FILE # 6105

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TEST PLAN

FOR

LRC TRAIN
SERVICE EVALUATION

December 21, 1976

Submitted:

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Approved:

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NATIONAL RAILROAD PASSENGER CORPORATION

Washington, D.C.

LRC TRAIN

SERVICE EVALUATION

I. Purpose

The purpose of this test is to demonstrate the performance of the LRC Train to the FRA, Burlington Northern and the AAR in order to show safe operation at speeds in curves in excess of that permitted by AAR and FRA standards in unbalance in curves. All speeds will, however, be within other FRA track safety standards.

II. Background

The National Railroad Passenger Corporation is directed to evaluate new concepts in rail travel equipment. The Canadian Light Rapid Comfortable (LRC) train set is such a concept. In determining the safeness of operation of this concept certain tests are required by the Federal Railroad Administration and by the railroads upon which the train is expected to operate. This concept of train travel contains a tilting mechanism that eliminate uncomfortable lateral forces for the passengers at speeds much higher than conventional trains on conventional curved track. Therefore, lateral forces of the wheel induced into the rail at those speeds above conventional must be investigated. This test is designed to satisfy these requirements.

III. Test Participants

Test participants are restricted to those personnel under contract to, or duly authorized by, AMTRAK. AMTRAK shall reserve the right of final approval and authorization in all cases, so as to exercise the necessary safety precautions. A daily sign-up sheet will be maintained on the Test Train and at the Wayside Test Site. All personnel present will be required to print their name and organizational affiliation on these sheets.

IV. Test Schedule

Fri., January 7, 1977 -- 1. Battelle arrives at curve test site MP 78 (East Haven) for installation of sensors.

2. Amtrak NEC provides flag men at East Haven test site to support Battelle.

	3.	Amtrak NEC puts test site out of service between Shore Line Junction and East Haven.
Tues., January 11, 1977 -	1.	Battelle measures revenue traffic and calibrates system.
	2.	E8 locomotive arrives New Haven with power car and 3 Amfleet cars.
Wed., January 12, 1977 -	1.	Test E8 consist - calibrate track measurement system upon arrival test site (MP 78 Track #2).
	2.	NEC Operations Department issues train order permitting test operations to exceed track speeds between Mill River interlocking and Branford. Speed up to 90 mph allowed.
	3.	NEC Track Department installs perturbation into track at Princeton MP 44.2.
	4.	NEC puts #3 Track Nassau to Midway out of service with train order.
Thurs, January 13, 1977 -	1.	Test Rohr RTG consist at MP 78.
Fri., January 14, 1977 -	1.	Test SDP40F consist at MP 78.
	2.	LRC departs Montreal on train #61.
	3.	ENSCO arrives New Haven for locomotive instrumentation installation.
	4.	Battelle installs sensors at Princeton (MP 44.2) test site.
Sat., January 15, 1977 -	1.	ENSCO instruments LRC, installs recording devices in LRC coach and calibrates system.
	2.	Contingency day for E8, RTG or SDP40F.
Sun., January 16, 1977 -	1.	Test LRC at MP 78.
Mon., January 17, 1977 -	1.	Contingency day for LRC test at MP 78.
	2.	Dead head LRC to Philadelphia (Race Street) at conclusion of testing at this site.
Tues., January 18, 1977 -	1.	Test LRC consist at Princeton (MP 44.2).
	2.	NEC puts #3 Track County to Milham out of service by train order.

	3.	NEC authorizes by train order speeds up to 90 mph enroute Philadelphia to Milham and up to 120 mph Milham to County track 3.
Wed., January 19, 1977 -	1.	Test RTG consist at MP 44.2.
	2.	(Same as January 18 #2)
	3.	(Same as January 18 #3)
Thur., January 20, 1977 -	1.	Test E8 consist at MP 44.2.
	2.	(Same as January 18 #2)
	3.	(Same as January 18 #3)
Fri., January 21, 1977 -	1.	Contingency test day at MP 44.2.
	2.	Return LRC on #60 to Montreal.
Sat., January 22, 1977 -	1.	Contingency test day at MP 44.2.
	2.	Deadhead RTG and E8 to normal operating areas.
Mon., January 24, 1977 -	1.	Review presentation material in Washington for Board of Directors.

V. Test Description

A. General

As part of the LRC Train evaluation tests, the following test conditions and requirements will be included:

1. Tests at speeds to induce unbalance in excess of 6 inches on curved track will be run on NEC track north of New Haven, Connecticut, with full track instrumentation as well as a fully-instrumented LRC locomotive over a selected test site.

2. The curved track test site shall be located at MP 78 (East Haven) 3^{o} 23' of curvature and 6 inches of super-elevation. No track geometry perturbations will be added to the track at this site. Testing will be done east bound between Mill River interlocking and Branford interlocking.

3. Tests at speeds up to 120 mph will be made west bound on NEC Test Track No. 3 between County and Millham, New Jersey, with full track instrumentation as well as a fully instrumented locomotive over a selected test site on tangent track with a class 6 track perturbation installed.

4. Track geometry perturbations will be designed for the tangent-track test site to provide predictable vehicle dynamic response for the LRC locomotive.

5. Series of tests will be run through the curved test site with the E8 and SDP40F locomotives and Rohr-RTG Turboliner to provide comparative data on track forces and L/V ratios. The E8 locomotive and the Rohr-RTG will also be run through the tangent test site.

6. Failure of tilt mechanism will be demonstrated.

B. Test Sites

1. A curved test site has been selected on the NEC track #2, MP 78, north of New Haven, Connecticut, with a curvature of 3° 23' and a superelevation 6 inches.

2. A tangent test site has been selected at MP 44.2 which is within the high-speed track area, track No. 3 on the NEC, between County and Millham, New Jersey. Track geometry perturbations will be installed to provide predictable truck and car body response for the LRC locomotive.

C. Test Consist

The test consist may include the following combinations of vehicles:

1. LRC Train - locomotive plus one tilt-body car plus 3 Amfleet cars. The Amfleet cars shall be put on siding if they in any way may prevent the high speed runs.

2. E8 locomotive with H.E.P. plus 3 Amfleet cars.

3. Rohr-RTG Turboliner train.

4. SDP40F locomotive plus power car and 3 Amfleet cars.

The LRC locomotive and car shall be instrumented for testing in one direction of travel and shall be turned as a unit, if it is necessary to turn the unit. All locomotives will be tested with full fuel tanks, and full water tanks if equipped with steam generator.

D. Test Runs

When the instrumentation for each of the test sites is installed, test runs shall be conducted in accordance with the following daily schedules, except as otherwise agreed upon by the test personnel and so ordered by the Test Director. Speeds above 60 mph on the curved site, 80 mph on the tangent site will be authorized by train order.

1. Curved Track Test Site

LRC Train Speed (mph)* As auth. by Amtrak	Unbalance (inch)	Operating Mode Power	Drift	Dynamic Braking	Change
50	0	X	X		
41	-2	X	X		
58	2	X	X	X	X
61	3	X	X	X	
65	4	X	X	X	X
71	6	X	X		X
(77)	8	X			
(80)	9	X			
(82)	10	X			

*Speeds will be adjusted to actual curvature and superelevation.

() indicates runs to be approved after data from previous, lower-speed runs are evaluated for safety.

E8 Locomotive Speed (mph) (As auth. by Amtrak	Unbalance (inch)	Operating Mode Power	Drift	Change
50	0	X	X	
41	-2	X	X	
58	2	X	X	X
62	3	X	X	
(65)	4	X	X	X
(71)	6	X	X	X

RTG-Rohr Turboliner Speed (mph)* (As auth. by Amtrak	Unbalance (inch)	Operating Mode Power	Drift	Dynamic Braking	Change
50	0	X	X		
41	-2	X	X		
58	2	X	X	X	
62	3	X	X	X	
(65)	4	X	X	X	
(71)	6	X	X		
(77)	8	X			

SDP40F Locomotive Speed (mph)* (As auth. by Amtrak	Unbalance (inch)	Operating Mode Power	Drift	Dynamic Braking	Change
50	0	X	X		
41	-2	X	X		
58	2	X	X	X	X
62	3	X	X	X	
(65)	4	X	X	X	X
(71)	6	X	X		X

2. Tangent track site Princeton, NJ, MP 44.2, Track #3

LRC TRAIN

Speed (mph) (As authorized by Amtrak	Operating Mode Power	Drift	Dynamic Brake
50	X	X	X
60	X	X	
70	X	X	X
80	X	X	X
90	X	X	X
95	X	X	
100	X		
105	X		
110	X		
115	X		
120	X		

RTG-Rohr Turboliner

Speed (mph) (As authorized by Amtrak	Operating Mode Power	Drift	Dynamic Brake
50	X	X	X
60	X	X	
70	X	X	
80	X	X	X
90	X	X	X
95	X	X	X
100	X		
105	X		
110	X		
115	X		
120	X		

E8

Speed (mph) (As authorized by Amtrak)	Operating Mode Power	Drift
50	X	X
60	X	X
70	X	X
80	X	X
90	X	
95	X	
100	X	
105	X	
110	X	

3. Test run distances shall be confined to the minimun track lengths needed to accelerate, drift, and stop, while making test

runs at the required speeds. The track in which the test sites are located shall be of sufficient length to permit this, and shall be controlled at one point each side of the site by an interlocking home signal and will be dedicated exclusively for these test runs. So that no other railroad traffic will be able to use this track, the test section shall also be taken out of service by train order for the entire period of the test. During any test runs over 95 mph at MP 44.2 and when exceeding 3 inches unbalance at MP 78, all adjacent tracks shall be clear of traffic. At the end of each test the entire test train shall be backed over the test site to the starting point for the next run. All test runs shall be made in an easterly on the curve and west bound on the tangent direction. Except as otherwise arranged, "home base" shall be New Haven, Conn. and Race Street, Philadelphia, and the test train shall be operated as a non-revenue passenger extra to and from the test sites under the direction of the Railroad. Upon receiving clearance to use the test rack, all movements of the train shall be under the jurisdiction of the Test Director, and it shall be the responsibility of each of the test participants to inform the Director when ready to initiate a test run, to recommend changes, to advise of safety conditions and to terminate a test. No unsafe condition shall be permitted to go unchecked, nor shall any run be made if there is sufficient evidence of an unsafe condition.

VI. Instrumentation

A. On-Board

On-board instrumentation shall include the necessary devices and recorders to monitor the dynamics associated with the parameters shown in Table 1, Item 1 through 22 inclusive. The test car shall be capable of providing filtered 110-120 VAC at 60 Hz $\pm$ 1%. Suitable heating/air conditioning shall be provided as part of the test car environment conducive to the use of electronic test devices. Preference shall be given to the analog techniques used to sum and integrate the various parameters listed in Table 1, i.e. lateral with vertical to provide real time analog L/V measurements on a time base, providing that:

1. The original signals may be recovered for other analysis when deemed necessary to recover original data;

2. The integration can be demonstrated to be accurate to the satisfaction and approval of AMTRAK-authorized test personnel.

AMTRAK shall reserve the right to reject any part of the proposed on-board instrumentation and data collection techniques, and agreement shall be reached before any subsequent

tests are made. Joint agreement with the instrumentation contractor shall be reached in the event that Amtrak requires others to perform part of the on-board or trackside data collection and/or associated data analysis. The final decision on each successive test run shall be made by Amtrak, and subsequent test runs shall then be conducted upon the orders of the Test Director.

B. Stationary Track Instrumentation

Sufficient instrumentation including the necessary devices and recorders, shall be installed at selected track sites and rail locations to monitor the following parameters:

1. Locomotive static and dynamic lateral forces exerted at the wheel/rail interface of each rail at one location within the test site boundaries;

2. Locomotive static and dynamic vertical forces exerted at the wheel/rail interface of each rail at one location within the test site boundaries;

3. Corresponding L/V ratio, each rail.

Three or more specific locations may be established within the test site boundaries, sufficient to describe the wave length of the dynamic forces generated by the LRC Train at all forward speeds up to and including 120 mph, and to provide accurate determinations of peak-to-peak values, time durations, and frequencies of occurance during each run-by of the test LRC Train.

The Track Instrumentation Contractor selected by AMTRAK shall provide all of the necessary equipment, power generators, and portable housing required to perform the field and track site testing, and suitable for the climate typical of the Northeast Corridor during the summer months of the year. The Contractor shall be able to instrument, in succession, up to three track sites, possibly up to several miles apart from each other. Both tangent and curved track sites may be selected, and any of these track sites may include special track work, such as turnouts, crossovers, etc. It is desirable that each new site once established can be made ready by the contractor in one week or less following de-instrumentation of the previous site.

In addition to the data collection of LRC test runs, data collection of other revenue trains passing over the test site shall be made, sufficient to estimate the track-induced input characteristics of that site. Both freight and passenger trains shall be monitored for a period to be determined by the test

personnel. The time of passage, direction, speed, and numbers of the lead locomotive shall be sufficient to characterize each revenue freight or passenger train; the number and type of cars (Amfleet or conventional) shall be recorded in addition for monitored passenger trains. Re-calibration of track instrumentation shall be mandatory prior to each series of test runs, and thereafter during runs as deemed necessary. Any equipment, subject to vandalism or to damage by passing trains, shall be removed when not testing, or when the site is to be left unattended for extended periods.

C. On-Board Data Collection System

Data collected on-board the test car shall be recorded on both analog charts and analog magnetic tape. The recording device shall be of an instrumentation grade, capable of simultaneously reproducing at least 12 channels of analog data for real time display or during post test reporduction. One channel on each recording device shall be dedicated to a time code for the purpose of correlating data channels on a single tape or among several tapes. Each recording device shall have a frequency response which is sufficiently broad so as not to distort or attenuate any pertinent data.

Minimum freuency response requirements shall be a flat response between DC and 100 Hz. No filtering shall be performed prior to recording. In the case of digital recording, all anti-aliasing filters shall have a flat frequency response between DC and 100 Hz.

Prior to the test runs and whenever deem necessary calibration of each transducer and conditioning electronics shall be performed and recorded on magnetic tape. In addition, calibration data sheets shall be kept, describing measurement parameters, channel assignment, transducer location, nominal scale factor and calibration readings. Calibration of a questionable channel shall be performed when possible during the test sequence and results recorded in the data log.

By use of selector switches or jacks it shall be possible to display in real time any 12 of the data channels on either the oscillograph or strip chart equipment during the test sequence. Conditioning and filtering of data prior to display is optional, but, caution must be exercised to insure that all information used subsequently is not distorted.

The frequency response of the display equipment should be sufficiently broad to avoid attenuation or distortion of any data deemed important for visual analysis.

During each test, a log shall be kept of peak data values and frequencies of occurence per mile, plus any other pertinent information not otherwise recorded for each data channel. This log shall be used as quick reference in determining the requirements for further testing after each test run.

At the end of each test sequence, the data contained on the strip chart or oscillograph paper shall be properly annotated in terms of test number, vehicle designation, date, scale factors, channel assignments, etc. Those channels which were not displayed during the test shall be reproduced and annotated in the same manner at a later time. All data charts shall be stored in a central location, accessible for further analysis.

D. Trackside Data Collection System

The data collection for the trackside instrumentation should follow the same guidelines as that of the on-board data collection system discussed above, with the exception of the frequency response requirements. Instrumentation located at a particular measurement site along the track is activated only when a vehicle wheel is passing over the instrumented location. At higher speeds, the time required for each vehicle wheel to pass the force responsive section is quite short. Therefore, both the recording and visual display equipment should maintain a flat frequency response over a frequency band from DC to 200 Hz. Once correlation is made between the instrumented wheel sets and the Wayside instrumentation, the latter will be removed.

VI. Special Instructions

A. Safety

The safe conduct of all personnel is of first importance. To insure the safety of these people, the following guidelines shall be followed:

1. A Test Director shall be designated in charge of all aspects of the test, and he shall be responsible for the safe conduct of the tests and the safety of all test personnel. In addition, three safety officers shall be designated from among the test personnel, representing the following group:

a. Test Car Personnel and Observers
b. Locomotive Personnel and Observers
c. Trackside Personnel and Observers

Group safety officers shall oversee that safety rules and regulations are observed by all personnel in their groups and that all personnel can be accounted for at any time.

2. A safety briefing shall be conducted by the Test Director or his designated representative with all participants at the beginning of each day's testing. The time shall be used to review pertinent safety items and to remind personnel of the many dangers which always exist when field testing is performed near mainline tracks and in electrified territory.

3. At all times, the Train Conductor is in charge of movements of the train and any desired train movement on the part of the Test Director shall be requested through the Conductor. At NO TIME shall the Conductor move the train without receiving clearance from the Test Director. When at the test site, the Test Director shall have a thorough understanding with the Conductor and Engineman as to who will order a train move. In NO CASE shall any test participant other than the Conductor, Test Director, or the Director's designated representative (in his absence) pass orders directly to the locomotive Engineman, unless it is to signal an emergency stop. Should any misunderstandings arise, the Director shall cease further testing until the point in question is clarified, and all operating personnel are aware of the clarification concerning order to move the train.

4. Any test participant is authorized to signal the locomotive Engineman to stop immediately, should any emergency condition be recognized. When signalled by means of two-way radio, the stop request shal be identified by the test locomotive road number to avoid any confusion on the part of other trains, which may be within radio change.

   The manual signal which is universally recognized as an "emergency stop" signal is with the arms or other visual object swung laterally from side to side, belt-high. This may be done by day or night, and with or without a flashlight. It should be noted that other hand signals are prohibited on the part of any test personnel. Therefore, test participants

are cautioned against waving their arms or making any hand gestures that could be construed to be a signal when on railroad property.

Extra care is required when handling and using flashlights or lanterns at night. They can be observed at great distances and could be mistaken as signals for other train movement.

5. Ground observers shall be stationed at trackside so that visual observations and audible warnings of approaching rail traffic is possible. A sufficient number of observers shall be utilized to observe approaching train traffic in areas of track curvature or other wayside obstructions, which prevent a clear view of the main line tracks for a distance less than one mile.

   Observers shall also be stationed at any highway grade crossing and shall be in direct communication with the test locomotive, to advise the test train crews that the crossings are protected. The rear brakeman shall also observe the track during backup moves, and shall be able to visually/audibly signal personnel on the ground. He shall also have emergency control of the train brakes by a standard backup hose and valve. One or more Engineering Department personnel shall be participants throughout the test to monitor the track status, to assist in the characterization of the test sites, and to advise of any questionable track structural conditions affecting the conduct of tests.

6. Direct, hardwire two-way intercom shall be established between both locomotive and test car. Two-way radio shall be utilized for locomotive-to-car, locomotive-to-ground, and ground-to-ground communications. The use of radio on the normal operating frequency shall be kept to a minimum since it is also used by the railroad and interferes with their normal business radio messages. In every case when a radio is used, the locomotive number shall be used for identification.

7. Except in the performance of instrument calibration or standing train inspections under the direct supervision of the Test Director, participants are not allowed out on the mainline tracks and shall stand clear of all tracks and turnouts. In absolutely no case shall any participant climb to the

roof of the locomotive or any car, shed, vehicle or catenary structure in electrified territory.

Any work which necessitates going to the roof shall be accomplished by qualified Railroad personnel only.

8. Boarding or de-training from cars or locomotives shall be done only when the train is standing and, if possible, to the side away from adjacent tracks and after checking with a member of the train crew as to the location of any approaching rail traffic. Participants are directed to step over the rails, and not on the rails, when crossing tracks so as to avoid slips and falls due to slippery rail heads. If possible avoid stepping across turnouts, since they are operated by remote control and subject to being operated at any time, without warning to ground personnel.

9. At no time shall there be more than four people in the leading cab of the test locomotive.

Summary of the test accomplishments of each locomotive.

(2) Description of field observations.

(3) Review of ongoing analysis.

(4) Graphical and tabulated data display.

(5) Conclusions and recommendations.

B. Final Report

The final report shall be submitted by each Contractor within 15 calendar days after the completion of the test and shall include:

(1) Statement of the Test Objective
(2) Technical Approach

(3) Summary of Testing

(4) Results of Testing including comparative date of this locomotive with data previously collected on locomotives of U.S. or Foreign design.

(5) Results of Analysis

(6) Specific and positive conclusions and recommendations.

(7) Appendices

(a) Reduced data
(b) Test logs

C. Locomotive Data

Prior to the start of the test MLW shall provide the information necessary to complete Table 2.

TABLE 1

A. Locomotive Instrumentation

	PARAMETERS	RANGE	FREQUENCY RESPONSE CHART	FREQUENCY RESPONSE MAG TAPE	TYPE
Body Inertial			Accelerometers		
1.	Lat. Accel. Forward Cab	± 1G	0-20 Hz	0-100 Hz	Servo (Strain Gage)
2.	Vert. Accel. Forward Cab	± 1G	0-20 Hz	0-100 Hz	Servo (Strain Gage)
3.	Lat. Accel. Rear Carbody	± 1G	0-20 Hz	0-100 Hz	Servo (Strain Gage)
4.	Vert. Accel. Rear Carbody	± 1G	0-20 Hz	0-100 Hz	Servo (Strain Gage)
5.	Yaw Angular Accel.	± 1 Rad/Sec^2	0-20 Hz	0-100 Hz	Servo
6.	Roll Angular Accel.	± 5 Rad/Sec^2	0-20 Hz	0-100 Hz	Servo
7.	Pitch Angular Accel.	± 1 Rad/Sec^2	0-20 Hz	0-100 Hz	Servo
Relative Truck-to-Body Motion			Transducers		
8.	Lat. Spring Disp. Sec. Susp. Truck 1	± 5 in.	0-30 Hz	0-100 Hz	LVDT
9.	Yaw Angle Truck 1	± 5 in.	0-30 Hz	0-100 Hz	LVDT
10.	Lat. Spring Disp. Sec. Susp. Truck 2	± 5 in.	0-30 Hz	0-100 Hz	LVDT
11.	Yaw Angle Truck 2	± 5 in.	0-30 Hz	0-100 Hz	LVDT
Axle Inertial			Accelerometers		
12.	Lat. Accel. Axle 1	± 25G	0-100 Hz	0-500 Hz	Strain Gage
13.	Lat. Accel. Axle 2	± 25G	0-100 Hz	0-500 Hz	Strain Gage
14.	Lat. Accel. Axle 3	± 25G	0-100 Hz	0-500 Hz	Strain Gage
15.	Lat. Accel. Axle 4	± 25G	0-100 Hz	0-500 Hz	Strain Gage
16.	Vert. Accel. Axle 1 - Right	± 25G	0-100 Hz	0-500 Hz	Strain Gage
17.	Vert. Accel. Axle 1 - Left	± 25G	0-100 Hz	0-500 Hz	Strain Gage

TABLE 1

PARAMETERS	RANGE	FREQUENCY RESPONSE	TYPE
Other			
18. Speed	0 - 150 mph	-	Optical Tach.
19. Automatic Location Detection (ALD)	-	-	Magnetic
20. Time-Code	-	-	
Operational Parameters			
21. Motor Current	0 - 1200 Amps	-	-
22 Braking Current	0 - 850 Amps	-	-

B. Coach Instrumentation	Range	Frequency Response Chart	Frequency Response Mag Tape	Type
23. Yaw Angle Truck #1	± 7 in.	0-30 Hz	0-100 Hz	LVDT
24. Roll Angle Right	± 7 in.	0-30 Hz	0-100 Hz	LVDT
25. Roll Angle Left	± 7 in.	0-30 Hz	0-100 Hz	LVDT
26. Lat. Accel. Carbody over Rear Truck Center	± sq.	0-20 Hz	0-100 Hz	SERVO

TABLE 2

LOCOMOTIVE PARAMETERS	VALUE	UNITS
Dimensional Data		
Distance Between truck Center and Lead Axle		ft.
Distance Between Truck Center and Middle Axle		ft.
Distance Between Truck Center and Trailing Axle		ft.
Distance Between truck Centers		ft.
Lateral Distance Between Primary Suspension		ft.
Height of truck Frame Center of Gravity		ft.
Height of Body Center of Gravity		ft.
Vertical Clearance Primary Suspension		ft.
Lateral Clearance Primary Suspension		ft.
Vertical Clearance Secondary Suspension		ft.
Lateral Clearance Secondary Suspension		ft.
Longitudinal Clearance Secondary Suspension		ft.
Wheel Diameter		ft.
MASS AND INERTIA DATA		
Body Mass		$lbs\text{-}sec^2/ft$
Truck Frame Mass		$lbs\text{-}sec^2/ft$
Wheelset Mass		$lbs\text{-}sec^2/ft$
Carbody Yaw Moment of Inertia		$lbs\text{-}ft\text{-}sec^2$
Carbody Roll Moment of Inertia		$lbs\text{-}ft\text{-}sec^2$
Truck Frame Yaw Moment of Inertia		$lbs\text{-}ft\text{-}sec^2$
Truck Frame Roll Moment of Inertia		$lbs\text{-}ft\text{-}sec^2$
Wheel Set Yaw Moment of Inertia		$lbs\text{-}ft\text{-}sec^2$

LOCOMOTIVE PARAMETERS	VALUE	UNITS
Spring Rates and Damping		
Lateral Primary Stiffness Per Axle		
Longitudinal Primary Stiffness Per Axle		
Lateral Secondary Stiffness Per Truck		
Yaw Secondary Stiffness Per Truck		
Vertical Primary Stiffness Per Truck		
Vertical Secondary Stiffness Per Truck Side		
Lateral Damping of Axle		
Longitudinal Damping of Axle		
Lateral Secondary Damping Per Truck		
Yaw Secondary Damping Per Truck		
Vertical Primary Damping Per Truck Side		
Vertical Secondary Damping Per Truck		
Miscellaneous		
Horsepower		
Description of Traction Units		
Description of Bearings		
Gear Ratios/Speeds		
Description of Braking System		