74-06) FRA-ORD&D-75-15, Nov. 1974, 45 pp, 23 Fig.

Contract DOT-FR-20032

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-239464/AS, DOTL NTIS

C1 083042
ULTRASONIC FLAW DETECTION IN THERMIT-WELDED JOINTS
Although not usually considered suitable for testing thermit welds, ultrasonic flaw detection equipment has been used for this purpose in India where gamma ray testing equipment could not be made available.

Bhatnager, SK *Railway Gazette International* Vol. 131 No. 1, Jan. 1975, p 31, 1 Fig.

PURCHASE FROM: XUM Repr. PC
DOTL JC

C1 084914
TRACK MEASUREMENT FOR TODAY'S RAILROAD SYSTEMS
This brochure describes the FRA Improved Track Inspection and Data Collection Technology Programs which utilize the Track Geometry Test Cars and Vehicle Dynamic Measurement Systems for the purpose of improving railroad safety, efficiency and economy. The data produced by the cars--through precise measurement of existing track structures--are used to plan effective track maintenance programs and to support the design of tomorrow's high-speed railroads.

Federal Railroad Administration 13 pp, Phots.
PURCHASE FROM: FRA Repr. PC

DOTL RP

C1 091294
ACQUISITION AND USE OF TRACK GEOMETRY DATA IN MAINTENANCE-OF-WAY PLANNING
The report describes data acquisition by the FRA Measurement Cars and subsequent use of the collected track geometry data by the Bessemer and Lake Erie (B and LE) and the Denver and Rio Grande Western (D and RGW) Railroads. These two railroads, in conjunction with ENSCO, Inc., have prepared the report for the Federal Railroad Administration. The major emphasis of the report is placed on use of the track geometry data by B and LE and D and RGW for immediate maintenance and maintenance planning. Also provided are descriptions of data processing reports, system and measurement repeatability data, and the Track Geometry Measurement System onboard the FRA Measurement Cars.

The information herein is intended for use by maintenance- of-way personnel who are concerned with the utilization of track geometry data collected by track measurement cars and by management personnel who are involved in maintenance planning. This report was sponsored by the Federal Railroad Administration.

Bradley, K Price, B Woll, T Burnes, R Gerber, R
ENSCO, Incorporated, Federal Railroad Administration, Bessemer and Lake Erie Railroad, Denver and Rio Grande Western Railroad, (DOT-FR-75-1) Tech Rpt. FRA-ORD&D-75-27, Mar. 1975, 130 pp

Contract DOT-FR-20032

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-241196/AS, DOTL NTIS

C1 095211
MEASUREMENT AND CALCULATION OF TRACK CURVES FROM ANGULAR CO-ORDINATES [Die Vermessung und Berechnung von Gleisboegen aus Winkelkoordinaten]
Track-geometry determination in conjunction with open track alignment using normal trigonometrical methods requires considerable quantities of instruments and major calculations. The author describes a method based on angular coordinates which achieves the desired objective without special instruments. [German]

Bose, E *Eisenbahningenieur* Vol. 25 No. 6, 1974, pp 200-209, 5 Fig., 6 Ref.

ACKNOWLEDGMENT: International Railway Documentation, Selection of
PURCHASE FROM: Dr. Arthur Tetzlaff-Verlag Niddastrasse 64, Frankfurt am Main, West Germany Repr. PC

C1 095294
A NON-DESTRUCTIVE METHOD OF MEASURING INTERNAL RAIL FORCE
Stability of continuously welded rail (cwr) can be monitored by determining the longitudinal force that exists at all times in the rail. British Rail Scientists have developed a rail-force transducer which permits rapid simple accurate measurements to be made of stress changes unaccompanied by changes of length. Using the results, the stress-free temperature of the rail is easily calculated. Transducers are cylindrical in shape and are installed by gluing in holes of the standard fishbolt size drilled in the rail's neutral axis. Readings from the transducers are taken at any time by using a portable measuring instrument.

Modern Railways Vol. 32 No. 318, Mar. 1975, p 123

PURCHASE FROM: XUM Repr. PC

DOTL JC

C1 095414
ANALYSIS OF TRACK PARAMETER HETEROGENEITY AS A COMPLEMENT TO GEOMETRICAL METHODS OF TRACK CONDITION RATING
The condition of a track may be defined by track rating indices (W indices at the PKP) taken from recordings by a track inspection car, or obtained by geometrical measurements (longitudinal dip and cross-sectional irregularities, without load or with a moving load, lateral displacement, etc.). By track heterogeneity, the writer means the differences that such indices reveal on lengths of line with identical make-up, similar age, and used by the same traffic. These heterogeneities, which may be caused by the laying or maintenance of the track, or by constructional features with different characteristics, are also likely to result in great differences in the rapidity with which these lengths of line deteriorate, necessitating earlier continuous track renewal. The article proposes methods of assessing these heterogeneities by tests based on classic statistics laws. Numerical examples thus deal with: heterogeneities in the W index, by the X to the 2nd power test; heterogeneities in the track gauge by a method called the "ZM test" taken from an American book referred to in the bibliography; correlations between rail dip and lateral displacement under a moving load, by an analysis of sequential correlation. These complex analyses are not used as a basis of routine maintenance decisions, but in investigations for the purpose of explaining abnormal phenomena.

Baluch, H *Rail International* Vol. 5 No. 7-8, Aug. 1974, pp 537-546, 6 Fig., 4 Tab., 6 Ref.

ACKNOWLEDGMENT: International Railway Documentation, Selection of
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

C1 095691
SURVEYING AND CALCULATION OF CURVED TRACK, USING ANGLE CONFIGURATION CO-ORDINATES
The method described for surveying and calculation of curved track with the aid of angle configuration coordinates is not inferior to values calculated on the strength of normal coordinates and has the following advantages: Less mathematical effort compared with polar marking and surveyings; work can be carried out with instruments currently available (measuring tapes and theodolites); application of calculators with the well known angle- Configuration method. The formulas which apparently are complicated can be derived without major effort from the calculation sketch for each individual case.

Bose, E *Rail International* Vol. 6 No. 1, Jan. 1975, pp 55-61, 5 Fig., 6 Ref.

ACKNOWLEDGMENT: Rail International
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

C1 095720
TRACK GEOMETRY SURVEY DEVICE FOR LIM RESEARCH VEHICLE TEST TRACK
A track survey device was designed, built and operated to measure the geometry of the FRA Linear Induction Motor Test Track at Pueblo, Colorado. A laser beam is used for the measurement of profile and alignment; an electronic level for the measurement of superelevation and mechanical sensors for both support rail and reaction rail gages. The measurement is stored in magnetic tape for processing.

Sponsored by the Federal Railroad Administration.

Medecki, H Panunzio, S
General Applied Science Laboratories, Incorporated, (GASL TR-776) Final Rpt. FRA-ORD & D-74-36, Oct. 1973, 110 pp, Figs., Tabs., Phots.

Contract DOT-FR-10016

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-241313/AS, DOT NTIS

C1 096546
THE BASICS OF TRACK INSPECTION-PLUS OTHER HELPFUL KNOWLEDGE FOR THOSE WITH NEW RESPONSIBILITIES IN TRACK MAINTENANCE
In this first of three installments, the author tells a new man how to get started on his territory. Next, the common rail defects are described and hints given on how to identify them. Problems encountered at joints are discussed and malfunctions of rail anchors are noted. Tie conditions to watch are explained and the need for maintaining a well-drained ballast section is emphasized. Split fills are discussed and methods of correcting them conclude this segment.

Blanchard, LC *Railway Track and Structures* Vol. 71 No. 5, May 1975, pp 38-40, 1 Fig.

PURCHASE FROM: XUM Repr. PC

DOTL JC

C1 096574
FIELD INVESTIGATION OF LONGITUDINAL FORCES IN A SANTA FE RAILWAY CONCRETE TRESTLE

This report contains a description and analysis of data obtained on a 660 ft long concrete trestle. The trestle contains 20 spans of 33 ft prestressed concrete box beams on reinforced concrete caps and columns. The height, base of rail to ground line, was uniform throughout at 26 ft. The purpose of this investigation was to determine the effect on the trestle of braking and traction as developed by a 278 ft long test train. Direct and bending stresses were obtained in the bents and axial stresses obtained in the rails at each abutment. Runs were made with both tight and loosened rail joints. In addition to the braking and traction runs, normal speed runs were made to determine stresses in the box beams and columns. On the basis of tests on this structure it may be concluded that: 1) The maximum longitudinal bent force measured was from braking and was 23 percent of the force computed on the basis of 15 percent of the test train bent reaction. 2) With tight rail joints the percentage range of total longitudinal braking force resisted by the bents was 41 to 56 percent, by the rails was 20 to 46 percent and by the backwalls apparently was 5 to 30 percent. 3) That portion of the longitudinal braking force transmitted to the bents was resisted by all bents of the bridge, acting as cantilevers, including those which carried no vertical live load. The distribution of longitudinal force was not uniform throughout the length of the bridge, but was highest for bents under the test train and gradually decreased with increase in distance from the test train. Loosening the rail joints at the ends of the bridge increased the longitudinal force resisted by the bents. 4) The maximum longitudinal force resulting from braking was 158 kips, which was 12 percent of the weight of the train. 5) The maximum longitudinal force resulting from traction of the locomotives was 76 kips, which was 15 percent of the weight on drivers. 6) Bending stresses were lower than those resulting from longitudinal forces. Also, bending stresses due to eccentricity were highest near the tops of the bents, while the stresses due to longitudinal forces were highest near the ground line. 7) For the test span, the arrangement of transverse tie rods, and the shear keys used was effective in producing a very nearly uniform distribution of the live load to each of the box beams comprising the span. 8) For the test span, the ratio of recorded to calculated strains due to bending, ranged from 0.83 to 0.94.

Conducted under sponsorship of AREA Committee 30-Impact and Bridge Stresses.

Association of American Railroads Technical Center ER-67, Aug. 1966, 22 pp, 46 Fig., 5 Tab.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC

DOTL RP

C1 096657
DOT TEST TRAIN PROGRAM SYSTEM INSTRUMENTATION MANUAL-FIFTH EDITION

This manual describes track measurement instrumentation which has been developed during the reporting period, and covers all instrumentation currently installed aboard the FRA Test Cars. The major emphasis of this report deals with the operation and calibration of the Track Geometry Measurement System installed aboard Test Car T-3. Ancillary systems, and equipment aboard Test Cars T-1, T-2 and T-4 is also summarized. The information herein is intended for use by technical personnel who are involved in the operation of FRA Test Car instrumentation, and by engineering and research personnel involved in the application of track geometry measurement techniques.

This was sponsored by Federal Railroad Administration, US DOT.

Anderson, L MacIntyre, S Kolcyzynski, N
ENSCO, Incorporated, (DOT-FR-74-13) Ann. Rpt. FRA-ORD&D-7504, Dec. 1973, 140 pp, Figs., Tabs.

Contract DOT-FR-20032

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche

DOTL NTIS

C1 098050
THE BASICS OF TRACK INSPECTION-PLUS OTHER HELPFUL KNOWLEDGE FOR THOSE WITH NEW RESPONSIBILITIES IN TRACK MAINTENANCE

In this article, the second of three installments, the author gives hints on how to check the condition of the track, especially gauge, discusses problems that can occur on curves in the presence of snow and ice, gives advice on inspection and maintenance of highway crossings, urges familiarity with operating and safety rules and discusses responsibilities in connection with communications, signals and bridges.

See also RRIS 01 096546, RRIS Bulletin 7502.

Blanchard, LC *Railway Track and Structures* Vol. 71 No. 6, June 1975, 3 pp

ACKNOWLEDGMENT: Railway Track and Structures
PURCHASE FROM: XUM Repr. PC

DOTL JC

C1 098082
ACOUSTIC EMISSION MONITORING OF SHOP AND FIELD WELDS OF RAIL

A short program was conducted utilizing state-of-the-art acoustic emission instrumentation to monitor both thermite cast welding and electric flash butt welding of rail. The primary objective of the program was to investigate the applicability of acoustic emission techniques for establishing the quality of the weld. Welds on continuous rail strings were monitored during electric flash butt welding, weld cool-down and weld anneal. The specimen welds were fabricated to represent a variety of good and poor conditions. Piped rail sections, for example, were joined to good rail and electrode burns were purposely made, as were good welds. The acoustic emission data, both location and number have been correlated with mechanical properties established by physical tests of the welds. Fractographs of the rail sections are shown. The acoustic emission data gathered during the weld anneal cycle shows a tentative relationship with the strength of the weld. A total of seven welds were monitored where acoustic emission data was obtained. Thermite cast welding, as used in the field joining of rail, was also monitored with the same acoustic emission instruments. Variations in the weld procedure were used to produce good and poor quality welds during this portion of the program. The acoustic emission data was obtained both during the pour and subsequent weld cool-down. A total of three welds were monitored. The instruments, techniques and test results present a clear description of the ease of performing acoustic emission monitoring. Due to the limited number of thermite welds monitored, the data by itself is inconclusive, however, analysis of the weld sections provides some rationale which tends to support the creditability of the technique. The data obtained during the electric flash butt welding shows a good to excellent possiblity of usefulness as a quality control monitor.

Stone, DH
Association of American Railroads Technical Center, (R-047) R-162, Sept. 1974, 71 pp, 44 Fig., Tabs., 9 Ref.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC

DOTL RP

C1 098701
RAIL FAILURE SYSTEM

File name is ENRF. Computer program. The "Rail Failure" application is designed to compile statistics of all types of rail failures. The system employes two highly regimented input forms entitled "Rail Removal Order" and "Rail Insertion Report" which also serve to cause the appropriate physical action to take place. The system is modular and as such contains over twenty (20) separate programs re: data validity edits, maintenance and print routines which can provide monthly, year-to-date and yearly statistics, e.g.: (a) "Audigage and Reflectoscope; Detector Car; and Service Rail Failure Statement": a three part statement, i.e., a separate report for each potential input source, giving a complete description by Division and District of type of track, location of rail, position, grade, weight, mill, etc. of all failures reported. (b) "Rail Insertion Report Statement Covering Service and Detected Rail Removal Orders"; this statement lists all rail that has had a defect and that has been replaced by a new rail, angle bar repaired or taken out of service. (c) "Annual Report of Rail Failures, Service and

Detected, in Rail of All Ages and Sections". (d) "Rail Removal Orders not Covered by Insertion Reports on the Eastern, Western and Coast Lines". Report will flag any removal order over 30 days old for which as insertion report has not been issued. (e) The "Transverse Fissure Rail Heat Statement": This statement provides listing of all transverse fissure heat failures over the system. The statement is written out in mill order and year rolled plus pertinent detail data. (f) The "Thermite and Butt Welded Joint Failure Statement"; This statement lists all thermite and butt welded rail failures by division, district, mile post, type track, weight or rail, mill and year rolled. Each report is year to date.

Robinson, RE
Atchison, Topeka and Santa Fe Railway 1972

ACKNOWLEDGMENT: AREA (AREA 02-01-001)
PURCHASE FROM: Atchison, Topeka and Santa Fe Railway 9th and Jackson Streets, Information Systems Department, Topeka, Kansas, 66628

C1 098705
RAIL AND TRACK CHARACTERISTICS PICKER PROGRAM
File name is Track Characteristics Master, Rail Defect Master, Derailment Master. Computer Program. The purpose of the rail and track characteristics picker program is to provide the information with which to develop the relationships between various rail and track characteristics and their correlation with rail failures, rail defects, and derailment frequency. The Track Characteristics Master contains rail type (jointed versus welded, kind of steel) weight, rail rolled and laid dates, history of surfacing dates, rail and track inspection and test data, grades, curves, load limits, and traffic density (tons per year) for all system track. Locations of rail failures, rail defects, and exceptions to track geometry standards found by testing and inspection are contained in the rail defect master. The derailment master contains pertinent data on all derailments. The rail and track characteristics picker program selects and prints out track locations from the track characteristics master with user-defined selection criteria; these can be minimums and/or maximum for any combination of the characteristics listed above. Up to 50 different combinations, i.e., cells in a matrix can be requested at one time. For each cell or specific request, the number of miles of track and the number of ton-miles is printed out. In addition for each cell, the progrm gives the types and numbers of rail defects and derailments reported over a time period selected by the user. Once relationships have been established, the program can be used for developing rail laying and timbering and surfacing programs, anchor and double spiking programs, problem area identification, budgeting, and other applications.

Brooks, BL
Southern Railway System 1974

ACKNOWLEDGMENT: AREA (AREA 02-01-005)
PURCHASE FROM: Southern Railway System 99 Spring Street, SW, Atlanta, Georgia, 30303

C1 098707
FAILED RAIL REPORT
File name is EN470230. Computer program compiles all of statistics for failed rails and their locations. This program is used in conjunction with EN9809 to produce the defects per mile per month in the Consist and History report. There are also three programs assigned with this program, EN8801, EN8802, and EN8803, what mill and date rolled and date laid, and the third, what means the defect was found.

Zednik, EV Jenkins, JW
Union Pacific Railroad Mar. 1970

ACKNOWLEDGMENT: AREA (AREA 02-01-007)
PURCHASE FROM: Union Pacific Railroad 1416 Dodge Street, Omaha, Nebraska, 68102

C1 099800
TRACK EVALUATION-UP STYLE
Annually the Union Pacific is measuring and recording 11 track structure parameters for all of its 5,851 miles of mainline and 4,128 miles of branch line track. The vehicle is a self-propelled unit built to UP's specification by Plasser American Corp. at a cost of $350,000. The detection system is composed of three major elements: measuring sensors, transducers coupled with an electronic transmission system, and a recording and analyzing device. The car tests the entire mainline three or four times each year, covering 200 miles daily. Strip charts indicate where immediate corrections should be made and also assist in long-range planning for tie renewals, track surfacing and lining in the future.

Progressive Railroading Vol. 18 No. 8, Aug. 1975, p 53, 2 Phot.

PURCHASE FROM: Murphy-Richter Publishing Company 9 South Clinton Street, Chicago, Illinois, 60606 Repr. PC

DOTL JC

C1 099801
COMPUTERS GO "ON TRACK"
This is a report of an IBM seminar on computerized management of track maintenance. Discussions centered on the use of a data base in which the computer can sort, store, combine and compute information and run simulations of maintenance strategies. The experience of several railroads was reported, along with the use of computer studies of track problems confronting the United States Railroad Association in its restructuring of the Northeast railroads. It is noted that the computer input has frequently been gathered and compiled manually by railroads, but only the barest use of such information could be made. Computer technology is changing all this.

Progressive Railroading Vol. 18 No. 8, Aug. 1975, pp 27-30, 1 Fig., 3 Phot.

PURCHASE FROM: Murphy-Richter Publishing Company 9 South Clinton Street, Chicago, Illinois, 60606 Repr. PC

DOTL JC

C1 099804
THE BASICS OF TRACK INSPECTION-WHAT TO LOOK FOR AT SWITCHES WITH SAFETY THE MAIN CONSIDERATION
This is the third installment of a series and discusses switches which the author identifies as the weakest and most critical part of track structure. Inspections of switch lights, switch stands, ties, switch points, frogs, and track gauge are all described.

Railway Track and Structures Vol. 71 No. 7, July 1975, pp 24-26

PURCHASE FROM: XUM Repr. PC

DOTL JC

C1 125824
CP RAIL PROJECTS NEW USES FOR TRACK GEOMETRY CAR
The graphs reproduced represent charting deterioration of track condition, track condition index for use by senior management, measuring track conditions under different cars, and developing an over-all information system. The process of developing the profile charts is represented by illustration.

Railway Age Vol. 176 No. 7, Apr. 1975, pp 38-40

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

C1 126445
BLUEPRINT FOR TRACK REHABILITATION?
The Iowa Department of Transportation has been authorized by the legislature, concerned about track conditions in the state, to take several steps. A program of rehabilitation of branch lines has seen work started on ten segments involving expenditure of $8.7 million. Condition of all trackage in the state is to be monitored annually by a new track-measuring car. Development of a numerical "sufficiency rating" for all trackage in the state will rate ability of the lines to perform in accordance with accepted standards. Steps will be taken to assure sufficient supplies of materials and machines and enough manpower to meet any crash program of railroad rehabilitation which might be initiated at the federal level. So far state, local and railroad funding is involved.

Railway Track and Structures Vol. 71 No. 9, Sept. 1975, pp 14-17, 1 Tab., 2 Phot.

PURCHASE FROM: XUM Repr. PC

DOTL JC

C1 127709
TRACK TESTING FOR VALIDATION OF COMPUTER MODELS
The purpose of the track stiffness test was to obtain data to assist in validation of the L/V and Lateral Train Stability models as an extension of earlier dynamic tests conducted at the Transportation Test Center. The first series of tests conducted was to obtain instrumented data on Vertical Track Modulus (VTM). The second series of tests were designed to collect data on rail to rail stiffness using various rail loads combined with and without static vertical loads. The third series of tests were conducted to measure lateral track stiffness with and without rail loads on a tangent segment of the track, on both left and right hand curves.

An International government-Industry Research Program on Train-Track Dynamics. Requests for this publication should be directed to J.G. Britton, Director of Operations, AAR.

Association of American Railroads AAR R-181, 1975, 20 pp, Phots.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

C1 127858
PRINCIPLES AND CRITERIA FOR THE DESIGN OF A RAILROAD TRACK TEST FACILITY
This paper discusses principles and criteria for design of a track test facility such as will be built by the Federal Railroad Administration to support various track research programs aimed at improving design and maintenance procedures. It is suggested the facility be as versatile as possible so that tests can include determination of stresses in rails due to vertical and horizontal loads, study of axial rail forces induced by moving trains and track buckling caused by temperature stresses and moving trains. Construction of permanent structures such as concrete piers should be avoided whenever mechanically possible.

Kerr, AD (Princeton University) *AREA Bulletin* Bul 654 Proc V77, Sept. 1975, pp 1-8, 6 Fig., 10 Ref.

ACKNOWLEDGMENT: AREA Bulletin
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

C1 127873
VELIM TEST CIRCUIT, RAILWAY RESEARCH INSTITUTE, PRAGUE
The Velim Railway Testing Circuit, located 50 km east of Prague is the test facility for the Institute which is engaged in technology relating to transport economics, track construction and maintenance, rolling stock and electric and diesel traction, communications and other areas. The 200-kph test loops are energized at 25 kV 50 Hz and they may be used for controlled service tests for ORE, OSShD and for European and Russian railways and suppliers. Slab and conventional track are being evaluated. Laboratories have computers which can be coordinated with dynamometer car activities.

Rail Engineering International Vol. 5 No. 5, Aug. 1975, pp 215-218, 1 Fig., Phots.

PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

C1 128192
A SYNTHETIC INSPECTION TRAIN FOR ELECTRIC AND TRACK FACILITIES OF THE SHINKANSEN
With extension of Shin Kansen to Hakata, JNR has put in service a seven-car train which can inspect the fixed facilities of the entire line at the revenue service speed of 210 kph. The cars have the following capabilities: Car 1--Measurement of communication, signal and catenary; Car 2--Measurement of electric power supply system and observation of pantograph action; Car 3--Power supply and data processing; Car 4--Power supply and crew facilities; Car 5--Measurement and data processing for track condition; Car 6--Storage and spare parts; Car 7--Measurement of Electric power supply system and of trolley wire.

Japanese Railway Engineering Vol. 15 No. 3/4, 1974, pp 23-24, 1 Tab.

PURCHASE FROM: Japan Railway Engineers' Association 2-5-18 Otemachi, Chyoda-ku, Tokyo, Japan Repr. PC
DOTL JC

C1 128608
CLASSIFYING TRACK BY POWER SPECTRAL DENSITY
Historically, the Power Spectral Density (PSD) has been used as a diagnostic tool and as a classifier in many disciplines. This paper illustrates how this valuable tool can be applied to railway track geometry data to assist in the understanding and management of the permanent way. The PSD can be used to diagnose random and periodic behavior in the track surface (profile). Three parameters are developed that are capable of describing this behavior. Furthermore, the PSD can be used to classify the track. Two of these parameters have a strong impact on the deviations of a 19-m (62-ft) midchord offset. Within prescribed confidence limits, these can be tied to the Federal Railroad Administration's track safety standards. This permits the assignment of the speed class at which the track may be economically maintained without major overhauling.

This paper was presented at the Winter Annual Meeting of ASME, Houston, Texas, Nov 30-Dec 5, 1975 and is from ASME Mechanics of Transportation Systems, RRIS 02 128605.

Corbin, JC Kaufman, WM (ENSCO, Incorporated)
American Society of Mechanical Engineers AMD-Vol. 15, 1975, pp 1-20, 11 Fig., 1 Tab., 16 Ref.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ASME Repr. PC
DOTL RP

C1 128630
AN INVESTIGATION OF FACTORS CONTRIBUTING TO WIDE GAGE ON TANGENT RAILROAD TRACK
Wide gage--a fatigue failure of the track to maintain the nominal lateral distance between rail heads--is one of several modes of track failure on which the AAR-FRA-RPI-TDA Track Train Dynamics Program has focused attention. To investigate the generation of wide gage on tangent track, experiments were conducted to measure track dynamic response and long-term fatigue life of track sections on the Union Pacific Railroad in Idaho. Results of these experiments have defined the important factors in this mode of track fatigue.

This paper was contributed by the Rail Transportation Division of the ASME for presentation at the Winter Annual Meeting, Houston, Texas, November 30-December 5, 1975.

Ahlbeck, DR Harrison, HD Noble, SL (Battelle Columbus Laboratories)
American Society of Mechanical Engineers 75-WA/RT-1, July 1975, 9 pp, 9 Fig., 1 Tab., 5 Ref.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL RP

C1 128850
CLOSE-UP OF SOUTHERN POLICIES AND PRACTICES
In a four-part feature, the Southern Railway policies in track maintenance are examined. Southern started early in mechanizing m/w operations and has achieved a high degree of efficiency in manpower use. It has always emphasized rail and tie renewals. In Part 1, The Strategy Behind the Progress, the development of a five-year plan, the acceptance of a high m/w ratio, and use of a track geometry car and rigid quality control are discussed. Part 2, Dual Method of Laying Highlights Rail Practices, tells how a 54-man gang lays eight welded rail strings in a day and discusses welding, heat-treated rail and hardening of frogs. Part 3, Top Efficiency Is Goal in T&S Operations, tells how highly mechanized system gangs are organized around machines, including those which remove ties for possible reuse. Part 4, Innovations Feature Prefabrication of Turnouts, Track Panels, tells how turnouts are produced for rail relay programs and new industrial tracks. Track panels are used in building sidings and industry tracks and for reconstructing tracks damaged during derailments.

Railway Track and Structures Vol. 71 No. 11, Nov. 1975, pp 16-20

PURCHASE FROM: XUM Repr. PC
DOTL JC

C1 129200
A REVIEW OF MEASUREMENT TECHNIQUES, REQUIREMENTS, AND AVAILABLE DATA ON THE DYNAMIC COMPLIANCE OF RAILROAD TRACK
The need for increasing train speeds and operating safety while, reducing track maintenance is responsible for much of the current research on track structues, vehicle dynamics, and vehicle/track interaction. This report covers Phase I of a 3-phase program to design and fabricate equipment for measuring track dynamic characteristics. It is generally recognized that the available data and measurement techniques for obtaining this type of data for U.S. track and inadequate. This Phase I report includes a review of previous measurement techniques, a compilation of available data on track dynamic characteristics, an evaluation of data requirements, and the development of concepts for measuring track dynamic compolance.

This project was sponsored by the Federal Railroad Administration, DOT.

Kaiser, WD Nessler, GL Meacham, HC Prause, RH
Battelle Columbus Laboratories Intrm Rpt. FRA-OR&D-76-70, May 1975, 59 pp, 18 Fig., 4 Tab., 28 Ref., 2 App.

Contract DOT-FR-30051

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-250547/AS, DOTL NTIS

C1 129311
ARE FRA RAIL STANDARDS RESTRICTING RAIL-FLAW DETECTION
Since the FRA Track Safety Standards were implemented the number of defective rails has decreased, but the number of accidents due to rail failures has increased. The article tries to explain this discrepancy. A 10% increase in the availability of test equipment has resulted in only 6% increase in test mileage. In fact, Railway Companies lack the means of applying regulations concerning defective rails and this could lead them, in some cases, to put off inspection. Moreover, there is no flexibility in existing standards in so far as the priority removal of potentially hazardous defects known to be in the rail is concerned. The article discusses the need to tighten regulations or make them more flexible.

Railway Age Vol. 176 No. 11, June 1975, pp 42-43

ACKNOWLEDGMENT: International Union of Railways, BD
PURCHASE FROM: XUM Repr. PC
DOTL JC

C1 129839
USE OF THE MAGNETIC ANISTROPIC METHOD TO ASSESS THE STRESSES OF TEMPERED RAILS [O vozmoznosti ispolzovanija metoda magnitnoj anizotropii dlja ocenki ostatocnogo naprjazennogo sostojanija zakalennyh relsov]
The most practical method of determining residual stresses without damaging the rail is by magnetic anisotropy which makes it possible to obtain information rapidly and without difficulty. A special device called "Pion" was built in the Soviet Union for application of this method. It is made up of a magnetic core in the form of a cross with a coil which generates a magnetic field in the centre and measurement coils (2 to 5) on the sides making up the arm of the bridge. The article gives the results of tests on certain types of rail in the Soviet Union using this device. [Russian]

Sahov, VI Konjuhov, AD *Trudy CNII MPS: Ostat naprja i proc zelez relsov* Vol. 491 1973, pp 56-65, 2 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Trudy CNII MPS: Ostat naprja i proc zelez relsov Moscow, USSR Repr. PC

C1 129852
DOT TEST TRAIN PROGRAM SYSTEM INSTRUMENTATION MANUAL-SIXTH EDITION
This manual describes track measuring instrumentation which has been developed during the report period and covers all instrumentation currently installed aboard the FRA test cars. The major emphasis of this report deals with the operation and calibration of the track geometry measurement system installed aboard test car T-3. Ancillary systems as well as equipment aboard test cars T-1, T-2, and T-4 are also summarized. New track measurement subsystems such as the alignometer, compensated accelerometer, grade, and magnetic gage systems are described briefly in this report. These systems are scheduled for prototype testing on the FRA test cars during the coming year, and will be fully documented in subsequent reports.

Sponsorship was from Federal Railroad Administration, U.S. DOT.

ENSCO, Incorporated, (DOT-FR-74-23) Ann. Rpt. FRA-ORD&D-75-26, Dec. 1974, 126 pp, 70 Fig.

Contract DOT-FR-20032

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-250776/AS, DOTL NTIS

C1 129860
STUDY OF TRACK IRREGULARITY INSPECTION SYSTEM WITH ACCELEROMETER
Measurements of rail profile and alignment are done by the mid-chord offset system; this is suitable for ride quality determinations of conventional vehicles. Japanese National Railways has been experimenting with a track profile measuring instrument for use on the Shinkansen which consists of an accelerometer mounted on the journalbox of one wheelset with the signal double integrated to give an absolute profile.

Takeshita, K Kishimoto, S *Railway Technical Research Institute* Quart Rpt. Vol. 16 No. 3, Sept. 1975, p 136, 2 Fig.

ACKNOWLEDGMENT: Japanese National Railways
PURCHASE FROM: Ken-yusha 1-45-6, Hikari-cho, Kokubunji, Tokyo, Japan Repr. PC
DOTL JC

C1 130817
DETERMINATION OF THE HEAT STRESSES IN THE RAILS OF A TRACK WITH LONG WELDED SECTIONS BY MEANS OF A PERMEABILITY CHANGE MEASURING DEVICE [Bestimmung der thermischen Kraftgroessen in den Schienen eines lueckenlosen Gleises mit Hilfe eines Permeabilitaetsaenderungs-Messkopfes]
To clarify various points over practical use of the effect of permeability to determine thermal stresses in tracks with long welded rails, the author shows a common characteristic of the causes behind mistakes in the results from the measuring device. He also defines the areas in which the method is applicable to obtain statistically accurate measurements and establish the temperature for laying long welded rails. [German]

Mazur, S *Eisenbahntechnische Rundschau* Vol. 24 No. 10, Oct. 1975, pp 378-381, 4 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Hestra-Verlag Holzhofallee 33, 61 Darmstadt, West Germany Repr. PC
DOTL JC

C1 131021
THE ROLE OF PULSE-ECHO ULTRASONIC TESTING IN THE MODERN RAILWAY CIVIL ENGINEERING ORGANISATION
Since the Hither Green disaster of 1967 there has occurred on the Chief Civil Engineers Department a drastic re-organization of the methods by which defects in rail are detected. Prior to 1967 the method of flaw detection used was the 'AUDIGAGE', which although a form of ultrasonic testing was without doubt a very inefficient method measured in modern terms. The methods used since 1967 are those which employ the 'PULSE-ECHO' method of ultrasonic testing and which are highly suited to the problem of rail defect detection in a modern railway system. The article was written with a view to bringing to the notice of the Permanent Way Sections of the Chief Civil Engineer's Department the impact that the introduction of 'Pulse-Echo' ultrasonic testing has had to date. The content was deliberately kept non-technical in order that the people concerned would not get 'Bogged down' with technical jargon, but to be informed as to what is going on and why.

Farley, PG *Permanent Way Institution, Journal & Rpt of Proc* Vol. 93 No. t2, 1975, pp 102-113

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: Derry and Sons, Limited Canal Street, Nottingham, England Repr. PC

C1 131234
STUDY INTO DYNAMIC FORCES IN RAILWAY TRACK AND LAYOUT OF A TESTING DEVICE [Estudio sobre esfueros dinamicos en las vias ferreas y diseno de un aparato de pruebas, basaco en mediciones directas]
The Secretariat for Civil Engineering in Conjunction with Mexico University's Institute of Engineering, has proposed a series of studies into the stresses caused by dynamic forces acting on the track superstructure, and the determination of pressure distribution under the sleeper and ballast, aimed at designing and developing equipment adapted for laboratory tests. This paper, which won first prize in Section A of the Caracas Congress, contains a description of the initial steps of this plan, and comprises three parts: 1) Theoretical bases, hypotheses, and calculation methods for orienting the on-site experiments. 2) Actual on-site recordings. 3) layout of testing equipment, particularly for concrete sleepers and rail fastenings, aimed at reproducing the necessary load and speed characteristics. [Spanish]

Gardulo, AM
Panamerican Railway Congress Proc Paper Section A, Nov. 1975, 89 pp, Figs.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr. PC

C1 131244
RECORDING AND ANALYSING TRACK IRREGULARITIES [Die Registrierung und Analyse von Gleisunregelmaessigkeiten]
The author discusses the possible procedures for recording track irregularities, and methods of analysing this data. He then explains the relationship between the duration of the analysis and the evaluation errors to be expected, indicating the respective analytical reports both for analogical and digital evaluation. He also gives the results from the testing vehicle running on the lines of the DB and other railways. Finally, the article explains a procedure based on power spectral density, using multivariable regression analysis. [German]

Krettek, O *Glasers Annalen ZEV* Vol. 98 No. 11, Nov. 1975, pp 326-334, 1 Tab., 14 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

C1 131245
APPLYING INFORMATION ON RAIL REPLACEMENTS TO THE STUDY OF RAIL SERVICE LIFE [Wykorzystanie danych o pojedynczych wymianach szyn do badania ich niezawodnosci eksploatacyjnej]
The author explains how an analysis of rail Service life was made in the PKP using statistics concerning damaged rails and replacements. He uses Weibull's law to quantify the stresses exerted on rails and thereby determines their service life.

Fijalek, M *Przeglad Kolejowy Drogowy* Vol. 22 No. 9, Sept. 1975, pp 23-29, 3 Tab., 9 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Wydawnictwa Komunikacji i Lacznosci Ul Kazimierzowska 52, Warsaw 12, Poland Repr. PC

C1 131258
METHOD FOR THE RAPID MEASUREMENT OF WHEEL AND RAIL WEAR BY MEANS OF RADIOACTIVE ISOTOPES [Kurzzeitverschleiss-Messverfahren an Rad und Schiene mit Hilfe radioaktiver Isotope]
No Abstract. [German]

Grohmann, HD *DET Eisenbahntechnik* Vol. 23 No. 12, Dec. 1975, pp 560-62, 1 Fig., 8 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: VEB Verlag Technik Oranienburgerstrasse 13-14, 102 Berlin, East Germany Repr. PC

C1 131634
HI-RAIL TRACK GEOMETRY CAR
The purpose of this paper is to describe the track geometry vehicle presently operating on the Louisville & Nashville Railroad. The reasoning behind this unique approach to the measurement of track geometry was based on the experience of operating gage measuring equipment on dissimilar types of vehicles and on fulfilling specified objectives set forth at the outset of our track geometry program.

Presented at the 1976 Joint ASME/IEEE Railroad Technical Conference, Chicago, Illinois, April 6-8, 1976.

Borntraeger, JE Hopkins, GE
Institute of Electrical and Electronics Engineers C76 456-9 1A, Jan. 1976, 4 pp, 1 Fig.

ACKNOWLEDGMENT: ASME, IEEE
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL RP

C1 132963
EFFECT OF HEAVY AXLE LOADS ON RAIL AND TIES
The Quebec North Shore and Labrador Railway was built in 1953 to handle iron ore from mines 350 miles north of the St. Lawrence River. Trains of up to 280 cars with five locomotive units are operated. This presentation reports the maintenance experience on track which carries up to 50 million net tons annually, and has handled almost 700 million gross tons since opening. Among the findings: line, surface and gauge must be maintained even on tangent track; corrugated rail develops quickly on grades and curves and must be countered promptly; joint bars must be kept tight and rail ends restored; oilers are all-important on curves.

Proceedings of the 12th Annual Railroad Engineering Conference held at Pueblo, Colorado, October 23-24, 1975. The complete volume is RRIS 02 132958, Pricing is for the complete volume: Repr. PC $6.75, Microfiche$2.25, NTIS PB-252968/AS.

Monaghan, BM (Iron Ore Company of Canada)
Federal Railroad Administration FRA OR&D 76-243, Oct. 1975, pp 45-48, 9 Fig.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS
DOTL NTIS, DOTL RP

C2 033078
DATA HANDLING MACHINE FOR THE NO. 2 TRACK INSPECTION CAR OF THE NEW TOKAIDO LINE
To make some maintenance plans from the results of measurement of track irregularities, some statistical treatment of data becomes necessary. For this purpose a high performance electronic data handling machine was installed to the No. 1 track inspection car of the new Tokaido Line. In the case of periodical maintenance of the No. 1 track inspection car, the No. 2 inspection car is to be used.

Nakamura, I Wada, K (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 7 No. 3, Sept. 1966, pp47-50, 5 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-014)
DOTL RP

C2 033086
TRACK INSPECTION CAR "SUYA-34" BODY RIGIDITY TEST
Measurements were carried out on the rigidity of car-body proper of the track inspection car under construction. The measured amounts of the bending, torsional and lateral-bending rigidities were large enough to estimate that the vibrational deflection of the body during operation would be within the requirements of specifications.

Railway Technical Research Institute Quart Rpt Vol. 1 No. 1, Mar. 1960, p23

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-023)
DOTL RP

C2 033115
RECORDING SYSTEM AND TABLE OF SCALES
Track inspection car used by Southern Railway is discussed. Measures the vertical uneveness of rail, the actual track gauge, curvature of rails. A detailed discussion of the manner in which this data is obtained is included.
Private Communication

Magee, GM Oct. 1971, 20pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-054)
DOTL RP

C2 033116
DEVELOPMENT AND USE OF A TRACK QUALITY INDEX
Discusses the factors used to make up the track quality index. These are the items which are measured by the Southern Railway's track inspection car. The factors measured include gauge, twist, surface, superelevation, and alignment. The measurement of these factors is an aid in scheduling and controlling track maintenance.

Crane, LS Sullivan, JH Kaelin, CR (Southern Railway) *American Society of Mechanical Engineers Trans* Jan. 1969, pp1-10

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-055)
DOTL RP

C2 033167
INTEGRAL TYPE MEASURING EQUIPMENT FOR SUPERELEVATION
In measuring superelevation with track inspection car a gyrostabilizer is generally used. The gyrostabilizer is considerably expensive and needs electric power source. So, for a simple mechanical type track inspection car, it is difficult to mount a measuring equipment for superelevation using a gyrostabilizer. A new mechanical integral type measuring equipment which enables measuring the superelevation from twist of track has been made. The equipment needs no source of electric power. The frequency characteristics of the equipment is fairy good for ordinary superelevation, the accuray of mechanical parts being about 10 percent.

Kishimoto, S Takeshita, K (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 8 No. 4, Dec. 1967, pp221-225, 2 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-121)
DOTL RP

C2 033214
QUALITY OF RAILS AND MEANS OF GUARANTEEING IT. TESTS WITH APPARATUS FOR THE CONTINUOUS EXAMINATION OF RAILS IN THE TRACK
Report discusses the use of high speed rail inspection equipment, the ways in which joint operation of such vehicles would be practical. The amount of track to be inspected, the frequency of inspection and geographic considerations are determinants of the practicality of joint ownership and operation. Also a comparison of the Teledetector, the Spema, and the DB ultra-sonic rail fault coach is made over identical track. A discussion of rail flaws and their classification is included.
Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways D45/RP 6/E, Oct. 1963, 16 pp, 1 Fig., 4 Tab., 2 App.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-172)
PURCHASE FROM: UIC Repr. PC
DOTL RP

C2 033252
ON THE ULTRASONIC RAIL INSPECTION CAR
Seventy percent of rail failures are located in the joint areas starting from the bolt hole, but these defects could not be found out by the electro-magnetic method. The new ultrasonic rail flaw detector car was designed and manufactured by the Railway Technical Research Institute, Japanese National Railways. Results of the tests are summarized as follows: (1) up to a test speed of 35 km/h records are satisfactory, (2) at a higher speed than that the recording of joint areas becomes unreliable, (3) jumping tendency of probe was avoided by elongation of shoes and water supply devices, (4) a revolving type searching unit has been manufactured and a test is now continuously being carried out.

Nakamura, R Tsuchidana, T (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 4 No. 3, Sept. 1963, pp53-55

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-200)
DOTL RP

C2 033261
DESIGN OF TRACK INSPECTION CAR
An efficient method of detecting the defects of track is desired. A new track inspection car has already been reported. It registers the following values during high-speed runs (up to 100 km/h), being equipped with an electronic data processing machine: (1) curvature (right rail), (2) curvature (left rail), (3) unevenness (right rail), (4) unevenness (left rail), (5) width of gauge, (6) superelevation, (7) twist of the track, (8) rolling of the body, (9) vertical acceleration of the body, (10) horizontal acceleration of the body.

Nakamura, I (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 3 No. 4, Dec. 1962, pp56-61, 2 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-210)
DOTL RP

C2 033331
ELECTRONIC EQUIPMENT TO ESTIMATE THE STANDARD DEVIATION OF TRACK IRREGULARITES
Discusses the data processing equipment used in a track inspection car of the JNR New Tokaido Line. This car uses the less expensive less complex system than that used in the MAYA 341. The car under discussion uses mechanical type equipment to inspect track for irregularities, changes because of slack, cant, etc.

Nakamura, I Wada, K (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 6 No. 3, Sept. 1965, pp27-28, 3 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-282)
DOTL RP

C2 033347
ELECTRONIC DATA HANDLING MACHINE FOR TRACK INSPECTION CAR
The record of the track inspection car is used in two ways. One is to find out remarkable irregularities and another is to afford data for making up maintenance plans. For the former purpose the record itself is enough but

for the latter purpose some extraction of information from the record is needed. Formerly, manual data reduction was executed. Though the process of data reduction is very simple, it requires enormous man-hour. By the accomplishment of the new track inspection car, we can measure more than 500 km in a day. This new system can be said to be reliable enough and has been in operation since April, 1961, for the inspection of track covering more than 20,000 km all over the country.

Nakamura, I (Japanese National Railways) *Permanent Way* Vol. 5 No. 2, No. 15, June 1962, pp18-22, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-300)

C2 033366
ROLLING LABORATORIES OF S.N.C.F. THE NEW CATENARIES INSPECTION COACH OPERATED BY THE FIXED INSTALLATIONS DEPARTMENT, S.N.C.F. TESTS COACH S. 445, S. 510, S. 512, S. 513--DYNAMOMETRIC RECORDING COACH

Discusses a number of mobile units used by the S.N.C.F. for such purposes as inspection of power lines and relationship to pantographs, pressure, movement and acceleration, tests of air and electro-braking systems. Measurements of noise levels as related to passenger comfort and a dynamometer coach. The details of each type of test unit are discussed and described individually.

French Railway Techniques No. 1, 1964, pp 39-59

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-320)
DOTL RP

C2 033384
ELECTRONIC DATA HANDLING MACHINE FOR TRACK INSPECTION CAR

Discusses the use of a track inspection car which is used to locate irregularities in the track system, and to gather data for making up maintenance plans. The car is able to measure more than 500 km per day. Formerly, the data was reduced manually. However, one day's gathering occupied 5 people for one month. Consequently, a data processing system was installed in the car with a resultant less variance than in manual data handling.

Nakamura, I (Japanese National Railways) *Rail International* June 1963, pp412-415, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-344)
DOTL RP

C2 033417
HIGH SPEED TRACK INSPECTION CAR

The high speed track inspection car serves to check efficiently the important factors of track condition such as track irregularity under train load, train vibration etc. It is effectively utilized to perform periodic track inspection based on JNR maintenance rules, as well as other testing and research; the maximum measuring speed is 120 km/h on the narrow-gauge lines and 160 km/h on the New Tokaido Line.

Hiroi, I (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 7 No. 4, Dec. 1966, pp40-41

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-380)
DOTL RP

C2 033421
DATA HANDLING OF HIGH-SPEED TRACK INSPECTION CAR

Measurement records made from the high-speed track inspection car are for two purposes, one of them is to defect and locate large track irregularities for preparation of the data necessary for spot maintenance. The other purpose is to give an overall information on the track irregularities found within a certain distance, as this helps service and maintenance planning. For the second purpose, however, records must be sorted, classified and processed statistically. The machine operation shows more stability than that of manual work and this is because the machine has no personal error. The machine has been employed officially since April 1961 and the inspection data over 40,000 km throughout Japan has been already handled. Therefore savings of man-power, cost and time to date have been very large.

Nakamura, I (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 4 No. 3, Sept. 1963, pp37-38

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-385)
DOTL RP

C2 033425
TRACK INSPECTION CAR FOR NEW TOKAIDO LINE

New ideas have been incorporated in the design and manufacture of a new track inspection car for use on the New Tokaido Line, which has performed well so far. Items to be measured are: (1) uneveness, left, (2) unevenness, right, (3) variation of uneveness, left, (4) variation of uneveness, right, (5) twist of track, (6) track gauge, (7) alignment, left, (8) alignment, right, (9) variation of alignment, left, (10) variation of alignment, right, (11) cross level, (12) rolling of car body, (13) vertical acceleration of car body, (14) lateral acceleration of car body, (15) lateral thrust, left, (16) lateral thrust, right, (17) wheel load, left, (18) wheel load, right, (19) lateral thrust/wheel load, left, and (20) lateral thrust/wheel load, right. Systems are designed for accurate and sensitive measurement at speeds up to 200 km/h. The frequency response is within plus or minus 2 percent up to 50 cycles and within plus or minus 10 percent up to 70 cycles, and the linearity plus or minus 0.3 mm.

Nakamura, I (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-389)

C2 033428
MECHANIZED MAINTENANCE OF TRACK ON THE JNR

The Japanese National Railways are making continuous efforts to mechanize track maintenance work in line with the policy towards general modernization of operation. Emphasis is laid on the wider employment of small-sized equipment which will allow a train to pass or which can easily be taken out of the track when a train is coming. So-called overall track renewal using heavy equipment is carried out where an interval of 3 or 4 hours is available between midnight and 4 o'clock in the morning as in the case of the electric multiple unit train lines in and around Tokyo and Osaka. This method is also used on some trunk lines, such as the Tokaido Line in cases where sufficient work time is available by blocking one side of the double track. Outlined are the principal kinds of maintenance work in which such equipment is used, and the measuring devices.

Ijichi, K (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 1 No. 4, Sept. 1960, pp24-26

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-392)
DOTL RP

C2 033429
HIGH SPEED TRACK INSPECTION CAR

The primary requirement for a rational control of track maintenance is to know the state of the track exactly. A high speed track inspection car of a new type was completed last year. In view of the high speed operation during which the measurement is made, arrangements have been made to take all records electrically. Accuracy of records is quite good even at a speed of 120 km/h.

Hayakawa, M (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt No. 2, Mar. 1960

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-393)

C2 033846
TRACK TEST EQUIPMENT FOR EVALUATION OF ROAD BED IRREGULARITIES

The Norfolk and Western Railway Company has been investigating various methods of evaluation of track irregularities. The R-S Three Way Ride Recorder records accelerations in 2 or 3 directions as required, such as vertical and lateral accelerations, whereby riding qualities of cars may be compared to evaluate the track structure. The Tracon system for track analysis is an electronic track inspection system which measures and digitalizes the dynamic cross level variations of a track structure. There are three possible multiples of cross level variations that may be measured. This system can be applied to any car and is designed to operate at any speed above 35 mph. In addition, consideration has also been given to a

computerized method road bed evaluation through measurements and simulation of "rock and roll" of a car. This problem is continuing under study.

Unpublished communications.

Norfolk and Western Railway 48pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-293)
DOTL RP

C2 037268
TRACK INSPECTION WHEEL-BARROW
The Track Inspection Wheelbarrow is a light manually-propelled vehicle which has been designed to deliver a continuous record of gauge width, cant, and curvature (the latter for each rail separately). This device is briefly described.

Railway Gazette Vol. 116 Apr. 1962, p 433, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-975)
DOTL RP

C2 037415
ULTRASONIC CAR WORKS AT 25 MPH
British Rail's detector car uses ultrasonic methods to detect and record hidden rail flaws while running at speeds up to 25 mph. The train can test up to 100 miles a shift--means that entire main routes can be ultrasonically tested in a matter of a few days. The train's rail scanning probes are carried on a trolley mounted between the running wheels of the equipment car. For scanning the rails the trolley is lowered to run on its own wheels, allowing the probes to slide along the surface of the running rails on a thin film of water. Using the principle of reflection of high frequency sound, the probes inspect the running rails for minute cracks and internal flaws Signals from the probes are relayed to monitoring devices on the train and then recorded on film. At the end of each day's testing, the film is sent to an evaluation center near Paddington station, London, where a team of evaluators examines it and reports any signals that indicate a possible rail deflect.

Modern Railroads July 1971, p 48, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-500)
DOTL RP

C2 037420
PURPOSES AND REQUIREMENTS OF TRACK INSPECTION AND MEASUREMENT
This is the first part of a two-part study prompted by recent interest in automated inspection devices and systems. This first portion, deals with the general questions about inspection such as why is track inspected, what is being looked for, when and how often inspection should be done rather than how it should be done. The first is as a fundamental guide to procedures and purposes of inspection, and for an examination of what may or may not be wrong about the way inspection is now being performed. The track materials inspection should include: the load bearing function of the track; the effects of loading on deformation and rupture and wear and abrasion, and on fatigue; and the environmental effects. The present inspection methods are given for rail, cross ties, switches, turnouts, crossings, and ballast.

Way, GH
Chesapeake and Ohio Railway Tech Rpt 71-103, Feb. 1971, 74 pp, 3 Fig, 3 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-485)
DOTL RP

C2 037445
DETECTION OF RAIL FAULTS ON SNCF
French National Railways methods of magnetic examination of rails in service are so successful that 95 percent of all rails lifted in 1967 for transverse cracks were as a result of inspections made on only one-sixth of the main lines. The development of transverse cracks in the rail head generally follow an exponential law related to the traffic carried. A transverse crack increases by 10 percent of the section of the rail head and with an initial detection at 55 percent by the electromagnetic process, the risk of breakage is reached when about 15,000 tons have passed over the track.

Deutsch, R (French National Railways) *Railway Gazette* Vol. 125 Sept. 1969, pp 459-464, 3 Fig, 10 Phot, 3 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-852)
DOTL RP

C2 037455
RAIL DEFECT TESTING IN THE UNITED STATES
Over 130,000 miles of track are tested annually in USA by the Sperry fleet of 25 self-propelled test cars. A new and highly efficient ultrasonic detection system was developed which is capable of finding most cracks and flaws in the joint area. Details are reported. As part of its service Sperry Rail Service has compiled and published a comprehensive manual of rail defects, covering subjects from history and methods of rail manufacture to causes of rail defects and classifications of every known rail defect. This Rail Defect Manual is furnished free to any railway.

Railway Gazette Vol. 125 Mar. 1969, pp 180-184, 4 Fig, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-865)
DOTL RP

C2 037618
ULTRASONIC TESTING OF RAIL--EXPERIENCE AND IMPROVEMENTS
The author discusses improvements in the methods of ultrasonic testing of rail for defects and flaws on the German Federated Railways, giving details of the present state of the art in the new test equipment, and reviewing the knowledge accumulated. Possible improvements in the testing techniques are discussed, including the need for doubling, at least, the speed presently required for this testing of rails.

Egelkraut, K *Eisenbahntechnische Rundschau* Vol. 14 No. 1-2, Jan. 1965, pp 49-59, 15 Fig, 11 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-519)
DOTL RP

C2 037634
SELF-PROPELLED TRACK RECORDER
A track recording trolley, is being used by the civil engineering department, Eastern Region, for detecting and recording track irregularities. It is self-propelled, weighs some eight tons, and is powered by a 65-hp petrol engine. As the vehicle travels along the track a series of probes and wheel flanges in contact with the rail surfaces communicate any irregularities to the recording table by means of wire cables and mechanical linkage. Records obtained include gauge variation, superelevation, and alignment. Speeds during recording are up to 20 mph, but up to 50 mph can be attained when not recording. A crew of five is carried.

Railway Gazette Vol. 106 June 1957, p 688, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-536)
DOTL RP

C2 037647
SYSTEMATIC DETECTION OF RAIL DEFECTS IN U.S.A.
The Missouri Pacific Lines have increased the daily mileage of a Sperry detector car from 21.1 to 30.0, and its annual mileage from 6,188 to 9,074. Annual examinations are made of 55 percent, or 4211 track miles, of the total rail system. Rail inspection statistics are given for the years 1931 to 1939, including: transverse fissures detected; longitudinal fissures detected; other defects; total defective rails; and average defects per track mile.

Railway Gazette Vol. 76 Jan. 1942, pp 159,166, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-550)
DOTL RP

C2 037679
THE NEW C AND O TRACK INSPECTION CAR
The design of the new car allows accurate measurements to be made at all speeds through 100 mph. The overall system of the RI-2 includes means for measurement of such track characteristics as curvature, cross level or superelevation of rails, surface, and joint condition. These measurements are continuously recorded on tape along with landmarks and other notes indicating location, as well as speed of the car. The recording and control

facilities are compactly located near the center of the car. Facilities are provided for unobstructed visual observation of the railroad through an observation deck seating 31 persons. The car is placed as the last car in a train with the observation end towards the rear. At the other end of the car are kitchen, office, conference, sleeping and toilet facilities. Two men can operate all the measuring and recording facilities. The operation and facilities of the RI-2 are illustrated.

Burris, TF (Chesapeake and Ohio Railway) *AREA Bulletin* Vol. 63 1962, pp 758-676, 4 Fig, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-593)
DOTL RP

C2 037778
ULTRASONIC RAIL TESTER
This sturdy lightweight rail tester has been designed to inspect rails automatically for bold hold cracks, wheel burns, "snowflakes," shatter cracks and other separations in the head and web. Pointwork and welded rail joints can also be examined manually. The assembly moves easily along a rail and test speeds of 80 ft/min are easily accomplished by skilled operators. The device is pictured.

Railway Gazette Vol. 126 Jan. 1970, p 35, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-793)
DOTL RP

C2 037794
ULTRASONIC FLAW DETECTION TRAIN ON THE DB
The German Federal Railway utilizes a two car set of railway vehicles which make graphic recordings of rail flaws. These flaws are detected by an ultrasonic detector which records the type of flaw, the size, and its relative position in the rail. Oblique and transverse flaws are also detected by the system. The vehicles may be operated at a speed of 10 km/h upwards, with a speed of 40 km/h as normal.

Railway Gazette Vol. 124 No. 1, Jan. 1968, pp 29-32, 1 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-835)
DOTL RP

C2 037850
CROSS-SECTIONS BY PHOTOGRAMMETRY
When exceptional loads have to be conveyed by rail, measurements must be made along the route to determine by how much the normal loading gauge may be infringed. The Swiss Federal Railways has devised a method based on stereoscopic photography and has built a special measuring vehicle that houses the appropriate equipment. Stereo photographs coupled with a special viewing attachment permit the recording of continuous profiles as a cross-sectional diagram. The vehicle is equipped with a dark room to provide immediate on site inspection of exposures. An electric tractor is used to take the vehicle to site and also provides a 220V supply for the spotlight, heating, and charging of the car-lighting batteries. In transit speeds up to 56 mph are permitted. While operating, the speed is limited to 18 mph.

Railway Gazette Vol. 118 June 1963, p 723, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-962)
DOTL RP

C2 037900
GAUGE AND CROSS-LEVEL TRACK RECORDER
The recorder, known as the Gauge Master P.11 consists of a 3-wheel chassis on to which are built the various instruments used for measuring and recording rail track dimensions and superelevation as it is propelled along the track. All measurements are graphically recorded on a registering strip and actual measurements can be read off as they are recorded. The instrument is provided with a driving stick for propelling purposes, the single operator walking beside the instrument, a warning bell fitted to the recorder rings when the instrument is passing over a portion of the track where gauge tolerances have been exceeded.

Railway Gazette Vol. 93 July 1950, p 15, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1091)
DOTL RP

C2 037996
TRACK RECORDING ON THE SOUTH AFRICAN RAILWAYS
Four track-recording trolleys, self-propelled by a 65-h.p. gas engine, purchased to mechanize track maintenance on the South African Railways, are described. As it travels along the track at 19 MPH, irregularities are detected by the combined movements of probes and wheel flanges carried on three sets of detector assemblies. The function of the trolley is to record high and low points on both rails, versines (curvature) of both rails, superelevation or cant of the track, twist or skew, gauge variations, recording speed, and mileage.

Railway Gazette Vol. 110 May 1959, p 624, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1416)
DOTL RP

C2 037999
BRITISH RAILWAYS TRACK RECORDING COACH
The coach is a four-wheel self-propelled vehicle capable of being driven at either end. It can travel at any speed up to 30 m.p.h. when recording and is capable of speeds of 55 m.p.h. when not recording. Cant is measured by comparing the position of one of the axles with a datum provided by the gyroscope mounted immediately above this axle. Measurements of curvature, gage, and cant are obtained as a.c. signals from synchro type pick-offs. These signals are linearly demodulated and the resulting d.c. signals applied to high sensitivity mirror galvonometers. In addition to the main measurements, the record includes the speed of the vehicle, distance marking, facilities to indicate events such as stations, and space for making notes.

Railway Gazette Vol. 111 Aug. 1959, pp 49-50, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1419)
DOTL RP

C2 039253
AUTOMATED TRACK INSPECTION INFORMATION AND ITS USE
The paper describes the type of track inspection information provided by the Department of Transportation test cars (railroad) and the way it is to be used. The D.O.T. track inspection car program and a computer program from which gage data is produced are discussed. The basic principle discussed apply to all track parameters. The concepts for data processing described and the resulting preferred formats for the presentation of track geometry data resulted from discussions with knowledgable people within the railroad industry. In particular track maintenance personnel were consulted regarding their preferred form for data presentation from the viewpoint of track maintenance. (Author)

Presented at the Roadmasters and Maintenance of Way Convention, Chicago, Illinois. 29 September 1970.

Woll, TP
Federal Railroad Administration FRA-RT-72-02, Sept. 1970, 39 pp

ACKNOWLEDGMENT: NTIS (PB-201621)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-201621, DOTL NTIS

C2 039265
SYSTEM INSTRUMENTATION MANUAL. DOT TEST TRAIN PROGRAM
The report describes current instrumentation installed aboard the Department of Transportation Test Train. The instrumentation is designed to gather research data on various rail research projects. The major discussion in this report covers the Track Geometry System aboard the test train, and the operation and calibration of this system. (Author)

Gerhardt, CL May, JT
ENSCO, Incorporated Annual Rpt Jan. 1971, 176 pp

ACKNOWLEDGMENT: NTIS (PB-203110)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-203110, DOTL NTIS

C2 039403
TRACON-A NEW SYSTEM FOR TRACK ANALYSIS
The article discusses an electronic track inspection system which is designed to give management rapid information on track condition. The system can

be attached to almost any passenger car without any modifications. It measures dynamic cross level at speeds above 35 mph. This concept was not expected to be an accurate defect detection and locating system, but is meant for rapid statistical analysis of track conditions for the allocation of maintenance funds.

22nd Annual ISA Conference and Exhibit, September 11-14, 1967, Chicago, Illinois.

Lombaroo, LR (New York Central Railway)
Instrument Society of America Conf Paper 23-1-T1D-67, Sept. 1967, 6 pp, 7 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-652)
DOTL RP

C2 039454
ULTRASONICS FOR PERMANENT WAY INSPECTION
A portable ultrasonic flaw detector known as the Sonirail is easily operated, and simple to adjust. The electronic apparatus, enclosed in a metal box, is connected to a probe stick which the operator slides on the rail. Indications are given audibly by means of a built-in loudspeaker, supplemented by visual signals on a milliammeter. An operator can identify common defects and estimate their size. The equipment is particularly suited for checking at fishplates.

Railway Gazette Vol. 100 Apr. 1954, p 468, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-711)
DOTL RP

C2 039456
COUNTING TRACK DEFECTS
This article discusses the development of a system for the New York Central Railroad to measure track irregularities, which uses crosslevel as the parameter of measurement. The readout is given in digital form at the end of any geographic unit desired. Crosslevel limits have not yet been determined. Further improvements include the addition of horizontal and vertical accelerometers to record dynamic action.

Railway Track and Structures Apr. 1966, pp 30-31, 4 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-713)
DOTL RP

C2 039512
TEST CAR PROGRAM SECOND PROGRESS REPORT
Developments such as a new signal conditioner for the gage sensors, a magnetic pulser for improved speed and distance measurement, and new sensor configurations were aimed at increasing the accuracy and reliability of track measurements. Improvements in overall system performance results from the development of special-purpose calibration devices, modifications to existing electronic circuitry, a more extensive use of selective filtering, and use of accelerometers which withstood the rough environment. Data processing techniques and displays were also modified to make better use of the data being collected and to present it in a convenient form for operating personnel. The design and development of an onboard digital data acquisition system is a distinct technological innovation with the ultimate purpose of improving the performance of the existing track geometry measurement system. Research during this period was conducted to provide data as input to other independent studies. These included data-collection runs to support the joint D.O.T./C&O-B&O RR Program, validation runs to verify the General Electric Pantograph-catenary simulation model and the Melpar rail car simulation model, track survey runs, ride quality studies, and Southern rail car roll oscillation studies.

Hurley, FJ Goeser, JN Koch, BR McConnell, PJ (Melpar, Incorporated)
Federal Railroad Administration Prog Rpt FRA-RT-71-48, Sept. 1970, 177 pp, 50 Fig, 2 Tab, 13 Phot, 4 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1024)
DOTL RP

C2 039551
RAIL FLAW DETECTION BY UNTRASONIC BEAM
The Audigage flaw detector, of Branson Instruments Inc. consists of a small-battery-operated ultrasonic frequency generator and receiver, carried in an 11-1/2-lb. pack on the operator's back, a crystal in a special holder on the end of a long handle, and a pair of headphones. The crystal is applied to the head of the rail and the presence of a crack indicated by a lowering of the continuous tone produced in the headphones by a perfect rail. In a cracked rail the wave is reflected by the flaw, and a change in tone--or loss of tone--is produced in the headphones. The nearer the crack to the head of the rail, the greater is the drop in frequency. The instrument has been in use by London Transport for about three weeks, during which time some 15 miles of rail have been inspected with it. Several minor defects which were not revealed by visual inspection were discovered in sections of rail covered by the fishplates.

Railway Gazette Vol. 99 July 1953, pp 45-46, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1190)
DOTL RP

C2 039616
MAUZIN TRACK INSPECTION CAR
This vehicle was designed to detect measure and record graphically all variations in true alignment, top and cross-level and curvature of the running rails under loaded conditions. The French National Railways have built three of these cars; two are in constant use in France and the third works regularly outside France. The equipment consists of a special eight-wheel bogie, situated midway between the normal running four-wheel bogies of the vehicle and sharing equally the weight of the vehicle. Thus a total of 16 wheels is available to form a reference plane and detect all vertical variation. Similarly, six disc-mounted feeler shoes which follow the contour of the running edge of the rail reveal any lateral displacement of the track. Vertical irregularities on each line of rails are detected by recording the difference between the height of one wheel and the average height of all eight wheels on that side of the vehicle. Alignment is determined from versines which are measured on each line of rails over a 10 m. chord by means of three disc-mounted feeler shoes bearing laterally against the rails. Gauge is measured by two disc feeler shoes bearing on opposite rails at two points on a line at right angles to the center line of the track. Variations are measured full scale.

Railway Gazette Vol. 97 Sept. 1952, pp 294-296, 1 Fig, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1270)
DOTL RP

C2 039800
ULTRASONIC TESTS ON RAILS IN SITU WITH ELECTRO-MAGNETIC AND ACOUSTIC TRANSDUCERS
Article describes an ultrasonic contactless testing equipment used for detecting defects in rails. System uses ultrasonic oscillations produced by electromagnetic-acoustic transducer. Mechanical details of the assembly are described, as well as block diagram of electric circuitry.

Vlassov, VV Lonchak, VA Glukhov, NA Invanov, LV Runov, NN
Russian Ultrasonics Vol. 1 No. 3, July 1971, pp 178-84, 4 Ref

ACKNOWLEDGMENT: EI (EI 72 52091)
PURCHASE FROM: ESL Repr PC, Microfilm

C2 039872
TEST TRAIN PROGRAM. SYSTEM INSTRUMENTATION MANUAL
The report describes current instrumentation installed aboard the Department of Transportation Test Train. The instrumentation is designed to gather research data on various rail research projects. The major discussion in this report covers the Track Geometry System aboard the test train, and the operation and calibration of this system. (Author)

Gerhardt, CL May, JT
ENSCO, Incorporated Ann Rpt Jan. 1972, 168p

Contract DOT-FR-00015

ACKNOWLEDGMENT: NTIS (AD-748286)
PURCHASE FROM: NTIS Repr PC, Microfiche
AD-748286, DOTL NTIS

C2 039933
PENNSYLVANIA RAILROAD CLEARANCE CAR
The Pennsylvania Railroad has introduced a specially designed car for the measurement of track clearnace. It is usually made up into a short train consisting of a locomotive, the clearance car, and a crew coach. The car has now been in service for three years. Aluminum rods, 3 ft. long, and steel tipped, project from the sides and roof of the car in the form of an arch. As the train moves slowly towards a structure to be measured the rods are brushed backwards by contact to conform to the contours of the structure. The rods, 126 in number, are each capable of giving readings to 1/8 in. Graphs show the profile and clearance of the structure measured. The clearance car can cover an average of 100 miles of track each day. The time taken for measurement is about five minutes for a bridge and 30 minutes for a tunnel a mile long.

Railway Gazette Vol. 100 Apr. 1954, p 386, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1210)
DOTL RP

C2 040011
RECENT EVOLUTION IN ON THE RAIL INSPECTION ON THE S.N.C.F.
Ultrasonic probing enables an operator, shifting a transductor over the surface of the railhead, to assess the extent of a crack. Rail inspection by ultrasonic apparatus employs two methods: vertical probing by a straight line transductor where the steel is subjected to a longitudinal beam of waves; and oblique probing by a transductor subjecting the steel to a refracted beam of transversal waves forming an angle of 65 degrees to 70 degrees with the vertical. The transversal fatigue cracks due to rail-head fatigue often causing railbreaks are detected by oblique probing. The present permissible speed at which the transductors are made to move along the rail is 12 km/h. The annual number of rail-breaks on the inspected lines which was about 1,100 has fallen to under 400, the majority of breaks being due to defects non-spottable by probing.

French Rail News Vol. 1 1969, pp 12-13, 9 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1494)
DOTL RP

C2 040112
COMPUTERIZED DATA PROCESSING OF TRACK GEOMETRY RECORDING
The British Railways system of automatic assessment of the records produced by track-condition recording cars is described. The mechanical movements of the pens of the recording trolley are converted to electric pulses, which are measured on a floating datum in the case of the versines and twist. All measurement and evaluation is electronic and in no way impairs the production of the standard track-record graph. All the information on the print-out and the date of the recording are reproduced on a punched tape which is subsequently processed by a central computer to produce future work programmes for tamping and lining machines. This is done by extrapolating the trend of deterioration revealed by the fault c nts to predict the content and order of priority of future maintenance w k loads on the tracks.

C mbs, DH (British Railways Board) *Railway Gazette* Vol. 122 July 1 6, pp 560-562, 3 Fig, 3 Phot

A- KNOWLEDGMENT: Battelle Memorial Institute (BCL-1608)
DOTL RP

C: 040120
R LATION BETWEEN TRACK IRREGULARITIES UNDER TI AIN LOADS AND NO LOAD
Tr ack irregularities were measured under train load conditions using a new high speed inspection car, Maya 341. The sizes of the irregularities were compared with the sizes measured under no load conditions with a light weight, Yoshiike type, inspection car. A unique rule connecting measurement under load versus no load conditions could not be formulated. Relationships are established for load versus no load conditions in a mathematical model.

Ikemori, M *Railway Technical Research Institute* Vol. 4 N2 June 1963, pp 48-50, 4 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1616)
DOTL RP

C2 040160
AUTOMATED TRACK INSPECTION ON THE SOUTHERN RAILWAY SYSTEM
Described are the track inspection system used on the Southern Railway System, the track rating index used in processing the data, and the benefits derived from automated track inspection. The inspection car does not negate the importance of track maintenance personnel, but rather places greater emphasis on their role. A rapid inspection technique, an accurate picture of track quality, and a well run, the digital gauge printout and the annotated charts are Extensive tests were planned for evaluating heavy-duty rail fasteners, concrete tie designs, and maintenance practices in 1970. The track inspection vehicle was to play a vital efficiently. The Gauge Data Reduction Program is a tool test sections and effecting a relative comparison with control sections of conventional track.

Crane, LS Kaelin, CR (Southern Railway) *AREA Bulletin* Vol. 71 1970, pp 775-785, 5 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-492)
DOTL RP

C2 040161
DIGITAL PROCESSING OF TRACK GEOMETRY DATA FOR MAINTENANCE PLANNING
The concepts for data processing described in this paper and the resulting preferred formats for the presentation of track geometry data resulted from discussions with knowledgeable people within the railroad industry. Data on 450 miles of track geometry are recorded by the test cars in less than 8 hours. The analog chart data is then scrutinized and edited. Within 48 hours after the test run, the digital gage printout and the annotated charts are ready for review by the maintenance engineer. By use of digital computer processing, a vast amount of track data can be collected and reduced into meaningful form quickly and efficiently. The Gage Data Reduction Program is a tool actively providing maintenance engineers and key management personnel with information to direct the planning of maintenance-of-way activities. The crosslevel program, presently under development, will be providing information on another key track parameter.

Woll, TP (Federal Railroad Administration) *AREA Bulletin* Vol. 71 1970, pp 785-797, 8 Fig, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-493)
DOTL RP

C2 040162
CANADIAN NATIONAL RECORDER CAR
A description of how the recorder car works is given and the data produced by the car and how the data are used are described. The instrument panel and various instruments in the car are photographed. Sample output is shown. From the output changes in track quality are observed by placing data produced from consecutive runs side by side.

Maughan, RG (Canadian National Railways) *AREA Bulletin* Vol. 71 1970, pp 798-813, 11 Fig, 6 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-494)
DOTL RP

C2 040165
ENGINEERING TRACK RECORDER CAR
The Canadian National Railways have developed a track recorder car which measures and records condition of track. Track measuring and recording equipment has been installed in a converted passenger car which is equipped with two six-wheel trucks. This car is capable of testing track when operated within the speed range of 20 mph to 100 mph. This car is equipped to measure and record the surface conditions of each rail, cross level and gauge. Photographs show the instrument panel and the equipment installation. Sample output is illustrated.

AREA Bulletin Vol. 71 1969, pp 161-169, 8 Fig, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-497)
DOTL RP

C2 040339
COMPUTERIZATION OF HIGH AND WIDE CLEARANCES
The clearance problem considered is limited to dimensional restrictions to movement. Weight distribution and axle-load restrictions are ignored. The operations of a typical railroad Clearance Bureau are outlined and the phases which would be simplified by the use of a computer are identified. Several photoelectric detector installations for measuring the clearance are photographed. The functions of the Mechanical and Engineering Departments regarding clearances are briefly described. The SCOPE car used to collect information for updating clearance records is shown and described. The flow chart of the digital computer program is illustrated.

Laden, HN (Chesapeake and Ohio Railway) *AREA Bulletin* Vol. 69 1968, pp 814-830, 1 Fig, 11 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1737)
DOTL RP

C2 040379
HIGH-SPEED RESEARCH TRAIN INSTRUMENTATION
The material presented in this paper will describe the basic instrumentation packages currently used in high-speed rail research. The instrumentation for the test and research program was subdivided into four separate packages, viz., body suspension (or ride quality), catenary-pantograph, track geometry, and track and roadbed dynamics. The task was to provide the necessary instrumentation for measurements, tests, and studies into the behavior and dynamic performances of rail vehicles, catenary, and supporting track structures at speeds up to 160 mph. The program was to be composed of four distinct but interrelated parts: (1) instrumentation, (2) computer programming, (3) data collection, reduction and interpretation, and (4) analysis and simulation. This presentation is concerned primarily with instrumentation. As a result of this program track geometry can now be determined at speeds in excess of 150 mph. Cross level, gauge, profile, alignment, warp, and rate of change of gauge can be measured at high speeds by using non-contract sensors.

Koch, BR (Transportation Systems Center)
Melpar Incorporated Tech Paper PRC 68-2

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1829)
DOTL RP

C2 040398
DYNAMIC MEASUREMENT OF ABSOLUTE TRACK PROPERTIES
A transducer developed to mount on the truck of a standard railway coach is the basis of a special track evaluation car. The practical application of this facility to track maintenance is described. Rail profiles are shown of track of good, intermediate, and poor quality. The SR and cross level values are shown in the figures.

Contributed by the Railroad Division of the ASME for presentation at the IEEE-ASME Joint Railroad Conference April 15-16; 1969, Montreal Quebec, Canada

Cass, R Berthiaume, PP Kalita, RE St. Louis, L (Canadian National Railways)
American Society of Mechanical Engineers Conf Paper 69-RR-6, Apr. 1969, 7 pp, 13 Fig, 3 Phot, 2 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1861)
DOTL RP

C2 040510
TWO-VIBRATOR TYPE SEARCHING UNIT AND ITS APPLICATION TO ULTRASONIC FLAW DETECTOR
In order to detect flaws located closely near surface in a metal material using a ultrasonic flaw detector, a two-vibrator type searching unit was invented. One of the two vibrators is a transmitter and the other a receiver. This unit can be used to inspect Thermit welded part of rails. Two-vibrator type searching unit is applied to an audigauge type flaw detector for use in rails. The unit can detect big flaws if they exist more than 1 to 5 mm apart from surface. In case of small flaws, they can be detected if their distances from surface are more than 5 mm.

Mano, K *Railway Technical Research Institute* Vol. 3 No. 4, Dec. 1962, pp 11-13, 2 Fig, 7 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2016)
DOTL RP

C2 040561
MEASURING ACCURACY OF MECHANICAL TYPE TRACK INSPECTION CAR
Mechanical type track inspection car YA210 has a measuring chord length 4.6m, its measuring accuracy being 19%. The accuracy has been improved to 12% by means of softer restoring springs. YA210 may be used up to the speed of 72km/h. There are prospects of constructing a mechanical type track inspection car with a measuring accuracy 10% and a measuring chord length 10 m. The new mechanical type track inspection car will have an integral type measuring equipment for superelevation of track, and a mechanical type automatic data processing equipment.

Kishimoto, S Takeshita, K *Railway Technical Research Institute* Vol. 9 No. 2, June 1968, pp 113-117, 6 Fig, 2 Tab, 3 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2024)
DOTL RP

C2 041672
MEASUREMENT AND ANALYSIS OF WHEEL-RAIL FORCES
Described is a method used to continuously measure, record, and analyze the lateral and vertical forces between wheels and rails of several types of railroad freight cars under a variety of car and track conditions. The method, using analog-to-digital conversion and computerized data handling, has produced results relating to a multitude of car and track behavior subject areas. Especially important is the definition, development, and verification of performance "signatures" which are generated in a unique and characteristic manner by each car in negotiating a given curve. The finding of such "signatures" to be completely reproducible and yet sensitive enough to change with relatively minor track or car component variations, i.e., modifications, supports the belief that these techniques can be applied beyond pure experimental scopes into routine (a) trackside inspection of cars in passing trains; (b) mechanized track inspection; and (c) truck design evaluation.

This paper was presented at the ASME Winter Annual Meeting, November 28-December 2, 1971. The notification of this paper appeared in Mechanical Engineering.

Peterson, LA (Bessemer and Lake Erie Railroad); Freeman, WH (Quebec Cartier Mining Company Railroad); Wandrisco, JM (United States Steel Corporation)
American Society of Mechanical Engineers 71-WA/RT-4, 1971

ACKNOWLEDGMENT: Mechanical Engineering
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL TF5.A72 1971

C2 044308
AUTOMATED GAGE INSPECTION
The L&N Railroad has been inspecting track gage using a "high railer" outfitted with a mechanical feeler system. The high railer was able to inspect the track at moderate speeds and it carried a paint spray system to identify with colored stripes those portions of track that required maintenance attention. Because of the possible dynamic gage widening that could occur under a locomotive during certain train handling operations, the L&N Railroad suspected that the unloaded measurement provided by the high railer might not be indicative of the true dynamic gage. Therefore, the L&N undertook to outfit a locomotive with a measuring system which could measure gage in the vicinity of the wheels most likely to encounter dynamic gage widening. A non-contact gage measuring system was installed on an L&N locomotive by ENSCO, Inc. This system was very similar to the gage measuring system in use aboard the DOT test cars. The system employs capacitive proximity sensors. By mounting the sensors in the shadows of the wheel flanges, the sensors are well protected from damage and are in a location close to the very point of interest where dynamic widening is anticipated.

This paper was recommended by the IEEE Land Transportation Committee of the IEEE Industry Applications Society for presentation at the 1973 Joint ASME/IEEE Railroad Conference, St. Louis, Mo., April 11-12, 1973. The price is $1.35 for members.

Kaufman, WM (ENSCO, Incorporated); Borntraeger, JE (Louisville and Nashville Railroad)
Institute of Electrical and Electronics Engineers Paper C73-921-4-IA, Jan.

1973, 6 pp, 5 Fig
ACKNOWLEDGMENT: IEEE
PURCHASE FROM: IEEE Repr PC

C2 044310
DATA ACQUISITION FOR AUTOMATED TRACK INSPECTION
The purpose of this paper is to describe the use of a mini-computer in an integrated track inspection program. The basic elements of such a program include the measuring vehicle, data reduction process, and presentation of data to the various management levels. The paper describes such a system which has been in use on the Southern Railway over five years, and points out desirable changes, problems and economics.

This paper was recommended by the IEEE Land Transportation Committee of the IEEE Industry Applications Society for presentation at the 1973 Joint ASME/IEEE Railroad Conference, St. Louis, Mo., April 11-12, 1973. The price is $1.35 for members.

Sullivan, JH (Southern Railway)
Institute of Electrical and Electronics Engineers Paper C73922-2-IA, Jan. 1973, 8 pp, 10 Fig

ACKNOWLEDGMENT: IEEE
PURCHASE FROM: IEEE Repr PC

C2 044314
AUTOMATIC RAILROAD TRACK INSPECTION
A technical survey of the automated stationary and mobile track test train systems to date is presented. The use and availability of sensors is also reviewed. A method of in-situ excitation in conjunction with a radio interrogation coupled to existing railway communication system is discussed. The automatic inspection system proposed here is limited to the track bed and the rails. The rails are tested for any fissures and flaws and not for the cross-over error and misalignment although these are invariably also caused by the settling of the track bed. The major features of this system are the real-time segment interrogation system and track sensors. The problem of selective random-spacing deployment to cover maximum optimum segment is also discussed. The need for the railroad industry to expand their efforts in the area of development of automatic track and track bed inspection is shown to be highly desirable as well as economical from an operational stand point.

This paper was recommended by the IEEE Land Transportation Committee of the IEEE Industry Applications Society for presentation at the 1973 Joint ASME/IEEE Railroad Conference, St. Louis, Mo., April 11-12, 1973. The price is $1.35 for members.

Hayre, HS (Houston University)
Institute of Electrical and Electronics Engineers Paper C73924-8-IA, Jan. 1973, 7 pp, 4 Fig

ACKNOWLEDGMENT: IEEE
PURCHASE FROM: IEEE Repr PC

C2 044434
THE FRA TEST CARS--WHAT ARE THEY DESIGNED TO DO, HOW THEY ARE BEING USED, NEW CAPABILITIES IN THE OFFING
The Department of Transportation's Federal Railroad Administration is using automated Rail Research Track and Vehicle Response Measuring Cars for rapid and thorough track inspection and vehicle behavior evaluation. The DOT Track Geometry Measuring System on board the DOT Test Cars is one of the many innovations in progress or in the planning stage at FRA. Equipped with computers and electronic measuring devices, the test cars offer opportunity for on-site analysis of track conditions. At the request of the managements of several railroads scattered throughout the country, the cars have already been used extensively in a variety of track geometry and vehicle performance tests. The measuring system of car T2 is described along with a demonstration of a long-range program with the Bessemer and Lake Erie and Denver & Rio Grande Western and tests at the DOT High Speed Ground Test Center in Pueblo, Colorado.

This article was prepared exclusively for Railway Track and Structures by the Public Affairs Department of the Federal Railroad Administration.

Railway Track and Structures Vol. 69 No. 1, Jan. 1973, pp 26-28, 2 Fig, 3 Phot

ACKNOWLEDGMENT: Railway Track and Structures
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

C2 044439
MECHANIZED TRACK INSPECTION: WHERE IT IS TODAY, WHERE IS IT HEADING?
Technology is available for mechanizing track inspection, but traditional methods are waging a stubborn battle against the new techniques which have been accepted in varying degrees on some roads but rejected on others. However, a significant point is the fact that no railroad after having acquired a track recorder, ever abandoned the idea later. The C&O/B&O, the Southern, the Canadian National, the Chicago and North Western, the Louisville and Nashville have track inspection cars which are described in this article. At least two track-measuring cars of European origin are now commercially available, the Matisa (Tamper) Trackfax car and the latest, the Plasser EM-50 Track Recording Car which has been in operaton on the Union Pacific. The technology of track-measurement and data processing has been brought to a high level of sophistication in the track-recording cars developed for the Department of Transportation. Known as "Rail Research Track and Vehicle Response Measuring Cars", these are self-propelled cars designed for operation in electrified territory, but operated also on portions of a number of roads and in more or less regular use for track-measurement in the Northeast Corridor.

Railway Track and Structures Vol. 69 No. 3, Mar. 1973, 4 pp, 8 Phot

ACKNOWLEDGMENT: Railway Track and Structures
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

C2 046868
FRA TEST CARS
The test cars described are self-propelled when overhead catenary power is available, but can operate over non-electrified lines when drawn by a diesel locomotive or included in a train. Track measurements made by the cars are processed to provide analog traces or printouts from digital magnetic tape. Equipped with computers and electronic measuring devices, the test cars offer opportunity for on-site analysis of track conditions. Measuring system and data processing are described.

Railway Track and Structures Vol. 69 No. 1, Jan. 1973, pp 26-28

ACKNOWLEDGMENT: EI (EI 73 014768)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

C2 046875
MODERN RAILWAY TRACK INSPECTION
It is shown that in addition to providing information of what sections of track need immediate attention, the Track Recorder Car will improve the long-term planning and machinery evaluation procedures of the railroad.

Maughan, RG (Canadian National Railways) *Chemical Engineering Progress* Vol. 5 1971, pp 41-45

ACKNOWLEDGMENT: EI (EI 73 030711)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL RP

C2 046897
ELECTRONICALLY CONTROLLED MOTOR COACHES FOR WENGERNALPBAHN
A series of motor coaches equipped with electronic control systems, is described. The fully transistorized electronic control system cuts the grouping and notching contactors in or out according to signals from the master controller, operating on the digital principle. Using electronic equipment resulted in a considerable saving in space and weight. It has also eliminated wear and tear and reduced maintenance accordingly. As far as operation is concerned, the use of electronics is reflected in smooth starting and rapid acceleration. It simplifies the motorman's job of operating the train composition, allowing him to devote more attention to the line ahead.

Menzi, G *Brown Boveri Review* Vol. 59 No. 10-11, Oct. 1972, pp 496-505

ACKNOWLEDGMENT: EI (EI 73 010438)
PURCHASE FROM: ESL Repr PC, Microfilm

C2 046913
ON THE SOUTHERN TRACK INSPECTION, MECHANIZED, AUTOMATED, COMPUTERIZED
It is shown how track-measuring car, put into service by Southern, produces printouts showing defects that need immediate attention and an index of condition for each mile of track covered. The system has objectives to detect and locate any condition requiring correction and to establish a numerical rating which would afford a comparison of the relative quality of each mile segment of track on the system.

Railway Track and Structures Vol. 67 No. 3, Mar. 1971, pp 18-21

ACKNOWLEDGMENT: EI (EI 73 79921)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

C2 046914
COMPUTERIZED TRACK MAINTENANCE. OUTLINE OF A PLAN THAT GOES ALL THE WAY
The possibility of raising track-work planning and execution to a highly proficient level by combining mechanical track measurement and electronic data processing in such a way as to exercise total control over mechanized field operations is suggested.

Railway Track and Structures Vol. 67 No. 3, Mar. 1971, pp 22-24

ACKNOWLEDGMENT: EI (EI73 79927)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

C2 047778
AUTOMATIC PROCESSING OF RECORDINGS MADE BY THE CASTAN SOUNDING AND MEASURING APPARATUS [LE TRAITEMENT AUTOMATIQUE DES ENREGISTREMENTS DE L'APPAREIL PALPEUR-MESUREUR CASTAN]
The author recalls the problems involving gauge when train speeds are raised or special consignments are carried: calculation of the extreme distance between track centres, gauge problems resulting from obstructions (in particular structures, tunnels, overbridges); these problems, which were previously resolved manually, are now dealt with by computers. He explains in this article how the SNCF Calculating Centre processes automatically the data obtained on line by the Castan sounding and measuring apparatus used for determining the cross-section of tunnels and in track layout modification studies. Starting with a speed, a vehicle gauge and diagrams giving the outline of obstructions, the processing operations very quickly provide, for all sections perpendicular to the obstructions, in the form of figures and graphs, the clearance available between the wall and the vehicle, and subsequently the optimal positioning of the tracks. He concludes by giving some practical examples of application and referring to the possibilities opening in the future when a data bank is formed and information on fixed obstructions is stored in a data file. [French]

Blanc, P *Revue Generale des Chemins de Fer* Dec. 1972, pp 785, 8 Fig

ACKNOWLEDGMENT: UIC
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

C2 047909
RING LASER GYRO FOR BART
The ring laser gyro was tried in an inspection system for measuring track conditions on San Francisco's computer-controlled Bay Area Rapid Transit (BART) system. During testing, the instrument proved its reliability in detecting the slightest variance in car attitude, thus eliminating the once-laborious task of inspecting each individual foot of track.

Sperry Technology Vol. 1 No. 3, 1973, pp 42-43

ACKNOWLEDGMENT: EI (EI 73 037064)
PURCHASE FROM: ESL Repr PC, Microfilm

C2 047969
C & NW IS NOW ABLE TO TELL MORE ABOUT TRACK AND CAR RIDE
The Chicago & North Western and Gulton Industries have jointly developed an electronic system called a Dynamic Track Analyzer. The system measures track deviations in cross level and alignment and then relates their combined effect upon the car's rock and roll action. It consists of rate gyroscopes to give measurements, a solid state analog computer along with a digital computer and a data processor to analyze the information, plus a printer to record all the pertinent data. The dynamic Track Analyzer has a pick-up device that is mounted on one of the axles of the car's rear truck. It includes two gyroscopes, one sensitive to the roll axis and the other to the turn axis. Tranducers convert the gyro measurements to signals. The analyzer system's speedometer pick-up is mounted on a different axle of the same truck and on the same side as the transducer housing. Another gyroscope within the computer cabinet measures spirals and curbes. The track geometry defects that are detected are divided into three classes; minimums, subcritical defects, and critical defects. The analyzer has proved to be an invaluable aid in picking out track areas that may be conductive to rock and roll derailments of a covered hopper car.

Railway Locomotives and Cars Vol. 146 No. 1, Jan. 1972, pp 14-16

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

C2 050373
DEVICE MEASURES TRACK-CENTER DISTANCES
Apparatus described was used for checking track centers on 120 mi between main tracks and 30 mi between main and side tracks in test. Truck is propelled by the outrigger pipes, but sliding frame permits it to move laterally so connecting cable actuates a transducer. Output voltage from potentiometric displacement transducer is fed into a recording voltmeter to produce a continuous tape for reading.

Railway Track and Structures Vol. 67 No. 9, Sept. 1917, pp 24-25

ACKNOWLEDGMENT: EI (EI 72 23287)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

C2 050473
USING FERROPROBES FOR TESTING THE RAILS OF ELECTROMAGNETIC WAGON/DEFECTOSCOPES
The parameters of the cores of a ferroprobe for operation of a high-speed rail defectoscope in relative strong fields are calculated by an approximate method. The possibility of using ferroprobes to indicate defects by high-speed electromagnetic nondestructive testing of railroad rails for low traveling speed is shown.

Shcherbinia, VA (All-Union Scientific Res Inst for Railw Transport); Valasov, VV Dovnar, DP *Soviet Journal of Nondestructive Testing* Vol. 8 No. 6, Nov. 1972, pp 641-647, 15 Ref

ACKNOWLEDGMENT: EI (EI 73 050854)
PURCHASE FROM: ESL Repr PC, Microfilm

C2 050537
COMPUTERS AND MECHANISED TRACK MAINTENANCE
An initial breakdown of track maintenance work reveals four major functions: track measuring and recording, classification and evaluation, actual performance of the work and checking and inspection. The Nepture System, which is a complete system of track fault analysis and correction comprised of four major parts (the track recording vehicle, Neptune computer analyser, maintenance planning and direction of mobile gangs to trouble spots) is presented.

Eden, GA *Railway Engineering Journal* Vol. 2 No. 1, Jan. 1973, 13 pp

PURCHASE FROM: ESL Repr PC, Microfilm

DOTL RP

C2 050582
RAILWAY TRACK MEASUREMENT USING LASER BEAM AS A REFERENCE LINE [SPARMATING MED LASERSTRALE SOM REFERENSLINJE]
At present a project aiming at improving calculation methods for studying interaction between track and traction bogies is being carried out by ASEA. For this project precise information on rail configuration is necessary. A method of measuring straight unloaded tracks is described in this article. The method uses a laser beam as a reference line approximately parallel to the rail. Along the rail is drawn a detector which can measure the distance between the laser beam and the centre of the light-sensitive detector surface. This makes it possible to determine the deviations of the rail from the straight line defined by the laser beam. [Swedish]

Sjpolvist, T *Jarnvagsteknik* No. 1/2, 1973, 4 pp, 6 Fig

ACKNOWLEDGMENT: International Railway Documentation
PURCHASE FROM: International Union of Railways, BDC 14 rue Jean Rey, 75015 Paris, France Repr PC

882

C2 051346
M/W PROBE NUMBER 1--THE UNION PACIFIC
Six related articles, all dealing with the Maintenance of Way Practices on the Union Pacific Railroad, are presented. Subjects covered included track standards, welded rail, organization of M/W gangs, the Track Recorder Car, and bridges.

Railway Track and Structures Vol. 69 No. 6, June 1973, 18 pp

PURCHASE FROM: XUM Repr PC

DOTL JC

C2 051535
A TRACK CURVATURE MEASURING SYSTEM AND ITS APPLICATION
A track curvature measuring system has been designed and installed in the Department of Transportation's rail test car by ENSCO, Inc. The system employs an inertial rate-of-turn gyroscope to measure the yaw rate of the car, an axle-driven tachometer to measure speed, and velocity transducers to measure the relative motions between the car and the trucks. An analog circuit receives these inputs and performs the curvature computation. The system is capable of making continuous curvature measurement at any speed greater than 3 mph at either direction of travel. The system performance and various applications of the data are demonstrated. Schemes for detecting undesirable superelevation and curvature mismatches are discussed.

Contributed by the Intersociety Committee on Transportation for presentation at the Intersociety Conference on Transportation, Denver, Colo., Sept. 23-27, 1973.

MacIntyre, SA May, JT (ENSCO, Incorporated)
American Society of Mechanical Engineers Paper 73-ICT-110, Sept. 1973, 8 pp, 11 Fig

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL RP

C2 051536
APPLICATION OF GUIDEWAY ROUGHNESS POWER SPECTRAL DENSITY AS A MANAGEMENT TOOL
Ground surface vehicles such as trucks or railway cars can be considered as mechanical systems suspended on vibrating wheels. The source of vibrational energy is the roughness in the roadway or the guideway. A portion of the vibrational energy is transmitted through the vehicle suspension system and to the passengers or lading inside the vehicle. The magnitude of the transmitted energy and its frequency content depend on the roughness of the surface, the speed of the vehicle, and the mechanical characteristics of the suspension system. If the roads and guideways are categorized by the Power Spectral Density (PSD) of their surface roughness, the amount of vibrational energy can be predicted if the speed and the characteristics of the vehicle suspension system are known. Conversely, if a safe limit of the vibration has been established for a particular lading, management can render a cost effective decision on guideway maintenance, speed practices, and vehicle design from knowledge of the PSD characteristics of a proposed route.

Contributed by the Intersociety Committee on Transportation for presentation at the Intersociety Conference on Transportation, Denver, Colo., Sept. 23-27, 1973.

Corbin, JC Yang, TL (ENSCO, Incorporated)
American Society of Mechanical Engineers Paper 73-ICT-114, Sept. 1973, 8 pp, 3 Fig, 11 Ref

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL RP

C2 051586
TEST TRAIN PROGRAM
The progress report covers a 12-month period of engineering, data management and analysis efforts related to the Rail Research Program. Subjects include operation of the DOT Rail Research Cars, associated testing programs, test car upgrading, expansion of the Rail Research Program, data management and data analysis tasks which have been undertaken to benefit the railroad technology. This research program is designed to provide high-speed measurement of railroad track characteristics, development of comprehensive instrumentation and measurement techniques, and data evaluation through analysis and electronic processing.

See also report dated Jun 71, PB-209 762.

May, J Kaufman, W Yang, TL Frankowski, D Holik, J
ENSCO, Incorporated Prog Rpt No. 4, June 1972, 118 pp

Contract DOT-FR-00015

ACKNOWLEDGMENT: NTIS (PB-226048/7)
PURCHASE FROM: NTIS Repr PC, Microfiche

PB-226048/7, DOTL NTIS

C2 051589
RAIL GAGE APPARATUS
The invention relates to apparatus for measuring the gage of any given track, and more particularly, to apparatus which can be affixed to revenue producing trains which pass over the tracks in question and provide electrical signals representative of the gage of the track while the train travels at high speeds.

Government-owned invention available for licensing. Copy of application available NTIS.

Wilmarth, RW
Department of Transportation, (DOT/Case-TSC-10041) Patent Apl PAT-APPL-378-510, 10 pp

ACKNOWLEDGMENT: NTIS (PB-224807/8)
PURCHASE FROM: NTIS Repr PC, Microfiche

PB-224807/8, DOTL NTIS

C2 052572
AN ANALOG-DIGITAL METHOD OF DETERMINING VERTICAL TRACK IRREGULARITIES AS THE EXCITATION OF A RAIL VEHICLE'S VERTICAL OSCILLATIONS
Unknown dynamic parameters of the track have been obtained by statistical calculations. The parameters are used to design an analog-system to determinate a "substitute vertical track irregularity" as an excitation of vertical vehicle oscillations for the accepted model of the track. The signal recorded on the magnetic tape may also be used for an analog study of the vertical vibrations of other vehicles. The computations have been based on the correlation function method.

This paper was presented at the Third ORE Colloquium held in Amsterdam, May 8th to 10th 1973, and its Summary is contained in the Colloquium report #AZ40/RP 5/E; See RRIS #052511. Restrictions on the use of this document are contained in the explanatory material.

Kosieradski, W
International Union of Railways June 1973

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

C2 052798
INTERACTION BETWEEN VEHICLES AND TRACK. POWER SPECTRAL DENSITY OF TRACK IRREGULARIES. PART 1-DEFINITIONS CONVENTIONS AND AVAILABLE DATA
The excitation of the track can be introduced into mathematical models in the form of "power spectral density of track irregularities" showing the relative importance of the various frequencies comprising the whole of the irregularities for a given section of track. A first stage for obtaining these spectra consists of recording the track irregularities by means of measuring vehicles, and a second stage consists of establishing these spectra by means of mathematical procedures (analogue and digital). The rules for the presentation of these spectra are laid-down and the spectra envelopes obtained by different Administrations are given. Numerous problems remain to be solved e.g. those relating to the stationarity of the records, to the influence of certain parameters (axle-load, measuring speed, wheel and rail profiles). For high speeds, it is also necessary to possess spectra in the low frequency field.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways C116/RP 1/E, Oct. 1971, 22 pp, 7 Fig., 1 Tab., 11 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC

DOTL RP

C2 053844
SANTA FE MEASURES TRACK CONDITIONS WITH NEW CAR
The Santa Fe has placed in service a highly sophisticated track geometry inspection car with a combination of significant features. The car will constantly monitor and record ten different track characteristics-surface and alignment of both rails, twist, gage, superelevation, distance and speed. Data will be produced for immediate identification and also for later analysis.

Progressive Railroading Vol. 16 No. 6, Nov. 1973, 1 p, 3 Phot

PURCHASE FROM: Murphy-Richter Publishing Company 9 South Clinton Street, Chicago, Illinois, 60606 Repr PC

DOTL JC

C2 053876
THE TRACK GEOMETRY CAR: NEWEST TOOL OF M/W POLICY
Convinced that the track-measuring car is now firmly entrenched as a tool of M/W policy, and that its use will grow rapidly in coming years, RT&S editors decided to devote their third "roundtable" to a discussion of such cars. Participants consisted solely of representatives from railroads in the United States owning such cars, and the discussion dealt with every conceivable aspect of the subject that was thought to be of interest to engineers on other railroads. An expression of opinion has been obtained from the Canadian Pacific, as well as from the Quebec, North Shore and Labrador, and these are presented. The second installment will be printed in the April issue.

Railway Track and Structures Vol. 70 No. 3, Mar. 1974, 5 pp

ACKNOWLEDGMENT: Railway Track and Structures
PURCHASE FROM: XUM Repr PC

DOTL JC

C2 054339
INERTIAL PROFILOMETER AS A RAIL SURFACE MEASURING INSTRUMENT
A pair of profilometers, modified from the original design of the Electro-Motive Division of General Motors, has been built and installed on the Department of Transportation rail test car by ENSCO, Inc. The inertial profilometer system is capable of accurately measuring variations in rail surfaces of both short wavelength (a few feet) and long wavelength (a few hundred feet). In addition to its application in vehicle-dynamic simulation, the measured inertial profile can be used as a data base for extracting mid-chord (or other types of relative profile measurement) at any selected chord length. Field and laboratory tests have been conducted to evaluate the performance of the profilometers. The laboratory tests consisted of shake table tests to measure the amplitude and phase response within the frequency range of interest. These results correspond closely to the theoretical frequency response. Extensive field tests were performed on tangent, spiral, and curved track. Both manual stringline and DOT mid-chord system measurements were made on the same sections of track. The results show good agreement between the profilometer data and the accurate stringline measurements.

Contributed by the Intersociety Committee on Transportation for presentation at the Intersociety Conference on Transportation, Denver, Colo., Sept. 23-27, 1973.

Rudd, TJ Brandenburg, EL (ENSCO, Incorporated)
American Society of Mechanical Engineers 73-ICT-102, July 1973, 9 pp, 15 Fig

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL RP

C2 057180
PHOTOGRAPHIC RECORDING OF STRUCTURE GAUGE FOR OUT-OF-GAUGE LOADS
Checking for infringement of structure-gauge by out-of-gauge transports on Netherlands Railways using a track-mounted pointer and trace-board has given place to a camera recording technique whereby lineside structures are photographed and annotated with a grid carrying both the load and the structure profiles. Great speed of information collection and evaluation is thus achieved with consequent cut in track occupation time.

Dekker, HAL (Netherlands Railways) *Rail Engineering International* Vol. 4 No. 4, May 1974, pp 169-172, Phots.

ACKNOWLEDGMENT: Rail Engineering International
PURCHASE FROM: Broadfields (Technical Publishers) Limited Little Leighs, Chelmsford, Essex CM3 1PF, England Repr. PC

DOTL JC

C2 057674
DOT TEST TRAIN PROGRAM SYSTEM INSTRUMENTATION MANUAL. FOURTH EDITION
This report describes current instrumentation installed aboard the Federal Railroad Administration Test Cars. The instrumentation is designed to gather research data on various rail research projects. The major discussion in this report covers the Track Geometry System aboard the test train, and the operation and calibration of this system.

See also RRIS #039279, PB-209709 and RRIS #039265. This document supersedes PB-203110 and AD-748286.

Anderson, L Kolczynski, N
ENSCO, Incorporated Annual Rpt DOT-FR-72-21, Dec. 1972, 194 pp, Figs.

Contract DOT-FR-20032

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC

PB-239462/5ST, DOTL NTIS

C2 071962
AN ANALYSIS OF TRACK PARAMETER HETEROGENEITY AS A COMPLEMENT TO GEOMETRICAL METHODS OF TRACK CONDITION RATING
Subject of the paper is methods used for track heterogeneity analysis. They are concerned with selected geometrical and structural parameters as well as with a synthetical track condition rating using track geometry cars. Results of UIC 60 track heterogeneity investigations are quoted.

Baluch, H (Institute of Railway Research, Poland) *Rail International* No. 7-8, July 1974, pp 537-546, 8 Fig., 4 Tab., 6 Ref.

ACKNOWLEDGMENT: Rail International
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

C2 072475
AUTOMATIC RAILROAD TRACK INSPECTION
A technical survey of the automated stationary and mobile track test train systems to date is presented. The use and availability of sensors is also reviewed. A method of in-situ excitation in conjunction with a radio

interrogation coupled to existing railway communication systems is discussed. The automatic inspection system proposed here is limited to the track bed and the rails. The rails are tested for any fissures and flaws and not for the cross-level error and misalignment, although these are invariably also caused by the settling of the track bed. The major feature of this system is the real-time segment interrogations system. Track spacial deployment to cover maximum optimum segment is, however, also discussed. The need for the railroad industry to expand its efforts in the area of the development of automatic track and track bed inspection is shown to be highly desirable as well as economical from an operational standpoint.

Hayre, HS (Houston University) *IEEE Transactions on Industry Applications* Vol. IA10 No. 3, May 1974, pp 280-384, 4 Fig., 19 Ref.

ACKNOWLEDGMENT: IEEE Transactions on Industry Applications
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

C2 072805
MODEL EMSE275 DYNAMIC TRACK ANALYZER
A Gulton Dynamic Track Analyzer is described. The Dynamic Track Analyzer performs three distinct functions. These are measurement of track dimensions, prediction of worst case roll amplitude of a selected type of car, and accumulation of a defect count (figure of merit) for each statute mile of track. All of these functions are performed in real time, giving immediate printed results. Train speed and distance traveled are measured and recorded. By operating the business car equipped with analyzer over a given stretch of track, it is possible to produce a chart showing the car roll for any desired type of car. A chart is attached showing the actual measured roll of a particular car over a section of track compared with the predicted roll determined from operating a business car equipped with the analyzer over the same track.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Gulton Engineered Magnetics Division Instr. Man June 1971

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: Gulton Engineered Magnetics Division 212 Durham Avenue, Metuchen, New Jersey, 08840 Repr. PC

C2 072813
ULTRASONIC 'EYES' ABOARD BRITISH TESTING TRAIN LOCATE RAIL DEFECTS
Ultrasonic "eyes" capable of detecting and recording hidden flaws in railroad tracks have been placed in use in Great Britain aboard a new rail testing train which travels as it works at speeds up to 25 mph. This paper reports the technique.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Materials Evaluation Vol. 39 No. 6, June 1971, pp 16A-18A

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: ESL Repr. PC, Microfilm

C2 072816
COMPUTER SPOTS RAIL DEFECTS FAST
Survey of applications of computer complex in the computerizing of rail-defect information developed by a fleet of rail detector cars and a variety of portable ultrasonic testing instruments. A monthly printout from Penn Central computer shows rail defects found by special cars and ultrasonic devices. Computer data is also shown to be useful in programming rail renewals.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Railway Age Vol. 169 No. 1, July 1970, pp 32-33

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: XUM Repr. PC

C2 083026
TRACK GEOMETRY MEASUREMENTS AND DATA PROCESSING DEVELOPMENTS IN THE RAIL RESEARCH PROGRAM
This report summarizes the FRA-sponsored Rail Research Program, and outlines many of the problems presently encountered by the railroad industry in providing safe, high-speed transportation; and illustrates the vital role of cost-effective maintenance planning. This report was originally presented at the IEEE/ASME Joint Railroad Conference in St. Louis, Missouri, in April 1973. The FRA Test Cars are described, with emphasis placed on the ability of the cars to measure all parameters of track geometry at high speed. Examples are included of the various types of computer-generated reports which are designed specifically for personnel who are responsible for maintenance planning and operations. The information in this report is intended for use by a general audience who desires a comprehensive nontechnical summary of the operation and application of the FRA Test Cars, related instrumentation and data processing operations.

This project is sponsored by the Federal Railroad Administration, Department of Transportation.

From, L
ENSCO, Incorporated, (DOT-FR-74-2Z) Tech. Sum. FRA-ORD&D-75-14, Oct. 1974, 29 pp, 20 Fig.

Contract DOT-FR-20032

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-239463/AS, DOTL NTIS

C2 083027
DEVELOPMENT OF AN INERTIAL PROFILOMETER
The information in this report covers the design, fabrication and testing of an inertial profilometer system, developed for use on the FRA Test Cars. The profilometer is used to measure rail profile at high speeds, relative to an inertial reference. Design details and analysis of the profilometer are covered, and comparisons are made between profilometer measurements, mid-chord measurements, and manual measurements made with stringline and roll-ordinator devices, to show the relative accuracy of the profilometer measurements. The inertial profilometer offers several advantages over the currently-used mid-chord syystem. Accuracy of the profilometer has proven to be quite good. Operation of the profilometer is not degraded by inclement weather, and system components are not subject to damage by protruding objects in close proximity to the rail being measured.

Brandenburg, EL Rudd, TJ
ENSCO, Incorporated, (DOT-FR-74-06) FRA-ORD&D-75-15, Nov. 1974, 45 pp, 23 Fig.

Contract DOT-FR-20032

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-239464/AS, DOTL NTIS

C2 084914
TRACK MEASUREMENT FOR TODAY'S RAILROAD SYSTEMS
This brochure describes the FRA Improved Track Inspection and Data Collection Technology Programs which utilize the Track Geometry Test Cars and Vehicle Dynamic Measurement Systems for the purpose of improving railroad safety, efficiency and economy. The data produced by the cars--through precise measurement of existing track structures--are used to plan effective track maintenance programs and to support the design of tomorrow's high-speed railroads.

Federal Railroad Administration 13 pp, Phots.

PURCHASE FROM: FRA Repr. PC
DOTL RP

C2 091294
ACQUISITION AND USE OF TRACK GEOMETRY DATA IN MAINTENANCE-OF-WAY PLANNING
The report describes data acquisition by the FRA Measurement Cars and subsequent use of the collected track geometry data by the Bessemer and Lake Erie (B and LE) and the Denver and Rio Grande Western (D and RGW) Railroads. These two railroads, in conjunction with ENSCO, Inc.,

have prepared the report for the Federal Railroad Administration. The major emphasis of the report is placed on use of the track geometry data by B and LE and D and RGW for immediate maintenance and maintenance planning. Also provided are descriptions of data processing reports, system and measurement repeatability data, and the Track Geometry Measurement System onboard the FRA Measurement Cars.

The information herein is intended for use by maintenance- of-way personnel who are concerned with the utilization of track geometry data collected by track measurement cars and by management personnel who are involved in maintenance planning. This report was sponsored by the Federal Railroad Administration.

Bradley, K Price, B Woll, T Burnes, R Gerber, R
ENSCO, Incorporated, Federal Railroad Administration, Bessemer and Lake Erie Railroad, Denver and Rio Grande Western Railroad, (DOT-FR-75-1) Tech Rpt. FRA-ORD&D-75-27, Mar. 1975, 130 pp

Contract DOT-FR-20032

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-241196/AS, DOTL NTIS

C2 091354
TEST TRAIN PROGRAM
This progress report covers a 12-month period of engineering, data collection and analysis efforts related to the Rail Research Program. Subjects include operation of the DOT Rail Research Cars, associated testing programs, test car upgrading, expansion of the Rail Research Program, data management and data analysis tasks which have been undertaken to benefit railroad technology.

See also report dated Jun 72, PB-226 048.

ENSCO, Incorporated, Federal Railroad Administration Prog. Rpt. #5, June 1973, 86p

Contract DOT-FR-20032

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-241419/1ST, DOTL NTIS

C2 095414
ANALYSIS OF TRACK PARAMETER HETEROGENEITY AS A COMPLEMENT TO GEOMETRICAL METHODS OF TRACK CONDITION RATING
The condition of a track may be defined by track rating indices (W indices at the PKP) taken from recordings by a track inspection car, or obtained by geometrical measurements (longitudinal dip and cross-sectional irregularities, without load or with a moving load, lateral displacement, etc.). By track heterogeneity, the writer means the differences that such indices reveal on lengths of line with identical make-up, similar age, and used by the same traffic. These heterogeneities, which may be caused by the laying or maintenance of the track, or by constructional features with different characteristics, are also likely to result in great differences in the rapidity with which these lengths of line deteriorate, necessitating earlier continuous track renewal. The article proposes methods of assessing these heterogeneities by tests based on classic statistics laws. Numerical examples thus deal with: heterogeneities in the W index, by the X to the 2nd power test; heterogeneities in the track gauge by a method called the "ZM test" taken from an American book referred to in the bibliography; correlations between rail dip and lateral displacement under a moving load, by an analysis of sequential correlation. These complex analyses are not used as a basis of routine maintenance decisions, but in investigations for the purpose of explaining abnormal phenomena.

Baluch, H *Rail International* Vol. 5 No. 7-8, Aug. 1974, pp 537-546, 6 Fig., 4 Tab., 6 Ref.

ACKNOWLEDGMENT: International Railway Documentation, Selection of
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

C2 095720
TRACK GEOMETRY SURVEY DEVICE FOR LIM RESEARCH VEHICLE TEST TRACK
A track survey device was designed, built and operated to measure the geometry of the FRA Linear Induction Motor Test Track at Pueblo, Colorado. A laser beam is used for the measurement of profile and alignment; an electronic level for the measurement of superelevation and mechanical sensors for both support rail and reaction rail gages. The measurement is stored in magnetic tape for processing.

Sponsored by the Federal Railroad Administration.

Medecki, H Panunzio, S
General Applied Science Laboratories, Incorporated, (GASL TR-776) Final Rpt. FRA-ORD & D-74-36, Oct. 1973, 110 pp, Figs., Tabs., Phots.

Contract DOT-FR-10016

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-241313/AS, DOT NTIS

C2 096657
DOT TEST TRAIN PROGRAM SYSTEM INSTRUMENTATION MANUAL-FIFTH EDITION
This manual describes track measurement instrumentation which has been developed during the reporting period, and covers all instrumentation currently installed aboard the FRA Test Cars. The major emphasis of this report deals with the operation and calibration of the Track Geometry Measurement System installed aboard Test Car T-3. Ancillary systems, and equipment aboard Test Cars T-1, T-2 and T-4 is also summarized. The information herein is intended for use by technical personnel who are involved in the operation of FRA Test Car instrumentation, and by engineering and research personnel involved in the application of track geometry measurement techniques.

This was sponsored by Federal Railroad Administration, US DOT.

Anderson, L MacIntyre, S Kolcyzynski, N
ENSCO, Incorporated, (DOT-FR-74-13) Ann. Rpt. FRA-ORD&D-7504, Dec. 1973, 140 pp, Figs., Tabs.

Contract DOT-FR-20032

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche
DOTL NTIS

C2 098073
FRA TRACK GEOMETRY MEASUREMENT SYSTEM VALIDATION REPORT
This report covers an extensive testing program which was conducted to validate the track geometry measurement system installed aboard the Department of Transportation Rail Test Cars. The tests were conducted to establish the accuracy and repeatability of measurements made with the high-speed electronic measurement system installed aboard the DOT Test Cars. The validation procedure involved both laboratory and field tests of the electronic measurement system. Comparisons were made between manual and high-speed electronic measurements of rail gage, crosslevel, profile and alignment. Results of these comparisons under various dynamic conditions, speeds, types of rail and rail loads are included in this report. The information contained in this report includes considerable detail which is intended for use by engineering and research personnel who are involved in the design, development, and validation of rail measuring devices.

This program sponsored by the Federal Railroad Administration, Office of Research and Development, US DOT.

Yang, TL
ENSCO, Incorporated, Federal Railroad Administration, (DOT-FR-73-08) Engr. Rpt. FRA-ORD&D-75-05, June 1974, 156 pp, Figs., Tabs., 3 App.

Contract DOT-FR-20032

ACKNOWLEDGMENT: FRA, NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-243677/AS, DOTL NTIS

C2 126445
BLUEPRINT FOR TRACK REHABILITATION?
The Iowa Department of Transportation has been authorized by the legislature, concerned about track conditions in the state, to take several steps. A program of rehabilitation of branch lines has seen work started on ten segments involving expenditure of $8.7 million. Condition of all trackage

in the state is to be monitored annually by a new track-measuring car. Development of a numerical "sufficiency rating" for all trackage in the state will rate ability of the lines to perform in accordance with accepted standards. Steps will be taken to assure sufficient supplies of materials and machines and enough manpower to meet any crash program of railroad rehabilitation which might be initiated at the federal level. So far state, local and railroad funding is involved.

Railway Track and Structures Vol. 71 No. 9, Sept. 1975, pp 14-17, 1 Tab., 2 Phot.

PURCHASE FROM: XUM Repr. PC

DOTL JC

C2 128640
TEST TRAIN PROGRAM SIXTH PROGRESS REPORT
This report describes the progress of the Rail Research Program involving operation of the FRA test cars and the performance of other rail research efforts during the period 1 July 1973 to 30 June 1974. Highlights of the work reported include operation of the FRA test cars to perform track surveys and other rail research activities; test car upgrading; expansion of the Rail Research Program; and data management and data analysis tasks which have been undertaken to benefit railroad technology. The Rail Research Program primarily involves the operation and instrumentation of the FRA test cars. This research program is designed to provide high-speed measurement of railroad track characteristics, development of comprehensive track measurement techniques, development of special testing instrumentation, and data evaluation through analysis and electronic processing.
Sponsorship was from FRA, DOT.

Peterson, C Kaufman, WM Yang, TL Corbin, JC
ENSCO, Incorporated, (DOT-FR-74-19) Prog Rpt. FRA-ORD&D-75-25, June 1974, 124 pp, 36 Fig.

Contract DOT-FR-20032

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-247084/AS, DOTL NTIS

C2 128850
CLOSE-UP OF SOUTHERN POLICIES AND PRACTICES
In a four-part feature, the Southern Railway policies in track maintenance are examined. Southern started early in mechanizing m/w operations and has achieved a high degree of efficiency in manpower use. It has always emphasized rail and tie renewals. In Part 1, The Strategy Behind the Progress, the development of a five-year plan, the acceptance of a high m/w ratio, and use of a track geometry car and rigid quality control are discussed. Part 2, Dual Method of Laying Highlights Rail Practices, tells how a 54-man gang lays eight welded rail strings in a day and discusses welding, heat-treated rail and hardening of frogs. Part 3, Top Efficiency Is Goal in T&S Operations, tells how highly mechanized system gangs are organized around machines, including those which remove ties for possible reuse. Part 4, Innovations Feature Prefabrication of Turnouts, Track Panels, tells how turnouts are produced for rail relay programs and new industrial tracks. Track panels are used in building sidings and industry tracks and for reconstructing tracks damaged during derailments.

Railway Track and Structures Vol. 71 No. 11, Nov. 1975, pp 16-20

PURCHASE FROM: XUM Repr. PC

DOTL JC

C2 129180
TRACK GEOMETRY CAR, MANAGEMENT USAGE
At Canadian Pacific tables and graphs are drawn up from track geometry car recordings and these supply information easily interpreted by the various different levels of staff in the Track Maintenance Department on: immediate action, long or medium term planning. This article describes such working methods.

Holt, RW *AREA Bulletin* Vol. 76 No. 653, June 1975, pp 561-572, 4 Fig., 3 Tab.

ACKNOWLEDGMENT: International Union of Railways, BD
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

C2 129852
DOT TEST TRAIN PROGRAM SYSTEM INSTRUMENTATION MANUAL-SIXTH EDITION
This manual describes track measuring instrumentation which has been developed during the report period and covers all instrumentation currently installed aboard the FRA test cars. The major emphasis of this report deals with the operation and calibration of the track geometry measurement system installed aboard test car T-3. Ancillary systems as well as equipment aboard test cars T-1, T-2, and T-4 are also summarized. New track measurement subsystems such as the alignometer, compensated accelerometer, grade, and magnetic gage systems are described briefly in this report. These systems are scheduled for prototype testing on the FRA test cars during the coming year, and will be fully documented in subsequent reports.
Sponsorship was from Federal Railroad Administration, U.S. DOT.

ENSCO, Incorporated, (DOT-FR-74-23) Ann. Rpt. FRA-ORD&D-75-26, Dec. 1974, 126 pp, 70 Fig.

Contract DOT-FR-20032

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-250776/AS, DOTL NTIS

C2 129860
STUDY OF TRACK IRREGULARITY INSPECTION SYSTEM WITH ACCELEROMETER
Measurements of rail profile and alignment are done by the mid-chord offset system; this is suitable for ride quality determinations of conventional vehicles. Japanese National Railways has been experimenting with a track profile measuring instrument for use on the Shinkansen which consists of an accelerometer mounted on the journalbox of one wheelset with the signal double integrated to give an absolute profile.

Takeshita, K Kishimoto, S *Railway Technical Research Institute* Quart Rpt. Vol. 16 No. 3, Sept. 1975, p 136, 2 Fig.

ACKNOWLEDGMENT: Japanese National Railways
PURCHASE FROM: Ken-yusha 1-45-6, Hikari-cho, Kokubunji, Tokyo, Japan Repr. PC

DOTL JC

C2 131244
RECORDING AND ANALYSING TRACK IRREGULARITIES [Die Registrierung und Analyse von Gleisunregelmaessigkeiten]
The author discusses the possible procedures for recording track irregularities, and methods of analysing this data. He then explains the relationship between the duration of the analysis and the evaluation errors to be expected, indicating the respective analytical reports both for analogical and digital evaluation. He also gives the results from the testing vehicle running on the lines of the DB and other railways. Finally, the article explains a procedure based on power spectral density, using multivariable regression analysis. [German]

Krettek, O *Glasers Annalen ZEV* Vol. 98 No. 11, Nov. 1975, pp 326-334, 1 Tab., 14 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

C2 131283
OVERALL EVALUATION OF TRACK CONDITIONS FOR THE PURPOSE OF PLANNING SYSTEMATIC MAINTENANCE [Syntetyczna ocena nawierzchni dla planowania napraw biezacych ciagtych]
It is necessary to know what the actual condition of track is to draw up overall track maintenance plans. The author describes a "synthesis" method for evaluating track conditions using an Amsler dynamometer car with Matisa measuring equipment. An index which is a synthesis of track characteristics and condition (Ws) is established on the basis of a statistical analysis of 5 parameters (levelling, gauge, track distortion, superelevation, and alignment). The analysis contains variations of Ws in relation to acceptable train speeds and lineload. The author concludes with a recommendation concerning the use of the Ws index for planning track maintenance operations. [Polish]

Semrau, A *Przeglad Kolejowy Drogowy* Vol. 22 No. 7/8, July 1975, pp 1-11, 7 Tab., 10 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Wydawnictwa Komunikafji i Lacznosci Ul Kazimierzowska 52, Warsaw 12, Poland Repr. PC

C2 131530
TEST TRAIN PROGRAM, SEVENTH PROGRESS REPORT
This report describes the progress of the Rail Engineering and Test Support Program during the period July 1, 1974 to June 30, 1975. Primary emphasis of the program was placed on the establishment of a viable operational track measurement capability. This emphasis resulted from efforts to meet the requirements of the National Track Inspection Program under implementation by the FRA's Office of Safety. Also covered in this report are special tests performed by the FRA test cars; operational improvements to the test car track measurement instrumentation; improvements in data-processing techniques that permit an analysis of track conditions in a more timely and more efficient manner; and highlights of other efforts performed under the Rail Engineering and Test Support Program.

Gunn, W
ENSCO, Incorporated, (DOT-FR-75-13) Prog. Rpt. FRA-ORD&D-76-140, June 1975, 140 pp, 28 Fig., Tab., 2 App.

Contract DOT-FR-54174

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-261186/AS, DOTL NTIS

C2 131622
NEW DEVELOPMENTS IN TRACK INSPECTION INSTRUMENTS
Instrumentation for a new automatic track inspection car is currently being built for the Federal Railroad Administration (FRA) by ENSCO, Inc. An existing rail safety research track measurement system, in operational service for several years, has successfully demonstrated that high-speed track geometry measurements can provide useful and timely inputs to FRA regional track inspectors. The new system will include the most advanced features of the instruments previously developed, expanded computer system hardware, and automatic rail flaw detection equipment. The new inspection system is being installed in an 85-foot rail car completely refurbished to accommodate the equipment and operating crew.

Presented at the 1976 Joint ASME/IEEE Railroad Technical Conference, Chicago, Illinois, April 6-8, 1976.

Demuth, HP Marine, RW (ENSCO, Incorporated); Mould, JC (Federal Railroad Administration)
Institute of Electrical and Electronics Engineers C76 457-7 IA, Jan. 1976, 8 pp, 14 Fig.

ACKNOWLEDGMENT: ASME, IEEE
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL RP

C2 131634
HI-RAIL TRACK GEOMETRY CAR
The purpose of this paper is to describe the track geometry vehicle presently operating on the Louisville & Nashville Railroad. The reasoning behind this unique approach to the measurement of track geometry was based on the experience of operating gage measuring equipment on dissimilar types of vehicles and on fulfilling specified objectives set forth at the outset of our track geometry program.

Presented at the 1976 Joint ASME/IEEE Railroad Technical Conference, Chicago, Illinois, April 6-8, 1976.

Borntraeger, JE Hopkins, GE
Institute of Electrical and Electronics Engineers C76 456-9 IA, Jan. 1976, 4 pp, 1 Fig.

ACKNOWLEDGMENT: ASME, IEEE
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL RP

C2 133570
MEASURING DEVICES OF TESTING CAR FOR SIGNAL APPARATUS
The measuring devices used for testing the wayside signal equipment of Japanese National Railways are described. All these are mounted on the high-speed inspection cars used on the New Tokaido line and on the conventional network. The functions checked are the ground coil for the automatic train stop device, the detector circuits used for grade crossing protection devices, and the regular track circuits. An elapsed distance system is also used for correlating measurements on the digital output tape. A computerized system is under study.

Kurotori, S *Railway Technical Research Institute* Quart. Rpt Vol. 16 No. 4, Dec. 1975, pp 189-190, 4 Fig.

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Ken-yusha 1-45-6, Hikari-cho, Kokubunji, Tokyo, Japan
DOTL JC

C2 136277
THE SM 125 RAIL EXAMINATION CAR [Die Schienenoberflaechenmessdraisine SM 125]
The SM 235 track motor car is equipped with a system for measuring the extent of rail corrugation; it operates on a permanent basis and is automatic. The author describes this system in detail and provides information on the practical aspects of the system and the results obtained. [German]

Harmening, E *Eisenbahningenieur* Vol. 27 No. 3, Mar. 1976, pp 97-101, 2 Fig., 2 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Dr Arthur Tetzlaff-Verlag Niddastrasse 64, Frankfurt am Main, West Germany

C3 033210
MODERN NON-DESTRUCTIVE METHODS FOR MATERIAL TESTING. CATALOGUE: APPLICATION OF THE TEST METHODS; RECOMMENDATIONS
The purpose of this report is to give an overall view of the results obtained so far and the development of non-destructive test methods by the railway Administrations. The Committee collected data on the application of non-destructive tests, of which the catalogue leaflets represent a concise summary. The leaflets of this catalogue refer to a selection of important components which are at present examined by non-destructive test methods on those Administrations included in the inquiry. The descriptions relate to components whose design, or behaviour in service, must be of immediate interest to all who already have experience of them and to those about to adopt similar designs. The sketches provoke thought not only in regard to service performance, but also to the necessity of repairing or of tolerating the presence of certain defects until such time as repairs can be carried out. Documentary report E 29/RP 1 is of considerable assistance for a sound understanding of the Catalogue. The report covers the detection of flaws in axle shafts, wheels, locomotive rod drives, plates, sheets and welded seams, diesel engine parts, and bearings by liquid penetrant, magnetic flux, ultrasonic, X-ray and gamma ray inspection.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Final Rpt. E29/RF/E, July 1962, Figs., Phots., 3 App.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-168)
PURCHASE FROM: UIC Repr. PC
DOTL RP

C3 033342
THE RATIO ALARM SYSTEM OF THE WESTERN PACIFIC HOT BOX DETECTOR PROGRAM
Describes the development of the Ratio Alarm system to detect overheating or distressed journals of hot-boxes. Uses a ratio between temperatures at hot end and cold end of the axle. A fixed percentage between the two journals is used. A signal at the scanner is set off, a tape in the dispatcher's office is also marked, which permits an override of the system if the dispatcher feels that the alarm can be ignored.

Unpublished paper presented for Signal and Communications Engineers.

McNeill, BL (Western Pacific Railroad) Vol. pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-295)
DOTL RP

C3 037248
TRAINING IN THE ULTRASONIC DETECTION OF FLAWS
Special training courses have been instituted at Derby for British Railways staff in ultrasonic detection of flaws and arc welding of metals. The ultrasonic school consists of a three week course for operators and an appreciation course of four days for supervisory staff. Student operators spend 12 days on practical training and three days in lectures on acoustic principles. Audiovisual aids and experimental demonstrations are used during the instruction. The welding school runs appreciation courses lasting five days, which qualifies the students to inspect and accept welded fabrications for the British Railways Board.

Railway Gazette Vol. 121 Aug. 1965, p 627, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-944)
DOTL RP

C3 037431
ULTRASONIC FLAW DETECTOR
The Sonatest TE/9 is a miniature battery-operated instrument for use where very small size and light weight are important. The unit measures only 8-1/2 times 5 times 10-1/4 in. weighs 7 lb, and is powered by a separate battery pack. Coarse and fine controls allow the range to be adjusted from 0.5 in. to 10 feet in steel so that axles can be tested with this instrument.

Railway Gazette Vol. 126 Mar. 1970, p 195, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-847)
DOTL RP

C3 037587
INVESTIGATION OF WHEEL SETS
With the increasing axle loads and train speeds, the stress limits are being approached for the steels used in the wheels, tires and axles. Described are the various aspects of the work being done to cope with the ever-increasing problems of axle, wheel tread and tire defects and failures. Magnetic particle testing and ultrasonic testing techniques are described, as also the balancing of the wheel sets and the testing of the form stability and strength of the axles. The results of these tests are tabulated.

Egelkraut, K Lange, H Mussnig, V (Bericht aus der Abteilung fuer Mechanik) *Eisenbahntechnische Rundschau* Vol. 15 No. 9, Sept. 1966, pp 346-360, 10 Fig, 2 Tab, 20 Phot, 3 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-470)
DOTL RP

C3 037848
TEST INSTRUMENT
The Hoyt Ultrasonic Bondmeter has been developed to check for proper bonds between the lining and the shell of a plain bearing. It should be especially useful in the examination of diesel engine bearings. Tests made with the unit are completely non-destructive. It can be used on newly-lined bearings, or for the routine inspection of bearings in service. The instrument will operate successfully with any white-metal, and with any shell material except cast-iron.

Railway Gazette Vol. 119 July 1963, p 76, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-960)
DOTL RP

C3 039270
FLAW DETECTION IN MODEL RAILWAY WHEELS
The purpose of the report is to present the results of a theoretical and experimental study of acoustic pulses propagating within a model railway wheel. The ultimate goal is the development of a method, using either ultrasound or audible sound, for detecting flaws in wheels that are moving. Ultrasonic pulses have been produced on the tread of each model wheel and an experimental investigation has been made of the propagation in the plate and on the tread surface. Echos from artificial plate flaws are identified, and, using pulse-echo and attenuation techniques, thermal flaws on the tread have been located. Records of pulse arrivals are made by photographing the oscilloscope trace with a Polaroid camera. The behavior of these pulses is shown to be in accordance with the predicted propagation of Lamb waves in the plate region of the wheel, Morse waves in the rim and surface waves on the curved tread surface. Artificial plate flaws have also been detected by differences in the spectrum of audio sound radiated into the air by a wheel excited with a random noise input. (Author)

Bray, DE Finch, RD
Houston University Final Rpt Feb. 1971, 234 pp

ACKNOWLEDGMENT: NTIS (PB-199956)
PURCHASE FROM: NTIS Repr PC, Microfiche
PB-199956, DOTL NTIS

C3 039429
HOT BOX WARNING DEVICE FOR CONTINUOUS MONITORING TO DETECT OVERHEATED JOURNAL BEARINGS
The devices discussed include: smoke and odor alarms, pyrotechnic devices, chemical detectors, infrared bolometer detectors, and mechanical and fusable plug devices.

Association of American Railroads Tech Rpt MR-441, Apr. 1965, 18 pp, 9 Fig, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-682)
DOTL RP

C3 039461
20 YEARS OF ULTRASONIC AXLE TESTING--ESTABLISHED METHODS AND MORE RECENT DEVELOPMENTS ON THE DB AND OTHER RAILWAYS
Ultrasonic tests of rolling stock axles, which several Railway Administrations introduced as early as 20 years ago, are now part of regularly

performed maintenance work. The present article describes test methods as well as probes and auxiliary equipment which were developed by the DB and which have found general acceptance. Information is given on which zones of the axles can be tested, on which detection sensitivity can be obtained and on which expenses have to be undergone. These considerations indicate which axle designs are suitable for testing and point to ways for testing even more complex axle design with justified expense.

Egelkraut, K (DB Research Institute)
International Railway Congress Association Jan. 1970, 23 pp, 11 Fig, 36 Phot, 7 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-756)
DOTL RP

C3 039597
ULTRASONIC EQUIPMENT FOR METAL FLAW DETECTION

In all the principle locomotive and carriage works of British Railways and also in the Acton Works of the London Transport Executive, ultrasonic flaw detectors have become routine testing instruments. This convenient method of non-destructive testing is providing even higher standards of safety for surface and underground rail travel by the location of hidden flaws which cannot be detected by the X-ray method. The use of ultrasonic methods allows every section of the wheels and axles to be rapidly and thoroughly inspected without dismantling the bogies, the saving in time and trouble being thus considerable. Pipe porosity hair-line cracks, slag inclusions, blow holes, laminations, fatigue cracks, and welding flaws are among the many defects which can be detected by this equipment.

Railway Gazette Vol. 96 Jan. 1952, pp 94-95, 1 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1249)
DOTL RP

C3 039613
DETECTION OF FLAWS IN FORGINGS

Increasing use is being made of ultrasonic equipment for the detection of hidden flaws in forgings, slag inclusion in welding, and so on. Apart from the value of such methods of inspection as a safety precaution, the detection of hidden flaws during the early stages of manufacture can contribute considerably to savings in machining costs, since flaws are not always apparent by visual inspection until machining reaches an advanced state. A diagrammatic representation of the testing of a steel bar with a discontinuity, using a Solus-Schall ultrasonic flaw detector is shown.

Railway Gazette Vol. 97 Aug. 1952, p 122, 1 Fig, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1266)
DOTL RP

C3 039621
APPARATUS FOR DETECTING WHEEL-SEAT FLAWS IN RAILWAY AXLES

The Research Department of the London Midland and Scottish Railway Company undertook the task of devising and developing a method of detecting wheel-seat flaws in railway axles without removing wheels from axles or even wheel and axle assemblies from the coach. The essential item consists of a rigid steel ring of square cross section, split diametrically to allow it to be clamped to the axle under test. Contact with the axle occurs at three spherical seatings, of which two are fixed to the inside of the ring and the third is adjustable and is screwed to grip the axle firmly after the two halves of the ring have been bolted together. The system described comprises essentially, two nominally rigid reference planes, fixed normal to the axle and set one on each side of a possible flaw situated near the inner end of the wheel seat. If such a flaw does exist the strength of the axle will be less in the direction passing through the center of the axle and the centroid of the flaw than in the direction at right angles to it. Details and case histories are given.

Johansen, FC *Railway Gazette* Vol. 78 1943, pp 190-192, 8 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1277)
DOTL RP

C3 039675
HOT-BOX DETECTORS IN THE U.S.A.

The problem is now being solved by the installation of hot-box detectors situated at strategic points beside the track and susceptible to any overheated box on a train passing at speed; they report the occurrence automatically to a controller or other operating officer. There is one detector on each side of the line and if there is an overheated box on one side or the other it is picked up by the detector on that side. The heat signal imposed on the telephone lines is instantaneously transmitted from the detector to the control office. Two separate Harmon F.M. carrier channels are provided, one reporting from each detector. The respective frequencies are 40 kcs. and 55 kcs. Any abnormal temperature is indicated to the controller on a graph, and he arranges for the train to be stopped by a special signal five miles after it has passed the detectors and for a maintenance call-light to be switched on. The train crew answering the call is informed of the position on the train of the heated journal, and decides whether the vehicle involved must be cut off.

Railway Gazette Vol. 112 May 1960, pp 561-562

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1391)
DOTL RP

C3 039995
FIRST PROGRESS REPORT OF THE COMMITTEE ON HOT BOX ALARMS

The object of the tests was to determine whether a device exists or might be developed which can effectively warn the train crews of the danger of a hot box. As a result of tests it was determined that the sensitive element of the device must be located in the bearing or the journal itself. The alarm should be sounded at a bearing temperature of approximately 350 degrees F for plain bearings. No one type of sensitive element or means of transmission was found superior to the others.

Association of American Railroads Tech Rpt AAR-MR-187, Apr. 1947, 1 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1462)
DOTL RP

C3 040049
MOBILE REFLECTOSCOPE INSPECTION OF RAILWAY CAR AXLES UNDER ROLLING EQUIPMENT ON THE CHESAPEAKE AND OHIO RAILWAY COMPANY

The Sperry Rail Service ultrasonic reflectoscope was tried to determine if this instrument could be used for fast inspection of caraxle journals for defects while they were still located in place in the rolling equipment. Having established that the reflectoscope was satisfactory for locating the faulty journals under freight cars, it was decided the best place to check these car journals would be the railway freight car repair yards. The King Midget automobile using an 8-1/2 hp driving engine, was modified to become the reflectoscope mobile carrier. This car is described and illustrated. A record is shown of 65 months of operation of the mobile reflectoscope units. A total of 363,821 freight cars have been checked. From this number of cars have been found 1002 cracked or defective journals.

Melrose, MF De Vilbiss, TE (Chesapeake and Ohio Railway)
American Society of Mechanical Engineers Conf Paper 59-A-228, Dec. 1959, 9 pp, 1 Fig, 1 Tab, 22 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1532)
DOTL RP

C3 040129
COMMENTS OF SERVO CORPORATION WITH REGARD TO DEPARTMENT OF TRANSPORTATION HOT BOX DECTOR STANDARDS

The test train was equipped with thermocouples imbedded in the bearing and outer box surfaces. Elapsed running time, ambient temperature, bearing and box temperatures were recorded in addition to train speed. All Hot Box Detectors commercially available employ infrared techniques which scan the friction journal box housing, a portion of the frame above the journal box top surface, or a region of the wheel hub. These detection methods are adversely affected by the air steam cooling effect on the outer surface of the target. The thermal gradient and time delay factors in hot box detection on friction journal trucks are illustrated.

Servo Corporation of America Test Rpt Dec. 1970, 6 pp, 2 Fig, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1629)
DOTL RP

C3 040132
INVESTIGATION OF FREIGHT CAR JOURNAL BEARING AND JOURNAL BOX SURFACE TEMPERATURES IN CONNECTION WITH HOT BOX DETECTORS
Laboratory and field tests are described for the Servo Hot Box Detective Unit, which is a track side installation. Some of the conclusions follow. Box surface temperature decreases approximately 0.6 degrees F for each 1.0 degrees F decrease in ambient temperature while the bearing temperature remains constant. The bearing temperatures increase more rapidly than the related box surface temperatures. The box surface temperatures do not always indicate that certain conditions are causing rapid increases in bearing temperatures. Operating conditions, such as restricted speeds, stops, etc., prior to trains passing over hot box detectors decrease the possibility of true hot box conditions being detected. It was recommended that the Servos be adjusted for changes in seasonal ambient temperature. Also it is suggested that the relocation of the sensor be studied.

Pinney, MA
Penn Central Transportation Company Test Rpt Jan. 1962, 45 pp, 27 Fig, 7 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1632)
DOTL RP

C3 040136
THE FUNDAMENTALS OF INFRARED HOT BOX DETECTION
Existing data on railroad car plain bearing temperatures are presented and interpreted by means of equivalent thermal circuits. Analyzing the radiation from the car truck, relating it to the characteristics of infrared measuring equipment, and discussing the handling of the resulting data suggests approaches to more efficient use of wayside hot box detectors. The effects of some ambient phenomena are presented. Further study of transient temperature conditions following lubrication failure is suggested.

Menaker, EG (General Electric Company)
American Institute of Electrical Engineers Conf Paper 21 pp, 7 Fig, 1 Tab, 8 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1636)
DOTL RP

C3 040166
DETERMINE THE OPTIMUM LOCATION OF HOTBOX DETECTORS
Two methods are presented to determine the optimum spacing of hotbox detectors. In both methods, optimum spacing is determined by economic factors, as well as other considerations. Growth or decline of traffic, changes in types and values of commodities hauled, changes in operating practices and changes in locations of car inspection points, all have a bearing on the results obtained from hotbox detectors. It may be desirable to change locations of detectors to fit new operating and/or traffic patterns. The increasing use of roller bearings must be taken into consideration when locating hotbox detectors. There is a short lead-time between the start of heating in a roller hearing and the presence of a critical case of a broken journal possibly within a distance of 30 miles or less. A good record should be kept of hotbox occurrences, set-offs and derailments, including costs, to determine if the study results are producing savings and reductions in hotbox set-offs and derailments due to hotboxes.

AREA Bulletin Vol. 71 1969, pp 131-139, 5 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-498)
DOTL RP

C3 040203
DESIGN AND DEVELOPMENT OF THE SERVO MODEL 8808 HOT BOX DETECTOR SYSTEM FEATURING RAIL-MOUNTED SCANNERS
The new Model 8808 Hot Box Detector System is a product of an extensive research program and has the following major features: a scanning technique which accurately accommodates the wide range of bearing and wheel configurations; reduced influence of the cooling air stream on the journal housings; increased system sensitivity on friction bearings; improved performance under snow conditions; total standby power capability; and reduced installation and maintenance costs.

Gallagher, CA
Servo Corporation of America Conf Paper May 1970, 7 pp, 16 Fig, 10 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1662)
DOTL RP

C3 040240
GRS OPTICALLY GATED WHEEL THERMO-SCANNER UNIT-OPERATION INSTALLATION MAINTENANCE
The GRS Wheel Thermo-Scanner Unit is a solid-state system for detecting and indicating abnormally hot journal temperatures of railroad cars traveling at speeds ranging from 5 to 85 mph. In the basic bidirectional system, magnetic wheel detectors on both approaches to the scanner location initiate system operation. The track-mounted equipment consists of two mounting assemblies (scanner and blower), four wheel detectors, three arrester boxes, two junction boxes, and connecting cables. The basic bidirectional system also includes a modular equipment cabinet, with plug-in printed circuit boards, which is designed for mounting in a 19-inch rack in a wayside housing. A basic unidirectional system requires two wheel detectors and a direction relay printed circuit board. Transmission lines for output are described.

General Railway Signal Company PAMPHLET 1421, June 1971, 144 pp, 68 Fig, 1 Tab, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1704)
DOTL RP

C3 040317
STUDY OF FREIGHT CAR AXLE DESIGN TO WITHSTAND LOADINGS UP TO 10 RO 20 PERCENT IN EXCESS OF PRESENT AXLE LOAD LIMITS AND SUMMARY OF DATA ON AXLES FOUND DEFECTIVE BY MAGNETIC PARTICLE AND ULTRASONIC TESTING OVER A FIVE-YEAR PERIOD
This report covers the engineering study of recommeded axle dimensions for a load rating of 10 and 20 percent in excess of present axle load limits. This study covers the nominal 5-1/2" times 10", 6" times 11" and 6-1/2" times 12" axle sizes or respectively, 40,000, 50,000 and 60,000 pound per axle load ratings. This report also covers the results of a questionnaire sent to Member Roads to develop summary data on axles found defective when tested by magnetic particle and ultrasonic equipment with a projected estimate of the increase in expected failures when overloading beyond present axle rated capacities.

Association of American Railroads Res Rpt MR-404, 8 pp, 6 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1821)
DOTL RP

C3 040335
HOT BOX RESEARCH
In order to determine the causes of hot boxes and to direct further research on the journal box assembly and truck details for improvement of plain journal bearing operation, a task force was authorized to make a field survey of hot boxes. Many of the undesirable conditions found in this study were of the type that design and material changes could avoid. It was determined that with a good journal lubricator, over a thousand miles could be run before all the free oil was wicked from the box. It was also found that generally 5,000 to 10,000 miles could be run without adding free oil before the bearing was in distress. These data suggest that changes in journal box, bearing, lubricator and other components should be made to eliminate the need for any servicing of these items at intermediate terminals. With the use of a reliable hot box detector to locate journal boxes operating above normal temperature, it appears that trains could be moved through terminals with minimum delay and the hot box set-outs between terminals greatly reduced.
Only 2 pp of total report available

Association of American Railroads Res Rpt AAR MR-375, Dec. 1959, 2 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1688)
DOTL RP

C3 040366
ECONOMIC ANALYSIS OF OVERHEATED JOURNALS
The following conclusions were drawn from this study: 1. The adoption of a rule to scrap all axles having overheated journals, or any other modification to scrap certain axles having overheated journals will not be completely effective in the elimination of broken journals, or have appreciable effect on the reduction of hot boxes. 2. Axles which are severely overheated are more likely to have inherent thermal damage than those which have been slightly overheated. 3. The primary cause of the majority of all broken journals results from burn-offs during overheating. The most effective remedy is the reduction of the incidence of hot boxes. 4. The annual cost of arbitrarily scrapping all axles having overheated journals would be $5,181,903. 5. The annual cost of compliance with a rule which would require that 1/8 inch additional service metal be arbitrarily turned off each overheated journal would be $2,647,165. 6. Ultrasonic testing of car journals during periodic lubrication attention would remove from service journals with cracks or related defects. Annual cost: $874,667.

Association of American Railroads Res Rpt AAR MR-290, July 1957, 4 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1810)
DOTL RP

C3 040374
HOT BOX RESEARCH--FIELD SURVEY ON CAUSES OF HOT BOXES
In order to determine the causes of hot boxes and to direct further research on the journal box assembly and truck details for improvement of plain journal bearing operation, a task force was authorized to make a field survey of hot boxes. This survey was made on 131 repair tracks, in 15 shops, and in 61 transportation yards of 51 representative railroads. The geographical distribution of the railroads was selected to represent all of the regional territories of the United States, and to embrace operations under all of the climatic conditions encountered. Data were collected through the following methods: 1. By examination of 295 cars which had developed 341 hot boxes. 2. By examination of 17,256 journal boxes in transportation yards after switching, both hump and flat, and before servicing. 3. By examination of 2,422 journal boxes at terminals after inspection and servicing by the regular yard forces. 4. By examination of 3,628 journal boxes at intermediate points where no journal box attention is given. 5. By observations of general maintenance practices on repair tracks. 6. By measurement of 1,588 journal temperatures on 10 trains. 7. By examination of 32 journal boxes which had indication of above normal temperature as recorded by fixed trackside hot box detectors. 8. By examination of 158 journal finishes through the use of a profilometer. In this study, primary attention was given to the journal bearing and its immediately related mechanical parts. However, the scope was extended sufficiently to include determination of the condition of such items as springs, center plates, side bearings, truck sides, and bolsters.

Association of American Railroads Res Rpt AAR MR-360, July 1959, 3 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1819)
DOTL RP

C3 040502
ULTRASONIC TESTING OF RAILWAY COMPONENTS
Ultrasonic testing has expanded to the stage where it is a vitally important inspection method for two major railway components, axles and rails. It is likely that the use of the method will extend in many other fields. The success with which ultrasonic testing is now practiced is dependent upon three factors. They are: a thorough understanding of the type and position of flaws likely to occur in the component and the significance of flaw size; a sound knowledge of the principles underlying the use of ultrasonics for this purpose; and, a testing organization which can put sound techniques, well-trained men, and well-maintained instruments of the right type to work.

Wise, S (British Railways Board) *Institution of Locomotive Engineers Journal* Vol. 58 No. 321, Part 1, pp 77-110, 12 Fig, 8 Phot, 4 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1989)
DOTL RP

C3 040782
REPORT ON COMMITTEE ON WHEELS
As a result of two meetings in 1955 and 1956 and Committee action this report is submitted on the following subjects: wheels--cast steel. Progress reports on two experimental designs, AARX-2 and AARX-3 were analyzed and approval of both as AAR standards was recommended. Wheels-wrought steel. Ultrasonic testing was recommended on new diesel locomotive wheels for a two year period to provide additional data for correlation of size of discontinuity with indication. A dimensional study of design F-36 was completed and no changes were recommended. Wheels and Axles. A ballot to discontinue mandatory magnetic particle inspection of freight car axles between wheel seats was submitted. Wheel and Axle Manual. Complete revision of the Wheel and Axle Manual will be made after decision is reached on the adoption of new designs of cast steel wheels. Changes in specifications and designs for axle dimensions for passenger cars, spun multiple wear cast steel wheels, cast iron wheel defects and boring mill practice were also made.

Garin, PV (Southern Pacific Company)
Association of American Railroads Circular D.V.-1368, May 1956, 65 pp, 39 Fig, 7 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2032)
DOTL RP

C3 041016
HB DETECTOR HAS FAST SHUTTER
A high-speed mechanical shutter in the GE hotbox detector opens during the scan time but closes between journals. Because the shutter blocks the line of sight in the closed position, it becomes the ambient reference against which are readings taken of passing journals.

Tate, JD (General Electric Company) *Railway System Controls* Vol. 3 No. 2, Feb. 1972, pp 15-17, 2 Fig, 4 Phot

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

C3 041017
HOTBOX DETECTOR EVALUATOR REFINES DETECTION TECHNIQUES
A hotbox detector data evaluator operates in series with a hotbox detector to receive and analyze the analog temperature use above ambient of each journal of each car as it passes. It calculates the average rise for each car side, and the compares each journal on a given side of the car to the calculated average for that side to establish its ratio. Warning outputs are given whenever the resulting ratio exceeds adjustable preset values for warm and hot. The same process occurs simultaneously and independently for both sides of the car. The data evaluator may be used by itself to operate directly into the conventional signal system or into a wayside visual display panel. Also, a chart recorder may be added in parallel to the data evaluator to provide a permanent record.

Caulier, PW (General Electric Company) *Railway System Controls* Vol. 3 No. 2, Feb. 1972, pp 20-25, 12 Fig, 1 Phot

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

C3 041028
12 ROADS TELL OF HB DETECTOR USAGE
A survey was conducted among several major U.S. and Canadian railroads concerning hotbox detector usage including questions pertaining to location practices, maintenance of detectors, means of alerting train crews when detectors are actuated by overheated journals, and train-stopping criteria. This article is developed from replies received from 12 railroads using 209 General Electric, 88 General Railway Signal, 9 Railtron and 914 Servo Corp, hotbox detectors.

Railway System Controls Vol. 2 No. 10, Oct. 1971, pp 13-17, 1 Tab, 3 Phot

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

C3 041030
HOTBOX DETECTOR HAS GAIN CONTROL, SELF CALIBRATION
The GRS Wheel Thermo-Scanner unit utilizes two revolutionary features to provide highly reliable, low maintenance system operation. The ultra-high speed optically gated quantum detector ensures precise temperature measurement of the wheel hub, eliminating false readings due to sunlight. Dust and dirt, component aging, drift in alignment and ambient temperature changes are eliminated by a unique digital automatic gain control and self-calibration feature.

Anderson, RF (General Railway Signal Company) *Railway System Controls* Vol. 2 No. 10, Oct. 1971, pp 23-27, 2 Fig, 3 Phot

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

C3 041031
L&N HAS EXTENSIVE HOTBOX DETECTOR SYSTEM
Louisville and Nashville Railroad has now 52 hotbox detectors strategically located along main lines and on other lines handling heavy traffic density, such as coal. To more promptly alert train crews of hotbox detector actuation, L&N has installed digital display boards at some hotbox detector sites. Digital readout shows the location of the hotbox from the rear of the train and a flashing-white light tells which side of the train has the hot box. An additional safety feature is that immediately after passage of the train an integrity check is made of the operation of the detector system. If, for any reason, the system fails this integrity check, a flashing-blue beacon is lighted at the detector site to alert the train crew to stop the train and make an on-the-ground inspection of the cars.

Railway System Controls Vol. 2 No. 9, Sept. 1971, pp 14-18, 3 Fig, 1 Tab, 2 Phot

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

C3 041040
HOTBOX DETECTOR SCANS INSIDE
Increased train speeds, while increasing bearing temperatures, have also increased the cooling effect of the air stream and thus have made more difficult the early detection of bearing overheating. Bi-directional operation on single track has further complicated the situation, since the cooling effect is particularly noticeable when the train motion is toward the aperture. A rail mounted scanner, which scans inside the truck sideframe, offers significant advantages: the inside location is less effected by the air stream, is less effected by sun or prevailing wind loading, is less subjected to cooling effect by sun or prevailing wind loading, is less subjected to cooling effect of rainfall, avoids radiation from brake shoes, is indifferent to open or missing lids, and by offering a shorter scan path is less affected by swirling snow. The scanner, which is clamped to the rail, permits increased system gain and provides a more consistent scan, which is important for the increasing number of roller bearings in service. The rail mounted scanner features easy installation, and reduced maintenance since it is not dependent on a rail to tie relationship. The low basic system power requirement of 500 va makes it possible to use a 24 v battery as a standby source.

Gallagher, CA (Servo Corporation of America) *Railway System Controls* Vol. 2 No. 6, June 1971, pp 22-27, 5 Fig, 2 Phot

ACKNOWLEDGMENT: Railway System Controls
PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC
DOTL JC

C3 044027
BR PROVES THE VALUE OF HOTBOX DETECTORS
British Railways is now installing hotbox detectors in areas which are being resignalled, following a five-year period of evaluation. Hawker Siddeley Dynamics Engineering is supplying a further 22 detectors, bringing the number in service to over 100.

Railway Gazette International Vol. 129 No. 1, Jan. 1973, 2 pp, 1 Fig, 2 Phot

ACKNOWLEDGMENT: British Railways Board
PURCHASE FROM: IPC Transport Press Repr PC
DOTL JC

C3 044525
PULSE EXCITATION OF RAILWAY WHEELS
A review is given of current applications of acoustic principles to testing and performance evaluation of railroad equipment. Also, a brief review is given of previous knowledge of the propagation of dispersive pulses in wave-guides. Pulses of a single frequency are produced at a point on the outer circumferential surface of each test piece and are received at other points along its periphery. Records of pulse arrivals are made by photographing the oscilloscope trace with a Polaroid camera. Experimental results show that pulses originating from a small source on the rim of the model railway wheel propagate directly through the wheel and also through the interior and on the surface of the rim. The behavior of these pulses is shown to be in accordance with the predicted propagation of Lamb waves in the plate region of the wheel and the predicted propagation of Morse waves in the rim of the wheel.

Bray, DE
Houston University MA Thesis M-2165, Aug. 1969, 111 pp, 37 Ref

PURCHASE FROM: University Microfilms 300 North Zeeb Road, Ann Arbor, Michigan, 48106 Repr PC, Microfiche

C3 044526
ULTRASONIC FLAW DETECTION IN MODEL RAILWAY WHEELS
This paper describes feasibility studies for ultrasonic inspection of railroad wheel treads and plates. Ultrasonic techniques had an early application in the railroad industry for locating cracks in steam locomotive driving axles and crank pins. Wet and dry magnetic particle inspection is also widely used in the industry as is the liquid penetrant method. Acoustic techniques, however, appear to offer potentially greater convenience than these methods when it comes to wheel inspection.

Bray, DE Dalvi, NG Finch, RD *Ultrasonics* Vol. 11 No. 2, Mar. 1973, pp 1-7, 10 Fig, 1 Tab, 16 Ref

ACKNOWLEDGMENT: Ultrasonics
PURCHASE FROM: IPC Science and Technology Press Limited 32 High Street, Guildford, Surrey, England Repr PC
DOTL JC

C3 046928
20 YEARS OF ULTRASONIC TESTING. ESTABLISHED METHODS AND MORE RECENT DEVELOPMENTS ON THE DB AND OTHER RAILWAYS
Ultrasonic tests of rolling stock axles, are now part of regularly performed maintenance work. The present article describes test methods as well as probes and auxiliary equipment which were developed by the DB and which have found general acceptance. Information is given which zones of the axles can be tested, which detection sensitivity can be obtained and which expenses have to be undergone. These considerations indicate which axle designs are suitable for testing and point to ways for testing even more complex axle designs with justified expense.

Egelkraut, K *Rail International* Vol. 1 No. 1, Jan. 1970, pp 36-58

ACKNOWLEDGMENT: EI (EI 73 07085)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

C3 046932
SCL USES BIN-LOOP TAPES FOR HB DETS
Seaboard Coast Line is using Ampex Corp, FB-500 bin-loop reproducers at 27 hotbox detector locations to provide recorded messages to passing train crews. As the train passes a detector location, components of the system are automatically activated. Simultaneously, a counter begins counting the axles of the train; the infrared detection sensors search the train's axles and bearings for higher-than-normal temperatures; the bin-loop reproducer begins playing prerecorded information which will identify the exact location of any overheated areas; and the computer-switcher receives information which enables it to retrieve the proper data from the reproducer which is transmitted by radio to the train crew.

Railway System Controls Vol. 1 No. N4, July 1970, p 23
ACKNOWLEDGMENT: EI (EI 72 56342)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

C3 048158
NEW HB DETECTOR IS AVAILABLE
The difficulty in determining from a chart recording whether a high reading is a normally operating roller bearing or an overheated friction bearing is minimized by the use of the ES hotbox detector. A major feature of the ES hotbox detector is its sophisticated electronics for discriminating between heat signals from friction and roller bearings. Thus the number of false train stops caused by the different operating temperatures of these bearings can be reduced.

Railway System Controls Vol. 4 No. 10, Oct. 1973, pp 22-24, 6 Fig

PURCHASE FROM: Simmons-Boardman Publishing Corporation 350 Broadway, New York, New York, 10013 Repr PC

DOTL JC

C3 050443
BRITISH RAILWAYS EXTENDS ITS HOT BOX DETECTION NETWORK
The above article contains a review of modern railway operating conditions, which have made the detection of hot boxes very desirable, as well as of the considerations which guide the localization of the detectors, the technology and functioning of the Servosa and Hawker Siddeley detectors adopted by the BR, the use made of the information which they provide, and the different stages of the introduction of the network.

Rail Engineering International Nov. 1972, 7 pp, 5 Fig

ACKNOWLEDGMENT: International Railway Documentation
PURCHASE FROM: International Union of Railways, BDC 14 rue Jean Rey, 75015 Paris, France Repr PC

733, DOTL JC

C3 050568
HOT-BOX ANALYSIS IMPROVES PERFORMANCE AT N&W
Norfolk and Western Railway is attacking successfully the hot box problem. The key to that success is complete knowledge of all hotboxes, where and when they occur. This data is put into the Mechanical Department's own data processing equipment where it is assimilated for easy access and monitoring. Printouts give N&W periodic pictures of the problem and indicate where follow-up is necessary. N&W has two men traveling over the system to spotcheck cars for bearing maintenance problems and to teach proper inspection procedure. Evidence turned up by these sources provides the basis for training aids distributed to inspection and maintenance people throughout the system. Another source of information is N&W's Derailment Investigation Committee known as the "Go Team" that flies to major derailments.

Roberts, R *Modern Railroads* Vol. 28 No. 3, Mar. 1973, pp 68-70, 1 Tab, 2 Phot

PURCHASE FROM: Cahners Publishing Company, Incorporated 5 South Wabash Avenue, Chicago, Illinois, 60603 Repr PC

DOTL JC

C3 051963
IS THE CORRUGATION AND PITTING OF RUNNING AND ROLLER ASSEMBLIES CAUSED BY ULTRASOUND? [RIFFELN UND GRUEBCHEN AUF ROLL-UND WALZKORPERN, SIND SIE ULTRASCHALLBEDINGT?]
The corrugation of railway wheels, which is revealed on the test bench, is due to the tone-frequency bending vibration of the wheel discs. Corrugation which is vertical to the direction of running is explained by lateral ultrasonic waves. [German]

Werner, K *Eisenbahntechnische Rundschau* No. 4, 1973, 8 pp, 10 Fig, 18 Ref

ACKNOWLEDGMENT: UIC (1019)
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75-15 Paris, France Repr PC

1019, DOTL JC

C3 052634
DEVELOPMENT OF A DEVICE FOR THE DETECTION OF WHEEL-FLATS OF A CERTAIN SIZE. TESTING OF THE SYSTEM RECOMMENDED BY THE A110 SPECIALISTS COMMITTEE FOR THE DETECTION OF WHEEL FLATS
The report deals with devices for the automatic detection and indication of wheel-flats, developed on the MAV and SJ. A detailed account is given of test results and applications of the MAV and SJ devices. A cost/benefit analysis for the MAV device is given.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways A110/RP 3/E, Oct. 1974, 18 pp, Figs., 7 Ref., Apps.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

C3 054756
INSPECT WHEELS "IN MOTION": AT ITS ARGENTINE YARD, SANTA FE SET UP AND TESTED AUTOMATIC SYSTEM TO CHECK FOR FLAWS IN WHEELS
Scanning Systems Inc., of Danbury, Connecticut developed an automatic system to check for flaws in freight car and locomotive wheels. In its Argentine Yard, Santa Fe set up and tested this development which is known as "Wheelfax." Various types of cracks were identified by ultrasonics, a non-destructive testing method widely accepted in metallurgy. The article explains in detail how the system works and its ability of detection at speeds of up to 30 mph. The system is also said to provide faster test evaluation.

Progressive Railroading Vol. 17 No. 1, Jan. 1974, pp 50-52

ACKNOWLEDGMENT: CNR
PURCHASE FROM: Murphy-Richter Publishing Company 9 South Clinton Street, Chicago, Illinois, 60606 Repr PC

DOTL JC

C3 054781
IMPROVEMENTS OF MAINTENANCE CRITERIA COVERING THE RUNNING GEAR OF SHIN-KANSEN RAILCARS BY MEASURING THE TRANSVERSAL ACCELERATIONS OF THE BODY [SHIN-KANSEN DENSHA SOKO KANRI SHIRYO SEIDO UO KOJO NI KANSURU KENKYU]
Osaka engine shed officials measure, under 200 km/h on line conditions, the body accelerations of Shin-Kansen railcars each time the wheels are re-profiled (every 70,000 km). Following these measurements, an index is calculated in accordance with an empirical formula that is a linear combination of the acceleration occurrence frequencies classified by section (linear combination of the values of the acceleration distribution analysis). Bogie overhaul is scheduled in accordance with the value of this index. In applying this method, the JNR encountered difficulties due to the effect of 3 factors on transversal accelerations: the state of the track, the speed (the index is very sensitive to speed variations of only a few km/h), weather conditions (transversal stability is distinctly improved in rainy weather). The article describes how corrective laws were worked out to eliminate the effect of the first 2 factors. For the 3rd factor, it was decided to limit measurements to periods of wet weather. [Japanese]

Tanida, I *Denkisha No Kagaku/Railway Electric Rolling Stocks* Vol. 26 No. 6, 1973, 5 pp, 8 Fig

ACKNOWLEDGMENT: UIC (95)
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr PC

95

C3 072703
ACOUSTIC FLAW DETECTION IN RAILWAY WHEELS
Ultrasonic pulse propagation has been studied in quarter-scale model railway wheels. Surface waves traveling around the tread of a wheel have been used to detect simulated thermal cracks using both pulse echo and attenuation methods. Pulse echoes from simulated plate flaws have been found using a transducer positioned on the tread surface to produce Lamb waves in the plate. Plate flaws have also been detected from the differences in the audio frequency acoustic radiation spectra of good and defective

quarter-scale models, using a real time analyzer. The extension of this work to full size wheels with actual defects is currently in progress.

Ultrason Int, Conf Proc, Imperial College, London, England, 27-29 March 1973.

Finch, RD (Houston University); Bray, DE
IPC Science and Technology Press Limited Conf Paper 1973, pp 194-198

ACKNOWLEDGMENT: EI (EI 74 065238)
PURCHASE FROM: ESL Repr. PC, Microfilm

C3 072861
AUTOMATIC MEASURING OF WHEEL-TREAD INSIDE DIAMETER ON THE NC TURNING MILL [Automatisierung der Messung des Radreifen-Innendurchmessers an numerisch gesteuerter Karussell-Drehmaschine]
A friction-wheel diameter-measuring unit with digital indication is used for automatic and very exact measurement in conjunction with punched-tape controlled machining of the inside diameter of wheel treads on an NC turning mill. [German]

Heckner, J *Eisenbahntechnische Rundschau* Vol. 23 No. 10, Oct. 1974, pp 416-419, 4 Fig.

ACKNOWLEDGMENT: Eisenbahntechnische Rundschau
PURCHASE FROM: Hestra-Verlag Hernichel und Dr. Strauss, Darmstadt, West Germany Repr. PC
DOTL JC

C3 072862
METHODS OF LOCATING "HOT BOXES" ON THE DB [Ausbau der Heisslauferortung bei der deutschen Bundesbahn]
The Author briefly reviews the equipment used on the DB for locating "hot boxes", discusses success so far achieved and reports on the new procedure. The newer equipment can distinguish between "warm boxes" and "hot boxes", and thus facilitates corrective action. [German]

Meyer, HJ *Eisenbahntechnische Rundschau* Vol. 23 No. 10, Oct. 1974, pp 411-416, 5 Fig., 4 Ref.

ACKNOWLEDGMENT: Eisenbahntechnische Rundschau
PURCHASE FROM: Hestra-Verlag Hernichel und Dr. Strauss, Darmstadt, West Germany Repr. PC
DOTL JC

C3 080427
ULTRASONIC RAILROAD AXLE INSPECTION
This report describes the basic principles involved in the generation of ultrasonic waves and their general behavior in railway axles. Other topics discussed include the operation of typical flaw detection instruments and methods useful in identifying true and false defect echoes.

Prepared by Oklahoma Univ., Norman. School of Aerospace, Mechanical and Nuclear Engineering.

Bray, DE
Transportation Safety Institute, Oklahoma University Final Rpt. TSI-R-74-100, Sept. 1974, 34p

ACKNOWLEDGMENT: NTIS (PB-237031/0ST)
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-237031/0ST, DOTL NTIS

C3 096653
5000 MILE BOX CAR VIBRATION TEST
There has been much research and testing to measure shock and vibration. However, such work has usually been restricted to specialized objectives over a limited territory and without complete instrumentation. This paper describes a 5000-mile test of an instrumented box car in revenue trains over five different railroads. It was part of the AAR Technical Center's Freight Loss and Damage Program and the RPI/AAR Cooperative Truck Safety Research and Test Project. The 60-foot, 70-ton car was operated between Chicago and the West Coast on a round trip involving two different routes.

This paper was prepared for a Panel Discussion on Freight Car Dynamics at the Rail Transportation Division of the ASME, Winter Annual Meeting, New York, New York, 19-20 November 1974.

Guins, SG Olson, LL (Association of American Railroads)
American Society of Mechanical Engineers Nov. 1974, 22 pp, 12 Fig., 1 Tab.

PURCHASE FROM: ASME Repr. PC
DOTL RP

C3 097997
IMPROVED METHOD FOR MEASURING THE RESIDUAL STRESSES IN RAILROAD SOLID WHEELS
In order to estimate the residual stress in railroad solid wheels, a new technique called plate-cut-out method has been developed. Fundamental idea of this method consists in that the residual stress in the wheel can be separated into two constituent components, by taking account of wheel geometry. These constituent components of the residual stress are determined respectively through simple strain measurements and elastic stress calculations.

Nishimura, S Morita, Y Tokimasa, K *Japan Society of Mechanical Engineers, Bulletin* Vol. 18 No. 116, Feb. 1975, pp 114-122, 8 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

C3 098058
SOME OBSERVATION ON FATIGUE PHENOMENA IN A LARGE PLATE SPECIMEN OF SPRING STEEL AFTER SHOT-PEENING TREATMENT
To obtain the fundamental data for the nondestructive finding of fatigue damage in vehicle parts, the fatigue due to pulsating repeated bending in a large plate of spring steel which had been shot-peened to increase its fatigue strength as a vehicle part, was investigated. It was clarified that there were two ways to find the fatigue damage: to observe the changing state of the surface residual stress and to detect the internal cracks non-destructively.

Murayama, S Kohara, M Iwamoto, M *Railway Technical Research Institute* Vol. 16 No. 1, Mar. 1975, pp 35-39, 6 Fig., 4 Tab.

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Ken-yusha 1-45-6, Hikari-cho, Kokubunji, Tokyo, Japan Repr. PC
DOTL JC

C3 099355
ODOMETERS FOR RAIL APPLICATION
Available mileage counters were evaluated, anticipating the possibility of using mileage intervals, rather than elapsed time, for freight car inspection. Simple, reliable and reasonably low costing devices were required. Only two unpowered mileage counting odometers were uncovered, one built in the U.S., the other in Switzerland. The Swiss device is not currently available in this country, presumably because of its particular suitability to European style trucks. The American built device was tested in eccentric rotation and for accuracy at both low and average freight car speeds. It was concluded that the American unit could serve satisfactorily in freight service, without modification, at what would appear to be acceptable cost levels.

This project was sponsored by US DOT, Federal Railroad Administration's Office of Research and Development.

Seekell, FM
Transportation Systems Center, Federal Railroad Administration, (DOT-TSC-FRA-75-9) Intrm Rpt. FRA OR&D-75-70, May 1975, 16 pp, 4 Fig.

ACKNOWLEDGMENT: FRA, NTIS
PURCHASE FROM: NTIS Repr. pC, Microfiche
PB-244460/2ST, DOTL NTIS

C3 125885
INSTRUMENTATION FOR MEASUREMENT OF FORCES ON WHEELS OF RAIL VEHICLES
The information in this report covers the procurement, development and testing of instrumentation designed to measure the dynamic forces and temperatures which are created in the wheels of a load rail vehicle truck. The information contained herein is intended for use by scientific, research and engineering personnel who are involved in the measurement of dynamic loads of rail vehicle wheels.

Sponsored by DOT Federal Railroad Administration.

Association of American Railroads Technical Center, ENSCO, Incorporated, (LT-328) Proj Engr. FRA-ORD&D 85-11, May 1974, 103 pp, Figs., Tabs., 13 Phot.

Contract DOT-FR-20010

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-247154/AS, DOTL NTIS

C3 126989
AN IMPROVED METHOD FOR MEASURING THE RESIDUAL STRESSES IN RAILROAD SOLID WHEELS
These residual stresses are those resulting in particular from heating due to braking applied to the running surface of the wheel. The suggested measurement method admits that stresses in the wheel have two possible causes: a stress due to rim/plate interaction; a residual stress which remains in the plate after its separation from the rim. It stems from this analysis. Once strain gauges have been placed: the plate is cut by a lathe out of the wheel; the rim is sawn; and opening displacements are estimated by a simple elastic stress calculation. Diagrams and tables give the results of tests carried out on three types of wheel.

Nishimura, S *Japan Society of Mechanical Engineers, Bulletin* Vol. 18 No. 116, Feb. 1975, pp 114-122, 14 Fig., 1 Tab., 8 Ref.

ACKNOWLEDGMENT: International Railway Documentation, Selection of
PURCHASE FROM: ESL Repr. PC, Microfilm

C3 127609
COMPUTERIZED DATA ACQUISITION SYSTEM
The system described relates to tests of the performance and durability of diesel engines. The system is designed as a tool for the test operator to enable him to get better data faster. In front of him and adjacent to throttle and dynamometer controls is an Operator's Panel mounting a group of push-button switches, indicator lamps and projection type digital readouts. Any parameter of the test may be displayed on the right-hand side of the panel by pressing the Display button and three Number buttons to define the data point of interest. At the start of an engine test, the operator sets the speed control potentiometer to give the required wide open throttle speed, he then types into the computer the "On Cycle" command. From then on throughout the control period set point adjustments are made, at 1/10 second intervals, as a required percentage of both speed and throttle. Repeatability of the cycle over a 1000-hour certification run is excellent and adjustments due to engine improvement or deterioration can be easily accomplished. The techniques of carrying out total Real-Time control and the calibration of gaseous emissions analyzers have been developed and the software written.

Henderson, J (General Motors Corporation)
Intl Symp on Autom of Engine & Emiss Test, 2nd Proc Paper Vol. 2 1973, 26 pp, 2 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: London University, England Queen Mary College, London, England Repr. PC

C3 127836
RAILWAY DYNAMIC TESTS
The verification of running safety and the quantitative assessment of the comfort of railway vehicles involves the taking of many dynamic measurements. The author first lists the range of the main recordings required and explains how they are taken: fitting of gauges, isolation of the phenomenon to be studied and transformation of the results into readings that can be interpreted more easily (usually an electric process), amplification, filtering, remote transmission of this data, reception and recording. The complex behaviour of a moving vehicle means that numerous phenomena must be recorded simultaneously and continuously by a whole series of measuring instruments. The author describes and explains in three sections the techniques used for measuring stresses and wheel-rail interaction, the series of measuring instruments, and the interpretation of the many and varied experimental results obtained, particularly with the TGV 001 trainset and the Z 7001 railcar. These results are very close to those obtained by calculation; they show the high value of the method using an analogue computer. [French]

Joly, R *Revue Generale des Chemins de Fer* Vol. 94 July 1975, pp 417-452

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

C3 127840
THE S.N.C.F. EQUIPMENT LABORATORIES
The author, Ingenieur en Chef at the SNCF, Head of the Equipment Control and Laboratories Department, explains that these laboratories are now housed under one roof following the gradual amalgamation of six laboratories previously operating on the different railway networks. These networks comprised several laboratories on the Western Region (chemistry, physics, mechanical tests and metrology), and each on the South West (various mechanical tests and chemical analyses), Northern (mechanical tests), Eastern (mechanical tests) and former Alsace-Lorraine (various tests) Regions. These Laboratories have, since 1973, been completely centralised. The article therefore deals successively with the functions of these laboratories, their organisation(staff and means facilities), their main activities over the last two years. It highlights the existing facilities and the diversity of the work carried out: the equipment modernisation policy will be continued, in order that the research work planned in various spheres may be carried out in optimum conditions. [French]

Revillon, A *Revue Generale des Chemins de Fer* Vol. 94 July 1975, pp 408-416

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

C3 127852
AUTOMATIC FREIGHT-TRAIN SURVEILLANCE IN SWITZERLAND
Swiss Federal Railways has been carrying out field trials of a number of devices capable of identifying faults which can occur on freight trains and triggering alarms as monitoring points so the defective train can be stopped for examination. Closed circuit television is used for general checking of trains with videotape records being made. The other monitoring systems include detectors for hot journal boxes, stuck-brake detectors, infrared beams for detecting anything about trains extending beyond loading gauge clearances, excessive axle loading detectors and means of detecting flat wheels. It is concluded that all these systems are needed if danger of serious derailment is to be reduced.

Modern Railways Vol. 32 No. 325, Oct. 1975, pp 411-413, Figs., Phots.

PURCHASE FROM: XUM Repr. PC
DOTL JC

C3 127858
PRINCIPLES AND CRITERIA FOR THE DESIGN OF A RAILROAD TRACK TEST FACILITY
This paper discusses principles and criteria for design of a track test facility such as will be built by the Federal Railroad Administration to support various track research programs aimed at improving design and maintenance procedures. It is suggested the facility be as versatile as possible so that tests can include determination of stresses in rails due to vertical and horizontal loads, study of axial rail forces induced by moving trains and track buckling caused by temperature stresses and moving trains. Construction of permanent structures such as concrete piers should be avoided whenever mechanically possible.

Kerr, AD (Princeton University) *AREA Bulletin* Bul 654 Proc V77, Sept. 1975, pp 1-8, 6 Fig., 10 Ref.

ACKNOWLEDGMENT: AREA Bulletin
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

C3 128635
ANALYTICAL AND EXPERIMENTAL DETERMINATION OF NONLINEAR WHEEL/RAIL GEOMETRIC CONTRAINTS
The wheel/rail geometric constraint relationships for actual wheel and rail profiles are generally nonlinear functions of wheelset lateral displacement. Two of these relationships which strongly influence the lateral dynamics of

railway vehicles are the effective conicity and gravitational stiffness. An algorithm for the digital computer is presented that calculates these nonlinear relationships for arbitrary wheel and rail head profiles. An experimental apparatus was developed to determine the location of the wheel/rail contact points as a function of wheelset lateral displacement for arbitrary profiles. Experimental data obtained with this apparatus are presented for various cases which validate the results of the analytical procedure.

To be presented at the Winter Annual Meeting.

Cooperrider, NK (Arizona State University); Law, EH (Clemson University); Hull, R (Arizona State University); Kadala, PS Tuten, JM (Clemson University)
American Society of Mechanical Engineers 1975, 44 pp, 11 Fig., 9 Ref.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL RP

C3 131016
INTEGRATED CIRCUITS IN THE EQUIPMENT OF THE PONAB DEVICE FOR HOT BOX DETECTION [Integralnye shemy v apparature PONAB]

No Abstract. [Russian]

Mironov, EG Brodnikov, IU *Avtomatika, Telemekhanika I Svyaz* Vol. 19 No. 8, Aug. 1975, pp 8-10, 1 Tab.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Avtomatika, Telemekhanika I Svyaz Mezhdunarodnaya Kniga, Moscow G-200, USSR Repr. PC

C3 131264
OPERATING TEMPERATURE OF ROLLER BEARINGS IN WHEELSETS OF RAILWAY VEHICLES. CALCULATION-MEASUREMENT-EFFECTS-MONITORING

[Betriebstemperatur der Radsatzrollenlager von Schienenfahrzeugen, Berechung-Messung-Auswirkung- Ueberwachung]

No Abstract. [German]

Pittroff, H Sommerfeldt, H *Glasers Annalen ZEV* Vol. 98 No. 11, Nov. 1975, pp 317-325, 2 Fig., 2 Tab., 8 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

C3 134532
A TEST BENCH FOR HIGH SPEED TRAIN AXLE BOX BEARINGS [Banc d'essai pour roulements de boites d'essieux de trains a grande vitesse]

Different types of bearings are tested on a special test bench under identical operating conditions. The friction torque of bearings is measured for various combined loads. Temperature distribution is determined, and heat sources located. The behaviour of the bearings and different lubricants is also studied under real-life dynamic load conditions. [French]

Burnaby, LE *Revue des Roulements* No. 186, 1976, pp 1-7, 9 Fig.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Revue des Roulements Brussels, Belgium

C4 019415
FATIGUE CRACK PROPAGATION THROUGH WELD HEAT AFFECTED ZONES
Fatigue tests were performed on specimens containing weld heat affected zones at two orientations to the stress axis. Two steels were used, one a low alloy steel and the other a mild steel. It is stated that, since the tests were performed on actual heat affected zones under known stress conditions, the conclusions can be applied to the behavior of fatigue cracks in actual structures under operating conditions. The observations suggest that, when fatigue cracks are present, the integrity of a welded structure may depend on the toughness of the component with the lowest flow stress.
Published Jointly by Metallurgical Society of American Institute of Mining, Metallurgical and Petroleum Engineers and American Society for Metals.

Dowse, KR (Central Electricity Generating Board); Richards, CE *Metallurgical Transactions* Vol. 2 No. 2, Feb. 1971, pp 599-603

ACKNOWLEDGMENT: EI (EI 71 42841)
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

C4 024763
A STUDY OF PRE-CRACK FATIGUE, PART I
The report is an examination of current technological posture in materials fatigue, especially that area of fatigue before the formation of a finite or 'technical' crack. A computerized search of the literature was performed by the Defense Documentation Center leading to the establishment of a bibliography which was intensively examined. The various concepts and rules of fatigue damage were critically examined as were their effects on fatigue analysis. The fatigue implications of Non-Destructive Evaluation (NDE) were also reviewed with the objective of recommending new approaches. Throughout all, a number of specific recommendations for future activity were made and discussed. These are summarized at the conclusion of this report. (Author)

Zisfein, MB
Franklin Institute Research Laboratories, (FIRL-F-C2231-2) Final Rpt AFOSR-TR-71-1802, May 1971, 94pp

F44620-68-C-0068

ACKNOWLEDGMENT: NTIS (AD-728292)
PURCHASE FROM: NTIS Repr PC, Microfiche
AD-728292, DOTL NTIS

C4 033091
STRESSES AT RAIL JOINTS AS INFLUENCED BY BOLT HOLES
The failures of rails caused by bolt holes of joints (end breaks) have recently come to occupy the majority of rail breaks. In order to prevent such breaks it was customary to reduce the diameter of the bolt holes or to keep the holes away from the rail ends. The present writers conducted experiments upon joints of the structure actually used for 50 kg/m rails, bolts of different diameters, rails with bolt holes of different intervals and fishplates with bolt holes of different diameters and different intervals with an aim of ascertaining what type of a fish joint is the most durable.

Koyama, K Sasaki, N (Japanese National Railways) *Railway Technical Research Institute* Vol. 1 No. 3, Sept. 1960, pp45-49

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-028)
DOTL RP

C4 033095
RAILWAY TRACK VIBRATION INDUCED BY TRAIN MOVEMENT
The railway track under train movement suffers progressive deterioration, which is equivalent to multiplication of repeated train load and vibration induced. The paper presents the results of measurements on the aggravated track vibration and the comparative study of track vibration on the concrete ties and on the traditional ties. Ballast acceleration in two sections laid with concrete ties using tie-pads of 110 t/cm spring constant averaged 23 percent and 35 percent respectively, less than that of the section laid with common ties. The value in a section laid with concrete ties using tie-pads of 250 t/cm spring constant averaged 24 percent larger. There is a conspicuous difference in occurrence distribution of acceleration at the welded joint.

Sato, Y Toyoda, M Kobayashi, S (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 1 No. 4, Dec. 1960, pp28-31

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-032)
DOTL RP

C4 033120
RAIL WEAR LIMITS
The Southern Railway, after reviewing rail wear conditions which were thought to have been a principal contributing factor to derailments, found that approximately 40 percent of loss of rail head wear for 130-132 lb. rail was the amount beyond which such derailments had occurred. Limits to show the top wear limit and side wear limit to be allowed for the different rail sections for various classes of track. The corresponding limits for the smaller sections of rail were pretty much a matter of judgment, using the limits for the 130-132 lb. sections as a guide.
Private Communication

Magee, GM (Southern Railway) June 1971, 4pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-059)
DOTL RP

C4 033126
EXPERIMENTS ON LOCAL STRESSES OF RAILS IN PRINCIPAL USE IN SEVERAL COUNTRIES
There is room for improvement in the current JNR standards for rail section with respect to their effectiveness as beam members and also to their pattern of distributed local stress. The project of the new Tokaido trunk line construction now being pushed forward has prompted JNR to the renewed design of its rail section from various angles since 1958. Laboratory and field tests were conducted for contributing to a better design to the two tentatively designed rail sections of 67 kg/m for the new trunk line and to the current 50 kg/m one, as well as to the five sections of imported rails.

Sasaki, N Kakisawa, M *Railway Technical Research Institute* Quart Rpt Vol. 2 No. 3, Sept. 1961, pp34-39

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-066)
DOTL RP

C4 033146
STUDIES ON CORROSION FATIGUE BY POTENTIAL MEASUREMENT
Using specimens made of mild steel (SS-41), fatigue tests were carried out both in air and in the corrosive medium of 1 N sodium sulfate solution acidified to pH 2.2. During fatigue testing, the corrosion potential of a specimen was recorded by a vibrating reed electrometer and the rate of corrosion was determined by colorimetry of total iron in waste solution. The results of potential measurement show that under alternating stress, the potential decreases after keeping a constant value for some hours. By the wet-dry stage fatigue tests, it is confirmed that the period until potential decreases accords with the so-called "Incubation Period", that is concentrated stress at the bottom of corrosion pits just reaches a fatigue limit, with initiation of potential decrease. In the end, the incubation period can be known by potential measurement, and by repetition of a few wet fatigue tests. A curve of stress concentration which rises with numbers of stress cycles under an acidic environment can be traced.

Kose, Y Ogawa, Y (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 8 No. 1, Mar. 1967, pp3-6, 3 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-100)
DOTL RP

C4 033183
RAILWAY TRACK STRUCTURE FOR HIGH-SPEED TRAIN
Examines the specifications of rail, fastenings, ballast vs. precoated with asphalt ballast, subgrade construction, longitudinal forces present when welded rail used on a bridge, transition curves and PC ties to be used on the New Tokaido Line. Results of tests of the above under high speed conditions are also discussed.
Special Issue

Hoshino, Y (Japanese National Railways) *Railway Technical Research Institute* Nov. 1961, pp4-14

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-137)
DOTL RP

C4 033190
TEST RESULTS BY FULL SIZE WHEEL-AXLE FATIGUE TESTING MACHINE

For the perfect solution of the problem of preventing train accidents due to axle failure, it is necessary to get an accurate grasp of mechanism of fatigue crack initiation and its propagation in wheel axle. From this standpoint, it was decided in 1964 to develop a full size wheel axle testing machine and the developed machine was set in RTRI and now, several kinds of fatigue tests have been carried out using this machine. This report describes the general performance of the machine and a few fatigue test results about old axles or new axles. The forms of wheel-seat are four kinds and the heat treatments of axles are two kinds.

Mori, B Yaguchi, S Nakamura, H Tanaka, S Hatsumo, K (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 9 No. 3, Mar. 1968, pp133-135

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-146)
DOTL RP

C4 033205
MAINTENANCE OF THE WHEELSETS OF TRAILER STOCK. CATALOGUE OF DEFECTS ON THE WHEELS OF RAILWAY TRAILER STOCK

This report forms a contribution towards the standardization of the terms used for designating the most frequent defects encountered on the wheels of trailer stock wheelsets. The defects have been grouped according to their location i.e. running tread and surface of the flange, wheel rim with tyre (solid wheel) or tyre and rim (tyre wheel), wheel disc, hub. For each type of defect, its designation, characteristics and apperance accompanied whenever possible by one or more characteristic photographs, have been indicated. In addition, information has been given concerning the means for detecting the defect, recommendations (of a general nature) concerning the procedure to be adopted following its detection, and its probable origin.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B79/RP 10/E, Oct. 1970, 11 pp, 2 Fig., Phots., 1 App.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-163)
PURCHASE FROM: UIC Repr. PC
DOTL RP

C4 033207
BEHAVIOUR OF THE METAL OF RAILS UNDER THE REPEATED ACTION OF WHEELS. STUDY OF THE FIELD OF STRESSES IN THE ELASTO-PLASTIC ZONE

This report contains the results of the various calculations effected so far. These can be considered as preliminary calculations carried out before proceeding to the complete calculation of the stresses in a railhead. The report likewise contains several analytical studies, both for the purpose of gaining a better insight of the stresses (the methods and the formulae are, as a rule, well known, though, generally speaking, the numerical results are not published) and for rendering possible a comparison of the results obtained by means of the numerical method with those obtained by means of exact calculations.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Interm Rpt Mar. 1964, 102pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-165)
DOTL RP

C4 033208
MUTUALLY PERMISSIBLE WEAR PROFILES OF WHEEL TYRES AND OF POINTS AND CROSSINGS. ASSESSMENT CRITERIA FOR THE PERMISSIBLE WEAR PROFILES OF WHEEL FLANGES AND SWITCH COMPONENTS.

Studies include the investigation of the wear forms of a great number of worn wheel flanges used on various types of vehicles (passenger coaches, wagons, railcars, electric and diesel bogie locomotives) and of worn rails in areas containing points and crossings so as to obtain an adequate basis, adapted to practical demands, for arriving at a judgment. Starting from a characteristic wear profile of a flange a track guage was developed, permitting the verification of the compatibility of the wear profiles of the ironwork of switches with such a flange.

Measurements conducted using the gauge enable development of wear forms of rails endangering the traffic to be detected (particularly in sections containing switches and stock rails) and they indicate, at the same time, how this risk can be eliminated and how their use can be prolonged by reprofiling operations. The results of the studies are that it will be possible to deduce, from an analysis of the geometry of the contact between flange wear shapes and track, the compatibility criteria adapted to practical conditions and only requiring simple measures to be taken on the wheel and the switch work items (checking by means of the gauge). This procedure will lead to a decisive improvement of the riding safety of vehicles.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Rpt C70/RP 1/E, Apr. 1969, 30 pp, 22 Figs., Tabs, 5 App.

ACKNOWLEDGEMENT: Battelle Memorial Institute (BCL-166)
PURCHASE FROM: UIC Repr. PC

C4 033229
HIGH SPEED ROLLING STOCK. I. AERODYNAMIC PROBLEMS

Articles discusses unique problems of high speed trains. Aerodynamic problems such as testing of sealed-nonsealed train units, means to measure aerodynamic drag are discussed. Structural analyses of side frames, load tests, strength of bodies and components are also included. Testing of power transmission, effects of wheel flat, bearings and life guard are further investigated.

Hara, T (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. .I. Aug. 1964, pp9-19

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-096)
DOTL RP

C4 033233
DISCUSSION ON THE STRENGTH OF WHEEL-AXLE FOR HIGH SPEED TRAIN AND SOME FUTURE PROBLEMS

When the train speed increases to more than 200 km/h, the variance and increase of wheel-load will be more remarkable than in present cars. The train speed must be increased carefully, the bogie construction, the track construction and its maintenance method must be fully investigated. In future, problems of the thermal crack, tire flat and residual stress are very important for wheel-tire and the fatigue strength under complex stress amplitude and the study of increasing press-fit parts strength are very important for axles. According to all data, the critical speed of wheel-tire will be 300 km/h.

Nakamura, H (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 9 No. 3, Sept. 1968, pp171-173

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-179)
DOTL RP

C4 033239
REPORT NO. MR-439 ECONOMIC SURVEY OF AXLES WITH OVERHEATED JOURNALS

In order to determine the economics involved in this subject, a survey was made in the main wheel shop on five large railroads in the United States, covering the following items: (Item 1) How many axles are scrapped due to all causes except those handled for overheated journals? (Item 2) How many new axles are now being used as replacements for axles which are scrapped due to condemning limits for wear on wheel seats, journals or uncorrectable defects such as cracks? (Item 3) How many axles are now being used to replace axles which were overheated and badly scored and gouged? (Item 4) How many axles are considered useable, machined and then tested and found to be defective and subsequently scrapped under present Interchange Rules? (Item 5) What is the approximate expense of reclaiming by turning, magnetic particle testing for cracks, and placing axles in condition for use

under current Interchange Rules? The data thus obtained was analyzed and these conclusion were reached: The adoption of a ruling to arbitrarily scrap all axles which had an overheated journal will not eliminate broken journals from other causes, or affect the number of hot boxes; The principal cause of the greater number of all broken journals is burn-offs as a result of being continued in operation without being detected while overheating; Further reduction in the number of hot boxes will most effectively reduce these incidents; The net annual material and labor costs of arbitrarily scrapping axles having overheated journals which are presently reconditioned for further service under current Interchange Rules, based upon the secondhand value of the replacement axles, is estimated to be $403,752.13.

Association of American Railroads Report MR-439, Apr. 1964, 12pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-185)
DOTL RP

C4 033254
DURABILITY TESTS ON TRACK COMPONENTS
Use of a Vibrogile is found the most simplified and effective method for determining the durabilities of various track components such as the fastenings, ties, pads, etc. It was felt necessary to perform durability tests on the fastenings and other components, using a hydraulic fatigue testing machine which can apply a repeated pressure of constant magnitude with accuracy, though without any vibration, and thereby supplement the Vibrogile testing. Thus, the durability tests were carried out on the fastenings for the existing line and the new Tokaido trunk line, using both the testing machines.

Hida, M Takenaka, S Domae, H (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 4 No. 4, Dec. 1963, pp49-50

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-202)
DOTL RP

C4 033284
SHOCK AND VIBRATION THEORY
It defines terms used in a mathematical representation of shock and vibration which are part of railroad phenomenon and discusses mass, inertia, momentum, force as related to "railroad impact shock". In addition the relationship of railroad car spring, and effect of flat wheels or rail joints upon the suspension of the car are represented and discussed.

The Railroad Environment: A Guide for Shippers and Railroad Personnel.

Railroad Environment pp27-32

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-235)
DOTL RP

C4 033297
TRACK-TRAIN DYNAMICS STUDY PROJECT TR-14 RAIL-VEHICLE INTERACTION STUDY REPORT NO. 1 (PRELIMINARY ANALYSIS OF SAMPLE DATA)
As a result of various derailments, a task force was formed to investigate the dynamic forces exerted by locomotive and freight car wheels against the rail. Critical study was directed at the 3 and 2 axle trucks of high horsepower locomotives, 85 feet TFC cars, and 50 feet box cars. The objective of this investigation was to determine if dynamic forces of sufficient magnitude to cause derailment were being generated by equipment, track structure and operating practice, and to recommend whatever corrective action might be indicated. Extensive field tests of wheel-rail interaction were conducted in various territories between Los Angeles and Pine Bluff, Arkansas. An analysis of these test results led to the following general conclusions: 1. Dynamic forces of sufficient magnitude to cause derailments are being generated in every day operation of revenue trains. 2. The forces are also sufficient to cause greatly accelerated wheel and rail wear. 3. Forces of sufficient magnitude to exceed the ability of the track structure to resist permanent deformation in alignment are also being generated.

Lynch, JP TenBroeck, HR Wagner, TB (Southern Pacific Company) Southern Pacific Company Report No.1, June 1970, 126pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-250)
DOTL RP

C4 033299
FATIGUE TESTS OF RAIL WEBS
The study of the fatigue strength of rail webs has been continued. Tests were made on T-shaped specimens cut from the web of a 112-lb RE rail, under a range of stress which simulated as nearly as possible stress conditions encountered in service, namely, a bending stress ranging from a maximum compressive stress at the surface to a tensile stress 20 percent as great. Since the fatigue failures were in compression, the cracks progressed very slowly, and the criterion of failure was taken to be the number of cycles when the crack could be first detected. Eight T-shaped specimens were cut from the same piece of 112-lb rail and were shot peened. Tests indicated that shot peening raised the endurance limit approximately 32 percent over that for the unstamped specimens with the surface as rolled. To get some measure of the reduction in fatigue strength resulting from corrosion, it was suggested that fatigue specimens be cut from a corroded or rusty rail and tested in the same manner to determine the amount of weakening due to a rusty, pitted surface. A short piece of very rusty rail was obtained from which specimens were cut for these tests. The curve for these date indicates an endurance limit of 57,000 psi at 10 million cycles, or a reduction of slightly less than 3-1/2 percent below that for the non-corroded specimens. To observe the effect of water corrosion on fatigue strength, several specimens were tested with tap water dripping continually on them. The fatigue curve shows an endurance limit of 56,000 psi at 40 million cycles, which is approximately the same as for the rusty rail specimens.

Jensen, RS (Illinois University) *AREA Bulletin* Vol. 48 pp804-808

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-253)
DOTL RP

C4 033301
FIFTH PROGRESS REPORT OF THE SHELLY RAIL STUDIES AT THE UNVERSITY OF ILLINOIS
Several specimens of alloy steel were received for rolling-load tests to study their resistance to shelling. The chemical analyses, Brinell hardness and some physical tests of these steels, are given in Table 1. The heat-treated specimens were short lengths of rails and very little materials is available for physical tests until the rolling-load tests have been completed. Photographs of the shelling cracks for some specimens are shown. Heat-treated low alloy rails were much superior to any other specimens and compare very favorably with the 3-percent chromium rails and heat-treated carbon steel rails. The 3-percent chromium rail stood up to 5,000,000 cycles and the laboratory heat-treated carbon steel rolled 4,560,000 cycles before complete failure. The two tests made on the silico-manganese spring steel rails were discouraging as these specimens developed a brittle type of fracture after only 983,000 cycles and 657,000 cycles, respectively. Photographs of both of these failures are shown. The rolling-load tests of the as-rolled alloy steels were also discouraging as the best of these ran approximately one million cycles in the cradle-type rolling machine. These alloy steels could, or course, be heat-treated to produce physical properties which would give much better rolling-load tests.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 48 pp756-766

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-255)
DOTL RP

C4 033302
DEVELOPMENT AND CHARACTERISTICS OF FRACTURES UNDER ENGINE BURNS IN RAIL TOGETHER WITH INVESTIGATIONS AS TO THE EFFECTIVENESS OF WELDING UP ENGINE BURNS BY OXYACETYLENE OR ELECTRIC METHODS
This is a progress report covering rolling-load tests and metallurgical investigations on engine-burned rails. In summary: a driver burn of a rail causes extreme hardness because of the development of a martensitic structure. This constituent develops from the process causing the burn, namely, (a) friction heating and (b) rapid quenching. The martensite transformation apparently creates quench cracks because of the volume change. The quench cracks greatly reduce the fatigue resistance and the rail may fail in a shorter time. Attention should be given in the repair of driver burns by welding, to removing parent metal containing quenching cracks beyond each end of the burned area in addition to the burned metal, before weld metal is applied. Study should also be given to means of making the weld to obtain a minimum of oxide inclusions. Numerous photographs document engine burns and quench cracks in rail.

Akers, JB Armstrong, JE Barnes, WC *AREA Bulletin* Vol. 48 pp734-750

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-256)
DOTL RP

C4 033303
FIFTH PROGRESS REPORT OF THE ROLLING-LOAD TESTS OF JOINT BARS
This is a report on the tests of joint bar failures and it gives consideration to the revision of design and specifications Observations of tests are: Joint bars for 131-lb RE rail subjected to a wheel load increased in proportion to the increased section modulus of the bars, thus giving equivalent bending stress, render approximately the same joint bar life as the 112-lb bars. The cyclic life of the 131-K14 36-in. bars tested was somewhat longer than that of 24-in. bars of the same type. Top surface bearing at the rail end is wider on TR bars with the 11/16-in. fillet radius than on 112-lb headfree bars with 3/8-in. fillet radius. The average cyclic life of TR bars greater than that found with 112-B34 bars. Rolling-load tests on one lot of 112-B34 bars show an increase of cyclic life resulting from shot-peening. Variations in hardness from bar to bar of the same heat may result from variations in quenching temperature. Surface decarburization usually found on joint bars is readily detected in the Rockwell Test.

Alleman, NJ (Illinois University) *AREA Bulletin* Vol. 48 1947, pp714-729

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-257)
DOTL RP

C4 033306
THE EFFECT OF THE RATIO OF WHEEL DIAMETER TO WHEEL LOAD ON EXTENT OF RAIL DAMAGE
This is a report of progress on studies of pressure as affected by the area of contact between wheel and rail. One phase of this investigation involves the conduct of rolling load tests of rails subjected to wheels of various diameters and loads. To summarize, a depth hardness survey on a 112-lb rail removed from service after approximately 12,000,000 tons of traffic shows the maximum hardness to be at a depth of approximately 0.04 in. at a distance of 1-3/6 in. from the center of the head toward the gage side, the maximum hardness being Rockwell C 34.6. Tests on a full section 131-lb rail under a 75,000-lb load after 1,333,000 cycles (100,000,000 tons) of testing are as follows: For the 33 in. wheel--a hardness of Rc 15 on the tread and a maximum of Rc 32 at a depth of 0.15 in.; for the 50 in. wheel--a hardness on the tread of Rc 23 and a maximum hardness of Rc 27.4 at a depth of 0.10 in. Using "mutilated" head specimens and a 50-in. wheel it was found that a 58,000-lb load could be carried for 100,000,000 tons, but that a 63,000-lb load would break down the rail tread after 15-45 million tons.

Alleman, NJ (Illinois University) *AREA Bulletin* Vol. 47 No. 453, June 1945, pp725-741

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-260)
DOTL RP

C4 033307
EXPERIENCE WITH CORRUGATED RAILS IN AUSTRALIA
Article discusses the problems of rail corrugation in Australia. A case study is included which covers rail corrugation of the New South Wales Railways. The unique conditions present are analyzed and the probable contributors to corrugation are mentioned and discussed. Finally, American engineers analyze the conclusions and make suggestions and offer critiques.

Cowdery, GE (New South Wales Railways) *AREA Bulletin* Vol. 46 pp37-56

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-261)
DOTL RP

C4 033308
TENTH PROGRESS REPORT OF THE JOINT INVESTIGATION OF FISSURES IN RAILROAD RAILS
Report discusses the field testing of end hardened rails for batter and resulting weeping cracks which developed and were repaired by welding. A series of rails from Carey Ohio (C&O) were examined for weeping cracks and the rails in which they developed were compared as to air and water quenched end hardened rail. The last section discusses control cooled rails which failed in service. Eleven illustrations show the types of failure.

Moore, HF Jensen, RS Cramer, RE (Illinois University) *AREA Bulletin* Vol. 45 pp481-502

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-262)
DOTL RP

C4 033309
SECOND PROGRESS REPORT OF THE SHELLY RAIL STUDIES AT THE UNIVERSITY OF ILLINOIS
The laboratory studies of the cause and prevention of shelling of rail surfaces are carried on in cooperation with the AREA Committee on Rail, Assignment 11-Investigate causes of shelly spots and head checks in rail surfaces for the purpose of developing measures for their prevention. Low strength of the steel, as indicated by low Brinell hardness, seems to be a significant factor in the development of shelly spots on rails. No defects were found in the metal of these rails which might have contributed to the development of shelling. It was also found that the shelling on these rails developed differently from that described as starting internally in last year's report on shelly rails. Several photographs are presented to illustrate the shelling that occurred. The rolling-load tests to compare the flow of various kinds of rail steels under laboratory controlled conditions, described in the 1942 report, have been continued, and the results are now complete on 21 specimens. Eight rails have changed less than one hundredth of an inch and a ninth rail was only slightly over this value. In contrast to these rails are 12 rails which changed in profile over two hundredths of an inch. It will be noted that all the rails except two which changed in profile over two hundredths of an inch were below 300 in Brinell hardness.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 45 pp462-469

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-263)
DOTL RP

C4 033311
INVESTIGATE CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL SURFACES FOR THE PURPOSE OF DEVELOPING MEASURES FOR THEIR PREVENTION
As the subcommittee investigates this subject more fully, it has been found that shelling is a much more serious and wide spread condition than was first realized, and while the shelly condition may be visible in some cases, in many others fractures of the rail may occur without the defect becoming noticeably visible on the surface of the head; therefore, it is doubly important that a solution be found. In addition to a study of rail-steel compositions, heat treatments, wheel and rail contacts and pressure, the subcommittee may turn to a study of mill practices as a possible cause of shelly steel, or it may finally resort to a consideration of larger diameter wheels or lighter loads on the wheels. If the answer lies in some special composition of rail steel or in heat treatment, the investigation must enbrace a study of the possibility that the new chemistry or heat treatment may give rise to some other types of defects or that they may lead to excessive difficulties or expense in production. While this assignment covers both shelling and head checking, very little mention has so far been made of the latter. At one time the subcommittee was of the opinion that one solution would cover both defects, but recent developments indicate that this may not be true. This report covers shelling only.

Hewes, FS (American Railway Engineering Association) *AREA Bulletin* Vol. 45 pp446-462

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-265)
DOTL RP

C4 033312
SECOND PROGRESS REPORT OF THE ROLLING-LOAD TESTS OF JOINT BARS
Discusses the results of rolling load tests on joint bars. Details of test equipment, specimens, are discussed as well as table illustrating the test program of cantilever bending moment. Brinell hardness readings, wheel load position, design, bolt tension, bar reflectors and spring actions. Finally, a short report in the development and characteristics of the fractures which are formed beneath wheel bars in rail.

Alleman, NJ (Illinois University) *AREA Bulletin* Vol. 45 1944, pp434-445

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-266)
DOTL RP

C4 033313
INVESTIGATION OF THE IMPACT EFFECT OF FLAT WHEELS PRELIMINARY REPORT
The test reported the effect of wheel flat upon rail, tie plates, ties. Test situation included a test track over which a loaded coal car with a 4 inch long flat spot, was run. Stress was measured by special M.I.T. testing gear and a high speed camera. The tests were run at speeds of 5 to 40 mph to determine effect of speed upon stresses created by out-of-round wheels.

Magee, GM Cress, EE (Association of American Railroads) *AREA Bulletin* Vol. 45 1944, pp9-23, 6 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-267)
DOTL RP

C4 033314
STUDIES OF THE PRESSURE AS AFFECTED BY THE AREA OF CONTACT BETWEEN WHEEL AND RAIL. EFFECT OF WHEEL SIZE
The following is a progress report on one phase of this investigation, namely, rolling-load tests in which wheels of various diameters are rolled to and fro on a short length of rail for the purpose of determining the number of cycles of load application required to produce failure. The results of the rolling-load tests to fracture show considerable "scatter" and no very marked difference between the results of tests under a 50-in. wheel and those from tests under a 33-inch wheel. The vertical wear on rail 757C (33-in. wheel) was 0.046 in. at failure, whereas the wear on rail 757C1 (50-in. wheel) at 580,900 cycles was 0.041 in. At failure, 750,100 cycles, the wear on rail 757C1 was 0.0425 in. A second type of test being tried to ascertain the effect of wheel size on the rail is to measure the depth of work hardening in the rail head. The rail head appeared to have been work hardened down to a depth of about 0.45 in. by the 33-in. wheel with a maximum hardness of 296 at a depth of 0.15 in. A test on a section from the same rail rolled with the 50-in. wheel appears to have been work hardened down to a depth of 0.20 in. with a maximum hardness of 269 at a depth of 0.10 in.

Alleman, NJ (Illinois University) *AREA Bulletin* Vol. 45 1944, pp3-8

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-268)
DOTL RP

C4 033315
STRESS MEASUREMENTS IN THE WEB OF RAIL ON THE DENVER AND RIO GRANDE WESTERN
Progress on stress measurement in rail located in curved and tangent situations was measured, and reported. The vertical web stresses under different locomotives is included, and the varying speeds are listed. A comparison of stresses between 112 lb and 115 lb rail as well as 112 lb and 131 lb rail is included in the discussion.

Magee, GM Cress, EE (Association of American Railroads) *AREA Bulletin* Vol. 44 1943

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-269)
DOTL RP

C4 033317
INVESTIGATE CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL SURFACES FOR THE PURPOSE OF DEVELOPING MEASURES FOR THEIR PREVENTION
This subcommittee began its investigation with a field inspection on two heavy coal carrying railroads where the rail conditions are unusually severe. Committee has taken up its assignment under the three topical headings: shelling, head cracks and flaking, rating them as to relative importance in the order named. Flaking is not as serious as shelling or head checking as a cause of failures in rails. Seven rail flaws are illustrated.

Hewes, FS Armstrong, SE Barnes, WC *AREA Bulletin* Vol. 44 1945, pp597-610

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-271)
DOTL RP

C4 033319
INVESTIGATE JOINT BAR FAILURES AND GIVE CONSIDERATION TO THE REVISION OF DESIGN AND SPECIFICATIONS
Rolling load tests have been conducted more or less continuously for two years with this machine and valuable information has been reported in the various committee reports. This information has dealt with fatigue life of joint bars, wear, stresses, effect of bolt tension, effect of abnormal conditions of joint bar fit, behavior of various designs of bars, etc. The following tests to be made on the rolling-load machine: (a) effect of "cocked" position of bars, (b) effect of design of bars, (c) effect of bolt tension on rail end breakage, (d) determination of fatigue strength of joint bars. Observational measurements were made during the year and the traffic carried over this test and the resultant joint bar wear are not yet sufficient to justify definite conclusions. Careful examination was made of all joint bars removed for evidence of cracks. One bar made of rail steel was found to have two small cracks on the top fishing surface.

McBrian, R Akers, JB Alexander, WT *AREA Bulletin* Vol. 43 1942, pp602-603

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-273)
DOTL RP

C4 033320
SPECIAL COMMITTEE ON STRESSES IN RAILROAD TRACK. SEVENTH PROGRESS REPORT
Since 1914 this committee has conducted analytical and experimental investigations on the action of railroad track under the loads of locomotives and cars running at various speeds and for a variety of conditions. The tests herein reported were made to obtain information on the action of various types of rail joints in track when subjected to the loads of locomotives and cars at speeds up to 90 miles per hour. Testing equipment enabled tests to be made accurately and expeditiously in a way that had not been accomplished before. Tests were undertaken particularly to obtain information on the action of different forms of rail joints in track under the traffic of locomotives and cars running at various speeds and to learn the magnitude of the bending moments developed in the joint bars as compared with those developed in the full rail away from a joint. It was also desired to learn if possible how speed of train affects these various matters. To serve as a basis of comparison, the stresses and moments and depressions of the full rail in the same track under the action of the same locomotive and cars were needed. Tests were conducted at Elkton, Md. The test site was on a 14-min. curve to the right with superelevation of 1-1/2 in. Ahead of and behind this curve the compound curve became 33 min. The total curve extended over a distance of about a mile.

Talbot, AN Bronson, CB Burton, WJ *AREA Bulletin*

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-274)
DOTL RP

C4 033322
ON THE LIFE OF RAIL
Annual trend of rail failures of the Japanese National Railways in recent years amounted to 5264 in 1963. There are included in rail failures the numbers of broken rails, cracked rails and defective rails all together, they do not always cause interference to train operation. It is known from the figures that end break ranks the first and amounts to more than 60 percent. The number of end breaks is divided into two parts, namely in tunnels and out of tunnels. End breaks in tunnels are more frequent for their track length and the rails in tunnel have shorter life than the ones out of tunnels, due to unfavorable conditions of corrosion in tunnels of our country. End breaks almost occur as results of rail fatigue by train loads. Stress induced on rail varies in magnitude according to train speed, wheel load, lateral force and position of wheel contact on rail, and the stress distribution was found in many measurements to be a normal distribution or its combination in most cases.

Sato, Y (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 7 No. 1, Mar. 1966, pp28-31

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-004)
DOTL RP

C4 033324
SEVENTH PROGRESS REPORT OF THE JOINT INVESTIGATION OF FISSURES IN RAILROAD RAILS
The development of detector cars made possible the detection of many fissures before rail fracture had occurred, but it did not touch the problem of prevention of fissures. A "rolling-load" testing machine was designed and built which subjected a specimen of rail to repeated cycles of wheel load and bending moment. Before testing in this machine an etch test to detect the presence of shatter cracks was made on the rail from which the specimen was cut. Rolling-load tests showed the following results: Only shatter-cracked rails developed fissures, but not all shatter-cracked rails developed fissures. It is the complex stresses directly under a wheel load which cause cracks to develop into fissures. Bending moment tends to cause fissures to take a transverse direction, and accelerates their spread. No greater wheel load was required to start a fissure in a heavy rail than in a lighter rail. The minimum wheel load which started a fissure in the rolling-load tests was 40,000 lb. The wheel load necessary to start a fissure, the theoretical shearing stress in the zone where shatter cracks are located, the fatigue strength of rail steel, and the weakening effect of minute cracks (shown by fatigue tests of specimens) form a coherent picture of the mechanism of fissure formation and spread. The solution of the problem of preventing shatter cracks in rails was attacked by making tests of specimens from rails cooled in air and also controlled cooled. A large amount of study has been given to the problem of finding a nondestructive test which could be used to detect shatter cracks in new rails. Shatter cracks are so minute that changes, due to these shatter cracks, in properties or structure of metal around them, are masked by other variations in the metal. Unfinished work of the investigation relating to fissures includes formulation of proposed standards for control cooling of rails and for bend tests for acceptance of rails. Numerous photographs detail rail defects of the type described.

Moore, HF (Illinois University) *AREA Bulletin* Vol. 42 1941, pp681-751, 15 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-275)
DOTL RP

C4 033325
INVESTIGATE JOINT BAR FAILURES AND GIVE CONSIDERATION TO THE REVISION OF DESIGN AND SPECIFICATIONS
This assignment to investigate joint bar failures, included the study of cracks which may or may not lead to ultimate breakage. The two most common types of cracking are illustrated in Figures 1 and 2, namely, (1) fatigue cracks originating in the spike slot, and (2) fatigue cracks originating at the upper contact surface of the bar. To study possible means of eliminating the cracking of joint bars, tests in track and tests in the laboratory are being conducted along the following lines. 1. Resistance to cracking by improving the physical properties. 2. Photoelastic studies as to effect of design and bolt tension. 3. Fatigue tests, using full size bars of various design in assembled joints. 4. Observations as to the effect of saw swelling of the rail end.

McBrian, R Akers, JB Armstrong, JE *AREA Bulletin* Vol. 42 1941, pp666-679

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-276)
DOTL RP

C4 033326
SECOND PROGRESS REPORT--JOINT INVESTIGATION OF CONTINUOUS WELDED RAIL
Report of committee on welded rail includes a brief resume of past research and then continues into the present research area. The first covered is the testing of welded rail joints under repeated wheel load. The procedure, the endurance limit and fractures developed are included. A comparison between welds and joint bars was included. Metallographic tests of the welds are included and such tests as hardness, etching and metallographic examination of the welds are also included. Mechanical tests of the welded joints were also part of the test sequence. A complete comparison of the test are indicative of metal qualities rather than joints, and that the quality of metal is important to the joint strength as weld outline, cracks and other stress raisers in the joint.

Moore, HF Thomas, HR Cramer, RE (Illinois University) *AREA Bulletin* Vol. 40 1940, pp737-755

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-277)
DOTL RP

C4 033329
THE 1/5 SCALE MODEL WHEEL-AXLE FATIGUE TESTING MACHINE AND SOME EXPERIMENTS
Article discusses the design of a machine to test for fatigue and failure of wheel-axle assembly. Machine is used to test 1/5 scale of wheel axles for fatigue calculated from bending stress and S-N curves of axles, and measurement of amplitudes of shock waves generated when wheel axles ran over rail joints or have flat on wheel tread.

Nakamura, H Hatsuno, K (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 6 No. 3, Sept. 1965, pp47-50

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-280)
DOTL RP

C4 033339
STRENGTH OF VARIOUS TYPES OF EYE BOLTS FOR SWITCH STANDS
Report discusses test of eye bolts in railraod switches. First, tests were made of stress, range of tension and compression in operation. A total of three switches were used to determine actual conditions. Then a series of tests were conducted with eye bolts with different thread patterns, different diameters, metallurgies, hot or cold rolled threads, heat treatments and cold working. Tests simulated conditions of eye bolt in switch operation. Results of testing and recommended eye bolt size, metallurgy and thread type is included.
Test results, AAR Research Center for Canadian Pacific Railway.

Magee, GM (Association of American Railroads)
Association of American Railroads 53pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-291)
DOTL RP

C4 033350
PROTECTION OF RAIL JOINTS FROM CORROSION TO PREVENT RAIL END BREAKS
Many parts of the railway track including the rails are made of carbon steel. Carbon steel excels in strength but is prone to be corroded. Rail end breaks are considered as fatigue destruction caused by corrosion. Since stress and corrosion act at the same time, cracking is developed easily. It is because the fatigue strength of a rail decreases sharply in acid environments, that end breaks are more liable to occur in non-electrified sections than in electrified sections. Since corrosion has much to do with end breaks of rails in tunnels, the application of a proper protective method prevents end breaks of rails.

Kose, Y (Japanese National Railways) *Permanent Way* Vol. 6 No. 3, No. 22, Sept. 1963, pp1-13

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-304)
DOTL RP

C4 033351
RESIDUAL STRESSES IN THE RAIL
When rail fasteners are loosened, the rail bends because of the accumulations of deformations caused by stress, workhardening or unevenness of stress. The resultant bend of a rail is the result of the nature of the rail as in the differences between a common or quenched rail. Residual stresses in rail tend to decrease which finally lead to rail deformation as a result of the loss of equilibrium of the forces.

Yasojima, Y (Tokyo University); Machi, (Japanese National Railways) *Permanent Way* Vol. 8 No. 1, No. 26, 1965, pp1-11, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-305)
DOTL RP

C4 033358
SHELLING OF RAILS EXPERIENCED IN JAPANESE RAILWAYS
In some local lines of the Japanese National Railways and in major privately owned railways and subways in the Kanto and Kansai districts, rail failures caused by shelling of rails are showing signs of increasing. AREA Committee for Rail Shelling says that in curved tracks, if the rail heads and wheel flanges are lubricated, the incidence of shelling increases, but if

lubrication is stopped, head checks, flaking and shelling conspicuously decreased. Rate of progress of the fatigue caused by contact should be made to balance with the rate of the progress of the wear. Allowing some wear to arise and also preventing for large plastic flow to occur, such failure may be prevented.

Ito, A Kurihara, R (Japanese National Railways) *Permanent Way* Vol. 8 No. 2, No. 27, pp17-32

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-312)
DOTL RP

C4 033383
RAILWAY TRACK STRUCTURE FOR HIGH-SPEED TRAIN OPERATION
Discussion of factors related to track structure for high speed operation. Running tests include running stability over a ruptured rail, dynamic effects of wheel flat, dynamic stresses of prestressed concrete ties, behavior of embankments under high speed traffic loads, and measurements of train wind. Additionally, comparative studies of welded rails, wooden sleepers, and a test vehicle to be used for high speed track inspection are discussed.

Hojoh, T (Japanese National Railways) *Rail International* Mar. 1965

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-342)
DOTL RP

C4 033388
WORK-HARDENING BOLT HOLES IN RAIL ENDS
Causes of rail failure occurring at holes near the rail head are discussed. These are radial or star cracking caused by high shear stress in the web aggravated by presence of fish bolt holes. Stresses are caused by locomotives with small driving wheels. Improvement in rail resistance is the result of work hardening the surface of the holes. Accomplished by drilling undersize holes, and broaching or drifting with a spherical tool.

Wise, S (British Railways) *Rail International* Oct. 1960, pp863-865

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-348)
DOTL RP

C4 033389
SELECTED BY THE S.N.C.F.: MONOBLOCK WHEELS OF NON-ALLOY STEEL, SURFACE TREATED
Discusses the types of stresses to which wheels are subject. Also, the damage caused by stress and the ways in which they may be controlled. Thermic flows, exfoliations, fissures of wheel rims are wheel problems which are treated in detail, and a practical solution to these problems is discussed.

Ravenet, P Gauthier, P (French National Railways) *Rail International* Oct. 1963, pp696-714

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-350)
DOTL RP

C4 033404
THE BEHAVIOUR OF WHEEL SETS ON S.N.C.F. MOTIVE POWER UNITS (THE EFFECTS OF CERTAIN TYPES OF STRESSES)
Discusses stresses of wheels. These are residual and fretting. The second section deals with the causes of fretting and its relation to tensile and compressive stresses. These are caused by overheating of axlebox and its adjacent wheel box. The frequency of overheating increases because of roller bearing systems. The destruction of wheels because of horizontal rail reaction, wheel loading, wheel skid and localized thermal damage is also considered. The use of surface treated wheels is suggested containing different steels for safety, regularity and economics.

Gauthier, P (French National Railways) *French Railway Techniques* No. 4, 1969, pp188-201

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-366)
DOTL RP

C4 033407
RESULTS OF TRIALS WITH A NEW TYPE OF BOGIE DESIGNED BY THE SNCF
These tests dealt with the truck Y 207 and considered particularly the transverse stability of this truck at speeds of from 140 to 245 km/h, with wheel tires in tread worn condition, corresponding to 350,000 km of operation, and with tires worn to profiles to generate "shaking". After the wheels on this truck had actually made 350,000 km (217,000 mi.) without requiring turning for sharp flanges or instability on the track, and having an average depth of tread wear of 2 mm, this vehicle was tested at 140 km/h. These tests were the first ever run at speeds over 200 km/h with wheel treads in such worn conditions, and have significant results.

Mauzin, A (French National Railways) *French Railway Techniques* No. 3, 1966, pp145-148

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-369)
DOTL RP

C4 033430
THE STRENGTH OF FISH-BOLTS
A report on performance of hardened and non-hardened fish bolts, also bending-free bolts are included. Tests included the use of Vibrogir to determine the effect of vibration in the loosening of a rail-fish plate and bolt unit. Under the equivalent of a passage of 85 million tons, no looseness because of nut turning was found.

Umekubo, S (Japanese National Railways) *Railway Technical Research Institute* Quart Rpt Vol. 6 No. 2, June 1965, pp23-26

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-394)
DOTL RP

C4 033445
STRESSES ACTING ON THE RAIL–RECENT FINDINGS
Increased axle pressures and reduced wheel radii give rise to higher stresses in the rail head. If the permissible shearing stress is exceeded, fatigue fractures will occur in the rail head. This can be counteracted by using a steel of greater strength and purity. Also of importance are the additional flexural tensile stresses at the lower edge of the rail head. This permits an indirect measurement of the guiding efforts.

Eisenmann, J (German Federal Railways) *Rail International* July 1967, pp537-550, 3 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-411)
DOTL RP

C4 033448
WHY METALS BREAK
To list some of the principal modes of failure at present known: 1 Collapse due to buckling or general yielding, 2. fatigue, 3. brittle fracture, 4. creep, 5. stress corrosion, 6. corrosion fatigue, 7. tearing or shear failure. This paper has endeavoured to list some of the failure mechanisms which can lead to fracture in metals, and to show that the tensile strength of the metal has virtually no significance in any of the important failure modes, although it may be useful as a simple basis for comparison between different steels or non-ferrous alloys. Photographs show failures of rail, axles, wheels and bogies.

Wise, S *Railway Division Journal* Vol. 2 No. 2, Mar. 1971, pp162-188, 7 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-418)
DOTL RP

C4 037168
THREE DIMENSIONAL FINITE DIFFERENCE SOLUTION FOR THERMAL STRESSES IN RAILCAR WHEELS
Numerical solution is presented for both transient temperature and three-dimensional stress distribution in railcar wheel resulting from simulated emergency brake application; computer program was written for generating thermoelastic solutions and results include effect of shear stresses caused by axial-radial temperature gradients and high degree of boundary irregularity associated with this type of problem; program has been validated by computing thermoelastic solutions for thin disks and long cylinders, computed values being in good agreement with closed form solutions.
ASME Meeting, April 15-16, 1969.

Novak, GE (Materials Research Laboratory, Incorporated); Eck, BJ American Society of Mechanical Engineers Paper 69-RR-4, 8pp, 12 Ref

ACKNOWLEDGMENT: EI (EI 70 15900)
PURCHASE FROM: ESL Repr PC, Microfilm

C4 037199
EFFECTIVENESS OF ALLOYING RAIL STEEL WITH CHROMIUM
Service tests have proved that type R-50 railway rails made of steel containing 0.63 to 0.75% C and 0.7 to 1.0% Mn and alloyed with chromium (0.5 to 1.0%) have an increased (by a mean 25%) resistance to contact-fatigue defects, less wear per 100 million gross tons of freight, and less rippling of the surface after use than carbon steel rails of standard composition. These advantages are obtained if the total C1/4 Mn content of the steel is not lower than 0.88%.

Original text published in "Stal" n9, September 1969, pp828-30, published by Mezhdunarodynaya Kniga, Moscow G-200, USSR.

Kazarhovskii, DS Shnaperman, LY Kravtsova, IP Ravitskaya, TM Pavlenko, YP Skvortsov, OS Shvarts, YF *Steels in the USSR* No. 9, Sept. 1969, pp823-5

ACKNOWLEDGMENT: EI (EI 70 34498)
PURCHASE FROM: ESL Repr PC, Microfilm

C4 037204
STRESSES IN RAIL HEADS--COMPARISON BETWEEN THEORY AND EXPERIENCE [SCHIENENKIPFBEANSPRUCHUNG-VERGLEICH ZWISCHEN THEORIE UND PRAXIS]
This article describes the latest investigations into the problems of rail loading and stresses. Laboratory experiments with a plastic model of a rail are described, with the results charted. These are related to the tests and experience of the German Railways in their investigations of rail failures and damage. Charts are included which show the relations of the shearing stresses in the rail head to the wheel diameter and axle loading, the stresses increasing as the wheel diameter decreases or as the axle load increases. [German]

Eisenmann, J *Eisenbahntechnische Rundschau* No. 10, Oct. 1967, pp 355-361, 17 Fig, 4 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-465)
DOTL RP

C4 037213
LATERAL DYNAMICS OF RAILWAY VEHICLES
The fundamentals of lateral dynamics theory of railway vehicles is reviewed. Numerous topics are presented, including: stable running theory, longitudinal creep, forward speeds, sinusoidal path, forces acting, hunting, conditons for stability, critical speeds, profiled wheels, suspension, coned and profiled wheels, wear of trends, vehicle design, and track geometry.

Wickens, AH (British Railways Research Department) *Railway Gazette* Vol. 121 Dec. 1965, pp 987-990, 4 Fig, 2 Phos, 14 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-633)
DOTL RP

C4 037228
ECONOMICS OF TRACK IMPROVEMENT ATTENDANT ON SPEED-UP
This article discusses some of the factors involved in determining the maximum speed of trains in the context of achieving maximum economic benefit at minimum risk of safety and minimum maintenance. Train speed is examined in terms of its effect on (1) strength of track structure; (2) fatigue of track; (3) strength for lateral thrust; (4) safety against derailment; (5) ride comfort index and vibrations of car.

Yamamoto, H *Railway Technical Research Institute* Vol. 3 No. 1, Mar. 1962, pp 6-8, 3 Fig, 3 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-649)
DOTL RP

C4 037229
WELDED RAIL JOINT FRACTURES AND THEIR EFFECT ON 200 KM/H OPERATION
JNR conducted a series of tests to determine the effect of broken welded rail joints on trains running at high speed. A rail gap of 20 to approximately 30 mm was employed since this was considered the likely amount just after a rail fracture in winter on the New Tokaido Line. The train used for this test consisted of six 2-axle bogie type electric rail-cars with an axle-load of 15 tons. Items measured included: rail deflection, rail stress, stess on the fastening device, track vibration acceleration and sleeper stress and the like; most of these were measured using wire strain gauges. On-the-rolling-stock measurements included: wheel side thrust, whee load, bogie stress, car body vibration, axle box vibration and similar forces. The results of the test indicate that train operation on the New Tokaido Line is judged as completely safe from the point of view of possible broken welded rail joints, in that even the lateral discrepancy of ends of the broken rails and wheel side thrust at the train passing the broken point were found to be less than 1/2 of respective maximum limits for safe train operation, and values for car body vibration and other items were also found to be sufficiently small.

Matsubara, K (Japanese National Railways) *Railway Technical Research Institute* Vol. 15 No. 3, Sept. 1964, pp 21-24, 8 Fig, 4 Phos

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-650)
DOTL RP

C4 037235
DERAILMENT OF ELECTRIC PASSENGER TRAIN
The derailment of the last coach of an electric multiple-unit down passenger train on December 13, 1963, which subsequently came into glancing contact with the side of another passenger train, was caused by axle fatigue. This fatigue would have been detected if the prescribed frequency for ultrasonic inspection had been observed. It was suggested that no axle be tested less frequently than every 18 months. One passenger was killed and 31 injured.

Robertson, JRH (Ministry of Railroads, England) *Railway Gazette* Vol. 120 Nov. 1964, pp 953

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-931)
DOTL RP

C4 037249
TRACK STRESS RESEARCH
The purpose of this work was (1) to verify the speed allowance formula, (2) to investigate the increment of stress over and above the static effect under normal conditions from track defects, (3) to investigate the conditions of support at rail joints, (4) to investigate the stability of ballast, and (5) to investigate the effects on rails and sleepers of the lateral forces set up by the hunting movement of locomotives. In regard to (1) and (2) it was found that experimental static deflections and stresses are in reasonably close agreement with calculated values. In regard to (3), it was concluded that stronger fishplates are needed to facilitate maintenance and rail joints of inadequate strength are the cause of much of the impact effect. Increasing the number of sleepers will reduce this impact effect. In regard to (4), the shape of the sleeper was found experimentally to have no noticeable influence on its deflection under a given load, but stress distribution between the sleepers and subsoil requires investigation. In regard to (5), further investigation on curved track was recommended to confirm the consideration that design to rolling stock to reduce nosing on the sharper main-line curves would reduce the secondary stresses and thus offset the increased stress due to centrifugal effects.

Gelson, WE Blackwood, FA (Railway Department, India) *Railway Gazette* Vol. 73 Feb. 1940, pp 254-255, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-945)
DOTL RP

C4 037269
THE EVOLUTION OF THE AMERICAN RAIL
A review is presented of the development of the railway rail in America, including the change from iron to steel, the evolution of the modern American flat-bottom section, up to 152 lb. per yd. in weight, and present-day American rolling methods. Rail sections arranged in chronological order from the 5 ft. long, cast iron plate, used in 1767, to the 131 and 152 lb. rails introduced in 1930, are shown to trace the development of the

American rail. Results are reported of a study to compare 100 lb. and 131 lb. rails as to maintenance costs and life, as affected by increasing weight loads. The heavier rails extended the life, not only of the rails, but also the sleepers and fishplates.

Allen, CJ (Massachusetts Institute of Technology) *Railway Gazette* Vol. 75 Dec. 1941, pp 581-584, 1 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-976)
DOTL RP

C4 037308
HOW RAILS BREAK
The manufacturing defects described are in ingots; in rolling methods; a transverse fissures, the fractures caused by stresses set up in cooling. The failures described arising from service conditions may be caused by excessive wear; fatigue or impact; rail-end batter; corrosion in tunnels, at water troughs, or at wet ashpits; slipping by wheels; faulty heat treatment, welding or cutting; corrugation; or war damage. Rail failures in India in 1929 due to rolling defects resulted in the use of impact testing on the side of the rail-head being added to test specification. The temperature equalization scheme adopted by British mills in 1928 to avoid transverse fissures is given.

Dinsdale, C (London North Eastern Railroad) *Railway Gazette* Vol. 80 Mar. 1944, p 213

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1294)
DOTL RP

C4 037419
NEW BRAKE SHOE CUTS STOPPING TIME, REDUCES WEAR AND SPARKING
A new brake shoe completely interchangeable with the standard metal shoe promises better train control, increased life and almost total spark suppression. Key to the breakthrough is an alloy of iron which exhibits a vastly different metallurgical structure from that of a standard shoe. The Samson shoe reduced stopping distance 32 percent and confirmed the improvement in train handling. The Samson retained the favorable friction characteristics of the standard metal shoe at static breakaway and low speed. Comparative sparking under drag braking conditions tested with cheese cloth placed in the trajectory of sparks leaving the wheel. At 45 mph, sparks from the standard metal shoe ignited the cheesecloth in seven minutes; Samson caused no fire.

Modern Railroads May 1971, pp 49-52, 1 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-882)
DOTL RP

C4 037429
ON THE USE OF INDIVIDUALLY SUPPORTED FREE ROLLING WHEELS ON RAILWAY VEHICLES [ZUR FRAGE DER VERWENDUNG VON LOSRADERN IM SCHIENENFAHRZEUGBAU]
The kinematics of wheel-sets on railway vehicles is discussed in theory. The tests are reviewed which were made of individually supported, free rolling wheels in frames under vehicles without a rigid connecting axle from wheel to wheel. The conclusions of this study point out the following: free rolling wheels have no guidance capabilities along the rail; wear on the curves is not avoided by free wheels. Safety factor against derailments is less than with conventional wheel sets, since the free wheel cannot develop sine waves in its running, it runs free of such lateral vibrations and is therefore quieter. [German]

Becker, P *Eisenbahntechnische Rundschau* Vol. 19 No. 11, Nov. 1970, pp 457-463, 8 Fig, 3 Phot, 12 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-575)
DOTL RP

C4 037434
TRAILS WITH GLUED WHEELSETS
One of the most recent developments in the metal adhesives field is their use in the assembly of wheelsets. One reason for this is the increasing demand for lighness of unsprung parts. The normal method of assembly of wheelsets by interference press fit has reached the limits which the materials can withstand. A careful choice of the adhesive to be used is most important in all cases, but especially so for such highly stressed parts as wheels, axles and tyres. With these factors in mind, the German Federal Railway decided on an experimental application of the process. Four axles were assembled using adhesive methods in the repair works at Stuttgart-Bad Cannstatt. For the joints between the wheel hubs and axles a very strong adhesive of low viscosity was chosen, but it was decided to press on the axle in the usual manner. A first test on a wheelset testing machine at the Minden Research Institute took the form of running 10,000 km with a constant axleload of 17 tons. This produced no displacement of the glued components, and it was noted that the wheelset ran remarkably quietly.

Railway Gazette Vol. 125 Jan. 1969, pp 61, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-869)
DOTL RP

C4 037446
WHEELSET DEVELOPMENT REVIEWED BY ENGINEERS
Design and wearing qualities to accommodate increased speeds and axleloads predominate in the papers delivered at the Third Wheelset Conference. Spalling of wheels experienced on North American rapid transit systems had been brought about by wheel slip and it was recommended that a total adhesion system should be considered at the design stage of coaches. In introducing synthetic brake blocks where wheel tyre cracking existed and it was considered that tyre steels which should be used were those which did not have a hardening tendency and soft steels of low carbon content which were immune from heat cracking. Resilient wheels for use under rail vehicles for suburban and main line railways, cast steel wheels, hollow-tread profiles, wrought-steel wheels, and non-alloy wheels are also briefly discussed as well as cast steel wheels.

Railway Gazette Vol. 124 July 1969, pp 550-553, 1 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-853)
DOTL RP

C4 037457
ULTRASONIC RAIL TESTING AT THE ROLLING MILL
Studies have shown that fatigue defects which appear in rails in the track can always be traced back to segregations in the metal, inclusions or micro-cracks. Metallographic tests which show up these defects are lengthy, costly and must inevitably be restricted in scope because they involve destruction of the specimen tested. Consequently, it was necessary to find a non-destructive method of detecting these defects by sounding the whole length of the rail head. The ultrasonic method using echoes was chosen by SNCF and ORE. The Ralus equipment was designed to detect heteorogeneities which are particularly harmful to the performance of the rail in the track: non-metallic inclusions and flakes located in the critical zone of the rail-head where most fatigue defects originate. Studies have shown that the Ralus testing method does give a reasonable indication as to the quality of the rails.

Railway Gazette Vol. 124 Oct. 1968, p 752, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-873)
DOTL RP

C4 037470
DERAILMENT AT TYSELEY
An express passenger train comprising 12 coaches hauled by a Type 4 diesel-electric locomotive was approaching Tyesley North signalbox on the down main line at 60 to 65 mile/h when the bracket on the locomotive supporting part of the a.w.s. equipment became loose. The wheels of the rear bogie of the locomotive and of all 12 coaches derailed. Examination of the fractured bracket bolts confirmed that high stress fatigue failures had occurred in the four bolts. Use of maximum tightening torque of 758 lb-ft is essential to achieve the longest life under fatigue loading conditions. It was also recommended that the bracket design should be re-examined to see if longer bolts could be used.

Railway Gazette Vol. 124 May 1968, p 397

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-848)
DOTL RP

C4 037587
INVESTIGATION OF WHEEL SETS
With the increasing axle loads and train speeds, the stress limits are being approached for the steels used in the wheels, tires and axles. Described are

the various aspects of the work being done to cope with the ever-increasing problems of axle, wheel tread and tire defects and failures. Magnetic particle testing and ultrasonic testing techniques are described, as also the balancing of the wheel sets and the testing of the form stability and strength of the axles. The results of these tests are tabulated.

Egelkraut, K Lange, H Mussnig, V (Bericht aus der Abteilung fuer Mechanik) *Eisenbahntechnische Rundschau* Vol. 15 No. 9, Sept. 1966, pp 346-360, 10 Fig, 2 Tab, 20 Phot, 3 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-470)
DOTL RP

C4 037591
INTERACTION OF WHEEL AND RAIL WITH RESPECT TO TRACKING, WEAR, FREE ROLLING AND STRESS IN WHEEL SETS

The author examines the interaction of wheel to rail with respect to tracking qualities, wear of wheel tread and rail, free rolling and stress in the power wheel sets under power or braking. A picture is shown comparing the stress lines in the rail under a wheel with the flange away from the rail with that where the wheel tread and flange both exert pressure on the rail. The verification of the theoretical considerations of these conditions by actual measurements has been made by modern techniques, which are closing the gap between theory and practice.

Kurek, EG *Eisenbahntechnische Rundschau* Vol. 15 No. 9, Sept. 1966, pp 338-346, 9 Fig, 2 Phot, 12 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-475)
DOTL RP

C4 037616
THEORETICAL OBSERVATIONS OF RAIL HEAD STRESSES AT POINT OF LOADING

The author presents a theoretical treatment of the stresses in rail heads resulting from both vertical and lateral pressures, as well as the oblique loading from imposed wheel loads, including the torsional as well as the vertical and horizontal stresses. Specific attention is directed to the "S 49" and "S 54" rail sections.

Eisenmann, J *Eisenbahntechnische Rundschau* Vol. 14 No. 1-2, Jan. 1965, pp 25-34, 16 Fig, 16 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-517)
DOTL RP

C4 037626
BRITISH TIMKEN RAILWAY WAGON BEARING UNIT

A new railway wagon bearing unit is in use on railway freight vehicles. The new design constitutes a two-part assembly which completely replaces the conventional roller-bearing axlebox. Production of the new assembly is much simpler, and therefore much more economical, than that of a conventional axlebox. Normal service wear is confined to the axle guard grooves of the horsehoe adapter. These are linered, and the liners can be renewed without interfering with the wagon bearing unit.

Railway Gazette Vol. 106 Mar. 1957, pp 251-252, 1 Fig, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-528)
DOTL RP

C4 037653
DEVELOPMENTS IN SPHERICAL ROLLER BEARING AXLEBOXES--1

The design of the spherical roller bearing has been improved to give an increased fatigue life of some 200 per cent compared with that used in railway axleboxes for over 35 years. The principal feature of the spherical roller bearing, its self-aligning property, has not been affected by using only one spherical roller bearing per axlebox, but even in rigid boxes where two bearings are used side by side, the self-aligning property of this kind of bearing is still valuable. Test equipment for accelerated life tests is shown.

Railway Gazette Vol. 107 Dec. 1957, pp 655-656, 2 Fig, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-557)
DOTL RP

C4 037654
DEVELOPMENTS IN SPHERICAL ROLLER BEARING AXLEBOXES--2

The carrying capacity of a roller bearing is increased to a greater extent by using larger diameter rollers rather than by increasing the number of rollers. Except for the difference in the end faces of the rollers, the rollers in the new SKF Type C spherical roller bearings are symmetrical. The close conformity and the uniform distribution of the load over the roller length--give an increased carrying capacity of approximately 15 percent. This means approximately three times longer fatigue life, a factor of no little importance. The bearings are pictured in several railway applications.

Railway Gazette Vol. 107 Dec. 1957, pp 707-710, 5 Fig, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-558)
DOTL RP

C4 037655
EXPERIENCE OF UNDULATORY WEAR OF RAILS

Undulatory wear on corrugation in rails is universally considered to be of two main types: roaring rails or washboard track; and what is sometimes described as saddles. The majority of railways consider that speed has no relationship with corrugations. Undulatory wear appears from 3 to 12 months after laying. The general opinion is that braking decreases washboarding but increases saddles. In the U.S.A. experiments with an acetylene torch to temper the Martensitic area of the high polished spots of washboard corrugations caused the ridges in the track to disappear. Various methods of grinding have been tried, but none have proved permanently successful.

Railway Gazette Vol. 109 July 1958, p 90

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-559)
DOTL RP

C4 037658
JOURNAL STOPS FOR WAGON-TYPE PLAIN BEARINGS

In a new A.A.R. journal bearing assembly, with all dimensions nominal and journals central laterally, the maximum displacement from impact is 7/16 in. Bronze stops, cap screwed to the side wall of the journal box to prevent displacement of the journal out of its bearing were considered the most practicable means to achieve the desired stabilization. The increased bearing life obtained with the journal stops is principally because of reduced end wear and the elimination of spread linings.

Railway Gazette Vol. 109 Oct. 1958, pp 425-426, 2 Fig, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-565)
DOTL RP

C4 037667
A WHEEL PROFILE: FOR BETTER RIDING AND LONGER WHEEL LIFE

Riding qualities can be improved and wheel life can be extended by making rather modest modifications to conventional profiles. The present AAR profile has one major shortcoming in common with the conventional British profile, and one additional problem that is unique to railroading in North America. The common problem is that there are two points of contact between the wheel and the rail when flange guiding is required. The uniquely American problem is associated with the inward cant at a 1:40 angle whereas the angle of the tread face is 1:20. Because of the angle between the rail and the tread face, there is rapid tread wear immediately after wheels are turned and an attendant loss in lateral riding qualities. The proposed profile uses a basic taper of 1:40. A flange throat contour which at all points has a slightly larger radius than the head of the rail, and a short section of flange face at a 70-degree angle. The region of the tread face which gets the least use is relieved at a 1:10 tamper. Using a modified flange throat contour will improve the steering action of a wheel set lateral movement of the wheel will be opposed by a smoothly increasing lateral restraining force and on a curve the rolling radius of the outside wheel can increase much more than is possible with a conventional wheel set.

List, HA *Modern Railroads* May 1970, pp 61-62, 4 Fig, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-580)
DOTL RP

C4 037671
DISC BRAKES IN THE U.S.A.
In 1948 the Union Pacific Railraod decided to use disc brakes in new stock. When the first disc-braked cars were put in service, they were mixed with cars equipped with clasp brakes. Trains composed exclusively of cars with disc brakes were assembled. The results have been a reduction in noise and in jolting when trains are being stopped. Thermal cracking of wheel tires has been virtually eliminated. Certain interesting cost figures have been got out comparing the use of clasp and disc brakes on one of the trains over a 12-month period. The cast-iron tread shoes of the clasp brakes required renewal after every round trip of 4,598 miles, 73 changes of shoes thus being made during the year; the disc brake shoes ran an average of 90,000 miles each, and so required an average of 3.73 changes only. Over a full year, the renewals of short clasp brakes cost a total of $48,865.60 and of the long type $65,045.26, whereas the corresponding expenditure for Budd disc brake renewals was $7,221.48.

Railway Gazette Vol. 108 June 1958, pp 677-678

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-584)
DOTL RP

C4 037676
FRICTION MATERIALS FOR RAILWAY BRAKING
The Ferodo composition brake block is compared to cast iron brake blocks. The braking characteristics are shown for the average of 20 stops using emergency brake applications of a train travelling 50 mph. The deceleration time for the Ferodo brake was greater than the cast iron brake, but the stopping distance was less. A composition brake block is less abrasive to the wheel than a cast iron block, and the product of wear less harmful. Although the Ferodo block still wears more rapidly than the wheel, its life has been found to be equal to as many as five cast iron blocks in some instances. Flange profiles are shown comparing the two types of brake blocks as to flange wear.

Pritchard, C (Ferodo Limited) *Railway Gazette* Vol. 108 Feb. 1958, pp 250-252, 3 Fig, 3 Phot, 3 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-589)
DOTL RP

C4 037677
SPECIAL COMMITTEE ON CONTINUOUS WELDED RAIL
Rolling-load tests were made of specimens of continuous welded rail in the 12-in stroke machine on four acetylene welds, 4 electric welds, and 4 thermit welds. All of the thermit welds failed in this test. One acetylene weld also failed just below 2 million cycles. Other rolling-load tests were made in a 33-in. stroke rolling machine primarily to test the welds in the rail bases. All the acetylene and electric welds ran to over 2 million cycles without failure. Two thermit welds developed failures in the rail heads. A few other observations on possible causes of weld failures are listed, including grinding burns electrode burns, and cases where the flame goes out in oxyacetylene welding. The fastenings subcommittee reports five methods used to anchor welded rail across open-deck steel viaducts or long deck steel spans.

Cramer, RE (Illinois University); Wise, E, Jr *AREA Bulletin* Vol. 59 Feb. 1958, pp 895-904, 3 Tab, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-590)
DOTL RP

C4 037678
SERVICE TESTS OF DESIGNS OF MANGANESE STEEL CASTINGS IN CROSSINGS AT MCCOOK, ILLINOIS
This report covers the service performance of the solid manganese test castings in the crossings between the double-track lines of the Baltimore and Ohio Chicago Terminal Railroad and the Atchison, Topeka and Santa Fe Railway at McCook, Illinois. This solid pedestal design that was not depth hardened on the tread corners was retired after a service life of 3.60 years. This casting was removed from service because of the combined weakening effect of the cracks from the top to the bottom of the casting. On June 3, 1957, for the same defects, the solid pedestal design with depth hardening was retired after 4.44 years of service in the same crossing. Although the USS depth-hardened casting had more cracks at its retirement than the unhardened specimen, it is judged that the major portion of the increase in life for the depth-hardened one can be attributed to that treatment.

AREA Bulletin Vol. 59 1958, p 1010
ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-591)
DOTL RP

C4 037683
FURTHER THREE-DIMENSIONAL PHOTOELASTIC STUDIES OF STRESSES IN RAIL HEAD DUE TO WHEEL CONTACT PRESSURE
A transparent model of a rail head about two-thirds scale was constructed and tested. The model testing showed that the three principal stresses are compressive immediately under the wheel, but as we go away from the wheel both to the right and to the left, all these compressive stresses become tensile. The main difficulty in this study was not studying the stresses in the model of the rail head or the rail, but rather from the difficulties of interpreting the meaning of the stresses in relation to shelly rail failures, or failures in general.

Frocht, MM (Illinois Institute of Technology) *AREA Bulletin* Vol. 60 1959, pp 1167-70

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-597)
DOTL RP

C4 037686
MEASUREMENT OF RAIL HEAD WEAR
A novel method of rail wear measurement is being used on the London Midland and Scottish Railway in order to compare rails of special composition or rails which have been specially treated to increase resistance to wear. The apparatus is simple, and consists of a jig formed to the contour of the part of the rail to be measured, and a dial gauge reading to 0.5 in. by 0.001 in. graduations. The actual gauging can be done at the rate of about one minute per section.

Railway Gazette Vol. 73 Aug. 1940, p 228, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-600)
DOTL RP

C4 037687
ESTIMATING WEIGHTS OF RAILS IN THE TRACK
The Railimeter measures rail in two directions simultaneously, and indicates the weight of the section in lb. per year by a pointer on a scale. If side cutting is present, a reading from a side-cut gage is subtracted from the reading of the Railimeter. Where the rail is galled it is of course necessary to displace the chair at the gall when measuring the weight of this section. A chart estimating rail life based on the Railimeter reading is illustrated. The results obtained with this instrument compare favorably with more laborious methods previously used.

Brown, GW (London Midland & Scottish Railway) *Railway Gazette* Vol. 73 Aug. 1940, pp 203-204, 2 Fig, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-601)
DOTL RP

C4 037713
TRACK MAINTENANCE AND HIGH CAPACITY TRUCKS
The high capacity truck from the maintenance of way standpoint is the means by which the increased gross weight of the large modern freight car is transmitted to the track, roadbed, bridges, trestles, viaducts and culverts, over which it must pass. As such, its design, dimensions and position are of vital concern to those responsible for the satisfactory operating condition of the railroad. Stress in rails and joint bars, track deflection, maximum load on ties and effect on undergrade bridges require specific consideration in determining whether or not a car can be accepted for movement; and if so whether it will be free-running or whether it will be restricted as to speed and routing. An immediate concern in relation to high capacity car trucks is the anticipated increase in shelling rail failures due to increased bearing pressure. Shelling rail failures are the result of the plastic flow of metal from the middle portion of the head toward the guage corner under high shearing stresses produced by intense wheel loads eventually starting a horizontal crack. The Joint Committee on Relation between Track and Equipment has recommended maximum axle loads of 52,800 pounds on 33 inch wheels, 58,400 pounds on 36 inch wheels, and 62,400 pounds on 38 inch diameter wheels.

Hammond, WT (Pennsylvania Railroad) *Engineering Interchange for Railroad Advancement* Tech Proc Sept. 1965, pp 1-3

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-714)
DOTL RP

C4 037760
MAINTENANCE CHECKS FOR ROLLER-BEARINGS
SKF has introduced an instrument for shock-pulse measurement of roller-bearings. The technique is based on spalling or flaking damage in roller-bearings producing mechanical shocks. Short-duration high-frequency oscillations produced by the shocks are transmitted to the bearing housing and by fitting measuring nipples to the housing at selected points, the shocks can be registered by an accelerometer. The magnitude of these is a measure of the degree of damage.

Railway Gazette Vol. 126 June 1970, pp 471, 1 Fig, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-770)
DOTL RP

C4 037763
SNCF PROBES THE 200-300 KM/H SPEED BAND
Recent tests at high speeds have shown that ample adhesion exists to overcome train resistance at 300 km/h and no technical factors need prevent commercial operation on steel rails at this speed. High speed running does not seem to produce any particular wear of parts other than wheels, although a close eye is kept on the friction linings that damp the pantograph. For the track, the SNCF does not consider it economically desirable to raise maintenance standards beyond those now considered necessary for speeds of 150 km/h. The policy is to build the rolling stock in such a way as to exert no greater forces on the track at high speeds than the trains of 20 years ago caused at the lower speeds then prevailing. Ride quality and current collection are discussed.

Nouvion, FF (French National Railways) *Railway Gazette* Vol. 126 Aug. 1970, 5 pp, 6 Fig, 1 Tab, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-773)
DOTL RP

C4 037765
RAIL FASTENING TEST CENTRE OPENED
The test center is part of the Elastic Railspike Company manufacturer of the Pandrol Clip. Key personnel are listed. The Amsler hydraulic rig for simulating dynamic rail loading conditions is described. The laboratory also has nine fatigue testing machines to accommodate various types of rail fastenings.

Railway Gazette Vol. 126 Sept. 1970, p 687

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-775)
DOTL RP

C4 037772
WEAR OF RAILS ON CURVES
Abrasion caused by locomotives and electric motor coaches, the condition of the track, and methods of alleviation are discussed. Insufficient information is available to say what type of vehicle produces the most rapid wear in the outer rails on curves. Increase in tractive effort may result in increased transversal reaction and greater lateral wear of the rails. Rate of wear varies inversely as the radius of the curve, but no quantitative relation between degree of wear and radius has yet been established, nor have the effects of irregularities in curvature. What is certain is that excess or deficiency in cant causes unequal wear on rails.

Railway Gazette Vol. 100 Mar. 1954, pp 266-267

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-782)
DOTL RP

C4 037827
FLANGE AND RAIL LUBRICATION
The Japanese National Railways has experimented with systems to reduce wheel and rail wear. Results of tests show that rail oiling reduces electric current consumption by 66%, reduces wheel wear to 1.25%, and reduces rail wear to 1%, compared with dry rail. Three systems have been suggested for lubricating the rails: site lubrication where it is picked up by the flange; flange lubrication in the vehicle; and automatic lubrication of the inside rail edge. A comparison of various devices to accomplish lubrication is included as well as a description of each system. Benefits of lubrication for different situations are included in a series of tables and charts.

Fujinawa, I (Kinki Nippon Railway) *Railway Gazette* Vol. 123 Dec. 1967, pp 899-902, 10 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-909)
DOTL RP

C4 037840
HEUMANN-LOTTER TYRE PROFILE
The Heumann-Lotter tyre profile was evolved with the idea of giving somewhat greater safety against derailment of locomotives and rolling-stock. This profile was applied to all engine and tender wheels, and was felt to be of particular value with tender-first running with the tender nearly empty, a condition which gave the greatest risk of derailment. Before adoption as the standard profile by the German Federal Railway, 68 percent of all tyre-turning costs were due to needed flange re-profiling. Observations showed that the tyre mileage was 30 percent greater with the new profile than with the old.

Railway Gazette Vol. 122 July 1966, p 568, 2 Fig.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-924)
DOTL RP

C4 037854
WEAR AND CORROSION OF RAILS
The use of the Shaw Rail Contourograph to measure vertical wear is described and illustrated. The wide limits of specific rail wear on the British Railways and London Transport are shown as a result of corrosive influence of atmospheric pollution in tunnels and industrial areas. Annual wear is approximately proportional to the square root of the number of axles passing per annum. A comparison between the British and American rail wear values shows much lower values in America for specific wear at the same traffic intensity. This may be partly because of the higher carbon content in America where the relative humidity is above 80 percent for much fewer hours per annum, and atmospheric pollution from industry is less concentrated than in Britain. The effects of steel composition, axleload and braking on rail wear are discussed.

Dearden, J (British Railways) *Railway Gazette* Vol. 121 Jan. 1965, pp 518-521, 3 Fig, 2 Tab, 1 Phot, 13 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-989)
DOTL RP

C4 037861
HEUMANN TYRE PROFILE TESTS ON BRITISH RAILWAYS
A new tire profile, based on the studies of Prof. Heumann, was designed and is illustrated. This tire profile should assist in ensuring good riding qualities, increase the resistance against derailment and this in turn should reduce tire and rail wear, and ensure a favorable wear pattern. This can be done by ensuring one-point contact running and a gradual transition of the throat profile. The result of trials carried out with standard 32 ton British Railways coaches running on B4 type bogies with 3-ft. wheels, positive axle guides, 19-1/2 in. effectively long swing-links and helical springs throughout are shown. Ride index values during acceleration and wear patterns for the tires are given. The tests have shown beneficial results, although further tests are needed.

Koffman, JL (British Railways Board) *Railway Gazette* Vol. 121 Apr. 1965, pp 279-283, 9 Fig, 17 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-997)
DOTL RP

C4 037912
TYPES OF SLEEPERS AND SLEEPER MAINTENANCE
Wood, steel, and concrete sleepers are compared based on experience to date with each type. No alternative has been found to the cross-tie or sleeper and timber was almost universally preferred at the time. Steel sleepers begin to fail from corrosion followed by cracks around the baseplate. Concrete sleepers may fail through cracking with ultimate exposure of the reinforcement. On an annual cost basis concrete may prove to be the cheapest sleeper-but this opinion is based on an estimated 50 year life for pre-stressed sleepers and experience is insufficient to justify the estimate. Preservation of

wood sleepers is usualy by creosoting. The article concludes that treated timber sleepers with fastenings are approximate in cost to steel sleepers, with concrete sleepers costing more than either.

Train, JCL (British Railways) *Railway Gazette* Vol. 86 June 1947, p 615

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1104)
DOTL RP

C4 037932
MANGANESE-STEEL AXLEBOX LINERS
Wear of axleboxes, more than any other single feature, is responsible for requiring locomotives to be returned to the workshop for repairs, and the mileage between shoppings is directly connected with the wear-resisting properties of the materials of which the axlebox rubbing surfaces are composed. It became clear that any considerable improvement in shopping mileage would require different material for the flat surfaces of the axleboxes, and the practice of fitting manganese steel liners to roller bearing axleboxes suggested a line of attack. Details for fitting axleboxes with new liners are presented. The leading features which were observed during examination in the shops and sheds following mileage runs average 80,000 miles shows. 1. The surfaces of the liners which are in contact with one another become work hardened in service and take on a high polish. 2. A very interesting feature has been that reduction of "knock" or wear in a longitudinal direction has had also a beneficial effect on lateral wear. 3. Bolts and rivets of the horn liners have remained tight. 4. Scoring of the liners has been negligible. The manganese steel liner has been adopted as standard and it has fitted to new construction of all types. Apart from the potential increase in shopping mileage, the liners already are proving of considerable value from an operating point of view in reducing development of rough riding.

Railway Gazette Vol. 88 Apr. 1948, pp 514-516, 4 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1126)
DOTL RP

C4 037935
UNBROKEN MAIN-LINE CROSSING FOR CATCH POINTS
A special crossing was designed and tested for heavily traveled sections of the London Transport system. The advantages of this unbroken crossing are: (a) elimination of wear on the wing rail and nose of a normal crossing, resulting in much longer life; (b) elimination of the jolt as every wheel passes over a normal crossing, with reduction in wear on rolling stock; (c) reduction of maintenance packing of the crossing; and (d) elimination of one crossing check rail. This same type of crossing may be used in turnouts to sidings which are little used.

Railway Gazette Vol. 88 May 1948, p 549, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1129)
DOTL RP

C4 037985
AXLE-FATIGUE TESTING MACHINE
A testing machine, designed for investigating the fatigue strength of railway rolling-stock axles, has been installed in the new Central Research Laboratory of London Transport at Chriswick. The machine is of the resonant type driven by an electric motor through a slipping clutch which is incorporated to ease the starting and stopping conditions. The test specimen are of a typical axle size. The stress is measured by several resistance strain gauges, calibrated in position, and various protective devices are provided to enable the machine to be left running unattended

Railway Gazette Vol. 113 Dec. 1960, p 714, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1405)
DOTL RP

C4 037987
RUBBER-CUSHIONED RESILIENT WHEELS FOR MAIN-LINE RAILWAYS
Most types of rubber-cushioned resilient wheels, including those for tramways and for narrow-gauge railways, consist of three metallic discs. Between these discs are placed either circular rubber blocks, positioned in one or two concentric rows, depending upon axleload, or a single pair of large rubber discs, which may be divided into segments. The central metal disc is fixed either to the wheel or to the wheel hub. Several applications of rubber-cushioned wheels, both on tramways besides main and secondary railway lines, have shown considerable reduction of maintenance costs for the mechanical parts and electric equipment, particularly collectors, because of the radial and tangential flexibility introduced by these wheels. The reduction of the wear on tires and flanges with resilient rubber-cushioned wheels, must result in a corresponding reduction of the wear of the rails.

Hug, AM *Railway Gazette* Vol. 110 Feb. 1959, pp 155-158, 6 Fig, 5 Phot, 2 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1407)
DOTL RP

C4 039167
SUPPLEMENTARY REPORT TO FEASIBILITY STUDY FOR A WHEEL-RAIL DYNAMICS RESEARCH FACILITY
This supplement to PB 182 472 deals with: (1) the trade-off considerations in extending the simulation capability of the wheel-on-roller design to lower speeds and sharper curves, and to more precise simulation of general system behavior; (2) the methods of implementation of the various simulation schemes and/or the method of compensation and constraint in lieu of such simulation; (3) the relative merit of electromechanical drive versus hydraulic drive systems, and some considerations in tractive and braking performance associated with the electromechanical drive-system selected; and (4) stress and deflection considerations of the diaphragm-coupler and the roller systems, their compliances, and how they relate to total system compliance and system performance.

Supplement to report dated Dec 68, PB-182 472.

General American Transportation Corporation Oct. 1969, 146 pp

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C4 039311
REDUCING FLANGE-WEAR ON BOGIE LOCOMOTIVES
The phenomenon of relatively rapid flange-wear on sharp curves with the bogies of Bo-Bo and Co-Co locomotives must be accepted pending the results of further research into the reduction of bogie weight and unsprung weight, the height of the bogie centre of gravity, different relative speeds of the axles and motors, weight transfer, etc. Flange or rail lubrication using a lubricant matched in viscosity to suit the ambient temperature lengthens the flange life from six to nine times, this factor varying according to the tire steel used. A change from tires of "D" steel to those of 70-ton tensile steel alone can increase flange life by as much as three times. A combination of lubrication, hard tires, and the fitting of a centralizer linking the movement of the two bogies and which is capable of drastically reducing flange forces on curves, will improve flange life by 12-15 times.

Railway Gazette Vol. 111 Dec. 1959, p 559

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1427)
DOTL RP

C4 039320
WHEEL AND RAIL LUBRICATION
Remarkable increases in life of rails and wheel flanges through lubrication, by as much as 700 percent, are quoted by Dr. Fritz Birmann, in his paper "Lubrication of Rails and Wheels." The requirements of a lubricating system to reduce wear of rails and tires, are that the lubricant must be prevented from spreading to the running surface of the rail, thereby reducing traction; that the efficiency of the system must not be spoiled by dust, dirt or weather influences; that the lubricating devices and spray nozzles must be profile free on the rail and vehicle; and that lubrication must not start too late on the curve, so that it is preferable, where possible, to lubricate tires before entering the curve.

Birmann, F (German Federal Railways) *Railway Gazette* Vol. 107 Oct. 1957, p 413

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1483)
DOTL RP

C4 039418
REUSE OF PARTIALLY LIFE-EXPIRED ROLLER BEARINGS
The life expectancy is discussed of freight car roller bearings which have seen extensive service. The meanings of the terms life expectancy and B-10 life as defined by the AAR are given. A typical bearing life expectancy curve is shown. A group of used bearings which are carefully inspected according to manufacturer's recommendtions should perform with reliability very nearly the same as new bearings. For maximum economy, such bearings should be reused based upon normal inspection and maintenance practices.

Timken Roller Bearing Company, Incorporated Aug. 1969, 3 pp, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-670)
DOTL RP

C4 039439
RAIL CORRUGATION--CAN IT BE PREVENTED
This is a research report which attempts to determine the causes of rail corrugation. The author suggests that higher rail speeds may cause rail corrugations or undulations as deep as 0.01, which accelerate rail wear. A relationship is established between the natural frequencies of rail vibration and the wear length of the corrugation. Further experiments are required into the possibility of eliminating corrugation by axle redesign as well as changes in rail profile and tie spacing.

Spaderna, CH *AREA Bulletin* pp 307-312, 3 Fig, 2 Tab, 3 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-693)
DOTL RP

C4 039451
ELEVENTH PROGRESS REPORT OF THE ROLLING-LOAD TESTS OF JOINT BARS
This report discusses the test program of rolling load tests of joint bars using 3-33 inch stroke rolling machines. The results of the tests of joint bars, which were heat treated and tempered are given. Hardness tests of the bars are included as well as the rolling load tests. Test results of 132 RE leadfree bars (oil quenched) averaged 573,100 cycles before failure which started at a rail end. Tests of 132 RE leadfree bars (water quenched) averaged 365,300 cycles. 4 bars failed, 2 from the top, 2 from the base.

Jensen, RS (Illinois University) *AREA Bulletin* Vol. 54 1953

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-708)
DOTL RP

C4 039469
DESIGN OF SPRINGS
Due to high stresses and abrasive action between laminated spring plates causing a reduction in thickness, it is recommended that a service life be established for the springs and the springs then be replaced. Several other design weaknesses are described, including the center fastening.

Frost, WE (John Spencer & Sons, Ltd.) *Railway Gazette* Vol. 97 Dec. 1952, pp 705-706

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-785)
DOTL RP

C4 039474
MECHANICS OF WHEEL AND RAIL
Tire-profiling tests undertaken in New South Wales to reduce oscillation resulted in an increase in the severity of the oscillations, which was directly traceable, not to the contact of the flange root with the edge of the rail, but of the steeply inclined portion of the tread adjoining the flange root. This is a well-known characteristic of all worn or hollow tire profiles. The objective of the tests was to defer the formation of the objectionable tread ramp near the flange in a worn tire. The design specifically allowed that there should always be a portion of the root radius still available to contact the edge radius of the rail. Diagrams representative of each of the tire contours and conditions of service are reproduced. In these diagrams, there will be noted a step developed after service at the junction of the flange root and the recess due to flange wear.

Railway Gazette Vol. 92 Mar. 1950, pp 247,253, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-806)
DOTL RP

C4 039480
WHEEL HUNTING AND IRREGULAR RAIL WEAR
In addition to the "hunting" of rolling stock wheels, there is the constant side-to-side movement of individual pairs of wheels. The standard taper of coning of wheel-treads is at 1 in 20, so the tread of a new tyre may be at right-angles to the centre-line of the rails. Experiments have been tried in varying the angle of taper of the treads and the radius of the railhead, but the wear of tires and rails complicates the problem, and hitherto has made it difficult to come to any final conclusion as to how the hunting problem may be solved. Persistent bogie hunting can cause bogie stock to ride uncomfortably. Of even greater importance is the wear-and-tear of rolling stock and the damage to rails caused in this way.

Torns, AH *Railway Gazette* Vol. 83 Dec. 1945, p 636

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-812)
DOTL RP

C4 039481
THE MOVEMENTS OF RAILWAY VEHICLES ON THE TRACK AND THE FORCE ARISING THEREFROM
A critical analysis is given of the interaction of flanges and rails, together with a resume of the scientific principles involved. The friction arising between wheel and rail is fundamental for all railway transport. The frictional force R is equal to or less than the product of the frictional factor f and the wheel load Q, which are the variable quantities. As the direction of force R coincides with the resulting sliding motor between wheel and rail, its action is opposed to the direction of motion. Force R determines not only rolling resistance, but also that due to curves, guiding pressure, security against derailment, maximum tractive and braking power, axle strain, wear of rail and flange, and--last but not least--freedom from hunting. Methods to determine the precise position and value of R are discussed.

Liechty, MR *Railway Gazette* Vol. 83 Nov. 1945, pp 564-565

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-813)
DOTL RP

C4 039496
RAIL FAILURES ON BRITISH RAILWAYS
Every rail or portion of rail that has to be removed from a running line prematurely because of a break, crack or other defect has to be reported as a failure; failed welds that are repaired by re-welding in situ without the removal of a rail must also be reported. Information relating to the rail and its conditions of service is coded and punched on computer tape. This enables the failures in any year to be easily and quickly analyzed according to region, rail section, age, traffic carried, class of line, manufacturer or any other feature considered to have or suspected of having an influence on the failure pattern. Failures in tunnels and on water troughs are analyzed separately from failures elsewhere, as are failures at welded joints. Types and causes of failure for 1961-1963 are reported. Comparisons between regions and manufacturing process used to produce the rail are also made.

Dearden, J (British Railways) *Railway Gazette* Vol. 121 Feb. 1965, pp 148-150, 4 Tab, 4 Phot, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-992)
DOTL RP

C4 039505
PULLMAN'S APPROACH TO CENTER PLATE PROBLEMS
Tests were conducted on fabricated cushioned underframe center plates using a Hy-Cube car, using a car rocking device designed to excite a fully-loaded car at its natural roll frequency. Results were correlated with field service reports. Tests were in progress on the rocking device using a 100-ton covered hopper car. The conclusion of the two-year test program on cushioned underframe cars has indicated these results: rock and roll is instrumental in center plate wear and breakdown; breakdown originates in the transition radius and propagates into the transverse and longitudinal reinforcement; the 3/8" radius is not satisfactory for today's fatigue environment; longitudinal reinforcement on the center plate should be located over the outer circumference of the bowl; a flat center plate application significantly reduces the attachment pre-stress in the transition radius; both fabricated and cast center plates can develop cracking unless fatigue design is considered; the center plate application is related to car configuration; and supplemental snubbing devices that reduce car body roll would increase the fatigue life of center plates.

Technical Proceedings from 1969 Railroad Engineering Conference.
Rousseau, GL (Pullman-Standard Car Manufacturing Company)
Dresser Transportation Equipment Division Tech Proc Sept. 1969, pp 39-41

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1007)
DOTL RP

C4 039563
WEARING PARTS OF ELECTRIC ROLLING STOCK
The subject of wear and tear on vehicles is considered. Focus is on two aspects; wear resulting from the work accomplished by the rolling stock and wear, particularly bogie frame wear, resulting from vibrations generated during operation. Tyre wear is also mentioned. This results in sharp flanges, deep flanges, thermal checking and flaking, and hollow treads. Each of these problems is briefly examined.

Railway Gazette Vol. 100 Jan. 1954, p 116

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1202)
DOTL RP

C4 039596
BALL AND ROLLER BEARINGS IN MODERN ROLLING STOCK
An increasing number of specifications calls for ball or roller bearings to be fitted at all vital points for locomotives and coaches. Advantages which have been realized include: (1) up to 85% lower starting and about 10% lower running resistance. (2) Reduced charges for inspection and maintenance. (3) Fewer hot boxes, resulting in an increased availability factor. (4) More economical use of lubricants. (5) Maintenance of axle and valve gear centres as designed, by virtue of the absence of wear. In the construction of locomotives and rolling stock generally, the following gives a fair idea of the extent to which this type of bearing has been used: locomotives: axleboxes, bogie driving, truck, and bogie pivots; spring compensation beams. Rolling stock: axleboxes bogie pivots. Diesel-engine vehicles; axleboxes; gearboxes; engine bearings; generator, armature bearings; motor armature bearings.

McArd, GW *Railway Gazette* Vol. 96 Jan. 1952, pp 39-43, 15 Fig, 1 Tab, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1248)
DOTL RP

C4 039602
GAUGING THE USEFUL LIFE OF RAILS
A device for determining the useful life of a rail is described. This particular instrument requires no attachment to the rail as do many other devices. The weight of the rail is read directly on a single scale. Also, a cross-section of the worn rail can be produced.

Railway Gazette Vol. 96 Apr. 1952, p 375, 1 Fig, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1254)
DOTL RP

C4 039621
APPARATUS FOR DETECTING WHEEL-SEAT FLAWS IN RAILWAY AXLES
The Research Department of the London Midland and Scottish Railway Company undertook the task of devising and developing a method of detecting wheel-seat flaws in railway axles without removing wheels from axles or even wheel and axle assemblies from the coach. The essential item consists of a rigid steel ring of square cross section, split diametrically to allow it to be clamped to the axle under test. Contact with the axle occurs at three spherical seatings, of which two are fixed to the inside of the ring and the third is adjustable and is screwed to grip the axle firmly after the two halves of the ring have been bolted together. The system described comprises essentially, two nominally rigid reference planes, fixed normal to the axle and set one on each side of a possible flaw situated near the inner end of the wheel seat. If such a flaw does exist the strength of the axle will be less in the direction passing through the center of the axle and the centroid of the flaw than in the direction at right angles to it. Details and case histories are given.

Johansen, FC *Railway Gazette* Vol. 78 1943, pp 190-192, 8 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1277)
DOTL RP

C4 039627
A NEW FATIGUE DEFECT IN RAILS
The shelling defect has been most commonly encountered in the 131-lb standard flat-bottom section, though it has been reported in some degree in all sections from 100 lb. upwards. The first manifestation of the trouble is the appearance, on the running surface of the rail near the running edge of dark spots, which indicate the presence of horizontal planes of separation of the steel within the rail-head; these may occur at a number of different levels in the same rail. The shelling is the result of wheel action on the rail causing failure of the metal, either by direct stress exceeding the elastic limit, or by loss of ductility which is the outcome of constant reversals of stress. Factors which may influence the relative severity of the shelling are the inclination of the rail, the superelevation, the bearing pressure exerted by the wheels, the radius connecting the flanges and the treads of the wheels, and the radius of the gauge corner of the railhead.

Railway Gazette Vol. 79 July 1943, p 38

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1283)
DOTL RP

C4 039636
RAIL WEB FAILURES
Out of 30,881 failures of new rails in U.S.A. tracks in 1942-51, and removed during that period because of defects, 13,554, or 44 percent, were web failures. The great majority of the latter were failures within the area of the rail joint. Laboratory and track tests showed that many web failures could be explained by corrosion-fatigue but not by corrosion alone. Various factors increase the web stresses at rail ends. One is poor or irregular fit of fishplates; loose or worn fishplates or loose fishbolts have a bad effect, as they are liable to cause greater impacts to develop under the rolling load. Excessive gaps at the rail-joints or battered rail ends similarly tend to increased impacts.

Code, CJ (Pennsylvania Railroad) *Railway Gazette* Vol. 102 Feb. 1955, p 162

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1332)
DOTL RP

C4 039661
HEAVY-DUTY CAST-STEEL WHEELS FOR FREIGHT CARS
American Brake Shoe Company has developed a wheel now in volume production for hard service on freight vehicles for heavy commodity loads. During service testing on 23 U.S.A. railways in 1947-55 the wheels have run more than 5,600,000 miles on van, hopper, tank, flat, refrigerator, and other types of wagon of 40, 50, and 70 tons capacity. Five of the vehicles averaged 275,000 miles of operation and one totalled more than 350,000 miles. Measurements of rolling and braking wear on 1,000 of the new wheels showed only equal results to that of other steel wheels and was less in some service conditions. The Casting process is described and a cross section of the wheel, known as the Southern wheel, is shown.

Railway Gazette Vol. 103 Dec. 1955, pp 706-707, 1 Fig, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1359)
DOTL RP

C4 039668
THE SAFE LIFE OF RAILS EXAMINED
The rail sections considered are the 109-lb. fb and rBS 95-lb. bh rail, both in common use on British Railways. Among the conclusions reached by the authors is the fact that the rail sections standardized by British Railways are of sufficient strength for long life under existing steam traffic where maintenance is good and corrosion not severe. But, they believe that rail life should be governed by the type, speed, and quantity of traffic carried rather than by loss of weight. Furthermore, they suggest that any practical way of altering rail joints to increase their life should be investigated and that the development of special joints for the ends of welded rails would appear necessary irrespective of any stress-relieving requirement.

Wise, S Lindsay, D Duncan, IGT *Railway Gazette* Vol. 112 Jan. 1960, pp 64-65

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1384)
DOTL RP

C4 039673
WORK-HARDENING BOLT HOLES IN RAIL ENDS
Analysis of rail failures has shown that the most frequently occurring type of failure is that classified as "4d" which takes the form of radial cracking from one or both boltholes known as star cracking. Various methods of improving the fatigue strength of drilled rails have been tested. The greatest improvement has been obtained by work-hardening the surface of the holes, by intially drilling undersize followed by broaching or drilling drifting with a spherical tool to the required size. The work hardening has resulted in increasing the fatigue strength of the rail by 50 percent, a figure which is maintained after exposure to corrosion. No trouble was experienced in workhardening any of the holes, including those where the axis is inclined to that of the rail.

Wise, S *Railway Gazette* Vol. 112 Apr. 1960, pp 511-512, 1 Fig, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1389)
DOTL RP

C4 039905
EXPERIENCE OF UNDULATORY WEAR OF RAILS
The results of a survey of 21 responding railroads from Europe and Africa on the subject of rail corrugation are presented. The types of corrugations are mentioned as well as possible causes. Means to eliminate or reduce the occurrence of these problems is also covered.

Railway Gazette Vol. 109 July 1958, pp 42

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-560)
DOTL RP

C4 039980
THE RAIL SHELLY CRACK IN JAPAN
Investigation into the growth mechanism of shelly cracks and a method of prevention is reported. Examinations included track condition, materials quality, loading condition and friction and wearing phenomenon of affected rails. It was found that in the ordinary contact condition, the contact stress between tyre and rail is so large that plastic flow is caused. With the progress of plastic deformation, steel becomes hard and its elastic limit rises. After these changes, rail surface becomes fit for ordinary wheel load. Though before this time the progress of plastic flow nearly stops, the crack grows through the fatigue due to rolling with slide. It was also found that the existence of ferrite in the surface layer seems to take part in the growth of the crack. As a first step in preventing shelly cracks, rail steel should be strengthened against fatigue. Water decreases the wear of rail and accelerates the development of crack. These conditions promote the growth of the crack due to the rolling fatigue. Secondly, though the decrease of stress is difficult to realize in general, the decrease of lateral force and the decrease of contact stress by decreasing the difference of both curvatures in contact part of wheel and rail are found effective. Thirdly, as it is clear that the existance of water is unfavourable, total stop or restraint of watering is very effective. Since the same effect is achieved by oiling, it is necessary to be careful not to oil excessively.

Nakamura, R Owaku, S Enomoto, N *Railway Technical Research Institute* Vol. 6 No. 3, Sept. 1965, pp 34-44, 21 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1445)
DOTL RP

C4 039997
REPORT ON THE CHARACTERISTICS OF STEELS AT LOW TEMPERATURES--COUPLER INVESTIGATION
The report discusses problems in finding a basis for coupler failures between geographic areas. The parameter for comparison was the number of failures per freight car miles travelled. Conclusions are that more couplers fail during cold than hot months. The critical temperature for failure occurs a few degrees below freezing.

Association of American Railroads Tech Rpt AAR-M-190, Nov. 1945, 4 pp, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1464)
DOTL RP

C4 040003
ALUMINUM IN ROLLING STOCK; THE VALUE OF RESEARCH AND DEVELOPMENT
In Canada, aluminum is considered standard for box cars roofs, the inside lining of refrigerator cars, brine tanks, hopper cars for bauxite and alumina, hopper car hatch covers, piggy-back trailers and passenger car furnishings. The properties of aluminum which make it ideal for use in rolling stock are good strength and impact resistance, light weight, excellent corrosion resistance and good fabricating characteristics. Service experience and impact tests, which were more rigorous than conditions encountered normally, have shown that all-welded aluminum hopper cars are strong and rugged enough to withstand such severe treatment. Impact and fatigue test results are reported for several types of aluminum cars. The lightness of aluminum cars mean that fewer of these cars are required to transport a given cargo. The excellent resistance of aluminum to the weather and corrosive cargoes means that annual maintenance costs can be lowered appreciably. The life of the aluminum cars will be governed by failure due to mechanical causes rather than corrosion and even after their normal service life they will have a high scrap value.

Campbell, RA Whiting, JF Kemp, RA (Aluminum Laboratories, Limited)
Aluminum Company of Canada, Limited Tech Rpt Nov. 1957, 36 pp, 8 Fig, 1 Tab, 12 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1486)
DOTL RP

C4 040011
RECENT EVOLUTION IN ON THE RAIL INSPECTION ON THE S.N.C.F.
Ultrasonic probing enables an operator, shifting a transductor over the surface of the railhead, to assess the extent of a crack. Rail inspection by ultrasonic apparatus employs two methods: vertical probing by a straight line transductor where the steel is subjected to a longitudinal beam of waves; and oblique probing by a transductor subjecting the steel to a refracted beam of transversal waves forming an angle of 65 degrees to 70 degrees with the vertical. The transversal fatigue cracks due to rail-head fatigue often causing railbreaks are detected by oblique probing. The present permissible speed at which the transductors are made to move along the rail is 12 km/h. The annual number of rail-breaks on the inspected lines which was about 1,100 has fallen to under 400, the majority of breaks being due to defects non-spottable by probing.

French Rail News Vol. 1 1969, pp 12-13, 9 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1494)
DOTL RP

C4 040012
THE BEHAVIOUR OF THE MOTIVE POWER AXLES (WHEELS) ON THE S.N.C.F.
Wheel-set stresses are modified by the action of the strains inherent in service which may be categorized as follows: those affecting the shrinking-on; those which correspond either to vertical effort exerted by the wheel on the rail, essentially cylical, or to the lateral reactions of the rail on the wheel both cyclical and erratic (abnormal shocks); and those set up by a temperature rise, due to braking. The SNCF has tested, both in the laboratory and in service, the diverse stresses as they are linked up with strains. Common damages to wheelsets are described and are shown. Wheel manufacturers are using the test results to enhance wheel design criteria.

French Rail News Vol. 4 1969, pp 52-54, 9 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1495)
DOTL RP

C4 040013
SURFACE-TREATED MONOBLOCK WHEELS
Ten years of experience is reviewed with the use of carbon and manganese low-alloy steels for monoblock wheels. The service-life of these wheels is shown. Compared to tired-wheels for electric locomotives the surface-treated wheels can last twice the distance. Compared to chromium-molybdenum wheels, the surface-treated wheels had 20 percent lower cost, an increased service life of 30 percent, and a longer time-lapse between non-destructive test inspections.

French Rail News Vol. 4 1969, p 55, 2 Tab
ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1496)
DOTL RP

C4 040022
RESEARCHES ON INCREASING THE FATIGUE STRENGTH OF PRESS-FITTED AXLES
Fatigue tests with 50 mm dia. press-fitted specimens, heat-treated by Tufftride process or other processes, were made to determine the influence of those treatments upon fatigue strengths, sigma(sub omega 2) and sigma(sub omega 1). These are fatigue strengths based upon complete fracture of the shaft and initiation of minute fatigue cracks in fretted region. Main results obtained as are as follows: tufftriding is strongly effective to increase sigma(sub omega 1) as well as sigma(sub omega 2); if the superficial compound layer of iron and nitrogen is removed, sigma(sub omega 1) is lowered but sigma(sub omega 2) does not change; specimens, heated in Argon gas at the same temperature as Tufftride process followed by quenching in water, have the same sigma(sub omega 2) as that of Tufftrided ones. It is concluded that the increases of sigma(sub omega 1) and sigma(sub omega 2) by Tufftriding are due to the hard compound layer and the compressive residual stresses.

Nishioka, K Komatsu, H (Sumitomo Metal Industries, Limited) *JSME Bulletin* Vol. 14 N No. 3, July 1971, p 712

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1505)
DOTL RP

C4 040026
RESEARCH INTO STRESSES IN TRACK
The extensive investigations that have been made in the past few years into the stress conditions obtained in the track structure (from rail to sub-structure) have resulted in positive evolution of the design and dimensioning of rails, ties and ballast bed. The results of this research are detailed, showing by graphs and tables the stresses in rail heads and flanges. The service requirements for the various sizes and strengths of rail are described. [German]

Eisenmann, J (Munich Technical University) *Eisenbahntechnische Rundschau* Vol. 20 No. 1,2, Feb. 1971, pp 64-70, 9 Fig, 2 Tab, 8 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1509)
DOTL RP

C4 040027
DEVELOPMENTS IN THE QUALITIES AND SERVICE CAPABILITIES OF PRESENT-DAY RAIL STEELS
The service requirements are discussed for steel rails, which are constantly increasing to bear the heavier axle loads and higher speeds, and with increased resistance to wear, fatigue and fractures. The progress in the manufacture of rails is related, including the improvements in profiles, dimensions, quality and physical properties, as shown by tables and charts. The forseeable limiting area of tensile strength for self-hardening alloy steel for the rails is given as 192,000-206,000 psi. Improved resistance must be developed to wear, plastic deformation crushing and fractures in the rail head, by raising the tensile strength, yield point and fatigue limit. [German]

Heller, W (Fried Krupp Huttenwerke AG) *Eisenbahntechnische Rundschau* Vol. 20 No. 1,2, Feb. 1971, pp 71-78, 8 Fig, 1 Tab, 6 Phot, 13 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1510)
DOTL RP

C4 040028
STEEL TIES FOR FIRST CLASS TRACKS
There is a revival of interest in steel ties due to newly designed shapes and improved manufacturing processes. The new ties have a higher moment of inertia and greater strength. Annealing after the cold working insures greater fatigue resistance and reduces the likelihood of cracks developing. Advantages of steel ties include: long life, the possibility of re-use later in secondary lines, and the reclamation possible after a derailment. Under switches, the longer lengths of steel ties are more easily provided. On electrified lines, steel ties provide an ideal grounding connection. The better quality of steel makes the welding process more usable for fastening the rail holding plates to the ties without the possibilities of fractures. [German]

Schmedders, H Bienzeisler, H (August Thyssen-Hutte AG) *Eisenbahntechnische Rundschau* Vol. 20 No. 1,2, Feb. 1971, pp 88-92, 5 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1511)
DOTL RP

C4 040061
STUDY OF RAIL FAILURES IN THE TRACK--STANDARD RAIL FAILURE STATISTICS
The main object was to define the type and form of presentation of rail-failure information to be supplied by various ORE Member Administrations so as to permit the better use of such information-and to draw some concrete conclusions. Committee D 88 found great difficulty in identifying a suitable denominator to which the rail failures could be related for purposes of comparison between administrations. In the absence of a more reliable denominator rail failures were related to the kilometres of track concerned with the type of failure being compared. This should enable Administrations to decide whether their present policies in regard to choice of rail section, steel quality, rail welding, joint design, track maintenance policy, rail renewal frequency (only to quote the main factors), require any alteration.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Intrm Rpt. D88/RP 1/E, Apr. 1965, 22 pp, Tabs., 9 App.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1544)
PURCHASE FROM: UIC Repr. PC
DOTL RP

C4 040076
SUITABILITY OF SIX-AXLE LOCOMOTIVES FOR C&O--B&O SERVICE--THE INTERACTION WITH TRACK STRUCTURE
A series of tests was conducted with 6-axle locomotives in heavy, coal drag service on Cranberry Grade to investigate the interaction of locomotive tractive power and track conditions. Particularly, the performance of 6-axle locomotives in this service was investigated to determine the relative merits of that design versus the 4-axle units previously used. Five major areas were found to be significant and completely interdependent: I. Locomotive wheel life with 6-axle units. II. Rail cleanliness affects locomotive adhesion. III. The condition of the track and the rail govern overall acceptability of 6-axle locomotives. IV. Operating practices covering the use of sand are related to increased wheel wear and increased track maintenance. V. Instrumented wheel tests: A. To determine to what extent and under what circumstances the wheel and rail wear attributable to 6-axle locomotives exceeds that of 4-axle units. B. To determine effect of track surface on locomotive riding qualities. C. To determine suitability of 6-axle locomotives.

Schmidt, JJ
Chesapeake and Ohio Railway, Baltimore and Ohio Railroad Res Rpt Feb. 1966, 27 pp, 3 Tab, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1572)
DOTL RP

C4 040081
OBTAINING A SMOOTH-RUNNING BOGIE--2
An approach to improve the conventional type truck as used on multiple-unit and locomotive-hauled stock by considering its faults is suggested. The tendency of the bogie to snake can be greatly reduced by guiding both axles rigidly in the frame and so forcing them to remain parallel, i.e., within 0.04 in. by using roller bearings. The second method of attacking hunting is to prevent the whole bogie frame from snaking by deliberately introducing friction to discourage it from rotating slightly about its pivot. The sidebearer friction will rise in step with tire wear and snaking tendency if the sidebearers are greased only once when the tires are profiled.

Railway Gazette Vol. 114 Jan. 1961, pp 74-77, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1577)
DOTL RP

C4 040083
CARRIAGE AND RAILCAR BOGIES: THEIR DESIGN AND DEVELOPMENT--IV
Design factors considered in this part include brake ratios; axle fatigue; adhesion, and P.D. More effective braking will require ratios 1:1.5 to 2.2 of the tare weight, cut back to 0.8 at lower speeds. A routine method of axle fatigue calculation indicating the influence of such design variables as fillet radii, type of vehicle, speeds, whether four-wheeler or bogie, and so on, relating to dynamic load allowance and other factors is long overdue. Adhesion improvement through truck linkage to the body at low level requires care that bogie pitching will not cause high stress peaks at the kingpin or cause intense shuttle of the body.

Koffman, JL (British Railways) *Railway Gazette* Vol. 115 Aug. 1961, pp 216-218, 4 Fig, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1579)
DOTL RP

C4 040109
BRITISH RAILWAYS CARRIAGE AND WAGON AXLE DESIGN
Information is presented relating to the effect of shapes and stresses on the fatigue properties of components. The journal load, wheel load, and flange force are tabulated for a 74-ton car with 4.5-ton trucks. Fatigue strength of steel axles and bending moments for steel are shown. The ride quality and center of gravity for passenger trains are calculated.

Koffman, JL (British Railways Board) *Railway Gazette* Vol. 122 Apr. 1966, pp 281-283, 2 Fig, 5 Tab, 7 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1605)
DOTL RP

C4 040110
DYNAMIC TESTS ON RAIL FASTENINGS
Concrete sleepers are used throughout the Pakistan Western Railway system. Over 70,000 have been cast and have proved entirely satisfactory except that the fastenings tend to become loose in time. Three fastening were withdrawal tested. A dynamic test on fasteners is presented and the dynamic test apparatus is shown.

Railway Gazette Vol. 120 June 1964, pp 496-498, 3 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1606)
DOTL RP

C4 040149
CHICAGO AND NORTHWESTERN RAILROAD TEST-DIESEL LOCOMOTIVE WHEEL LIFE DATA
Maintenance data are accumulated for 46, Class-B wheels for an average mileage of 201,532 miles. The mileage, reason for turning, date, and tread remaining before and after turning are recorded.

Chicago and North Western Railway 60-1013, June 1952, 9 pp, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1649)
DOTL RP

C4 040150
WHEEL TREAD FAILURE-CHICAGO AND NORTHWESTERN RAILROAD
Two 36" locomotive wheels were tested after their removal from service because of shelling. These wheels had approximately 10,000 service miles under an E-8 locomotive after they had been turned down once. The wheels had previously seen 77,700 service miles under a locomotive before being turned down. The tests run included visual examination with magnafluxing, chemical analysis, hardness evaluation, and microstructure. The tests showed that the wheels were classified incorrectly at the factory as Class B wheels. They were actually Class A type, which were not capable of withstanding the severe service to which they were subjected.

Novy, SF
General Motors Corporation Eng Rpt 53-139, May 1953, 15 pp, 2 Fig, 10 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1650)
DOTL RP

C4 040151
TEST NUMBERS LD-2 AND LD-14
The groups of test wheels were tested for life expectancy under E-8 locomotives for passenger trains. Tests were suspended because the test wheels could not surpass the performance of the standard type F-36 multiple wear steel wheels of the non-heat-treated class.

General Motors Corporation Apr. 1955, 9 pp, 4 Fig, 3 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1651)
DOTL RP

C4 040164
DETERMINATION OF MAINTENANCE OF WAY EXPENSE VARIATION WITH VARIOUS TRAFFIC VOLUMES AND EFFECT OF USING SUCH VARIATIONS, IN TERMS OF EQUATED MILEAGE OR OTHER DERIVED FACTORS, FOR ALLOCATION OF AVAILABLE FUNDS TO MAINTENANCE OF WAY
The purpose of this study was to determine the relationship between the characteristics of traffic and track and track maintenance costs. In this preliminary study a procedure was developed and checked in a general way against actual maintenance of way costs as reported by the C&O--B&O for the year 1966, with reasonable correlation. For general application it is believed that some further improvements can be made in the procedure that has been developed, to take into account the effect of climatic conditions on weed and brush control, of age of rail, etc. Extensive data are shown.

Christianson, HB *AREA Bulletin* Vol. 70 1968, pp 75-94, 8 Fig, 7 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-496)
DOTL RP

C4 040169
LATERAL OSCILLATIONS OF BOGIE BOLSTERS
It is imperative to break away from the adherence to general recipes regarding spring rates and swing link angles of inclination often regarded as a universal panacea against ailments generally diagnosed as "bad riding." Vertical leaf springs succeed only in increasing the lateral centering force thus reducing the effective length of the swing link arrangement and increasing its natural frequency, inadvertently acting as swing link spoilers. So far as design layouts are concerned detail components should be used along rational lines, each component being allowed to perform the basic function allotted to it. Thus swing links should be permitted to swing and dampers used to ensure damping. Excessive body amplitudes sometimes encountered with some designs can be controlled with the aid of lateral centering springs preferably with a non-linear characteristic and here suitably shaped rubber units can be of great help.

Koffman, JL (British Railways) *Railway Gazette* Vol. 112 No. 9, Feb. 1960, pp 245-250, 7 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-650)
DOTL RP

C4 040190
SD TRUCK PERFORMANCE ON THE BALTIMORE & OHIO RAILROAD AND RELATED WHEEL WEAR ON THE CUMBERLAND DIVISION
This test program was designed to determine the causes of excessive rail wear and associated wheel flange wear, and derailments involving SD-35 locomotive units, which resulted during operation of the first SD-35 units on coal trains between Grafton and Terra Alta, W.V. The test program was to measure the actual wheel-to-rail lateral loads and the associated truck motions under all possible operating conditions. Also, wheel wear tests were run on standard wrought steel and new cast steel wheels as a first step in an effort to find a better wear resistance wheel. Test results are reported and recommendations are made.

Marta, HA
General Motors Company Test Rpt 128, Dec. 1966, 165 pp, 54 Fig, 10 Tab, 11 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1625)
DOTL RP

C4 040209
SHELLY RAIL STUDIES AT THE UNIVERSITY OF ILLINOIS
Three rolling-load tests of induction-hardened rails from Japan averaged 2,715,000 cycles. Two rolling-load tests of a standard carbon 115-lb rail averaged 3,063,000 cycles. Two rolling-load tests of 100-lb continuous-cast rail from Europe averaged 2,027,000 cycles. Flame-hardened high-silicon rails failed at 1,005,800 cycles and 3,834,000 cycles. Rolling-load tests of a series of rails flame-hardened at different speeds are reported. One group averaged 2,947,000 cycles and the other two groups all failed at less than 1,000,000 cycles. Rolling-load tests on one flame-hardened specimen from Dominion Steel Co. ran 3,857,000 cycles.

Cramer, RE (Illinois University, Urbana)
American Railway Engineering Association Vol. 65 N No. 84, Feb. 1964, pp 598-605, 1 Tab, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1668)
DOTL RP

C4 040210
INVESTIGATION OF FAILURES OF WELDED RAILS AT THE UNIVERSITY OF ILLINOIS
Three weld failures are reported in 115-lb rail. One was caused by poor fusion in the weld. The second was believed caused by a flake of mill scale caught between the rail ends during welding. The third failure was a web crack through the head on both sides of the weld. Thirteen bend test are reported, which were made on full-section rails.

Cramer, RE (Illinois University, Urbana)
American Railway Engineering Association Vol. 65 N No. 84, Feb. 1964, pp 611-614, 1 Tab, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1669)
DOTL RP

C4 040213
DISCUSSION ON STRESSES IN RAILROAD TRACK
The inspection tests of rail-joints in track made for the purpose of learning the source of the wear of the joint bars and the rail, the places of wear, information bearing on the mutual interaction of the worn bars and rail when under load and when the bolts are newly tightened, and other information relating to the stability and maintenance of the rail-joints have given desirable information. The occurrence of high stresses in the unloaded worn joint bars in track due to the tightening of the bolts was found to be as great as 30,000 and 40,000 lb. per sq. in. and in a few cases as high as 60,000 lb. per sq. in. The stresses were fairly proportional to the amount of the lateral bending put into the bar by tightening the joints, measured from the loose condition. The instruments designed and built to facilitate the measurement of profiles and shapes and straightness of joint bars and rail and their position with respect to each other in the joint have proved satisfactory.

Talbot, AN (Illinois University, Urbana)
American Railway Engineering Association Vol. 36 pp 957-958

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1676)
DOTL RP

C4 040214
RAILROAD AXLE DESIGN FACTORS
Railroad axle designs have been developed from an application of theoretical principles of Reuleaux combined with extensive laboratory fatigue studies supplemented to some extent by road service tests. The designer is presented with data on the effects of the complex forces acting on axles operating in railroad service. Criteria for wheel seat and axle body stresses established from fatigue tests and modified by practical considerations are discussed. The paper gives elaborate reference material for use by future investigators of axle properties and designs.

Byrne, R (Association of American Railroads) *ASME Journal of Engineering For Industry* PAPER NO 67-RR-3, Apr. 1967, 10 pp, 8 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1677)
DOTL RP

C4 040215
WHEEL, AXLE, AND RAIL STRESS PROBLEMS RELATED TO HIGHER CAPACITY CARS PART 1 AXLE PROBLEMS
This paper submits some fundamental considerations in the design of axles and propose two new axle designs of 72,000 and 80,000 pounds capacity. Larger axle design standardization must satisfy a wide range of car geometry factors such as (a) center of gravity height from 72 to 94 in and (b) wheel diameter ranging up through 40 in. The effect of these factors on axle capacity is shown by curves derived from the Reuleaux formula; serious deficiencies in this formula are also discussed. Other primary axle design factors presented are (c) wheel seat design (f) effect of switches, frogs, and crossings (e) effect of curved track (h) effect of flat spots and shellouts of wheel treads.

Horger, OJ (Timken Roller Bearing Company)
American Society of Mechanical Engineers Paper Nov. 1963, 16 pp, 7 Fig, 1 Tab, 24 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1678)
DOTL RP

C4 040216
BRITISH RAILWAYS INVESTIGATIONS INTO THE PROBLEM OF AXLE FATIGUE FAILURES UNDER THE WHEEL HUB
This paper discusses the problem of the fatigue failure of railway axles and points out the main factors contributing to failures of this type. The reasons behind the investigation currently in progress are described and the results obtained to date are given. Future work is detailed and it is shown how the results of these experiments should enable a more satisfactory axle service performance to be obtained. A certain amount of increase in axle fatigue strength has been obtained by the straightforward application of metallurgically better materials--as happened when wrought iron was replaced by steel. However, because of the overriding importance of shape in a component subjected to fatigue loading, as an axle is, it can be predicted that the use of even higher strength steels will not produce proportionate increases in axle fatigue strength unless allied to a shape of axle which excludes, as far as possible, all notch and stress concentration effects.

Burdon, ES
British Railways Conf Paper Apr. 1963, pp 27, 13 Fig, 12 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1679)
DOTL RP

C4 040217
WHEEL, AXLE, AND RAIL STRESS PROBLEMS RELATED TO HIGHER CAPACITY CARS--PART IV-EFFECT ON RAIL
Those items that have been found advantageous in reducing shelling caused by higher capacity (85 to 100-ton) cars are wheel loads should be limited in proportion to wheel diameter. Higher strength material in the rail will greatly reduce shelling but not entirely eliminate it (under the wheel loading conditions existing with 70-ton capacity cars before the allowable load was increased 5%). Modified rail head contours in today's modern rail sections which approach the average worn wheel condition, have been helpful in reducing shelling. Rail lubrication on curves extends the rail life but results in the removal of more rails for shelling rather than abrasive wear.

Stampfle, RB
American Society of Mechanical Engineers Paper Nov. 1963, 13 pp, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1680)
DOTL RP

C4 040218
WHEEL MILEAGE PERFORMANCE ON ORE CARS OPERATING OVER THE QUEBEC NORTH SHORE AND LABRADOR RAILWAY
The content of this paper reports the mileage performance between wheel reprofiling that is associated with both nonheat-treated and rim heat-treated wheels applied to 3000 high-capacity ore cars. Train operating speed is in the 35-mph range. Data are presented which compare the performance of the two wheel classes and demonstrate the life-range characteristic relative to a series of wheels. Incidence of wheel defects is given. Discussion is included of the effect that track condition and rail lubrication have on wheel wear.

Tyler, HA (Quebec North Shore and Labrador Railway Company)
American Society of Mechanical Engineers Conf Paper 64-WA/RR-6, Dec. 1964, 12 pp, 14 Fig, 4 Tab, 8 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1681)
DOTL RP

C4 040219
STUDY OF THE DEFECTS THAT ORIGINATE AND DEVELOP IN THE TREADS OF RAILROAD WHEELS DURING SERVICE
Mechanism theories for the formation of defects that originate and develop in the treads of railroad wheels during service are presented. These defects were classified after a study of wheels that developed these defects during service and of wheels that were subjected to simulated service tests on a wheel-testing dynamometer. At least two general types of defects were found to occur during service-defects caused by stresses developed by braking and defects caused by stresses imposed by rolling loads.

Wandrisco, JM Dewez, FJ, Jr (United States Steel Corporation)
American Society of Mechanical Engineers Conf Paper 60-RR-1, Apr. 1960, 12 pp, 2 Fig, 2 Tab, 14 Phot, 8 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1682)
DOTL RP

C4 040220
RESEARCH ON THE OPERATING STRESSES IN PATH RAILCAR AXLES, DRIVE SYSTEMS, WHEELS, AND RAIL JOINTS
This paper identifies the cause of premature cracking of axles with inboard bearings as being the bending-mode oscillation of the axle. It points out the importance of gear-tooth separation produced by torsional oscillations in the drive motor system in both right angle and parallel drive gear failures. A unique technique of simultaneous measurement of impulse and thermal loads on the wheel tread is explained and the test data are presented. The relation between the wheel impact loads and the dynamic behavior of rail joints is shown.

Yontar, M (New York Port Authority :)
American Society of Mechanical Engineers Conf Paper 66-RR-6, May 1966, 21 pp, 33 Fig, 2 Phot, 36 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1683)
DOTL RP

C4 040222
WHEEL, AXLE, AND RAIL STRESS PROBLEMS RELATED TO HIGHER CAPACITY CARS--WHEEL PROBLEMS
Factors to consider in selecting a wheel for high capacity cars--aside from dimensional compatibility with the rail and truck, are wheel class, wheel diameter, and rim thickness. Rim thickness determines replacement period and is primarily a function of car utilization. Wheel diameter determines stress in the contact area of the wheel tread and rail. Wheel class determines relative resistance of wheels to wear and service damage, principally shelling and thermal cracking. Safety and economy of the operation depends largely on freedom from excessive shelling, thermal cracking, and rapid wear, all commensurate with the cost of new wheels, reconditioning, and maintenance.

Panel Symposium, the ASME Railroad Division November 21,1963

Johnsen, AM (Armco Steel Corporation)
American Society of Mechanical Engineers Conf Paper Nov. 1963, 5 pp, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1685)
DOTL RP

C4 040223
A THREE-DIMENSIONAL FINITE DIFFERENCE SOLUTION FOR THE THERMAL STRESSES IN RAILCAR WHEELS
A numerical solution is presented for both the transient temperature and three-dimensional stress distribution in a railcar wheel resulting from a simulated emergency brake application. A computer program has been written for generating thermoelastic solutions applicable to wheels of arbitrary contour with temperature variations in both axial and radial directions. The results include the effect of shear stresses caused by the axial-radial temperature gradients and the high degree of boundary irregularity associated with this type of problem. The program has been validated by computing thermoelastic solutions for thin disks and long cylinders; the computed values being in good agreement with the closed form solutions. Currently, the computer program is being extended to general stress solutions corresponding to the transient temperature distributions obtained by simulated drag brake applications. When this work is completed, it will be possible to synthesize the thermal history of a railcar wheel and investigate the effects of wheel geometry in relation to thermal fatigue.

Novak, GE (Materials Research Laboratory, Incorporated); Eck, BJ (Griffin Wheel Company) *ASME Journal of Engineering For Industry* 69-RR-4, Apr. 1969, pp 891-896, 13 Fig, 2 Phot, 12 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1686)
DOTL RP

C4 040224
ANALYSIS OF RESIDUAL, THERMAL, AND LOADING STRESSES IN A B33 WHEEL AND THEIR RELATIONSHIP TO FATIGUE DAMAGE
This investigation involves the problem of service loading conditions that produce the highest stresses and the possibility of fatigue damage. Static loading, rim heating, residual stress measurements, and fatigue tests were made in the laboratory on representative b33 wheels. A series of simulated loading conditions was studied and the resulting stresses combined by simple superposition principles. The resultant stress patterns were compared with fatigue test results using the modified Goodman relationship. In this way the service loading conditions that produce fatigue damage may be predicted.

Bruner, JP Benjamin, GN Bench, DM (Armco Steel Corporation)
ASME Journal of Engineering For Industry RR-3 Paper No 66-WA/, Aug. 1966, pp 10, 14 Fig, 9 Tab, 5 Phot, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1687)
DOTL RP

C4 040226
EFFECT OF DESIGN VARIATION ON SERVICE STRESSES IN RAILROAD WHEELS
The continuing trend of present railroad operating practices toward higher wheel loads and speeds has created the need for better design criteria to insure that wheel configurations are the best attainable. Computer programs to simulate service braking and loading conditions have been applied to various wheel designs and the braking and loading stresses computed. The results indicate that cyclic stresses of significant magnitude may occur under different operating conditions, so fatigue concepts are important in wheel design considerations. There was no one optimum wheel design for all possible service conditions, although several configurations showed promise. A method was proposed for optimizing design for specific service conditions to safeguard against fatigue damage.

Contributed by Railroad Division of the ASME for presentation at the Winter Annual Meeting Energy Systems Exposition Pittsburgh Pennsylvania, November 12-17,1967

Bruner, JP (Armco Steel Corporation); Levy, S Jones, RD (Canadian Steel Wheel Limited); Wandrisco, JM (United States Steel Corporation)
American Society of Mechanical Engineers Paper 67-WA/RR-6, Nov. 1967, 16 pp, 12 Fig, 1 Tab, 10 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1690)
DOTL RP

C4 040257
WEAR OF IN-SERVICE SWITCH RAILS
A series of three related letters address the problem of excessive wear in switch points. Attempts to relate the wear problem to rail chemistry and hardness are described. It was thought that rail with higher carbon content would resist flow and show less wear than rail low carbon contents. Hardness could not consistently be related to wear.

Penn Central Transportation Company Test No. 181, July 1931, 4 pp, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1722)
DOTL RP

C4 040259
RAIL ABRASION AND END BATTER OF CONTROL COOLED 131 LB. R.E. RAILS

This is a progress report showing results of rail abrasion and end batter of control cooled 131 lb. R.E. rails rolled and treated by various manufacturers and laid during 1935. The Illinois and Bethlehem rails were laid on the Middle division No. 4 westbound passenger tracks on tangent and 4 degrees 0" curve east and west of Lewistown, Pa. The Carnegie and Inland rails were laid on the Panhandle Division No. 1 eastbound passenger and freight track on tangents and curves ranging from 3 degrees 14' to 7 degrees o" west of Carnegie, Pa. It was found that for the tangent track the differences in both abrasion and batter as between thermal treated and ordinary hot bed cooled rails are hardness of the rail has resulted from the thremal treatment. The information for curve is not directly comparable on account of wide variations in curvature where measurements were obtained. There have been no transverse fissures or other failures in either the test or comparative rails during the three year period between measurements.

Penn Central Transportation Company Prog Rpt Test No. 245, July 1939, 3 pp, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1724)
DOTL RP

C4 040273
STRESS CORROSION OF RAIL WEB STEEL (STATIC)

The test included six rail joint segments containing one bolt hole with a bolt inserted to make the joint. It also included twenty steel specimens taken from rail steel which were subjected to static bending stresses. The twenty corrosion test specimens were tested after nearly twelve and one half years of exposure to the elements. The joint segments were tested approximately one month later. All of the test specimens were cleaned throughly and examined in the laboratory by Magnaflux and Magnaglow methods for the presence of corrosion cracks. While there was considerable pitting to be found, the laboratory examination disclosed no cracks in any of the specimens. This test shows that static stress combined with corrosion has little or no effect upon the development of cracks in rail web steel.

Code, CJ (Pennsylvania Railroad)
Penn Central Transportation Company Test Rpt Test 475, Nov. 1960, 16 pp, 2 Fig, 1 Tab, 9 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1742)
DOTL RP

C4 040278
DETERMINATION OF PLASTIC FLOW IN RAIL HEAD

The purpose of the test was to determine the amount of plastic flow which takes place in the gauge corner of a rail on the high side of a curve under conditions which produce shelling. The rails were laid on the Bolivar Curve. At this location the track was laid with 140-lb., 1948 rail, which in August 1953, was showing flaking and light shelling. This is a 4-degree curve with 4-inches superelevation, authorized speed 45-mph, and carries moderate to heavy eastward freight traffic. Records kept in connection with another test indicate a tonnage of approximately 29,000,000 gross tons annually. The three test rails were installed August 17, 1953. Inspection September 12, 1955, showed light flaking on all three rails. On the high rail of curves there is a flow of metal at the top gauge corner of the rail toward the gauge side. This flow of metal extends to a depth of 1/4-inch to 3/8-inch below the rail surface. The magnitude of deformation is positive evidence of shear stresses well beyond the yield point of the steel.

Code, CJ
Penn Central Transportation Company Test No. 591, Aug. 1971, 19 pp, 5 Fig, 1 Tab, 7 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1751)
DOTL RP

C4 040279
RAIL WEB STRESSES IN HIGH SPEED TERRITORY

The purpose of the present test was to determine if possible the cause of frequent split web failures in the joint on 131-lb. RE rail on the Fort Wayne Division, and in 152-lb. PS rail on the New York Division. Web failures in 131-lb. and 152-lb. rail on the Fort Wayne and New York Divisions are adequately explained by the corrosion fatigue theory. The ocassional bolt hole failures in 133, 140, and 155-lb. rail are not readily explained. A 50% allowance for impact is justifiable based on measured wheel loads. Application of reformed bars changes stress distribution in the rail web and in many cases increases web stresses, accelerating rail web failure. Loose bolts and increase in rail end gaps increase rail web stress. The results of this test emphasize the need for protection of rail steel against corrosion, for maintaining standard bolt tension, a good fit between bars and rail, and good surface through joints.

Code, CJ
Penn Central Transportation Company Test Rpt Test No. 597, June 1960, 6 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1752)
DOTL RP

C4 040281
ALLOY STEEL RAIL (CHROME-VANADIUM OR "CV")

The CV rail was laid in October 1953, in connection with regular rail renewals. The location was selected because it was one where moderate shelling had developed in the previous 131-lb. rail over a period of about 11 years. A total of 47 CV rails were laid--16 on the low side and 31 on the high side of the curve. Measurements of gauge superelevation, ordinates and rail head wear were made. A final inspection of CV rail was made on October 29, 1959, at which time 30 CV rails remained in track. There was no indication of shelling, although, some flaking was noted on the CV rail, and there was no indication of rail and defects. The results of this test have shown the CV alloy steel of the composition used to be unreliable. Its good wearing qualities and superior resistance to shelling are over-shadowed by its poor resistance to impact.

Code, CJ
Penn Central Transportation Company Test Rpt Test No. 645, Jan. 1960, 23 pp, 3 Fig, 1 Tab, 15 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1754)
DOTL RP

C4 040282
FLAME HARDENED AND HEAT TREATED STOCK RAILS

Flame hardened and heat treated stock rails were installed at locations where the open hearth stock rail had shown short life due to excessive wear, primarily flange wear. Flame hardening and heat treating produced a Brinell hardness on the rail head of approximately 350. Both the flame hardened and heat treated stock rails gave better performance than the open hearth stock rail; however, the flame hardening process resulted in considerable vertical distortion of the stock rail, as much as five feet in 60-ft. As a result, this type of hardening was discontinued. While this test was installed initially to investigate the reduction in flange wear, the use of heat treated stock rails to date and the results of heat treated rails used for other purposes indicate that they provide greatly increased life and reduced maintenance as compared with ordinary stock rails where crushing and plastic flow cause frequent renewal.

Code, CJ
Penn Central Transportation Company Test Rpt Test No. 608, Apr. 1960, 10 pp, 1 Tab, 6 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1755)
DOTL RP

C4 040283
FLAME HARDENED VS HEAT TREATED AND MANGANESE CROSSINGS

The purpose of this test was to determine the relative value from a service point of view of flame hardened crossings, as compared with heat treated and manganese crossings. Two flame hardened, one heat treated and one maganese crossings were installed on new timber supports in a two over two track crossings, making an angle of 71 degrees 38'. All crossings were interchangeable. These crossings were installed on May 2, 1953. On the September 8, 1954, inspection it was found that excessive batter on one of the flame hardened crossings made renewal necessary. Initial cost, maintenance required, as well as service life indicate a preference for the heat treated crossing over the flame hardened.

Code, CJ
Penn Central Transportation Company Test Rpt Test No. 613, Dec. 1957, 9 pp, 3 Fig, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1756)
DOTL RP

C4 040301
ANALYSIS OF TAPERED ROLLER BEARING DAMAGE
Tapered roller bearings, damaged in field applications or laboratory tests have been subjected to a systematic analysis of such damage to prevent its recurrence in the field or to gain knowledge of its control in the laboratory. A method of analysis is described which has been developed for examining such bearing damage. The essential steps of the analysis are described with emphasis on the visual classification and metallographic examination of the damage. Bearing damage is classified in two major categories, that resulting from contact fatigue, and that due to other mechanisms. Damage which is related to material, surface finish, geometry, local asperities (grooves and bruises), the lubricant viscosity is usually due to contact fatigue. Damage due to other mechanisms is that which results from obvious mechanical, chemical, or electrical factors in the application which either change bearing geometry or eventually cause contact fatigue.

Widner, RL Wolfe, JO (Timken Roller Bearing Company, Incorporated)
American Society for Metals C 7-11.1, Oct. 1967, 32 pp, 1 Fig, 2 Tab, 37 Phot, 21 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1782)
DOTL RP

C4 040306
A VIBRATING RIG TEST FOR RAILWAY BEARING GREASES
A test rig utilizing a standard reaction type vibration test machine was developed to determine the consistent stability of grease lubricants in anti-friction bearings. This program was undertaken in view of the ever increasing demands upon greases in railway service and also the lack of direct correlation among performance characteristics obtained through existing standardized bench tests, full scale rotational tests lacking vibration, and those characteristics displayed in the field. General performance of the products tested appeared to be insensitive to the parameters of vibration within the range of parameters occurring in service. A 48 hours test which subjects the test cartridge to 4 G's at 38 cps with the grease bulk temperature thermostatically controlled at 180 F emerged as the condition which yielded results duplicating field service conditions.

Lieser, JE West, CH
Timken Roller Bearing Company, Incorporated Conf Paper May 1968, 10 pp, 4 Fig, 4 Tab, 6 Phot, 8 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1787)
DOTL RP

C4 040311
FATIGUE TESTS OF FREIGHT CAR AXLES 5 1/2 TIMES 10 INCH JOURNALS
The series of fatigue tests was concluded on a proposed design of raised wheel seat freight car axle with "as forged" (unmachined) body between wheel seats. The proposed design has a considerably greater fatigue strength in the wheel fit than the Standard Freight Car Axle (Black Collar Design). One group of Standard Freight Car Axles had an abnormally low fatigue resistance of 13,000 psi in the body portion between the wheel seats. This value was raised to the normal value of 17,500 psi by stress relieving at 1150 degrees F for six hours. One group of axles of the proposed freight car design had a similarly low body fatigue resistance of 13,000 psi. Machining the axle body was found to be beneficial in improving the fatigue resistance. This finding may mean that unfavorable residual stresses due to straightening were removed by machining.

Association of American Railroads Prog Rpt MR-242, June 1955, 59 pp, 23 Fig, 16 Tab, 6 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1792)
DOTL RP

C4 040315
WEAR LIFE OF HEAT TREATED 131 LB., 18 FT. SWITCHES
This brief letter correspondence records the fact that an in-service test of heat treated switches progressed to the point where the first switch was removed because of excessive wear after 27 months of service. This was considered about seven times the life of an ordinary switch. The cost of this 130 lb., 18', heat-treated switch was $161 which was thought to be the cost of untreated switches at the date of purchase.
Unpublished Correspondence.

Penn Central Transportation Company Test No. 129, July 1933, 1 p

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1718)
DOTL RP

C4 040317
STUDY OF FREIGHT CAR AXLE DESIGN TO WITHSTAND LOADINGS UP TO 10 RO 20 PERCENT IN EXCESS OF PRESENT AXLE LOAD LIMITS AND SUMMARY OF DATA ON AXLES FOUND DEFECTIVE BY MAGNETIC PARTICLE AND ULTRASONIC TESTING OVER A FIVE-YEAR PERIOD
This report covers the engineering study of recommeded axle dimensions for a load rating of 10 and 20 percent in excess of present axle load limits. This study covers the nominal 5-1/2" times 10", 6" times 11" and 6-1/2" times 12" axle sizes or respectively, 40,000, 50,000 and 60,000 pound per axle load ratings. This report also covers the results of a questionnaire sent to Member Roads to develop summary data on axles found defective when tested by magnetic particle and ultrasonic equipment with a projected estimate of the increase in expected failures when overloading beyond present axle rated capacities.

Association of American Railroads Res Rpt MR-404, 8 pp, 6 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1821)
DOTL RP

C4 040324
RELATION OF WHEEL TREAD WEAR AND BRAKE SHOE WEAR
Brake shoe requirements on freight cars equipped with conventional brake rigging are not completely equitable at all shoe locations. Studies indicate that replacments of mated shoes on the same brake beam can vary from 8 percent on the inside beams to 13 percent on the outside beams. Four diagonal locations are found to have a shoe requirement approximately 55 percent, and the four mating positions 45 percent of total replacements. The unequal shoe wear adversely in so far as realizing uniformity of service life on the wheels in the four positions as well as on mated wheels at the respective locations. The pattern of wheel wear disclosed is not conductive to economy of car maintenance not to the best standard attainable in car utilization.

Jennings, JR (Wilson Car Lines)
American Society of Mechanical Engineers 61-WA-217, Dec. 1961, 11 pp, 7 Fig, 5 Tab, 1 Phot, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1847)
DOTL RP

C4 040325
STUDY OF VIBRATION FREQUENCIES UNDER IMPACT CONDITIONS
A study is presented of vibration frequency characterisitcs under impact conditions for typical friction type draft gears used on railroad freight cars of a comparison of typical instrumentation records showing force-closure clutch action of typical and of representative electronic equipment used to measure these vibration forces. When determining the reaction-force characteristics of draft gears during closure, careful selection of instrumentation must be made. Instrumentation having a flat frequency response of 0 to 600 cycles is prefereed in order to attenuate the higher frequencies encountered in friction-draft-gear characterisitcs. Instrumentation having higher frequency response can be used but this usually results in confusion in interpreting the records to determine the fundamental force measurements.

Newcomer, GH (Association of American Railroads)
American Society of Mechanical Engineers 59-A-250, Dec. 1959, 8 pp, 1 Fig, 2 Tab, 10 Phot, 2 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1848)
DOTL RP

C4 040341
R.M.C. PLASTIC RAIL JOINT PACKING WITH VERMICULITE BASE
R.M.C. Plastic Rail Joints Packing is a cake composed of vermiculite impregnated with an asphalt oil and rust inhibitors. It is placed at the end rail behind the joint bar for the purpose of lubricating and protecting the joint. No-Ox-Id "A" is a rust inhibiting grease used for the same purpose. Comparison was made of these two substances by applying them to alternate 10 joint stretches. While the damage to rail ends by corrosion fatigue, which was found in so many cases with the original R.M.C. packing, does not seem to be repeated with the Vermiculite packing, there is no evidence that the overall protection is superior to that given with No-Ox-Id "A". The protection to the rail end in most cases appears to be inferior. Since rail web failures have been reduced in new rail designs, and since there was a lack of apparent benefit from the use of packing, the use of packing was abandoned.

Code, CJ
Penn Central Transportation Company Test Rpt Sept. 1957, 3 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1745)
DOTL RP

C4 040346
STRESSES IMPOSED BY PROCESSING
Types of residual stress, measurement and formation are discussed. Residual stresses were measured on two different sizes of truck axle shafts of 1 11/16-in. and 2 1/8-in. diameter. Two specimens were taken for residual stress investigation from each shaft, one toward the flange end and the other from the splined end. Metallurgical examination was made. Results of completely reversed torsional fatigue tests made on 1 11/16-in. diameter shafts are presented. Fatigue tests were made in rotating bending on full-size large-diameter shafts of two different designs. Fatigue results are summarized. Residual stresses were measured in these large shafts. Favorable surface compressive stresses were determined for these shafts water-quenched from the tempering temperature as compared with nil stresses in those aircooled. It was concluded that favorable thermal stresses were a very important consideration in improving fatigue strength.

Horger, OJ (Timken Roller Bearing Company, Incorporated) *SAE Quarterly Transactions* Vol. 5 No. 3, July 1951, pp 393-403, 19 Fig, 1 Tab, 1 Phot, 27 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1775)
DOTL RP

C4 040348
FATIGUE OF LARGE SHAFTS BY FRETTING CORROSION
Rotating bending fatigue tests were made for the AAR on sixty-six shafts of 9 1/2 inches diameter. A press-fitted member was mounted on each shaft. Fatigue failure initiated in the shaft under the fitted member. Six different engineering steels were used for the shaft forgings. Some steels were normalized and tempered while others were quenched and tempered. Two groups of specimens were quenched below the critical temperature to develop residual compressive stresses in the surface zone. All shafts were run 85 million stress reversals unless breakage developed earlier. The maximum allowable bending stress of endurance limit to prevent the shaft breaking off under the fitted member for all normalized and tempered or quenched and tempered shafts ranged from 9,500 to 12,500 lb. per sq. in. The two groups of shafts given a subcritical quench gave endurance values of 18,000 and 19,000 lb. per sq. in.

Horger, OJ (Timken Roller Bearing Company, Incorporated)
Institution of Mechanical Engineers Conf Paper Sept. 1956, 11 pp, 5 Fig, 6 Tab, 4 Phot, 9 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1777)
DOTL RP

C4 040349
FATIGUE STRENGTH OF NORMALIZED AND TEMPERED VERSUS AS-FORGED FULL SIZE RAILROAD CAR AXLES
Rotating cantilever fatigue tests were made on 48 full size railroad car axles to determine the fatigue strength of the axle wheel seat on which is pressed-on. Plain carbon steel of 0.39 to 0.53 per cent carbon content in both the as-forged and normalized and tempered condition was investigated. As-forged axles had 1/3 greater fatigue resistance in the wheel seat to the initiation of fatigue cracks than normalized and tempered axles of practically same carbon content. Of two groups of as-forged axles the one having about 10 points higher carbon showed 1/3 greater fatigue resistance in the wheel seat to the initiation of fatigue cracks than the lower carbon content axles.

Horger, OJ Buckwalter, TV (Timken Roller Bearing Company, Incorporated)
American Society for Metals Sept. 1943, pp 559-581, 2 Fig, 5 Tab, 12 Phot, 9 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1778)
DOTL RP

C4 040350
STRESSING AXLES AND OTHER RAILROAD EQUIPMENT BY COLD ROLLING
The history associated with the development of surface pressing is discussed, followed by examples of tests and practical applications. A discussion of the reasons and theory for the improvement in fatigue resistance is presented.
Reprinted from "Surface Stressing of Metals"

Horger, OJ (Timken Roller Bearing Company, Incorporated)
American Society for Metals pp 85-142, 32 Fig, 8 Tab, 26 Phot, 63 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1779)
DOTL RP

C4 040359
EFFECT OF OVERHEATING ON THE FATIGUE RESISTANCE OF PLAIN BEARING AXLE JOURNALS
A laboratory test of axles was authorized in which axle journals would be overheated under load in the laboratory and subsequently fatigue tested to determine the effect of overheating. It was decided to carefully evaluate all axles which had failed in the test to determine whether or not copper penetration was present. Tentative conclusions based on the data obtained to date are: 1. Damage to the steel structure of axles due to severe journal overheating can occur without being caused by copper penetration. 2. No traces of copper penetration have been found in the overheated specimens.

Association of American Railroads Prog Rpt AAR MR-212, 1952, 1 p

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1803)
DOTL RP

C4 040360
IMPROVEMENT IN FATIGUE RESISTANCE OBTAINED BY WATER QUENCHING UNTREATED 5-1/2" TIMES 10" PASSENGER AND FREIGHT CAR AXLES FROM 1000 DEGREES F
Fatigue tests were made on eleven passenger car axle assemblies and seven freight car axle assemblies prepared from axle forgings which had been modified by water quenching from 1000 degrees F. These forgings were originally produced to AAR Spec. M-101-49, Grade A, but were given this subsequent treatment to determine the improvement in fatigue resistance that could be obtained from the beneficial thermal residual stresses produced by quenching from below the critical. It was concluded that water quenching untreated axle forgings does not improve the resistance to initiation of fatigue cracks in the wheel fit portion, but does greatly increase the resistance to breaking off in the wheel fit. In some cases over 100%.

Horger, OJ Neifert, HR
Association of American Railroads Res Rpt MR-213, Dec. 1953, 28 pp, 13 Fig, 4 Tab, 6 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1804)
DOTL RP

C4 040362
EFFECT OF PERIODIC NORMALIZING OF TRUCK SIDE FRAMES
The two series of tests on eight side frames covered by this report are the basis for the following conclusions: 1. Heat treatment of second hand truck side frames did not increase their fatigue life expectancy. 2. The reconditioning of worn column areas by welding when subsequently heat treated does

not impair fatigue life expectancy. 3. The normalizing heat treatment process (heating to 1550 degrees F and cooling in still air) did not result in improved fatigue test performance in comparison with the stress relieving heat treatment as given the first four frames.

Association of American Railroads Res Rpt AAR MR-219, May 1954, p l

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1806)
DOTL RP

C4 040363
FATIGUE TESTS OF FREIGHT CAR AXLES 5 1/2 TIMES 10 INCH JOURNALS
This is the first Progress Report on a series of tests made at the Canton Laboratory on a proposed design of raised wheel seat freight car axle with "as forged" body between wheel seats. These tests are part of the program undertaken with the object of providing an improved freight car axle. The indications at this time are that: the proposed design "as forged" raised wheel seat axle appears to have a slightly greater fatigue life than the present standard AAR black collar design axle. Machining the axle body between wheel seats is beneficial to the fatigue life of the axle.

Association of American Railroads Prog Rpt AAR MR-221, Apr. 1954, 1 p

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1807)
DOTL RP

C4 040365
FATIGUE TESTS OF FREIGHT CAR AXLES 5 1/2 TIMES 10 INCH JOURNALS
This report concludes the series of fatigue tests made at the Canton Laboratory on a proposed design of raised wheel seat freight car axle with "as forged" (unmachined) body between wheel seats. These tests constitute a part of the program undertaken to develop an improved freight car axle. The conclusions drawn from this investigation are as follows: 1. The proposed design "as forged" raised wheel seat freight car axle has a considerably greater fatigue strength in the wheel fit than the Standard Freight Car Axle (Black Collar Design) due to two factors: (a) The removal of the black collar and use of the raised wheel seat design gives an improved shape, resulting in at least 13% greater fatigue resistance to breaking off in the wheel fit. (b) The increased diameter at the wheel seat decreases the stress at that location by 21%.

Association of American Railroads Prog Rpt AAR MR-242, June 1955, 1 p

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1809)
DOTL RP

C4 040371
INVESTIGATION OF AXLE JOURNAL FILLETS AND DUST GUARD SURFACES RESULTING FROM CONTACT WITH JOURNAL BOX DUST GUARD FLANGES
In order to determine the extent to which damage was occurring with the dust guard opening in its present configuration, the Research Department made a field survey of axles coming into the wheel shop for attention. A total of 126 dust guard seats and fillets of axles were examined. During this examination it was observed that the following damage was occurring: 1. Pounding at the fillet, 2. Wear at the juncture of the fillet and dust guard seat diameter, 3. Grooving at the fillet caused by pressure on the dust guard seat diameter cold working the metal. As a result of damage to axle fillets by contact with dust guard wall surfaces, the Car Construction Committee reviewed the matter and decided that the dust guard wall projection should be modified to prevent damage to journals and also to provide better retention of oil in the journal box.

Association of American Railroads Res Rpt AAR MR-324, Aug. 1958, 4 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1816)
DOTL RP

C4 040401
COMPOSITION BRAKE BLOCKS--INTERACTION BETWEEN COMPOSITION BRAKE BLOCKS AND WHEELS
The service tests with various makes of K-block on the Berliner S-Bahn are described. The object of the tests was to study the interaction of the two friction elements, block/wheel. Although a strong tendency for the formation of cracks in wheel tires had occasionally been observed with K-blocks, in the service tests such a tendency could not be detected. All the stages of grooving and follow-wear were present on the tires. Similar phenomena had been observed by the SNCF on suburban services. Experience gained by the DB showed that some difficulty arose due to metallic particles sometimes becoming embedded in the braking surface of the block. K-blocks were used extensively on the London Transport Underground lines. Thermal cracking, tire spalling and wear constituted a special problem on the frequently-stopping motor coaches with heavily-loaded small diameter wheels, running in tube tunnels. The performance of a K-block depended on various parameters: characteristics of the block and of the wheel steel, application conditions, service conditions, weather, and shape of block. The development of a universal K-block would be difficult.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Intrm Rpt. B64/RP 2/E, Mar. 1967, 62 pp, Figs., Phots., 8 App.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1864)
PURCHASE FROM: UIC Repr. PC
DOTL RP

C4 040404
COMPOSITION BRAKE BLOCKS-METALLIC INCLUSIONS IN THE COMPOSITION BRAKE BLOCKS
Metallic inclusions is given types of composition brake blocks lead to excessively severe wear of the tires and of the blocks. Recent experience has shown that not all composition brake blocks are affected by metallic inclusions. A list indicates those composition brake blocks which, according to data collected up to mid-1969, are unaffected or are affected only in certain isolated instances by metallic inclusions, and which therefore behave favourably with respect to undue wear of the wheel-tire. The list also shows which organizations obtained these favorable results, with which type of vehicles and in which kind of service.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B64/RP 6/E, Oct. 1979, 9 pp, 21 Fig., 5 Tab., 3 App.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1867)
PURCHASE FROM: UIC Repr. PC
DOTL RP

C4 040406
COMPOSITION BRAKE-BLOCKS-TESTS WITH COMPOSITION BRAKE-BLOCKS OF VARIOUS DIMENSIONS AND SHAPE
The German State Railway conducted the necessary tests on the bench and on the Berlin S-Bahn. The tests were based on the assumption that the wheel wear might be diminished if the shape of the composition brake blocks was altered from the usual rectangular shape taken over from cast-iron blocks. A number of different geometrical shapes of the friction surface of composition brake blocks were considered. The coefficient of friction under various conditions was similar with all block shapes tested. None of the block shapes tested produced any bad side effects. It was not possible to find any significant differences between the different block shapes when braking with one block per wheel or with two blocks per wheel; though tire wear for braking with one block per wheel was slightly lower than that for braking with two blocks per wheel. The tests have not revealed any compelling reason for diverging from the customary simple rectangular shape brake blocks.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B64/RP 8/E, Oct. 1970, 9 pp, 35 Fig., 3 App.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1869)
PURCHASE FROM: UIC Repr. PC

DOTL RP

C4 040412
GENERAL PROBLEMS CONNECTED WITH WHEELS AND THEIR ASSEMBLY: SOLID CAST-STEEL WHEELS, WHEELS OF DIFFERENT DIAMETER AND SHAPE--THIRD CONTRIBUTION TO THE STUDY OF SOLID CAST-STEEL WHEELS

In this report an account is given of the running tests, the braking tests on the wheel testing machine and the test runs on steep falling gradients. The running tests employed wheels of 730 mm diameter with treated wheel-rim of non-alloyed steel with a carbon content of either 0.61% or lower than 0.5% with an ultimate tensile strength of 115 to 130 hbar and 84 to 101 hbar respectively. Other tests were made with solid wheels of 920 mm diameter made of Wt steel (carbon and manganese content lower than or equal to 0.52% and 0.80% respectively. These tests consisted of falling-gradient runs on the St. Gothard line and of runs on flat sections under loaded wagons. Some wheels were also submitted to tests on the test rigs at MINDEN, VITRE-sur-SEINE and DERBY, in order to determine their behavior under the effect of heat generated by braking (liability to thermal cracks and deformations of the wheel-rim). Finally, one wheel of 730 mm diameter and wheels of 920 mm diameter of Wt steel were submitted to investigations in the laboratory and the latter wheels were in addition, studied with a view to the stresses developed. The braking tests carried on the rig with 730 mm diameter ABEX wheels have given unfavorable results. The running tests in commercial service have also given unfavorable results (spalling of running-tread). Concerning the GRIFFIN wheels of the same diameter, the running tests have also supplied disappointing results, there wheels displaying spalling or even perhaps flaking. The ABEX and GRIFFIN wheels of 970 mm diameter with treated wheel-rim and somewhat high carbon content showed a good behavior in SWEDEN during tests under high load (25 t/axle) but very mild braking conditions, the climatic conditions however being very severe. The 920 mm ABEX wheels, ordered in Wt steel have shown a good behavior during the running tests and during the braking-tests on the MINDEN, VITRY and DERBY rigs (resistance to thermal cracks). However, during the falling-gradient runs on the St. Gothard line, they had given rise to deformations reducing the play of the axle.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways B98/RP 8/E, Oct. 1970, 29 pp, Figs., Tabs., Phots., 8 App.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1875)
PURCHASE FROM: UIC Repr. PC

DOTL RP

C4 040413
QUALITY OF RAILS AND MEANS OF GUARANTEEING IT--FALLING WEIGHT TESTS AND DEFINITION TESTS (1ST AND 2ND SERIES OF TESTS)

The main object of these tests--was to define and to standardize the conditions of use of the falling weight tests laid-down in UIC Leaflets 860-1-0 and 860-2-0, for the acceptance of rails of current quality and rails of nontreated steel of a quality resistant to wear. It was concluded that a falling weight test, irrespective of its type, is not representative of the fatigue behavior of rails in the track, but it was considered advisable to retain for the time being, such a test on complete pieces of rail, to make it possible to detect and eliminate brittle rails with a large degree of probable success and to maintain each rail production within a truly characteristic and correct scatter range.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Intrm Rpt. D45/RP 5/E, Apr. 1963, 35 pp, Figs., Apps.

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1876)
PURCHASE FROM: UIC Repr. PC

DOTL RP

C4 040416
BEHAVIOUR OF THE METAL OF RAILS AND WHEELS IN THE CONTACT ZONE-RESIDUAL STRESSES IN THE RAIL (CONTINUED) STUDY OF THE WORK-HARDENED ZONE

This report contains the results of measurements taken to study the work-hardening caused by traffic, and more especially the changes in the residual stresses in the rails near the running tread which constitute an important factor in the study of rail fatigue phenomena. About 5 mm below the surface the work-hardening is very large, and the rail is the center of a hydrostatic pressure zone extending down to a depth of approximately 10 mm, this then changing into a tensile one with a maximum at about 15 mm. This may explain why the fatigue cracks (of the kidney-shaped flaw type) tend to originate at a depth of 10 to 20 mm but do not develop in the upper highly compressed zone. Furthermore, the residual-stress fields vary from one section of the rail to another, probably as a result of the oscillations of the wheel-loads due to short-wave rail corrugations.

Question C53 Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Report No. 6, Oct. 1970, 58 pp, 36 Fig

DOTL RP

C4 040417
BEHAVIOUR OF THE STEEL AT THE POINT OF RAIL-WHEEL CONTACT- INTRODUCTORY STUDY ON THE CAUSES OF SHELLING CRACKS IN RAILS

This report reviews pertinent literature on the subject of shelling cracks in rail head. From the research conducted at the University of Illinois it is concluded that shelling cracks in rail heads are primarily due to fatigue under repeated rolling action. Obvious methods of reducing the development of shelling cracks would be to reduce wheel loads on the rails, to use larger diameter wheels or to use stronger rail steels. Future research should be directed towards the closing of the gap between standard fatigue data and the fatigue phenomenon as it occurs under contact stresses due to rolling action. At the moment, the prime difficulty in correlating tensile or torsion and rolling contact fatigue data stems from insufficient knowledge of stress distributions modified with respect to elastic theory by plastic deformation.

Question C53. Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Document No. 1, Oct. 1961, 10 pp, 9 Ref

DOTL RP

C4 040418
PROBLEMS OF INTERACTION OF VEHICLES AND TRACK--WORN PROFILES OF RAIL HEADS AND WHEEL TYRES

As a result of a large number of tests it has been proved that service wear on wheel tires and rail heads leads to definite profiles. These worn profiles are to a large degree independent of the initial profiles of tires and rail heads. In the worn condition the profiles maintain their form and are not subject to any further change. The worn profiles are characterized by good mutual conformity and thus by little increase in wear. The worn profile of tires results in a shortening of the wave length of the periodical wheel set motions (hunting) in the track clearance. It was concluded that to wear new profiles of rail heads and tires should be adapted as much as possible to the worn profile. The use of special wheel tire profiles promise no lasting influence on the riding quality of vehicles. Therefore other design measures on the vehicles should be preferred to control the hunting motion.

Question C9 Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Interim Report No. 6, Oct. 1962, 2 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1881)

DOTL RP

C4 040421
SHELLY RAIL STUDIES AT THE AAR RESEARCH CENTER

Rolling-load test results obtained in a cradle-type machine are listed. Macrographs are presented to reveal cross-sectional qualities of shelly rail. Slow-bend test results are tabulated for flame and induction-hardened rail. It can be noted that all of the rails tested showed excellent results and that no effective stresses were set up between the head and web due to flame and induction hardening.

AREA Bulletin Vol. 66 Bulletin 591, Feb. 1965, pp 484-493, 7 Fig, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1886)
DOTL RP

C4 040426
ROLLING-LOAD AND SLOW-BEND TEST RESULTS OF BUTT-WELDED RAIL JOINTS

In the period from October 1, 1965, to October 1,1966, sixteen rolling load tests and six slow bend tests were conducted on butt-welded rail joints at the Association of American Railroads Research Center. The joints were made by the thermite (Thermex Metallurgical, Exomet and Orgotherm), submerged-arc and oxyacetylene pressure-butt-welding process. The rolling-load tests were made on a 12-in-stroke rolling-load machine. Welded specimens were tested for various reasons including: (1) to determine the quality of the submerged-arc-welded rail joints, (2) to evaluate 115-lb thermite welded rail joints made by the Exomet process, (3) to determine the seriousness of making butt welds from rails with hairline cracks of (pipe) in the web. (4) to investigate the possible detrimental effects of a collar that was not removed from an Orgotherm thermite welded rail joint. The slow bend tests were made with the rail resting on supports 4 ft. apart and loaded at 2 points, one on each side of and 6 in. from the weld. These tests were made with the rail base down, thereby subjecting the head to a compressive stress and the base to a tension stress. For satisfactory service performance a minimum of 1.5 in. of deflection and 140,000 psi modulus of rupture are being used as tentative criteria for oxyacetylene and electric-flash pressure butt welds. A summary of the slow bend test results is provided.

AREA Bulletin Vol. 68 Bulletin 605, Feb. 1967, pp 383-396, 16 Fig, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1891)
DOTL RP

C4 040432
SHELLY RAIL INVESTIGATION, ROLLING-LOAD AND SLOW-BEND TEST RESULTS

Two methods presently employed for improving shelling resistance is the addition of alloying elements and the heat treating of rail. The rolling-load tests in a cradle-type machine are designed to evaluate these methods of improving the resistance to shelling. Rolling-load test results obtained from these cradle-type machines for the period between October 1, 1965, and October 1, 1966, are shown. The S-13 series were initiated to compare the effects of welding prior to flame hardening and flame hardening prior to welding. The electric-flash butt welds were made from secondhand 132-lb HF rail and flame hardened by the Hammon process. Specimens S-13A and S-13C failed after being subjected to 389,800 and 656,900 cycles, respectively. As a result of this performance, rolling-load tests were conducted on welded joints made from 132-lb HF secondhand rail having no flame hardening applied. These joints, S-13E and S-13J, shelled after being subjected to 1,088,000 and 1,163,000 cycles, respectively. Rails flame hardened by the Linde process developed shells after being subjected to 1,254,400 and 844,900 cycles in the cradle-type rolling-load machine. During this period there were no slow-bend tests.

AREA Bulletin Vol. 68 Bulletin 605, Feb. 1967, pp 477-487, 3 Fig, 2 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1897)
DOTL RP

C4 040436
BEHAVIOUR OF THE METAL OF THE RAILS AND WHEELS IN THE CONTACT ZONE--ENQUIRY INTO THE PROBLEM OF SMALL DIAMETER WHEELS APPENDIX 3

The observations made at the Mairy mine concerning the wheel-rail dynamics are discussed. The width of the rolling band is wider than on the SNCF and can be explained by wear of the wheel and rail. It could also be due to transverse elastic deformation of the wheel. The calculations and measurements are summarized which were carried out in the laboratory of the SNCF to investigate the influence of the load, the curvature of the rail and the tire, and more particularly of wheel diameter on the stresses to which these components are subjected.

Partial Copy--Appendix Only-Summary of Report Abstracted Separately, Question C53. Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Interim Report No. 3, Oct. 1966, 11 pp, 5 Fig

RESPONSIBLE INDIVIDUAL:

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1902)
DOTL RP

C4 040437
BEHAVIOUR OF THE METAL OF THE RAILS AND WHEELS IN THE CONTACT ZONE--ENQUIRY INTO THE PROBLEM OF SMALL DIAMETER WHEELS

This report summarizes the responses to an enquiry into the effect that a reduction in the diameter of wheels would have on the behavior in service of the rails and wheels. Information was collected on the subject of P/D ratios (P = load per wheel in tons, D = diameter in meters) and includes an analysis of tests carried out by the U.S., Russia, Germany, the British and the French. Very different values of P/D were found, depending on the railway and especially on the type of steel in the rails.

Partial Copy--Appendix 3 Abstracted Separately, Question C53. Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Interim Report No. 3, Oct. 1966, 6 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1903)
DOTL RP

C4 040438
BEHAVIOUR OF THE METAL OF THE RAILS UNDER THE REPEATED ACTION OF THE WHEELS--RESIDUAL LONGITUDINAL STRESSES IN THE RAIL (PART 1)

The residual stresses result: from heat effects during the cooling of the rail after it leaves the rolling mill; from trimming, after rolling in the vertical and horizontal directions; and, from the cold rolling of the top surface of the rail by the passage of loads. The object of this report is: to lay down a method for the determination of residual stresses, and to supply the results obtained by applying such a method in some special cases.

Partial Copy, Question C53. Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways Interim Report No. 4, Oct. 1966, 11 pp, 6 Fig, 8 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1904)
DOTL RP

C4 040443
DERAILMENT OF A PASSENGER TRAIN CONSISTING OF A DIESEL LOCOMOTIVE WITH SIX-WHEEL TRUCKS, A BAGGAGE CAR, AND A COACH

Three letters discuss the derailment of June 7, 1968. A sketch of the derailment area and photographs of sections of the track involved are included. This derailment is characteristic of a number of derailments that have occurred on curves at or near permissible speed of passenger trains having locomotives with six-wheel trucks, derailment apparently occurring first of the rear truck of the locomotive unit or the lead truck of the baggage car following. In each case the high rail of the curve was overturned. A high ratio of L/V is required to overtrun a rail and it is unlikely that this high a L/V ratio would be developed in track unless there is some unusual condition such as a jack-knifing of couplers between cars, an unloading of the lead wheel of the truck on the high rail, or some severe wedging action of the truck between rails due to a malfunction of the truck components.

Letter Correspondence.

Angold, JA (Atchison, Topkea and Santa Fe Railway); Stuppi, FN 14 pp, 1 Fig, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1909)
DOTL RP

C4 040445
TEST TO DETERMINE VERTICAL AND LATERAL FORCES IMPARTED TO THE RAIL BY A TYPE U28CG GENERAL ELECTRIC LOCOMOTIVE, SANTA FE CLASS 350

The test runs were made using a train consisting of two lightweight chair cars and three baggage cars and a locomotive of two units, one having the instrumented truck. Tests were run at speeds up to 90 mph on dry rail and

moderate temperature. The test results show lateral forces of substantial magnitude being exerted on the rails, an occasional one having a finite duration of ten feet. They also show vertical wheel loads of low value in some locations. The test results indicate it is possible for these two conditions to occur simultaneously on two or three adjacent wheels of a truck and produce an effective L/V ratio of sufficient magnitude to overturn the rail.

Angold, JA
Atchison, Topeka and Santa Fe Railway Test Rpt Aug. 1969, 37 pp, 17 Fig, 3 Tab, 2 Phot, 1 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1911)
DOTL RP

C4 040446
MEMORANDA ON CONFERENCES HELD TO DISCUSS THE DERAILMENT PROBLEM WITH 6-AXLE TRUCK LOCOMOTIVES
Two memoranda discuss derailments involving 6-wheel truck locomotives in which the high rail of a curve has been rolled over. An itemization is made of 20 derailments involving six railroads during the time period 1964 to 1970. The memoranda discuss the deliberations of a meeting between representatives of each of the railroads involved and the AAR.

Angold, JA Lanning, HK
Atchison, Topeka and Santa Fe Railway File 32-03.07, 3 pp

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1912)
DOTL RP

C4 040449
DERAILMENTS OF TWO PASSENGER TRAINS
The pertinent facts are given for the two derailment sites and the train consist. In both cases derailment occurred at the rear truck of the last locomotive unit or front of the following car. A drawing of the wide gage is shown of the actual worn wheel and rail contour of the derailed axle involved in the first derailment. Both derailments are not satisfactorily explained.
Unpublished Data.

Magee, GM (Association of American Railroads) 1967, 2 pp, 1 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1915)
DOTL RP

C4 040456
INVESTIGATION OF SERVICE AND DETECTED BUTT WELDED RAIL JOINT FAILURES
Eight service failures and three detected failures in butt welded rail joints were investigated by the AAR between October 1967 and September 1968. A summary is given of the causes of failure, type of weld, size of rail, date of rolling, and the fabricator. Photographs of the rails at the point of failure are shown.

AREA Bulletin Vol. 70 No. 619, Feb. 1969, pp 681-698, 1 Tab, 25 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1922)
DOTL RP

C4 040457
RESULTS OF ROLLING-LOAD TESTS OF BUTT WELDED RAIL JOINTS
Between October 1, 1967 and September 30, 1968 fifteen butt welded rail joints were tested on the rolling-load machines at the AAR. The rails were tested to a maximum of 2,000,000 cycles, or to failure, of repeated loading. The rolling-load tests are tabulated. For the failed rails the damage points are shown.

AREA Bulletin Vol. 70 No. 619, Feb. 1969, pp 699-711, 1 Fig, 1 Tab, 10 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1923)
DOTL RP

C4 040459
INVESTIGATION OF FAILURES IN CONTORL-COOLED RAIL
Between October 1, 1967 and September 30, 1968 six service failures and one detected failure in control-cooled rail were investigated by the AAR. A summary of the failures is given and each failure is described and photographed.

AREA Bulletin Vol. 70 No. 619, Feb. 1969, pp 718-733, 1 Fig, 1 Tab, 17 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1925)
DOTL RP

C4 040461
SHELLY RAIL INVESTIGATION--RESULTS OF ROLLING-LOAD AND SLOW-BEND TESTS
Addition of alloying elements and heat treating rail are used to improved the shelling resistance. Cradle-type rolling-load tests are conducted by the AAR to evaluate these methods. Rolling-load test results obtained from these cradle-type machines for the period between October 1, 1967 and September 30, 1968 are shown.

AREA Bulletin Vol. 70 No. 619, Feb. 1969, pp 772-780, 2 Tab, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1927)
DOTL RP

C4 040466
INSULATED RAIL JOINT DEVELOPMENT AND RESEARCH--THIRD PROGRESS REPORT
The results of rolling-load tests on 15 AAR-Veelcaboned joints are given. Two 132-lb joints completed the 2,000,000 cycles without failure. One permali insulated joint was tested, but failed after only 600 cycles. Results are tabulated.

AREA Bulletin Vol. 67 No. 598, Feb. 1966, pp 478-482, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1932)
DOTL RP

C4 040469
SHELLY RAIL INVESTIGATION--RESULTS OF ROLLING-LOAD AND SLOW-BEND TESTS
The rolling-load test results obtained in the cradle-type machine on tests conducted between October 1, 1964, and October 1, 1965, are shown. During this period there were no slow-bend tests conducted. The cycles to failure under a wheel load of 50,000 lb. are given for 36 specimens; for the majority of these specimens, hardness values are reported.

AREA Bulletin Vol. 67 No. 598, Feb. 1966, pp 500-508, 3 Fig, 1 Tab, 12 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1935)
DOTL RP

C4 040472
RESULTS OF ROLLING-LOAD AND SLOW-BEND TESTS OF BUTT WELDED RAIL JOINTS
In the period between October 1, 1966 and October 1, 1967, 22 rolling-load tests were conducted on butt welded rail joints but no slow-bend tests were conducted. These butt welded rail joints were made by the oxyacetylene and electric flash butt welding process. The rolling-load tests were made on a 12-in-stroke rolling-load machine. Investigation 214 (samples A through F) was conducted to determine the seriousness of hairline cracks (segregation and pipe) on oxyacetylene pressure butt weld quality. Five of the six joints with stood 2,000,000 cycles of repeated loadings without failure, which is considered a run-out, and one joint (214E) failed after 897,100 cycles. A macroscopic examination made on transverse sections cut from the end of each rail prior to welding indicates that this failure originated from a fishtail. Investigation 220 (samples A through F) is a continuation of the problem presented in investigation 214 but was conducted to determine the effects of hairline cracks on joints from rails of heavier sections. It was found that fatigue of the failed specimens originated in the fillet between the head and web and can be attributed to a shear drag introduced while removing the weld upset. Investigation 226 (samples A and B) was conducted to evaluate two electric flash butt welded joints from which the upset metal had been ground from the top and sides of the head and bottom and sides of the base

but not removed from the web. An examination of the fracture surface to determine the fracture mechanics indicates that this failure originated in the fillets between the web and upset metal. Investigation 230 (samples A and B) was conduced to evaluate oxyacetylene pressure butt welded joints made with a new type of welding head. Joint 230A failed after 33,500 cycles of repeated loading and joint 230B withstood the 2,000,000 cycle minimum requirement without failure. This failure can be attributed to the lack of fusion at the weld interface.

AREA Bulletin Vol. 69 Bulletin 612, Feb. 1968, pp 589-597, 11 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1938)
DOTL RP

C4 040474
INVESTIGATION OF FAILURES IN CONTROL-COOLED RAIL

In the period between October 1, 1966 and October 1, 1967 there were seven failures in control-cooled rail, three service and four detected, investigated by the metallurgical laboratory of the AAR. Investigations 132-10A and B involved two rail specimens both having a detected transverse discontinuity in the head. These transverse discontinuities were detected by a detector car. Rail specimen 132-10A was identified as a 100-lb RE. This failure should be classified as a transverse fissure from hot torn steel. Rail specimen 132-10B was identified as a 132-lb RE. This failure should be classified as a detailed fracture from a shell. Investigations 132-12A and B involved two rail specimens both having a detected internal imperfection in the web. These internal imperfections were detected by a detector car and a hand test. Both rail specimens were identified as 132-lb RE. It was noted that both these rails have a pipe, and a non-metallic entrapment (slag) commonly associated with pipe, in the web. Investigation 135-16 involved a rail that failed in service. This rail was identified as a 112-lb RE. A photograph of the fractured faces showed a fatigue ring development. This fatigue ring development (detail fracture) started from a longitudinal separation close to the running surface of the rail head, then turned downward to form a transverse separation at a right angle to the running surface. This failure should be classified as a detail fracture from a shell. Investigation 135-28 involved a service failure that resulted from a derailment. This rail was identified as a 112-lb RE. This failure was caused by an impact force of unusually high magnitude that is believed to have been the result of a derailment. Investigation 135-29 involved a rail that failed in service. This rail was identified as a 115-lb RE. This failure was attributed to the presence of a base seam in conjunction with a high impact loading at subzero temperatures.

AREA Bulletin Vol. 69 Bulletin 612, Feb. 1968, pp 620-631, 19 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1940)
DOTL RP

C4 040476
SHELLY RAIL INVESTIGATION--RESULTS OF ROLLING-LOAD AND SLOW-BEND TESTS

The S-15 series was initiated to evaluate rail heat treated by the flame-hardening process. Rolling-load test results for specimens S-15A through S-15W were reported last year and are included in this report for information. Specimens S-15W, S-15X, S-15E-2 and S-15F-2 are all secondhand 132-lb head-free rail heat treated to 3/16 in depth. Specimens S-15G-2 and S-15H-2 were not heat treated (secondhand 132-lb head-free rail) and used as control samples. The S-16 series was initiated to evaluate rail heat treated by the Linde process. During this period there were no slow bend tests.

AREA Bulletin Vol. 69 Bulletin 612, Feb. 1968, pp 699-707, 5 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1942)
DOTL RP

C4 040496
THE DUAL ROLES OF DESIGN AND SURFACE TREATMENT IN COMBATING FATIGUE FAILURES

The problem of producing components which will have satisfactory lives under repeated stress conditions requires a twofold approach. In the first instance the design must take account of any stress concentration effects in the component by geometrically distributing the material in the most efficient way so as to reduce such stress concentration effects to a minimum. The second approach is based on the fact that fatigue failures in the vast majority of cases are initiated on the surfaces of components. The designer must consider what deleterious surface effects occur on the component being designed, and counter these with the use of a surface treatment applicable to the particular case being studied. The present-day incidence of fatigue failures in all branches of engineering 90 percent of all service failures, is intolerably high. The importance of the twofold approach in designing for fatigue loading conditions is extremely important.

Wise, S Burdon, ES (British Railways Board) *Institution of Locomotive Engineers Journal* Vol. 54 No. 298, Part 2, pp 142-215, 23 Fig, 8 Tab, 1 Phot, 27 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1980)
DOTL RP

C4 040504
RHEOSTATIC BRAKING WITHOUT MOTORING ALL AXLES

The power circuits for the system are shown. The detailed sequence of events during a stop using rheostatic braking is as follows: A command is received to brake at one of the specified rates (1.5, 2.1, or 2.6 mph p.s.), both electro-pneumatic and rheostatic brake circuits are energized. When a rheostatic braking current has been established on every equipment on the train a change-over relay is energized and this releases the air brakes on all cars. The rheostatic braking continues to build up through the operation of a camshaft switching unit, which reduces progressively the degree of field divert until it is checked by the operation of the rheostatic current limit relay (RCLR) when the current value is reached which represents the maximum which can reasonably be permitted under tare conditions. The performance is shown which was obtained with the equipment in terms of percentage of train energy dissipated rheostatically for various speeds of entry and various rates of retardation. The degree of success which is achieved with this scheme will be revealed by the extent to which wheel wear is reduced.

Manser, AW (London Transport Board) *Institution of Locomotive Engineers Journal* Vol. 55 No. 303, Part 1, pp 18-58, 12 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1991)
DOTL RP

C4 040515
THIRTEENTH PROGRESS REPORT ON SHELLY RAIL STUDIES AT THE UNIVERSITY OF ILLINOIS

One specimen of a chromium-vanadium rail, heat treated to 490 Brinell hardness gave a rolling-load test of 21 million cycles. Ten specimens of high-silicon rails gave rolling-land tests that averaged 2,307,000 cycles. Two specimens of 140-lb. chrome-vanadium alloy rail, gave rolling-load tests that averaged 3,625,000 cycles. One shelling crack started at a segregation streak in the rail. Rolling-load tests to produce detail fractures from shelling indicate that both chrome-vanadium alloy rails and heat-treated carbon-steel rails resist the production of detail fractures better than standard carbon-steel rails. All rolling-load tests to produce shelling indicate that rails with higher hardness, with corresponding increase in mechanical strength, give longer laboratory rolling-load tests.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 56 No. 521, Feb. 1955, pp 954-959, 1 Tab, 14 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2069)
DOTL RP

C4 040516
THE EFFECT OF STRESS RAISERS AROUND A BOLT HOLE ON THE FATIGUE LIFE OF A RAIL

A universal fatigue testing machine was obtained and a bending fixture was designed. The function of the machine is to apply a vertical vibratory force to any specimen. The alternating force is applied 1800 times a minute to an elastic test specimen, and can be adjusted between zero and 5000 lb. The 132-lb. RE section was used because it represents the heaviest of AREA sections, and the 140-lb. PS section was used because it had a bolt hole location in the heavier web area. The severity of the defects varied from light to heavy drill gouges, and from light to heavy burrs, as well as the location of the brand one the edge of the hole. The effect of the stress raisers on the fatigue life of the rail sections is very pronounced. All these stress raisers around the bolt hole were produced in the manufacturing process. The statistical data indicates that a bolt hole drilled with a dull or improperly sharpened drill through a brand reduces the fatigue life of the rail by 50 percent.

AREA Bulletin Vol. 56 No. 521, Feb. 1952, pp 960-975, 4 Fig, 2 Tab, 14

Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2070)

DOTL RP

C4 040525

SHELLY RAIL STUDIES AT THE UNIVERSITY OF ILLINOIS

Rolling-load tests are reported for the following types of rail: (1) German abrasion-resistant rails; (2) basic-oxygen standard carbon-steel rails; (3) basic-oxygen high-silicon steel rails; (4) 115-lb. standard carbon-steel rails; and (5) flame-hardened rails. Mechanical tests are presented for Japanese induction-hardened 119-lb. rails.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 64 No. 577, Feb. 1963, pp 534-541, 6 Tab, 4 Phot, 1 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2079)

DOTL RP

C4 040534

MEASURES TO COUNTER FATIGUE FAILURE IN RAILWAY AXLES

This paper reviews the experience in London Transport of fatigue cracking in railway axles, and presents the results of laboratory fatigue tests on full-scale axle specimens under simulated rotating bending. The investigation was undertaken with the aim of entirely eliminating fatigue cracking and fretting under the press fits of wheel-axle sets. Cold rolling of wheel seats strongly inhibits the propagation of such fatigue cracks but it does not prevent their initiation. The introduction of a stress-relieving groove, such that the edge of the press fit overhangs the groove, leads to a marked reduction in fretting and increase in life of test specimens, and the results of a limited service test suggest that the presence of such a groove reduces the stresses under the wheel hubs to a level at which cracking is eliminated.

Maxwell, WW (London Transport Board); Dudley, BR (Nottingham University, England); Cleary, AB (Imperial Chemical Industries Limited); Richards, J Shaw, J (London Transport Board) *Institution of Locomotive Engineers Journal* Vol. 58 No. 322, Part 2, pp 136-171, 5 Fig, 2 Tab, 4 Phot, 27 Ref, 3 App

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1986)

DOTL RP

C4 040539

THE SULZER 12LDA29 DIESEL ENGINE AS APPLIED TO RAIL TRACTION

It is very difficult to make a fabricated structure which has no 'stress raisers' due to either bad geometry or lack of welding quality. Any fabricated structure which carries a high general stress is likely to develop fatigue fractures in certain areas. In order to avoid this situation and provide an engine structure which will reliably last the life of the engine, it is necessary to design the engine to a standard which will avoid a generally high stress and avoid areas which will concentrate stress. It will also be necessary to ensure a very high standard of welding quality. The additional expense and weight penalty of raising the standard of the structure in this way will tend to narrow the economic gap between the fabricated structure and the cast structure and may indeed close it completely.

Holmes, SC *Institution of Locomotive Engineers Journal* Vol. 59 No. 328, Part 2, pp 153-167, 4 Fig, 10 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1996)

DOTL RP

C4 040556

EXPERIMENTS ON THE SETTING OF RAILWAY BALLAST UNDER REPETITION OF LOAD

Four types of ballast were laid a top 30 cm layer entirely composed of standard crushed stone; upper 20 cm composed of crushed stone and lower 10 cm of standard screened gravel; upper 10 cm of crushed stone and lower 20 cm of screened gravel; and 30 cm entirely composed of screened gravel. Comparison between the Grade 1 crushed stone with size distribution as produced and the one with size distribution modified by screening to 30 to 50 mm indicated that the setting rate of the ballast composed of the latter was 21% slower than that of the one of the former. Comparison between the wooden and the concrete ties used in the experiment with reference to both types of ballast revealed that the ballast setting under concrete ties was 50% less than under wooden ones. A ballast of screened gravel with coarse sand fillings was compared with the one of the same material minus sand. It was found that the setting rate of the former was very much slower than that of the latter; it means that good stability will be gained if the cavities are well filled.

Sato, Y *Railway Technical Research Institute* Vol. 1 No. 3, Sept. 1960, p 75

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2019)

DOTL RP

C4 040569

INVESTIGATION OF FAILURES IN CONTROL-COOLED RAILS

Eleven control-cooled rail failures were analyzed and the results of the analysis are tabulated. The following types of rail failures are described and photographed: transverse fissure from inclusion; split web at electric flash weld; fatigue of switch point; detail fracture at bond wire weld; fracture from deformed tie plate; and vertical and horizontal split heads from fishtail defects.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 63 No. 570, Part 1, Feb. 1962, pp 503-511, 1 Tab, 14 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2048)

DOTL RP

C4 040570

SERVICE TESTS OF HEAT-TREATED AND ALLOY-STEEL RAIL

The results of service tests conducted by five railroads are reported. The rail types included in the tests were: 115-RE columbium-treated, chrome-vanadium alloy rail, 132 RE heat-treated rail, 140 RE high-silicon rail, 155 PS high-silicon rail, and 115 RE head-treated rail. Areas of heavy shelling and continuous flaking are illustrated.

AREA Bulletin Vol. 63 No. 570, Part 1, Feb. 1962, pp 533-545, 1 Fig, 7 Tab, 8 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2049)

DOTL RP

C4 040572

INVESTIGATION OF FAILRUES IN CONTROL-COOLED RAILS

A summary is given of the failure analysis of 32 failed control-cooled rails. Photographs of failures due to detail fracture from shelling, horizontal split head from fishtail, and head and web separation failure, are shown.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 62 No. 563, 1961, pp 593-597, 2 Tab, 6 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2051)

DOTL RP

C4 040573

SHELLY RAIL STUDIES AT THE UNIVERSITY OF ILLINOIS

Four rolling load tests of high silicon-vanadium rails averaged 1,850,000 cycles. Two similar tests of high silicon-chromium-vanadium rails ran 1,682,000 and 5,805,400 cycles. One more test of standard carbon rails flame hardened by the Union Pacific Railroad ran 11,501,100 cycles. Two rails containing 0.047 percent columbium ran 2,051,000 and 2,304,800 cycles, and the rails developed excessive flow at the gauge corner. Pictures are shown of induction-hardened rails from service. This method of treatment did not prevent early shelling failures. Five specimens were tested to develop detail fractures from shelling.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 62 No. 563, 1961, pp 630-634, 1 Tab, 12 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2052)

DOTL RP

C4 040576

SHELLY RAIL STUDIES AT THE UNIVERSITY OF ILLINOIS

Two rolling load tests were made on a high-silicon rail which ran 1,944,400 and 1,480,000 cycles. A standard carbon-steel rail gave unusually long tests of 4,371,000 cycles. These specimens deformed considerably before the shelling cracks were visible on the side of the rail head. Two induction-hard-

ened 50-kg rails from Japan gave rolling-load tests of 517,400 and 718,300 cycles. One double-flame hardened specimen ran 4,185,000 cycles in the rolling-load test. This is a much higher test than previous flame-hardened specimens. Single flame-hardened rails ran from 1,490,000 cycles to 3,[illegible]800 cycles, which are also very high rolling-load tests for flame-hardened rails. Two rails with high manganese and high silicon were tested. The rolling load tests varied from 1,792,400 cycles to 3,260,500 cycles. Three specimens were tested to develop detail fractures from shelling. They developed failures at 2,007,400; 5,204,900 and 4,492,200.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 61 No. 556, 1960, pp 874-881, 1 Tab, 20 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2055)
DOTL RP

C4 040577
ROLLING-LOAD-TEST RESULTS OF WELDED ENGINE-WHEEL BURNS ON RAIL SUPPLIED BY THE SEABOARD AIR LINE RAILROAD

The oxyacetylene-welding method is the standard procedure for repairing wheel burns. Two welds of this type were prepared as controls. Eight engine-wheel burns were then welded by means of the electric-arc method. The first six welds were made on 115-lb RE rail and the last four welds were made on 132-lb RE rail. In this type of test 2,000,000 cycles without failure are considered a run-out. All of the welds were checked ultrasonically for defects. The oxyacetylene welds had the best results, in that one ran to 2,000,000 cycles without a failure and the other ran to 589,000 cycles, failing from a detected inclusion. The electric-arc welds failed prematurely at 49,000 to 159,000 cycles. The microscipic examination of fractures revealed taht a sharp line of demarcation between the weld metal and rail metal existed as well as very fine porosity on the interface. This porosity in all of the electric-arc welds was the cause of the failure. The microsocpic porosity in the interface could not be detected ultrasonically whereas the indication of the inclusion was very definite.

AREA Bulletin Vol. 61 No. 556, 1960, pp 891-896, 2 Tab, 8 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2056)
DOTL RP

C4 040578
INVESTIGATION OF FAILURES IN CONTROL-COOLED RAILS

Twenty-five failed control-cooled rails were examined. Only two failures were transverse fissures from shatter cracks. Six failures were from hot torn steel. One failure was a transverse fissure from an inclusion. A vertical split head developed from a rolling defect in the bottom rail from an ingot. There were only one or two each of several other common types of rail failures.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 60 No. 549, 1959, pp 878-882, 2 Tab, 8 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2057)
DOTL RP

C4 040579
SHELLY RAIL STUDIES AT THE UNIVERSITY OF ILLINOIS

Laboratory tests of chrome-vanadium rails give high cycles for failure but with considerable scatter in results. Rolling-load tests are reported on six extremely high-silicon rails with 1.63 percent silicon. These specimens did not give as good results as previous tests on rails with less than 1 percent silicon content. Rolling-load tests are reported on six induction-hardened rails. These rails resist flow or abrasion on the gauge corner but develop shelling cracks in the laboratory tests sooner than standard carbon-steel rails. Two detail fractures from shelling were produced in laboratory rolling-load tests of 136-lb chrome-vanadium rails with Brinell hardness of 368 and 373. These two rails ran 2,837,900 and 9,258,500 cycles.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 60 No. 549, 1959, pp 941-948, 1 Tab, 23 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2058)
DOTL RP

C4 040582
SIXTEENTH PROGRESS REPORT ON THE ROLLING-LOAD TESTS OF JOINT BARS

Seven tests using 115 RE bars with easements on the top bar surfaces to depths of approximately 0.220 and 0.110 in were completed. The shallow easements were effective in eliminating gouging of the bars by the rail ends. Six joints with shallow easements averaged 349,080 cycles. Twelve tests of joints using 132 RE bars with the same type of milled easement were completed. Two bars with deep easements failed. The shallow easements were effective in preventing gouging of the bars. Average cycles for failure for 6 joints with deep easements were 611,630 and average cycles for failrue for 6 joints with shallow easements were 583,530 cycles.

Jensen, RS (Illinois University) *AREA Bulletin* Vol. 59 No. 542, Feb. 1958, pp 938-946, 2 Tab, 13 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2061)
DOTL RP

C4 040584
SIXTEENTH PROGRESS REPORT ON SHELLY RAIL STUDIES AT THE UNIVERSITY OF ILLINOIS

Three rolling-load tests are reported on chrome-vanadium rails. One specimen ran 4,874,000 cycles. One failed at 14,831,000 cycles, a record for this type of rail. A third specimen ran 2,857,000 cycles before it developed shelling. Seven rolling-load tests to produce shelling failures in high-silicon rails averaged 2,277,000 cycles. Past tests of standard carbon steel rails have averaged 1,000,000 cycles in the same rolling-load test. Results are given of the examination of several detail fractures and one shelly rail from service.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 59 No. 542, Feb. 1958, pp 975-981, 2 Tab, 14 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2063)
DOTL RP

C4 040586
FIFTEENTH PROGRESS REPORT OF THE ROLLING-LOAD TESTS OF JOINT BARS

Six tests of U.S.S. compromise joints, from 132 RE to 115 RE rail section averaged 288,800 cycles. All of the failures originated at the center of bar length at the change of section at the base of the bar. Six tests of Du-Wel compromise joints from 132 RE to 115 RE rail section avaraged 237,600 cycles. Five of the failures were from the base and one was from the top, and all six failures started at blowholes or porosity within the cast steel. Five tests of 115 RE, 36-in. headfree, bars with milled easements 1-1/2 in. long and approximately 0.200 in. in depth averaged 278,080 cycles. Two bars failed through the center of the milled easement and two companion bars revealed cracks in the easements. Fatigue tests on small specimens cut from joint bars tested under two ranges of stress indicated endurance limits from 26,000 to 72,000 psi. Both increasing the Brinell hardness and grinding the surface, in general, increased the endurance limit.

Jensen, RS (Illinois University) *AREA Bulletin* Vol. 58 No. 535, Feb. 1957, pp 1005-25, 6 Fig, 3 Tab, 22 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2065)
DOTL RP

C4 040587
FIFTEENTH PROGRESS REPORT ON SHELLY RAIL STUDIES AT THE UNIVERSITY OF ILLINOIS

Mechanical tests and rolling-load tests produced shelling on 16 different rails: four standard carbon rails averaged 1,358,000 cycles; five silicon rails averaged 1,692,000 cycles; four higher silicon rails averaged 1,940,000 cycles; two silicon-vanadium rails averaged 2,038,000 cycles; and one chrome-vanadium rail ran 4,874,000 cycles; Laboratory examinations were made of six rails which developed detail fractures in service. Rolling-load tests produced detail fractures from shelling in 10 rails.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 58 No. 535, Feb. 1957, pp 1041-47, 1 Fig, 2 Tab, 16 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2066)
DOTL RP

C4 040591
NINTH PROGRESS REPORT OF THE SHELLY RAIL STUDIES AT THE UNIVERSITY OF ILLINOIS
Rolling-load and physical tests of heat-treated rails were continued on two specimens of 132-lb rails. Brinell hardness was increased from 269 to 360 by the heat treatment. Yield strength was increased 65 percent, tensile strength 31 percent, elongation 18 percent, reduction of area 100 percent, and endurance limit 40 percent. Cycles for failure of as-rolled rails averaged 1,257,000 while the heat-treated rails averaged 4,421,000 cycles before failure. Rolling-load tests were made on seven rails which were flame hardened different amounts on the rail treads. Four of these specimens failed by head and web separation cracks. The three specimens which failed by shelling averaged 1,448,000 cycles. Rolling-load and physical tests were made on two specimens of alloy rail steel. They ran eight million and five million cycles in the rolling-load tests.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 52 No. 493, Feb. 1951, pp 664-679, 1 Tab, 31 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2097)
DOTL RP

C4 040592
FATIGUE TESTS OF RAIL WEBS
This report covers corrosion fatigue tests using a corroding agent of tap water mixed with sufficient sulfuric acid. Specimens were stressed at a rate of 150 cycles per minute for the first 1,000,000 cycles or until a crack had been detected. After 1,000,000 cycles, the speed of testing was increased to 800 cycles per minute and maintained at that rate until the specimen cracked, or until 10,000,000 cycles had been reached. From these tests it may be concluded: that the stresses in the upper rail fillets on tangent track outside of the joint bar limits at the rail end and at the first bolt hole with the new 115 RE rail section and new AREA bolt spacing are well within limits that can be tolerated, provided no unusual corrosion conditions exist that substantially reduce the fatigue strength of the rail steel.

Jensen, RS (Illinois University) *AREA Bulletin* Vol. 52 No. 493, Feb. 1951, pp 680-690, 5 Fig, 2 Tab, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2098)
DOTL RP

C4 040778
SUMMARY OF FATIGUE TESTS OF FREIGHT CAR AXLES AND ESTIMATED EFFECT OF OVERLOADING
This report was prepared to accumulate and consolidate all data now available for consideration on the problem of overloading of cars in order to resolve the question as to whether the strength of axles and other car conditions justify changes in the present rules which would permit or restrict heavier loading. With a 10 percent overload, the estimated number of axles which will fail before running their full life expectancy is 72 percent. With a 20 percent overload, the estimated number of axles which will fail before running their full life expectancy is 100 percent.

Association of American Railroads MR-390 Res Rpt, July 1960, 18 pp, 2 Fig, 6 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1820)
DOTL RP

C4 040781
TESTS OF ELECTRIC FLASH BUTT-WELDED RAILS
This paper describes rolling-load tests and physical tests of specimens of 131 and 130-lb electric flash butt-welded rails which were undertaken to determine if stress relief treatment would be necessary. The 131-lb. rail was set up for rolling-load tests of weld 73 in. in a 33-in. stroke rolling-load machine. The second rolling-load test was made on weld 52 in the 131-lb. rail, which was supplied with all the flash metal ground off except under the rail base. 1. The first two-rolling load tests that failed at a bolt hole and stress raiser on the rail webs emphasize the damaging effects of such conditions. 2. The rolling-load tests which ran over 2,000,000 cycles with 60,000-lb. wheel load without failure, are considered very satisfactory for welded rails. 3. The bend tests of 132-lb rails gave higher tests than unwelded 131-lb. rails, and as high as any previously tested rail welds. 4. Some of the physical tests indicate that the welds which were not stress relieved were slightly stronger than the stress relieved welds. However, the difference is negligible and no conclusions on this subject should be based on tests of only two welds.

Cramer, RE Jensen, RS (Illinois University) *AREA Bulletin* Vol. 55 1954, pp 684-694, 2 Tab, 12 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2077)
DOTL RP

C4 040783
FATIGUE COMPARISON OF 7-IN. DIAMETER SOLID AND TUBULAR AXLES
The object of this experimental investigation was to determine the fatigue resistance of solid versus tubular type axles for railroad car service. Solid axles tested represented conditions consistent with existing railroad specifications. The tubular axles investigated were of two types; one of which was tested with permission of A.A.R. and the results reported by the manufacturer, the other was tested as a separate project in order to contribute information on certain questions pertaining to the fatigue strength of axles. Rotating cantilever beam fatigue tests were made on axles about 7 in. in diameter using steel of about S.A.E. 1045 analysis. Comparison of axle fatigue resistance due to a press-fitted wheel was made between "as-forged" solid members and seamless tubes in "hot-rolled" and several conditions of heat treatment. Results showed that tubular axles having high tensile strength values may or may not exhibit greater fatigue strength than those having lower physical properties. Observations on the effect of residual stresses are given. Some tubular axles showed greater fatigue strength than the solid ones.

Horger, OJ Buckwalter, TV (Timken Roller Bearing Company, Incorporated)
American Society for Testing and Materials Proceeding Vol. 41 1941, 12 pp, 6 Fig, 3 Tab, 6 Phot, 9 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2033)
DOTL RP

C4 040800
WHAT CAUSES WHEEL TREAD DEFECTS? PART 1: SHELLING
Studies were made of wheels that shelled in service after being subjected to the usual on-tread braking as well as a wheel equipped with disc-type brakes. These studies have indicated that shelling is essentially a fatigue failure that is caused by rolling loads. The formation of structurally weakened metal as the result of the heat of braking friction is believed to accelerate the formation of shelling cracks. Macroscopic examinations of radial-tangential sections from shelled areas have indicated that shelling is caused by cracks that form at angles of 30 to 50 deg to the tread surface. Because shelling cracks are oriented at 30 to 50 deg to the tread surface they are assumed to be caused by high shear stresses developed by rolling loads.

Wandrisco, JM Dewez, FJ, Jr (United States Steel Corporation) *Railway Locomotives and Cars* July 1960, pp 30-32, 10 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2030)
DOTL RP

C4 040802
EIGHTH PROGRESS REPORT OF THE ROLLING LOAD TESTS OF JOINT BARS
Twelve tests of 133 RE head contact 36-in. bars averaged 509,200 cycles. Twelve tests of 115 RE head free 36-in. bars averaged 1,462,450 cycles. Five of the joints ran to 2,000,000 cycles with no failure. Micrographs, taken on all failed bars, revealed decarburized bar surfaces to varying depths up to 0.024 in. No clearly defined correlation between cycles for failure and depth of decarburization was apparent. Brinell and tensile tests on 12 of 100 failed bars from service indicated higher hardness reading near the surface of the bars than at the center of the head. Ten of the 12 bars tested failed to meet the specifications of 100,000 psi, minimum tensile strength and 11 fell short of the 70,000 psi minimum yield point.

Jensen, RS (Illinois University) *AREA Bulletin* Vol. 51 No. 486, Feb. 1950, pp 585-593, 1 Fig, 4 Tab, 7 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2101)
DOTL RP

C4 040803
RAIL FRACTURES RESULTING FROM ENGINE WHEEL BURNS, INCLUDING EFFECT OF REPAIRING SUCH BURNS BY OXYACETYLENE OR ELECTRIC WELDING
Twenty-one specimens were artificially burned with the wheel rotating at a speed of 15 mph, the rails being applied to the moving surface of the wheel for 3-sec. intervals. The burns produced by this method were approximately 1-1/2 in. wide by 2-1/2 in. long and appeared to be quite uniform in nature. A tabulation of the rolling-load tests completed on these specimens up to the present time is shown. Up to the present time no explanation can be offered for the difference in fatigue life due to the location of the built-up metal on the engine burn. Tests have not progressed far enough to lead to any conclusions.

Akers, JB *AREA Bulletin* Vol. 51 No. 486, Feb. 1950, pp 594-595

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2102)
DOTL RP

C4 040804
EIGHTH PROGRESS REPORT OF THE SHELLY RAIL STUDIES AT THE UNIVERSITY OF ILLINOIS
Two rails were selected from the high side of a 4-deg curve. These rails had carried 63,385,600 tons of traffic at average speeds of 35 mph. One rail showed flaking along the gauge corner over its entire length and had also developed 6 or 7 small black shelly spots. The second rail contained 30 black shelly spots. During the past year, 23 specimens have been tested in the cradle type rolling load machine. The chemical analysis, physical properties and results of rolling-load tests of these specimens are shown. The laboratory rolling-load tests produce shelling failures similar to the deeper type of shelling which develops in service. It is also believed that the laboratory tests give a quick method of determining the relative length of service which can be expected in track as compared with standard carbon steel rails. Preliminary results of service tests of rails tested in the rolling-load machines last year give indications of this correlation but the service tests are not as yet completed.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 51 No. 486, Feb. 1950, pp 597-607, 1 Fig, 1 Tab, 26 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2103)
DOTL RP

C4 040806
MEASUREMENTS OF STRESSES IN 132 RE RAIL ON TANGENT TRACK--SANTA FE RAILWAY
Three test sections are as follows: new AREA design, headfree 36 in. joint bar for 132 RE rail, with bolt spacing of a 3-1/2--6--6 in.; same joint bar design with bolt spacing of 4-1/2--9 in.; and same joint bar design with bolt spacing of 2-1/2--6-1/2--6-1/2 in. This installation offered an opportunity to obtain measurements of stresses developed under regular traffic in the new 132 RE section. On tangent track under conditions typical of main line operation, it may be concluded: that the stresses in the upper rail fillets on tangent track outside of the joint bar limits have been reduced with the new 132 RE section to well within the fatigue strength of rail, steel, and that the concentrated rail web stresses within joint bar limits at the rail end and at the first bolt hole with the new 132 RE rail section and the new AREA bolt spacing are well within limits that can be tolerated, provided no unusual corrosion conditions exist that substantially reduce the fatigue strength of the rail steel.

AREA Bulletin Vol. 51 No. 486, Feb. 1950, pp 626-640, 11 Fig, 1 Tab

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2105)
DOTL RP

C4 040807
FATIGUE TESTS OF RAIL WEBS
Two sets of tensile specimens were cut from the webs of the rails; one set parallel to direction of rolling, and the second set transverse to direction of rolling. Physical properties of the rail web steel as determined by these tensile tests are listed. Only slight differences in the physical properties of the two groups of specimens were disclosed. Previous studies of the fatigue of rail webs in the laboratory indicated a fatigue life several times greater than was actually obtained in service at some locations. Since corrosion of the rail web was quite heavy at the locations where early service failures occurred, it was thought that the discrepancy was due to corrosion. The S-N diagrams are shown for the tests completed to date with no corrosion on the specimens. The S-N diagram is shown for specimens under completely reversed stress, with tap water corrosion, have not revealed as great a reduction in fatigue corrosion, hav not revealed as great a reduction in fatigue life of rail webs as service failures indicate.

Jensen, RS (Illinois University) *AREA Bulletin* Vol. 51 No. 486, Feb. 1950, pp 640-647, 7 Fig, 1 Tab, 1 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2106)
DOTL RP

C4 040808
SERVICE TESTS OF MANGANESE CROSSINGS
The report covers the comparative tests of designs of solid manganese steel crossing frogs at McCook, Illinois, the tests of manganese insert and solid manganese crossings on structural steel and longitudinal timber supports, and tests of crossing frog bolt tension. Some of the designs included in the tests are more resistant to the development of fatigue cracks than others, but in none were the developed stresses low enough relative to the fatigue strength of the manganese steel to give the service life under heavy traffic that should be expected. Four railroad crossings were installed in the double-track main lines of the Indiana Harbor Belt Railroad and the Chicago and Western Indiana Railroad. The structural steel T-beam support was placed under one each of the solid manganese and insert crossings and the other two crossings are carried on longitudinal bolted crossing timbers. The inspection made in 1947, after approximately one year's service, showed all castings in the four crossings to be in good condition with no-flangeway cracks. A plan of the flangeways of the four crossings showing the flangeway cracks as found on May 7, 1948 is presented. The extent of the cracks was about the same, regardless of kind of support, for the two types of crossings.

AREA Bulletin Vol. 50 No. 479, Feb. 1949, pp 572-579, 3 Fig, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2109)
DOTL RP

C4 040809
FATIGUE TESTS OF MANGANESE STEEL
All specimens were tested under a range of stress from a maximum compressive stress to a tensile stress 50 percent as great. Endurance limits at 10 million cycles were indicated as follows: As-cast surface 38,000 psi; ground surface 42,000 psi; shot peened surface 48,000 psi. Corrosion fatigue tests using a 5-percent solution of sulfuric acid were made on unprotected specimens with as-cast, ground, and shot peened surfaces, and the S-N diagrams approached a vertical line at approximately one million cycles for all specimens. The protective paint coating applied to three groups of specimens proved to be beneficial, although not totally effective in increasing their fatigue life under 5-percent acid corrosion. A few hardness tests on unstressed specimens indicated little difference in hardness for as-cast and ground surfaces and a much greater hardness for shot peened specimens.

Jensen, RS (Illinois University) *AREA Bulletin* Vol. 50 No. 479, Feb. 1949, pp 579-588, 4 Fig, 2 Tab, 2 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2110)
DOTL RP

C4 040811
FATIGUE TESTS OF RAIL WEBS
Corrosion fatigue tests were made on T-shaped specimens cut from the web of a 112 lb-RE rail under bending stresses ranging from a maximum compressive stress to a tensile stress 20 percent as great. A solution of 36 percent sulfuric acid was used as a corroding agent and was allowed to drip at the rate of 10 drops per min. on the specimens. in addition, corrosion fatigue tests were made on three groups of painted specimens in order to test the practicability of different types of paint as protective coatings for rails in tunnels, highway crossings, and other places where corrosion fatigue failures are likely to occur.

Jensen, RS (Illinois University) *AREA Bulletin* Vol. 49 1947, pp 485-490, 1 Fig, 1 Tab, 4 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2108)
DOTL RP

C4 040812
WHAT CAUSES WHEEL TREAD DEFECTS? PART 2: THERMAL CRACKING
United States Steel undertook an investigation of wheel-tread defects. Shelling was shown to be the result of repeated stress application to the rolling wheel, which apparently caused the tread metal to fail in shear. Cracks propagate from below to the tread surface. When two of these cracks of opposed orientation meet beneath the tread, metal between them is loosened and finally expelled. This is the typical shelling type of failure. While shelling apparently is not caused by braking, there are wheel defects which can be caused by stresses that develop in the wheel rim as a result of thermal gradients generated by friction between the tread and brake shoe during braking. Shelling and thermal cracking of railroad wheels shorten wheel life, and checking brought on by severe braking may occasionally result in a complete wheel failure.

Wandrisco, JM Dewez, FJ, Jr (United States Steel Corporation) *Railway Locomotives and Cars* Aug. 1960, 4 pp, 5 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1463)
DOTL RP

C4 040814
TENTH PROGRESS REPORT ON THE ROLLING-LOAD TESTS OF JOINT BARS
Twelve tests of 115 K4 headfree, oil quenched 36-in. bars averaged 748,500 cycles. Four tests of 132 RE headfree 36-in. bars, not oil quenched, averaged 78,750 cycles. Four tests of 132 RE headfree 36-in. bars, not oil quenched, with the top fishing surface cold worked by rolling averaged 90,770. Four tests of 132 RE headfree 36-in. bars, not oil quenched, with easements ground 1/16 in. in depth over the central 2 in. of the top fishing surface, increased the number of cycles to 182,900. For the 2 joints in which the easements were carried completely over the top surfaces of the bars, the average cycles increased to 316,650. Tensile tests on 81 specimens selected from 347 failed bars from service revealed that 36 percent passed the yield point specification of 70,000 psi and 69 percent passed the tensile strength specification of 100,000 psi.

Jensen, RS (Illinois University) *AREA Bulletin* Vol. 53 No. 500, Feb. 1952, pp 878-892, 1 Fig, 5 Tab, 10 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2085)
DOTL RP

C4 040816
TENTH PROGRESS REPORT OF THE SHELLY RAIL STUDIES AT THE UNIVERSITY OF ILLINOIS
Repeat cradle type rolling-load tests on two specimens of manganese chrome, vanadium alloy rails gave high cycles for failure 8,117,000 and 9,635,000 indicating that these alloy rails may be several times as good as standard carbon steel rails. A 115-lb. heat-treated standard carbon rail gave 9,625,000 cycles in the cradle rolling machine, which indicates that this type of rail is as good as the manganese, chrome, vanadium alloy rails. Rolling-load tests are reported on high silicon rails, nickel alloy bars and rails, and flame-hardened rails, but none of these particular specimens gave tests comparable with the maganese, chrome, vanadium alloy steel or the heat-treated standard carbon steel rails. Metallographic examination of 14 failed rails which had developed detail fractures in service located rather large inclusions in the steel near the fractures in half of these rails.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 53 No. 500, Feb. 1952, pp 902-915, 2 Tab, 42 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2087)
DOTL RP

C4 040817
SUMMARY OF PROGRESS OF INVESTIGATION OF STRESS RELAXATION IN RAIL STEEL
Relaxation of stresses in small bar specimens is being studied as a function of time and temperature, and rolling-load fatigue tests are being run on small specimens. These specimens were cut from a 152-lb rail rolled in 1939. The rail had shelly spots throughout its length. Measurements are made before bending after bending and before heating and after heating and removal from the jig. A summary of test results is shown in a plot of percent stress relaxation versus time at temperature. For temperatures lower than 900 deg F., the amount of relation is quite small. After an initial period, the amount of relaxation at a given temperature increases only slightly as time at temperature increases.

Jenkins, DR Grover, HJ (Battelle Memorial Institute) *AREA Bulletin* Vol. 53 No. 500, Feb. 1952, pp 916-920, 2 Fig, 3 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2088)
DOTL RP

C4 040820
STRESS MEASUREMENTS IN 115 RE AND 132 RE RAIL ON CURVED TRACK
Stress distribution in 112, 115, 131, and 132 RE rails on curved track is shown. Most measurements were made for steam locomotive wheel load; however, a diesel locomotive was used for one measurement with 115 RE rail. Fatigue test results are shown on a Goodman diagram.

Magee, GM (Association of American Railroads) *AREA Bulletin* Vol. 53 1952, pp 1140-50, 10 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2091)
DOTL RP

C4 040824
TWELFTH PROGRESS REPORT OF THE ROLLING-LOAD TESTS OF JOINT BARS
This report covers tests of joint bars conducted during the past year. The criterion for bar failure is taken to be the number of cycles of loading to propagate a fatigue crack to one-half of the bar height. 1. Twelve tests of 132K44 headfree, long-toe bars with pressed easements averaged 832,290 cycles in the rolling-load tests. Physical properties of these bars were well above AREA specifications. 2. Twelve tests of 132 RE headfree, 36-in. bars with pressed easements averaged 406,590 cycles, an average only about half as great as previous tests on this type of bar. 3. Tests on five 115 RE bars which failed in service indicated low hardness and low physical properties. 4. Tensile tests on 20 specimens from 50 failed bars from service for 100-lb rail indicated that 11 of the 20 passed the AREA specification of 100,000 psi tensile strength and 8 of the 20 passed the AREA specification of 70,000 psi yield point. 5. Micrographs on both laboratory tested bars and failed bars from service indicated depths of decarburization from less than 0.001 in. to 0.028 in.

Jensen, RS (Illinois University) *AREA Bulletin* Vol. 55 1954, pp 814-828, 1 Fig, 5 Tab, 8 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2072)
DOTL RP

C4 040825
TWELFTH PROGRESS REPORT ON SHELLY RAIL STUDIES AT THE UNIVERSITY OF ILLINOIS
This paper summarized the past year's progress on shelly rail studies at the University of Illinois: 1. Stress relieving of specimens during laboratory rolling-load tests at either 1000 or 800 deg F have not appreciably increased the life of the rails. 2. Rolling-load tests of commercially flame-hardened rails gave tests about 50 percent above the average for standard carbon steel rails. 3. Rolling-load tests of high silicon steel rails gave tests almost double the average for standard carbon steel rails. 4. An electric furnace 60-lb steel rail with European chemistry gave very low tests in the rolling-load machine--94,400 cycles. 5. Metallographic examination of 17 shelly rails from service found only 1 rail which contained extra large non-metallic inclusions, which could explain why it had developed shelling in service. 6. Using a special rolling-load machine, detail fractures from shelling were produced in five standard steel rails and one alloy rail. 6. The cause of shelling in service appears to be that present wheel loads are too heavy for the small area of contact between wheel and rail, so that as a result of the flow of the steel, internal stresses are produced that exceed the capacity of the steel to withstand such stresses. 7. Laboratory rolling-load tests indicate that stronger rail steel, such as high silicon steel rails, intermediate manganese chrome-vanadium alloy rails, or heat-treated rails should give longer life before shelling develops in service.

Cramer, RE (Illinois University) *AREA Bulletin* Vol. 55 1954, pp 832-840, 6 Tab, 19 Phot

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2073)
DOTL RP

C4 040826
FINAL REPORT ON THE STUDY OF SIMULATED RAILS UNDER REPEATED ROLLING LOAD
This investigation has studied some of the factors which might contribute to shelly failure formation. The investigation has been directed particularly toward a study of the effects of progressive plastic deformation resulting from repeated rolling-wheel loads. Some variables introduced were wheel load, wheel radius, and cycles of repeated rolling load. Experimental evidence suggests that plastic deformation occurs in a rail with early successive load repetition. Further, the tests show that, although deformation is inelastic, many of the effects of the variables studied would be qualitatively predictable by elastic equations such as the Herz equations and this work suggest that smaller wheel loads or larger diameter wheels would be quite helpful. It is also interesting to note that the Herz equations would suggest the use of higher strength rails for longer rail life. This is also in agreement with general observations from actual service and from laboratory tests of rail.

Hyler, WS Grover, HJ (Battelle Memorial Institute) *AREA Bulletin* Vol. 55 1954, pp 840-854, 5 Fig, 5 Tab, 3 Phot, 6 Ref

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2074)
DOTL RP

C4 040833
FATIGUE TESTS OF RAIL WEBS
Two specially designed vibratory machines were used to determine the fatigue of less-than-full-size rails because rolling-load machines were unable to break the web of full-sized sections. In all tests a constant ratio of compressive to tensile stress was maintained, the bending stress on the top side ranging from a maximum compressive stress to a tensile stress 20 percent as great. The specimens were cut from two sections of 112-lb. RE rail. The fatigue curves show that reduced fatigue strength results from stamping. These data would indicate an endurance limit of approximately 59,000 psi, for unstamped specimens, and 51,000 psi for stamped specimens at 40 million cycles. At one million cycles, the reduction in fatigue strength for the stamped specimens is slightly over 20 percent. Although these tests were made on specimens instead of a complete rail section, the stresses were of the same order of magnitude as the web stresses which occur in the field, thus affording a measure of the reduction in fatigue strength of a full-sized web which may be ascribed to the presence of stamped numbers.

Jensen, RS (Illinois University) *AREA Bulletin* Vol. 47 1946, pp 464-466, 2 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-2113)
DOTL RP

C4 040870
RAIL DESIGN AND SERVICE MEASUREMENT OF RAIL WEB STRESSES OUTSIDE OF JOINT
The report on rail design deals primarily with the revisions of design to improve the strength in the upper web fillet of the rail to better resist the high range of stress that occurs on curved track on the gauge side at this location. The work described on rail design in the report was occasioned by the occurrence of web failures in the 131 lb. RE rail section on the low rail of curves after considerable traffic had been carried and there had been a reduction in height of section because of rail wear. The cause of split web failures (head and web separations) in 131 RE rail has been found to be corrosion fatigue. Laboratory and service stress measurements have demonstrated that this section develops high stresses in the upper web fillet gauge side, on the low rail of sharp curves. Based on practical experience, mathematical theory, and laboratory and service tests using modern strain measuring equipment, the 140 PS rail section has been developed to retain all the desirable characteristics of the 131 RE section and eliminate its weaknesses. The report contains a detailed drawing of the 140 PS rail section developed from this research and which is now known as the 140 RE rail section, having been adopted by the American Railway Engineering Association as a standard standard section. A detailed drawing of the 133 PS section and of the 155 PS section which were developed from this research are also included in the report.

Code, CJ (Pennsylvania Railroad)
Penn Central Transportation Company Test 405, 416, 8 pp, 3 Fig

ACKNOWLEDGMENT: Battelle Memorial Institute (BCL-1732)

C4 044275
STANDARDIZED FORMAT FOR RAILROAD ENVIRONMENT WITH APPLICATION TO FATIGUE DESIGN AND TESTING
This paper outlines a format for recording railroad environmental spectrum data that utilizes the standard arrangement of the modified Goodman diagram. In this form the environmental data is applicable to theoretical finite life fatigue design and to variable-cycle spectrum-type fatigue testing. Maximum loadings for operational guidance, equivalent static design analysis, lading damage studies, and proof testing are also accurately portrayed. The extensive environmental data requirements for modern design dictate the need for standardization of data format and content to provide compatibility of data from various sources and facilitate formation of the national data bank required by the railroad industry.

Contributed by the Rail Transportation Division of ASME for presentation at the IEEE-ASME Joint Railroad Conference, St. Louis, Mo., April 11-12, 1973.

Cook, RM (Association of American Railroads)
American Society of Mechanical Engineers Paper 73-RT-2, Apr. 1973, 8 pp

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL RP

C4 046362
DETECTING THE PROPAGATION OF KIDNEY-SHAPED FATIGUE FLAWS IN RAIL HEADS ON THE LINES OF THE HUNGARIAN STATE RAILWAYS
The author discusses the cause and propagation of kidney-shaped fatigue flaws in the rail head as well as the measures designed to prevent fractures. The main purpose is the description of the functional relationship between the propagation of the fatigue flaw and the traffic load. The formation of flakes in the rail material, the hardness of the rail head and the notch effect set up in the rail head by internal flaws are discussed. It is found that the propagation of the flaws is jointly caused by a number of processes such as microinclusions, oscillatory movements of dislocations, high stresses in the rail head, etc. The positions of the initial centres have been investigated by examining and measuring several fractures. Methods for calculating the height of the fissure and its inclination towards the vertical are developed. An analysis is made of the development of fatigue flaws as a function of the traffic load, and the existing relationship is established by an equation. In determining the effective cross-sectional area of the rail, the wear of the rail is also taken into account and added to the area of the fatigue flaw. After an analysis of the permissible threshold values, certain specifications are suggested, and the size of the flaw area in percent of the total cross-sectional area of the rail head is indicated with the aid of nomographs. In addition to the manual examinations, the introduction of ultrasonic high-speed testing vehicles is urgently recommended. In modern railway operation, ultrasonic testing is the most suitable method of detecting dangerous flaws; but the influence of human subjectivity in evaluating the results must be eliminated by using modern computers.

Kecskes, OS *Rail International* Vol. 3 No. 9, Sept. 1972, pp 493-506, 12 Fig, 14 Ref

PURCHASE FROM: International Railway Congress Association 17-21 rue de Louvrain, 1000 Brussels, Belgium Repr PC
DOTL JC

C4 046408
STUDY OF RIM STRESSES RESULTING FROM STATIC LOADS ON DIFFERENT 36-INCH RAILROAD WHEEL DESIGNS
This report is the result of a series of experimental tests made at the Southern Railway Research & Tests Laboratory in Alexandria, Va., on 36-in.-dia., one-wear railroad wheels. The purpose of this investigation was to evaluate the stress levels developed in the rim section of different wheel designs, and to determine if there exists a relationship between high stress levels in the wheel rim and a history of fatigue failures of the wheel tread.

Lovelace, WS
American Society of Mechanical Engineers Paper 71-RR-4, Apr. 1971, 12 pp

ACKNOWLEDGMENT: British Railways (29015)
PURCHASE FROM: ASME Repr PC
DOTL TF5.A72 1971

C4 046917
HOW IC INCREASES THE LIFE OF CURVE RAILS
After experimenting with two heats of rail steel in which the percentage of manganese was increased, the Illinois Central was able to obtain the prolonged service life of a rail on curves at a reasonable cost. By adding to the manganese content of the rail steel, a life expectancy four times greater than conventional rail on curves is expected.

Railway Track and Structures Vol. 66 No. 9, Sept. 1970, p 23

ACKNOWLEDGMENT: EI (EI 73 46972)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

C4 046943
NOTCH TOUGHNESS AND CRACK PROPAGATION RATE OF LOW CARBON STEEL ALLOY RAIL
A new movable nose crossing for Shinkansen is made of low carbon alloy steel. In order to test the mechanical properties of this steel, the falling weight test and the bending fatigue test have been done. These tests indicate that this steel has the sufficient mechanical properties.

Kurihara, T Sugiyma, T *Railway Technical Research Institute* Quart Rpt. Vol. 14 No. 2, 148, 1972, June 1973, pp 116-117, 4 Fig., 2 Tab.

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Ken-yusha #1-45-6, Hikari-cho, Kokubunji, Tokyo, Japan Repr PC

DOTL JC

C4 047556
THE EFFECTS OF FATIGUE UPON METALS JOINED BY WELDING AND BOLTING
Fatigue failures occur in railroad bridges, highway bridges, crane runway girders, large ships, and railroad cars. Fatigue failures are a serious problem and expense. A railroad bridge was reinforced by welding flange plates to the structure, but this introduced severe stress concentrations which led to failure, by fatigue cracking. Numerous fatigue studies have been made, producing stress-life relationships. Fatigue testing machines have been developed, capable of applying repeated cyclic loading. This article covers welded, bolted, and riveted connections, and their testing. Diagrams and photographs are included. The comments of the delegates are included.

Proceedings of the 1972 Railroad Engineering Conference, Advancing Freight Car Design to Meet the Changing Environment of Modern Train Operations, Sponsored by Dresser Industries, Incorporated, 6-8 September 1972.

Munse, WH (Illinois University, Urbana)
Dresser Transportation Equipment Division Proceeding 1972, pp 58-66, 14 Fig, 2 Tab

PURCHASE FROM: ESL Repr PC, Microfilm

DOTL RP

C4 048075
THE EFFECT OF SURFACE FILMS ON FATIGUE CRACK INITIATION
The suppression of fatigue crack initiation by surface films can be viewed in terms of two mechanisms: (1) protection against environmental attack, and (2) suppression of surface plasticity. These two mechanisms are described in detail. Environmental protection requires a flawless coating which is impermeable to the active component of the environment and resistant to fracture under repeated cyclic strain. Suppression of plasticity requires a film with an elastic modulus greater than the substrate metal. The stiffer coating repels dislocations from the surface and suppresses the development of slip bands and crack initiation. (Author)

Availability: Pub. in Corrosion Fatigue, p201-210 1972.

Crosskteutz, JC
Midwest Research Institute Tech Rpt TR-12, 1972, 14 pp

Contract N00014-71-C-0020

ACKNOWLEDGMENT: NTIS (AD-760072)
PURCHASE FROM: NTIS Repr PC, Microfiche

AD-760072, DOTL NTIS

C4 048195
FAILURE MODES OF ROTATING SHAFTS
It is the intent of this paper to present the principal modes of failure of rotating axisymmetric shafts made of ductile material. Shear failure as a result of overtorque is generally the first consideration. This is covered by elementary texts on stress analysis. However, should the strength of a design be adequate to carry the shear stress from torque, failure may still occur by either fatigue or buckling. In addition to fatigue and buckling, one must consider impact as a cause of possible overstress. Thus this paper shall consider fatigue, buckling and impact as modes of failure for rotating shafts.

The Announcement for this book appears in Mechanical Engineering, August 1973, #72-DE-40.

Kaiser, FA
Bendix Corporation

PURCHASE FROM: ESL Repr PC, Microfilm

C4 048196
ISOLATION AND ABSORPTION OF MACHINERY VIBRATION
The problem of isolating machinery vibration from both rigid and nonrigid foundations is considered, and reasons why predicted levels of force transmissibility are often exceeded in practice are discussed and illustrated by representative examples. Both one-and two-stage mounting systems are analyzed. The machinery, and the intermediate mass of the two-stage mounting system, may sometimes be supported on rubber antivibration mounts by multiresonant flanges or feet, which are represented here by short shear beams. Two long clamped-clamped beams comprise the nonrigid foundation considered, and it is shown how the levels of transmitted force vary when these beams (a) are suitably mass loaded, (b) are held rigidly by a central clamp, or (c) are damped by the attachment of dynamic vibration absorbers of optimum design and relatively small mass. The internal damping of the rubber mounts, the shear-beam feet and the foundation beams is considered throughout.

The Announcement for this book appears in Mechanical Engineering, August 1972, #72-DE-34.

Snowden, JC
Pennsylvania State University, University Park

PURCHASE FROM: ESL Repr PC, Microfilm

C4 050322
FRACTURE MECHANICS APPROACH TO FATIGUE ANALYSIS IN DESIGN
Many engineering structures are subjected to cyclically varying (fatigue) loads during service. Fatigue analysis, or the estimation of fatigue lives of such structures, is therefore an essential part of engineering design. In this paper, the fracture mechanics approach to fatigue analysis is described. This approach has evolved over the last decade, and is based on the assumptions (i) that there are preexisting flaws or cracks in a structural component, or that cracks are initated early in the life of the component, and (ii) that the fatigue life of the component is determined principally by the rate of growth of these cracks under cyclic loading. Characterization of the rate of fatigue crack growth in terms of fracture mechanics parameters is discussed. The relationship between these parameters and those commonly used in fatigue analysis is identified. A procedure for estimating fatigue lives from crack growth data is outlined. The importance of various loading and environmental variables on fatigue life prediction is considered. A number of example problems are given to illustrate the procedure and the various effects.

Copies are $1.00 to ASME members.

Wei, RP (Lehigh University)
American Society of Mechanical Engineers Paper ASME #73-DE-22, Jan. 1973, 11 pp, 9 Fig, 43 Ref

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL RP

C4 051370
NEW ALLOY FIGHTS CORROSION AND WEAR
Some metal alloys are wear resistant, some are corrosion resistant, and some are relatively easy to fabricate. But try to find an alloy that rates high in all three areas. After a long development program, metallurgists have come up with a series of alloys that combines these three unusual characteristics.

These proprietary, intermetallic alloys are based on cobalt or nickel, and they're called Tribaloy.

Cameron, CB Ferriss, DP *Machine Design* Vol. 45 No. 19, Aug. 1973, 5 pp

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

C4 051924
COUPLER AND KNUCKLE SERVICE PERFORMANCE
Combines failure data from two sources with fleet population data to obtain a relative failure index which is a measure of the relative failure rates among the coupler and knuckle components currently in freight service on american railroads. Also, includes statistics from the AAR mechanized car repair billing exchange system for couplers and knuckle components currently in freight service on American Railroads. Also, includes statistics from the AAR mechanized car repair billing exchange system for couplers and knuckles removed from service during an eighteen month period. A relative wear index has been calculated. Includes recommendations for removal from service of highest failure rate coupler and knuckle components.
Sponsored by RPI/AAR Railroad Coupler Safety Research and Test Project.

Morella, N Cook, RM
Association of American Railroads Technical Center Tech Rpt No. 5, #R-149, June 1973, 67 pp, 3 Ref

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr PC

DOTL RP

C4 052253
JOINT BARS-DESIGN SPECIFICATIONS AND SERVICE TESTS INCLUDING INSULATED JOINTS AND COMPROMISE JOINTS
Various tests and application procedures of joints are discussed. Insulated joints, glued joints, web-contact joint bars, Huck fasteners, and joints with structural adhesives are studied in service tests, both in the laboratory and in field installations. The field installations are varied in location. Static stresses in rail and dynamic stresses in rail joint are studied in connection with field installations Huck fasteners. Among the conclusions are: 1)service tests of redesigned vulcabond insulated joints showed much chipping and flaking off; 2) Huck fasteners on polyurethane insulated joints were in satisfactory condition after two to twelve months installation; 3) Huck fasteners in standard head-free toeless angle bars would not satisfactorily restrain rail movement.

AREA Bulletin Proceeding Vol. 73 N No. 36, Feb. 1972, pp 312-337, 2 Fig, 7 Tab, 22 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052254
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
Part one of this report discusses a laboratory investigation of 132-pound rail made from vacuum degassed steel. The purpose of this investigation is to determine whether rails made from vacuum degassed steel and air cooled are comparable in properties with rail steel produced by currently common practices. The manufacturing process and test specimens are described. Rolling load tests, drop tests, slow bend tests, Charpy impact tests, hardness tests, and chemical analysis are performed. Macroscopic and microscopic examinations and physical property determinations are examined. The properties of vacuum degassed steel rails without controlled cooling were comparable to those manufactured by conventional techniques. Part two is a report on a field inspection of vacuum degassed steel rail on the Norfolk & Western Railway. Slight curve wear was noted in the high side rails, and slight rail wear was noted on the low side rails. No shelling or head checking was noted.

AREA Bulletin Proceeding Vol. 73 N No. 36, Feb. 1972, pp 338-394, 16 Fig, 16 Tab, 31 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052262
SOME ASPECTS OF SERVICE DEVELOPMENTS IN RAIL-HEAD METAL
Service developments in rail-head metal characterized by the presence of white etching regions have been studied. After the development of microstructural white-etching regions resulting from traction and adhesion conditions, spalling begins as a result of trains passing repeatedly over these hard and increasingly brittle areas. White-etching regions on a car-dumper hoop rail resulted from impact during loading and unloading of the dumper, because these areas were in contact with mating guide wheels in the normal load and unload positions of the car dumper. White-etching also results from the effects of repeated loads on the vertical face of non-end-hardened bolted rail. A rolling-contact fatigue test concludes that rail steels have longer life at lower maximum static contact stress levels than at higher stress levels.

Henry, RJ (Bethlehem Steel Company) *AREA Bulletin* Proceeding Vol. 72 N No. 33, 72-733-13, July 1971, pp 586-599, 1 Fig, 1 Tab, 10 Phot, 4 Ref

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052263
STRESS DISTRIBUTION IN THE PERMANENT WAY DUE TO HEAVY AXLE LOADS AND HIGH SPEEDS
The stress distribution in the rail head near the contact surface between rail and wheel with heavy axle loads at high speeds is discussed. An experimental investigation of the stress distribution was performed. Tensile bending stresses in the rail head and rail foot, and lateral forces are discussed. In Germany a test track of prefabricated concrete slab was constructed, and the measurements taken showed that scattering of stresses in the rail foot were small and did not vary with the driving speed.

Eisenmann, J (Munich Technical University) *AREA Bulletin* Proceeding Vol. 71 N No. 22, 71-622-3, Oct. 1969, pp 24-59, 15 Fig, 13 Tab, 1 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052275
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL--METHODS FOR THEIR PREVENTION
The information in this report on shelly spots and head checks in rail and methods for their prevention is contained in the two appendixes. Appendix 8a is concerned with the investigation of heat-treated rail and alloy-rail service test installations on curves with histories of shelling. Appendix 8b presents the laboratory investigation and results involving rolling-load and slow-bend tests. This information is presented in tables and figures.

AREA Bulletin Proceeding Vol. 69 N No. 12, Feb. 1968, pp 664-707, 24 Fig, 3 Tab, 4 Phot, 2 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052280
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
Causes of shelly spots and head checks in rail are discussed and methods for their prevention are presented. Two phases of the project include the inspection of heat-treated rail and alloy-rail service test installation on curves with a history of shelling, and the laboratory investigation of shelling rail involving rolling-load and slow-bend tests. Field inspections are made at test installations on the Norfolk and Western, Chesapeake and Ohio, Great Northern, and Pennsylvania Railroads. Results of the inspections are presented for each respective railway. It is concluded that the heat-treated rails show generally good results and promise considerably more service.

AREA Bulletin Proceeding Vol. 68 N No. 05, Feb. 1967, pp 463-487, 3 Tab, 3 Phot, 2 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052285
RESULTS OF ROLLING LOAD AND SLOW-BEND TESTS OF BUTT-WELDED RAIL JOINTS
Results of 13 rolling-load and 13 slow-bend tests of butt-welded rail joints are described. The butt welded rail joints are made by the thermit (Exomet and Orgotherm process), the electric-flash and the oxyacetylene pressure butt-welding processes, and are submitted for testing to evaluate the various welding methods. Rolling-load tests are made on either use 12 in. or the 33 in. stroke rolling-load machine; slow-bend tests are made on supports 4 ft. apart with a two-point loading 6 in. on each side of the weld. Results of rolling load tests indicate that with the thermit weld orgotherm process and the thermit weld type from Exomet, Inc. a rail broke, but otherwise no failures occurred in butt-welded rail joints. Results of slow-bend tests indicate that a rail broke in each test situation, but that there was good structure in Southern Railroad's Thermit Weld (Orgotherm) specimen.

AREA Bulletin Proceeding Vol. 67 N No. 98, Feb. 1966, pp 428-436, 2 Fig, 2 Tab, 4 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052287
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
Causes of shelly spots and head checks in rail are explored and methods for their prevention are presented. Heat-treated-rail and alloy rail service test installations are inspected on curves with shelly histories, and laboratory investigations of shelly rail involving rolling-load and slow-bend tests are also made. Service test installations on the Great Northern Railway of rails rolled from continuously cast blooms, fully heat-treated rails, Columbium-treated rail, and Curve-master rail, were inspected, and contour tracings of the rail inspected were made. Service test installations on curves are designed to study both resistance to wear and flow and resistance to shelling. Two methods presently employed in improving these properties are the addition of alloying elements and heat treating. The addition of certain alloying elements improves resistance to wear and flow but does not necessarily improve resistance to shelling. The use of other alloying elements may improve both of these properties. It is shown that rail if properly heat treated, will be improved in both of these properties. If improperly heat treated, the results are detrimental rather than beneficial.

AREA Bulletin Proceeding Vol. 67 N No. 98, Feb. 1966, pp 493-508, 4 Fig, 3 Tab, 12 Phot, 2 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052294
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
Causes of shelly spots and head checks in rail are determined, and methods for their prevention are discussed. Two phases of the investigation include the inspection of heat treated and alloy rail service test installations on curves with shelly histories and the laboratory investigations of shelly rail involving rolling-load and slow-bend tests. The usual service test inspections are made of the fully heat-treated and alloy rail installations to corroborate the observations of previous years. Investigations featured include the service test installation of induction-hardened rail on the Great Northern Railway and on the Norfolk and Western Railway and the test installation to compare high-carbon rail with blue-end rail on the Pennsylvania Railroad. New developments in induction and flame hardening of rails to increase their resistance to shelling are also reported.

AREA Bulletin Proceeding Vol. 66 N No. 91, Feb. 1965, pp 479-493, 1 Fig, 2 Tab, 6 Phot, 2 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052295
RESULTS OF ROLLING-LOAD AND SLOW-BEND TEST OF BUTT-WELDED RAIL JOINTS
Results of rolling-load and slow-bend tests of butt-welded rail joints are reported. Welding methods include submerged arc, thermit process, and oxyacetylene pressure process with abrasive-wheel-cut weld faces and with variations in upset pressure and Btu input. Welds with magnaflux and ultrasonic indications of defects are also included in tests. It is noted that results, particularly results of submerged arc process, represent initial work on developments needing considerable further refinement. Results on thermit welds are representative of the results obtained in previous test of such welds, except those made by the Southern Railway, which show results meeting the standards established by tests of oxyacetylene pressure butt welds and flash butt welds for the first time. Investigations of welds with magnaflux and ultrasonic indications indicate a lack of uniformity existing in judging these indications at the inspection stations.

AREA Bulletin Proceeding Vol. 66 No. 591, Feb. 1965, pp 514-516, 1 Fig, 2 Tab

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052308
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAILS; METHODS FOR THEIR PREVENTION
Causes of shelly spots and head checks in rail are reviewed, and methods for their prevention are recommended. Data on rolling load tests of rail flame hardened for the SP, UP, and the QNS & L, rail of Japanese manufacture, hardened by the induction method, and high-silicon rail, as well as standard carbon rail, is presented. Topics discussed include results of inspections of heat-treated and alloy rail service test installations on curves with shelly histories, and shelly rail studies at the University of Illinois.

AREA Bulletin Proceeding Vol. 65 N No. 84, Feb. 1964, pp 576-605, 12 Fig, 5 Tab, 8 Phot, 2 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052309
AN INVESTIGATION OF WELDING USED RAIL WITHOUT CROPPING
Investigation is made of welding used rail without cropping. If such a procedure, using the electric flash method, is satisfactory, economic savings of cropping the rail prior to welding and scrapping cropped rail ends would ensue. Tests are summarized, and findings discuss calculated stress range at bolt holes, effect of weld on bolt-hole stress, and relation of test conditions to track conditions. It is concluded that the electric flash pressure weld reduces fatigue strength at bolt holes and increases the possibility of a progressive fracture developing from a bolt hole. Bond-wire holes or welds on sides of butt-welded rails suggests another possibility for progressive fracture. Use of two half joints each side of the weld has no appreciable effect on fatigue strength at the bolt hole regarding development of a progressive fracture from the hole. Use of special washers with high-strength bolts is effective in removing stress concentration effect of the bolt hole, but the procedure is not practical. It is noted that the calculated range of repeated stress at bolt holes to be expected with continuous welded rail in track is so near the fatigue strength as to give little assurance that fatigue cracks would not develop at bolt holes in time.

AREA Bulletin Proceeding Vol. 65 N No. 84, Feb. 1964, pp 637-649, 3 Fig, 4 Tab, 7 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052324
SERVICE TEST OF SOLID MANGANESE STEEL CROSSING FROGS WITH PRESTRESSED CONCRETE SUPPORT VERSUS TIMBERS
An inspection of a service installation of a prestressed concrete crossing support is presented. The crossing had been given normal maintenance during the service period. At the end of the first winter the concrete was performing much better than the timbers, with very little vertical movement during traffic. After heavy rainfall the wet subgrade condition resulted in vertical moving of timbers double that of the concrete. A concrete corner was broken off at the point of failure in one of the post-tensioning rods, but there was no evidence of further distress due to reduction of effective rods from six to five. No cause for the break was found. A record of maintenance costs was not kept.

AREA Bulletin Proceeding Vol. 63 N No. 70, Feb. 1962, pp 493-494

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052326
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL: METHODS FOR THEIR PREVENTION
This report is presented in two appendices. Appendix 8-a covers the inspection of service tests of fully heat-treated and alloy rail installations. There are five tests of fully heat-treated rail, three of high-silicon rail, one of chrome-vanadium, and one of columbium-treated rail. The heat treatment in some locations has shown considerable value in extending rail life under shelly conditions and in resisting head flow on the low side of curves. The high silicon and low-alloy rails show a resistance to wear and shelling. The chrome-vanadium rail shows excellent performance. Appendix 8-b covers 1) rolling-load tests to produce shelling in high-silicon chrome-vanadium rail, columbium-treated rails, basic-oxygen standard carbon rails and flame-hardened rails; and 2) end-quench hardenability curves determining the quenching characteristics of some of the low-alloy rail steels. High-silicon chrome-vanadium rails rated high in rolling-load tests. End-quench hardenability curves are given for four rail steels to furnish information on the quenching characteristics of low-alloy rail steels.

AREA Bulletin Proceeding Vol. 63 N No. 70, Feb. 1962, pp 532-552, 2 Fig, 11 Tab, 12 Phot, 2 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052333
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
This informational progress report is contained in two appendices. Appendix 8-a covers inspections of service tests of heat-treated and alloy-rail installations at 11 locations. There were five tests of heat-treated rail, three of high-silicon rail, and three of chrome-vanadium alloy rail. Heat-treated rail continues to show decided increased life over standard rail. Use of heat-treated rail on the low side of curves has increased life of rail 5 to 8 times, and on high sides 1 1/2 to 4 times. High-silicon rails have shown greater resistance to the detrimental effects of heavy wheel loads on the low side of curves than standard rails. Chrome-vanadium alloy rails show greater resistance to wear than standard rails. However, in this test the chrome-vanadium alloy steel of the composition used was unreliable. Appendix 8-b covers rolling-load tests to produce shelling in 136-lb high-silicon vanadium rails, failed shelly rails from service, and rolling-load tests to produce detail fractures from shelling. Results of tests of 115-lb columbian rail and tests of 133-lb rail single flame hardened by the Union Pacific Railroad are also reported.

AREA Bulletin Proceeding Vol. 62 N No. 63, Feb. 1961, pp 622-634, 1 Tab, 5 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052334
SERVICE PERFORMANCE AND ECONOMICS OF 78-FT RAIL; SPECIFICATIONS FOR 78-FT RAIL
The service test of rail laid in 78-ft lengths on the Illinois Central Railroad was covered in this progress report. The prime purpose of the test was the determination of adequate arrangement of rail anchors to control rail creepage better, and to obtain an improved rail gap uniformity. Winter gaps were measured before adjustment of the gaps was made. The average of summer gaps in the two test sections was not materially changed by the adjustment of gaps in the winter, except for one rail. The joints in this rail that would not close at high temperatures, before adjustment, now have summer gaps comparable to other joints measured. The anchorage, alternate ties boxed, in the test mile will give satisfactory results with 78-ft rail provided it is laid with expansion required to have it tight at 85 deg. Because joint slippage resistance is required to keep the joints from opening too much in the winter, especially in 78-ft rail, it is important that the track bolts be retightened frequently. In proposing expansion of the use of 78-ft rail a table is provided.

AREA Bulletin Proceeding Vol. 62 N No. 63, Feb. 1961, pp 635-638, 2 Fig

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052352
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
Most of the information in this report on causes of shelly spots and head checks in rail is contained in the two appendices. Appendix 8a covers inspections of service test of heat-treated and alloy steel rail installations at five locations. There are three tests of heat-treated rail and two of high-silicon rail. Heat-treated rail in tests on the Norfolk & Western Railway continues to show increased life over standard rail. High-silicon have shown greater resistance to the detrimental effects of heavy wheel loads in the low side of curves than standard rails. Appendix 8b contains studies done at the University of Illinois. Three rolling-load tests to produce shelling in high-silicon rails, standard carbon-steel rails and 50-kg rails induction hardened in Japan are presented and discussed. Two rolling-load tests on a high-silicon rail ran 1,944,400 and 1,480,000 cycles. A standard-carbon-steel rail gave unusually long tests of 4,347,000 and 4,371,000 cycles. These specimens deformed considerably before the shelling cracks were visible on the side of the headrail. Two induction-hardened 50-kg rails from Japan gave rolling-load tests of 577,400 and 718,300 cycles.

AREA Bulletin Proceeding Vol. 61 1960, pp 869-881, 1 Tab, 4 Phot, 2 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052362
STATIC AND FATIGUE TESTS ON PRESTRESSED CONCRETE RAILWAY SLABS
The fatigue properties of prestressed pretensioned concrete railway slabs are discussed. A theoretical study of the fatigue resistance of such members is first presented, followed by a description of laboratory tests on six beams. Test results are discussed and interpreted. The theory of fatigue failure is based on three diagrams including a failure envelope based on a limited amount of fatigue test data on prestressing strands and a diagram of the fatigue characteristics of plain concrete. The two failure envelopes are combined with curves expressing the moment-stress relationship for a given beam. The investigator is able to predict the critical loading. It is concluded that the test results check reasonably well with the critical fatigue loads predicted on the basis of the stated theory of fatigue failure.

AREA Bulletin Proceeding Vol. 60 1959, pp 3-50, 15 Fig, 11 Tab, 11 Phot, 6 Ref

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052363
CUMULATIVE DAMAGE IN STRUCTURAL JOINTS
Cumulative damage in structural joints is determined, to assess the fatigue lives of members which are subjected to variable cycles of loading. Tests are made with cyclic stresses of the same frequency and magnitude as the actual service stresses, and a hypothesis is formulated to predict the fatigue life of a member or joint subjected to a variable loading cycle. It is concluded that the variations in a maximum cyclic stress obtained in railway bridges may provide a life markedly greater than expected on the basis of the maximum applied stresses. It is noted also that all the loading cycles affect the life of a member and must be considered in any evaluation of the member's fatigue resistance.

Munse, WH (Illinois University, Urbana) *AREA Bulletin* Proceeding Vol. 60 1959, pp 67-128, 26 Fig, 9 Tab, 5 Phot, 28 Ref

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052373
SERVICE TESTS OF VARIOUS TYPES OF JOINT BARS
Report is made of two service tests of joint bars for 115 RE and 132 RE rail. Service test installations are described, and test data is presented. It is concluded after 10 years of service that the test sections show good performance with little difference except that the 4-hole bars show slightly more difference in the level at the 1/4-inch points of the rail ends. The long-toe bars on the Santa Fe continue to show a slight tendency toward developing cracks in the spike slits, although the progression is slow.

AREA Bulletin Proceeding Vol. 60 1959, pp 905-915, 6 Fig, 4 Tab, 2 Phot, 10 Ref

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052374
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION

Causes of shelly spots and head checks in rail are discussed, and methods for their prevention are recommended. Topics considered include six tests of heat-treated rail, a final report of service tests of 155-lb rail on the Pennsylvania RR laid on the high side of a 6-deg curve, a University of Illinois study of rolling tests, investigation into the significance of the hydrogen level in rail steel, and report on a three-dimensional photoelastic investigation to study the internal stresses within the rail head due to wheel contact pressures.

AREA Bulletin Proceeding Vol. 60 1959, pp 917-969, 19 Fig, 4 Tab, 19 Phot, 10 Ref

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052381
FATIGUE RESISTANCE OF QUARTER-SCALE BRIDGE STRINGERS OF GREEN AND DRY SOUTHERN PINE

Quarter-scale bridge stringers of green and dry southern pine were tested for fatigue due to stress. All test specimens were fabricated in pairs. One of each pair was used for a static control test and the other for a fatigue test. The green stringers had no checks. The dry stringers either had checks or were artificially checked. Both types were straight grained or had a 1:12 slope of grain. The specimens were tested by loading at third points of a 39-inch span. Fatigue tests were made by loading at 500 cycles per minute in an axial loading fatigue machine. Fatigue failures do not develop in the green specimens repeatedly stressed in bending unless actual stresses in compression are large enough to produce compression wrinkles. The indicated fatigue strength of green specimens for 10 million repetitions of stress is about 50 percent of the static strength for straight-grained specimens, and 60 percent for those with slope of grain. Fatigue strength is about 3000 psi for both straight-grained and slope-grained material. Fatigue stresses are more critical in shear in dry material than in bending, even though slope of grain is present. The static control specimens with both 1:12 slope of grain and checks failed in cross-grain tension, while all specimens tested by repeated loading failed in shear along the check regardless of the level of the repeated stress.

Prepared in cooperation with the Association of American Railroads.

Lewis, WC (Forest Products Laboratory) *AREA Bulletin* Proceeding Vol. 59 1958, pp 363-390, 14 Fig, 12 Tab, 11 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052389
SERVICE PERFORMANCE AND ECONOMICS OF 78-FT RAIL, SPECIFICATIONS FOR 78-FT RAIL

Tests and measurements made on two service installations of 78-ft rail were presented. The purpose of the tests on the Chicago & North-Western and the Pennsylvania Railroad was to determine if the presence of greater joint gaps on the 78-ft rail would create an increase in cost of maintaining the remaining joints, thereby reducing benefits due to the elimination of one half of the joints. Measurements show no outstanding difference between the 78-ft rail and the 39-ft rail at the Chicago and Northwestern site. At the Pennsylvania Railroad site measurements show pull-in of 78-ft rail to be almost identical to that of 39-ft rail. Joint gap measurements on the Illinois Central reveal that rail anchorage of 22 alternate ties boxed per 78-ft rail has given a more satisfactory rail gap uniformity than in earlier tests.

AREA Bulletin Proceeding Vol. 59 1958, 18 pp, 9 Fig

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052394
LIFE OF RAIL

Recommendations on rail life and other revisions are adopted to amend the manual regarding operating data required for a study of the economic justification of line and grade revisions. Regarding rail and fastenings, charge should be made only for that portion in excess of that used in the present operation on the basis of experience; in the absence of actual experience, anticipated rail life on a new location under similar operating conditions may be determined with a recommended formula. Recommendations are also made for additional bridging steel, additional creosote trestles, enginehouse additions, additional or other buildings, and additional signals.

AREA Bulletin Proceeding Vol. 58 1957, pp 359-360

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052398
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS OF THEIR PREVENTION

Causes of shelly spots and head checks in rail are discussed, and methods for their prevention are recommended. Research conducted by the research staff of the Engineering Division of AAR and by the University of Illinois is reported. Inspections of service tests of heat-treated and alloy rail are made at nine locations, including five tests of heat-treated rail, two of chrome vanadium alloy, and two of high-silicon rail. The final report of heat-treated rails on the Norfolk & Western Railway reveals a very definite advantage of heat-treated rail over standard control-cooled rail, with rail life increased by 2 1/2 times in the case of shelling. Economic advantage of heat-treated rail involves a rail life 4 1/2 times that of standard rail. University of Illinois reports results of mechanical and rolling-load tests to produce shelling failure and details fractures and tests of six rails which developed detail fractures in service.

AREA Bulletin Proceeding Vol. 58 1957, pp 1026-10, 3 Fig, 4 Tab, 13 Phot, 1 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052402
FOURTEENTH PROGRESS REPORT OF THE ROLLING-LOAD TEST OF JOINT BARS

Tests of joint bars were covered. The tests were made in three 33-in. stroke rolling machines. The criterion for bar failure was taken to be the number of cycles of loading to propagate a fatigue crack to one-half the bar height. Brinell and Rockwell B hardness readings were taken on the upper and lower fishing surfaces of all the bars before testing. Twenty-one pieces of failed bars from service were examined and tested. Eleven tests of 115 RE, headfree, 36-in. bars with ground easements averaged 1,344,100 cycles. Four of the joints ran to 2,000,000 cycles with no failures. The ground easements of 3/64-in. in depth were adequate to eliminate gouging of the bars by the rail ends. On the four bars which failed from the top surface, the cracks started outside the easements. Six tests of cast Rajo compromise joints, type 106A failed from base with small porosity visible in four of the fractures. Examination and tests of the bars which failed in service indicated that yield points for 13 bars were below specifications. All of the bars had failed from the top surface at a gouge mark caused by a rail end.

Jensen, RS (Illinois University, Urbana) *AREA Bulletin* Proceeding Vol. 57 1956, pp 818-829, 1 Fig, 3 Tab, 7 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052403
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL METHODS FOR THEIR PREVENTION

Continuing investigations confirmed that heat-treated or alloy rails were effective in extending the service interval before gage corner shelling occurs in track. A description and summary of eight test installations of heat-treated and alloy rails in areas of high shelling was presented. Appendix 8-a presented the progress of shelly rail studies. Rolling-load tests of high-silicon rails and one chrome-vanadium rail were performed. Shelly rail failures from service were examined and rolling-load tests to produce detail fractures in the laboratory were performed. Detail fractures from shelling in European rails were discussed. High-silicon rails gave rolling-load tests 50 to 100 percent better than standard carbon-steel rails before developing shelling failures. Three tests of a chrome-vanadium alloy rail gave two tests over 5,000,000 cycles and one test of 1,846,000 cycles. Rolling-load tests of high-silicon rails to develop detail fractures from shelling produce failures similar to those produced in track.

AREA Bulletin Proceeding Vol. 57 1956, pp 830-857, 5 Fig, 3 Tab, 20 Phot, 1 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052404
RECENT DEVELOPMENTS AFFECTING RAIL SECTIONS
Recent developments affecting rail sections were discussed. Tests made at the Area Research Center of a 115-lb rail in which holes had been punched with a velocity power punch showed that the fatigue strength of the specimen was higher than that of a specimen in which the holes had been drilled. However, cracks developed in service rail on which this tool had been used. Further testing was done, and it was concluded that an improved velocity power punch must be manufactured.

AREA Bulletin Proceeding Vol. 57 1956, pp 858-859

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052406
CURVE WEAR WITH DIESEL LOCOMOTIVES ON THE BESSEMER AND LAKE ERIE RAILROAD
A series of test runs were made to obtain definite information on the amount of rail curve wear produced by diesel locomotives relative to that produced by the remainder of the train. A second series of tests was made for the purpose of relating the effectiveness of flange oilers on the locomotive and rail lubricators in the track in controlling the amount of curve wear. Instrumentation consisted of a box to catch metal abraided by diesel units from the track and a motion picture camera to photograph the passing wheel flange on the high rail. The tests show that although the rate of rail and wheel wear with a diesel unit is greater than for a heavily loaded freight car, the greater amount of rail wear is due to the train rather than the diesel units. Rail and wheel flange wear on curved track can be practically eliminated by lubrication with either flange oilers on the diesel units or rail lubricators in track, or a combination of the two.

AREA Bulletin Proceeding Vol. 56 1955, pp 269-281, 1 Fig, 2 Tab, 9 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052410
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
Progress in the continuing study of the causes of shelly spots and head checks was reported. The performances of various installations of heat-treated and alloy-steel rail have been tabulated. Appendix 8-a presented rolling-load tests of heat-treated chrome-vanadium rail, high-silicon rails, and 140-lb. chrome-vanadium alloy rail. Examination of shelly rails from service and rolling-load tests to produce detail fractures in the laboratory were discussed. One specimen of chrome-vanadium rail, heat-treated to 490 Brinell hardness, ran 21 million cycles in a rolling-load test. Ten specimens of high-silicon rails averaged 2,307,000 cycles in rolling-load tests. Two specimens of 140-lb. chrome-vanadium alloy rail averaged 3,625,000 rolling-load cycles. Photographs of one shelling crack in a service rail indicate the crack started at a segregation streak in the rail. All rolling-load tests to produce shelling indicate that rails with higher hardness, with corresponding increase in mechanical strength, give longer laboratory rolling-load tests.

AREA Bulletin Proceeding Vol. 56 1955, pp 951-959, 2 Tab, 3 Phot, 1 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052412
INVESTIGATION OF FATIGUE STRENGTH OF RAILROAD TIMBER BRIDGE STRINGERS
Laboratory testing of southern pine and Douglas fir bridge stringers was reported. The work consisted of fatigue bending tests on full-size timber stringers and standard block shear tests on small clear specimens at Purdue University, and static bending tests on small clear specimens , fatigue bending tests on small clear specimens and tests on one-quarter scale specimens in Wisconsin. The timbers were to be tested in green condition, but partial seasoning had taken place. Specimens were loaded in the fatigue machine and deflection and shear distortion measurements were taken. Results of repeated loading indicate that if checking is present failure occurs in horizontal shear rather than in bending. Failures in horizontal shear were sudden and near the centroidal axis where checks are deepest. Shear failure generally originates at the end of the specimen which has the least overhang beyond its support. Fatigue bending tests on specimens subjected to center loading on a simple beam span indicate that fatigue failures in bending the green specimens always started with a compression failure near the loaded surface. Static and fatigue bending tests on one-quarter scale specimens indicate that green checked specimens usually fail in bending rather than horizontal shear after static and repeated loads. Checked dry specimens fail in horizontal shear in static loading and repeated loading.

Leggett, JL (Kentucky University) *AREA Bulletin* Proceeding Vol. 55 1954, pp 161-211, 16 Fig, 12 Tab, 6 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052418
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
Five service tests of rail are discussed. There are four of heat-treated rail and one of alloy rail. In the progressive study of shelly rail rolling-load tests of flame-hardened rails, high-silicon rails, and electric furnace steel rails were performed. Examination of shelly rails from service was performed. Rolling-load tests to produce detail fractures were done. The rolling-load tests indicate that stronger rail steel should give longer life before shelling develops in service. Study and testing on simulated rails indicated that plastic deformation is the major factor in shelly failure. Design changes and metallurgical changes to limit plastic deformation would improve rail life. Use of lower wheel loads, larger wheels and higher strength material is indicated. A photoelastic study of the stresses in a model of a railhead utilizing developments in three dimensional photoelasticity for a better understanding of rail shelling was presented. Plastic models of the prototype were thinly sliced and the data obtained were subjected to a field of polarized light. Processing the data was done by the shear difference method. Principal stresses and maximum shears were studied through loading tests. Principal stresses and maximum shears were found in the transverse section of the rail under the center of the wheel.

AREA Bulletin Proceeding Vol. 55 1954, pp 828-897, 27 Fig, 5 Tab, 14 Phot, 4 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052426
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
A summary of the performance of heat-treated rail at five installations is presented. Results of rolling-load tests for each installation was presented. The progress on shelly rail studies was presented. Rolling-load rests on heat-treated rail, three experimentally flame-hardened rails and commercially flame-hardened rails were performed. Rolling-load tests to develop detail fractures and stress relaxation tests were made. The tests of the experimentally flame-hardened rails did not compare favorably with tests of heat-treated or alloy rail. Progress in the studies of stress relaxation in rail steel and deformational behavior of rails is reported. Bending fatigue tests of rail steel specimens were run to investigate whether a subcritical thermal treatment might heal progressive fatigue damage. No beneficial effect was noted. The mechanisms involved in rolling-load failures were then studied by work with low-carbon steels sensitive to the Fry "strain-etch" technique and with silver chloride which has optical properties and metal-like mechanical behavior. More work will be done with these two materials.

AREA Bulletin Proceeding Vol. 54 1953, 14 pp, 2 Tab, 4 Phot, 2 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052434
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
A summary of the performance of five test installations of heat-treated rail was presented. Appendix 9-a presented the progress of shelly rail studies at

the University of Illinois. Repeat cradle type rolling-load tests on two specimens of manganese chrome, vanadium alloy rail indicated that these rails may be several times as good as standard carbon steel rails. A test of 115-lb heat-treated standard carbon rail indicated that this type was as good as the manganese, chrome, vanadium alloy steel of the heat-treated standard carbon steel rails. An electron micrograph of nickel alloy steel showed detail in fine pearlite structure which was not revealed by a light microscope. Appendix 9-b presented a summary of progress on the investigation of stress relaxation in rail steel. The work was in two areas: 1) Relaxation of stresses in small bar specimens was studied as a function of time and temperature, and 2) rolling-load fatigue tests on small systems. Specimens cut from the top section of the rail were tested and results indicated possibly larger values of relaxation in percent of applied stress than for other specimens. Rolling-load fatigue tests produced failures that require further investigation of the effect of alleviation of damage by stress relaxing heat-treatment.

AREA Bulletin Proceeding Vol. 53 1952, pp 899-920, 2 Fig, 2 Tab, 12 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052436
FATIGUE TESTS OF BEAMS IN FLEXURE
This report gave a description and summary of the results of fatigue tests on various types of beams similar to those used in actual structures and subjected to repeated cycles of loads. The tests consisted of subjecting the beams to repeated loads varying from a small load on the beam to the maximum in the cycle. This load cycle was repeated at about 150 cycles per minute until failure developed at some location in the beam. Fatigue data were obtained on 27 different types of beams and a total of 104 specimens were tested. A description of each series with the average fatigue strength obtained for each series at 100,000 cycles and 2,000,000 cycles was shown. The results indicate the following points: 1) The carrying capacity of a rolled beam is considerably higher than that with a fabricated beam of equivelant section modulus. 2) The carrying capacity of a beam with cover plates cannot be increased indefinitely with an increase on cover plate thickness. 3) The use of cover plates on rolled beams appears to be limited to reinforcement jobs where the beam is already in place. 4) Cover plates on beams should be full length or extended past the theoretical cut-off point, so that the stress in the beam at the end of the plate is only about 40 percent of the stress at the center. The stress-raising effect of welding across the ends of partial length cover plates is about the same as that of the longitudinal welds along the edges of the cover plates.

AREA Bulletin Proceeding Vol. 52 1951, pp 111-129, 7 Fig, 2 Tab

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052440
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
A summary of the performance of heat-treated rail in two test installations was presented. Progress on shelly rail studies at the University of Illinois was presented in appendix 10-a. Rolling-load tests of heat-treated rails, flame-hardened rails, alloy rails and headfree rails were performed. Laboratory examination of detail fractures from shelling was performed. Design and construction of a new cradle-type rolling machine was discussed. A description of the technique used to produce electron micrographs at 35,000X magnification was given. Rolling load tests continued on 132-lb heat-treated rail revealed that yield strength was increased 65 percent, tensile strength 31 percent, elongation 18 percent, reduction of area 100 percent, and endurance limit 40 percent. Results of rolling-load tests on seven rails flame-hardened different amounts on the rail treads showed four specimens failed by head and web separation cracks, and three failed by shelling. Rolling-load and physical tests on two specimens of alloy rail steel showed that these rails have physical properties which compare closely with those of heat-treated rails. Examinations of seven detail fractures from shelling revealed that the shelling cracks started longitudinally in the steel and then turned into transverse detailed fractures.

AREA Bulletin Proceeding Vol. 52 1951, pp 661-679, 1 Tab, 12 Phot, 1 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052441
REVIEW OF JOINT BAR RESEARCH
A summary of the joint bar research program at the University of Illinois was presented. The testing machine was described. Fractures from the base and top of the bars, rail fishing surface profiles, bar hardness, physical properties, decarburization, shot peening, bolt hole spacing, and cycles of failure are discussed. The results of rolling-load tests on the new RE bars for both 115-lb and 132-lb rail which show a substantial increase in fatigue life over the older bars, together with a reduction in weight, indicate that considerable improvement has been made in the design of joint bars and should afford the railroads quite a savings both in lower cost and longer life.

Jensen, RS (Illinois University, Urbana) *AREA Bulletin* Proceeding Vol. 52 1951, pp 835-846, 5 Fig, 1 Tab, 4 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052447
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-METHODS FOR THEIR PREVENTION
Progress on the continuous study of shelly spots and head checks in rail was presented. Heat-treated rail tests indicate that its use extended the life of a rail before gage corner shelling occured. Appendix 10-a described studies at the University of Illinois where examinations of shelly rails from service and laboratory tests to produce shelling were performed. It was observed that the black shelly spots developed by two processes. Two rolling-load test on an alloy rail were high. Examination of the failed specimen revealed non-metallic inclusions. Rolling-load tests on heat-treated rail specimens of standard chemical analysis compared with non-heat-treated companions revealed that heat-treated specimens gave 3 to 4 times the performance of the non-heat-treated specimens. Appendix 10-b presented a summary report on the examination of rails containing detail fractures found by detector cars. The purpose was to determine if the chemistry, mechanical properties, or structures of detail fracture rails varied from those of random rails. The average chemical analyses and mechanical properties of 44 rails having detail fractures and 26 random rails were so nearly the same that no distinction between the two groups was possible. The mechanical tests included hardness, tensile properties, and impact properties. Examination of deep etched structures and microstructures of detail fracture rails indicated that the steel used was of relatively good quality.

AREA Bulletin Proceeding Vol. 51 1950, pp 595-620, 4 Fig, 4 Tab, 16 Phot, 2 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052458
STRESS DISTRIBUTION IN BRIDGE FRAMES-FLOORBEAM HANGERS
Report is made on stress distribution in bridge frames and floorbeam hangers. A survey of floorbeam hanger failures is conducted, and field and laboratory studies of stress analysis are made. It is preliminarily concluded that the increase in stress concentration at the sides of the rivet holes due to rivet bearing is often quite large and may easily be the major factor in the fatigue failures at the gussets. Fatigue tests of plates connected by rivets to gussets on one side only produce progressive fracture through the plate at the rivet holes at relatively low unit stresses. Loss of clamping force in the rivets reduces the fatigue strength of such riveted joints. Due to the extensive hanger failures on some railroads, it is recommended that railroads keep close inspection of floorbeam hangers.

AREA Bulletin Proceeding Vol. 50 1949, pp 443-445, 2 Fig

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052459
LABORATORY TESTS OF TWO WELDED RAILS
Laboratory tests of two continuous welded rails are conducted. One welded rail is tested for comparison with previous tests, placing the rail head in repeated tension, and another test is conducted with the base in repeated tension for comparison with rolling-load tests of bolted joints. Illustrations show the specimen in the testing machine and the manner of supporting the second welded joint to place the rail head in tension. Test values for several

specimens in tensile and Charpy tests and for the endurance limit obtained from the fatigue specimens are reported. Test results reveal that the welds are uniform in strength and that the properties of the welds compare favorably with the strength of unwelded rail steel.

Cramer, RE (Illinois University, Urbana) *AREA Bulletin* Proceeding Vol. 50 1949, pp 510-512, 1 Fig, 1 Tab, 2 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052460
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL-MEASURES FOR THEIR PREVENTION
Causes of shelly spots and head checks in rail are reported and measures for their prevention are recommended. Reports of four study groups are presented. It is noted that no definite relationships or trends exist in the relationship between chemistry and shelling, or curvature, elevations, speeds, and grades. It is found that transposing shelly high rails to the low rail, if done in time, is worthwhile. Rail slow-cold worked under traffic in nonshelling locations and relaid in shelling locations possesses very little, if any, greater resistance to shelling than ordinary rail. Studies of high carbon rail indicate that it will retard but not eliminate shelling and that it has a tendency to head check and this in turn causes gage corner flaking or minute shelling. A seven-year summary report of shelly rail investigation at the University of Illinois is presented. Also presented is a summary report on the examination of 300 shelled spots selected from the track of 11 major roads, indicating that the shelled spots were predominantly of surface origin.

AREA Bulletin Proceeding Vol. 50 1949, pp 534-557, 3 Fig, 2 Tab, 16 Phot, 2 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052461
COMPARISON OF WEB STRESSES IN 131-LB RE AND 140 PS -(PENNSYLVANIA) SECTIONS
Report is made of field measurement of stresses made by the Pennsylvania Railroad in 131-lb. RE and 140 PS sections of rail. The 140 rail section is designed to compensate for the inadequacy of the 131 section, and the two sections are compared. Stresses reported include the maximum stress in the web in a vertical plane occurring under a concentrated load. It is noted that in the service tests, made under conditions where rails were failing, the maximum stress is always found on the gage side of the low rail and that is where fatigue cracks develop. It is concluded from these service measurements that the laboratory basis of design of the new section is sound and that the laboratory stress measurements forecast the reduction in service stress with satisfactory accuracy.

AREA Bulletin Proceeding Vol. 50 1949, pp 558-566, 7 Fig, 3 Tab

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052462
REPORT ON SERVICE TEST OF SOLID MANGANESE CROSSINGS FROGS AT MCCOOK, ILLINOIS
Service tests of solid manganese crossing frogs at McCook, Illinois, are reported. Stress measurements are covered in the flangeways and at other significant stress areas of five different designs of manganese castings placed in the crossings of the Baltimore & Ohio Chicago Terminal Railroad and the Atchinson, Topeka & Santa Fe Railway. Service tests include tests of the original design of casting by Taylor-Wharton and the Carnegie-Illinois casting. It is concluded that some of the designs included in the tests are more resistant to the development of fatigue cracks than others, but in none were the developed stresses low enough relative to the fatigue strength of the manganese steel to give the service life under heavy traffic that should be expected, and efforts to further reduce these stresses are recommended.

AREA Bulletin Proceeding Vol. 50 1949, pp 572-576, 1 Fig, 2 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052468
CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL SURFACES-DEVELOP MEASURES FOR THEIR PREVENTION
Causes of shelly spots and head checks in rail surfaces are investigated, and preventative measures are recommended. It is found that no definite relationship exists between chemistry and shelling, and no definite trend regarding curvature, elevations, speeds and grades. Transposing shelly high rails to the low rail, if done in time, is worthwhile. Rail slow-cold worked under traffic in non-shelling locations and relaid in shelling locations possesses little resistance to shelling compared to ordinary rail. It is also found that high carbon rail does not eliminate shelling but retards it more than ordinary carbon rail; however, the high carbon rail tends to head check and in turn cause gage corner flaking or minute shelling. Reports are submitted by the Norfolk & Western, Pennsylvania, Duluth, Missabe & Iron Range, and Chesapeake & Ohio Railroads.

AREA Bulletin Proceeding Vol. 49 1948, pp 434-463, 10 Fig, 5 Tab, 19 Phot, 3 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052469
FOURTEENTH PROGRESS REPORT OF THE COOPERATIVE INVESTIGATION OF FAILURES IN RAILROAD RAILS IN SERVICE AND THEIR PREVENTION
Report is made of the cooperative investigation of failures in railroad rails in service and their prevention. Careful examination of transverse fissures is made. Laboratory rolling-load tests are studied to find a type of rail steel to resist shelling failures which occur in rails on curves. Work on end-hardened rails is continuing. Failed rail conditions are summarized and illustrated.

Conducted by the Engineering Experiment Station, University of Illinois in cooperation with the Association of American Railroads and the American Iron and Steel Institute.

Cramer, RE (Illinois University, Urbana) *AREA Bulletin* Proceeding Vol. 49 1948, pp 490-495, 3 Tab, 3 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052470
INVESTIGATE CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL SURFACES FOR THE PURPOSE OF DEVELOPING MEASURES FOR THEIR PREVENTION
Causes of shelly spots and head checks in rail surfaces are investigated, and preventative measures are presented. Topics discussed include mill chemistry records; curvature tabulation, elevation, speeds, and grades; effect of rail lubricators, transposing rails, slow cold rolling; field tests of special rails; experience of roads having these defects; radius of gage corners of rail, tread of wheels, radius between flange and tread of wheels; relationship between wear of rail and wheel; bearing pressure of wheel on rail; cant of rail; superelevation of rail on curves; examination of service rail failures caused by these defects; rolling-load tests to produce these effects under laboratory conditions; resistance of rail steel of various composition to the development of these defects under laboratory conditions; resistance of different heat treatments of rails to the development of these defects under laboratory conditions. Progress is made but no definite solution has been found.

AREA Bulletin Proceeding Vol. 46 1945, pp 643-659, 6 Fig, 3 Tab, 6 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052471
INVESTIGATE CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL SURFACES FOR THE PURPOSE OF DEVELOPING MEASURES FOR THEIR PREVENTION
Causes of shelly spots and head checks in rail surfaces are investigated to develop measures for their prevention. Topics discussed include study of rail steel compositions, heat treatments, wheel and rail contacts and pressures, mill practices, and consideration of larger diameter wheels or lighter loads on the wheels. It is cautioned that new chemistry or heat treatment may induce other types of defects or excessive expense. Study of shelling reveals no definite trend or definite conclusions. It is noted that the control cooled

process will not prevent shelling. Rolling load machines and tests are discussed.

AREA Bulletin Proceeding Vol. 45 1944, pp 446-469, 14 Fig, 1 Tab, 9 Phot, 2 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052472
INVESTIGATE CAUSES OF SHELLY SPOTS AND HEAD CHECKS IN RAIL SURFACES FOR THE PURPOSE OF DEVELOPING MEASURES FOR THEIR PREVENTION
The investigation into the causes of shelly spots and head checks in rail surfaces was presented. A definition and description of shelly spots, the most serious type of rail damage, was presented. The division of the work of this subcommittee was described. Appendix A presented the shelly rail studies conducted at the University of Illinois. Laboratory studies of failed shelly rails concluded that shelling appears to be the result of cold working of the rail steel by "line contact" with car wheels. The presence of imperfections accelerated the formation of cracks. Laboratory rolling-load tests to produce shelling were performed. Different rail steel compositions were studied through rolling-load tests. The Brinell hardness of the wheel path after rolling was measured. Full sections specimens of heat-treated carbon rail were tested under rolling-load. No conclusions were reached.

AREA Bulletin Proceeding Vol. 44 1943, pp 597-610, 3 Fig, 12 Phot, 1 App

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052473
NINTH PROGRESS REPORT OF THE JOINT INVESTIGATION OF FISSURES IN RAILROAD RAILS
The information in this report of the joint investigation of fissures in rails was contained in five sections. Field tests for batter of end-hardened rails in service on the Chesapeake and Ohio Railway were performed. The summary of the batter values was tabulated. Rail ends with large cracks had approximately three times the batter of uncracked ends. Examination of end-hardened rails from the C and O test track in Carey, Ohio revealed that most damage, weeping cracks and flow of the metal over the ends and sideways, produced batter and drooping of the rail ends. Tests of mill cooling containers for rails were discussed. Examination of control-cooled and Brunorized rails which failed in service revealed that none of the control-cooled rails contained shatter cracks, but did have transverse fissures from blow holes and welded spots, horizontal split heads, detailed fractures from engine wheel burn, fatigue failures starting in the web, and detailed fractures from shelly spots. The Brunorized rails had developed transverse fissures from shatter cracks as nuclei. A comparison of drop and bend tests was summarized.

Conducted by the Engineering Experiment Station, University of Illinois in cooperation with the Association of American Railroads and the Rail Manufacturers' Technical Committee.

Moore, HF Alleman, NJ Cramer, RE Jensen, RS (Illinois University, Urbana) *AREA Bulletin* Proceeding Vol. 44 1943, pp 611-621, 9 Fig, 2 Tab, 1 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052477
DISCUSSION ON STRESSES IN RAILROAD TRACK. PART 1
A discussion of the comparison of tests on stretches of welded track under observation was presented. The purpose was to learn of the magnitude and distribution of the anchorage given between the ties and ballast at the ends of the welded stretch and along its length to resist the forces set up by chance changes in the temperature of the rail, and to learn how the influences tending to change the length and alignment are met in the track. Stress measurements were made on the web of the rail, and the temperature of the rail was taken with the open ended thermocouple and portable potentiometer. The observations were reduced by temperature corrections of gage readings and made comparable for both strains and stresses. Throughout the intermediate part of the welded stretch very little change occurred throughout the variations in summer and winter temperatures. The rails changed length through an average distance of seven rail lengths for the end portions of the rails for both the summer and winter tests. For the higher summer temperatures and lower winter temperatures the stresses may be expected to increase in proportion to the increase in change of temperature from the 63 F base. Lateral deflection of angle bars occurred when bolts were tightened. Tightening of the inner bolts in worn bars also developed lateral bending stresses in the bars. The stresses were generally compressive and the bars bend about an axis appproaching the vertical and high tensile stresses occurred on the inner flanges of the bar. These will add to the tensile bending stresses produced by wheel loads.

Talbot, AN (Illinois University, Urbana) *AREA Bulletin* Proceeding Vol. 38 1937, pp 674-681, 6 Fig

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052478
DISCUSSION ON STRESSES IN RAILROAD TRACK. PART 2
Observations and tests made on the stretches of welded rail of the Delaware and Hudson Railroad, one section at Albany, and two at Schenectady, were presented. The purpose of the tests was to find changes in length in rail at any place along the stretch, anchorage or restraint at any place along the length and temperature stresses set up in the rail at any place. Readings were taken with strain gages. Temperature of the rail was taken with a thermocouple and potentiometer. Summer and winter measurements were taken. All the welded stretches kept their alignment well even on curves. The longitudinal movement at the ends of the welded stretches and at points along the length due to temperature changes was small. No noticeable movement of the ties in a direction longitudinal of the track was seen. At the end of a welded stretch a tensile or compressive force of considerable magnitude may be transmitted to the adjoining rail. Variable anchorage forces developed in the summer at points due to the presence of under-crossings and viaducts. The flexural stresses developed in the rail by the loads of traffic will be superimposed on the temperature stresses and the two sets of stresses at any point in the height of the rail must be added or subtracted according to their nature.

Talbot, AN (Illinois University, Urbana) *AREA Bulletin* Proceeding Vol. 37 1936, pp 954-961, 3 Fig, 1 Phot

ACKNOWLEDGMENT: AAR
PURCHASE FROM: AREA Repr PC

C4 052519
OPTIMUM ADAPTION OF THE CONVENTIONAL TRACK TO FUTURE TRAFFIC. THE BEHAVIOUR OF RAILS IN RELATION TO THEIR CONDITIONS OF USE
Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways D117/RP3/E, Apr. 1973

C4 052525
QUALITY OF RAILS AND MEANS OF GUARANTEEING IT. PROPOSALS CONCERNING THE 6TH EDITION OF TECHNICAL SPECIFICATION 860-0 GOVERNING THE SUPPLY OF VIGNOLE (FLAT-BOTTOM) RAILS OF NON-TREATED STEEL
At the request of the 7th UIC Commission, the D 45 Specialist Committee has been charged with studying the dimensional tolerances of rails with a metric weight greater than 60 kg. As the administrations made increasing use of heavy rails it become necessary to include in Technical Specification 860-0 for the supply of Vignole (flat-bottom) rails of non-treated steel, the maximum permissible dimensional tolerances for these heavy rails. Having regard to the results of the tests already carried out within the scope of its programme of work and the experience gained by its members, the D 45 Specialist Committee deemed it advisable not to limit its investigations merely to the problem of dimensional tolerances, but to examine the whole specification at the same time, and to group into one report all the amendments and additions which it intended making to the existing text. The most important amendments concern marking, freedom from defects, dimensional tolerances, and certain acceptance and guarantee conditions. The wording of the texts at present in force and of the texts proposed to the 7th UIC Commission have been completed by remarks explaining or justifying the decisions of the D 45 Specialist Committee.

Restrictions on the use of this document are contained in the explanatory

material.
International Union of Railways D45/RP 11/E, Apr. 1969, 29 pp, 3 App.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

C4 052533
BEHAVIOR OF THE METAL OF RAILS AND WHEELS IN THE CONTACT ZONE. EXPERIMENTAL STUDIES: 1) WORK-HARDENING SPEED WITH THE EMS 60 MACHINE (ADDITIONAL MEASUREMENTS), 2) RESIDUAL STRESSES IN HARD-GRADE STEEL RAILS (ADDITIONAL MEASUREMENTS) 3) CHECKING OF FATIGUE CRITERION PROPOSED BY MR. DANG VAN

This report is in three parts: 1) Work-hardening speed examined with the EMS 60 machine: The development of the two principal residual stresses produced on the running surface of rails made of different grades of steel has been studied as a function of the repeated passages of a loaded wheel. It has been shown that this development ceases at about approximately 1 million cycles. 2) Residual stresses in hard-grade steel: These stresses have been measured inside 2 rails of hard-grade steel, one new and the other work-hardened in service. The use of the rail in the track produces severe longitudinal and transverse compressive stresses at the surface. The stress field is affected strongly throughout the height of the rail-head. 3) Checking of fatigue criterion proposed by Mr. Dang Van: The fatigue limits of a rail steel have been determined for different cases of stressing. The results have enabled the validity of the fatigue criterion proposed by Mr. Dang Van (see Report C 53/RP 7) to be confirmed.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways C53/RP 8/E, Oct. 1973, 31 pp, Figs., 2 Tab.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

C4 052555
BEHAVIOUR OF THE METAL OF RAILS AND WHEELS IN THE CONTACT ZONE. CALCULATION OF THE COMPLEX STRESS CYCLES IN THE RAIL SUBJECTED TO ROLLING LOADS. ASSESSEMENT OF THE DANGER OF DAMAGE (CONTINUED)

This study deals with new calculations of the composition of the residual stresses and the stresses induced in the rail during the passage of wheels, for different loading values, wheel diameters and wheel-tyre transverse curvatures. One thermal stress and three residual stresses have been considered. The latter have been calcuated and then measured with the help of an original strain-gauge method. The danger of rail damage has then been evaluated by means of the damage line criterion proposed by Mr. Dang Van (see C 53/RP 7 and C 53/RP 8). It has been possible in this way to define the danger factor for each loading case. It has been shown that two types of danger exist, namely, fatigue and plastic deformation.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways C53/RP 9/E, Oct. 1973, 27 pp, 26 Fig., 5 Tab., 2 App.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

C4 052599
FATIGUE PHENOMENA IN WELDED CONNECTIONS OF BRIDGES AND CRANES. FATIGUE OF LARGE BUTT WELDS ON BRIDGES

The report describes fatigue tests on large butt-welded beams and concludes that strength is lower than would be predicted from results using small specimens, or from many codes of practice. Tests incorporated shop and site welds and attachments provoking local stress concentration.

Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways D130/RP 1/E, Apr. 1974, Figs., Tabs., Apps.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: UIC Repr. PC

DOTL RP

C4 053753
SFSA: PREVENTING BRITTLE FRACTURE

Prevention of brittle failures in steel castings has been the goal of a technical research program of the Steel Founders' Society of America. SFSA now recommends the results of its research involving the NDTT (Nil Ductility Transition Temperature) concept. A related project involves the relationship between fracture toughness and strength. SFSA sees this pointing toward a new design philosophy of not specifying an absolutely flawless metallurgical structure but enabling an engineer to predict whether or not a flaw of given dimension will cause brittle failure.

Railway Locomotives and Cars Vol. 147 No. 10, Dec. 1973, 1 p

PURCHASE FROM: XUM Repr PC

DOTL JC

C4 053758
LINEAR EQUALITY CONSTRAINTS IN FINITE ELEMENT APPROXIMATION

This is the first of a series of reports to appear in which the development of a new finite element stress analysis technique will be documented. The work is being conducted at Washington University under a cooperative research program with AMCAR Division of ACF Industries, Inc. Washington University's participation is sponsored by the U.S. Department of Transportation under the Program of University Research and by the Association of American Railroads. The main project objective is the development of a mathematical modeling capability for the benefit of the rail transportation industry that will permit design optimization of key structural components such that the probability of fatigue failure can be minimized with respect to a given load environment. The current finite element technology is not cost-effective in fatigue design applications because a very large number of successive analyses must be executed with progressively refined finite element subdivision in order to establish confidence in the accuracy of solution in those areas where stresses change rapidly.

Research sponsored by Department of Transportation and Association of American Railroads. Work done in cooperation with AMCAR Division of ACF Industries, Inc.

Szabo, BA Kassos, T
Washington University, St Louis Sept. 1973, 32 pp, Figs, 16 Ref, Apps

PURCHASE FROM: Washington University, St Louis St Louis, Missouri, 63130 Repr PC

C4 053837
STANDARDIZED FORMAT FOR RAILROAD ENVIRONMENT

This paper outlines a format for recording railroad environmental spectrum data that utilizes the standard arrangement of the modified Goodman diagram. In this form the environmental data is applicable to theoretical finite life fatigue design and to variable-cycle spectrum-type fatigue testing. Maximum loadings for operational guidance, equivalent static design analysis, lading damage studies, and proof testing are also accurately portrayed. The extensive environmental data requirements for modern design dictate the need for standardization of data format and content to provide compatibility of data from various sources and facilitate formation of the national data bank required by the railroad industry.

Cook, RM (Association of American Railroads)
American Society of Mechanical Engineers 73-RT-2, Jan. 1973, 8 pp, 4 Fig

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL RP

C4 053853
FRACTURE MECHANICS

Failure of components is a matter of concern to both design engineers and materials engineers. Looking at this problem from a materials standpoint,

three types of failures are of particular significance because of the frequency and, at times, unexpected behavior. These three types of failures are fatigue, stress corrosion cracking and brittle or abrupt failure. This paper is concerned with brittle failure. The situations are different, of course, in the other two cases. Brittle failure in engineering materials is generally defined as failure that takes place at applied stresses below the yield strength level of the material. Designing against this type of failure has been a very important consideration.

Presented at the Tenth Annual Railroad Engineering Conference, Depew, New York, Sept. 5-7, 1973.

Wallace, JF (Case Western Reserve University)
Dresser Transportation Equipment Division 1973, 7 pp, 14 Fig

ACKNOWLEDGMENT: Dresser Transportation Equipment Division
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL RP

C4 053854
FATIGUE DESIGN CRITERIA FOR CARBODY BOLSTERS

The purpose of the static test is to prove design and, more or less, verify stress calculations of the bolster. Where, this is a step in the right direction, it does not point out indeterminates and areas of concentrated high stresses. It is these high stress areas that will lead to fatigue failure of the bolster. Unless these areas are located and steps taken to correct these conditions, failure will continue to occur. In making these tests, employed was the use of photoelastic analysis, which has helped in pointing out high stress areas that calculations of the bolster would not indicate.

Presented at the Tenth Annual Railroad Engineering Conference, Depew, New York, Sept. 5-7, 1973.

Reichow, K (Pacific Car and Foundry Company)
Dresser Transportation Equipment Division 1974, 8 pp, 29 pp

ACKNOWLEDGMENT: Dresser Transportation Equipment Division
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL RP

C4 054000
COMPONENTIZATION FOR FATIGUE DESIGN AND TESTING

This paper briefly reviews the most common cause for fatigue initiation in freight cars, the specialized data required for theoretical fatigue design, fatigue design criteria, appropriate modern fatigue testing equipment, and the types of full-scale component tests believed most applicable to the car building and railroad industry. The concept of componentization is introduced as a means for expediting both the fatigue design and testing phases of a freight car development program. An objective has been to present the overall aspects of the subject in terms understandable to the person who is not an expert in the fatigue area by presenting only the fundamentals most directly applicable to freight cars.

Contributed by the Rail Transportation Division of The American Society of Mechanical Engineers for presentation at the IEEE-ASME Joint Railroad Conference, New York, N.Y., April 19-21, 1971.

Cook, RM (ACF Industries, Incorporated)
American Society of Mechanical Engineers ASME #71-RR-2, Jan. 1971, 8 pp, 5 Fig, 7 Ref

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL TF5.A721971

C4 054005
ENVIRONMENTAL FINITE LIFE FATIGUE TESTING, UTILIZING MINER'S HYPOTHESIS

This paper outlines one method suitable for cost effective computerized theoretical finite life structural fatigue design and determination of means for conducting laboratory fatigue tests that can predict or confirm finite service life of a component or product. Basic modified Goodman type fatigue test data is utilized with the actual environmental loading spectrum and Miner's hypothesis to determine the damaging cycles experienced in service. The total damaging portion of the environmental loading incurred during the long life of railroad equipment can then be applied in laboratory tests of practical duration. Hence, this is truly an environmental test and not what is often termed an accelerated fatigue test. The technical opinions expressed herein are those of the author and do not necessarily represent the policy of the Association of American Railroads.

Contributed by the Rail Transportation Division of The American Society of Mechanical Engineers for presentation at the ASME-IEEE Joint Railroad Conference, Pittsburgh, Pa., April 3-4, 1974

Cook, RM (Association of American Railroads)
American Society of Mechanical Engineers ASME #74-RT-7, Jan. 1974, 8 pp, 3 Fig, 13 Ref

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL RP

C4 054006
DEVELOPMENT OF FATIGUE STANDARDS FOR FREIGHT CAR TRUCK COMPONENTS AND WHEELS

Factors which should be considered in the development of fatigue standards for freight car truck components and wheels are discussed. These standards would be formulated to provide a desired level of operational reliability, and they would be based on the fluctuating loads acting on the components in service. Typical data describing this environmental are presented. Statistical considerations in establishing the margin between the environmental loads and component fatigue strength are also described.

Contributed by the Rail Transportation Division of The American Society of Mechanical Engineers for presentation at the ASME-IEEE Joint Railroad Conference, Pittsburgh, Pa., April 3-4, 1974

Johnson, MR (IIT Research Institute)
American Society of Mechanical Engineers ASME #74-RT-4, Dec. 1973, 11 pp, 17 Fig, 8 Ref

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL RP

C4 054007
DETERMINATION OF CAR BODY CENTER PLATE FATIGUE DESIGN CRITERIA BY FULL-SCALE CAR TESTING

Fatigue design criteria are established based on full-scale car tests conducted on a 100-ton Southern Railway Hopper car. Stress levels on body center plate and its attachments to the car were determined for static car loading by means of jacking, for standing car dynamic loading under a full roll mode received on AAR rock and roll environmental prepared track testing. Correlation of determined stress loadings leads to three proposed axioms for design criteria.

Contributed by the Rail Transportation Division of The American Society of Mechanical Engineers for presentation at the ASME-IEEE Joint Railroad Conference, Pittsburgh, Pa., April 3-4, 1974

Martin, AE Smith, LW (Dresser Transportation Equipment Division)
American Society of Mechanical Engineers ASME-#74-RT-8, Jan. 1974, 9 pp, 16 Fig, 3 App

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL RP

C4 054351
THE MECHANICS OF RUPTURE--DOES IT ONLY BENEFIT SCIENCE? [BRUCHMECHANIK--NUR FUER DIE WISSENSCHAFT?]

The article examines ruptures due to brittleness without deformation of materials with high tensile strength. Functions have been calculated for different types of fissure taking into account only the residual tension and the shape of the fissure, and this enables the stress intensity at the edge of the fissure to be ascertained. A characteristic of the material is the critical intensity of the stress when the sample or component part is ruptured. This method is still limited to ideally elastic and brittle materials, but could also be extended to real materials. [German]

Kalkbrenner, E *Glasers Annalen ZEV* Vol. 97 No. 9, 1973, 4 pp, 3 Fig, 1 Tab, 14 Ref

ACKNOWLEDGMENT: UIC (1249)
PURCHASE FROM: ESL Repr PC, Microfilm

DOTL JC

C4 054680
WHAT DESIGNERS SHOULD KNOW ABOUT FRACTURE TOUGHNESS
Is brittle fracture a brand new problem? Brittleness becomes a threat with high strength steels or thicker plates. Only within the past 20 years have we started using these higher strength steels for structures. During the same time, welding has become commonplace and has brought a strong temptation to use thicker plates. In about 90% of the cases involving cracking, if any toughness at all had been specified, trouble would probably have been avoided. Designers or owners should test the steel he gets; steel companies also have an obligation to provide information on steel toughness. They should state the range of fracture toughnesses at given temperatures.

Elliot, AL *ASCE Civil Engineering* Apr. 1974, pp 70-71

ACKNOWLEDGMENT: ASCE
PURCHASE FROM: ESL Repr PC, Microfilm
DOTL JC

C4 054782
THE BEHAVIOUR OF RAILS IN RELATION TO THEIR CONDITIONS OF USE
The principal rail failure statistics of 5 Administrations have been analysed with a view to determining the respective influence of the different features involved in the behaviour of rails in service. Some recommendations are proposed concerning the choice of rail-section as a function of the traffic, the grade and quality of the rail steel and the construction of rail joints. The problems raised by welds in continuously welded rails, by the substructure and by the environment are also mentioned. It seems that the rail withdrawals for fatigue defects increase proportionally with the total traffic load on the one hand with the cube of the average axle-load on the other.
Restrictions on the use of this document are contained in the explanatory material.

International Union of Railways D 117/RP 3, Apr. 1973, 34 pp, 27 Fig, 8 Tab

ACKNOWLEDGMENT: UIC (33)
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr PC
33

C4 057171
AMERICAN STEEL FOUNDARIES DYNAMIC TEST FACILITY FOR RAILWAY TRUCK COMPONENTS
This article describes the ASF test facility for truck components. The facility permits dynamic testing of the various components. The article describes the test equipment and the test procedures, and several conclusions that have been reached are discussed.

Tennikait, HG (American Steel Foundries) *Closed Loop* Vol. 4 No. 2, Apr. 1974, pp 10-16, 6 Fig., Phots.

ACKNOWLEDGMENT: Closed Loop
PURCHASE FROM: MTS Systems Corporation P.O. Box 24012, Minneapolis, Minnesota, 55424 Repr. PC
DOTL JC

C4 071628
FATIGUE STRENGTH OF STEEL BEAMS WITH WELDED STIFFENERS AND ATTACHMENTS
Following an intensive study of the fatigue behavior of steel bridge members, researchers at Lehigh University recommend changes in the Standard Specifications for highway bridges published by the American Association of State Highway and Transportation Officials and in specifications of the American Welding Society and the American Railway Engineering Association. In the past, only approximate general design relationships have been possible on the basis of the limited existing experimental data. Some 157 steel beams and girders were fabricated and tested, primarily to define the fatigue strength of transverse stiffeners and attachments under constant-amplitude fatigue loading. Stress range accounted for nearly all the variations in fatigue life.
Research sponsored by the American Association of State Highway and Transportation Officials in cooperation with the Federal Highway Administration.

Fisher, JW Albrecht, PA Yen, BT Klingerman, DJ McNamee, BM (Lehigh University) *Transportation Research Board NCHRP Reports* No. 147, 1974, 85 pp, Figs., Tabs., 54 Ref., 7 App.

PURCHASE FROM: TRB Repr. PC
DOTL RP

C4 071782
MEAN STRESS EFFECTS ON FATIGUE CRACK GROWTH AND FAILURE IN A RAIL STEEL
Over a limited range, the effect of mean stress has been studied on fatigue crack propagation and on the critical fatigue crack size associated with sudden fast fracture in center-notched plate specimens of a rail steel under pulsating loading. The results have been presented in terms of the stress intensity factor range K and the ratio R of the minimum to maximum stress. Increasing R was found to both accelerate cracking and reduce the critical crack size at instability. The data have been correlated with three crack growth equations currently used in the literature and it was found that the equation of Forman et al. relating crack growth rate to K and R gave the best fit. This equation was used to predict life in the finite range of the S-N curve. Fractographic examination revealed that the fracture surfaces were complex and a number of fracture modes contributed to cracking.

Evans, PR (National Physical Laboratory); Owen, NB McCartney, LN *Engineering Fracture Mechanics* Vol. 6 No. 1, Mar. 1974, pp 183-193, 8 Ref.

ACKNOWLEDGMENT: EI (EI 74 0801972)
PURCHASE FROM: ESL Repr. PC, Microfilm

C4 071797
APPLICATION OF THE COATING SYSTEM TOGETHER WITH THE ZINC COATING FOR THE PROTECTION OF STEEL BRIDGES
The coating system together with the zinc coating is reported to be resistant to the severe corrosive environment and highly durable. The zinc spray coating and the zinc-rich paint are used as the zinc coating. Methods of coating, the surface preparation before painting, application of this coating system to steel bridges and the repainting are reviewed in this paper.

Sato, Y *Railway Technical Research Institute* Quart Rpt. Vol. 48 No. 5, May 1974, pp 8-13, 8 Ref.

ACKNOWLEDGMENT: EI (EIX740804601)
PURCHASE FROM: Ken-yusha 1-45-6, Hikari-cho, Kokubunji, Tokyo, Japan Repr. PC
DOTL JC

C4 071829
THE DETERMINATION OF STRESSES IN ROLLING-CONTACT ELEMENTS
Stress patterns in lubricated rolling-contact elements have been computed from surface pressures and temperatures between pairs of rolling disks, both cylindrical or both crowned, measured by means of evaporated surface transducers. The maximum mechanical shearing stresses computed for both cylindrical and crowned disks proved to be nearly equal to those that would have occurred under static contact, but the calculated depth of those stresses was reduced for cylindrical rollers in dynamic contact. The maximum shear reversals computed for rolling cylindrical disks were noticeably below the corresponding shear differences for the static cases. Local pressure anomalies, such as the pressure spike in the one particular case chosen for investigation, did not seem to alter significantly the shear-stress patterns. Thermal shearing stresses do not appear to be a significant portion of the maximum stress but do dominate over mechanical shearing stresses near the surface of the elements.
Contributed by the Lubrication Division of the American Society of Mechanical Engineers for presentation at the ASME-ASLE Lubrication Conference, Minneapolis, Minn., Oct. 18-20, 1966.

Kannel, JW Walowit, JA Bell, JC Allen, CM (Battelle Memorial Institute)
American Society of Mechanical Engineers Paper 66-Lub-16, 1973, 12 PP, 17 Fig., 4 Tab., 13 Ref.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ASME Repr. PC
DOTL TF550.G85 V.3

C4 071840
NOISE IN RAIL TRANSIT CARS: INCREMENTAL COSTS OF QUIETER CARS
U.S. rail rapid transit systems, car operations, and the car building industry are described in relation to the procurement of quieter cars. The noise environment of passengers in rapid transit cars is discussed and the major noise sources and paths of noise transmission into cars are delineated. For essentially all combinations of car noise-control modifications deemed technically and economically feasible for implementation in new vehicles, estimates are presented of the associated noise reductions, initial costs, and operating costs. It is concluded that significant reductions in in-car noise under typical operating conditions can be achieved at incremental costs that are small percentages of the total car costs.

Ungar, EE
Bolt, Beranek and Newman, Incorporated, Environmental Protection Agency Final Rpt. June 1974, 45p

Contract EPA-68-01-1539

ACKNOWLEDGMENT: NTIS (PB-234992/6)
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-237992/6, DOTL NTIS

C4 072580
FUNDAMENTALS OF FRACTURE MECHANICS
This text deals mainly with the macromechanics of fracture. However, consideration is given also the microscopic aspects particularly with regard to the use of models that are devised to show why cracks propagate and voids coalesce at particular stresses or strains. Notched bars and crack tip phenomena are discussed in considerable detail, as are fracture toughness testing methods and the cleavage-fibrous transition.

Knott, JF
Halsted Press 1973, 273 pp

ACKNOWLEDGMENT: ASME Journal of Mechanical Engineering
PURCHASE FROM: Halsted Press 605 Third Avenue, New York, New York, 10016 Orig. PC

C4 072588
METALLURGICAL EXAMINATION AND PHYSICAL TEST RESULTS OF CHROMIUM AND MANGANESE--VANADIUM ALLOY RAIL STEEL INVESTIGATION
This report contains the results of metallurgical examinations and laboratory accelerated testing of samples of chromium and manganese-vanadium rail to determine the quality and strength of these types of rail steel. The rail samples, for purposes of this investigation, of both types of rail were furnished to the AAR Technical Center by the Canadian Pacific Limited. The investigation consisted of rolling-load tests, drop tests, slow bend tests, physical property determinations, charpy impact tests, chemical analysis, hardness surveys and macroscopic and microscopic examinations conducted at the AAR Technical Center, Chicago.

Schoeneberg, KW *AREA Bulletin* Proceeding Vol. 76 Bulletin 649, Sept. 1974, pp 65-98, 25 Fig., 9 Tab.

ACKNOWLEDGMENT: AREA Bulletin
PURCHASE FROM: AREA Repr. PC
DOTL JC

C4 072655
DIRECTIONS IN TRACK STRUCTURE RESEARCH
This paper presents a survey of contemporary problems in track structure technology and the programs of research and development addressing these problems. It reports current and anticipated investigations into aspects of the service environment of railroad track structures, the mechanics of track structure degradation, the fatigue and fracture of rails, the development of rational design and maintenance techniques, the improvement of track components, and the development of non-conventional, low maintenance track structures for application to high speed high density service. Efforts involved with both the fundamentals of track mechanics, and the design of improved structures for urban rapid transit applications, as well as mainline railroad use are included.

Contributed by the Applied Mechanics Division of the American Society of Mechanical Engineers for presentation at the winter Annual Meeting, 17-22 November 1974, New York, New York.

McConnell, DP (Transportation Systems Center)
American Society of Mechanical Engineers 74-WA/APM-24, July 1974, 9 pp, 1 Tab., 47 Ref.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ASME Repr. PC
DOTL RP

C4 072693
ASSESSING THE SIGNIFICANCE OF FLAWS IN WELDS SUBJECT TO FATIGUE
The substitution of fracture mechanics crack propagation data for simple S-N curves provides additional data on welds defects, other than applied stress and the influence of geometry. It allows the fatigue process to be entered (variation in initial flaw size) and left (variation in failure criterion) at will and variations in geometry and crack share to be taken into account. The value of the method has been confirmed by accurately predicting the fatigue behavior of fillet welds containing flaws on the basis of the generalized stress parameter.

Maddox, SJ (Welding Institute) *Welding Journal* Vol. 52 No. 9, Sept. 1974, pp 401-409, 38 Ref.

ACKNOWLEDGMENT: EI (EI 74 067198)
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

C4 072694
SOME RELATIONSHIPS BETWEEN FRACTURE TOUGHNESS, APPLIED STRESS OF STRAIN AND FLAW SIZE
For low values of strain divided by yield strain, more accurate measures of displacement are required so that large errors are not involved when determining strain and strain divided by yield strain values. Measurements to 1x10 to the minus 3rd power in. should be sufficiently accurate for elastic displacements of the order of 35x10 to the minus 3rd power in. Testpiece geometry and flaw type have a significant effect on non-dimensional crack open displacement versus strain over strain yield. Surface flaws (part through the thickness) exhibit more developed COD at the same applied strain level than either the double edge notched or center notched tension geometries. Data are also included for determining critical flaw sizes for failure by brittle fracture.

Egan, GR *Welding Research International* Vol. 4 No. 1, 1974, pp 1-18, 17 Ref.

ACKNOWLEDGMENT: EI (EI 74 067195)
PURCHASE FROM: ESL Repr. PC, Microfilm

C4 072770
CONTRIBUTION TO THE THEORETICAL EXAMINATION AND EXPERIMENTAL TESTING OF RAILS [Ein Beitrag zur Theoretischen Untersuchung und Experimentallen Pruefung von Eisenbahnschienen]
The forces acting on rails under different conditions of service stress were calculated. Calculations were compared with results of fatigue tests on S49 and UIC60 rails. The variables investigated for their specific effects included locomotives vs freight cars and fast succession of trains. Fracture formation and propagation are discussed. It is concluded that high axle loads require a large rail section, and small wheel diameters also require a high tensile rail steel. The UIC60 rail of steel with 900 N/mm2 minimum tensile strength meets the two requirements and offers ample reserves. [German]

Oberweiler, G *Archiv fuer das Eisenhuettenwesen* Vol. 45 No. 8, Aug. 1974, pp 545-550

ACKNOWLEDGMENT: EI (EI 74 072845)
PURCHASE FROM: ESL Repr. PC, Microfilm

C4 072771
FAILURES OF RAILS AND TRACK SWITCHES [Schadensfaelle an Eisenbahnschienen und Weichen]
Statistics of failures and investigation of the rail material point out to the specific kind of failure of rails. In particular there occur fractures in the form of the running edge peeling off as well as of cross fractures. Even the rails manufactured of high-strength steels cannot cope with heavy loading, occurring in curves with a narrow radius. This led to the development of rails

with a yield point exceeding 600 N/sq mm that are being successfully used. A method for analysis of failures is suggested. [German]

Augustin, H Laizner, H Schossmann, R *Berg und Huettenmaennische Monatshefte* Vol. 119 No. 7, July 1974, pp 268-275, 9 Ref.

ACKNOWLEDGMENT: EI (EI 74 072843)
PURCHASE FROM: ESL Repr. PC, Microfilm

C4 072775
DERAILMENTS: THE PROBLEM ONLY DOLLARS CAN SOLVE
The purpose of the study described was to develop the condition of the railroad plant in the United States with respect to tie and rail replacement. The study involved the use of a computer program to determine the long-term maintenance-of-way requirements of railroads and to estimate the amount of deferred maintenance which exists on the railroads. The analysis was made for 25 railroads having a total of 236,000 miles of track.

Dick, MH *Railway Age* Vol. 175 No. 17, Sept. 1974, 3 pp

ACKNOWLEDGMENT: EI (EI 74 072838)
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

C4 072791
METALLURGICAL FACTORS CONTROLLING THE FRACTURE TOUGHNESS OF WELD MICROSTRUCTURES, WITH PARTICULAR REFERENCE TO THE MICROMECHANISM OF FRACTURE INITIATION
To link fracture toughness measurements specifically to particular micromechanisms, correlations between toughness, microstructure and composition must be related directly to the mechanism of initiation by inspection of the fracture surface in the region of the specimen notch after testing. Some factors which are beneficial to resistance to cleavage may be deleterious as regards resistance to microvoid coalescence and that, for optimum toughness over a wide range of temperature, applied strain rate and stress state, compromises in composition are required. However where, in a given application, only one micromechanism of fracture is of concern, efforts can be more simply concentrated on optimizing composition and welding procedure to produce HAZ and weld metal microstructures having the maximum resistance to fracture by this particular mechanism, subject, of course, to any other requirements, such as retaining adequate tensile properties and resistance to weld cracking problems.

Presented at Practical Implications of Fracture Mechanics, Spring Meeting, University of Newcastle Upon Tyne, England, March 27-29, 1973.

Dolby, RE (Welding Institute); Saunders, GG Widgery, DJ Institute of Metallurgy Conf Paper Ser2,No.10,604-73-Y, 1973, 10 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

C4 072792
APPLICATION OF FRACTURE MECHANICS TO RAILWAY FAILURES
The authors have attempted to demonstrate both the potential and the current limitations of fracture mechanics in the context of railroad engineering. The principal limitations are the need for detailed service stress data and the establishment of appropriate K-calibrations. The benefits of applying a fracture mechanics approach to railway failures are discussed. In failure investigations, fracture mechanics enables the failure stress to be estimated.

Cannon, DF Allen, RJ *Railway Engineering Journal* Vol. 3 No. 4, July 1974, pp 6-23, 41 Ref.

ACKNOWLEDGMENT: EI (EI 74 072829)
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

C4 072797
FATIGUE-WEAR TESTING OF RAILS UNDER ROLLING LOAD
The fatigue-wear endurance model tests conducted on surface hardened and untreated low-carbon rails, as well as the test results, are presented. Both the wear and fatigue load resistance of the surface hardened rails surmounted those of the untreated rails.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Toth, L *Acta Technica* Vol. 70 No. 3-4, 1971, pp 445-457

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: ESL Repr. PC, Microfilm

C4 072799
INCREASING THE STRENGTH OF RAILS AND THEIR RELIABILITY IN SERVICE ON THE RAILWAYS OF THE USSR
The main measures are aimed at increase of the rail strength. Partly the rail strength increase is attained by means of raising the carbon content is steel, improvement of its metallurgical quality and by addition of alloying elements. The drastic improvement of the rail strength is being attained through the heat-treatment. This article comprises also a short review of the investigation of mechanical properties of hardened rails and their performance after 4-year service. The strength is noted to be considerably increased, the contact-fatigue damage reduced greatly and the general durability raised. Authors give also the method of recovering the hardness of the metal in the zone of welded joints in CWT.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Zolotarsky, AF Rauzin, YR *Rail International* Vol. 2 No. 12, Dec. 1971, pp 908-915

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: ESL Repr. PC, Microfilm

C4 072803
BETTER RAILS [Amelioration des rails]
By using eutectoid steel with higher carbon and manganese contents than customary, only insignificantly deformed, hard, fatigue resistant rails are obtained when the following patented heat treatment is applied. Start heat treatment immediately after finish rolling. Step-quench in fluidized powder (e.g., of metallic chromium and superheated steam) above Ms, transform isothermally to lower bainite, and temper.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Pomey, J Chavane, R Cornet, R Rozenhole, S Leger, D *Revue de Metallurgie* Vol. 67 No. 1, Jan. 1970, pp 19-22

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: ESL Repr. PC, Microfilm

C4 072808
PROPERTIES OF ISOTHERMALLY QUENCHED AND ALLOY STEEL RAILS
In laboratory and production-scale trials, rails were subjected to austenitizing temperature 850 to 900 C (holding for 1-1/2 hr), cooling for 35 to 40 min in a molten bath of 50% KNO sub 3 and 50% NaNO sub 3 with a water addition of 9.68% to increase cooling efficiency. The temperature of the molten bath varied between 280 and 320 C according to the chemical composition of the steel. The rails are rinsed in hot water (50 C) after quenching. Properties were investigated on sections from carbon, silicon, chromium and Cr-Si-Mn steel rails. The isothermally quenched rails had a high tensile (130 to 160 kg/sq mm) and fatigue strength (53 to 68 kb/sq mm) and, with optimum structure, showed good resistance to brittle failure. Ductile and impact properties were satisfactory and a more favourable pattern of internal residual stresses was obtained.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Kazarnovskii, DS Pridantsev, MV Babich, AP Gurenko, VD Biryukova, VN Aref'ev, BV *Stahl* No. 5, May 1970, pp 465-468

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: Metals Society 1 Carlton House Terrace, London SW1 5DB, England Repr. PC

C4 072848
EFFECTS OF PRODUCTION METHODS ON RESIDUAL STRESSES IN COMPLETELY QUENCHED RAILS
Complete quenching sets up high residual stresses in rails. Tempering lowers them while only slightly reducing rail hardness. Straightening after quenching and tempering again raises the residual stresses, making the rails prone to fracture along the neck. This is due to plastic deformation during straightening in the vertical plane, and to lower the residual stresses the maximum bending deflection should be limited. The increase in the residual stresses is then compensated by the high strength values of steel obtained by quenching.

This abstract is also contained in "A Bibliography on the Design and Performance of Rail Track Structures", September 1974, RRIS #072794, which was prepared for the Urban Mass Transportation Administration.

Konyuhov, AD Rabinovich, DM Vinokurov, IY *Stal* No. 6, June 1969, pp 555-558

ACKNOWLEDGMENT: Battelle Columbus Laboratories
PURCHASE FROM: Mezhdunarodynaya Kniga Smolenskaja Ploscad 32/34, Moscow G-200, USSR Repr. PC

C4 072949
COMPUTERIZED PLANNING OF ANNUAL RAIL PROGRAMS
The Chessie System's computer guides the Engineering Department in preparing annual rail replacement programs. The system: (1) Determines the priority of replacement for each unbroken length of track having essentially uniform terrain and operating conditions with age and remaining life calculated; (2) Selects the most economical rail type at a given location applying the discounted cashflow method utilizing a mathematical model which incorporates effects of tax regulations, and interest rates; (3) Provides a long range monitoring of rail condition by computing the annual amount of new rail necessary for a desired level of operating condition.

Reiner, IA (Chessie System) *Railway Management Review* Vol. 74 No. 2, 1974, pp 30-47, 9 Fig., 18 Ref.

PURCHASE FROM: Railway Systems and Management Association 181 East Lake Shore Drive, Chicago, Illinois, 60611 Repr. PC
DOTL JC

C4 080107
FAILURE ANALYSIS WITH THE ELECTRON MICROSCOPE
The author of this book has studied, by transmission electron microscopy, the characteristic failure modes of metals resulting from various known mechanisms and has applied the techniques developed to determine service failures and to settle negligence claims in commercial service. Some observations made in these studies form the basis of this book. The book contains an introduction to different failure modes in metals, factors which are important in failure analysis, and specimen preparation for failure analysis by electron microscopy. The behavior of metals under various physical forces, such as static, dynamic, and cyclic loads, are reviewed. The types of corrosive attack by environment, stress corrosion, wear, hydrogen embrittlement, and high-temperature creep are discussed. The microstructural changes in metals caused by these different load, environment, and temperature effects, and the resulting modes of failure are described. The goal has been to show how these failure modes can be identified by the use of the electron microscope while holding the complicated theoretical aspects of the subject to a minimum.

Tiner, NA
Fox-Mathis Publishing Company 1973, 177 pp

ACKNOWLEDGMENT: ASME Journal of Mechanical Engineering
PURCHASE FROM: Fox-Mathis Publishing Company 72663/4 Sunset Boulevard, Los Angeles, California, 90046 Orig. PC

C4 080118
THE FRACTURE PROPERTIES OF TWO FAILED CAST STEEL WHEELS FROM THE UNION PACIFIC RAILROAD
During the late autumn of 1972 the Union Pacific Railroad had what appeared to be an unusually high number of wheel failures associated with low ambient temperatures. This behavior suggested to the Union Pacific that the temperature may have dropped below the materials transition temperature. In this connection the AAR was requested to determine the fracture properties of two cast steel wheels which failed during low temperature conditions (less than 35 F). On the basis of both the Charpy and critical stress intensity factor tests both wheels did not significantly change their fracture characteristics over the entire range of operating temperatures.

Stone, DH
Association of American Railroads Technical Center, (R027) R-123, May 1973, 10 pp, 3 Ref.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

C4 080122
COUPLER STEEL STUDY
FRA regulations stipulate that only approved couplers may be used on tank cars. Since some considerations was given a requirement for the use of Grade "E" steel in Type "F" couplers, the AAR Research and Test Department undertook a preliminary study of the properties of "C" and "E" steels in "F" couplers selected at random from stocks about to be utilized by railroads. The increase of strength between "C" steel and "E" steel does not contribute to an increase in a tendency toward brittle failure. In fact, the increase in strength is accompanied by a reduction in the transition temperature. Brittle service failures can be expected, especially in winter operating circumstances with heavy loads. The macroscopic examination reveals that the quality of the castings is lower than should be expected of material subjected to high service loading.

Contributing agencies are the Battelle Memorial Institute and the Southern Railway System.

Wisnowski, MJ
Association of American Railroads Technical Center, (70-R-61) Proj. Rpt. R-107, Dec. 1970, 49 pp, 23 Fig., 10 Tab., 20 Phot., 2 App.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

C4 080123
PROGRESS REPORT--DEVELOPMENT OF AN ASSOCIATION OF AMERICAN RAILROADS DYNAMIC BOLSTER TEST
Preliminary work was completed on the analysis of the strength of truck bolsters relative to possible service type loadings. Measurements were made of maximum tensile and compressive stresses occurring in a bolster specimen under laboratory conditions simulating predicted service imposed loadings occurring with cyclic frequency. The results of the full study are expected to lead to a laboratory fatigue test for use in an acceptance specification for bolsters. The stress measurements were made for two general types of loading conditions considered to be the principal types of cyclic fatigue loadings imposed on truck bolsters in service. For both type loadings, stress measurements were made at a number of load levels. The basic procedures used in this study are presented in this report. There were some deviations required from these procedures that are explained in the report.

Association of American Railroads Technical Center R-106, Oct. 1970, 7 pp, 11 Fig., 2 Tab., 2 Phot., 2 App.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

C4 080128
STATISTICAL SUMMARY OF JOINT AAR-RAILROAD SURVEY OF CRACKED OR BROKEN COUPLERS, KNUCKLES AND YOKES IN FREIGHT SERVICE ON FIVE RAILROADS
To determine the approximate number of cracked or broken couplers, knuckles and yokes being regularly removed from freight service and to note the general relation of design, service life, location of failure and ambient temperature, the AAR and five railroads initiated a joint program. The investigation took the form of a field survey. This is a summary report and includes all the statistical data that has been computer sorted into tabular form for both the summer and winter periods of the program.

An RPI-AAR Cooperative Project.

Morella, NA Cook, R
Association of American Railroads Technical Center, (C-65-7) R-118, Sept. 1972, 176 pp, Figs., 114 Tab., 6 App.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

C4 080129
SUMMARY OF VISUAL INSPECTION RESULTS CRACKED OR BROKEN FREIGHT CAR COUPLERS, KNUCKLES AND YOKES
This report contains the results from a visual inspection of 1097 broken freight car couplers, knuckle and yoke components collected by five railroads during a thirty day period. The sample was collected as part of a joint AAR-Railroad program, just prior to the start of this joint RPI-AAR Railroad Coupler Safety Research and Test Project, to initially determine the approximate extent and character of current failures in couplers, knuckles and yokes. The result of this inspection, when combined with current population data, do not permit the determination of failure rate for the various components because the proportion of the total industry failures represented by the sample is indeterminate and the sample is, for most components, too small to provide the desired reliability. The results from this inspection will, however, supply valuable insight required to determine the necessary procedures, data and sample size to achieve the project objective.

Morella, NA Cook, R
Association of American Railroads Technical Center, (C-65-7) R-117, Aug. 1972, 122 pp, 3 Fig., 104 Tab.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

C4 080280
REPORT ON ANALYSIS OF TANK CAR TUB ROCKETING IN ACCIDENTS
The objective of Phase 12 of the RPI-AAR Tank Car Safety Project is to explain fundamentally the phenomena of tank car fracture behavior in accidents, particularly those fractures which led to violent ruptures. The Battelle Columbus Laboratories was engaged to conduct this research, and Battelle's final report on the study has been published under Report RA-12-2-20, "Phase 12 Report on Analysis of Fracture Behavior of Tank Cars in Accidents". The analysis explained the various fracture phenomena that have occurred and which have led to various tank rupture patterns. One type involves a fracture which runs longitudinally, then turns to a circumferential tearing shear fracture. This sometimes completely encircles the tank and creates a tank section open at the fractured end and closed at the other end by the tank head. The unreleased pressure acting on the closed end creates an unbalanced force on the "tub" and causes it to rocket. Battelle analyzed this rocketing phenomena and discusses the effectives on possible design changes which would offer the potential of reducing the distance travelled by the tubs, or eliminating the rocketing completely.
An RPI-AAR Cooperative Project.

Phillips, EA
Association of American Railroads Technical Center, (RA-12-2-23) R-146, Dec. 1972, 52 pp, Figs., Tabs., Refs., 3 App.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

C4 080287
YOKE SERVICE PERFORMANCE
Presents the initial 18 months of yoke removal data (for foreign cars only) reported to the newly established AAR Mechanized Car Repair Billing Exchange System in Washington, D.C. This computerized system lists the reason the yoke was removed under eight code numbers which interpreted mean: worn out, broken, missing, bent, bent beyond repair, obsolete, account other repairs, and removed in good condition. There were a total of 19,647 yoke removals reported in the initial 18 months. The number of reporting railroads (11 total) participating in the system at the end of the first 18 months accounted for a little over half of the freight car ownership in 1972 and therefore perhaps about half of the yokes removed from foreign cars by railroads (foreign cars are cars not owned by the reporting railroad). Considering this condition combined with other factors it seems reasonable to multiply the total removals reported to the AAR Billing Exchange by about 6 to obtain the total removals by the industry for the entire current service fleet of freight cars.
An RPI-AAR Cooperative Project.

Morella, NA Cook, R
Association of American Railroads Technical Center Res. Rpt. R-150, July 1973, 24 pp, 4 Ref.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

C4 080289
FINAL PHASE 09 REPORT ON TANKS, FITTINGS, AND ATTACHMENTS IN THE MECHANICAL ENVIRONMENT OF ACCIDENTS
Phase 09 of the RPI-AAR Tank Car Safety Research and Test Project concerns the behavior of tank car tanks and their appurtenances in the mechanical environment of railroad accidents. Thus, the items treated under this Phase 09 are: Tank shell-the portion of the tank between the heads, Tank fittings-the appurtenances attached to the tank shell and heads which are associated with openings through the vessel wall, and tank attachments-appurtenances attached to the tank shell and heads which are not associated with openings through the vessel wall. As an underlying principle, in the cost/benefit analyses under this study, the benefit values of design improvements, such as protective devices or "shields," are developed from accident data only from cases involving lading loss, the total dollar losses being the value of the lost lading plus that of subsequent losses caused by the lading loss. The cost of mechanical damage itself to shells or appurtenances is not considered reducible by a design change, it being assumed that the cost of repairing the "shield" is the same as that of repairing the unshielded item. Following the statement of the objective, the report comprises four main sections: (1) review of typical current tank car shell and appurtenance designs, (2) review and analysis of accident data, (3) discussion and conclusions, and (4) recommendations.
An RPI-AAR Cooperative Program.

Reedy, CE Phillips, EA
Association of American Railroads Technical Center, (RA-09-1-24) R-147, 88 pp, Figs., 3 App.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

C4 080290
EXAMINATION OF BRIDGE EYEBARS
Four carbon steel eyebars taken from two bridges have been examined at the AAR Technical Center. Metallurgical examination and testing was performed on specimens prepared from these eyebars to study the properties and fracture behavior in both a corrosive and non-corrosive environment. Experimental results were compared to the findings of the National Transportation Safety Board's report on the collapse of the Point Pleasant, West Virginia bridge. The findings for the eyebars studies indicate that they were less susceptible to failure because: 1. Higher fracture toughness in the bars investigated. 2. Insignificant effect of a corrosive environment in accelerating the growth of a flaw leading to failure. Therefore, the results indicated that eyebar bridges constructed prior to the use of heat treated eyebars (before 1920), are less likely to develop a non-detectable eyebar crack leading to failure than those bridges where heat treated eyebars were used.

Stone, DH Shearer, MP
Association of American Railroads Technical Center, (R-022) Mat Survey R-151, Dec. 1973, 43 pp, 21 Fig., 9 Tab., 3 Ref., 1 App.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

C4 080367
RESIDUAL STRESSES IN THE PLATE FILLETS OF TWENTY-EIGHT-INCH DIAMETER WROUGHT STEEL WHEELS
Past experience with the B-28 wheel has shown that this design is susceptible to plate cracking. This reports the results of a program to determine the state of residual stress in class U untreated and class B heat-treated wheels. Measurements were made according to the procedure outlined in the AISI Steel Products Manual for Wrought Steel Wheels and Forged Railway Axles. Measurements were taken at the front hub-plate fillet and the back rim-plate fillet on each wheel. While the maximum principal residual stresses developed in the class B wheels were two to four times higher than those developed in the class U wheels, analysis by Goodman diagram shows similar fatigue properties in both wheels.

Direct requests to the Director's Office, AAR Technical Center, Chicago, Illinois.

Stone, DH
Association of American Railroads Technical Center, (R-026) R-158, May 1974, 11 pp, 7 Ref.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

C4 080369
AN INTRODUCTION TO THE FRACTURE MECHANICS OF RAILROAD MATERIALS
This report is intended to serve as a primer for railway personnel on the subject of fracture mechanics. Most structural materials contain flaws or cracks that are introduced during fabrication or service. Under various combinations of static and alternating loads and reactive environments, these flaws begin to grow slowly and stably. Unstable fracture leading to complete structural failure occurs when a flaw has developed to a critical size. The critical flaw size is a function of both the applied and/or residual stresses acting on the structure, and the toughness of the materials. The principles of linear elastic fracture mechanics can be used to describe the functional relationships for unstable (brittle, rapid) fracture that occurs even though nominal stresses are below the general yield strength (i.e., before full-plasticity has occurred in the structure). The effects of temperature, composition, strain rate and microstructure are discussed using data gathered from railway materials.

Direct requests to the Director's Office, AAR Technical Center, Chicago, Illinois.

Tetelman, AS Stone, DH
Association of American Railroads Technical Center, (R0917) R-157, May 1974, 27 pp, 11 Ref.

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

C4 080374
METALLURGICAL ANALYSIS OF FAILED RIMS ON FIVE BURLINGTON NORTHERN UNIT TRAIN TRUCK BOLSTERS
Results of fracture analysis, dimensional study, chemical analysis, Brinell hardness tests, and examination of the microstructures of five failed unit train truck bolster castings are reported. It was concluded that the failures were all triggered at the rim-bowl base fillet by various stress risers created by impacts of the horizontal liner plates against the rims. The failures propagated suddenly or in fatigue under impact of the rims with the body center plates. It was also found that the vertical liner rings had broken away from the rims of two bolsters before they were removed from service.

Direct requests to Directors Office, AAR Research Center.

Fleming, L
Association of American Railroads, (R015) R-152, Sept. 1973, 56 pp

ACKNOWLEDGMENT: AAR
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

C4 081260
METHOD OF ASSESSING THE ENDURANCE OF SLEEPERS ON A TRACK USED FOR FREIGHT TRAFFIC [Metodika ocenki vynoslivosti zelezobetonnyk spal e ucetom grazonaprjazennosti linu]
The article describes a method and results of comparative assessment of the endurance of reinforced concrete sleepers under various operating conditions. The main parameter defining the work capacity of reinforced concrete sleepers in various operating conditions is the endurance threshold of the sleeper in certain transversal cross-sections. The "typical load", a value which determines the endurance of the sleepers for a specific type of freight traffic, is essentially a function of the type of rail and number of fully-loaded heavy wagons; it is calculated on the basis of: (1) the number of loading cycles borne by the sleeper; (2) the maximum load applied during these cycles; and (3) the frequency of the repetition of these cycles, according to the traffic. This method may be applied, for instance, when assessing the endurance of reinforced concrete sleepers in the case of an increase in the axle load. [Russian]

Malysev, VG *Vestnik Vniizt* No. 3, 1974, pp 38-43, 4 Ref.

ACKNOWLEDGMENT: International Railway Documentation, Selection of (UIC Serial No. 1136)
PURCHASE FROM: International Union of Railways, BD 14 rue Jean Rey, 75015 Paris, France Repr. PC
DOTL JC

C4 081625
A GENERAL METHOD FOR THE FATIGUE RESISTANT DESIGN OF MECHANICAL COMPONENTS. PART 2: ANALYTICAL
This paper develops the general analytical solution to the design of mechanical components under fatigue loading. Its only limitation is that the overloading lines must be a straight line on the sigma a-sigma m diagram. The designer is free to select his own failure theory for the material he intends to use as well as to select his own fatigue fracture criterion.

This paper will also be published in the ASME Journal of Engineering for Industry.

Vaughan, DT Mitchell, LD
American Society of Mechanical Engineers Paper #74-WA/DE-5

ACKNOWLEDGMENT: ASME Journal of Mechanical Engineering
PURCHASE FROM: ASME Repr. PC
DOTL JC

C4 081626
A GENERAL METHOD FOR THE FATIGUE-RESISTANT DESIGN OF MECHANICAL COMPONENTS. PART 1: GRAPHICAL
Presented is a graphical method for the direct solution of fatigue design problems where the mode of overloading is to be taken into account. The material fatigue failure diagram is modified to give a new failure diagram called the safety diagram. The infinity of possible component designs is described by a line called the locus of design points. The intersection of the locus of design points with the safety failure diagram yields a direct design solution. Because of graphical difficulties, the method is limited to those cases where the locus of design points and the load lines are straight lines.

This paper will also be published in the ASME Journal of Engineering for Industry.

Mitchell, LD Vaughan, DT
American Society of Mechanical Engineers Paper #74-WA/DE-4

ACKNOWLEDGMENT: ASME Journal of Mechanical Engineering
PURCHASE FROM: ASME Repr. PC
DOTL JC

C4 083032
THE SPEED-RESPONSIVE HYDRAULIC DAMPER, THE NEXT STAGE IN DAMPER DEVELOPMENT
Riding qualities and dynamic forces on the track have been thoroughly evaluated but the understanding of dampers in relation to reduced maintenance, both vehicular and track is also pertinent. Degree of magnitude of vertical and sinusoidal irregularities are expressed as a function of acceptable acceleration, excitation frequencies and amplitude. Ride-index values important in determining riding qualities but suspension characteris-

tics in terms of reduced amplitude at higher speeds show speed-sensitive damping is desirable although the control system could be complex.

Koffman, JL *Rail Engineering International* Vol. 4 No. 9, Nov. 1974, 3 pp, Figs.

ACKNOWLEDGMENT: Rail Engineering International
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

C4 083033
TRIALS BY SNCF OF A NEW BOGIE DESIGNED FOR VERY HIGH SPEEDS
The Y226 bogie design with a body-suspended drive studied by SNCF, built by industry in 12 months, and applied to a multiple-unit power car remodelled to run as a self- sufficient vehicle incorporating a mobile laboratory. The Y226 embodies newly-developed primary suspension and secondary suspension adapted from the RTG which is giving such good results at 300 km/h as to promote their application to the TGV concept for the Paris-Lyons high- speed line, both for gas-turbine and electric traction.

Garde, R (French National Railways) *Rail Engineering International* Vol. 4 No. 9, Nov. 1974, pp 399-405

ACKNOWLEDGMENT: Rail Engineering International
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

C4 083061
FINAL REPORT ON THE EVALUATION OF CUSHIONED UNDERFRAMES
This report covers a study and evaluation of special cushioning devices under impact conditions. The types of devices tested included sliding center sill, end of car hydraulic draft gears and column connected draft gears. Each device was evaluated with both canned goods and steel lading which respectively represented a resilient type of lading and a heavy rigid type of lading. This study indicates that the commodity protection needs under impact are not entirely a function of the special cushioning device but are also related to loading methods and types of packaging. In these tests the indications of cushioning protection provided by different shock absorption systems as summarized from the conclusions made in this report are: 1. Sliding sill type cars with 18 to 30 in. travel gave the highest degree of protection of lading through reduction of body force and resultant acceleration, followed in descending order by end of car hydraulic draft gears, column connected draft gears and standard draft gears. 2. The non-continuous or "split" design of sliding center sill provided the maximum protection to the car structure under dynamic squeeze, followed in descending order by end of car hydraulic draft gears, conventional continuous or through designs of sliding center sills and column connected draft gears. 3. Length of travel of sliding center sill is not an absolute indication of overall performance, particularly under dynamic squeeze conditions. 4. Small differences in sliding sill travel do not significantly change the performance characteristics. 5. Floating loads shift excessively, even with sliding center sill cars. 6. Energy absorption means are needed at the couplers in sliding center sill cars. 7. Sliding sills require high column strength to prevent bending.

Association of American Railroads Technical Center MR-443, Aug. 1965, 89 pp, 38 Fig., 35 Tab.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

C4 083067
HIGH SPEED TRACK AND ITS MAINTENANCE
The author discusses the conditions necessary for technically and economically acceptable track construction on high-speed routes with mixed-traffic working, taking into consideration the track alignment and the construction elements. Already at the planning and design stage, the track-building conditions and economical maintenance of heavily-worked routes must be given full consideration, and also adhered to later during regular operation. Proper staff training is also important. But further tests, for example with concrete-slab track structure under heavy working loads, are necessary before final decisions are made.

This publication is available in German, English, French and Spanish editions.

Fastenrath, F *Eisenbahntechnische Rundschau* Vol. 23 No. 12, Dec. 1974, pp 491-498

PURCHASE FROM: Hestra[Verlag Holzhofallee 33, 61 Darmstadt, West Germany Repr. PC
DOTL JC

C4 094316
FRACTURE MECHANICS AND RESIDUAL FATIGUE LIFE ANALYSIS FOR COMPLEX STRESS FIELDS
This report reviews the development and application of an influence function method for calculating stress intensity factors and residual fatigue life for two-and three-dimensional structures with complex stress fields and geometries. Through elastic superposition, the method properly accounts for redistribution of stress as the crack grows through the structure. The analytical methods used and the computer programs necessary for computation and application of load independent influence functions are presented. A new exact solution is obtained for the buried elliptical crack, under an arbitrary Mode I stress field, for stress intensity factors at four positions around the crack front. The IF method is then applied to two fracture mechanics problems with complex stress fields and geometries. These problems are of current interest to the electric power generating industry and include (1) the fatigue analysis of a crack in a pipe weld under nominal and residual stresses and (2) fatigue analysis of a reactor pressure vessel nozzle corner crack under a complex bivariate stress field.

Besuner, PM
Failure Analysis Associates, Electric Power Research Institute, (EPRI-217-1) Tech. Rpt. FAA-75-4-10, EPRI-217-1-TR-2, July 1975, 88 pp

ACKNOWLEDGMENT: NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche
PB-246254/7ST, DOTL NTIS

C4 095213
THE EFFECTS OF VARIATIONS IN HEAT TREATMENT ON THE STRENGTH AND TOUGHNESS OF RAIL STREEL
Because of the growing number of incidents due to rail failures, research is being made into possible improvements. The AAR and Carnegie-Mellon University have jointly sponsored a research programme into the possiblity of improving rail strength (which determines what axle load can be supported without any permanent rail deformation), and toughness (defined as the measure of the steel's resistance to brittle fracture or the slowness with which a defect spreads) by simply altering the heat treatment conditions (rolling or austenization temperature, isothermal transformation temperature or cooling rate). The general tendencies of the phenomenon have been determined. Strength and hardness are unaffected by austenization temperatures between 1470 degrees F and 1830 degrees F but toughness decreases. Resistance increases as isothermal transformation temperature rises (between 1010 degrees F and 1155 degrees F and toughness would reach its maximum at about the lowest temperatures tested). This unfinished study should make it possible to decide whether the improvements that can thus be obtained are adequate for justifying a transformation of the heat treatment process or whether this line of research is pointless.

Hyzak, JM *AREA Bulletin* No. 648, June 1974, pp 776-778, 2 Fig.

ACKNOWLEDGMENT: International Railway Documentation, Selection of
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

C4 095220
A COMPARISON OF CHARPY V-NOTCH, DYNAMIC TEAR, AND PRECRACKED CHARPY IMPACT TRANSITION-TEMPERATURE CURVES FOR AAR GRADES OF CAST STEEL
Impact tests using Charpy V-notch, Dynamic Tear and Precracked Charpy samples were conducted on AAR-B, AAR-C (several compositions and heat treatments), and AAR-E cast grades of steel and on a high-strength, alloy cast steel. Graphical presentations of the transition-temperature data are given. Differences in the relative shapes of the curves and the locations of the NDT temperatures with respect to the transition temperatures are discussed. Fracture toughness, K sub Id, values are also presented.

Contributed by the Rail Transportation Division of the ASME to be presented at the Joint Railroad Conference held jointly with IEEE, San

Francisco, Calif., April 15-17, 1975.
Sharkey, RL (American Steel Foundries); Stone, DH (Association of American Railroads Technical Center)
American Society of Mechanical Engineers 75-RT-1, Apr. 1975, 7 pp, 11 Fig., 14 Ref.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL RP

C4 095221
LIFE CYCLE COSTING: A KEY TO FREIGHT CAR COMPONENT EVALUATION
The cost of repairing and replacing freight car components represents a very sizeable expenditure for the railroad industry. Of major concern to the railroad industry are the "costs" associated with various components. These costs include not only the direct costs of procuring and servicing such components but also related costs such as occur in derailments, train delays, and train handling mishaps. Phase II of the International Government-Industry Research Program on Track Train Dynamics is concerned with improving freight train performance and operating safety through the development of performance specifications and design guidelines for car components. If this activity is to be effective, it is essential that present and potential costs of component ownership be thoroughly evaluated. The authors have pursued this end through the development of a life Cycle Cost Model. Once necessary data sources are developed, this model will be used to evaluate research and implementation strategies for the program.

Contributed by the Rail Transportation Division of the American Society of Mechanical Engineers for presentation at the IEEE-ASME Joint Railroad Conference, San Francisco, California, April 15-17, 1975.

Byers, RH (Battelle Columbus Laboratories); Hawthorne, KL (Association of American Railroads Technical Center)
American Society of Mechanical Engineers 75-RT-9, Apr. 1975, 9 pp, 3 Fig., 1 App.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL RP

C4 095245
CAUSE FOR THE FORMATION OF GROOVES ON THE WHEELS OF BLOCK-BRAKED RAILROAD ROLLING STOCK AND THEIR PREVENTION [Ursache der Rillenbildung und Deren Vermeidung bei Raedern Klotzgebremster Schienefahrzuege]
Grooves on the friction surface of block-braked car and locomotive wheels are not formed as a result of hard structural consitituents in the cast-iron brake blocks, but rather as a result of partial melting and displacement of the wheel steel softened by heating in excess of the solids temperature during the friction process. The displaced steel collects for the most part on the braking surface of the block in the form of foil laminations. The cause for this phenomenon lies in an excessively high softening temperature of the brake block material. To prevent the occurrence of this defect, it is suggested to use cast iron containing low-melting structural constituents in adequate quantity and distribution. [German]

Pahl, E (Bundesbahn-Versuchsanst, Germany) *Maschinenschaden* Vol. 47 No. 3, 1974, pp 107-114, 30 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

C4 095414
ANALYSIS OF TRACK PARAMETER HETEROGENEITY AS A COMPLEMENT TO GEOMETRICAL METHODS OF TRACK CONDITION RATING
The condition of a track may be defined by track rating indices (W indices at the PKP) taken from recordings by a track inspection car, or obtained by geometrical measurements (longitudinal dip and cross-sectional irregularities, without load or with a moving load, lateral displacement, etc.). By track heterogeneity, the writer means the differences that such indices reveal on lengths of line with identical make-up, similar age, and used by the same traffic. These heterogeneities, which may be caused by the laying or maintenance of the track, or by constructional features with different characteristics, are also likely to result in great differences in the rapidity with which these lengths of line deteriorate, necessitating earlier continuous track renewal. The article proposes methods of assessing these heterogeneities by tests based on classic statistics laws. Numerical examples thus deal with: heterogeneities in the W index, by the X to the 2nd power test; heterogeneities in the track gauge by a method called the "ZM test" taken from an American book referred to in the bibliography; correlations between rail dip and lateral displacement under a moving load, by an analysis of sequential correlation. These complex analyses are not used as a basis of routine maintenance decisions, but in investigations for the purpose of explaining abnormal phenomena.

Baluch, H *Rail International* Vol. 5 No. 7-8, Aug. 1974, pp 537-546, 6 Fig., 4 Tab., 6 Ref.

ACKNOWLEDGMENT: International Railway Documentation, Selection of
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

C4 095633
CHARACTERISTICS OF THE ORIGIN AND DEVELOPMENT OF INTERNAL FATIGUE CRACKS AS EXEMPLIFIED BY RAIL FRACTURE [Osobennosti Zarozhdeniya i Razvitiya Vautrennikh Treshchin Ustalosti na Primere Razrusheniya Rel'sov]
Experimental data are presented that have been obtained during an investigation into the failure of railroad rails. Specific features of this kind of fracture are studied. They are connected with cold hardening of the rail surface layer and generation of cracks within the material. [Russian]

Ravitskaya, TM *Problemy Prochnosti* Vol. 6 No. 11, Nov. 1974, pp 77-82, 23 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

C4 095673
M/W COSTS: HOW THEY ARE AFFECTED BY CAR WEIGHTS AND THE TRACK STRUCTURE
Using a combination of theory and actual field measurements, the author develops the relative maintenance costs associated with axle loads and the type and condition of the track. The article attaches definite values to variables such as total tonnage carried, track condition and car size. The Illinois Central Gulf considers that 53% of total track expense and capital investment is incremental--varying with the tonnage moving over the railroad. This incremental cost is then broken into its own increments based on rail deflection, rail bending stress, rail life and miscellaneous costs.

Ahlf, RE (Illinois Central Gulf Railroad) *Railway Track and Structures* Vol. 71 No. 3, Mar. 1975, 7 pp, 6 Fig.

PURCHASE FROM: XUM Repr. PC

DOTL JC

C4 095674
SANTA FE LOOKS FAR AHEAD IN M/W PROGRAMMING
Maintenance of way requirements on this road are projected as far as 20 years into the future. To bring out the thinking behind this practice, including the expected benefits, the Santa Fe's chief executive officer, vice president operations and chief engineer participated in a roundtable which is reported in this article. The long-term planning is aimed at overcoming peaks and valleys in earnings by avoiding peaks and valleys in maintenance operations.

Railway Track and Structures Vol. 71 No. 3, Mar. 1975, pp 20-24

PURCHASE FROM: XUM Repr. PC

DOTL JC

C4 095682
FLAME HARDENING OF RAIL BY THE HAMMON CONTINUOUS PROCESS AND PHYSICAL AND ROLLING LOAD TEST RESULTS
Since the standard carbon rail is removed from track due to abrasion, head flow on the low rail of the curves and shelling on the high rail, it is of interest to the industry to investigate any process that alleviates this problem. Failures due to shelling alone amount to 40 percent of all types of failures. Alloy rail steel chemistries and heat treatment have been found helpful in extending rail life where the above conditions existed. In the area of heat

treatment, various types of flame hardening of the rail head have been found applicable economically and available in all parts of the United States. Summarizing, features of this process that may be of interest to railroads are: 1. Evaluation of rail flame hardened by this process at the Research Center and the University of Illinois indicates that it should give good service performance. 2. It is claimed that it will be economical because of its ability to use propane or natural gas for heating the rail. 3. Rail of any length can be continuously flame hardened, before or after welding. 4. The equipment can be mounted on railroad cars to be used either at the welding or cropping site.

Association of American Railroads Technical Center No. ER-44, Apr. 1964, 3 pp, 10 Fig., 4 Tab.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

C4 095683
FATIGUE RESISTANCE OF QUARTER-SCALE BRIDGE STRINGERS IN FLEXURE AND SHEAR

Scaled specimens of Douglas-fir and southern pine were evaluated under several combinations of variables to obtain information on the behavior in flexure and shear under repeated loading. Fatigue strengths are summarized.

Lewis, WC
Association of American Railroads Technical Center No. ER-39, Dec. 1963, 28 pp, 33 Fig., 2 Ref.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

C4 095684
LABORATORY INVESTIGATION OF PRESTRESSED CONCRETE RAILWAY BRIDGE BEAMS

This report contains a description and analysis of laboratory tests made during 1960, 1961, and 1962 on 23 full-size prestressed concrete beams. These beams are 18 in. deep, 15 in. wide, and 19 ft. long and were patterned after the full-size slabs reported in AREA Proc. Vol. 59, p. 133. This investigation was directed toward a study of the effect of size of strand and level of prestress on their static and fatigue strength, and is an extension of one conducted at Lehigh University on similar beams, and reported in AREA Proc. Vol. 60, p. 1. From this tests, it can be concluded that: 1. In the static tests, the cracking loads and the deflection were affected by the level of prestress but not by the size of strand. Taking into consideration the difference in concrete strength the ultimate strength apparently is not affected by level of prestress or by size of strand. 2. Fatigue strength was influenced by the level of prestress. 3. The test results were inconclusive with regard to the relationship between fatigue strength and size of strand. 4. The mode of failure in the static tests was by crushing of the concrete accompanied by large strains of steel strands, while breakage of the steel strands caused failure in the fatigue tests. 5. The ultimate load varied from 2.5 to 3.0 times design load for static tests and from 1.3 to 1.8 times design load for fatigue tests. 6. Fatigue life decreased as the cycling load increased. 7. Strains and deflections changed only slightly for those beams which did not fail for 2,000,000 cycles of repetitive loading. 8. There was no evidence of strand slip. 9. Recorded ultimate static moments compared favorably with values computed by using the formula given in the current AREA Specifications. 10. The fatigue strength of beams could be predicted by using an idealized stress-moment diagram combined with a failure envelope for the steel strands.

Association of American Railroads Technical Center No. ER-36, Dec. 1963, 17 pp, 22 Fig.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Research Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

C4 095708
LABORATORY INVESTIGATION TO DETERMINE STATIC AND REPEATED LOAD STRENGTH OF FULL-SIZE SOUTHERN PINE GLUED LAMINATED STRINGERS

This report contains the analysis of data recorded during the laboratory investigation of 24 full size southern pine glued laminated stringers at the Association of American Railroads Research Center and a description of certain physical properties as determined by the Forest Products Laboratory at Madison, Wisconsin. The purpose of the investigation was to determine the static and repeated load strength of the stringers and the effect of load placement. The stringers were loaded in increments of the shear design load with the load points that were 4 ft-8 in. apart and with the first load point at 1-1/2d, 2-1/4d and 3d from center line of bearing. Design load was that load which produced an allowable design shear stress of 180 psi. The following observations may be made from the recorded data: 1. The three stringers tested statically at load points 1-1/2d, 2-1/4d, and 3d failed at 5.34, 4.71, 3.72 shear design increments. Failure was in bearing for 1-1/2d and 2-1/4d loading; and tension for 3d loading. The deflection and flexural strains were linear up to failure. Pending failure was not noticeable and it occurred quite rapidly 2. Four stringers which did not fail after 2,000,000 cycles of repeated loading were later tested statically. One stringer was tested at 1-1/2d, one at 2-1/4d, and two at 3d loading. The shear design increments were 5.04, 4.41, and 3.83 respectively. The stringer at 1-1/2d and the two at 3d did not fail since the capacity of the loading jack was reached first. At 2-1/4d the stringer failed in horizontal shear. 3. Five stringers were tested under repeated loads positioned at 1-1/2d. Of the two stringers loaded at 2.13 times shear design load, one did not fail and one failed at 882,000 cycles because of a knot within the lamination. One stringer was subjected to a shear stress design load ratio of 2.33 and it did not fail. Another stringer was subjected to a shear design load of 2.72 and failed in bearing at 1,365,000 cycles. The final stringer was subjected to 3.11 shear design load and it failed in horizontal shear at 666,200 cycles. 4. Seven stringers were tested under repeated loads positioned at 2-1/4d. One stringer was tested at a shear design load 2.18 or 25,500 lbs per load point and it did not fail. Another stringer subjected to the same shear load ratio failed in horizontal shear after only 417,000 cycles of repeated loading. Failure was attributed to a knot.

Association of American Railroads Technical Center ER-52, Dec. 1964, 16 pp, 23 Fig., 4 Tab., 12 Phot.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

C4 095874
RAIL STUDY BESSEMER AND LAKE ERIE RAILROAD

Because of the ever increasing concern with shelling of rail and its possible connection with wheel loads and the present day trend to still heavier wheel loads, a study was conducted on the Bessemer and Lake Erie Railroad to analyze their rail conditions in conjunction with their use of 90-ton cars for transporting of ore. This railroad has been using these 90-ton capacity hopper cars since 1931, with practice being to load ore for southbound movement to capacity, thus creating loads averaging 32,300 lbs. per wheel. It has been noted over the years that even with these wheel loads and rather high annual tonnages, the Bessemer has had little or not shelling of their rail. This study was prompted to see if an answer could be derived as to why no shelling problem exists here. In particular, two locations on the railroad were checked where the present rail in track is 131 lb., laid in 1938, and has had over 400,000,000 gross tons of traffic, most of which consisted of are carried in these 90-ton hopper cars. The northmost location is at Springboro, Pennsylvania, where there is a length of one mile of the 131 lb. rail in track (north and south of Mile Post 116). The other location is through and to the south of Grove City, Pennsylvania, Mile Post 60-63, where there is a 3-mile section of 131 lb. rail in track. Both of these sections of 131 lb. rail now carry both northbound and southbound tonnage, but prior to single tracking and installation of C.T.C. in 1957, this trackage was the southbound main track in both instances and carried the predominant southbound ore traffic. At both locations of 131 lb. rail, rail profiles were taken, degree and superelevation of curves were noted, predominant speeds of tonnage trains in both directions were noted, condition of the entire track structure and, in particular, condition of the rail both on tangent and curves were noted. Photographs were taken to show the rail condition. Because of curvature in the locations not exceeding 3 degrees, other locations on the railroad were

chosen to make like studies, these locations having the same or less annual tonnages, and having different weights of rail of shorter service life, but having greater degree of curvature. Rail profiles and photographs were taken at these locations also. Along with the study of the rail and track conditions, a study of the 90-ton B & LE hopper cars was conducted, obtaining all pertinent data, prints, and photographs having to do with their construction and maintenance. The Bessemer's rail replacement policy is guided by the formula--T = .703xWxD.565 where T = Life of rail in million gross tons. W = Weight of rail in lbs. per yard. D = Traffic density in million gross tons per year.

Conducted under sponsorship of AAR Joint Committee on Relation Between Track and Equipment.

Association of American Railroads Technical Center ER-55, Mar. 1965, 3 pp, 4 Fig., 3 Phot.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

C4 095877
SERVICE INVESTIGATION OF VARIOUS TYPES OF JOINT BARS ON SANTA FE AND NORTHWESTERN RAILWAYS

This report covers the service investigation of various types of joint bars and variations of bolt spacing on the Atchison, Topeka and Santa Fe Railway near Streator, Illinois and on the Chicago and Northwestern Railway at Sterling, Illinois. 1. All design of joint bars have been adequate throughout the service period of 16 years. 2. Four bolts in 36 in joints with 9-9 1/8-9 in spacing are adequate to hold the rail, but do not provide sufficient rail end support, hence, create additional batter and droop of the rail ends compared with 6-bolt bars. 3. There appears to be little difference in the performance of the current AREA bolt hole spacing of 6-6-7 1/8-6-6 in compared with the 6 1/2-6 1/2-5 1/8-6 1/2-6 1/2 in spacing where such a comparison can be made in the Santa Fe test. Inasmuch as the current AREA spacing has been shown to produce less stress concentration at the bolt holes and this service test has shown no disadvantage in other respects, it has confirmed the desirability of continuing the current AREA bolt hole spacing.

Conducted under sponsorship of AREA Committee 4-Rail.

Lamport, LR
Association of American Railroads Technical Center 6 pp, 12 Fig., Phots., 10 Ref.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

C4 095879
METALLURIGICAL, PHYSICAL AND ROLLING LOAD TEST RESULTS OF RAIL ROLLED FROM CONTINUOUSLY CAST BLOOMS

The development of information relative to any new process applicable to producing rail more economically is of interest to the industry. The opportunity of investigating the application of continuous casting in rolling rail presented itself when the M.W. Kellog Company became interested in investigating this process on behalf of a Mexican client. The AAR Research Center cooperated in developing the metallurgical, physical and rolling load test results of rail rolled to the S49 section from continuously cast blooms. The results on the same type of of tests as described above tested in the 12 in stroke rolling load machine are shown on Table 4. The S49 rails and the oxyacetylene pressure butt welded rail joints did not fail. The flash butt welded rail joints failed prematurely due to grinding cracks away from the weld caused by heavy cold grinding as shown in Figs. 8 and 9. The drop test results of the rail as shown on Table 5 indicate that the rail met the AREA specification. Fig. 10 illustrates the effect of the drop test. As mentioned before, very few butt welded rail joints have withstood the standard drop test for rail. The structure of these fractures were noted to be fiberous. The results of the investigation of the S49 rail rolled from continuously cast blooms at the AAR Research Center and comparable results of the investigation by Dr. Janiche indicate that rail produced by this process is of equal quality to rail produced by the standard process. The results are surprising in this first attempt of producing rail in this manner. As the art of of continuous casting in reference to rail is advanced, all of the defects such as segregations will undoubtedly be eliminated. The economy of the process is predicated on the elimination of mold and teeming practices as well as soaking pits and primary mill installations. It is of interest to call attention to the last paragraph of the attached report which states that the UIC specification for rolling rail calling for a bloom cross section of at least 20 times larger than the rail cross section was not met in this case. In the above rolling, the ratio amounted to 15 to 1 in the case of the 30 d rail and 9 to 1 in the case of the S49 rail.

Association of American Railroads Technical Center ER-45, Aug. 1964, 6 pp, 13 Fig., 6 Tab.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC
DOTL RP

C4 096596
PROBLEMS ASSOCIATED WITH ROLLER TEST BENCH INVESTIGATIONS WITH VIEWS TO THE DETERMINATION OF THE RESPONSE OF FRICTIONAL CONNECTION BETWEEN WHEEL AND RAIL [Zur Problematik von Waelzpruefstandsversuchen im Hinblick auf die Errnittlung des Kraftschlussverhaltens Zwischen rad und Schiene]

The theorem associated with frictional connection and its most important parameters are discussed, with emphasis on the effects of location and time. The study is of importance in conjunction with plans for increasing the speed of railroad trains. [German]

Kretterk, O (Tech Hochsch, Germany) *Elektrische Bahnen* Vol. 45 No. 11, Nov. 1974, pp 258-264, 9 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm
DOTL JC

C4 097317
FREIGHT CAR DYNAMICS--ONE CARBUILDER'S APPROACH

Amcar Division of ACF Industries, like the other carbuilders, is taking on additional responsibilities for all aspects of car dynamics design and test, particularly with respect to carbody structure. Explained is the ACF computerized system for analysis of carbody structural dynamics, intended to combat fatigue problems. Mathematical modeling is used to develop load paths and stress profiles of complex structures. Road testing is important in developing environmental data and ACF has acquired an instrument car for this purpose. Modified Goodman Diagrams are developed and their use is discussed.

This is a paper from the proceedings of the 11th Annual Railroad Engineering Conference held at Southern Colorado State College, Pueblo, Colorado, October 23-24, 1974. Other individual papers from this conference have been accessioned separately for RRIS. The following is a list of the RRIS numbers of these papers preceded by its section number as it is contained in the bulletin: 03 097308, 03 097309, 13 097310, 04 097311, 03 097312, 03 097313, 04 097314, 03 097315, 03 097316, 03 097318, 03 097319. The entire proceedings 03 097307 has also been accessioned. All of these are contained in Bulletin 7502.

Billingsley, RH, Jr (ACF Industries, Incorporated)
Federal Railroad Administration 1974, pp 11-15, 10 Fig.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC
PB-241730/1ST, DOTL NTIS

C4 098058
SOME OBSERVATION ON FATIGUE PHENOMENA IN A LARGE PLATE SPECIMEN OF SPRING STEEL AFTER SHOT-PEENING TREATMENT

To obtain the fundamental data for the nondestructive finding of fatigue damage in vehicle parts, the fatigue due to pulsating repeated bending in a large plate of spring steel which had been shot-peened to increase its fatigue strength as a vehicle part, was investigated. It was clarified that there were two ways to find the fatigue damage: to observe the changing state of the surface residual stress and to detect the internal cracks non-destructively.

Murayama, S Kohara, M Iwamoto, M *Railway Technical Research Institute* Vol. 16 No. 1, Mar. 1975, pp 35-39, 6 Fig., 4 Tab.

ACKNOWLEDGMENT: Railway Technical Research Institute
PURCHASE FROM: Ken-yusha 1-45-6, Hikari-cho, Kokubunji, Tokyo, Japan Repr. PC

DOTL JC

C4 098079
THE FRACTURE TOUGHNESS OF CARBON-STEEL, ALLOY-STEEL AND HEAT-TREATED RAILWAY RAILS
The static and dynamic fracture toughness of standard carbon steel rail was determined using precracked Charpy bars. The static, fracture toughness was found to be higher than the dynamic fracture toughness across the entire range of railway operating conditions. Since rails are subjected to dynamic loading conditions, dynamic fracture toughness tests were conducted on specimens from alloy-steel and heat-treated rails in order to compare fracture properties. In addition, the standard British rail steel and two heat-treated grades of British rail steel were evaluated. It was found that carbon levels above 0.55 w/o did not affect fracture toughness while increasing silicon decreased fracture toughness in both high and low carbon rails. In line with earlier work, it was found that decreasing pearlite spacing increased fracture toughness. In addition, the effects of manganese, chromium and molybdenum are discussed.

Stone, DH
Association of American Railroads Technical Center, (R-014) R-163, Sept. 1974, 23 pp, 7 Fig., 1 Ref.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC

DOTL RP

C4 098080
THE EFFECTS OF MICROSTRUCTURAL VARIATIONS ON THE STRENGTH AND TOUGHNESS OF RAIL STEELS
An experimental program was carried out on fully-pearlitic rail steel to determine the effects of microstructural variations on tensile and impact properties. A heat treating schedule was developed to isolate the effects of prior austenitic grain size, pearlite interlamellar spacing, and to a minor extent, pearlite colony size. Grain size was varied by a factor of ten, and pearlite spacing by a factor of two. Room temperature yield strength increased monotonically with decreasing interlameller spacing, with the latter controlled by the transformation temerature and prior austenitic grain size. Charpy impact tests were performed to obtain an evaluation of toughness, and showed that toughness increased with decreasing grain size, and was largely independent of an influence of pearlite spacing. Dynamic fracture toughness values, (KID), obtained from instrumented impact testing of precracked Charpy bars, were compared with the standard Charpy results, and yielded Similar findings. Thus, it was found that strength and toughness are controlled by different microstructural parameters, and can be varied independent of each other to optimize service performance.

Hyzak, JM Bernstein, IM (Carnegie-Mellon University); Stone, DH
Association of American Railroads Technical Center, (R-021) R-168, Apr. 1974, 33 pp, Figs., 16 Ref.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC

DOTL RP

C4 098081
SUMMARY OF PERFORMANCE OF STANDARD-CARBON AND VARIOUS WEAR-RESISTANT RAILS IN TEST CURVES ON THE CHESSIE SYSTEM-SECOND REPORT
This report contains the summary of the second annual inspection of a service test installation of fully heat-treated, induction head-hardened, intermediate- manganese and standard control-cooled rail on the Chessie System. The field inspection is part of the cooperative effort on rail research of the American Railway Engineering Association, the American Iron and Steel Institute and the Association of American Railroads to observe and analyze those rails in curved track that display some potential for improvement in wear-resistance and retarding the onset of shelling. Measurements were made and recorded of curvature, superelevation and gage of four service test curves located near Oakland, Maryland, General track conditions were observed also. Rail head cross-section contours were taken and recorded of the 80 test rails contained in these curves. Rail wear has been calculated for the second year of service for the various types of rail in test.

Schoeneberg, KW
Association of American Railroads Technical Center, (R-057) R-171, Apr. 1975, 70 pp, 25 Fig., 1 Tab.

ACKNOWLEDGMENT: Association of American Railroads Technical Center
PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616 Repr. PC

DOTL RP

C4 098702
RAIL STRESS CALCULATIONS-UNIT LOAD OF 1 KIP
For given rail sections, the program produces a table of rail stresses by inches from the load point up to 300 inches, for a unit load of 1 Kip. The stress values are shown for various values of the modulus of foundation, ranging from 400 to 3,000 lb/in.

Holt, RW
Canadian Pacific 1974

ACKNOWLEDGMENT: AREA (AREA 02-01-002)
PURCHASE FROM: Canadian Pacific Windsor Station, Montreal, Quebec H3C 3E4, Canada

C4 098703
RAIL STRESS CALCULATIONS FOR MULTIPLE LOADS
For a given set of rail sections, the program calculates stress values for given load configurations. For each loading, the rail stress is calculated under each axle and at the mid-point between axles. Also, for each rail section, the program calculates maximum equipment operating speeds within a stress safety limit of 35 Kips (30 Kips for C.W.R.) using maximum tension value found on the rail base.

Holt, RW
Canadian Pacific 1972

ACKNOWLEDGMENT: AREA (AREA 02-01-003)
PURCHASE FROM: Canadian Pacific Windsor Station, Montreal, Quebec H3C 3E4, Canada

C4 099175
ADVANCED DESIGN TECHNOLOGY FOR RAIL TRANSPORTATION VEHICLES
This is an interim report on a cooperative research project between Washington University and AMCAR Division of ACF Industries Inc. The purpose of the project is development of a new finite element stress analysis capability which is more cost effective and better suited for fatigue life evaluation than existing finite element computer programs. The report contains a general outline of the method, description of the algorithm structure and methods by which the computational efficiency can be further increased. A benchmark problem established by experimentation and by computation using an existing finite element computer program (STARDYNE) is presented.

The Association of American Railroads and AMCAR Division of ACF Industries, Inc. provided for partial funding of this project.

Szabo, BA Katz, IN Rossow, MP Rodin, EY Peano, A Lee, JC
Washington University, St Louis, (64262) Intrm Rpt. DOT-OS-30108-2, June 1974, 153 pp, Figs.

Contract DOT-OS-30108

ACKNOWLEDGMENT: DOT
PURCHASE FROM: NTIS Repr. PC, Microfiche

DOTL NTIS

C4 099842
ANALYSIS OF RAILROAD CAR TRUCK AND WHEEL FATIGUE. PART I-SERVICE LOAD DATA AND PROCEDURES FOR THE DEVELOPMENT OF FATIGUE PERFORMANCE CRITERIA
The development of fatigue performance standards for freight car truck components and wheels requires a knowledge of the fluctuation service load

environment, and a basis for stating the conservatism of the design with respect to the environment. On this program special emphasis was given to determining the load environment by analyzing data from 53 test runs conducted on the Erie Branch test track of the Bessemer and Lake Erie Railroad. A number of test parameters were varied, such as speed, type of truck, modifications to the suspension system, etc., to determine those parameters having the greatest influence on the severity of the load. Vertical loads were measured at the side-frame-pedestal/roller-bearing-adapter interface and lateral loads were determined at the wheel/rail interface. The cyclic load data are summarized in a series of load spectra. Factors which must be considered in the development of fatigue performance standards from these spectra include reliability goals, the statistical spread of both load and fatigue strength data, and the philosophy followed in the design of the truck itself.

Sponsored by Federal Railroad Administration and under contract from Transportation Systems Center.

Johnson, MR
IIT Research Institute, Federal Railroad Administration, Transportation Systems Center, (DOT-TSC-FRA-75-11) Intrm Rpt. FRA-OR&D-75-68, May 1975, 146 pp, Figs., Tabs., Phots., 20 Ref., 4 App.

Contract DOT-TSC-727

ACKNOWLEDGMENT: FRA, NTIS
PURCHASE FROM: NTIS Repr. PC

PB-244090/AS, DOTL NTIS

C4 125869
PREVENTION AND CURE OF RAIL CORRUGATION
The author has discovered that corrugation is a function of track modulus and wheel loading. There is a critical range of shear and compressive stress within which rail corrugation takes places but below or above this range the phenomenon is absent, possibly because wear particles are either not generated or they are removed altogether. Not only will correct matching of track modulus, to axleloads carried avoid generation, but elimination of a mismatch will also cause existing corrugation to disappear without the need for grinding.

Srinivasan, M *Railway Gazette International* Vol. 131 No. 3, Mar. 1975, pp 97-101

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

C4 126402
DAMPING PROPERTIES OF RUBBER-STEEL SHOCK ABSORBERS [Wlasnosci tlumiace amortyzatorow gumowo-stalowych]
The results of the author's own studies of the effect of repeated loading and artifical aging of rubber-steel shock absorbers on their mechanical characteristics are presented. An evaluation is made of the suitability of rubber-steel shock absorbers for use in railway couplers in comparison with the hitherto used spring-type shock absorbers which consist of elastic-frictional rings. [Polish]

Mikula, S *Przeglad Mechaniczny* Vol. 34 No. 1, Jan. 1975, 3 pp

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

C4 126409
MATHEMATICAL STRESS ANALYSIS AND TESTS OF COMPONENTS IN THE DEVELOPMENT OF WHEEL SETS [Rechnerische Spannung-sanalyse und Bauteilpruefung in der Radsatzentwicklung]
The dynamic forces between wheel and rail increases with increasing traveling speeds. This fact requires minimization of the unsprung weight of the wheel sets. For the solution of this problem, the stresses caused by the dynamic forces and the stress-sustaining capacity of the material must be known. Stresses in highly strained areas of wheel sets are calculated and compared with experimentally determined fatigue strengths of the steels used. [German]

Raquet, E (Krupp Huettenwerke); Knorr, W *Technische Mitteilungen Krupp, Werksberichte* Vol. 33 No. 2, May 1975, pp 69-72

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

C4 126974
LABORATORY WEARING TESTS OF WHEEL MATERIALS
Laboratory tests were made of the stress imposed on materials in the boundary layer, of the hardness of materials and of the wearing process with a view to analysing the causes of frictional wearing between wheel and rail. For the choice of optimum wheel materials recommendations are given with respect to their temperature sensitivity (lower carbon content). [German]

Pigors, O *DET Eisenbahntechnik* Vol. 23 No. 8, Aug. 1975, pp 359-361

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: VEB Verlag Technik Oranienburgerstrasse 13-14, 102 Berlin, East Germany Repr. PC

C4 126978
FRACTURE RESISTANCE OF RAILROAD WHEELS
The effects of manufacturing method, chemical composition, heat treatment, temperature, and loading rate on the plane strain fracture toughness KIC of railroad wheels have been determined. Carbon content of the wheels is shown to be the principal factor which controls their toughness. One hundred wheels which fractured in service are analyzed by means of fracture mechanics procedures. The locations, configurations, and size of thermal and plate cracks which initiated brittle fracture are reviewed, and estimates made of the stress levels which resulted in failure. Estimates have been made of the minimum size of crack which could result in the failure of wheels under adverse service conditions. These are discussed with respect to the minimum size of defect which can be reliably detected by NDT. Included in the report are state-of-the-art reviews on thermal and plate cracking and on the stresses developed in railroad wheels.

Sponsored by FRA.

Carter, CS Caton, RG
Boeing Company, (DOT-TSC-FRA-74-10) Intrm Rpt. FRA-ORD&D-75-12, Sept. 1974, 216 pp, Figs., Tabs., Phots., 45 Ref., 3 App.

Contract DOT-TSC-617

ACKNOWLEDGMENT: FRA, NTIS
PURCHASE FROM: NTIS Repr. PC, Microfiche

PB243638/AS, DOTL NTIS

C4 126988
AUTOMATIC CONTROL OF WHEELTREAD WEAR [Avtomaticeskij kontroliznosa katanija koles]
The article presents: the structure, working principles and results of tests on a prototype electronic image-convertor for measuring the type profile on a moving train; the structural diagram of the test model of a system for controlling wear on the running surface of the rail; the algorithm of the solution to the problem of automation, control of the maximum value and the irregularity of the wheel profile. [Russian]

Sapovalov, VM *Zeleznodoroznij Transport* Vol. 57 No. 2, Feb. 1975, pp 58-60, 3 Fig.

ACKNOWLEDGMENT: International Railway Documentation, Selection of
PURCHASE FROM: Zeleznodoroznij Transport Moscow, USSR Repr. PC

C4 127353
P-S-N CURVE FOR WHEEL-SEAT OF CAR-AXLE
This paper presents a fatigue life for the wheelseat of car axles. The results were obtained from fatigue test results for test axles using a full-scale fatigue testing machine. Statistical data are presented on fatigue crack initiation of actual axles and the reliability and usefulness of the P-S-N curve are discussed.

Tanaka, S Hatsuno, K Yaguchi, S *Railway Technical Research Institute* Vol. 16 No. 2, June 1975, pp 75-76, 2 Fig., 2 Tab.

PURCHASE FROM: Ken-yusha 1-45-6, Hikari-cho, Kokubunji, Tokyo, Japan Repr. PC

C4 127619
TESTING OF BOGIE FRAMES FOR RAILWAY CARS [Pruefung von Drehgestellrahmen fuer Eisenbahnfahrzeuge]
A new method of testing by the German Federal Railways laboratories is described. Only arc-shaped road travel is simulated. The deviations from the mean stress observed in these tests are treated as the basic stress amplitude. The forces are applied by servohydraulic equipment. A nomogram for determination of permissible lateral fatigue stresses is given. [German]

Schenk, H Lange, H *Materialpruefung* Vol. 17 No. 6, June 1975, pp 178-180

ACKNOWLEDGMENT: EI
PURCHASE FROM: VDI-Verlag GmbH Postfach 1139, 4 Duesselforf, West Germany Repr. PC

C4 127716
PROCEEDINGS OF CONFERENCE ON TRACK/TRAIN DYNAMICS INTERACTION, VOLUME 1
The problems caused by track/train dynamics manifest themselves in a variety of ways. Regardless of how, the manifestations are extremely costly to the industry and must be solved. To provide interim solutions and to clarify those areas that should receive the greatest attention in the research effort on track/train dynamics, the AAR sponsored a conference on the subject. This is the first of two volumes. Subjects covered in this volume include: Interaction Mechanics; Train Operations and Control; Analytical and Experimental Techniques; Performance of Freight Car Component Systems.

Requests for this publication should be directed to J.G. Britton, Director of Operations, AAR. See also Volume 2, RRIS #1277170 Price for 2 Volume set is $6.00 Conference held Dec. 15 & 16, 1971 in Chicago.

Association of American Railroads AAR-R190, Dec. 1971, 449 pp, Figs.

PURCHASE FROM: Association of American Railroads Technical Center 3140 South Federal Street, Chicago, Illinois, 60616

DOTL RP

C4 127856
TIE RENEWALS AND COSTS
This report of AREA Committee 3 involves statistics on tie renewals and average tie costs for 1974 as compiled by the Economics and Finance Department of AAR. The details are given in tabular form. Along with conclusions about the rates at which Eastern, Southern and Western railroads inserted ties, it is shown that the "indicated" wooden tie life for all U.S. Class I railroads is 47 years. The average cost of ties increased by 43% from 1973 to 1974. There was only an increase of 5% in tie renewals in 1974. The average number of concrete ties inserted was the same in both years but the tie cost went up 44%.

Advance Report of AREA Committee 3--Ties and Wood Preservation.

AREA Bulletin Bul 654 Proc V77, Sept. 1975, pp 13-23, 4 Tab.

ACKNOWLEDGMENT: AREA Bulletin
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

C4 127873
VELIM TEST CIRCUIT, RAILWAY RESEARCH INSTITUTE, PRAGUE
The Velim Railway Testing Circuit, located 50 km east of Prague is the test facility for the Institute which is engaged in technology relating to transport economics, track construction and maintenance, rolling stock and electric and diesel traction, communications and other areas. The 200-kph test loops are energized at 25 kV 50 Hz and they may be used for controlled service tests for ORE, OSShD and for European and Russian railways and suppliers. Slab and conventional track are being evaluated. Laboratories have computers which can be coordinated with dynamometer car activities.

Rail Engineering International Vol. 5 No. 5, Aug. 1975, pp 215-218, 1 Fig., Phots.

PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

C4 128630
AN INVESTIGATION OF FACTORS CONTRIBUTING TO WIDE GAGE ON TANGENT RAILROAD TRACK
Wide gage--a fatigue failure of the track to maintain the nominal lateral distance between rail heads--is one of several modes of track failure on which the AAR-FRA-RPI-TDA Track Train Dynamics Program has focused attention. To investigate the generation of wide gage on tangent track, experiments were conducted to measure track dynamic response and long-term fatigue life of track sections on the Union Pacific Railroad in Idaho. Results of these experiments have defined the important factors in this mode of track fatigue.

This paper was contributed by the Rail Transportation Division of the ASME for presentation at the Winter Annual Meeting, Houston, Texas, November 30-December 5, 1975.

Ahlbeck, DR Harrison, HD Noble, SL (Battelle Columbus Laboratories)
American Society of Mechanical Engineers 75-WA/RT-1, July 1975, 9 pp, 9 Fig., 1 Tab., 5 Ref.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL RP

C4 128632
PROPOSED SOLUTIONS TO THE FREIGHT CAR TRUCK PROBLEMS OF FLANGE WEAR AND TRUCK HUNTING
This paper reports on the progress of a development program whose objective is to devise cost effective solutions to the problems of excessive flange wear and truck hunting. It is expected that later papers will deal with separate aspects of this program in greater detail. Three solutions for freight cars are proposed: (1) a retrofit steering assembly kit for application to the trucks of existing roller bearing cars, (2) modification of the side frame and bolster castings to incorporate a more cost effective steering assembly for new trucks and (3) a completely new truck design incorporating improvements in car suspension as well. All three designs include a steering feature which will reduce wheel and rail wear in curves and elminate truck hunting. The second and third designs also provide better brake shoe/wheel alignment for additional savings in wheel wear. The appendices define the terminology used and identify the design characteristics of conventional trucks which lead to the present high cost of ownership.

This paper was contributed by the Rail Transportation Division of the ASME for presentation at the Winter Annual Meeting, Houston, Texas, November 30-December 4, 1975.

List, HA (Instrument Society of America); Caldwell, WN Marcotte, P (Canadian National Railways)
American Society of Mechanical Engineers 75-WA/RT-8, July 1975, 7 pp, 7 Fig., 2 App.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL RP

C4 128635
ANALYTICAL AND EXPERIMENTAL DETERMINATION OF NONLINEAR WHEEL/RAIL GEOMETRIC CONTRAINTS
The wheel/rail geometric constraint relationships for actual wheel and rail profiles are generally nonlinear functions of wheelset lateral displacement. Two of these relationships which strongly influence the lateral dynamics of railway vehicles are the effective conicity and gravitational stiffness. An algorithm for the digital computer is presented that calculates these nonlinear relationships for arbitrary wheel and rail head profiles. An experimental apparatus was developed to determine the location of the wheel/rail contact points as a function of wheelset lateral displacement for arbitrary profiles. Experimental data obtained with this apparatus are presented for various cases which validate the results of the analytical procedure.

To be presented at the Winter Annual Meeting.

Cooperrider, NK (Arizona State University); Law, EH (Clemson University); Hull, R (Arizona State University); Kadala, PS Tuten, JM (Clemson University)
American Society of Mechanical Engineers 1975, 44 pp, 11 Fig., 9 Ref.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL RP

C4 128875
AXIALLY STRESSED RAILROAD TRACK ON AN ELASTIC CONTINUUM SUBJECTED TO A MOVING LOAD
The recent introduction of the welded railroad track raises the possibility that high axial compressive forces may occur in the rails due to constrained thermal expansions. This in turn may reduce the critical velocity of the track to within the operational velocities of present day trains. Recently the effect of axial forces upon the critical velocities of the track was analyzed by A.D. Kerr using the Winkler model for the base response. In this study, the effect of the axial compressive force on the critical velocity of the track is studied assuming for the base an elastic half space with inertia.

Labra, JJ (ENSCO, Incorporated) *Acta Technica* Vol. 22 No. 1-2, 1975, pp 113-129, 11 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

C4 129787
EFFECT OF RESIDUAL STRESSES IN HARDENED RAILS ON THE FORMATION AND PROPAGATION OF STRESS FISSURES DUE TO CYCLIC STRAINS [Vlijanie ostatocnyh naprjazenij V Zakalennyh rel'sah Vozniknovenie i rasprostranenie ustalostnyh trescin pri Cikliceskom izgibe]
The authors have reached the following conclusions: The railhead, as a result of heat treatment or cold straightening, can develop a considerable drop in the stress limit, a drop in the number of cycles completed before stress fissures occur, a drop in the number of cycles completed during the stress fissure propagation period, a reduction in the critical size of each stress fissure, or a drop in the curability of hardened rail, 2) the residual compression stresses which occur in the rail head accentuate the above characteristics. [Russian]

Sur, EA Konjuhov, AD *Trudy CNII MPS: Ostat naprja i Proc Zelez relsov* Vol. 491 1973, pp 29-37, 1 Tab., 13 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Trudy CNII MPS: Ostat naprja i Proc Zelez relsov Moscow, USSR Repr. PC

C4 129833
EFFECT OF RAIL FLANGE CORROSION ON FATIGUE STRENGTH OF RAILS [Vlikanie korrozii podosvy relsov na ih ustalostnuju procnost]
The article describes: a method of assessing flange surface irregularities and the results of tests to determine the fatigue strength of rail flanges which have been damaged by corrosion. [Russian]

Konjuhov, AD *Vestnik Vniizt* Vol. 34 No. 5, 1975, pp 44-47, 1 Fig., 1 Tab.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Vestnik Vniizt Moscow USSR

C4 129855
FATIGUE STRENGTH OF STEEL WIRE FOR PRESTRESSED CONCRETE SLEEPER
This paper describes calculation of the fatigue strength of steel wire used for prestressing concrete cross ties. From the results of rotating bending fatigue tests of deformed prestressing wires and plain wires pretreated in various ways, the following conclusions were obtained: (1) Suitable deformed prestressing wires are available for concrete cross ties; (2) Some surface damage may decrease the fatigue strength of the prestressing wire (corrosion, notching and sparks, for instance); (3) JNR's present prestressing loads are sufficient. The effects of spark damage to wires are particularly critical.

Watanabe, S *Railway Technical Research Institute* Quart Rpt. Vol. 16 No. 3, Sept. 1975, pp 131-134

ACKNOWLEDGMENT: Japanese National Railways
PURCHASE FROM: Ken-yusha 1-45-6, Hikari-cho, Kokubunji, Tokyo, Japan Repr. PC

DOTL JC

C4 130672
LI TRIES FOR MORE TIE LIFE BY REDUCING TIE-PLATE WEAR
To reduce the cutting of wooden cross ties by tie plates, the Long Island Rail Road has initiated tests of Pandrol rail fastenings with special plates having shoulders that accommodate the legs of the spring clips. The goal was to increase the 28-year tie life experienced on heavy-density routes. A 13-mile stretch of new continuous welded rail has been secured with the Pandrol fastenings; tie plates are secured with three Lock Spikes. Tie life is enhanced by eliminating movement of the plates on the ties and a stiffer track structure is thought to have been produced. In addition to the longer service from ties, the Pandrol assembly simplifies the changing of defective rails and avoids problems of spike killing of ties and the loss of plate gauge every time a rail is changed.

Railway Track and Structures Vol. 72 No. 1, Jan. 1976, pp 26-27, 5 Phot.

PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

C4 130790
EXPERIENCE WITH A LONG DISTANCE UNIT COAL TRAIN
This paper is intended to provide an insight into the operation and maintenance experiences encountered during 7 1/2 years of operation of a unit coal train, that makes a 2164-mile round trip over a territory of varied operating and climatic conditions every 96 hr.

Contributed by the Intersociety Committee on Transportation for presentation at the Intersociety Conference on Transportation, Atlanta, Georgia, July 14-18, 1975.

Angold, JA (ENSCO, Incorporated)
American Society of Mechanical Engineers 75-ICT-4, July 1975, 7 pp, 1 Tab.

ACKNOWLEDGMENT: ASME
PURCHASE FROM: ASME Repr. PC

DOTL RP

C4 130804
CALCULATIONS BASED ON AVERAGE USEFUL LIFE [Das Rechnen mit gemittelten Nutzungszeiten]
To determine the capital cost of articles made up of parts with different average useful lives, it is usual to use averages. The author shows that calculating averages in this way lead to systematic error which makes results wrong. He explains the error and proposes a new method. Using an example with figures, he also shows the practical application of the method suggested and at the same time, the disparity between the results of the two methods. [German]

Effmert, W *Eisenbahntechnische Rundschau* Vol. 24 No. 10, Oct. 1975, pp 385-388, 3 Tab.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Hestra-Verlag Holzhofallee 33, 61 Darmstadt, West Germany Repr. PC

DOTL JC

C4 130923
USING NDT EFFECTIVELY-EDDY CURRENT TESTING
The principles and the advantages of eddy current testing for casting defects are reviewed. Equipment and recommended procedures are discussed.

Heine, HJ *Foundry Management and technology* Vol. 103 No. 0, Sept. 1975, 5 pp

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

C4 131241
DETERMINATION OF THE DENSITY OF THE BALLAST BED BY MEANS OF RADIOACTIVE ISOTOPES [Bestimmung der Bettungsdichte mittels radioaktiver Isotope]
The measuring principle is based on the absorption of the gamma rays by the ballast, situated between a radioactive preparation and ray detector. The author describes this measuring method, used by the DB Test Centres at Minden and Munich.

Schmidt, W *Eisenbahntechnische Rundschau* Vol. 24 No. 11, Nov. 1975, pp 426-427, 1 Fig.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Hestra-Verlag Holzhofallee 33, 61 Darmstadt, West Germany Repr. PC

DOTL JC

C4 131245
APPLYING INFORMATION ON RAIL REPLACEMENTS TO THE STUDY OF RAIL SERVICE LIFE [Wykorzystanie danych o pojedynczych wymianach szyn do badania ich niezawodnosci eksploatacyjnej]
The author explains how an analysis of rail Service life was made in the PKP using statistics concerning damaged rails and replacements. He uses Weibull's law to quantify the stresses exerted on rails and thereby determines their service life.

Fijalek, M *Przeglad Kolejowy Drogowy* Vol. 22 No. 9, Sept. 1975, pp 23-29, 3 Tab., 9 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Wydawnictwa Komunikacji i Lacznosci Ul Kazimierzowska 52, Warsaw 12, Poland Repr. PC

C4 131263
WEAR ON EXTERNAL SURFACES OF WHEELS AND RAIL DUE TO FRICTION [Verschleissvorgang im Grenzschichtbereich der Reibpaarung Rad/Schiene]
The stresses borne by rail and wheel elements are analysed on the basis of several fundamental definitions of wear by Fleischer. A number of studies were carried out on plastic deformation, running surfaces and wear characteristics. Partial oxidation can occur when the external surfaces of wheels or rails are deformed because the materials come into contact with the surrounding atmosphere. Oxidised metallic particles are then worn away. Wear is often affected by the characteristics of the process itself or by layers of martensite which are produced by shoe brakes. [German]

Pigors, O *DET Eisenbahntechnik* Vol. 23 No. 11, Nov. 1975, pp 495-498, 5 Fig., 12 Ref.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: VEB Verlag Technik Oranienburgerstrasse 13-14, 102 Berlin, East Germany Repr. PC

C4 131266
MEASUREMENT OF WEAR BY THE LAYER THICKNESS DIFFERENTIAL METHOD [Verschliessmessungen nach dem Duennschicht-Differenzmessverfahren]
The principle for determining the wear is based on the fact that the radioactivity of a component subjected to radiation by protons or deuterons will be destroyed by wear under operating conditions. The difference between initial and final radioactivity is a measurement of wear. The author describes this measuring method used by the DB Test Centre at Minden (Westphalia). [German]

Schmidt, W *Eisenbahntechnische Rundschau* Vol. 24 No. 11, Nov. 1975, pp 425-426, 1 Fig.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Hestra-Verlag Holzhofallee 33, 61 Darmstadt, West Germany Repr. PC

DOTL JC

C4 131301
DEVELOPMENT OF CORRUGATIONS ON SURFACES IN ROLLING CONTACT
The self-generation of corrugation on metal surfaces in rolling contact has been studied experimentally in a rolling contact disc machine and theoretically using a computer simulation. The system vibrates in the "contact resonance" mode excited by surface irregularities, and these vibrations may be severe enough to cause plastic indentation of the surface in one revolution which then amplifies the vibration in the next revolution.

Johnson, KL Gray, GG *Institution of Mechanical Engineers Proceedings* Vol. 189 No. 13, 1975, pp 45-58, 14 Fig.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

C4 131533
CRACK GROWTH RATE ITS MEASUREMENT AND A CONTROLLING FACTOR IN ROLLING CONTACT FATIGUE
An optical method has been developed for measuring the extent of cracking in test specimens which have failed by fatigue under rolling contact conditions. The data from these measurements are expressed in terms of the overall crack growth rate, and it is found that an excellent correlation exists between fatigue life and the rate at which cracks branch and propagate. The correlation appears to be independent of stress, lubricant chemistry, and probably metallurgy; this shows that crack branching rate controls fatigue life. The results do show that lubricant chemical factors affect fatigue life through the crack branching rate.

Polk, CJ Rowe, CN *American Society of Lubricating Eng-Transactions* Vol. 19 No. 1, Jan. 1976, pp 23-32

ACKNOWLEDGMENT: British Railways
PURCHASE FROM: ESL Repr. PC, Microfilm

C4 131621
FREIGHT CAR TRUCK OPTIMIZATION: TRUCK ECONOMIC DATA COLLECTION AND ANALYSIS
A first interim report covering the development of the TDOP economic methodology was published by the Federal Railroad Administration in April 1975. It contains the truck investment economic evaluation procedures intended for the use of the railroad industry and their suppliers. The primary objective of the Truck Economic Data Collection and Analysis Program is to test the procedures for establishing the significant actual operating costs of existing Type I general purpose trucks. This second interim report covers the progress of the program. A generalized truck cost information system was designed for the collection and integration of truck economic data. The collection of test data for off-line truck maintenance costs was completed. Test data collection was initiated for on-line truck maintenance and other associated costs and operating conditions. Preparatory work was begun to develop the appropriate data analysis guidelines. A preliminary analysis of some of the test data clearly revealed the truck's reported off-line wear and failure cost performance. Railroad companies and their suppliers are encouraged to consider adopting the tested procedures of the TDOP economic methodology. A progressive implementation of this methodology will provide them with the timely opportunity to develop a truck economic evaluation capability of their own.
Sponsored by the Federal Railroad Administration.

April, D
Southern Pacific Transportation Company, (TDOP 75-2) Tech Rpt. FRA-OR&D 75-58A, Mar. 1976, 86 pp

Contract DOT-FR-40023

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS Repr. PC, Microfiche

PB-251400/AS, DOTL NTIS

C4 131642
ROAD AND LABORATORY INVESTIGATION OF TRUCK BOLSTERS FOR UNIT TRAIN CARS
Problems of "excessive" wear and failure have arisen in new cars in unit train service, some due to over-the-road running, others to handling of light cars. Similar problems can arise in trains of non-uniform, but regularly assigned, car types in continuous high-mileage, high speed, rapid turnaround service. Railroad cars permanently assigned to unit train service travel many more miles yearly than cars in conventional freight service. At terminals their loading and unloading is expedited to reduce turnaround time. Consequently, the load spectrum that a conventional-service car would encounter over years, is compressed, for the unit train car, into a much shorter time interval. This paper describes the experiences with truck bolsters from a coal-hauling fleet of unit train cars.
Presented at the 1976 Joint ASME/IEEE Railroad Technical Conference, Chicago, Illinois, April 6-8, 1976. For the complete volume see RRIS No. 02 131638, Publication 7602.

Weber, HB (Midland-Ross Corporation); Driver, JB (Association of American Railroads)
American Society of Mechanical Engineers 1976, pp 87-114, 15 Fig., 2 Tab., 4 Ref.

ACKNOWLEDGMENT: ASME, IEEE
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL RP

C4 132929
APPLICATION OF FRACTURE MECHANICS TO THE BRITTLE FRACTURE OF STRUCTURAL STEELS
Calculation of defect size based on current theory, from measurements of K1c or COD in laboratory tests and demonstration of the influence of various design factors, stress concentration and residual stress effects on the defect tolerance calculated are given in graphical and equation form.

Barr, PR Terry, P *Journal of Strain Analysis* Vol. 10 No. 4, Oct. 1975, pp 233-241, 34 Ref.

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

C4 132949
EFFECT OF THE DEVELOPMENT OF RESIDUAL STRESSES IN SOLID WHEELS ON WEAR [Evolution des contraintes residuelles dans les roues monoblocs. Influence sur les degradations]
After describing the special procedures employed to determine the residual stresses by destructive methods and X-ray diffraction, an assessment is made of the results obtained witn new solid wheels, to which different braking powers had been applied, over varied distances. The effect of these stresses is studied on the following mechanisms of wear: thermal flaws, fatigue cracks in the rim or the center and buckling. [French]

Revillon, A Leluan, A *Revue Generale des Chemins de Fer* Vol. 94 Nov. 1975, pp 647-662

ACKNOWLEDGMENT: EI
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

C4 132962
OBSERVATIONS ON THE EFFECT OF HEAVY WHEEL LOADS ON RAIL LIFE
The Bessemer and Lake Erie Railroad has operated 90-59 open-top cars since 1931 and has some statistics on rail wear and rail life under the stresses imposed by such equipment. Rail life on tangent track has been around 440 million gross tons for jointed rail and beyond 650 million gross tons for continuous welded rail. Statistics are also available for Curvemaster and controlled cooled rail on curves. On newer ore carrying railways, rail life appears to be appreciably shorter. Among possible reasons are the bidirectional operation of loaded trains on B&LE, the mixing of various capacities of cars, and the predominance of traffic on solid, rather than roller-type, journal bearings.

Proceedings of the 12th Annual Railroad Engineering Conference held at Pueblo, Colorado, October 23-24, 1975. The complete volume is RRIS 02 132958, Pricing is for the complete volume: Repr. PC $6.75, Microfiche$2.25, NTIS PB-252968/AS.

Rougas, M (Bessemer and Lake Erie Railroad)
Federal Railroad Administration FRA OR&D 76-243, Oct. 1975, pp 41-44, 5 Fig.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS

DOTL NTIS, DOTL RP

C4 132975
RAIL WEAR AND CORRUGATION PROBLEMS RELATED TO UNIT TRAIN OPERATIONS: CAUSES AND REMEDIAL ACTION
This paper is a case study of rail wear problems on Canadian National's main line through the Rocky Mountains as a result of unit train operation. The problems are gauge-face wear on the high rail on curves, rail head flow on the low rail and corrugations having a wavelength varying from 8 to 30 inches on the low rail. Prior to introduction of unit trains there were almost no such problems. A study of the lateral forces is described. Remedial action requires a concentrated effort by Engineering, Equipment and Transportation groups with no quick "fix" available. Absence of any action will only cause track deterioration and if it is desired to more bulk commodities in unit trains, the problem must be attacked in an organized manner.

Proceedings of the 12th Annual Railroad Engineering Conference held at Pueblo, Colorado, October 23-24, 1975. The complete volume is RRIS 02 132958, Pricing is for the complete volume: Repr. PC $6.75, Microfiche$2.25, NTIS PB-252968/AS.

King, FE (Canadian National Railways)
Federal Railroad Administration FRA OR&D 76-243, Oct. 1975, pp 139-147, 11 Fig.

ACKNOWLEDGMENT: FRA
PURCHASE FROM: NTIS

DOTL NTIS, DOTL RP

C4 134532
A TEST BENCH FOR HIGH SPEED TRAIN AXLE BOX BEARINGS [Banc d'essai pour roulements de boites d'essieux de trains a grande vitesse]
Different types of bearings are tested on a special test bench under identical operating conditions. The friction torque of bearings is measured for various combined loads. Temperature distribution is determined, and heat sources located. The behaviour of the bearings and different lubricants is also studied under real-life dynamic load conditions. [French]

Burnaby, LE *Revue des Roulements* No. 186, 1976, pp 1-7, 9 Fig.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Revue des Roulements Brussels, Belgium

C4 134553
MICROWAVE MEASUREMENT OF STRESSES AND STRAINS IN REVOLVING PARTS [La mesure par voie hertzienne des contraintes et des efforts sur pieces tournantes]
The microwave equipment for measuring the dynamic stresses in revolving parts picks up the information by means of an aerial fixed near the moving part. The modulated and amplified signals are fed into an oscilloscope. The various units in the equipment have been miniaturised by the Testing Section of the SNCF ROlling Stock Department. The equipment is used for measuring the stresses and strains in the axles of RTG trainsets, and in the cardan shaft transmission system of the Z 7001 railcar.

Moreau, M *Revue Generale des Chemins de Fer* Vol. 95 Jan. 1976, French

ACKNOWLEDGMENT: UIC
PURCHASE FROM: ESL Repr. PC, Microfilm

DOTL JC

C4 134557
MODERN METHODS OF FATIGUE ASSESSMENT
A report on modern methods of fatigue assessment. The authors discuss: positions of stress concentration zones; service records and cycle counting; criteria (Neuber analysis) and equations relating to the stress-strain curve and the properties of materials. They give some examples of practical applications to certain railway equipment. The article is followed by a discussion.

Watson, P Rebbeck, RG *Railway Engineer* Vol. 4 No. 6, Nov. 1975, pp 10-23, 4 Phot.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Mechanical Engineering Journal Penthouse 1, 15 West 55th Street, New York, New York, 10019

DOTL JC

C4 134580
LARGE SCALE TESTING
The article describes techniques used by B.R. in measuring deflections and stresses in bridges. No specific bridge test is mentioned. New developments in equipment and techniques are reviewed.

Aitken, WR Whitbread, JE *Railway Engineer* Vol. 1 No. 1, Jan. 1976, pp 38-40, 4 Fig.

ACKNOWLEDGMENT: UIC
PURCHASE FROM: Mechanical Engineering Publications Penthouse 1, 15 West 55th Street, New York, New York, 10019
DOTL JC

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The Transportation Research Board is an agency of the National Research Council, which serves the National Academy of Sciences and the National Academy of Engineering. The Board's purpose is to stimulate research concerning the nature and performance of transportation systems, to disseminate information that the research produces, and to encourage the application of appropriate research findings. The Board's program is carried out by more than 150 committees and task forces composed of more than 1,800 administrators, engineers, social scientists, and educators who serve without compensation. The program is supported by state transportation and highway departments, the U.S. Department of Transportation, and other organizations interested in the development of transportation.

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The National Academy of Sciences was established by a congressional act of incorporation signed by President Abraham Lincoln on March 3, 1863, to further science and its use for the general welfare by bringing together the most qualified individuals to deal with scientific and technological problems of broad significance. It is a private, honorary organization of more than 1,000 scientists elected on the basis of outstanding contributions to knowledge and is supported by private and public funds. Under the terms of its congressional charter, the Academy is called upon to act as an official—yet independent—advisor to the federal government in any matter of science and technology, although it is not a government agency and its activities are not limited to those on behalf of the government.

To share in the task of furthering science and engineering and of advising the federal government, the National Academy of Engineering was established on December 5, 1964, under the authority of the act of incorporation of the National Academy of Sciences. Its advisory activities are closely coordinated with those of the National Academy of Sciences, but it is independent and autonomous in its organization and election of members.