TANK CAR MANUFACTURING/REPAIR/RETEST FACILITY EVALUATION FORM

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16. Abstract

An evaluation form has been developed to aid Federal Railroad Administration (FRA) inspectors in recording data when examining tank car manufacturing and repair facilities, when inspecting newly constructed cars, or when examining cars which have been repaired or retested. Instructions and background information for entering data on the form are provided along with a copy of the evaluation form. The intent of the evaluation form is to emphasize those items which are covered by regulations given in the Code of Federal Regulations since the principal role of the FRA inspector would be to determine whether or not these requirements have been satisfied. The major sections of the evaluation form include information about:

- the inspector,
- the manufacturing, repair or retest facility,
- the characteristics of a particular tank car,
- the details of a tank car repair, alteration or conversion,
- the items to check on a newly manufactured car, and
- the tank car markings.

A database system for recording and storing the information entered on evaluation forms also has been developed. It is based on the Paradox database software, Version 4.0. The use of the database program is described and a hypothetical example is described.

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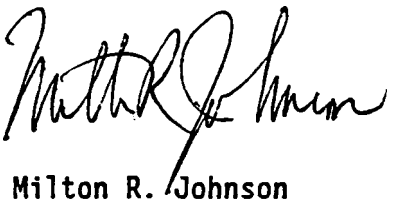
PREFACE

The work described in this report was conducted by IIT Research Institute (IITRI) under authorization of Federal Railroad Administration (FRA) Contract No. DTFR53-90-C-00042, Task Order No. 4. The period of performance was from December 1991 to August 1993. The work included the development of a form to assist FRA inspectors examining railroad tank car manufacturing, repair and retest facilities, and this report which presents background information and instructions for filling out the form.

Dr. Milton R. Johnson was the IITRI Project Manager for this work. He was assisted by Mr. William Peterman for the design of the database. Mr. Jose S. Pena was the FRA Task Monitor and Mr. Garold R. Thomas was the FRA Contracting Officers Technical Representative on this project. Their assistance throughout the course of the work is gratefully acknowledged.

Respectfully submitted,



Milton R. Johnson
Senior Engineering Advisor
Railroad Technology Center

Approved:

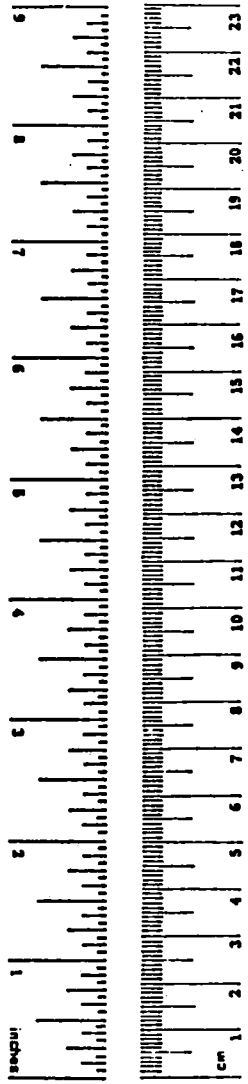
A. R. Valentino
Vice President
Applied Sciences

METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

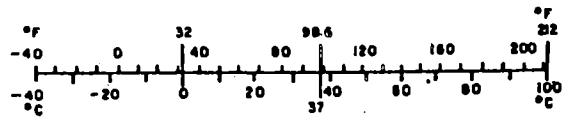
Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
	VOLUME			
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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EXECUTIVE SUMMARY

An evaluation form has been developed to aid Federal Railroad Administration (FRA) inspectors in recording data when examining tank car manufacturing and repair facilities, when inspecting newly constructed cars, or when examining cars which have been repaired or retested. Instructions and background information for entering data on the form are provided in this report. A copy of the evaluation form is included as an Appendix. The background information includes extensive quotations from two documents which govern the design, construction, and repair of railroad tank cars: the Code of Federal Regulations (CFR), Title 49, Transportation, and the Specifications for Tank Cars, Specification M-1002, published by the Mechanical Division of the Operations and Maintenance Department, Association of American Railroads.

The intent of the evaluation form is to emphasize those items which are covered by federal regulations given in the CFR since the principal role of the FRA inspector would be to determine whether or not these requirements have been satisfied.

The major sections of the evaluation form include information about:

- the inspector,
- the manufacturing, repair or retest facility,
- the characteristics of a particular tank car,
- the details of a tank car repair, alteration or conversion,
- the items to check on a newly manufactured car, and
- the tank car markings.

Only the sections of the form applicable to a given type of inspection (e.g., the qualification of a facility, or the examination of a repaired car) need be completed by an inspector.

A database system for recording and storing the information entered on evaluation forms also has been developed. It is based on the Paradox database software, Version 4.0, supplied by Borland International of Scotts Valley, CA. The use of the database program is described and a hypothetical example is provided.

FRA TANK CAR MANUFACTURING/REPAIR/RETEST FACILITY EVALUATION FORM

1. INTRODUCTION

1.1 OBJECTIVE

This report provides instructions and background information for entering data on the FRA TANK CAR MANUFACTURING/REPAIR/RETEST FACILITY EVALUATION FORM. This form has been developed to aid Federal Railroad Administration (FRA) inspectors in recording data when examining tank car manufacturing and repair facilities, when inspecting newly constructed cars, or when examining cars which have been repaired or retested. A copy of the form is included in Appendix A of this report.

A database system for recording and storing the information entered on evaluation forms also has been developed. It is based on the Paradox database software, Version 4.0, supplied by Borland International of Scotts Valley, CA. The database program is described in Appendix C of this report.

This report contains extensive quotations from two documents which govern the design, construction and repair of railroad tank cars: the Code of Federal Regulations (CFR), Title 49, Transportation, and the Specifications for Tank Cars, Specification M-1002, published by the Mechanical Division of the Operations and Maintenance Department, Association of American Railroads (AAR), which is commonly referred to as the Tank Car Manual (TCM). These documents are referenced by the initials CFR and TCM. The appropriate part and section number is given following the initials CFR.

Certain functions related to hazardous materials tank cars are, by regulatory delegation, vested in the AAR Tank Car Committee (TCC). See, for example, CFR 179.3. These include approvals for the construction of a particular tank car design and approvals for repair or alteration procedures. Therefore, the parts of the CFR dealing with tank car requirements contain frequent mention of the word "approved", which means approval by the TCC.

The intent of the inspection form is to emphasize those items which are covered by federal regulations given in the CFR since the principal role of the FRA inspector would be to determine whether or not these requirements would have been satisfied.

1.2 SCOPE

The section numbers in this report correspond to the section numbers on the inspection form. Section 1 deals with the purpose of the inspection and information about the individual making the inspection.

Section 2 of the inspection form deals with the capabilities of facilities where tank cars are built or repaired. The AAR requirements for certifying such facilities are indirectly part of the Department of Transportation (DOT) regulations. This follows from CFR requirements that welding be done in accordance with Appendix W of the TCM, which requires that welding be done in an AAR-TCC certified facility. TCC requirements for facilities are set forth in Appendix B of the TCM. Therefore, Section 2 of the inspection form is based primarily in Appendix B of the TCM.

Sections 3 and 6 to 11 of the inspection form pertain to new tank car construction. The items covered in these sections generally follow the requirements set forth in Subparts B through F of CFR 179. Since these aspects of tank car design and construction are specifically mentioned in the CFR, it would be important that an FRA inspector verify that they meet the requirements given in the CFR.

Sections 4 and 5 of the inspection form deal with the repair, alteration, conversion, or periodic retest of tank cars. Section 12 deals with the markings required on tank cars.

1.3 INSTRUCTIONS FOR COMPLETING FORM

The inspection form has been designed for the eventual entry of the information into a computerized database. Therefore, it is important to adhere to the following instructions when completing the form:

- If the response calls for either "yes" or "no" (or "yes" or "no or NA"), put an X in the appropriate box. If there is some reason the question cannot be unambiguously answered by one of the choices given, put the letter A in the "yes" box, and append a statement, referencing the section number of the question, explaining why the question cannot be answered.

- If the response calls for the entry of specific data, observe the following: An elongated box divided into a number of spaces is provided. Enter the data, using one space for each letter, numeral or punctuation mark. If a meaningful response cannot be given within the

provided number of spaces, enter the letter A in the first space, leave the rest of the spaces blank and append a statement giving the information and referencing the section number of the question.

- An entry should be made on each line of the inspection form unless the statement on the line is not applicable to the inspection. The box for entering data can then be left blank.

1.4 SECTION 1 OF EVALUATION FORM

Section 1 of the inspection form deals with the type of inspection for which the form will be used and the sections which must be completed for each type of inspection. The evaluation form will be used for one of four types of inspections: the inspection of a tank car construction, repair or retest facility (which would not involve the inspection of individual tank cars); the inspection of a newly constructed tank car; the inspection of a tank car which has been repaired, altered or converted*; or the inspection of a tank car which is undergoing periodic retest. Since the form may be used for one or more of these types of inspections at a given location, each set of boxes should be checked in Section 1.2. Next, the appropriate boxes should be checked to indicate the sections of the form on which data have been entered. Finally, the location where the inspection took place should be entered. Note that each type of inspection requires the completion of only certain sections of the form.

Section 1 of the inspection form also provides for entering information about the individual using the form. The inspector completing the form is asked to enter their name, inspector number (if any), and home office location (only city and state are required).

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*The TCM, Appendix R, Section R2.00 defines these terms as follows: REPAIR means reconstruction of a tank to its original design. ALTERATION means a change in tank or fittings that does not change the specification but which does change the Certificate of Construction. CONVERSION means a change in tank or fittings that changes the specification.

2. FACILITY INFORMATION

2.1 TYPE OF FACILITY

Section 2 of the form is to be used when the capabilities of a tank car manufacturing, repair or retest facility are being examined. Since these facilities are to be certified by the AAR TCC, most of the items in this section relate to requirements given in Appendix B of the TCM.

Indicate the type of work done at the facility. Check one of the boxes on each line. If more than one type of activity is performed, one, two or three of the boxes can be checked "yes".

2.2 COMPANY DATA

Enter the descriptive data requested in this section.

2.3 EXTENT OF FACILITY CERTIFICATION

This section pertains to facilities where welding is done on tank cars. If the facility is used only to retest tank car tanks, interior heater systems, or valves, check the indicated box.

The TCM, Appendix B, describes AAR requirements for certification of facilities for fabrication, assembly, alteration, conversion, repair, and associated testing of completed tank car tanks as required by AAR and DOT specifications for tank cars. Each facility that is to perform welding on tank car tanks must be certified by the AAR.

The type of work that can be conducted at the facility is described by three descriptors:

Specification categories,
Material groups, and
Facility class

The specification categories are defined as follows:

(I) All AAR and DOT specifications for tanks, except categories II and III,

(II) DOT 179.300 Multi-unit tank car tanks (DOT-106A, 110A), and

(III) DOT 179.500 Seamless steel tank car tanks (DOT-107A).

The material groups include the following:

Group 1, Carbon Steel Plate

ASTM A515, Gr 70
ASTM A285, Gr A
ASTM A285, Gr B
ASTM A285, Gr C
ASTM A516, Gr 70
AAR TC128, Gr B
Manganese-molybdenum steel plate, ASTM A302, Gr. B
Manganese-silicon steel plate, ASTM A537, Cl. 1

Group 2, Aluminum Alloy Plate

ASTM B209, Alloy 5052
ASTM B209, Alloy 5083
ASTM B209, Alloy 5086
ASTM B209, Alloy 5154
ASTM B209, Alloy 5254
ASTM B209, Alloy 5454
ASTM B209, Alloy 5652

Group 3, High Alloy Steel Plate

ASTM A240, Type 304
ASTM A240, Type 304L
ASTM A240, Type 316
ASTM A240, Type 316L

Group 4, Nickel Plate

ASTM B162

Group 6, Open-Hearth or Electric Steel Defined in the CFR 179.500-5

Description	Class 1 (percent)	Class II (percent)	Class III (percent)
Carbon, maximum	0.50	0.50	0.53
Manganese, maximum	1.65	1.65	1.85
Phosphorous, maximum	.05	.05	.05
Sulphur, maximum	.06	.05	.05
Silicon, maximum	.35	.30	.37
Molybdenum, maximum		.25	.30
Chromium, maximum		.30	.30
Sum of manganese and carbon not over	2.10	2.10	

Note - Alternate steel containing other alloying elements may be used, if approved.

Group 7, Nickel Alloy Steel Plate

AAR TC 133

AAR TC 134

The facility classes are defined as follows:

Class A - Fabricate, repair, alter, convert or assemble.

Class B - Repair, alter, convert or assemble.

Class D - Tank fabrication or repair. Confined to tank car tanks that are moved to and from the facility without trucks (running gear).

Under specification Category I there are 5 possible material groups: 1, 2, 3, 4 and 7; under Category II there can be only one material group, 1; and under Category III there is only one material group, 6. For any permitted combination of specification category and material group, one of these facility classes (A, B or D) must apply or no work may be authorized. Thus, there should be an entry on every line in Section 2.3, either the entry of a letter in the permitted work class box, or an "X" placed in the "none" box.

Facilities are certified for a 5 year period and must be recertified before the end of this period. Enter the certification expiration date as indicated. When a certified facility changes ownership recertification procedures must be initiated within 90 days.

2.4 FACILITY ACTIVITY

Both parts of this section should be completed unless the facility is used only for retest.

2.5 FACILITY ACTIVITY, RETEST

Complete this section even if the facility is primarily a repair or construction facility.

2.6 EQUIPMENT

Appendix B of the TCM presents requirements for facilities that fabricate, repair or alter tank cars as well as the procedures for their certification. Section B4.02 of the appendix describes the equipment each facility is required to possess and maintain. Section B5.02 describes the information about the processing and test equipment that must be provided when a facility is submitting an application for certification to work on tank cars. The application must include certain information about processing and test equipment.

Section 2.6 of the inspection form, which includes Subsections 2.6.1 to 2.6.8, provides a check list of the major items specified in the TCM requirements. By determining the presence or absence of these items one can get a good overall appreciation of the capability of the facility and whether or not it meets TCM requirements.

Examine the facility for each of the items listed in Sections 2.6.1 through 2.6.5 and indicate whether or not they are present.

Heat Treatment Equipment

Appendix W, Section W17.02 of the TCM states that the preferred method for postweld heat treatment of a tank is to enclose the tank as a unit in a furnace. A tank may be heat treated in more than one heat in a furnace provided that the overlap of the heated sections is at least 5 feet and that any portion outside of the furnace is shielded so that the temperature gradient is not harmful to the tank.

Appendix R, Section R21.03 permits local postweld heat treatment of some welded repairs on carbon steel tanks provided controlled gas or electric heating devices are used that will provide a constant and uniform temperature to an area at least six times the plate thickness on each side of the weld.

Indicate in Section 2.6.6 on the inspection form whether or not the listed equipment is present at the facility.

Testing Equipment

Appendix W, Section W2.00 of the TCM presents definitions of certain nondestructive testing methods.

LIQUID PENETRANT INSPECTION is a nondestructive test method utilizing contrasting liquids/dyes that penetrate to highlight discontinuities open to the surface (cracks, porosity, seams, etc.). Indicate on the inspection form if this equipment is available at the facility.

MAGNETIC PARTICLE INSPECTION is a nondestructive test method utilizing variations in magnetic fields to detect discontinuities at or slightly below the surface. It is limited to ferro-magnetic materials. Liquid dye penetrant and magnetic particle inspections are required as part of certain tank car repair procedures (See Section 4.2.8). Indicate on the inspection form if this equipment is available at the facility.

Hardness tests are required following butt welded repairs to pressure car tanks made of carbon steel plate (See Section 4.2.8). Indicate on the inspection form if this equipment is available at the facility.

RADIOSCOPY is a nondestructive test method of observing the internal characteristics of objects that are opaque to light with X-rays or gamma rays, specifically with radiographic or fluoroscopic techniques. The radiographic inspection of welds is required for new construction and repairs under certain conditions. Indicate the availability of this equipment at the facility on the inspection form. The detailed requirements for radioscopic procedures are given in Appendix W, Section W11.02 of the TCM. Either X-rays or gamma rays may be used. Indicate the types on the inspection form. The AAR requirements include that detailed procedures must be established to insure acceptable radiographs are obtained. Review the procedures and indicate their acceptability on the inspection form.

AAR requirements also include that a complete set of radiotapes for each tank must be retained for not less than five years by the tank fabricator (or the car owner if he so desires). Indicate on the inspection form if there is an adequate film storage capability and an adequate system for maintaining the files at the facility.

Indicate on the inspection form if the facility has the equipment needed to conduct tank and heater coil pressure tests in accord with the requirements summarized in Section 5.

Indicate on the inspection form if the facility has the equipment needed to check the start-to-discharge and vapor tight pressures of safety relief valves.

Tension and bend test machines are required to conduct tests used to evaluate welding procedures, welder performance and production welding (See Appendix W, Section W5.01 of the TCM). Indicate on the inspection form if this equipment is available at the facility.

Indicate on the inspection form if ultrasonic and acoustic emission equipment are available at the facility.

ULTRASONIC INSPECTION is a nondestructive test method that transmits ultrasonic energy through the test material to detect internal and surface discontinuities. It is also used for thickness measurements.

ACOUSTIC EMISSION INSPECTION is a nondestructive test method, utilizing sounds emitted by materials when under stress, to detect internal or surface discontinuities.

Calibration Equipment

Each inspection technique utilizing quantitative measurement requires calibration to insure correct values are being obtained. Review the calibration equipment at the facility to insure its sufficiency to check equipment and indicate the result on the inspection form.

2.7 PERSONNEL

2.7.1 QUALITY CONTROL PERSONNEL

Appendix B, Section B4.01 of the TCM, describes minimum requirements for personnel qualifications. These include, in part, that all certified facilities have at least one qualified welding inspector per American Welding Society (AWS) WIQC-1 or Canadian Standards Association (CSA) W178.2 Level 2. Enter on the inspection form the number of weld inspectors meeting this criteria and whether or not their certification records are on file.

Section B4.01 further requires that all welding inspectors at certified facilities must be qualified as a Welding Inspector or Associate Welding

Inspector per AWS WIQC-1 or CSA W178.2 Level 1, except that at those facilities which maintain an in-house training program the inspection personnel may be considered exempt from the requirements provided their facility application outlines the details of the program. The minimum requirements of the program must be comparable to the AWS or CSA welding inspector programs. Indicate on the inspection form if an in-house training program for welding inspectors is used.

Section B4.01 also requires that all certified facilities must have at least one qualified radiographer per American Society of Nondestructive Testing (ASNT) Spec. SNT-TC-1A, Level II. Enter on the inspection form the number of qualified radiographers and whether or not their certification records are on file.

2.7.2 WELDERS

Appendix B, Section B4.01 of the TCM states, in part, that all personnel engaged in welding on tank car tanks must be performance-qualified for each welding procedure under which they do welding. Enter on the inspection form the number of qualified welders at the facility and whether or not their certification records are on file.

2.8 SUBCONTRACTORS

Appendix B, Section B3.04(d) of the TCM requires that all work performed by outside subcontractors for a certified facility must be verified by the certified facility for compliance with all applicable specifications and regulations. Also, Section B4.02(b) requires that a subcontractor evaluation sheet, (AAR Form Exhibit B-1), must be maintained in the facility's file for each outside subcontractor and must be submitted to the TCC with the request for facility certification. If subcontractors are used, enter the requested information on the inspection form. (For more than one subcontractor, append additional data.)

2.9 QUALITY CONTROL DOCUMENTATION

Appendix W, Section W10.03 of the TCM requires that each facility must maintain a "Welding Procedure Specification" for each of its qualified welding procedures and must maintain records of test results obtained in the qualification of welding procedures, a "Procedure Qualification Record," and the performance qualification of welders and welding operators. These records must be attested by a responsible official of the facility and must be accessible.

Check to see that these documents are on file and indicate the results on the inspection form.

Under the AAR Specification for Quality Assurance, M-1003, a contractor is required to have an approved Quality Assurance Manual. Check to see that this document is on file and indicate the result on the inspection form.

3. TANK CAR INFORMATION

Section 3 of the evaluation form pertains to an inspection which involves the examination of a tank car. It is designed to record certain information about the car.

3.1 DESCRIPTION

DOT Specification Number

If a DOT specification number is assigned to a tank it signifies that the tank car is subject to federal regulations given in the CFR because it is to be used for the transportation of hazardous materials in commerce (CFR 179.1). The CFR also indicates that when a tank is marked with a DOT specification, compliance with the associated requirements is the responsibility of the tank builder. Marking the tank with the DOT specification is understood to certify compliance by the builder that the functions performed by the builder, as prescribed in the CFR, have been performed.

The complete significance of the specification number and its relationship to the "class" of the car is described in Section 1.2.3.1 of the TCM as follows:

DOT tank car specification numbers consist of a class designation followed by identifying letters and numbers.

The class of a tank car is a general designation usually including several specifications, for example "Class DOT-111A" or "Class DOT-111A***W*." The word "class" is used if the designation embraces several specifications. The specification of a tank car is the specific designation within a class, for example "Spec. DOT-111A100W2."

The second number, where present, indicates tank test pressure in psi. In all classes except 103, 104, and 113, the two number series are separated by an "A" which has no special significance. Suffix "W" denotes a fusion-welded tank; suffix "F" denotes a forge welded tank and suffix "X" has special significance as discussed below. The absence of a suffix indicates seamless tank construction.

Class DOT-103*W tank cars are insulated or uninsulated non-pressure cars with an expansion dome. The expansion capacity in the dome is listed below. Class 103*W cars built for specific services or requiring special fittings or

materials of construction are designed by letters interposed for the asterisk as follows:

	Tank	Bottom Outlet	Bottom Washout	Minimum % Expansion
No ltr	carbon steel			2
A	carbon steel	no		1
AL	aluminum alloy			2
A-AL	aluminum alloy	no		1
AN	nickel	no		1
B	carbon steel, elastomer lined	no	no	1
C	alloy steel	no	no	1
D	alloy steel			2
E	alloy steel	no		1

Class DOT-104W tank cars are insulated carbon steel non-pressure cars with an expansion dome and having a minimum expansion capacity of 2 percent in the dome.

Class DOT-105A, J or S***W tank cars are insulated carbon steel pressure cars, with a manway nozzle, designed for top loading and unloading; a bottom outlet or washout is prohibited. Class 105A or J***ALW tank cars are similar except that they have aluminum alloy tanks. Class 105A***F has forge welded tanks. The letters are defined as follows:

A means equipped with top and bottom shelf couplers,
J means equipped with jacketed thermal protection, tank head puncture resistance and top and bottom shelf couplers,
S means equipped with tank head puncture resistance and top and bottom shelf couplers.

Class DOT-106A***X tanks are uninsulated carbon steel tanks designed to be removed from the car structure for filling or emptying, and designed to a maximum stress level in the shell.

The letter code is defined as follows:

X means fusion-welded longitudinal tank seam and forge welded heat seams,
XNC means nickel clad,
NCI means nickel - chromium - iron.

Class DOT-107A**** tank cars are uninsulated high pressure service cars having several permanently mounted seamless forged and drawn steel tanks. These tanks are designed to a maximum stress level in the shell.

Class DOT-109A***W tank cars are insulated or uninsulated carbon steel pressure cars with a manway nozzle, designed for top loading and unloading, bottom washout optional. Class DOT-109A***ALW tank cars are similar except they have aluminum alloy tanks.

Class DOT-110A***W tanks are uninsulated carbon steel tanks designed to be removed from the car structure for filling or emptying, and designed to a burst pressure.

Class DOT-111A***W* tank cars are insulated or uninsulated non-pressure cars without an expansion dome. The expansion capacity in the tank is two percent. Class DOT-111A***W* tank cars built for specific services or requiring special fittings or materials of construction are designated by suffix letters or numerals. Class DOT-111A***F* have forge welded tanks converted from Spec. ICC-105A300, 400, or 500. Suffix letters are:

	Tank	Bottom Outlet	Bottom Washout
ALW1	aluminum alloy		
ALW2	aluminum alloy	no	
W1	carbon steel		
W2	carbon steel	no	
W3*	carbon steel		
W4*	carbon steel	no	no
W5	carbon steel, elastomer lined	no	no
W6	alloy steel		
W7	allow steel	no	no
F1	carbon steel		
F2	carbon steel	no	

*Insulation required.

Class DOT-112A, J, S, or T***W tank cars are carbon steel pressure cars, with a manway nozzle and without bottom connections, designed for top loading and unloading. They are designed for loading of liquified compressed gases or flammable liquids.

A means equipped with top and bottom shelf couplers, and uninsulated,
J means equipped with jacketed thermal protection, tank head puncture resistance, and top and bottom shelf couplers,
S means equipped with head shields and top and bottom shelf couplers, and uninsulated,
T means equipped with non-jacketed thermal protection system, top and bottom shelf couplers and head shields.

Class 112A, J, S or T***F tank cars are similar except they are forge-welded tanks converted from Class ICC-105A.

Class DOT-113****W tank cars are vacuum insulated cars having an inner container and carbon steel outer shell. The insulation system is designed for a holding time. Class DOT-113 cars are designed for specific loading and shipping temperatures and have certain materials and fittings requirements as designated by the intermediate letter:

A means Minus 423F (-253°C) loading; high alloy steel inner container; special fittings and insulation for refrigerated (cryogenic) liquid hydrogen.
C means Minus 260F (-162°C) loading; high alloy steel inner container; special fittings for refrigerated (cryogenic) liquid natural gas, refrigerated (cryogenic) liquid methane (DOT exemption required), or refrigerated (cryogenic) liquid ethylene.
D means Minus 155F (-104°C) loading; nickel alloy steel inner container; special fittings for refrigerated liquid ethane (DOT exemption required) or refrigerated (cryogenic) liquid ethylene.

Class DOT-114A, J, S or T***W tank cars are carbon steel pressure cars with a manway nozzle and optional non-circular cross section. An additional group of valves and fittings may be provided in another location. They are designed for loading of liquified compressed gases or flammable liquids.

A means equipped with top and bottom shelf couplers, and uninsulated,
J means equipped with jacketed thermal protection, tank head puncture resistance, and top and bottom shelf couplers,
S means equipped with head shields and top and bottom shelf couplers, and uninsulated,
T means equipped with non-jacketed thermal protection system, top and bottom shelf couplers, and head shields.

Class DOT-115A***W* tank cars are insulated non-pressure cars having an inner container and carbon steel outer shell with optional bottom connections.

Suffix letters are:

W1 means Steel inner container,
W6 means Alloy steel inner container,
ALW means Aluminum inner container.

Proposed Class DOT-120***W tank cars are insulated pressure cars designed for ambient temperature loading of liquified compressed gases and/or flammable liquids. Proposed Class DOT-120***ALW tank cars are similar except that they have aluminum alloy tanks.

Enter the complete specification number of the car on the inspection form.

Car Identification

The car identification consists of a sequence of letters, called the reporting mark, which designates the railroad or private car company operating the car, followed by a number. The reporting mark is assigned by the AAR Transportation Division. The car number is assigned by the operator. Enter the reporting mark and the car number on the inspection form.

Intended Commodity Service

If the tank car is stencilled to indicate that the car is to be used in the transportation of a specific commodity, enter the name of the commodity on the inspection form.

Water Capacity

The water capacity of a car is defined in the TCM Appendix C, Section 3.03(a) as follows:

Non-pressure tank cars: shell full volume, not including manway or dome,
Pressure tank cars: shell full volume, and
Component tank cars: shell full volume of each compartment.

The term "shell full" refers to the volume corresponding to a liquid level at the inside top of the shell at the manway opening or dome ring opening. Enter the water capacity on the inspection form.

Light Weight

The light weight of the car is the scale weight of the unloaded car. Enter the light weight on the inspection form.

Load Limit

The load limit is the difference between the allowable total weight on the rail for the journal size and the light weight of the car. On some cars the nominal capacity may be stenciled instead of the load limit. This is being changed and any tank car not stenciled with the load limit must have the load limit stencil applied and nominal capacity stencil removed before January 1, 1993. Enter the load limit on the inspection form.

Specification Conversion

Under certain conditions a tank car may be converted from one specification to another (see, for example, the CFR 173(c)(7)). If it can be definitely established that the car has or has not been converted, check either the "yes" or "no" box. If this cannot be established, check the "unknown" box.

3.2 CERTIFICATION OF CONSTRUCTION

The requirements for the submission of a Certificate of Construction are given in the CFR 179.5. They state that before a tank car is placed in service, the party assembling the completed car must furnish a Certificate of Construction, Form AAR 4-2, to the owner, the Bureau of Explosives and the Secretary, Mechanical Division, AAR, certifying that the tank, equipment, and car completed comply with all the requirements of the specification. Enter the date of the Certificate of Construction on the inspection form.

Before a tank of Class DOT 106A, 107A or 110A is placed in service, the builder must in addition provide a Certificate of Inspector's Report certifying that the tank and appurtenances comply with all the requirements of the specifications.

3.3 CONSTRUCTION DATE

The construction (or built) date of a tank car is defined in the TCM, Section 1.2.2, as follows: The built date of a tank car is the date (month and year) that the completed car is shipped from the car builder's facility. Tank cars shipped to a lining applicator, whether or not returned to the car builder after lining, are considered "built" as of the first departure from the car builder's facility. Enter the construction date on the inspection form.

3.4 RETEST REQUIREMENT

The date of the last test of the tank should be stenciled on the side of the tank. The due date for the next test should also be stenciled on the tank. This should agree with the retest interval prescribed in the CFR 173.31 (See Section 5 of this report). Enter these dates on the inspection form.

The test report(s) may not be available at the time of the inspection. Section 173.31(d)(8) of the CFR requires that the reports must be submitted to the car owner and retained until the next retest has been conducted and recorded. Indicate on the inspection form whether or not the test report is available to the inspector.

If the car is equipped with an interior heater system or a safety relief valve, these items also will be subject to retest requirements (See Section 5). If applicable, enter the last test date, retest due date, and the availability of the test report.

4. REPAIR, ALTERATION OR CONVERSION

4.1 REPAIR - BACKGROUND INFORMATION

This section will be filled out if the inspection pertains to the repair of a tank car. Then check the "yes" box at the end of the Section 4.1 line. Repair means reconstruction of a tank to its original design.

4.1.1 DEFECT

Check all items that apply.

Dent

Dent means a deformation that changes the tank contour from the original manufactured state. The location of the dent should be identified by the location code shown in Appendix B. This figure is based on Exhibit R1 in the TCM. A marked copy of the figure should accompany the inspection form. Measure the length and width of the dent and enter the dimensions on the inspection form. Measure the maximum depth of the dent with respect to the original contour of the tank.

Fracture

Designate the location of the fracture using the location code of Appendix B. Include a marked copy of the figure showing the location of the fracture. measure the length of crack and enter on the inspection form.

Pits or Corrosion

These defects would normally be due to normal wear and tear and develop over an extended period of time.

Scores or Gouges

Score means a narrow deformation, caused by mechanical means, where the parent or weld metal is upset and relocated. Gouge means a deformation, caused by mechanical means, that results in the loss of parent or weld metal.

Wheel Burn

Wheel burn means damage to tank shell due to frictional contact with rotating wheel, resulting in metal flow and/or discoloration due to frictional heat.

Manway or Closure Plate

Check this box if the manway or closure plate is damaged.

Valves

Check this box if loading or unloading valves or associated piping is damaged.

Safety Relief Device

Check this box if safety relief valve or vent or associated structure is damaged.

Interior Heater Pipes

Check this box if interior heater pipes or connections are damaged.

Other

If the damage cannot be identified with any of the above topics, check this box and append a description of the damage to the form.

4.1.2 CAUSE

Check all the boxes in this section that apply.

Normal Wear and Tear

Check this box if the cause is not due to an accident, but to normal wear and tear leading to corrosion, leaky gaskets, etc.

Derailment

Check this box if it is known that the damage is due to a train derailment.

Derailment and Collision with Fixed Object

Check this box if it is known that the damage is due to a train derailment and the subsequent collision of the car with one or more fixed objects along the track.

Derailment and Collision with Other Cars

Check this box if the damage is due to a train derailment and the subsequent collision of the tank car with one or more railroad cars or locomotives.

Fire

Check this box if the tank car was subject to the effects of fire. Estimate the percent of the surface of the tank which was exposed to fire and enter the value on the form as a decimal (e.g. 0.30).

Other

If none of the above categories fit the cause of the damage to the tank car, check the appropriate box and append a description of the cause of the damage to the inspection form.

Unknown

If the cause of the defect is unknown, check the "yes" box on this line.

4.2 REPAIR PROCEDURES

The CFR 173.31 (f) states that the procedures to be followed in securing approval and making repairs, alterations, or conversion to all tank car tanks, are those outlined in the TCM, Appendix R. After repairs, alterations, or conversions of a tank car tank are made that could result in a possible reduction in the tank wall thickness at any point, the thickness of the tank car tank must be measured in the affected area to verify that the tank thickness meets the requirements of the applicable tank specification, except as provided in 173.3(a)(11), where certain localized reductions in wall thickness are permitted.

Subsections 4.2.1 to 4.2.6 deal with specific types of repairs and refer to sections in the Appendix R of the TCM where a detailed set of requirements are given for the repair procedure.

4.2.1 FRACTURE

There are three basic ways of repairing fractures: welding, welding and applying a reinforcing patch, or removing the defective area and replacing it by a welded insert (or riveted insert in the case of riveted cars). Indicate the technique used for the repair on the inspection form as well as the dimensions of the repair. See TCM, Appendix R, Sections R11.0 and R14.0 for more detailed requirements for the repair procedures.

4.2.2 PITS AND CORROSION

There are different requirements if the defect area is in a weld or on the plate of the tank. In a weld area, the weld can be ground and rewelded. On the

plate the defective area can be ground and rewelded, or if the integrity of the tank is affected, the area must be removed and replaced by an insert. Indicate the type of repair on the inspection form and the size of the repaired area. See TCM, Appendix R, Sections R12.0 and R14.0 for more detailed requirements for the repair.

4.2.3 DEFORMATION AND SCORING

Dent or Buckle

If the sharpest radius formed by the dents or buckle is at least four times the plate thickness, the dent or buckle may be removed by pressing or jacking to restore the original contour.

After complete removal of a deformation, the interior and exterior surfaces of the affected area must be examined for surface cracking.

If the sharpest radius formed by the dent or buckle is less than four times the plate thickness or if the material thickness has been reduced, the affected area must be removed and replaced.

Enter the type of repair and the size of the affected area on the inspection form. See TCM, Appendix R, Sections R13.01 to R13.03 and R14.00 for more detailed requirements for the repair.

Scores and Gouges

Scores or gouges associated with dents must be prepared first by restoring the dented area to original contour. The score or gouge must then be prepared by grinding or by air-carbon arc gouging to sound metal removing all upset metal and injurious defects.

If the plate has been reduced more than 0.010 inch (0.254 mm) below the specified shell thickness, it must be restored or replaced by using an insert. The thickness may be restored by fusion-welding and the surface ground flush.

Enter the type of repair and the size of the affected area on the inspection form. See TCM, Appendix R, Sections R13.04 and R14.00 for more detailed requirements including inspection requirements.

Wheel Burn

Wheel burn refers to damage to the tank shell caused by wheel contact. Normally this would only occur during a derailment.

Wheel burns that do not exceed 1/16 inch (1.58 mm) in depth and 6 inches (152 mm) in length, width not limited, can be repaired by grinding, provided the shell thickness following grinding is not less than the minimum allowable thickness. Wheel burns that do not exceed 3/16 inch (4.76 mm) in depth and 12 inches (305 mm) in length can be repaired by fusion-welding and the surface ground flush. Wheel burns in excess of these limits must be repaired by insert.

Enter the type of repair and the size of the affected are on the inspection form. See TCM, Appendix R, Sections R13.05 and R14.00 for more detailed requirements including inspection requirements.

4.2.4 CONNECTIONS ADDED, RELOCATED OR ELIMINATED

Connections, such as nozzles, may be added or relocated on dome heads and tank shells when approved procedures are followed.

Miscellaneous connections through the tank shell or heads, when added, relocated or eliminated, and closures for openings may be fusion-welded by a double-welded butt joint, or a double full fillet lap joint, or these closures may be riveted. Note that this permits riveted connections on welded tanks.

When welded inserts are applied to cover riveted nozzle openings, the openings must preferably be increased in diameter, so that the rivet circle is removed, and an insert large enough to cover the entire area applied. When necessary to close rivet holes, the holes must be plug-welded and radiographed.

Indicate on the inspection form whether or not a closure of an opening was required, and, if so, the technique used. See TCM, Appendix R, Sections R16.01 to 16.04 for more detailed requirements.

Nozzles and domes attached to the tank shell must be designed to meet certain approved reinforcement requirements set forth in Appendix E of the TCM. Postweld heat treatment is required. See TCM, Appendix R, Section R16.05 for more detailed requirements.

4.2.5 ATTACHMENTS

In general, reinforcement pads will be required for attachments to the tank. The CFR (See Sections 179.100-16, 179.200-19, and 179.220-20) requires that reinforcing pads must be used between external brackets and shells if the attachment welds exceed 6 inches of 1/4 inch fillet or equivalent weld per bracket or bracket leg. When reinforcing pads are used, they must not be less

than 1/4 inch in thickness, have each corner rounded to a 1 inch minimum radius, and be attached to the tank by continuous fillet welds except for venting provisions. The ultimate shear strength of the bracket to reinforcing pad weld must not exceed 85 percent of the ultimate shear strength of the reinforcing pad to tank weld.

The TCM, Appendix R, Section R17.02, further states that exterior or interior brackets, supports and reinforcement bar pads may be fillet welded to tank shell, without postweld heat treatment, provided welds do not exceed 3 inches (76.2 mm) in length for any intermittent welding (skip or stepback welding permitted), and the total length of the welds does not exceed 24 inches (610 mm) per bracket, support or reinforcing bar pad.

Also note the recent requirement, CFR 173.31(a)(7), that effective July 1, 1991, no railroad tank car, regardless of its construction date, may be used for the transportation in commerce of any hazardous material unless the air brake equipment support attachments of such tank car comply with the standards for attachments set forth above.

Enter on the inspection form whether or not a pad was used for the attachment, and, if so, its size.

4.2.6 STUB SILL

The replacement of a stub draft sill is a major repair. The TCM, Appendix R, Section R18.00 states that stub draft sills may be fusion-welded to bottom reinforcement plates. Tanks mounted on underframes may also be modified by attaching welded stub draft sills. When all welding to the tank has been completed, regardless of attachment design, the tank must be postweld heat treated.

Indicate on the inspection form if the stub sill was repaired or replaced.

4.2.7 OTHER REPAIRS

If the type of repair is not covered by any of the above categories, check the yes box on the inspection form, and append a description of the repair.

4.2.8 NONDESTRUCTIVE TESTING

Radiography

The requirements for radiographic examination following repair are given in the TCM, Appendix R, Section R20.01.

Butt welds must be examined throughout their entire length by radiography. When a deformation has been removed, all weld seams in that area and 2 inches (50.8 mm) beyond must be radiographed.

When uniform inserts, tank sections or heads are being welded on a series of tanks of the same material, using the same welding procedures and practices as in new construction, it may be possible to use less than 100 percent of radiographic weld inspection. Procedures given in the TCM, Appendix W, Section W19.00 apply. The radiographs must be retained for five years.

Indicate on the inspection form if radiography was required following the repair, and, if so, if the radiographs were retained.

Liquid Penetrant Examination

Liquid dye penetration examination (or magnetic particle examination) may be required during the repair of fractures, dents, buckles, scores, gouges or wheel burn. (See TCM, Appendix R, Sections R11.00 and R13.00.) The procedures and basis of evaluation and acceptance are given in the TCM Appendix W, Section W11.03.

Indicate on the inspection form if liquid penetrant examination was used.

Magnetic Particle Examination

Magnetic particle inspection (or liquid dye penetrant examination) may be required during the repair of fractures, dents, buckles scores, gouges or wheel burn. (See TCM, Appendix R, Sections R11.00 and R13.00.) The procedures and basis of evaluation and acceptance are given in the TCM Appendix W, Section W11.04.

Indicate on the inspection form if magnetic particle examination was used.

Ultrasonic Examination

Indicate on the inspection form whether or not an ultrasonic examination was made. The procedures and basis of evaluation and acceptance are given in the TCM, Appendix W, Section W11.05.

Acoustic Emission Examination

Indicate on the inspection form whether or not an acoustic emission test was conducted.

Hardness Test

Indicate on the inspection form whether or not hardness tests were conducted. The TCM, Appendix R, Section R10.00 requires that butt welded repairs, in pressure car tanks that are constructed of carbon steel plate materials, must be tested for hardness. Each weld must be checked at one point inside and one point outside the tank at the centerline of the weld. Weld hardness must not exceed Brinell 225 (Rockwell 20) after postweld heat treatment.

4.2.9 POSTWELD HEAT TREATMENT

Postweld heat treatment requirements are given in the TCM, Appendix R, Section R21.00. These include, in part, that after all welding is complete, postweld heat treatment of the tank, as a unit or by the double ended method, is preferable for carbon steel tanks. Postweld heat treatment of the tank as a unit is mandatory for high alloy steel tanks, except tanks fabricated from Types 304L or 316L materials.

In lieu of unit postweld heat treatment for carbon steel tanks, local postweld heat treatment may be employed. Approved stress relieving equipment must be used, such as controlled gas or electric heating devices that will provide a constant and uniform required temperature to an area at least six times the plate thickness on each side of the weld.

Postweld heat treatment may be omitted under certain conditions including:

When specifically permitted for the type of repair.

For single or double butt welds not exceeding 3 inches (76.2 mm) in length.

For intermittent fillet welds (skip or step back welding permitted) not exceeding 3 inches (76.2 mm) in length, 1/4 inch (6.35 mm) in throat thickness, when the total length of these welds per attachment does not exceed 24 inches (610 mm).

Enter the type of heat treatment used on the inspection form. If heat treatment is not required, append a statement regarding the basis for this to the form.

4.2.10 FIRE DAMAGED TANK REPAIR

The repair of fire damaged tanks is governed by the CFR 173.31(e). It states that tank car tanks of other than classes DOT 106A, 107A or 110A bearing evidence of damage to the metal by fire must be withdrawn from transportation

service except that if the damage to the tank is local only or confined to not more than 25 percent of the tank surface, the damaged material may be replaced.

Tank car tanks of classes DOT 106A, 107A or 110A bearing evidence of damage to the metal by fire must be withdrawn from transportation service until they have been inspected inside and outside to determine that no reduction in wall thickness has resulted, and have been heat treated and retested. These operations must be carried out, supervised and reported as prescribed by the specifications for original heat treatment and test.

AAR requirements (TCM, Appendix R, Section R24.01) include that:

- Parts or portions of a tank car tank that have been exposed to fire, or heat sufficient to render their performance unsafe, must be replaced.
- Unsafe parts or portions must be identified by physical testing of removed material, or by evaluation of the physical condition of materials on the tank car tank, such as paint film, insulation, gasket materials, surface oxidation film, etc.
- Detailed evidence of the safe condition of any part or portion of the tank car tank that is to be retained in service must be submitted for approval using Form 4-2.
- All valves and fittings must be removed, overhauled and tested according to the valve manufacturers' instructions for suspected overheating.

Indicate on the inspection form if the AAR Form 4-2 has been submitted and if the valves and fittings have been removed and retested.

4.2.11 AAR R-1 REPORT

The CFR 173.31(f)(1) requires that the procedures given in Appendix R of the TCM be followed when making repairs to tank cars. This includes the preparation and submission of an R-1 form. The procedures given in Section 4.00 of this Appendix include that:

- When repairs, alterations or conversions to tank car tanks are to be made using procedures or materials which have not been previously approved, an application for approval must be submitted to the AAR Tank Car Committee and to the Secretary for distribution to other Mechanical Division committees, when applicable. Tank cars must not be returned to service until approval has been granted.

- When repairs, alterations or conversions to tank car tanks are to be made using previously approved procedures and materials, an Exhibit R-1 report, in compliance with this Appendix, must be submitted, by the company performing the work, to the car owner, Bureau of Explosives and Secretary, Mechanical Division, AAR. Companies with multiple facilities may submit Exhibit R-1 reports from one location. Tank cars must not be returned to service until submission of the report.

Indicate on the inspection form if it can be ascertained that the R-1 form has been completed. Also indicate if a copy of the form is at the facility, If not, give the location of the report.

4.3 ALTERATION

Alteration means a change in tank or fittings that does not change the specification, but which does change the Certificate of Construction.

Type

Indicate the nature of the alteration on the inspection form. Append additional description if needed.

Certificate of Compliance

For alteration of a tank car the CFR 173.31(f)(2) requires completion of a Certificate of Compliance as follows: After alterations of a tank car or equipment from an original design, a Certificate of Compliance with the respective specification must be furnished to the car owner, to the Bureau of Explosives, and to the Secretary, Mechanical Division, Association of American Railroads.

Indicate on the inspection form if the Certificate has been submitted to the AAR.

AAR R-1 Report

Conversion of the tank car requires the completion of an AAR R-1 report. See Section 4.2.11 of this report.

Indicate on the inspection form if it can be ascertained that the R-1 form has been completed. Also indicate if a copy of the form is at the facility. If not, give the location of the report.

4.4 CONVERSION

Conversion means a change in tank or fittings that changes the specification.

Type

Indicate on the inspection form the prior specification (the specification before conversion) and the new specification.

AAR R-1 Report

Conversion of the tank car requires the completion of an AAR R-1 report. See Section 4.2.11 of this report.

Indicate on the inspection form if it can be ascertained that the R-1 form has been completed. Also indicate if a copy of the form is at the facility. If not, give the location of the report.

5. RETEST

This section applies to the inspection of the periodic retest of a tank, interior heater system, or a safety relief valve.

5.1 PURPOSE

The CFR 173.31(c) requires, in part, that tanks, interior heater systems, and safety relief valves must be retested periodically. The retests generally may be made at any time during the calendar year the retest falls due. Periodic retest of exterior heater systems is not a specification requirement. The required retest interval for each single unit tank car specification is tabulated in the CFR 173.31(c). The required retest intervals for tanks other than single unit tank car tanks are given in a separate table. The tables also require certain tanks to be retested at the time of their conversion. The tables also exempt some tanks from the retest requirement if they are lined with certain materials. Tanks must be retested after repairs to restore the tank contour.

Enter the type of test on the inspection form. If the retest is other than to satisfy the periodic requirement (e.g., conversion) enter the reason on the form.

Retests of tanks and safety relief devices must be reported by the party making the test to car owners. Reports must show the reporting marks and numbers of cars, pressure to which tested, date and place of test, and by whom tested. The report of latest retest must be retained by the owner until the next retest has been accomplished and recorded.

5.1.3 INTERNAL INSPECTION

The CFR 173.31(c)(3) requires that unless a longer retest interval is authorized, tanks in service 10 years or over must be internally inspected and interior heater systems inspected for defects which would make leakage or failure probable during transit.

Indicate on the inspection form whether or not an internal inspection was made.

5.2 TYPE OF TEST

5.2.1 TANK PRESSURE TEST

The CFR 173.31(c)(2) gives the procedures for conducting a tank pressure test as follows: Each tank must be retested by completely filling the tank and

manway nozzle or expansion dome with water or other liquid of similar viscosity and applying the specified pressure for 10 minutes if the tank is not insulated, or 20 minutes if the tank is insulated. There must be no leakage or evidence of distress. The tank insulation and jacket need not be removed unless leakage is indicated by a drop in pressure. The liquid temperature must not exceed 100°F during the test. Caulking of welded joints to stop leaks developed during retests is prohibited. Enter the test pressure and the test result on the inspection form.

5.2.2 INTERIOR HEATING SYSTEM

The CFR 173.31(c)(5) requires that interior heater systems must be retested hydrostatically at 200 psi and must show no leakage. Indicate the test pressure and the test result on the inspection form.

5.2.3 SAFETY RELIEF VALVE

The CFR 173.31(c)(6) requires that safety relief valves must be retested with air or gas and must start-to-discharge at the pressure prescribed within ±3 percent except that if the start-to-discharge pressure is under 100 psi, the valve must start-to-discharge at the pressure prescribed within ±3 psi. Valves must be vapor tight at the prescribed pressure. Indicate the result of the test on the inspection form.

6. GENERAL DESIGN CHARACTERISTICS

This section pertains to general design requirements for tank cars which are common to all classes of cars. It includes some of the items covered in the CFR Parts 179.3 to 179.14.

6.1 DESIGN APPROVAL

The CFR 179.3 delegates the tank car design approval process to the AAR as follows: Application for approval of designs, materials and construction, conversion or alteration of tank car tanks under these specifications, complete with detailed prints, must be submitted in prescribed form to the Secretary, Mechanical Division, AAR, for consideration by its Committee on Tank Cars and other appropriate committees. Approvals or rejections of applications, based on appropriate committee action, must be issued by said Secretary.

The application will be unconditionally approved when, in the opinion of the Committee, such tanks and related equipment are in compliance with effective regulations and DOT specifications.

Conditional approval, subject to service trials of a limited number of cars may be granted if in the opinion of the Committee, such tanks and related equipment may not be in accordance with effective regulations and DOT specifications. The conditional nature of the approval would normally be reviewed after a 2 year service trial. See AAR Standard S-060 for additional details concerning the approval process.

Indicate on the inspection form the date of the tank car design approval and whether it is conditional or unconditional.

6.2 INSULATION

A tank car specification may or may not call for the tank to be insulated. Insulation systems are of two general types, those which are designed to prevent heat transfer at ambient conditions, and those which are designed to protect the tank against high temperature fire effects (See CFR 179.105-4). Ambient temperature systems are all covered by a jacket. Some authorized high temperature systems are coatings applied to the tank which need not be jacketed.

Enter on the inspection form the material used for the insulation system, whether or not it is a high-temperature system, the thickness to which it is applied on the tank, and the thickness of the jacket, if so equipped.

6.3 BURSTING PRESSURE

The minimum bursting pressure (psi) required for the tank car is given in the appropriate part of the CFR for each tank car specification (e.g. Parts 179.101, 179.201, etc.). Enter the pressure on the inspection form.

6.4 MATERIALS

Enter the material type and the alloy specification on the inspection form. The CFR (Section 179 various parts) authorizes the following steel plate materials, except as noted, for all pressure, non-pressure (including the inner container of Class DOT 115 tank cars consisting of an inner container supported within an outer shell) and multi-unit tank car tanks with heads fusion-welded to the tank shell.

Specifications	Minimum Tensile Strength (psi) Welded Condition[1]	Minimum Elongation In 2 Inches (%) Welded Condition (Longitudinal)
ASTM A 515-70, Gr. 55	55,000	28
ASTM A 515-70, Gr. 60	60,000	25
ASTM A 515-70, Gr. 65	65,000	20
ASTM A 515-70, Gr. 70	70,000	20
ASTM A 285-70a, Gr. A	45,000	29
ASTM A 285-70a, Gr. B	50,000	20
ASTM A 285-70a, Gr. C	55,000	20
ASTM A 516-70a, Gr. 55	55,000	28
ASTM A 516-70a, Gr. 60	60,000	25
ASTM A 516-70a, Gr. 65	65,000	20
ASTM A 516-70a, Gr. 70	70,000	20
AAR TC128-70, Gr. A & B (Note 2)	81,000	19
ASTM A 537-80, Class 1 (Note 3)	70,000	23
ASTM A 302-70a, Gr. B (Note 3)	80,000	20

[1] Maximum stresses to be used in calculations.
[2] Not authorized for multi-unit tank car tanks
[3] Not authorized for non-pressure or multi-unit tank car tanks.

The maximum allowable carbon content must be 0.31 percent when the individual specification allows carbon greater than this amount. The plates may be clad with other approved materials.

The following high alloy steel plate and manganese plate materials are authorized for all non-pressure cars including the inner tank of Class DOT-115 cars. They must comply with one of the following specifications:

Specifications	Minimum Tensile Strength (psi) Welded Condition[1]	Minimum Elongation In 2 Inches (%) Weld Metal (Longitudinal)
ASTM A 240-70, Type 304	75,000	30
ASTM A 240-70, Type 304L	70,000	30
ASTM A 240-70, Type 316	75,000	30
ASTM A 240-70, Type 316L	70,000	30

[1] Maximum stresses to be used in calculations.
[2] Except for inner tanks of Class DOT-115 cars, high alloy steel materials used to fabricate tank and expansion dome, when used, must be tested in accordance with the procedures in ASTM Specification A 262-68 titled, "Recommended Practices for Detecting Susceptibility to intergranular Attack in Stainless Steels," and must exhibit corrosion rates not exceeding the following:

Test Procedure	Material	Corrosion Rate (IPM)
Practice B	Types 304, 304L, 316, and 316L	0.0040
Practice C	Type 304L	0.0020

Type 304L and Type 316L test specimens must be given a sensitizing treatment prior to testing. (A typical sensitizing treatment is 1 hour at 1250°F.)

Manganese-molybdenum steel plate must be suitable for fusion-welding and comply with the following specification:

Specifications	Minimum Tensile Strength (psi) Welded Condition[1]	Minimum Elongation In 2 Inches (%) Weld Metal (Longitudinal)
ASTM A 302-69a, Gr. B	80,000	20

[1] Maximum stresses to be used in calculations

The following nickel plate steel may be used on all non-pressure cars (except the inner tank of DOT Class 115 cars).

Specifications	Minimum Tensile Strength (psi) Welded Condition[1]	Minimum Elongation In 2 Inches (%) Weld Metal (Longitudinal)
ASTM B 162-69[2]	40,000	20

[1] Maximum stresses to be used in calculations
[2] When used as cladding for carbon steel plate, low-carbon nickel is required.

The carbon steel plate material used to fabricate tanks with forge welded heads must comply with the following specification:

Specifications	Minimum Tensile Strength (psi) Welded Condition[1]	Minimum Elongation In 2 Inches (%) Welded Condition (Longitudinal)
ASTM A 285-69 Gr. A	45,000	29

[1] Maximum stresses to be used in calculations

The materials used to construct cryogenic liquid tank car tanks must conform to the following requirements: Stainless steel of ASTM Specification A240, Type 304 or 304L must be used for the inner tank and its appurtenances, as specified in the TCM, Appendix M, and must be:

(1) In the annealed condition prior to fabrication, forming and fusion-welding;

(2) Suitable for use at the temperature of the lading; and

(3) Compatible with the lading.

Any steel casting, steel forging, steel structural shape or carbon steel plate used to fabricate the outer jacket or heads must be as specified in the TCM, Appendix M.

Steel used to construct Specification DOT-107A seamless steel tank car tanks must conform to the following requirements as to chemical composition:

Designation	Class 1 (percent)	Class II (percent)	Class III (percent)
Carbon, maximum	0.50	0.50	0.53
Manganese, maximum	1.65	1.65	1.85
Phosphorous, maximum	.05	.05	.05
Sulphur, maximum	.06	.05	.05
Silicon, maximum	.35	.30	.37
Molybdenum, maximum		.25	.30
Chromium, maximum		.30	.30
Sum of manganese and carbon not over	2.10	2.10	

Note - Alternate steel containing other alloying elements may be used, if approved.

Aluminum alloy plate materials are authorized for all pressure and non-pressure cars (including the inner tanks of Class DOT-115 cars). The aluminum alloy plate must be suitable for welding and comply with one of the following specifications:

Specifications	Minimum Tensile Strength (psi) Welded Condition[3,6]	Minimum Elongation In 2 Inches (%) Weld Metal (Longitudinal)
ASTM B 209-70, Alloy 5052[1]	25,000	18
ASTM B 209-70, Alloy 5083[2]	38,000	16
ASTM B 209-70, Alloy 5086[1]	35,000	14
ASTM B 209-70, Alloy 5154[1]	30,000	18
ASTM B 209-70, Alloy 5254[1]	30,000	18
ASTM B 209-70, Alloy 5454[1]	31,000	18
ASTM B 209-70, Alloy 5652[1]	25,000	18
ASTM B 209-70, Alloy 6061[4]	24,000[5]	5[5]

[1] For fabrication, the parent plate material may be O H112, or H32 temper, but design calculations must be based on the minimum tensile strength shown.
[2] O temper only.
[3] Weld filler metal 5556 must not be used.
[4] Not authorized for tank shells, manways or domes.
[5] T6 temper only.
[6] Maximum stresses to be used in calculations.

6.5 CENTERSILL

Almost all modern tank cars are constructed with so called "stub centersills". Longitudinal train forces from the coupler are thus carried through the bottom part of the tank wall for most of the length of the car.

Some older cars still in use are built with continuous centersills. The attachment of the tank to the underframe of the car must be made using an approved design. As indicated in the CFR 179.10 the use of rivets to secure anchors to tanks is prohibited.

Indicate on the inspection form the type of centersill, and, if a continuous centersill, whether or not the tank anchorage is satisfactory.

6.6 INTERIOR HEATER SYSTEMS

Some tank car tanks are equipped with interior pipes through which steam or other heated fluid can be circulated to heat the contents of the tank. There are a number of requirements for the construction of such systems. Approval for the design and materials is required as indicated in the CFR 179.12-1.

Compartmentalized Tanks

The CFR 179.12-1 states that if a tank is divided into compartments, a separate system must be provided for each compartment.

Indicate on the inspection form whether or not a separate system is used for each compartment if the tank is compartmentalized.

Piping

The system may be constructed with standard piping or tubing. Enter the type on the inspection form. Enter the outside diameter (inches) for tubing and the standard size designation for piping. The CFR 179.12-2 states that interior heater systems and plug flanges, if welded to the tank or dome, must be cast, forged or fabricated metal, and be of good weldable quality in conjunction with metal of tank or dome. Piping must be not less than 2 inches IPS. Tubing must be not less than 2-3/8 inches (60.3 mm) outside diameter and the wall thickness must be at least equivalent to the corresponding pipe size. Material specifications and nominal wall thickness must be as follows:

Material	Nominal Thickness Minimum[1]		ASTM Specifications
	2 Inches	Over 2 Inches	
Carbon Steel Alloy Steel Aluminum Nickel	0.175 Schedule 40S Schedule 80 Schedule 40	Schedule 40 Schedule 40S Schedule 80 Schedule 40	A53-69a, A192-69, A178-70 A312-70, A269-69 B241-69, B210-70, B221-69 B161.70

[1] Thickness must be increased 25 percent or to next higher schedule, whichever is less, when threaded joints are used.

Systems may be fabricated of other materials and of other than circular cross section, if approved.

Indicate on the inspection form the material used for the system.

Joints and Fittings

Note on the inspection form whether bolted or welded joints are used. If both types are used, enter "both". The CFR 179.12-3 states that welded butt joints are preferable. Bolted joints with the flange welded to piping may be used if welding is not feasible or to facilitate tank cleaning or application of linings. Return bends must be forged, or made by bending the pipe. Cast, forged or fabricated manifolds of approved design may be used.

Inlet, Outlet Closures

The CFR 179.12-3 states that inlets and outlets of heater systems must be equipped with valve cock, cap or plug. Caps and plugs must be secured by chain.

Check if inlet and outlet closures are suitable and secured and enter the result on the inspection.

Fail Safe Construction

Fail safe construction of the heater system is required. The method of attachment of the coils should be examined along with provision for expansion and contraction. The CFR 179.12-4 states that interior heater systems must be so constructed that the breaking off of their external connections will not cause leakage of the contents of the tank. The inlets and outlets may be located in any portion of dome, shell, heads, or steam jacketed outlet provided that proper drainage of the heater system is accomplished.

If the ends of the coils are not attached to a manifold or steam jacketed outlet, they must be attached to pads or reinforcements. Such reinforcements

must be attached to the tank in compliance with the requirements of the tank specification. Outside pipe connections to steam coils must not be an integral part of the interior coils and must be screwed or welded, or both, into the outside of pads or reinforcements. All piping must be secured so as to permit necessary expansion and contraction.

Indicate on the inspection form whether or not fail-safe construction practices were followed, the coils are attached to a manifold or reinforced pad, and that the method of attachment allows for expansion.

Hydrostatic Test

A hydrostatic test of the system is required and the date of the test should be noted on the Certificate of Construction.

The CFR 179.12-5 states that each interior heater system must be hydrostatically tested at not less than 200 psi and must hold the pressure for 10 minutes without leakage or evidence of distress.

The CFR 179.12-6 states that the Certificate of Construction for the completed car must indicate installation of interior heater system and date of initial hydrostatic test.

Indicate on the inspection form from the date the hydrostatic test was performed.

Stenciling

The CFR 179.12-7 states that to indicate that the tank is equipped with an interior heater system, the tank, or the jacket if tank is insulated, must be stenciled in compliance with the applicable requirements of the TCM, Appendix C, which includes the test pressure, date tested and due date for retest.

Indicate on the inspection form whether or not the car is appropriately stencilled.

6.7 SHELF COUPLER

Performance standards are established for the vertical restraint capabilities of couplers used on tank cars in the CFR 179.14. This has led to the publication of a list of authorized coupler designs in paragraph (d) of the section as follows: As an alternative to the test verification (of coupler strength) the following couplers are authorized:

E double shelf couplers designated by the Association of American Railroads' Catalog Nos., SE60CHT, SE60CC, SE60CHTE, SE60CE, SE60DC, SE60DE, SE67CC, SE67CE, SE67BHT, SE67BC, SE67BHTE, SE67BE, SE68BHT, SE68BC, SE68BHTE, SE68BE, SE69AHTE, and SE69AE.

F double shelf couplers designed by the Association of American Railroads' Catalog Nos., SF70CHT, SF70CC, SF70CHTE, SF70CE, SF73AC, SF73AE, SF73AHT, SF73AHTE, SF79CHT, SF79CC, SF79CHTE, and SF79CE.

Indicate on the inspection form the type of coupler used on the tank car.

7. PRESSURE TANK CAR TANKS (CLASSES DOT-105, 109, 112 AND 114)

This section pertains to the specific design requirements for pressure tank cars. It includes items covered in the CFR Parts 179.100 to 179.105.

7.1 HIGH TEMPERATURE THERMAL INSULATION SYSTEM

The CFR 179.105-4 requires that each Specification 105J, 112T, 114J and 114T tank car be equipped with a thermal protection system that prevents the release of any of the car's contents (except release through the safety relief valve) when subject to:

(1) a pool fire for 100 minutes; and
(2) a torch fire for 30 minutes.

The test methods for demonstrating these capabilities are described in the regulation. The DOT maintains a list of thermal protection systems which comply with these requirements and which are exempted from the test verification requirements. Information necessary to equip tank cars with one of these systems is available in the Dockets Branch, Room 8426 of the Nassif Building, 400 Seventh Street, SW, Washington, D.C. 20590-0001, between the hours of 8:30 a.m. and 5:00 p.m., Monday through Friday.

Indicate on the inspection form if the tank car utilizes a high temperature insulation system.

7.2 DIMENSIONS

The inside diameter of the tank is a basic design parameter which is set by the tank car builder. Enter this dimension on the inspection form.

The minimum shell and head thicknesses are set by the requirements of the CFR 179.100-6 and 179.101. The CFR 179.101 gives the minimum plate thickness for tank shells and heads for each of the specification numbers within the pressure car classes. The CFR 179.100-6 gives a formula for minimum thickness based on the diameter, material tensile strength, and tank burst strength as follows:

$$t = Pd/2SE$$

where:

d = inside diameter in inches;
E = 1.0 welded joint efficiency (0.9 for heads with seams);
P = minimum required bursting pressure in psi;
S = minimum tensile strength of plate material in psi;
t = minimum thickness of plate in inches after forming.

If the plates are clad with a material having tensile strength properties at least equal to the base plate, the cladding may be considered a part of the base plate when determining thickness. If the cladding material does not have a tensile strength at least equal to the base plate, the base plate alone must meet the thickness requirement. The minimum plate thickness is the larger of the two values obtained above.

Enter the minimum prescribed plate thickness and the measured shell and head thicknesses on the inspection form.

7.3 LINING

If the tank is lined enter the lining material and its thickness on the inspection form.

7.4 MANWAY NOZZLE

The CFR 179.100-12(a) prescribes the following requirements for the manway nozzle: Manway nozzles must be of approved design of forged or rolled steel for steel tanks or of fabricated aluminum alloy for aluminum tanks, with an access opening at least 18 inches inside diameter, if circular, or at least 14 inches by 18 inches if oval. The nozzle must be welded to the tank and the opening reinforced in an approved manner in compliance with the requirements of the TCM. Enter whether a circular or oval nozzle is used, and the minimum inside dimension (diameter for circular nozzle) on the inspection form.

7.5 MANWAY COVER THICKNESS

The CFR 179.100-12(b) prescribes the following requirements for the manway cover: The manway cover must be machined to approved dimensions and be of forged or rolled carbon or alloy steel, or rolled aluminum alloy or nickel when required by the lading. The minimum thickness is listed in the CFR 179.101. The manway cover must be attached to the manway nozzle by through or stud bolts not entering the tank. Enter the thickness of the manway cover and the number of bolts attaching it to the tank on the inspection form.

On Class 114-A tank cars the manway cover may be of the internal self-energizing type.

7.6 MANWAY PROTECTIVE HOUSING

The CFR 179.100-12(c) prescribes the following requirements for the manway protective housing. A protective housing of cast, forged or fabricated approved materials must be bolted to manway cover with not less than twenty 3/4 inch studs. The shearing value of the bolts attaching the protective housing to the manway cover must not exceed 70 percent of the shearing value of bolts attaching the manway cover to the manway nozzle. The housing must have steel sidewalls not less than 3/4 inch in thickness and must be equipped with a metal cover not less than 1/4 inch in thickness that can be securely closed. The housing cover must have suitable stop to prevent the cover from striking loading and unloading connections and it must be hinged on one side only with an approved riveted pin or rod with nuts and cotters. The openings in the wall of the housing must be equipped with screw plugs or other closures.

On Class 114-A tank cars a protective housing is not required if no valves or measuring and sampling devices are mounted on the manway cover. On the inspection form check appropriate box if car meets this condition. Also enter the thickness of the sidewall and cover, the type of cover hinge design and the number of connecting bolts.

7.7 VENTING, LOADING AND UNLOADING VALVES

The following requirements for valves are given in the CFR 179.100-13 (a&b). Venting, loading and unloading valves must be of approved design, made of metal not subject to rapid deterioration by the lading, and must withstand the tank test pressure without leakage. The valves must be bolted to seatings on the manway cover. The valve outlets must be closed with approved screw plugs or other closures fastened to prevent misplacement.

The interior pipes of the loading and unloading valves must be anchored and may be equipped with excess flow valves of approved design. (See referenced CFR paragraphs for certain exceptions.) Enter the number and type(s) of valves on the inspection form. Indicate if closures are present.

7.8 GAUGING DEVICE

The CFR 179.100-13(c) states, in part, that a gauging device is not a specification requirement. When used it must be of approved design, made of metal not subject to rapid deterioration by the lading, and able to withstand the tank test pressure without leakage. The interior pipe of the gauging device may be equipped with an excess flow valve of approved design.

An excess flow valve is a device which closes automatically against the outward flow of the contents of the tank in case the external closure valve is broken off or removed during transit. Excess flow valves may be designed with a by-pass to allow the equalization of pressure.

Indicate on the inspection form if a gauging device is used and whether or not it is equipped with an excess flow valve.

7.9 SAMPLING VALVE

The CFR 179.100-13(c) also states, in part, that a sampling valve is not a specification requirement. When used, it must be of approved design, made of metal not subject to rapid deterioration by the lading, and able to withstand the tank test pressure without leakage. The interior pipe of the sampling valve may be equipped with an excess flow valve of approved design.

Indicate on the inspection form if a sampling valve is used and whether or not it is equipped with an excess flow valve.

7.10 THERMOMETER WELL

The CFR 179.100-13(c) also states, in part, that a thermometer well is not a specification requirement. When used it must be of approved design, made of metal not subject to rapid deterioration by the lading, and able to withstand the tank test pressure without leakage. The interior pipe of the thermometer well must be anchored in an approved manner to prevent breakage due to vibration. The thermometer well must be closed by an approved valve attached close to the manway cover or other approved location, and closed by a screw plug.

Indicate on the inspection form if a thermometer well is present and whether or not the closure valve and screw plug are present.

7.11 SUMP OR SIPHON BOWL

The requirements for the design of a sump or siphon bowl are given in CFR 179.100-13(e). They include, in part, that the bottom of tank shell may equipped

with a sump or siphon bowl, or both, welded or pressed into the shell. Sumps or siphon bowls, if applied, are not limited in size, but must be made of cast, forged or fabricated metal. Each sump or siphon bowl must be of good welding quality in conjunction with the metal of the tank shell. When the sump or siphon bowl is pressed in the bottom of the tank shell, the wall thickness of the pressed section must not be less than that specified for the shell.

The CFR requirements further state that any portion of a sump or siphon bowl not forming a part of cylinder of revolution must have walls of such thickness and be so reinforced that the stresses in the walls caused by a given internal pressure are no greater than the circumferential stress which would exist under the same internally pressure in the wall of the tank of circular cross section.

Indicate on the inspection form whether or not the tank is equipped with a sump or siphon bowl.

7.12 BOTTOM OUTLET

Bottom outlets for discharge of lading are prohibited for pressure tank cars except for Class 114A cars. These tanks may be equipped with bottom outlet valves if they meet the requirements of the CFR 179.103-5. These requirements include, in part, that when an external bottom outlet valve without interior pipes is used in liquified flammable gas service, the valve opening must be closed with an internally bolted or self-energizing closure of approved design. A protective housing is not required.

On cars without continuous centersills, a ball valve may be welded to the outside bottom of the tank or mounted with a tongue and groove or male and female flange attachment on a pad attached to the outside bottom of the tank. The mounting pad must have a maximum thickness of 2-1/2 inches measured on the longitudinal centerline of the tank. The valve operating mechanism must be provided with a suitable locking arrangement to insure positive closure during transit.

When an internal bottom outlet valve is used in liquified flammable gas service, the outlet of the valve must be equipped with an excess flow valve of approved design, except when a quick-closing internal valve of approved design is used. A protective housing is not required.

A bottom outlet valve must be equipped with a liquid tight closure at its lower end.

The extreme projection of the bottom outlet equipment may not be more than allowed by Appendix E of the TCM. All bottom outlet reducers and closures and their attachments must be secured to the car by at least 3/8 inch chain or its equivalent, except that bottom outlet closure plugs may be attached by 1/4 inch chain. When the bottom outlet closure is of the combination cap and valve type, the pipe connection to the valve must be closed by a plug, cap or approved quick coupling device.

The valve operating mechanism must be provided with a suitable locking arrangement to insure positive closure during transit.

If the outlet nozzle extends 6 inches or more from the shell of the tank, a V-shaped breakage groove must be cut (not cast) in the upper part to the outlet nozzle at a point immediately below the lowest part of the valve closest to the tank. In no case may the nozzle wall thickness at the roof of the "V" be more than 1/4 inch. On cars without continuous centersills, the breakage groove or its equivalent must not be more than 15 inches below the tank shell. On cars with continuous centersills, the breakage groove or its equivalent must be above the bottom of the centersill construction.

The valve body must be of a thickness which will insure that accidental breakage of the outlet nozzle will occur at or below the "V" groove, or its equivalent, and will not cause distortion of the valve seat or valve.

Enter on the inspection form whether or not the car is equipped with bottom outlets, and if the above requirements have been met.

7.13 BOTTOM WASHOUT

According to CFR 179.101-1 bottom washouts are only permitted on Class 109-A and Class 114-A pressure cars. The requirements for a bottom washout are given in the CFR 179.100-41, which include, in part, that if a washout is permitted, its extreme projection may not be more than allowed by Appendix E of the TCM. It must be of cast, forged or fabricated metal and must be fusion-welded to the tank. It must be of good weldable quality in conjunction with the metal of the tank.

If the bottom washout nozzle extends 6 inches or more from the shell of the tank, a V-shaped breakage groove must be cut (not cast) in the upper part of the

outlet nozzle at a point immediately below the lowest part of the inside closure seat or plug. In no case may the nozzle wall thickness at the root of the "V" be more than 1/4 inch. Where the nozzle is not a single piece, provision must be made to insure that accidental breakage will occur at or below the "V" groove or its equivalent. On cars without continuous centersills the breakage groove or its equivalent must not be more than 15 inches below the tank shell.

The closure plug and seat must be readily accessible or removable for repairs. The closure of the washout nozzle must be equipped with a 3/4 inch solid screw plug and the plug must be attached by at least a 1/4 inch chain.

Indicate on the inspection form whether or not a bottom washout is used, and if on a centersill-less car, its extension distance from the tank and whether or not a breakage groove is present.

7.14 SAFETY RELIEF VALVES

Indicate the number and type of safety relief valves on the inspection form. The requirements for safety relief valves are given in the CFR 179.100-15. These include, in part, that the tank must be equipped with one or more safety relief valves of approved design, made of metal not subject to rapid deterioration by the lading.

On all pressures cars except Class 114 cars the safety relief valve, or valves, must be mounted on the manway cover. On Class 114 cars the safety relief devices and pressure regulators must be located on top of the tank near the center of the car on a nozzle mounting plate or recess in the shell. Through or stud bolts, if used, must not enter the tank. A metal guard of approved design must be provided to protect the safety relief devices and pressure regulators from damage.

The total valve discharge capacity must be sufficient to prevent building up pressure in tank in excess of 82-1/2 percent above the start-to-discharge pressure, whichever is higher. The formulas for calculating discharge capacity are given in the TCM, Appendix A. The start-to-discharge and vapor tight pressures must comply with those tabulated in CFR 179.101 and must not be affected by any auxiliary closure or other combination. For certain commodities, alternate pressures are permitted (see the CFR 179.102-11).

Enter the start-to-discharge pressure, the required flow capacity and the actual flow capacity of the valve(s) on the inspection form.

Indicate on the inspection form if the safety relief valve is used in combination with a breaking pin device. If so, the breaking pin device must be designed to fail at a pressure of 75 percent of the tank test pressure and the safety relief valve must be set for a start-to-discharge pressure of 71 percent of the tank test pressure. However, for Specification DOT-105A500W tanks, the start-to-discharge pressure must be 360 psi. For certain commodities alternate pressures are permitted (see the CFR 179.102-11).

Indicate on the inspection form if the safety relief valve is used in combination with a frangible disc. If so, the frangible disc must be designed to burst at a pressure of 75 percent of the tank test pressure and the safety relief valve must be set for a start-to-discharge pressure of 71 percent of the tank test pressure, as prescribed in the CFR 179.101. A device must be installed to detect any accumulation of pressure between the frangible disc and the safety relief valve. This device must be a needle valve, trycock, telltale indicator or other approved device. It must be closed during transportation. Alternative pressures for certain commodities are permitted in accordance with the CFR 179.102-11. The tolerance on the valve start-to-discharge pressure is ±3 psi for 100 psi test pressure tanks and ±3 percent for all higher test pressure tanks. The minimum vapor tight pressure is 80 percent of the valve start-to-discharge pressure.

7.15 ATTACHMENTS

Indicate on the inspection form if the attachments to the tank are made with reinforcing pads on the tank shell in accordance with the CFR 179.100-16, which states, in part, that the reinforcing pads must be used between external brackets and shells if the attachment welds exceed 6 inches of 1/4 inch fillet or equivalent weld per bracket or bracket leg. When reinforcing pads are used, they must not be less than 1/4 inch in thickness, have each corner rounded to a 1 inch minimum radius, and be attached to the tank by continuous fillet welds except for venting provisions. The ultimate shear strength of the bracket-to-reinforcing pad weld must not exceed 85 percent of the ultimate shear strength of the reinforcing pad-to-tank weld.

7.16 CLOSURES

The requirements for closures are given in the CFR 179.100-17. They include, in part, that closures be of approved design and made of metal not subject to rapid deterioration by the lading. Plugs, if used, must be solid,

with NPT threads, and must be of a length which will screw at least 6 threads inside the face of the fitting or tank.

Indicate on the inspection form whether or not the tank car is equipped with suitable closures.

7.17 TANK PRESSURE TEST

The CFR 179.100-18 requires each tank to be tested to the prescribed pressure associated with the specification. The requirements include that the tank must be tested by completely filling it and the manway nozzle with water or other liquid having similar viscosity, at a temperature which must not exceed 100°F during the test. The tank must hold the prescribed pressure for at least 10 minutes without leakage or evidence of distress. Insulated tanks must be tested before insulation is applied. Caulking of welded joints to stop leaks developed during the test is prohibited.

Indicate on the inspection form the date on which the test was conducted and documented.

7.18 SAFETY RELIEF VALVE TEST

The CFR 179.100-19 requires that each valve be tested by air or gas for compliance with the start-to-discharge pressure and the minimum vapor tight pressures which are tabulated for each specification in the CFR 179.100.

Indicate on the inspection form the date on which the test was conducted and documented.

7.19 TANK HEAD PUNCTURE RESISTANCE SYSTEM

The CFR 179.105-1(c) requires that Specification 105S, 105J, 111J, 112S, 112J, 114S, 114J and 114T tank cars be equipped with a tank head puncture resistance system. The performance standard for this system is given in the CFR 179.105-5 and states, in part, that the tank car must be capable of sustaining, without loss of contents, coupler-to-tank head impacts within the lower half of the tank head area at relative car speeds up to 18 miles per hour. When tested under prescribed conditions.

Tank cars required to have puncture resistance systems may, as an alternative, be equipped with a head shield at each end of the car that is at least 1/2 inch thick and in the shape and size of the lower half of the head of the tank car or in the shape of a trapezoid with prescribed dimensions.

Most tank cars required to be equipped with a tank head puncture resistance system use a shield that covers the full head of the tank and is incorporated into the jacket covering the tank car thermal insulation.

Indicate on the inspection form if the tank car is equipped with a head shield and, if so, the type of system.

7.20 AIR BRAKE SUPPORT ATTACHMENTS

The CFR 173.31(7) requires that effective July 1, 1991, no railroad tank car, regardless of its construction date, may be used for the transportation in commerce of any hazardous material unless the air brake equipment support attachments of such tank car comply with the standards for attachments set forth in CFR 179.100-16 (See Section 7.15).

Indicate on the inspection form whether or not this requirement has been met.

7.21 SPECIAL COMMODITY REQUIREMENTS

Note that there may be specific tank car design requirements for certain commodities. Check appropriate sections of the CFR for these requirements.

8. NON-PRESSURE (LOW-PRESSURE) TANK CARS (CLASSES DOT-103, 104, 111AF, 111AW, AND 115AW)

This section pertains to the specific design requirements for non-pressure tank cars. It includes items covered in the CFR Parts 179.200 to 179.220.

8.1 THERMAL INSULATION

Certain classes of non-pressure tank cars may have their tanks covered by thermal insulation and jacketed. Indicate on the inspection form if the tank is insulated. Class-111 cars may be protected by a high temperature thermal insulation system, meeting the requirements of the CFR 179.105-4 (See Section 7.1). If the tank is insulated, check the type of insulation system used on the form. Then enter the thickness and type of insulation material. Note that some high temperature insulation systems are coatings which need not be jacketed.

8.2 DIMENSIONS

The inside diameter of the tank is a basic design parameter which is set by the tank car builder. Enter the dimension on the inspection form.

The minimum shell and head thicknesses are set by the requirements of the CFR 179.100-6 and 179.201-1. The CFR 179.201-1 gives the minimum plate thickness for tank shells and heads for each of the specification numbers within the non-pressure car classes. The CFR 179.100-6 gives formulas for minimum head thickness based on the diameter, material tensile strength, and tank burst strength. For the tank, dome shell, and 2:1 ellipsoidal heads the minimum thicknesses are:

$$t = Pd/2SE$$

For 3:1 ellipsoidal heads the following formula applies:

$$t = \frac{Pd}{2SE} \quad (1.83)$$

For a flanged and dished head the following formula applies:

$$t = \frac{5PL}{6SE}$$

where:

D = inside diameter, in inches

E = 0.9 welded joint efficiency; except E = 1.0 for seamless heads

L = main inside radius to which head is dished, measured on concave side, in inches

P = minimum required bursting pressure, in psi

S = minimum tensile strength of plate material in psi as prescribed in the CFR 179.200-7

t = the minimum thickness of plate in inches after forming.

If the plates are clad with a material having tensile strength properties at least equal to the base plate, the cladding may be considered a part of the base plate when determining thickness. If the cladding material does not have a tensile strength at least equal to the base plate, the base plate alone must meet the thickness requirement. The minimum plate thickness is the larger of the values given in the table (CFR 179.201-1) and calculated by the appropriate formula.

Enter the minimum prescribed shell and head thicknesses and the measured shell and head thicknesses on the inspection form.

8.3 LINING

If the tank is lined enter the lining material and its thickness on the inspection form.

8.4 COMPARTMENTALIZED DESIGN

According to the CFR 179.200-3 the tank may be divided into separate compartments, which then must be treated as individual tanks. Indicate on the inspection form whether or not the tank is compartmented.

8.5 GAUGING, LOADING AND UNLOADING, VENTING AND AIR INLET DEVICES

8.5.1 VACUUM RELIEF VALVE

According to the CFR 179.200-16(c) a tank may be equipped with a vacuum relief valve of an approved design. Indicate on the inspection form if the tank is equipped with such a device.

8.5.2 GAUGING DEVICE

The tank may be equipped with a gauging device. Certain non-pressure specifications require the use of a gauging device (See CFR 179.201-1). When a gauging device is required the requirements of the CFR 179.200-16(d) apply. These include, in part, that an outage scale visible through manway opening must be provided. If loading devices are applied to permit tank loading with cover closed, a telltale pipe may be provided. The telltale pipe must be capable of determining that required outage is provided.

Indicate on the inspection form if a gauging device is used. Check to see that outage determination is possible and enter the result on the form.

8.5.3 EXPOSED PIPING

The CFR 179.200-16(f) contains, in part, the following requirements for exposed piping: When top loading and discharge devices, or venting and air inlet devices are installed with exposed piping to a removed location, shutoff valves must be applied directly to reinforcing pads or nozzles at the point of their penetration through the tank shell, and must be enclosed in a protective housing with provision for a seal. The piping must include breakage grooves, and suitable bracing. Relief valves must be applied to liquid lines for protection in case lading is trapped. Provision must be made to insure closure of the valves while the car is in transit.

Indicate on the inspection form whether or not there is exposed piping, and, if so, if breakage grooves are used.

8.5.4 PROTECTIVE HOUSING

The CFR 179.200-16 (b&g) pertain to the use of a protective housing around the valves and fittings. These include, in part, that when the characteristics of the commodity for which the car is authorized are such that these devices must be equipped with valves or fittings to permit the loading and unloading of the contents, these devices including valves, must be of an approved design, and be provided with a protective housing except when plug or ball type valves with operating handles removed are used. Provision must be made for closing pipe connections of valves. The protective housing must be fabricated of approved material and have cover and sidewalls not less than 0.119 inch in thickness.

Indicate on the inspection form whether or not there is a protective housing around the valves and fittings.

8.5.5 SUMP OR SIPHON BOWL

The CFR 179.200-16(e) states, in part, that the bottom of a tank shell may be equipped with a sump or siphon bowl, or both, welded or pressed into the shell. Such sumps or siphon bowls, if applied are not limited in size, but must be made of cast, forged, or fabricated metal. Each sump or siphon bowl must be of good welding quality in conjunction with the metal of the tank shell. When the sump or siphon bowl is pressed in the bottom of the tank shell, the wall thickness of the pressed section must not be less than that specified for the shell. Any portion of a sump or siphon bowl not forming a part of a cylinder of revolution must have walls of such thickness and be so reinforced that the stresses in the walls caused by a given internal pressure are not greater than the circumferential stress which would exist under the same internal pressure in the wall of a tank of circular cross section. (See Section 8.2).

Indicate on the inspection form whether or not the tank is equipped with a sump or siphon bowl.

8.6 BOTTOM OUTLETS

Bottom outlets are permitted on certain non-pressure tank car specifications as indicated in the table in the CFR 179.201-1. If applied, the bottom outlet must comply with requirements set forth in the CFR 179.200-17. These requirements include, in part, that the extreme projection of the bottom outlet equipment may not be more than that allowed by Appendix E of the TCM. All bottom outlet reducers and closures and their attachments must be secured to the car by at least a 3/8 inch chain, or its equivalent, except that the bottom outlet closure plugs may be attached by an 1/4 inch chain.

If the outlet nozzle extends 6 inches or more from the shell of the tank, a V-shaped breakage groove must be cut (not cast) in the upper part of the outlet nozzle at a point immediately below the lowest part of valve closest to the tank. In no case may the nozzle wall thickness at the root of the "V" be more than 1/4 inch. On cars without continuous centersills, the breakage groove or its equivalent must be no more than 15 inches below the tank shell. On cars with continuous centersills, the breakage groove or its equivalent must be above the bottom of the centersill construction.

Indicate on the inspection form if bottom outlets are used and, if so, the maximum extension from the tank, and whether or not a breakage groove is present.

8.7 BOTTOM WASHOUT

A bottom washout is permitted on certain non-pressure tank car specifications as indicated in the table in the CFR 179.201-1. If applied, the bottom outlet must comply with requirements set forth in the CFR 179.200-17. These requirements include, in part, that the extreme projection of the bottom outlet equipment may not be more than that allowed by Appendix E of the TCM.

If the washout nozzle extends 6 inches or more from the shell of the tank, a V-shaped breakage groove must be cut (not cast) in the upper part of the nozzle at a point immediately below the lowest part of the inside closure vent or plug. In no case may the nozzle wall thickness at the root of the "V" be more than 1/4 inch. On cars without continuous centersills, the breakage groove or its equivalent must be no more than 15 inches below the tank shell. On cars with continuous centersills, the breakage groove or its equivalent must be above the bottom of the centersill construction.

Enter on the inspection form if a bottom washout is used and, if so, the maximum extension from the tank, and whether or not a breakage groove is present.

8.8 SAFETY RELIEF DEVICES

According to the table in the CFR 179.201-1, non-pressure tank cars must be equipped with either a safety relief valve or a safety vent closed by a frangible disc. The CFR 179.200-18 gives the requirements for the safety relief devices.

8.8.1 SAFETY RELIEF VALVE

If the tank is equipped with a safety relief valve, enter the number of valves and their start-to-discharge pressure on the inspection form. Enter the minimum flow capacity as determined from the formulas in the TCM, Appendix A and the actual rated flow capacity of the valve(s). Also indicate if a frangible disc is used in series with the valve.

8.8.2 SAFETY VENT

Indicate if a safety vent is used, and if so, the rated rupture pressure of the frangible disc.

8.9 ATTACHMENTS

Indicate on the inspection form if the attachments to the tank are made with reinforcing pads on the tank shell in accordance with the CFR 179.200-19,

which states, in part, that the reinforcing pads must be used between external brackets and shells if the attachment welds exceed 6 inches of 1/4 inch fillet or equivalent weld per bracket or bracket leg. When reinforcing pads are used, they must not be less than 1/4 inch in thickness, have each corner rounded to a 1 inch minimum radius, and must be attached to the tank by continuous fillet welds except for venting provisions. The ultimate shear strength of the bracket-to-reinforcing pad weld must not exceed 85 percent of the ultimate shear strength of the reinforcing pad-to-tank weld.

8.10 CLOSURES

The requirements for closures given in the CFR 179.200-21. They include, in part, that all plugs must be solid, with NPT threads, and must be of a length which will screw at least 6 threads inside the face of fitting or tank. Plugs, when inserted from the outside of tank heads, must have the letter "S" at least 3/8 inch in size stamped with steel stamp or cast on the outside surface to indicate the plug is solid.

Indicate on the inspection form whether or not the tank car is equipped with suitable closures.

8.11 TANK PRESSURE TEST

The CFR 179.200-22 requires each tank to be tested to the prescribed pressure associated with the specification. The requirements include, in part, that the tank be tested by completely filling it and the manway nozzle with water or other liquid having similar viscosity, at a temperature which must not exceed 100°F during the test. The tank must hold the prescribed pressure for at least 10 minutes without leakage or evidence of distress. Insulated tanks must be tested before insulation is applied. Rubber-lined tanks must be tested before rubber lining is applied. Caulking of welded joints to stop leaks developed during the foregoing test is prohibited.

Indicate on the inspection form the date on which the test was conducted and documented.

8.12 SAFETY RELIEF VALVE TEST

The CFR 179.200-23 requires that each valve be tested by air or gas for compliance with the start-to-discharge pressure and the minimum vapor tight pressure tabulated for each specification in CFR 179.201-1. Indicate on the inspection form the date on which the test was conducted and documented.

8.13 TANK HEAD PUNCTURE RESISTANCE SYSTEM

Certain Class DOT-111 tank cars may be required to have a puncture resistance system meeting the requirements of CFR 179.105-5. (See Section 7.19.) Most tank cars required to be equipped with a tank head puncture resistance system use a shield that covers the full head of the tank and is incorporated into the jacket covering the tank car thermal insulation.

Indicate on the inspection form if the tank car is equipped with a head shield and, if so, the type of system.

8.14 SPECIAL COMMODITY REQUIREMENTS

Note that there may be specific tank car design requirements for certain commodities. Check appropriate sections of the CFR for these requirements.

8.15 OTHER ITEMS

8.15.1 ITEMS NOT APPLICABLE TO CLASS 115 CARS

8.15.1.1 MANWAY NOZZLE

The CFR 179.200-13 contains requirements for the manway nozzle and other nozzle and attachment flanges. These include, in part, that these attachments must be fusion-welded to the tank and reinforced in an approved manner in compliance with the requirements of the TCM, Appendix E, Figure 10. The opening in the manway ring must be at least 16 inches in diameter except that acid resistant-lined manways must be at least 18 inches in diameter before lining.

Indicate the inside diameter of the manway nozzle on the inspection form.

8.15.1.2 EXPANSION CAPACITY

Tanks must have the minimum expansion capacity prescribed in the table given in CFR 179.201-1. The requirement for the expansion capacity to be in the dome of the car, or in the tank itself, depends on the individual specification of the tank car.

Indicate on the inspection form whether or not the expansion capacity is provided in the dome or the tank.

8.15.2 ITEMS APPLICABLE ONLY TO CLASS 115 CARS

Class DOT-115 tank cars are non-pressure tank car tanks consisting of an inner container supported within an outer shell. The CFR 179.220-3 states, in

part, that tanks built under these specifications must consist of an inner container, a support system for the inner container, and an outer shell.

The inner container must be a fusion-welded tank of circular cross section with formed heads designed convex outward and must have a manway on top of the tank. When the inner container is divided into compartments, each compartment must be considered a separate container. The outer shell must be a fusion-welded tank with formed heads designed convex outward.

The CFR 179.220-4 states, in part, that the annular space between the inner container and the outer shell must contain an approved insulation material.

8.15.2.1 OUTER TANK WALL THICKNESS

The CFR 179.220-6(c) specifies that the wall thickness after forming of the cylindrical section and heads of the outer shell must be not less than 7/16 of an inch.

Enter the shell and head thickness of the outer tank on the inspection form.

8.15.2.2 INNER CONTAINER MANWAY NOZZLE

The CFR 179.220-13(a) requires that the inner container manway nozzle must be of approved design with access opening at least 18 inches inside diameter, or at least 14 inches by 18 inches oval.

Enter the minimum inside diameter of the inner container manway nozzle on the inspection form.

8.15.2.3 INNER CONTAINER MANWAY COVER

The CFR 179.220-6(b) requires that the design of the inner container must provide a secure closure of the manway and must make it impossible to remove the cover while the tank interior is under pressure.

Check to see if this requirement is satisfied and enter the result on the inspection form.

8.15.2.4 INNER CONTAINER SUPPORT SYSTEM

The CFR 179.220-15 requires, in part, that the inner container must be supported within the outer shell by a support system of adequate strength and ductility to support the inner container when filled with liquid lading to any level at its operating temperature. The support system must be designed to

support, without yielding, impact loads producing accelerations of the following magnitudes and direction when the inner container is loaded so that the car is at its rail load limit, and the car is equipped with a conventional AAR Specification M-901 draft gear.

Longitudinal	7G
Transverse	3G
Vertical	3G

The longitudinal acceleration may be reduced to 3G when a cushioning device of approved design is used.

Indicate on the inspection form whether or not this requirement has been met.

8.15.2.5 EXPANSION CAPACITY

The CFR 179.200-16 requires that the minimum expansion capacity must be provided in the shell of the inner container.

Verify whether or not this requirement has been met and enter the result on the inspection form.

9. MULTI-UNIT TANK CAR TANKS (CLASSES DOT-106A AND DOT-110AW)

This section pertains to the specific design requirements for multi-unit tank car tanks. It includes items covered in the CFR Part 179.300. These cars are built with multi-unit tanks designed to be removed from car structures for filling and emptying. The CFR 179.300-3 states, in part, that the tanks are to be cylindrical, circular in cross section and have heads of approved design. All openings must be located in the heads. Each tank must have a water capacity of at least 1500 pounds and not more than 2600 pounds.

9.1 NUMBER OF TANKS

Enter the number of tanks mounted on the car on the inspection form. Complete one form for the car and the first tank on the car, and separate forms, Section 9 only, for the remaining tanks on the car.

9.2 DIMENSIONS

9.2.1 INSIDE DIAMETER

The inside diameter is a basic design parameter which is set by the tank builder. Enter the inside diameter of the tank on the inspection form.

9.2.2 CLASS-110A TANKS

Shell Thickness

The CFR 179.30-6 states that the wall thickness after forming of the cylindrical portion of the tank must not be less than that given in the table in the CFR 179.301 nor that calculated by the following formula:

$$t = \frac{Pd}{2SE}$$

where:

d = inside diameter in inches;
E = 1.0 welded joint efficiency;
P = minimum required bursting pressure in psi;
S = minimum tensile strength of plate material in psi;
t = minimum thickness of plate, in inches, after forming.

Head Thickness

The CFR 179-300.8 requires that Class DOT-110A tanks must have fusion-welded heads formed concave to pressure. Heads for fusion-welding must be an

ellipsoid of revolution with a 2:1 ratio of major to minor axis. They must be one piece, hot formed in one heat so as to provide a straight flange at least 1-1/2 inches long. The thickness must not be less than that calculated by the following formula:

$$t = \frac{Pd}{2SE}$$

where the terms are defined above.

9.2.3 CLASS-106A TANKS

Shell Thickness

The CFR 179.300-6 states that the wall thickness of the cylindrical portion of the tank must not be less than that given in the table in the CFR 179.301 and must be such that at the tank test pressure the maximum fiber stress in the wall of the tank will not exceed 15,750 psi as calculated by the following formula:

$$s=[p(1.3D^2 + 0.4d^2)]/(D^2-d^2)$$

where:

d = inside diameter in inches;
D = outside diameter in inches;
p = tank test pressure in psi;
s = wall stress in psi.

Head Thickness

The CFR 179.300-8 requires that Class DOT-106A tanks must have forged-welded heads, formed convex to pressure. The heads for forge welding must be torispherical with an inside radius not greater than the inside diameter of the shell. They must be one piece, hot formed in one heat so as to provide a straight flange at least 4 inches long. They must have a snug drive fit into the shell for forge welding. The wall thickness after forming must be sufficient to meet the prescribed test requirements and to provide for adequate threading of openings.

Enter the minimum prescribed and the measured shell and head wall thicknesses on the inspection form.

9.3 MANUFACTURING INSPECTION

9.3.1 INSPECTOR'S REPORT

The CFR 179.300-20 requires that before a tank is placed in service, the inspector must furnish to the builder, tank owner, Bureau of Explosives and the Secretary, Mechanical Division, Association of American Railroads, a report in approved form certifying that the tank and its equipment comply with all the requirements of this specification.

Indicate on the inspection form whether or not the inspector's report has been submitted, and, if so, the date of the report.

9.3.2 SAFETY RELIEF DEVICE

The CFR 179.300-15 requires, in part, that unless prohibited by a specific section of the CFR the tanks must be equipped with one or more safety relief devices of approved type, made of metal not subject to rapid deterioration by the lading and screwed directly into the tank heads or attached to the tank heads by other approved methods. The total discharge capacity must be sufficient to prevent the pressure in the tank from building up in excess of 82.5 percent of the tank test pressure. When safety relief devices of the fusible plug type are used, the required discharge capacity must be available in each head.

The safety relief valves must be set for a start-to-discharge pressure not exceeding that specified in the table in the CFR 179.301. Frangible discs must also burst at this pressure. Fusible plugs must function at a temperature not exceeding 175°F and must be vapor tight at a temperature of not less than 130°F.

Indicate on the inspection form if a safety relief device is used, and if so, the type of device.

9.3.3 TANK PRESSURE TEST

The tanks must be tested in accordance with the CFR 179.300-16. This requires, in part, that tanks must be subjected to a hydrostatic expansion test in a water jacket. Each tank must be tested to the prescribed pressure which must be maintained for 30 seconds and sufficiently longer to insure complete expansion of tank. No leaks must appear and permanent volumetric expansion must not exceed 10 percent of total volumetric expansion at the test pressure.

After all the fittings have been installed, each tank must be subjected to interior air pressure test of at least 100 psi under conditions favorable to detection of any leakage. No leaks must appear.

Enter the date of the report of this test on the inspection form.

9.3.4 SAFETY RELIEF DEVICE TEST

Safety relief devices must be tested in accordance with the CFR 179.300-17. This states, in part, that each safety relief valve must be tested by air or gas before being put into service. The valve must open and be vapor tight at the pressure prescribed for the tank specification. The frangible discs of safety vents must be tested as prescribed in the TCM. For safety relief devices of the fusible plug type, a sample of the plug used must function at the prescribed temperatures.

Enter the date of the report of this test on the inspection form.

9.4 OPERATIONAL INSPECTION

9.4.1 PROTECTIVE HOUSING

The CFR 179.300-12 contains regulations pertaining to the protection of fittings. These include, in part, that tanks must be of such design as will afford maximum protection to any fittings or attachments to the head. Tank ends must slope or curve inward toward the axis so that the diameter at each end is at least 2 inches less than the maximum diameter.

Loading and unloading valves must be protected by a detachable protective housing of approved design which must not project beyond the end of the tank and must be securely fastened to the tank head. Safety relief devices must not be covered by the housing.

Check for the presence of the protective housing and that it is securely fastened to the tank head, and indicate the result on the inspection form.

9.4.2 STAMPING

To certify that the tank complies with all specification requirements, the CFR 179.300-18 requires that certain data be stamped into the metal of the valve end chime. The required markings are given in Section 12.3.

Check to see if each of the required markings is legible on the tank head and indicate the results on the inspection form.

9.5 SPECIAL COMMODITY REQUIREMENTS

Note that there may be specific tank design requirements for certain commodities. Check appropriate sections of the CFR for these requirements.

10. CRYOGENIC LIQUID CARS (CLASS DOT-113)

This section pertains to the specific design requirements for cryogenic liquid tank cars. It includes items covered in the CFR Parts 179.400 and 179.401. These tank cars are constructed for the transport of cryogenic liquids. They consist of an inner tank of circular cross section supported concentrically within an outer jacket of circular cross section. The annular space is filled with an approved insulating material and evacuated. The inner tank heads are designed concave to pressure and the outer jacket heads designed convex to pressure.

10.1 INNER TANK DIMENSIONS

The inside diameter of the inner tank is a basic design parameter which is set by the tank car builder. Enter this dimension on the inspection form.

The minimum shell and head thickness of the inner tanks are set by the CFR 179.400-8 and 179.401-1. These requirements are that the minimum wall thickness after forming, of the inner shell and any 2:1 ellipsoidal head for the inner tank must be the maximum of 3/16 inch or that calculated by the following formula.

$$t = Pd/2SE$$

The minimum wall thickness, after forming, of any 3:1 ellipsoidal head for the inner tank must be the maximum of 3/16 inch or that calculated by the following formula:

$$t = 1.83Pd/2SE$$

The minimum wall thickness, after forming, of a flanged and dished head for the inner tank must be the minimum of 3/16 inch, or that calculated by the following formula:

$$t=[PL(3+\sqrt{(L/r)})]/(8SE)$$

where:

t = minimum thickness of plate, after forming, in inches;
d = inside diameter in inches;
P = minimum required bursting pressure, in psi;

L = main inside radius of dished head, in inches;
r = inside knuckle radius, in inches;
S = minimum tensile strength of plate material, as prescribed in the TCM, Appendix M, Table M1, in psi;
E = 0.9, a factor representing the efficiency of welded joints, except that for seamless heads, E = 1.0.

Enter the minimum inner tank prescribed wall and head thicknesses and the measured wall and head thicknesses on the inspection form.

10.2 INSULATION SYSTEM

A performance test for determining the acceptability of the insulation system is described in the CFR 179.400-4. A calculated heat transfer rate (CHRT) is determined by a prescribed test procedure and compared with a standard heat transfer rate (SHTR) listed in a table in the CFR 179.401-1. Standard heat transfer rates are given for two tank car specifications in the table. For DOT-113A60W tank cars the CHTR must be less than the SHTR. For Specification 113C120W tank cars the CHTR must be less than 75 percent of the SHTR.

Indicate both the SHTR and CHTR on the inspection form.

10.3 OUTER JACKET

Enter the inside diameter of the outer jacket on the inspection form. The CFR 179.400-8(d) prescribes requirements for the outer jacket including that the minimum wall thickness, after forming, of the outer jacket shell may not be less than 7/16 inch. The minimum wall thickness, after forming, of the outer jacket heads may not be less than 1/2 inch. Enter the head and shell thicknesses on the inspection form.

The annular space is to be evacuated, and the cylindrical portion of the outer jacket between heads, or between stiffening rings, if used, must be designed to withstand an external pressure of 37.5 psi (critical collapsing pressure), as determined by the following formula:

$$P_c = [2.6E(t/D)^{2.5}] / [(L/D) - 0.45(t/D)^{0.5}]$$

where:

P_c = Critical collapsing pressure, in psi;
E = modulus of elasticity of jacket material, in psi;
t = minimum thickness of jacket material, after forming, in inches;

D = outside diameter of jacket, in inches;
L = distance between stiffening ring centers in inches. (The heads may be considered as stiffening rings located 1/3 of the head depth from the head tangent line.)

Stiffening rings may be used to strengthen and stabilize the resistance of the cylindrical shell to external pressure. Detailed requirements for their design are given in the CFR 179.400-9. Indicate their use on the inspection form and whether they are used on the inside or outside of the jacket.

10.4 INNER TANK SUPPORT SYSTEM

The CFR 179.400-13 requires that the inner container must be supported within the outer shell by a support system of approved design. The system and its areas of attachment to the outer jacket must have adequate strength and ductility to support the inner tank when filled with the lading to any level incident to transportation at operating temperatures.

The support system must be designed to support, without yielding, impact loads producing accelerations of the following magnitudes and directions when the inner tank is fully loaded and the car is equipped with a conventional draft gear:

Longitudinal	7G
Transverse	3G
Vertical	3G

The longitudinal acceleration may be reduced to 3G where a cushioning device of approved design, which has been tested to demonstrate its ability to limit body forces to 400,000 pounds maximum at 10 miles per hour, is used between the coupler and the tank structure.

The inner tank and outer jacket must be permanently bonded to each other electrically, by either the support system, piping, or a separate electrical connection of approved design.

Indicate on the inspection form whether or not a cushioning device is used to limit the longitudinal design load requirement. Also check to see if the inner tank and outer jacket are electrically bonded as required, and indicate the result on the inspection form.

10.5 ACCESS TO INNER TANK

The CFR 179.400-16 requires, in part, that the inner tank must be provided with a means of access having a minimum inside diameter of 16 inches. Closure of the inner tank by welding is permitted. If a welded closure is used, it must be designed to allow it to be reopened by grinding or chipping and to be closed again by rewelding, preferably without the need for new parts. A cutting torch may not be used.

Indicate on the inspection form the minimum diameter of the inner tank access and whether or not a welded closure is used.

10.6 INTERIOR TANK PIPING

10.6.1 LOADING, UNLOADING, AND VAPOR PHASE LINES

The CFR 179.400-17 (1 and 2) describes requirements for the loading and unloading line, and for a vapor phase line. The valve and secondary closure requirements for these lines include, in part, that they must have a manually operated shut-off valve located as close as practicable to the outer jacket, plus a secondary closure that is liquid and gas tight. This secondary closure must permit any trapped pressure to bleed off before the closure can be removed completely. On the loading and unloading line a vapor trap must be incorporated and located as close as practicable to the inner tank.

A vapor phase line must connect to the inner tank and must be of sufficient size to permit the required pressure relief devices connected to this line to operate at their design capacity without excessive pressure build-up in the tank. The vapor phase line must have a manually operated shut-off valve located as close as practical to the outer jacket, plus a secondary closure that is liquid and gas tight. This secondary closure must permit any trapped pressure to bleed off before the closure can be removed completely.

Check to see if the shut-off valves and closures are operational and enter the results on the inspection form.

10.6.2 VAPOR PHASE BLOWDOWN LINE

In accordance with the CFR 179.400-17(3) a vapor phase blowdown line must be provided. The requirements include that it must be attached to the vapor phase line upstream of the shut-off valve. A by-pass line with a manually

operated shut-off valve must be provided to permit reduction of the inner tank pressure when the vapor phase line is connected to a closed system.

Check to see if the shut-off valve on the vapor phase blowdown line is operational and enter the result on the inspection form.

10.7 INNER TANK PRESSURE TEST

The CFR 179.400-18 presents requirements for an inner tank pressure test. These include, in part, that after all items to be welded to the inner tank have been welded in place, the inner tank must be pressure tested at the test pressure prescribed in the table in the CFR 179.401-1. The temperature of the pressurizing medium may not exceed 100°F during the test. The inner tank must hold the prescribed pressure for a period of not less than ten minutes without leakage or distortion.

Enter the date of the test report on the inspection form.

10.8 VALVES AND GAGES

Valve and gage requirements are given in the CFR 179.400-19. The major features of these requirements are given as follows:

10.8.1 LIQUID LEVEL GAGE

A liquid level measurement device must be provided to indicate the quantity of liquified lading within the inner tank. A gage may be mounted where it will be readily visible to an operator during transfer operations or storage, or a portable gage may be used with a readily accessible connection, or a fixed length dip tube may be used, with a manually operated shut-off valve located as close as practicable to the outer jacket. The dip tube must indicate the maximum liquid level for the allowable filling density. The inner end of the dip tube must be located on the longitudinal centerline of the inner tank and within 4 feet of the transverse centerline of the inner tank.

Check to see if the liquid level measuring device is operational and enter the result on the inspection form.

10.8.2 VAPOR PHASE PRESSURE GAGE

A vapor phase pressure gage of approved design, with a manually operated shut-off valve located as close as practical to the outer jacket must be installed. The gage must indicate the vapor pressure within the inner tank and must be mounted where it will be readily visible to an operator.

Check to see if the vapor phase pressure gage is operational and enter the result on the form.

10.9 PRESSURE RELIEF DEVICES

The requirements for pressure relief devices are given in the CFR 179.400-20. These include, in part, that the inner tank must be equipped with one or more pressure relief valves and one or more safety vents, except that an alternate, a pressure relief valve may be used in lieu of the safety vent, provided it meets the flow capacity at a flow rating pressure of 110 percent of its start-to-discharge pressure.

Pressure relief devices for the inner tank must be attached to the vapor phase piping and mounted so as to remain at ambient temperature prior to operation. The safety vent must function at the specified pressure. The safety vent must be flow rated in accordance with the applicable provisions of the TCM, Appendix A.

The openings through all piping and fittings between the inner tank and the pressure relief devices must have a cross-sectional area at least equal to that of the pressure relief device inlet, and the flow characteristics of this upstream system must be such that the pressure drop will not adversely affect the relieving capacity or the proper operation of the pressure relief device.

The opening through the discharge lines must have a cross-sectional area at least equal to that of the pressure relief device outlet and may not reduce the relieving capacity below that required to properly protect the inner tank.

On the inspection form note the presence and number of safety relief valves and vents. Also note the total required flow capacity of the safety relief valves. Indicate if the safety relief valves have been tested to demonstrate acceptable start-to-discharge and vapor tight pressures, a requirement of the CFR 179.400-21.

10.9.2 EVAPORATION CONTROL

Evaporation control requirements are given in the CFR 179.400-20(c)(4). They include, in part, that the routine release of vaporized lading may be controlled with a pressure controlling and mixing device, except that a pressure controlling and mixing device is required on each DOT-113A60W car. The device must prevent the discharge of a gas mixture exceeding 50 percent of the lower

flammability limit to the atmosphere under normal conditions of storage or transportation.

Indicate on the inspection form if the car is equipped with a pressure controlling and mixing device and whether or not it is operational.

10.9.3 SAFETY INTERLOCK

Safety interlock requirements are given in the CFR 179.400-20(c)(5). They include, in part, that if a safety interlock is provided for the purpose of allowing transfer of lading at a pressure higher than the pressure control valve setting, but less than the pressure relief valve setting, the design must be such that the safety interlock will not affect the discharge path of the pressure relief valve or safety vent at any time. The safety interlock must automatically provide an unrestricted discharge path for the pressure control device at all times when the tank car is in transport service.

Indicate on the inspection form whether or not a safety interlock is used and whether it meets the above requirements.

10.9.4 OUTER JACKET PRESSURE RELIEF

The CFR 179.400-20(d) requires, in part, that the outer jacket must be provided with a suitable system to prevent buildup of annular space pressure in excess of 16 psig or the external pressure for which the inner tank was designed, whichever is less.

Verify that this system is present and meets the requirements of the CFR and include the result on the inspection form.

10.10 VALVE OPERATING INSTRUCTIONS

The CFR 179.400-23 requires that all valves and gages must be clearly identified with corrosion-resistant nameplates. A plate of corrosion-resistant material bearing precautionary instructions for the safe operation of the equipment during storage and transfer operations must be securely mounted so as to be readily visible to an operator. The instruction plate must be mounted in each housing containing operating equipment and controls for product handling. These instructions must include a diagram of the tank and its piping system with the various gages, control valves and pressure relief devices clearly identified and located.

Check to see that the above requirements are met and enter the result on the inspection form.

10.11 SPECIAL MARKING REQUIREMENTS

10.11.1 STAMPING

The CFR 179.400-24 requires that a tank that complies with all specification requirements must have certain information plainly and permanently stamped into the metal near the center of the head of the outer jacket at the "B" end of the car. See Section 12.3 for the required information.

Check to see if this requirement is met and indicate the result on the inspection form.

10.11.2 STENCILING

The CFR 179.400-25 requires, in part, that in addition to the general requirements for marking tank cars (See Section 12), the stenciling on the outer jacket must also include the following in letters at least 1-1/2 inches high:

The date on which the frangible disc was last replaced and the initials of the person making the replacement,

The design service temperature and maximum lading weight,

The water capacity, in pounds net at 60°F, with the tank at its coldest operating temperature, after deduction for the volume above the inlet to the pressure relief device or pressure control valve, structural members, baffles, piping and other appurtenances inside the tank,

Both sides of the tank car, the statement "DO NOT HUMP OR CUT OFF WHILE MOTION", and

The outer jacket, below the tank classification stencil the statement, "VACUUM JACKETED".

Check to see that the above stencils are included and indicate the result on the inspection form.

11. MULTI-UNIT SEAMLESS STEEL TANK CAR TANKS (CLASS DOT-107)

This section pertains to the specific design requirements for multi-unit seamless steel tank car tanks. It includes items covered in the CFR 179.500.

Tanks built under this specification must be hollow forged or drawn in one piece. Forged tanks must be machined inside and outside before the ends are necked-down and, after necking down, the ends and outside diameter must be machined to size. Machining is not necessary on the inside or outside of the seamless steel tubing.

11.1 NUMBER OF TANKS

Enter the number of tanks mounted on the car on the inspection form. Complete one form for the car and the first tank on the car, and separate forms, Section 11 only, for the remaining tanks on the car.

11.2 DIMENSIONS

Inside Diameter

The inside diameter is a basic design parameter which is set by the tank builder. Enter the inside diameter of the tank on the inspection form.

Shell Thickness

The CFR 179.500-4 gives the requirements for the tank wall thicknesses as follows: The minimum thickness of wall of each finished tank must be such that at a pressure equal to 7/10 of the marked test pressure of the tank, the calculated fiber stress in pounds per square inch at inner wall of tank multiplied by 3.0 will not exceed the tensile strength of any specimen taken from the tank and tested. The minimum wall thickness must be 1/4 inch.

Calculations to determine the maximum marked test pressure permitted on the tank must be made by the formula:

$$P = [10S(D^2-d^2)]/[7(D^2+d^2)]$$

where:

P = maximum marked test pressure permitted (psi);

$$S = U/3.0$$

where:

U = tensile strength of that specimen which shows the lower tensile strength of the two specimens taken from the tank and tested as prescribed (psi);

3 = factor of safety;

$(D^2-d^2)/(D^2+d^2)$ = the smaller value obtained for this factor by the operations specified below.

Measure at the one end, in a plane perpendicular to the longitudinal axis of the tank and at least 18 inches from that end before necking-down:

d = maximum inside diameter (inches) for the location under consideration; to be determined by direct measurement to an accuracy of 0.05 inch;

t = minimum thickness of wall for the location under consideration; to be determined by direct measurement to an accuracy of 0.001 inch.

Take D=d+2t.

Calculate the value of $(D^2-d^2)/(D^2+d^2)$

Make similar measurements and a calculation for a corresponding location at the other end of the tank. Use the smaller result obtained, from the foregoing, in making the calculation prescribed above.

Enter the minimum prescribed and the calculated test pressure on the inspection form.

11.3 MANUFACTURING INSPECTION

11.3.1 INSPECTOR'S REPORT

The CFR 179.500-18 requires, in part, that before a tank car is placed in service, the party assembling the completed car must furnish to car owner, Bureau of Explosives, and the Secretary, Mechanical Division, AAR, a report in proper form certifying that tanks and their equipment comply with all the requirements of this specification and including information as to serial numbers, dates of tests, and the ownership marks on the tanks mounted on the car structure. The referenced section of the CFR gives detailed requirements for the form of this report.

Indicate on the inspection form whether or not the inspector's report has been submitted, and if so, the date of the report.

11.3.2 HARDNESS TESTS

The CFR 179.500-6(b) requires that to check uniformity of heat treatment, Brinnel hardness tests must be made at 18 inch intervals on the entire longitudinal axis of the tank. The hardness must not vary more than 35 points in the length of the tank. No hardness tests need be taken within 12 inches from the point of head to shell tangency.

Determine whether or not these tests were successfully made and indicate the result on the inspection form.

11.3.3 MAGNETIC PARTICLE INSPECTION

The CFR 179.500-6(c) requires that a magnetic particle inspection must be performed after heat treatment on all tanks subjected to a quench and temper treatment to detect the presence of quenching cracks. Cracks must be removed to sound metal by grinding and the surface exposed must be blended smoothly into the surrounding area. A wall thickness check must then be made of the affected area by ultrasonic equipment or other suitable means acceptable to the inspector and if the remaining wall thickness is less than the minimum recorded thickness it must be used for making the calculation prescribed in Section 11.2.

Indicate on the inspection form whether or not this test was conducted.

11.3.4 TANK PRESSURE TEST

The CFR 179.500-14 requires that after heat treatment, tanks must be subjected to hydrostatic tests in a water jacket, or by other accurate method, operated so as to obtain reliable data. No tank must have been subjected previously to internal pressure greater than 90 percent of the marked test pressure. Each tank must be tested to a pressure at least equal to the marked test pressure of the tank. The pressure must be maintained for 30 seconds, and sufficiently longer to insure complete expansion of tank. A pressure gage must permit a reading to an accuracy of 1 percent. An expansion gage must permit reading of total expansion to an accuracy of 1 percent. The expansion must be recorded in cubic centimeters.

No leaks must appear and permanent volumetric expansion must not exceed 10 percent of the total volumetric expansion at test pressure.

The results of these tests are to be recorded as part of the inspector's report (See Section 11.3.1). Determine if the data is contained in the report and indicate the result on the inspection form.

11.3.5 TESTS OF SAFETY RELIEF DEVICES

The CFR 179.500-16 requires tests of safety relief devices as follows: Safety relief valves must be tested by air or gas before being put into service. A valve must open at a pressure not exceeding the marked test pressure of the tank and must be vapor tight at 80 percent of the marked test pressure. These limiting pressures must not be affected by any auxiliary closure or other combination.

For safety relief devices of the frangible disc type, samples of discs used must burst at a pressure not exceeding the marked test pressure of tank and not less than 7/10 of the marked test pressure.

Verify that these tests have been conducted and indicate the date of the test report on the inspection form.

11.4 OPERATIONAL INSPECTION

11.4.1 TANK END COVERS

The CFR 179.500-8 states, in part, that each tank end must be closed by a cover made of forged steel. The covers must be secured to ends of the tank by through bolts or studs not entering the interior of the tank. Alternately each end may be closed by internal threading to accommodate an approved fitting.

Joints between the covers and ends and between the covers and attachments must be of approved form and made tight against vapor or liquid leakage.

Check to see if the covers are secure and vapor tight and indicate the result on the inspection form.

11.4.2 PROTECTIVE VALVE HOUSING

The CFR 179.500-10 contains the following requirements for protective housings. Safety devices, and loading and unloading valves on tanks must be protected from accidental damage by approved metal housing, arranged so it may be readily opened to permit inspection and adjustment of safety relief devices and valves, and securely locked in the closed position. The housing must be provided with an opening equal to twice the total discharge area of safety relief device enclosed.

Determine that the protective housings meet the above requirements and open for inspection and indicate the result on the inspection form.

11.4.3 SAFETY RELIEF DEVICES

The CFR 179.500-12 states, in part, that the tank must be equipped with one or more safety relief devices of approved type and discharge area, mounted on the cover or threaded into the non-marked end of the tank. The safety relief devices must open at a pressure not exceeding the marked test pressure of the tank and at not less than 7/10 of the marked test pressure.

Indicate the type of safety relief device on the inspection form.

11.4.4 IGNITION DEVICE ON SAFETY RELIEF DEVICE

The CFR 179.500-12(c) requires that cars used for the transportation of flammable gases shall have the safety devices equipped with an approved ignition device.

Indicate on the inspection form if the tank is equipped with such a device, and, if so, if the device is operational.

11.4.5 STAMPED MARKINGS

The CFR 179.500-17 requires certain data be stamped into the metal of the necked-down section of tank. The required markings are given in Section 12.3.

Verify that these marks are legibly stamped on the tank and indicate the result on the inspection form.

11.4.6 NAME OF GAS

The CFR 179.500-7 also requires that the name of gas for which tank car is being used is stenciled in letters at least 2 inches high on each side of car where they are clearly visible.

Check that the stenciling is present and indicate the result on the inspection form.

12. MARKING

This section pertains to the markings required on a tank car. Under the CFR 179.100-21(a), 179.200-25(a), 179.220-26(a), and 179.400-25 the tank, or the jacket if tank is insulated, must be stenciled in compliance with the requirements of the TCM, Appendix C. For each of the items listed on the inspection form indicate if the marking is required and then whether or not it is present. The requirements include the following:

12.1 STENCILED MARKINGS ON SIDE OF CAR

DOT Specification Number

The initials and number of the DOT specification applicable to the tank must be stenciled on both sides of tank in letters and numerals at least 1-1/2 inches high.

CLAD Tank

Tanks made of clad plates must be stenciled on the tank "(MATERIAL) CLAD TANK." These marks must be in letters at least 1-1/2 inches high immediately below the car specification stencil.

Commodity Description

When tanks are designed and authorized for the transportation of a particular commodity only, "(NAME OF COMMODITY)," or such other wording as may be required to indicate the limits of usage of the car, must be marked in letters at least 1 inch high on each side of tank.

Tank cars carrying the following commodities must be marked on both sides of the tank or jacket in 4 inch high letters:

ACROLEIN
ANHYDROUS AMMONIA
BROMINE
BUTADIENE
CHLORINE
CHLOROPRENE
DISPERSANT GAS
ETHYLENE OXIDE
flammable gases-Use Shipping Name per DOT 172.101
FORMIC ACID
FUSED POTASSIUM NITRATE AND SODIUM NITRATE
HYDROCYANIC ACID
HYDROFLUORIC ACID
HYDROGEN CHLORIDE
HYDROGEN FLUORIDE
HYDROGEN PEROXIDE
HYDROGEN SULFIDE*
HYDROGEN, REFRIGERATED LIQUID
METHYL CHLORIDE
METHYL MERCAPTAN
MOLTEN SULFUR
MOTOR FUEL ANTIKNOCK COMPOUND or ANTIKNOCK COMPOUND
NITRIC ACID
NITROGEN TETROXIDE
NITROGEN TETROXIDE-NITRIC OXIDE MIXTURE
PHOSPHORUS
REFRIGERANT GAS
SULFUR TRIOXIDE
VINYL CHLORIDE
VINYL FLUORIDE
VINYL METHYL ETHER

Not for Flammable Liquids

All tanks equipped with safety vents must be stenciled "NOT FOR FLAMMABLE LIQUIDS" in letters at least 1 inch high on each side of the tank.

Safety Valve, Tank and Heater Pipes Test Dates

The year (or month and year) on which the tank, safety relief valves and interior heater systems (if so equipped) were last tested, the pressure to which tested, and the test due date must be stenciled on the tank, or on the jacket, if insulated, in letters and numerals at least 1 inch high. For tanks in other than chlorine service, the test due date to be stenciled is the year due only. For chlorine tank cars, the test due date to be stenciled is the month and year due, and the month must be the month of the just-completed test.

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*The jackets of tank cars intended to be loaded at ambient temperatures must be stenciled adjacent to water capacity stencil "MINUS 20F (or MINUS 20F or MINUS 28.9°C) MINIMUM LOADING TEMPERATURE".

The jackets of tank cars intended to be loaded at lading temperatures below minus 20F (minus 28.9°C) must be stenciled adjacent to water capacity stencil "MINUS 50F (or MINUS 50F or MINUS 45.6°C) MINIMUM LOADING TEMPERATURE".

When a tank, safety relief valve and interior heater systems are tested on the same date, it is preferable to use a combination stenciling covering these tests. When a tank safety relief valve and interior heater systems are tested on different dates, individual stenciling covering these tests must be applied.

Built Date

The built date of a tank car is the date (month and year) that the completed car is shipped from the car builder's facility. Tank cars shipped to a lining applicator, whether or not returned to the car builder after lining, are considered "built" as of the first departure from the car builder's facility.

Conversion Date

When tanks are converted from one class to another, or when a conversion results in a change in the tank retest interval, the date of conversion must be stenciled below the tank built date.

Liquid Tank

If the tank contains a protective coating or lining the kind of coating or lining and the date (month and year) of application must be stenciled on the tank.

Pressure Test Not Required

Any glass, rubber, or lead-lined tank need not be periodically retested. Also, any tank lined with an elastomeric polyvinyl chloride at least 3/32 inch thick or an elastomeric polyurethane at least 1/16 inch thick need not be periodically retested. Those lined tanks which are not required to be retested must be stenciled to indicate the test is not required, in place of stenciling covering the test of tanks; for example, "(MATERIAL) LINED TANK-PRESSURE TEST NOT REQUIRED," in letters at least 1 inch high.

Water Capacity

If required by the specification (i.e., all pressure tank cars all non-pressure tank cars, and cryogenic liquid tank cars) the water capacity in pounds must be stenciled on both sides of the tank in letters and numerals at least 1-1/2 inches high. If the car is equipped with side ladders, the stencil may be behind the ladders or within 3 feet of either side of the ladders. If the car is compartmented, the stencil must be applied to each compartment, on the sides of the tank near each manway.

Minimum Operating Temperature

The CFR 179.102-4(j) and 179.102-17(k) require that cars used to transport vinyl fluoride, or hydrogen chloride refrigerated liquid, must have the words stenciled on the jacket adjacent to the water capacity stencil, "MINIMUM OPERATING TEMPERATURE--°F."

Consolidated Stencil

A consolidated stencil for lubrication and air brakes is to be applied in accord with AAR Field Manual Rule 80. When a tank car has a consolidated stencil applied, the date built new (month and year) is not required to be stenciled on the right side of the tank. However, the date converted or rebuilt (month and year) if applicable must be stenciled as shown on Figure C1, in the TCM.

Reporting Mark and Number

The CFR 215.301 requires, in part, that the railroad or private car owner reporting mark and the car number must be stenciled, or otherwise displayed, in clearly legible letters and numbers not less than 7 inches high, on each side of the car and in any location that is visible to a person walking at track level beside the car.

Reporting marks are assigned by the AAR Transportation Division. The reporting mark and number may be stenciled on top of the car on or near the longitudinal centerline, at the B-end, reading from B-end to A-end. If so stenciled, the size and spacing must be the same as on the side of the tank or jacket. On cars equipped with centersills, reporting marks must be stenciled on the underframe, centersills or side sills, and both truck bolsters. On stub sill cars, the reporting marks must be stenciled on both truck bolsters.

Load Limit

The load limit is the difference between the total weight on rail for the journal size and scale light weight of the car.

Effective January 1, 1985, the load limit is to be stenciled, instead of nominal capacity, on all tank cars built new. The load limit stencil will replace the nominal capacity stencil on all tank cars when reweighed, repainted, retested, shopped for repair or restenciled for any reason, effective January 1, 1985. Any tank car not stenciled with the load limit must have the load limit stencil applied and the nominal capacity stencil removed before January 1, 1993.

Load Limit Restriction

If the load limit is restricted or reduced for any reason, a 3 inch (76.2 mm) star symbol must be added immediately to the left of the load limit stencil.

Light Weight

The light weight is the scale light weight of the car.

Date New

The "NEW" stencil adjacent to the light weight stencil refers to the date the car was weighed to establish the light weight. The term "NEW" is used when the car is newly constructed. For subsequent reweighings of the car the Station Symbol would replace the word new.

AAR Certified SS Number

Stub sill non-pressure, non-exterior coiled tank cars built prior to July 1, 1974 that qualify for defect card protection under Field Manual Rule 95 must be stenciled "AAR CERTIFIED SS NUMBER XX" in 1-1/2 inch letters below the light weight stencil on each side of the tank.

Dimensions Exceeding Plate B

All cars having dimensions exceeding Plate B must have the appropriate stencil shown in AAR Manual of Standards and Recommended Practices, Section L, Standard S-913 applied directly to the right of the reporting marks.

High Friction Brake Shoe Note

All cars which use high friction type brake shoes must be stenciled on BL and AR sides in not less than 1-1/2 inch letters, showing type and thickness of brake shoes standard to the car.

12.2 END OF CAR

The reporting mark and number of the tank car must be stenciled on both ends of the car. The water capacity must also be stenciled on the ends of the car. When an owner desires cars to be marked to provide information with respect to couplers, brake beams, wheels, raised wheel seat axles, heater systems or volume of tank, such marks must be stenciled on heads of tank in letters at least 1-1/2 inches (38.1 mm) high.

Cars equipped with springs having 2-1/2 inch or greater travel must be stenciled on ends of car with one of the following AAR designations:

SPRG D-3
SPRG D-4
SPRG D-5

12.3 STAMPING

The CFR Parts 179.100-21, 179.200-14, and 179.220-25 require that all specification pressure and non-pressure cars be plainly and permanently stamped in letters and figures at least 3/8 inch high into the metal near the center of both outside heads, to certify that the tank complies with all specification requirements. On insulated cars it may not be possible to check the stamping. If so, check the indicated box on the inspection form and skip the rest of this subsection.

The following is an example of the required stamping:

	Example of Required Stamping
Specification	DOT-105A100W
Material	ASTM A515-70
Cladding material (if any)	ASTM A240-304 Clad
Tank builder's initials	ABC
Date of original test	00-0000
Car assembler (if other than tank builder)	DEF
Water capacity	00000 lbs

On Class DOT-111 tank cars, the last numeral of the specification number may be omitted from the stamping; for example, DOT-111A100W.

On Class DOT-115 tank cars, the stamping near the center of both outside heads must be as follows:

	Example of Required Stamping
Specification	DOT-115A60W6
Inner container:	
Material	ASTM A240-316L
Shell thickness	Shell 0.167 inch
Head thickness	Head 0.150 inch
Tank builders initials	ABC
Date of original test	00-0000
Outer shell:	
Material	ASTM A285C
Tank builders initials	XYZ
Car assembler (if other than inner container or outer shell builders)	DEF

The CFR 179.300-18 requires that Multi-Unit Tank Car Tanks (Classes DOT 106A and 110AW) must be plainly and permanently stamped in letters and figures 3/8 inch high into the metal of valve end chime as follows:

(1) The DOT Specification Number.

(2) The material and cladding material, if any, (immediately below the specification number).

(3) The owners's or builder's identifying symbol and serial number (immediately below the material identification). The symbol must be registered with the Bureau of Explosives, duplications are not authorized.

(4) The inspector's official mark (immediately below the owner's or builder's symbol).

(5) The date of original tank test (month and year, such as 1-64 for January 1964). This should be so placed that dates of subsequent tests may easily be added thereto.

(6) The water capacity-0000 pounds.

A copy of the above stamping in letters and figures of the prescribed size stamped on a brass plate secured to one of the tank heads is authorized.

The CFR 179.400-24 requires that Cryogenic Liquid Tank Car Tanks Class DOT-113 must have the following information plainly and permanently stamped into the metal near the center of the head of the outer jacket at the "B" end of the car in letters and figures at least 3/8 inch high, in the following order:

	Example of Required Stamping
Specification	DOT-113A60W
Design service temperature	Minus 423°F
Inner tank	
Material	ASTM A240-304
Shell thickness	Shell 3/16 inch
Head thickness	Head 3/16 inch
Inside diameter	ID 107 inches
Inner tank builders initials	ABC
Date of original test (month and year) and initials of person conducting original test	00-0000GHK
Outer jacket	
Material	ASTM A515-70
Outer jacket builder's initials	DEF
Car assembler's (if other than inner tank or outer jacket builder)	XYZ

In lieu of this stamping, the specified markings may be incorporated on a data plate of corrosion-resistant metal, fillet welded in place on the head of the outer jacket at the "B" end of the car.

The CFR 179.500-17 requires that Specification DOT-107A seamless steel tank car tanks must be plainly and permanently marked, by stamping into the metal of necked-down section of tank at marked end, in letters and figures at least 1/4 inch high, as follows:

(1) The Spec. DOT-107A****,the**** to be replaced by figures indicating marked test pressure of the tank.

(2) The serial number immediately below the stamped mark.

(3) The inspector's official mark immediately below the stamped mark.

(4) The name, mark (other than trademark), or initials of company or person for whose use tank is being made.

(5) The date (such as 1-62, for January 1962) of tank test, so placed that dates of subsequent tests may easily be added thereto.

(6) Date (such as 1-62, for January 1962) of latest test of safety relief valve or of frangible disc, required only when tank is used for transportation of flammable gases.

12.4 PLACARD HOLDER

All cars used to transport commodities classed as hazardous by the DOT must have metal placard holders which must be applied to both sides toward the right

end, preferably near to and below the DOT and AAR stencils, and to both ends of the car.

12.5 BRAKE LEVER BADGE PLATE

A metal badge plate showing the dimensions of brake levers standard to the car must be secured to the centersill in an accessible location at the BL end of the car.

APPENDIX A

FRA TANK CAR MANUFACTURING/REPAIR/RETEST FACILITY EVALUATION FORM

FRA TANK CAR MANUFACTURING/REPAIR/RETEST FACILITY EVALUATION FORM

(Note: abbreviation "NA" used for not applicable)

1. REPORT INFORMATION

1.1 Date of Report ☐☐☐☐☐☐☐☐

1.2 Type of Report

1.2.1 Facility Inspection Yes ☐ No ☐
Complete Sections 1 and 2

1.2.2 Inspection of New Car Construction Yes ☐ No ☐
Complete Sections 1, 3, 6, and 12, and
Applicable Specific Design Section 7, 8, 9, 10, or 11

1.2.3 Inspection of Tank Car Repair, Alteration or Conversion Yes ☐ No ☐
Complete Sections 1, 4, and 12

1.2.4 Inspection of Tank Car Periodic Retest Yes ☐ No ☐
Complete Sections 1, 5, and 12

1.3 Sections of Report Completed

Indicate the sections in which data have been entered as follows:

Section 2	Yes ☐	No ☐
Section 3	Yes ☐	No ☐
Section 4	Yes ☐	No ☐
Section 5	Yes ☐	No ☐
Section 6	Yes ☐	No ☐
Section 7	Yes ☐	No ☐
Section 8	Yes ☐	No ☐
Section 9	Yes ☐	No ☐
Section 10	Yes ☐	No ☐
Section 11	Yes ☐	No ☐
Section 12	Yes ☐	No ☐

1.4 Location where inspection was conducted ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

1.5 INSPECTOR INFORMATION

Name

Inspector No.

Home Office Location

2. FACILITY INFORMATION

2.1 Type of Facility

Manufacturing	Yes ☐	No ☐
Repair	Yes ☐	No ☐
Retest	Yes ☐	No ☐

2.2 Company Data

Company Name

Address

Street, RFD No. or P.O. Box No.

City, State and Zip Code

Manager's Name

Telephone No.

2.3 Extent of Facility Certification To Perform Welding

If facility is used only for retest, check this box ☐, skip this Section and go to Section 2.5.

Specification Category	Material Group	Permitted Work Class A,B,C or D	Permitted Work Class None
I	1		
	2		
	3		
	4		
	7		

Specification Category	Material Group	Permitted Work Class A,B,C or D	Permitted Work Class None
II	1		
III	6		

Certification Expiration Date

2.4 Facility Activity

2.4.1 Number of Tank Cars Built in Prior 12 months

None ☐ 1 to 5 ☐ 6 to 24 ☐ 25 or more ☐

2.4.2 Number of Tank Cars Repaired or Converted in Prior 12 months

None ☐ 1 to 5 ☐ 6 to 24 ☐ 25 or more ☐

2.5 Facility Activity, Retest

2.5.1 Number of Tank Cars Tested in Prior 12 months

None ☐ 1 to 5 ☐ 6 to 24 ☐ 25 or more ☐

2.6 Equipment

If facility is used only for retest, complete only Sections 3.6.7 and 3.6.8.

2.6.1 Plant Processing Equipment

Planers	Yes ☐	No ☐
Shears	Yes ☐	No ☐
Benders	Yes ☐	No ☐
Punch	Yes ☐	No ☐
Press Brake	Yes ☐	No ☐
Cutters	Yes ☐	No ☐
Grinders	Yes ☐	No ☐
Saws	Yes ☐	No ☐
Other (append description)	Yes ☐	No ☐

2.6.2 Bending Rolls Yes ☐ No ☐

2.6.3 Pressing or Jacking Equipment for Removal of Tank Dents Yes ☐ No ☐

2.6.4 Manual Welding Machines Yes ☐ No ☐

2.6.5 Automatic Welding Machines Yes ☐ No ☐

2.6.6 Post-Weld Heat Treatment Equipment

Furnace for Unit Heating of Car	Yes ☐	No ☐
Furnace for Partial Heating of Car	Yes ☐	No ☐
Fixtures for Controlled Area Heating	Yes ☐	No ☐
Temperature Measuring and Recording Equipment	Yes ☐	No ☐

2.6.7 Testing Equipment

Liquid Dye Penetrant	Yes ☐	No ☐
Magnetic Particle	Yes ☐	No ☐
Hardness Testing	Yes ☐	No ☐
Radiographic	Yes ☐	No ☐
Type(s)	☐☐☐☐☐☐☐☐☐☐	
Acceptable Procedures Established	Yes ☐	No ☐
Film Storage Facilities	Yes ☐	No ☐
Film File Management System in Place	Yes ☐	No ☐

Hydrostatic Testing (tank and heater coil) Yes ☐ No ☐
Valve Testing Yes ☐ No ☐
Tension and Bend Test Machines Yes ☐ No ☐
Ultrasonic Yes ☐ No ☐
Acoustic Emission Yes ☐ No ☐

2.6.8 Adequate Facilities for Calibration of Test Equipment Yes ☐ No ☐

2.7 Personnel

2.7.1 Quality Control Personnel

Number of Qualified Weld Inspectors ☐☐☐☐
Certification Records on File Yes ☐ No ☐
In-House Training Program for Welding Inspectors Used Yes ☐ No ☐
Number of Qualified Radiographers ☐☐☐☐
Certification Records on File Yes ☐ No ☐

2.7.2 Welders

Number of Certified Welders ☐☐☐☐
Certification Records on File Yes ☐ No ☐

2.8 Subcontractors Utilized in Construction or Repair Work Yes ☐ No ☐
(if more than one, append additional information)

Name: ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐
AAR Subcontractor Evaluation Sheet on File
(AAR Exhibit B-1) Yes ☐ No ☐
Date (if applicable) ☐☐☐☐☐☐☐☐

2.9 Quality Control Documentation on File

2.9.1 Procedure Qualification Record Yes ☐ No ☐
2.9.2 Welding Procedure Specification Yes ☐ No ☐
2.9.3 Quality Assurance Manual Yes ☐ No ☐

3. TANK CAR INFORMATION

3.1 Description

DOT Specification No. ☐☐☐☐☐☐☐☐☐☐
Car Identification
Reporting Mark ☐☐☐☐
Number ☐☐☐☐☐☐☐☐
Intended Commodity Service (if applicable) ☐☐☐☐☐☐☐☐☐☐
Water Capacity (gal) ☐☐☐☐☐

Light Weight (lbs) ☐☐☐☐☐☐

Load Limit (lbs) ☐☐☐☐☐☐

Has the Specification of this car been previously converted Unknown ☐ Yes ☐ No ☐

3.2 Certificate of Construction

Submission Date ☐☐☐☐☐☐☐☐

3.3 Construction Date (month and year) ☐☐☐☐☐

3.4 Retest Requirements

3.4.1 Tank

Date of Last Test ☐☐☐☐☐☐☐☐

Report Available Yes ☐ No ☐

Retest Due Date ☐☐☐☐☐☐☐☐

3.4.2 Interior Heater System (if applicable)

Date of Last Test ☐☐☐☐☐☐☐☐

Report Available Yes ☐ No ☐

Retest Due Date ☐☐☐☐☐☐☐☐

3.4.3 Safety Relief Valve (if applicable)

Date of Last Test ☐☐☐☐☐☐☐☐

Report Available Yes ☐ No ☐

Retest Due Date ☐☐☐☐☐☐☐☐

4. REPAIR, ALTERATION OR CONVERSION

4.1 Repair - Background Information Yes ☐ No ☐

4.1.1 Defect

Dent or Buckle Yes ☐ No ☐

Location (see location code) ☐☐☐

Length (ins) ☐☐☐☐

Width (ins) ☐☐☐☐

Depth (ins) ☐☐☐☐

Fracture Yes ☐ No ☐

Location (see location code) ☐☐☐

Pits or Corrosion Yes ☐ No ☐

Scores or Gouges Yes ☐ No ☐

Wheel Burn Yes ☐ No ☐

Manway or Closure Plate Yes ☐ No ☐

Valves (loading, unloading) Yes ☐ No ☐

Safety Relief Device Yes ☐ No ☐
Interior Heater Pipes Yes ☐ No ☐
Other (if yes, attach explanation) Yes ☐ No ☐

4.1.2 Cause

Normal Wear and Tear Yes ☐ No ☐
Derailment Yes ☐ No ☐
Derailment and Collision with fixed object(s) Yes ☐ No ☐
Derailment and Collision with other Cars Yes ☐ No ☐
Fire Yes ☐ No ☐
Extent of Tank Affected (percent, expressed as decimal, e.g. o.nn) ☐☐☐☐
Other (if yes, attach explanation) Yes ☐ No ☐
Unknown Yes ☐ No ☐

4.2 Repair - Procedures Followed

4.2.1 Fracture Yes ☐ No ☐
Weld Repair Yes ☐ No ☐
Length (ins) ☐☐☐☐
Reinforcement Plate Used Yes ☐ No ☐
Size (length and width (ins)) ☐☐☐☐ ☐☐☐☐
Defective Area Removed and Replaced by Insert Yes ☐ No ☐
Size (length and width (ins)) ☐☐☐☐ ☐☐☐☐

4.2.2 Pits and Corrosion Yes ☐ No ☐
Weld Area Yes ☐ No ☐
Length of Weld Removed and Rewelded (ins) ☐☐☐☐
Post Weld Heat Treatment Yes ☐ No ☐
Radiography Required Yes ☐ No ☐
Plate Area Yes ☐ No ☐
Affected Area Ground and Welded Yes ☐ No ☐
Plate Removed and Insert Required Yes ☐ No ☐
Size (length and width (ins)) ☐☐☐☐ ☐☐☐☐

4.2.3 Deformation and Scoring Yes ☐ No ☐
Dent or Buckle Yes ☐ No ☐
Repaired by Pressing or Jacking Yes ☐ No ☐
Plate Removal and Replacement Yes ☐ No ☐
Size of affected area (length and width (ins)) ☐☐☐☐ ☐☐☐☐

Scores or Gouges Yes ☐ No ☐
Contour Restoration Required Yes ☐ No ☐
Repaired by Grinding Alone Yes ☐ No ☐

Repaired by Welding Yes ☐ No ☐
Size of Weld Area
(length and width (ins)) ☐☐☐☐ ☐☐☐☐
Repaired by Insert Yes ☐ No ☐
Size (length and width (ins)) ☐☐☐☐ ☐☐☐☐

Wheel Burn Yes ☐ No ☐
Repaired by Grinding Alone Yes ☐ No ☐
Repaired by Welding Yes ☐ No ☐
Size of Weld Area
(length and width (ins)) ☐☐☐☐ ☐☐☐☐
Repaired by Insert Yes ☐ No ☐
Size (length and width (ins)) ☐☐☐☐ ☐☐☐☐

4.2.4 Connections Added, Relocated or Eliminated Yes ☐ No ☐
Closure of Opening Required Yes ☐ No ☐
Welded Insert Used for Closure Yes ☐ No ☐
Rivetted Closure Used Yes ☐ No ☐
Rivet Holes Plug Welded Yes ☐ No ☐
Nozzle or Dome Added Yes ☐ No ☐
Adequate Reinforcement Provided Yes ☐ No ☐

4.2.5 Attachments Added or Relocated Yes ☐ No ☐
Attachment Pad Used Yes ☐ No ☐
Size of Attachment Pad
(length and width (ins)) ☐☐☐☐ ☐☐☐☐

4.2.6 Stub Sill Repaired or Replaced Yes ☐ No ☐

4.2.7 Other Type of Repair (if yes, append description) Yes ☐ No ☐

4.2.8 Nondestructive Testing Required as part of Repair Process
Radiography Required Yes ☐ No ☐
Radiographs Retained Yes ☐ No ☐
Liquid Penetrant Examination Yes ☐ No ☐
Magnetic Particle Examination Yes ☐ No ☐
Ultrasonic Examination Yes ☐ No ☐
Acoustic Emission Examination Yes ☐ No ☐
Hardness Test Yes ☐ No ☐

4.2.9 Post-Weld Heat Treatment
Unit Heat Treatment Yes ☐ No ☐
Local Heat Treatment Yes ☐ No ☐
Not Required Yes ☐ No ☐
Basis Statement Appended to Form Yes ☐ No ☐

4.2.10 Fire Damaged Tank Repair — Yes ☐ No ☐
AAR Form 4-2 Submitted — Yes ☐ No ☐
Valves and Fittings Removed and Retested — Yes ☐ No ☐

4.2.11 AAR R-1 Report Completed — Yes ☐ No ☐
Copy of Report at Repair Facility — Yes ☐ No ☐
If "no" give location of report ☐☐☐☐☐☐☐☐☐☐

4.3 Alteration — Yes ☐ No ☐

4.3.1 Type ☐☐☐☐☐☐☐☐☐☐

4.3.2 Certificate of Compliance Submitted to AAR — Yes ☐ No ☐

4.3.3 AAR R-1 Report Completed — Yes ☐ No ☐
Copy of Report at Repair Facility — Yes ☐ No ☐
If "no" give location of report ☐☐☐☐☐☐☐☐☐☐

4.4 Conversion — Yes ☐ No ☐

4.4.1 Type
Prior Specification ☐☐☐☐☐☐☐☐☐☐
New Specification ☐☐☐☐☐☐☐☐☐☐

4.4.2 AAR R-1 Report Completed — Yes ☐ No ☐
Copy of Report at Repair Facility — Yes ☐ No ☐
If "no" give location of report ☐☐☐☐☐☐☐☐☐☐

5. RETEST

5.1 Purpose

5.1.1 Periodic — Yes ☐ No ☐
5.1.2 Requalification Other Than Retest — Yes ☐ No ☐
Type or Reason ☐☐☐☐☐☐☐☐☐☐
5.1.3 Internal Inspection Made — Yes ☐ No ☐

5.2 Type of Test

5.2.1 Tank Pressure Test — Yes ☐ No ☐
Test Pressure (psi) ☐☐☐☐☐
Result — Pass ☐ Fail ☐

5.2.2 Interior Heating System — Yes ☐ No ☐
Test Pressure (psi) ☐☐☐☐☐
Result — Pass ☐ Fail ☐

5.2.3 Safety Relief Valve — Yes ☐ No ☐
Result — Pass ☐ Fail ☐

6. DESIGN CHARACTERISTICS - GENERAL

6.1 Design Approval (date) ☐☐☐☐☐☐☐☐
Approval Type — Conditional ☐ Unconditional ☐

6.2 Insulation — Yes ☐ No ☐
Material ☐☐☐☐☐☐☐☐☐☐
Thickness (ins) ☐☐☐☐☐

Jacket — Yes ☐ No ☐
Metal Jacket Thickness (gage) ☐☐☐☐

6.3 Bursting Pressure (psi) ☐☐☐☐☐

6.4 Tank Material ☐☐☐☐☐
Alloy ☐☐☐☐☐

6.5 Centersill

6.5.1 Stub Centersill — Yes ☐ No ☐

6.5.2 Continuous Centersill — Yes ☐ No ☐
Satisfactory Tank Anchorage — Yes ☐ No ☐

6.6 Interior Heater System — Yes ☐ No ☐
Separate Systems if Tank Compartmentalized — Yes ☐ No ☐
Piping or Tubing
Type ☐☐☐☐☐☐☐☐
Diameter (ins) ☐☐☐☐
Material ☐☐☐☐☐☐☐☐☐☐
Approval for Non-Circular Systems or Other Materials — Yes ☐ No ☐
Bolted or Welded Pipe Joints ☐☐☐☐☐☐☐☐
Inlets and Outlets Equipped with Valve Cock, Cap or Plug and Secured — Yes ☐ No ☐
Fail Safe (no leakage) Construction — Yes ☐ No ☐
Coils Attached to Manifold or Reinforced Pad — Yes ☐ No ☐
Securement Allows for Expansion — Yes ☐ No ☐
Hydrostatic Test Date ☐☐☐☐☐☐☐☐
Car Appropriately Stencilled — Yes ☐ No ☐

6.7 Shelf Coupler Type ☐☐☐☐☐☐☐☐☐☐

7. SPECIFIC DESIGN CHARACTERISTICS: PRESSURE CARS (CLASSES DOT-105, 109, 112 AND 114)

7.1 Thermal Protection System — Yes ☐ No ☐

7.1.1 Ambient Temperature Insulation — Yes ☐ No ☐
- Material ☐☐☐☐☐☐☐☐☐☐
- Thickness (ins) ☐☐☐☐

7.1.2 High Temperature Thermal Protection — Yes ☐ No ☐
- Material ☐☐☐☐☐☐☐☐☐☐
- Thickness (ins) ☐☐☐☐
- Jacket Present — Yes ☐ No ☐

7.2 Dimensions
- Inside Diameter (ins) ☐☐☐☐
- Plate Thickness
  - Minimum Prescribed (ins) ☐☐☐☐
  - Measured Shell Thickness (ins) ☐☐☐☐
  - Measured Head Thickness (ins) ☐☐☐☐

7.3 Lining — Yes ☐ No ☐
- Type ☐☐☐☐☐☐☐☐☐☐
- Thickness (mil) ☐☐☐☐

7.4 Manway Nozzle
- Shape — Circular ☐ Oval ☐
- Minimum Inside Dimension (ins) ☐☐☐☐

7.5 Manway Cover Thickness (ins) ☐☐☐☐
- Number of Connecting Bolts ☐☐☐☐

7.6 Manway Protective Housing
- Not Required Because Class 114 Car and No Valves Mounted on Manway Cover — Yes ☐ No ☐
- Sidewall Thickness (ins) ☐☐☐☐
- Cover Thickness, ins. ☐☐☐☐
- Cover Hinge Design ☐☐☐☐☐☐☐☐
- Number of Connecting Bolts ☐☐☐☐

7.7 Venting, Loading and Unloading Valves

Number ☐☐☐☐

Type(s) ☐☐☐☐☐☐☐☐☐☐

Screw Plugs or Other Closures Present Yes ☐ No ☐

7.8 Gauging Device Yes ☐ No ☐

Excess Flow Valve Used Yes ☐ No ☐

7.9 Sampling Valve Yes ☐ No ☐

Excess Flow Valve Used Yes ☐ No ☐

7.10 Thermometer Well Yes ☐ No ☐

Closure Valve Yes ☐ No ☐

Screw Plug Yes ☐ No ☐

7.11 Sump or Siphon Bowl at Bottom of Tank Yes ☐ No ☐

7.12 Bottom Outlet Yes ☐ No ☐

Requirements Met Yes ☐ No ☐

7.13 Bottom Washout Yes ☐ No ☐

Extension From Tank (ins) ☐☐☐☐

Breakage Groove Present Yes ☐ No ☐

7.14 Safety Relief Valves

Type ☐☐☐☐☐☐☐☐☐☐

Number ☐☐☐☐

Start to Discharge Pressure (psig) ☐☐☐☐

Flow Capacity, (CFM, air) Actual ☐☐☐☐☐☐

Flow Capacity, (CFM, air) Required ☐☐☐☐☐☐

Is Braking Pin Used in Conjunction with Safety Valve? Yes ☐ No ☐

Is Frangible Disc Used in Series with Safety Relief Valve? Yes ☐ No ☐

7.15 Attachments

Reinforcing Pads Used Where Required Yes ☐ No ☐

7.16 Closures Acceptable ☐ Unacceptable ☐

7.17 Tank Pressure Test, Report Date ☐☐☐☐☐☐☐☐

7.18 Safety Relief Valve Test, Report Date ☐☐☐☐☐☐☐☐

7.19 Tank Head Puncture Resistance System Yes ☐ No ☐

Full Head Yes ☐ No ☐

Lower Half Head Shield Yes ☐ No ☐

7.20 Are air brake equipment support attachments acceptable? Yes ☐ No ☐

7.21 Tank cars carrying certain commodities may be subject to specific provisions. See CFR parts 172, 173 and 179 for these requirements.

8. SPECIFIC DESIGN CHARACTERISTICS; NON (LOW)-PRESSURE CAR (CLASSES DOT-103, 104, 111AF, 111AW AND 115AW)

8.1 Thermal Protection System Yes ☐ No ☐

8.1.1 Ambient Temperature Insulation Yes ☐ No ☐
Material ☐☐☐☐☐☐☐☐☐☐
Thickness (ins) ☐☐☐☐

8.1.2 High Temperature Thermal Protection Yes ☐ No ☐
Material ☐☐☐☐☐☐☐☐☐☐
Thickness (ins) ☐☐☐☐
Jacket Present Yes ☐ No ☐

8.2 Dimensions
Inside Diameter (ins) ☐☐☐☐
Plate Thicknesses
Shell: Minimum Prescribed (ins) ☐☐☐☐
Measured (ins) ☐☐☐☐
Head: Minimum Prescribed (ins) ☐☐☐☐
Measured (ins) ☐☐☐☐

8.3 Lining Yes ☐ No ☐
Type ☐☐☐☐☐☐☐☐☐☐
Thickness (mil) ☐☐☐☐

8.4 Compartmentalized Design Yes ☐ No ☐
(Inner tank compartmentalized in Class 115 car)

8.5 Gauging, loading and unloading, venting and air inlet devices

8.5.1 Vacuum Relief Valve Yes ☐ No ☐

8.5.2 Gauging Device Yes ☐ No ☐
Outage Determination Possible Yes ☐ No ☐

8.5.3 Exposed Piping Yes ☐ No ☐
Breakage Grooves Used Yes ☐ No ☐

8.5.4 Protective Housing for Valves — Yes ☐ No ☐

8.5.5 Sump or Siphon Bowl at Bottom of Tank — Yes ☐ No ☐

8.6 Bottom Outlet — Yes ☐ No ☐
Extension From Tank (ins) ☐☐☐☐
Breakage Groove Present — Yes ☐ No ☐

8.7 Bottom Washout — Yes ☐ No ☐
Extension From Tank (ins) ☐☐☐☐
Breakage Groove Present — Yes ☐ No ☐

8.8 Safety Relief Devices

8.8.1 Valve — Yes ☐ No ☐
Number ☐☐☐☐
Start to Discharge Pressure (psig) ☐☐☐☐
Flow Capacity, (CFM, air) Actual ☐☐☐☐☐☐
Flow Capacity, (CFM, air) Required ☐☐☐☐☐☐

Is Frangible Disc Used in Series with Safety Relief Valve — Yes ☐ No ☐

8.8.2 Vent — Yes ☐ No ☐
Rupture Disc Rupture Pressure ☐☐☐☐

8.9 Attachments
Reinforcing Pads Used Where Required — Yes ☐ No ☐

8.10 Closures
Type ☐☐☐☐☐☐☐☐☐☐

8.11 Tank Pressure Test, Report Date (inner tank on Class 115 car) ☐☐☐☐☐☐☐☐

8.12 Safety Relief Valve Flow Test, Report Date ☐☐☐☐☐☐☐☐

8.13 Tank Head Puncture Resistance System — Yes ☐ No ☐
Full Head Shield Incorporated in Jacket — Yes ☐ No ☐
Lower Half Head Shield — Yes ☐ No ☐

8.14 Tank Cars Carrying Certain Commodities May Be Subject to Specific Provisions. See CFR parts 172, 173 and 179 for these requirements.

8.15 Other Items

8.15.1 Items Not Applicable to Class 115 Cars

8.15.1.1 Manway Nozzle Inside Diameter (ins) ☐☐☐☐

8.15.1.2 Expansion Capacity
Provided within Tank Yes ☐ No ☐
Provided within Dome Yes ☐ No ☐

8.15.2 Items Applicable Only to Class 115 Cars

8.15.2.1 Outer Tank Wall Thicknesses:
Shell Thickness (ins) ☐☐☐☐
Head Thickness (ins) ☐☐☐☐

8.15.2.2 Inner Container Manway Nozzle Minimum
Inside diameter ☐☐☐☐

8.15.2.3 Inner Container Manway Nozzle Cover
Not Removable While Tank Under Pressure Yes ☐ No ☐

8.15.2.4 Acceptable Inner Container Support System Yes ☐ No ☐

8.15.2.5 Expansion Capacity Provided in Inner Container Yes ☐ No ☐

9. SPECIFIC DESIGN CHARACTERISTICS: MULTI-UNIT TANK CAR TANKS (CLASSES DOT-106A AND DOT-110AW)

9.1 Number of Tanks on Car ☐☐☐☐
(Complete this section for each tank on car)

9.2 Dimensions

Inside Diameter (ins) ☐☐☐☐
Shell Thickness
Minimum Prescribed (ins) ☐☐☐☐
Measured (ins) ☐☐☐☐
Head Thickness
Minimum Prescribed (ins) ☐☐☐☐
Measured (ins) ☐☐☐☐

9.3 Manufacturing Inspection

9.3.1 Inspector's Report Submitted Yes ☐ No ☐
Report Date ☐☐☐☐☐☐☐☐

9.3.2 Safety Relief Device — Yes ☐ No ☐
- Valve — Yes ☐ No ☐
- Vent with Frangible Disc — Yes ☐ No ☐
- Fusible Plug — Yes ☐ No ☐

9.3.3 Tank Pressure Test, Report Date ☐☐☐☐☐☐☐☐

9.3.4 Safety Relief Device Test, Report Date ☐☐☐☐☐☐☐☐

9.4 Operational Inspection

9.4.1 Loading and Unloading Valve Protective Housings Securely Fastened — Yes ☐ No ☐

9.4.2 Stamped Markings Legible
- DOT Specification No. — Yes ☐ No ☐
- Material — Yes ☐ No ☐
- Cladding Material, if any — Yes ☐ No ☐
- Owner's or Builder's Symbol — Yes ☐ No ☐
- Owner's Serial No. — Yes ☐ No ☐
- Inspector's Mark — Yes ☐ No ☐
- Tank Test Date — Yes ☐ No ☐
- Water Capacity — Yes ☐ No ☐

9.5 Tank Cars Carrying Certain Commodities May Be Subject to Specific Provisions. See CFR parts 172, 173 and 179 for these requirements.

10. SPECIFIC DESIGN CHARACTERISTICS: CRYOGENIC LIQUID CARS (CLASS DOT-113)

10.1 Inner Tank Dimensions

Inside Diameter (ins) ☐☐☐☐

Shell Thickness
- Minimum Prescribed (ins) ☐☐☐☐
- Measured (ins) ☐☐☐☐

Head Thickness
- Minimum Prescribed (ins) ☐☐☐☐
- Measured (ins) ☐☐☐☐

10.2 Insulation System Performance

Standard Heat Transfer Rate (btu/deg/lb of water capacity) ☐☐☐☐☐☐

Calculated Heat Transfer Rate Based on Performance Test Data (btu/deg/lb of water capacity) ☐☐☐☐☐☐

10.3 Outer Jacket

Inside Diameter (ins) ☐☐☐☐

Shell Thickness (ins) ☐☐☐☐

Head Thickness (ins) ☐☐☐☐

Stiffening Rings Used Yes ☐ No ☐

If used: Outside ☐ Inside ☐

10.4 Support System for Inner Tank

10.4.1 Cushioning Device used to Limit Longitudinal Design Load Yes ☐ No ☐

10.4.2 Inner Tank and Outer Jacket Electrically Bonded Yes ☐ No ☐

10.5 Access to Inner Tank

10.5.1 Minimum Diameter (ins) ☐☐☐☐

10.5.2 Welded Closure Used Yes ☐ No ☐

10.6 Interior Tank Piping

10.6.1 Loading, Unloading and Vapor Phase Line Shut-off Valves and Secondary Closures Operational Yes ☐ No ☐

10.6.2 Vapor Phase Blowdown Line Shut-off Valve Operational Yes ☐ No ☐

10.7 Pressure Test of Inner Tank (date) ☐☐☐☐☐☐☐☐

10.8 Valves and Gages

10.8.1 Liquid Level Gage Operational Yes ☐ No ☐

10.8.2 Vapor Phase Pressure Gage Operational Yes ☐ No ☐

10.9 Pressure Relief Devices

10.9.1 Type

Safety Vents Yes ☐ No ☐

Number ☐☐☐☐

Pressure Relief Valves Yes ☐ No ☐

Number ☐☐☐☐

Flow Capacity ☐☐☐☐☐☐

Pressure Test Conducted Yes ☐ No ☐

10.9.2 Pressure Controlling and Mixing Device Required for Evaporation Control Yes ☐ No ☐

Operational Yes ☐ No ☐

10.9.3 Safety Interlock Used for Allowing Transfer of Lading at Pressure Higher than Pressure Control Valve Setting — Yes ☐ No ☐
Operational — Yes ☐ No ☐

10.9.4 Outer Jacket Pressure Relief — Yes ☐ No ☐

10.10 Valve and Gage Operating Instruction Nameplates Legible — Yes ☐ No ☐

10.11 Special Marking Requirements

10.11.1 Required Stamping on Outer Jacket Head Present — Yes ☐ No ☐
10.11.2 Required Stenciling Present — Yes ☐ No ☐

11. SPECIFIC DESIGN CHARACTERISTICS: MULTI-UNIT SEAMLESS STEEL TANK CAR TANKS (CLASS DOT-107)

11.1 Number of Tanks on Car ☐☐☐☐
(Complete this section for each tank on car.)

11.2 Dimensions

Inside Diameter (ins) ☐☐☐☐
Shell Thickness
Minimum Prescribed (ins) ☐☐☐☐
Test Pressure (psi) ☐☐☐☐☐

11.3 Manufacturing Inspection

11.3.1 Inspector's Report Submitted — Yes ☐ No ☐
Report Date ☐☐☐☐☐☐☐☐

11.3.2 Brinnel Hardness Test Made After Heat Treatment — Yes ☐ No ☐

11.3.3 Magnetic Particle Inspection Made After Quench and Temper Heat Treatment — Yes ☐ No ☐

11.3.4 Tank Pressure Test Data Part of Inspector's Report — Yes ☐ No ☐

11.3.5 Safety Relief Device Test Report Date ☐☐☐☐☐☐☐☐

11.4 Operational Inspection

11.4.1 Tank End Covers and Securements Acceptable — Yes ☐ No ☐

11.4.2 Protective Housing for Valves Opens for Inspection — Yes ☐ No ☐

11.4.3 Type of Safety Relief Device
- Vent with Frangible Disc — Yes ☐ No ☐
- Pressure Relief Valve — Yes ☐ No ☐

11.4.4 Safety Relief Device Equipped with Ignition Device for Transport of Flammable Gases — Yes ☐ No ☐
- Ignition Device Operational — Yes ☐ No ☐

11.4.5 Stamped Markings Legible — Yes ☐ No ☐

11.4.6 Name of Gas Stenciled on Car — Yes ☐ No ☐

12. MARKING

12.1 Stenciling

12.1.1 Side of Car

	Required: Present	Required: Not Present	Not Required
DOT Specification No.	☐	☐	☐
Clad Tank Material	☐	☐	☐
Commodity Designation	☐	☐	☐
"Not for Flammable Liquids"	☐	☐	☐
Safety Valve	☐	☐	☐
Test Date	☐	☐	☐
Test Due Date	☐	☐	☐
Tank			
Test Date	☐	☐	☐
Test Due Date	☐	☐	☐
Heater Pipes	☐	☐	☐
Test Date	☐	☐	☐
Test Due Date	☐	☐	☐
Built Date	☐	☐	☐
Conversion Date	☐	☐	☐
Lined Tank	☐	☐	☐
Material	☐	☐	☐
Date Applied	☐	☐	☐
"Pressure Test Not Required"	☐	☐	☐
Water Capacity (lbs)	☐	☐	☐
Minimum Operating Temperature	☐	☐	☐
Consolidated Stencil	☐	☐	☐
Air Brakes	☐	☐	☐
Lubrication	☐	☐	☐

	Required Present	Not Present	Not Required
Car Reporting Mark and Number	☐	☐	☐
Load Limit(lbs)	☐	☐	☐
Restriction	☐	☐	☐
Light Weight (lbs)	☐	☐	☐
Date New	☐	☐	☐
"AAR Certified SS Number"	☐	☐	☐
Dimensions Exceeding Plate B Note	☐	☐	☐
High Friction Brake Shoe Note	☐	☐	☐

12.1.2 End of Car

Car Reporting Mark and Number	☐	☐	☐
Capacity (gallons)	☐	☐	☐
Draft Gear Type	☐	☐	☐
Brake Beam Type	☐	☐	☐
Spring Travel	☐	☐	☐
Wheels	☐	☐	☐

12.2 Stamping (End of Car)

Unable to check because jacketed car If "yes" skip the rest of this section. Yes ☐ No ☐

Specification	☐	☐	☐
Material	☐	☐	☐
Cladding Material (if any)	☐	☐	☐
Tank Builder's Initials	☐	☐	☐
Date of Original Test	☐	☐	☐
Car Assembler (if other than tank builder)	☐	☐	☐
Water Capacity (lbs)	☐	☐	☐

12.3 Placard Holders

Sides	☐	☐	☐
Ends	☐	☐	☐

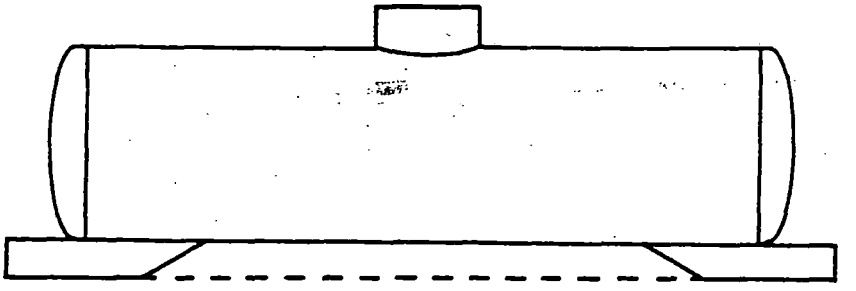
12.4 Brake Lever Badge Plate Present Yes ☐ No ☐

APPENDIX B

DIAGRAMS FOR INDICATING AREA OF REPAIR ON TANK CAR

SIDE VIEW

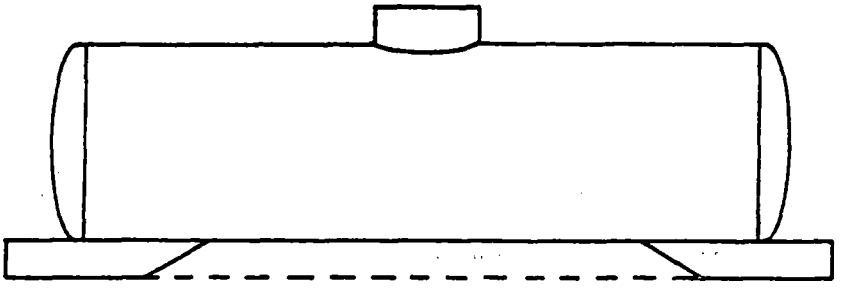
A-END



B-END

SIDE VIEW

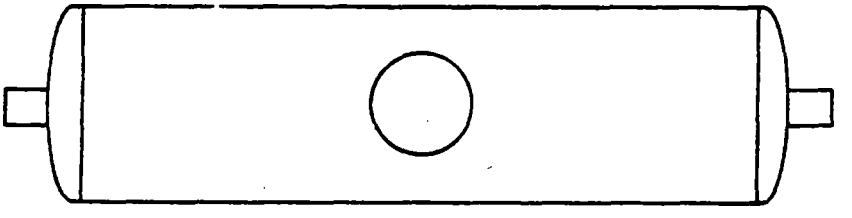
B-END



A-END

TOP VIEW

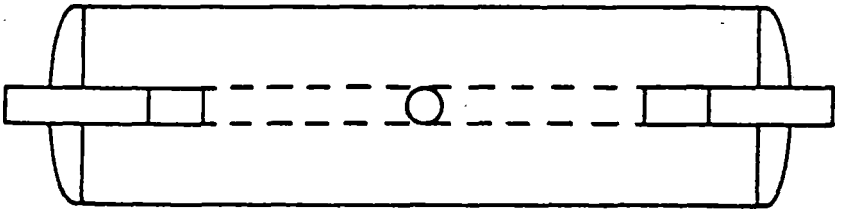
A-END



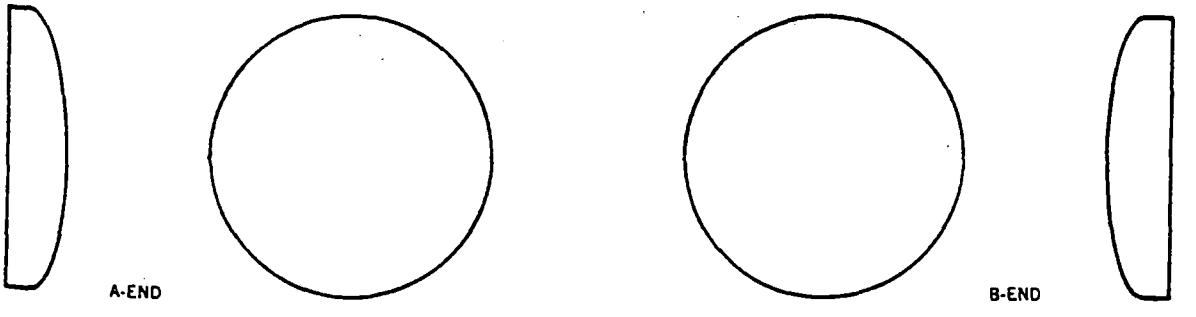
B-END

BOTTOM VIEW

A-END



B-END



A-END

B-END

APPENDIX C

DATABASE FOR EVALUATION FORM INFORMATION

C.1 ORGANIZATION OF DATABASE

A database management system has been developed for recording and storing the information entered on evaluation forms. It is based on the Paradox database software, Version 4.0, supplied by Borland International of Scotts Valley, CA. Paradox is stated to be a full featured relational database management program that can be used either as a stand alone system on a single computer or as a multiuser system on a network. The Paradox "Getting Started" and "User's Guide" manuals should be reviewed before attempting the use of the software.

Twelve tables have been configured to store the data entered on the evaluation form. The formal names of the tables are designated TABLE_N, where N is the table number. There are two computer files associated with each table which are named TABLE_N.DB and TABLE_N.F, where again N is the table number. The tables correspond to the major sections of the Evaluation Form (e.g., Database Table 1 corresponds to Section 1 of the Evaluation Form, etc.).

Each table begins with an item not listed on the evaluation form which is designated as "Record No." This number should be assigned when information from an evaluation form is being entered into the database. It provides a means for linking information in the various tables to a common evaluation form. It is important to have this link because data on a specific evaluation form is not likely to be entered into every table. Therefore, one cannot rely on the sequence of entries in a table to correspond from one table to another.

In the Paradox database software each table has a corresponding "form". The form can be used to display the data contained in any given row of a table.* The form can contain more descriptive matter about the information in any given column of the table, than can be included in the field descriptor at the top of the column in the table.

C.2 ENTRY OF DATA

New information can be entered into a table by editing the table directly (see Chapter 8 of the "Getting Started" Paradox Manual) or by entering the data on the database form corresponding to the table. This latter process is the easiest for the entry of evaluation form data (Appendix A) since the database form allows line-by-line identification of the evaluation form items with the

*See pages 67-69 of the "Getting Started" Paradox Manual.

fields in the table. This is especially helpful for entry of evaluation form data because most of the fields in the tables can only accommodate 3 characters. Thus, the headings for the field in the table can contain only very limited information. See pages 82-85 of Chapter 8 of the Getting Started Manual for an example of data entry using a form. The specific Paradox commands are Modify/Data Entry, then entry of the table name, and finally F7 to get to a "form" on which data can be entered. The cursor will be automatically positioned at the proper location for the entry of data in each field. When the data for one field has been typed in, the ENTER command will move the cursor to the next field. When all the information on the form has been put in place, the ENTER command will move to the top of the form for the entry of the next record number information. When all of the desired data has been entered, exercise the DO IT command to place all of the information in the table.

Note the instruction in Section 1.3 of this report that no entry is required on the evaluation form if a question does not apply. Similarly when entering data from the evaluation form into a table, if there is no information, the field in the table can be left blank.

Also note the instruction in Section 1.3 of this report that if a question cannot be unambiguously answered an explanation should be attached to the evaluation form and the letter A entered in the yes box. Similarly, if the letter A is found for an answer on the evaluation form, the letter A should be entered in the corresponding field in the database table.

As the evaluation form is used it is likely that there will be the desire to add some new fields and delete some of the existing fields in the tables. The Paradox software provides means for accomplishing this without disturbing data already entered in the tables.

C.3 EXAMPLE DATABASE

As an example of the storage and use of the database, hypothetical data has been entered into abbreviated versions of the first four tables of the database. These tables are named DATA_N, where N is either 1,2, 3 or 4. The number of fields in these tables have been reduced so that they can be printed on a single page. They correspond, respectively to TABLES_1 to 4. The DATA tables, along with their respective 'forms', are illustrated in Figures C.1 through C.4. Note that where a single letter is to be stored in a table, like a Y for a yes, a 3 character code is used as a field descriptor at the top of the column in the table. This descriptor is also included in the description of the information on the form.

Once information has been entered into the database there are many ways in which it can be processed using the Paradox software. For example, using the hypothetical data, suppose it is desired to construct a list of all of the

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RECORD NO.	DATE	11	12	13	1A	1B	1C	INSPECTOR	NUMBER	LOCATION
1	12/06/91	Y	N	N	Y	N	N	JONES	35	CHICAGO
2	1/15/92	N	Y	N	N	Y	N	SMITH	56	ST. LOUIS
3	7/05/92	N	Y	N	N	Y	N	ANDERS	22	WASH. DC
4	7/31/92	N	N	Y	N	Y	Y	WILLIAMS	89	AUSTIN
5	7/15/93	Y	N	N	Y	N	N	JONES	35	CHICAGO
6	7/16/93	N	Y	Y	N	Y	Y	SMITH	56	ST. LOUIS
7	7/17/93	N	Y	N	N	Y	N	JONES	35	CHICAGO
8	7/17/93	Y	N	N	Y	N	N	ANDERS	22	WASH. DC
9	7/19/93	N	N	Y	N	Y	Y	ANDERS	22	WASH. DC
10	7/20/93	N	Y	N	N	Y	N	WILLIAMS	89	AUSTIN
11	7/21/93	N	N	Y	N	Y	Y	SMITH	56	ST. LOUIS
12	7/25/93	Y	N	N	Y	N	N	ANDERS	22	WASH. DC

a. Table DATA_1 as Stored in Database

DATA 1 - THIS TABLE CONTAINS SECTION 1 AND 2 DATA

DATA_1 #_____

RECORD NO.: _____

DATE OF REPORT: _____

1.0 TYPE OF INSPECTION: (Indicate Y or N, for Yes or No)

FACILITY (11): __

NEW CAR CONSTRUCTION (12): __

REPAIR ALTERATION OR CONVERSION (13): __

INDICATE (Y for yes, N for no) WHETHER DATA HAS BEEN ENTERED INTO ANY OF THE FOLLOWING TABLES FOR THE ABOVE RECORD NO.

DATA_2 (Section 3 of Evaluation Form), (1A): __

DATA_3 (Section 4 of Evaluation Form), (1B): __

DATA_4 (Section 5 of Evaluation Form), (1C): __

2.0 INSPECTOR INFORMATION

INSPECTOR: _____

INSPECTOR NUMBER: _____

INSPECTOR LOCATION: _____

b. Form Showing Added Information About Each Field in Table Along with Prompts for Entering Data

Fig. C.1 Database Table and Form Associated with Example Table Data_1

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RECORD NO.	MF	RP	TS	COMPANY	LOCATION	FC	BN	BA	BB	BC	RN	RA	RB	RC
1	Y	Y	Y	XYZ INC.	MUNCIE IN	N	N	N	Y	N	N	N	N	Y
5	N	Y	Y	ABC CO.	PEORIA IL	N	Y	N	N	N	N	Y	N	N
8	Y	Y	Y	NEWTANK	BALT. MD	N	N	N	N	Y	N	N	N	Y
12	N	N	Y	USRV CO.	TRENTON NJ	Y	N	N	N	N	N	N	N	N

a. Table DATA_2 as Stored in Database

DATA_2 #_____

DATA 2 - FACILITY INFORMATION

RECORD NO.: _____

3.1 INDICATE TYPE(S) OF FACILITY (Indicate yes (Y) or no (N) for each type)
MANUFACTURING (MF): __
REPAIR (RP): __
RETEST (TS): __

3.2 COMPANY DATA
COMPANY NAME: _____

LOCATION: _____

IS FACILITY IS USED ONLY FOR RETEST? (Indicate yes (Y) or no (N)), (FC): __

3.4 FACILITY ACTIVITY (Indicate yes (Y) or no (N))
Tank Cars Built in Prior 12 Months;
None (BN): __
1 to 5 (BA): __
6 to 24 (BB): __
Over 24 (BC): __
Tank Cars Repaired or Converted in Prior 12 Months;
None (RN): __
1 to 5 (RA): __
6 to 24 (RB): __
Over 24 (RC): __

b. Form Showing Added Information About Each Field in Table Along with Prompts for Entering Data

Fig. C.2 Database Table and Form Associated with Example Table Data_2

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RECORD NO.	DOT SPEC.	MARK	CAR NO.	CAPACITY	LT. WT.	LD. LT.	CV	CNS. DT.
2	111A100W4	FATX	601345	25000	93000	170000	N	12/01/91
3	105A400W	VTLX	111324	20000	73000	190000	N	6/05/92
4	105A300W	FATX	231106	22000	80000	183000	N	8/21/80
6	112A400W	CATX	31109	30000	86000	157000	N	3/15/77
7	111A100W4	VTLX	179328	20000	70000	193000	N	7/03/93
9	105A500W	FATX	391048	18000	85000	178000	N	11/06/81
10	111A60W2	CATX	261349	15000	60000	150000	N	7/01/93
11	105A300W	VTLX	112617	20000	75000	188000	N	9/24/69

a. Table DATA_3 as Stored in Database

DATA 3 - TANK CAR INFORMATION

DATA_3 #_____

RECORD NO. _____

4.1 DESCRIPTION
DOT SPECIFICATION NUMBER: _____
REPORTING MARK: ____
CAR NUMBER: _____
WATER CAPACITY (gal): _____
LIGHT WEIGHT (lbs): _____
LOAD LIMIT (lbs): _____
HAS CAR BEEN CONVERTED (Y or N): __

4.3 CONSTRUCTION DATE: _____

b. Form Showing Added Information About Each Field in Table Along with Prompts for Entering Data

Fig. C.3 Database Table and Form Associated with Example Table Data_3

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RECORD NO.	10A	11A	11B	11C	11D	11E	11F	11G	11H	11I	30A	40A
4	Y	N	Y	Y	N	N	N	N	N	N	N	N
6	Y	N	N	N	N	N	Y	Y	N	N	N	N
9	Y	Y	N	N	N	N	N	N	N	Y	N	N
11	Y	N	N	N	N	N	N	N	Y	N	N	N

a. Table DATA_4 as Stored in Database

DATA 4 - REPAIR, ALTERATION OR CONVERSION DATA_4 #_____

RECORD NO.: _____

5.1 INDICATE IF REPAIR WAS CONDUCTED (Y or N), (10A): ___
IF SO, ENTER THE FOLLOWING DATA:

5.1.1 TYPE OF DEFECT (Indicate yes (Y) or no (N))
DENT (11A): ___
FRACTURE (11B): ___
PITS OR CORROSION (11C): ___
SCORES OR GOUGES (11D): ___
WHEEL BURN (11E): ___
MANWAY OR CLOSURE PLATE (11F): ___
VALVES (11G): ___
SAFETY RELIEF DEVICE (11H): ___
INTERIOR HEATER PIPES (11I): ___

5.3 WAS TANK CAR ALTERED? (Indicate Y or N), (30A): ___
5.4 WAS TANK CAR CONVERTED? (Indicate Y or N), (40A): ___

b. Form Showing Added Information About Each Field in Table Along with Prompts for Entering Data

Fig. C.4 Database Table and Form Associated with Example Table Data_4

evaluation records completed by inspector Jones, including the dates and nature of these inspections. This would represent a subset of the information contained in the DATA_1 table. Using the procedures described on pages 95 to 101 of the Paradox Getting Started Manual, which involved using the "Ask" command, a special table can be constructed with the desired information. The result is shown in Fig. C.5.

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RECORD NO.	DATE	11	12	13
1	12/06/91	Y	N	N
5	7/15/93	Y	N	N
7	7/17/93	N	Y	N

Fig. C.5 Summary Table for Data_1 Information

Another example is provided using the hypothetical data. It is desired to construct a table listing all of the inspections of Class 105 cars and giving the dates of the inspections, the name of the inspector, the complete DOT specification number, and the reporting mark and number of the tank car. This involves selecting out data from both the table DATA_1 and the table DATA_3. Using the procedures described on pages 101 to 105 in the Paradox Getting Started Manual a special table can be constructed with the desired information. The result is shown in Fig. C.6.

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DATE	INSPECTOR	DOT SPEC.	MARK	CAR NO.
7/05/92	ANDERS	105A400W	VTLX	111324
7/31/92	WILLIAMS	105A300W	FATX	231106
7/19/93	ANDERS	105A500W	FATX	391048
7/21/93	SMITH	105A300W	VTLX	112617

Fig. C.6 Summary Table for DATA_1 and DATA_3 Information

Figs. C.5 and C.6 present the summary data in tabular form using the field descriptors in the database as headings for the columns. These headings are only of limited width because of the desire to save space in the original database table. The information presented in these tables (or any other table) can be expanded using the "Report" procedures described in Chapters 7 and 8 of the Paradox User's Guide. This has been done for Tables C.5 and C.6 to provide examples of the "Report" format possibilities. The results are presented in Figs. C.7 and C.8 where titles for the tables have been added as well as more information in the column headings.

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RECORD NO.	DATE	TYPE OF INSPECTION FACILITY	NEW CAR	REPAIR
1	12/06/91	Y	N	N
5	7/15/93	Y	N	N
7	7/17/93	N	Y	N

Fig. C.7 Report Format for Table in Fig. C.5

8/06/93 CLASS 105 TANK CAR INSPECTIONS Page 1

DATE OF INSPECTION	NAME OF INSPECTOR	DOT SPECIFICATION	REPORTING MARK	CAR NUMBER
7/05/92	ANDERS	105A400W	VTLX	111324
7/31/92	WILLIAMS	105A300W	FATX	231106
7/19/93	ANDERS	105A500W	FATX	391048
7/21/93	SMITH	105A300W	VTLX	112617

Fig. C.8 Report Format for Table in Fig. C.6

CLASS 105 TANK CAR INSPECTIONS Page

NAME OF INSPECTOR	DOT SPECIFICATION	REPORTING MARK	CAR NUMBER
ANDERS	105A400W	VTLX	111224
WILLIAMS	105A300W	FATX	231106
ANDERS	105A500W	EATX	391048
SMITH	105A300W	VTLX	112617

Fig. C.8 Report Format for Table in Fig. C.6

Tank Car Manufacturing/Repair/Retest Facility Evaluation Form, US DOT, FRA, Milton R Johnson, 1993 -14-HazMat