



ASSOCIATION OF
AMERICAN RAILROADS



Field Guide **To Tank Cars**

FIELD GUIDE TO TANK CARS

Compiled By Allen D. Maty, Chief Inspector, Bureau of Explosives

**Association of American Railroads
Transportation Technology Center, Inc.
Bureau of Explosives
55500 DOT Road
P. O. Box 11130
Pueblo, Colorado
www.boe.aar.com**

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Acknowledgements

The Association of American Railroads, Transportation Technology Center, Inc., and the Bureau of Explosives gratefully acknowledge the assistance of GATX Corporation and Midland Manufacturing Company for granting us permission to use their tank car drawings.

We also wish to thank Charles J. Wright, Patrick J. Student, Paul B. Williams, and William J. Oertly for their critical review and/or comments. Without their help, this publication would not have been possible.

Dedication

Field Guide to Tank Cars is dedicated to the memory of:

Mr. Roy J. Holden

(1921–1989)

Engineer, Technical Services

Bureau of Explosives

Association of American Railroads

“Uncle Roy” was a pioneer in the development of tank car damage assessment techniques. His wit, wisdom, experience and dedication to tank car safety are sorely missed.

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INTRODUCTION

Field Guide to Tank Cars is intended to be used by emergency responders and others involved with railroad tank cars. It provides information on the types, safety systems, stenciling, and markings of tank cars utilized to transport regulated (hazardous materials/dangerous goods) and nonregulated commodities.

Given the varying characteristics of the different commodities being transported and the shipper's differing needs and uses, it is impossible to cover all of the various types of tank cars and fittings used. The illustrations contained in this guide are intended to provide a general overview of tank car types and typical fittings. They show the most common types of single-unit tank cars (a tank car tank mounted on, or forming part of, a railcar structure) currently used to transport both regulated (hazardous materials/dangerous goods) and nonregulated commodities.

All railroad tank cars are built to specifications, standards, and requirements established, implemented, and published by the U.S. Department of Transportation (DOT), Transport Canada (TC), and/or Association of American Railroads (AAR).

These specifications, standards, and requirements address tank car design, type, and thickness of material required to be used in construction, types of fittings, welding procedures, inspection, maintenance, repair, and quality assurance system requirements.

Note: Regulatory and railroad industry specifications, standards and requirements are contained in U.S. DOT: Title 49 Code of Federal Regulations, Parts 173 (Subpart B), 174, 179 and 180 (Subpart F); Transport Canada: Transportation of Dangerous Goods Regulations (Transport Canada TDG Regulations); Canadian General Standards Board: National Standard of Canada CAN/CGSB 43.147; and Association of American Railroads Manual of Standards and Recommended Practices Section C-III, Specifications for Tank Cars, Specification M-1002.

Although there are many different single-unit tank cars, they can generally be divided into three separate categories:

1. Nonpressure tank cars (also called general service or low-pressure tank cars) are built to transport low-vapor pressure commodities, including regulated (hazardous materials/dangerous goods), as well as nonregulated commodities.
2. Pressure tank cars are built with thicker tanks to withstand higher internal pressures, making them stronger than a nonpressure tank car. They are typically used to transport liquefied compressed gases, poison/toxic inhalation hazard (PIH/TIH) materials, reactive materials, and/or some corrosive materials.
3. Cryogenic liquid tank cars are vacuum-insulated cars having an inner container (tank) and carbon steel outer shell (tank, not jacket). They are used to transport refrigerated (extremely cold) liquefied gases having a boiling point

colder than minus 130°F at atmospheric pressure; e.g., liquid hydrogen, ethylene, oxygen, nitrogen, and argon.

Field Guide to Tank Cars is divided into eight sections:

Section 1: Tank Car Classification and Specifications

Explains the various DOT, TC, and AAR tank car classes and specifications.

Section 2: Tank Car Safety Systems

Describes the various kinds of pressure-relief devices (PRD) and other systems applied to protect the tank.

Section 3: Tank Car Stenciling and Markings

Provides information on various stenciling/markings required on tank cars by DOT, TC, and AAR.

Section 4: Nonpressure Tank Cars

Describes the most common tank cars currently used to transport both regulated (hazardous materials/dangerous goods) and nonregulated commodities. This section also describes typical types of top and bottom valve and fittings arrangements with which these cars may be equipped.

Section 5: Pressure Tank Cars

Describes the tank cars currently used to transport hazardous materials/dangerous goods under pressure, as well as some low-pressure, high-hazard materials, such as PIH/TIH materials, that may require the additional protection of a stronger tank car.

Section 6: Cryogenic Liquid Tank Cars

Describes the tank cars currently used to transport cryogenic liquids, such as argon.

Section 7: Guidelines for Initial Emergency Response

Provides general guidance when approaching the scene of an emergency (accident or incident) involving tank cars in transportation. It also provides information on assessing damage to tank cars.

This damage assessment information is presented to familiarize emergency responders with techniques used by trained and experienced professionals in analyzing and handling tank problems. It is not intended to replace on-scene judgment.

Section 8: Glossary of Railroad and Tank Car Terms

Provides emergency responders and others involved with tank cars with some of the terminology associated with tank cars.

SECTION 1: TANK CAR CLASSIFICATION AND SPECIFICATIONS

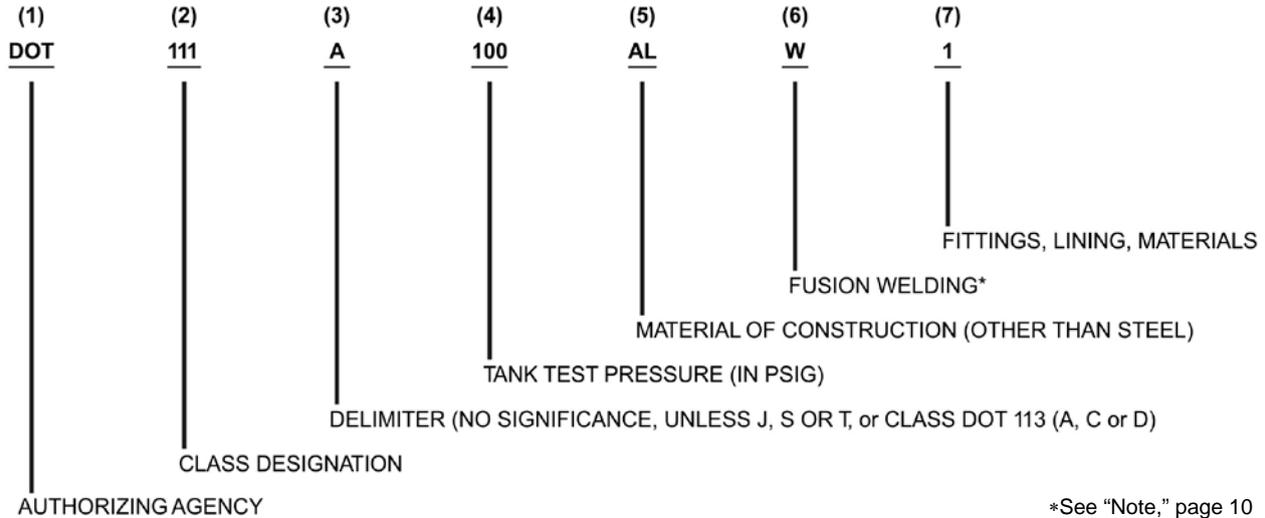
DOT, TC, and the AAR have established specifications for the design, construction, testing, repair, and maintenance of tank cars. The tank car's specification is required to be stenciled on both sides of the car. A sample specification appears on the next page. The below information defines the lettering.

Current tank car specifications consist of the **authorizing agency (1)**, which is followed by the three-digit **class designation (2)**. Except for certain AAR-specification tank cars, a **delimiter letter (3)** (usually A, J, S, or T; or for Class DOT 113 cryogenic liquid tank cars A, C, and D) will follow the class designation. When present, the second number indicates the **tank test pressure (4)** in pounds per square inch gauge (psig). Typically, tank test pressure is

20 to 40 percent of the tank's theoretical minimum burst pressure, which ranges from 240 psig to 1500 psig.

The next set of letters, if shown, indicates the **material of construction (5)** for the tank when that material is other than carbon steel. Currently, only the letters AL (for aluminum) are being used. The next letter W denotes **fusion welding (6)** (see "Note," page 10, for more information). The last digit, if present, indicates that the tank car is required to have, or is permitted to have, **fittings, linings, material (7)**, such as insulation, top loading/unloading fittings, bottom outlet, bottom washout, interior lining, and/or the tank's required material of construction.

Sample Specification: DOT-111A100ALW1



*See "Note," page 10

Components of the Specification Marking

1. Authorizing Agency:

AAR – Association of American Railroads

DOT – U.S. Department of Transportation

TC – Transport Canada (replaced Canadian Transport Commission (CTC))

2. Class Designation: The term “Class” is a general designation for tank cars. The class designation usually includes several specifications and is made up of the authorizing agency followed by the three digit class number, such as Class DOT-111 or Class AAR-204.

- Nonpressure Tank Car Classes:

DOT-111: insulated or noninsulated, without an expansion dome.

DOT-115: insulated with a carbon or alloy (stainless) steel or aluminum inner container (tank) and a carbon steel outer shell (tank, not jacket). Also referred to as a tank-within-a-tank.

AAR-206: insulated with an inner container (tank) and carbon steel outer shell (tank, not jacket). These tank cars are similar to Class DOT-115 tank cars. Also referred to as a tank-within-a-tank.

AAR-211: insulated or noninsulated, without an expansion dome. These tank cars are similar to Class DOT-111 tank cars.

Note: The following classes of nonpressure tank cars are currently authorized for use. However, new construction is no longer authorized, and due to their age, few, if any, are in commercial service. Therefore, the below classes are not presented in this field guide.

DOT-103: insulated or noninsulated, carbon or alloy (stainless) steel, aluminum, or nickel, with an expansion dome.

DOT-104: insulated carbon steel, with an expansion dome.

AAR-203: insulated or noninsulated, carbon or alloy (stainless) steel, with an expansion dome.

- Pressure Tank Car Classes:

DOT-105: insulated carbon or alloy (stainless) steel.

DOT-109: insulated or noninsulated, carbon steel or aluminum.

DOT-112: insulated or noninsulated, carbon or alloy steel.

DOT-114: insulated or noninsulated, carbon or alloy steel.

DOT-120: insulated carbon steel or aluminum.

- Cryogenic Liquid* Tank Car Classes:

DOT-113: vacuum insulated with a high alloy (stainless steel) or nickel alloy inner container (tank) and carbon steel outer shell (tank, not jacket).

AAR-204: vacuum insulated with an inner alloy (stainless) steel container (tank) and carbon steel outer shell (tank, not jacket). These tank cars are similar in concept to DOT Class 113 tank cars.

*Refrigerated liquefied gases having a boiling point colder than minus 130°F at atmospheric pressure, such as liquefied argon and liquefied oxygen.

3. Delimiter Letter: On the majority of nonpressure tank cars, the letter A separates the class from the tank test pressure and has no meaning. On pressure and cryogenic liquid tank cars (and some nonpressure tank cars), the delimiter letter is an indicator of tank head puncture resistance and/or thermal protection systems.

- Nonpressure or Pressure Tank Cars:

A – no significance.

J – equipped with a thermal protection system that is covered by a jacket and tank head puncture-resistance system.

S – equipped with tank head puncture-resistance system.

T – equipped with a thermal protection system that is not covered by a jacket (the thermal protection material is sprayed directly onto the tank's surface) and tank head puncture-resistance system.

- Cryogenic Liquid Tank Cars:

A – authorized for minus 423°F loading.

C – authorized for minus 260°F loading.

D – authorized for minus 155°F loading.

4. Tank Test Pressure: The next set of digits is the tank test pressure in psig; typically 20 to 40 percent of the tank's burst pressure.

For nonpressure cars, test pressures are specified as 60 or 100 psig; however, some manufacturers test 100-pound tanks to 165 psig, because they are equipped with 165 psig pressure relief devices (PRD), which equates to 33 percent of the tank's 500 psig burst pressure.

For pressure tank cars, test pressures range from 100 psig to 600 psig.

For cryogenic liquid tank cars, tank test pressures range from 60 psig to 120 psig.

5. Material of Construction (other than steel): The letters AL appearing after the tank test pressure indicate that the tank was constructed of aluminum alloy. For other materials of construction, no letters or numerals are shown.

Note: Poison (Toxic) Inhalation Hazard (PIH/TIH) Materials. On January 13, 2009, DOT's Pipeline and Hazardous Materials Safety Administration (PHMSA) published a Final Rule (FRA-2006-25169), titled "Hazardous Materials: Improving the Safety of Railroad Tank Car Transportation of Hazardous Materials."

This rule prescribes enhanced safety measures for PIH/TIH materials transported in tank cars, primarily stronger tanks with higher tank test pressures, fittings, and tank head-puncture resistance protection and, for some commodities, thermal protection.

Tank cars built after, March 16, 2009, used for the transportation of PIH/TIH materials will have the letter I stenciled in place of the letter W; e.g, Specification DOT-105J500I, Specification DOT-112J500I, or Specification DOT-105J600I. The letter I may be said to indicate interim design standards for a PIH/TIH tank car. More information on these requirements is found in Section 5, Pressure Tank Cars.

6. Fusion Welding: The letter W following the tank test pressure or the letters AL indicates that the tank was constructed using fusion welding. All tank cars are currently constructed using fusion welding. See "Note," this page, for PIH/TIH materials.
7. Fittings, Linings, and Materials: For nonpressure tank cars, the numeral following the W will indicate the tank's material of construction, requirements for insulation or interior lining, and options for bottom outlet or bottom washout:

| Designator | Tank Material | Bottom Outlet | Bottom Washout |
|------------|--------------------------------|---------------|----------------|
| ALW1 | Aluminum Alloy | Optional | Optional |
| ALW2 | Aluminum Alloy | No | Optional |
| W1 | Carbon Steel | Optional | Optional |
| W2 | Carbon Steel | No | Optional |
| W3 | Carbon Steel (Insulated) | Optional | Optional |
| W4 | Carbon Steel (Insulated) | No | No |
| W5 | Carbon Steel (Elastomer Lined) | No | No |
| W6 | Alloy (Stainless) Steel | Optional | Optional |
| W7 | Alloy (Stainless) Steel | No | No |

SECTION 2: TANK CAR SAFETY SYSTEMS

Tank cars are equipped with various devices and safety systems to protect the tank and fittings from damage during an accident or severe impact. These devices and safety systems, discussed below, include pressure relief devices (PRD), coupler vertical restraint systems (double-shelf couplers), tank head puncture-resistance systems (head shields), thermal (fire) protection systems, service equipment (filling, discharge, venting, safety, heating, and measuring devices), and protection systems.

Pressure Relief Devices — Per DOT regulation, single-unit tank cars transporting Division 6.1, Packing Group (PG) I and II (poisonous/toxic) materials, Class 2 (compressed gas), Class 3 (flammable liquid), and Class 4 (flammable solid, spontaneously combustible, or dangerous when wet) materials must have reclosing PRDs. However, tank cars built before January 1, 1991,

and equipped with a nonreclosing PRD may be used to transport Division 6.1, PG I or II materials or Class 4 liquids, provided the materials are not poisonous (toxic) by inhalation. Look under subsection titled Pressure Relief Devices, page 13, for more information on PRDs.

Coupler Vertical Restraint Systems — All tank cars used to transport hazardous materials/dangerous goods must be equipped with double-shelf couplers that have top and bottom shelves. These shelves function to prevent couplers from separating in a derailment, thus preventing a tank car's head from being punctured by another car's overriding coupler in the event of an over-speed impact during switching operations.

Tank Head Puncture-Resistance Systems —

Tank cars transporting Class 2 (compressed gas) materials and those constructed of aluminum or nickel plate used to transport hazardous materials/dangerous goods must have a system capable of sustaining, without the loss of lading, coupler-to-head impacts of 18 mph. This is usually accomplished by the installation of separate head shields or full-head tank jackets made of ½-inch-thick steel on each end of the tank car. On some insulated tank cars (typically Class DOT-105 pressure tank cars), head protection is accomplished by a combination of the thickness of the tank heads and the insulation system, the gauge (thickness) of the head jacket, and the stand-off distance between the jacket and the tank head, which must be proved by testing.

Thermal Protection Systems — Single-unit tank cars (except Class DOT-113 cryogenic liquid tank cars) transporting Class 2 (compressed gas) materials must be equipped with a thermal protection or insulation system

that provides sufficient thermal resistance so that there will be no release of any lading, except through the PRD, when subjected to a pool fire for 100 minutes or a torch fire for 30 minutes.

Bottom Discontinuity Protection Systems —

Depending upon the commodity being transported and the projection distance from the shell, tank cars equipped with bottom fittings, sometimes called bottom discontinuities (including bottom outlets, bottom washouts, sumps, and blind flanges) must have these fittings protected from being sheared off or otherwise damaged in the event of a derailment or by other impact that could result in the loss of lading. Bottom fittings protection may be accomplished by mounting the valve operating mechanism inside the tank and/or protective skids applied to the bottom of the tank. Continuation of the valve assembly below the tank shell or skid must be designed so that it will fail without damaging the valve, causing a release of product. This is accomplished by incorporating a shear

groove in the valve body or sizing the bolts attaching the valve extension to have low-shear strength. Some tank cars are equipped with top fittings protection that consists of rollover (skid) protection.

Pressure Relief Devices

PRDs are fittings designed to relieve the internal pressure within a tank car above a specified value that may result from abnormal conditions or from normal pressure increases during transportation (pressure relief device is synonymous with safety relief device). Conditions that may cause a PRD to function include the exposure of the tank car to fire, hydrostatic pressure created within a tank overloaded by volume, chemical (exothermic) reaction of the lading in the tank that builds up pressure (such as polymerization), and/or an over-speed impact that results in a pressure spike due to the surge action of the liquid.

A type of a PRD (a regulating valve) may be used on certain tank cars to intentionally vent vapor during transportation. Such venting is normal in transportation.

In addition to devices that relieve internal pressure, nonpressure tank cars may be equipped with a device to prevent a vacuum from forming within the tank.

In general, there are two categories of PRDs: (1) reclosing devices, such as pressure relief valves (PRVs), and (2) nonreclosing devices, such as safety vents, also called rupture disc devices.

On nonpressure and pressure tank cars, the PRDs are located on the top of the tank; on cryogenic liquid tank cars, the PRDs are located in closed compartments or cabinets containing the loading and unloading equipment, typically mounted on the sides or on one end of the car.

Pressure relief valves (PRVs) are spring-loaded, reclosing PRDs designed to open at a set pressure to relieve excessive pressure within the tank. They then automatically reclose after normal conditions are restored. A tank car may be equipped with multiple PRVs to provide the necessary flow capacity for the commodity.

Safety vents (rupture disc devices/nonreclosing PRDs) are equipped with a rupture (or frangible) disc designed to burst at a certain pressure to relieve pressure. Once the disc bursts, the safety vent remains open until the disc is replaced.

Rupture discs are made from plastic/composite materials or a metal body (usually stainless steel) incorporating an elastomeric-type membrane. Safety vents, instead of PRVs, are typically used on tank cars transporting corrosive materials (such as sulfuric acid) and other materials that may have properties that would be detrimental to the components of a PRV.

Safety vents are also used on tank cars transporting nonregulated commodities, such as corn syrup and clay slurry, and in combination with other PRDs on tank cars transporting cryogenic liquids, such as ethylene, argon and oxygen.

Combination PRDs incorporate a nonreclosing device, such as a breaking pin or rupture disc, in series

with a spring-loaded reclosing pressure relief valve. The PRV must be outboard of the nonreclosing device (breaking pin or rupture disc). The breaking pin or rupture disc must be designed to fail at a pressure higher than that of the spring-loaded portion of the device. Thus, if internal pressure causes the pin or disc to fail, the spring-loaded portion will open.

Combination PRDs are typically used on high-hazard PIH/TIH materials, such as chlorine. Combination PRDs utilizing a rupture disc are required to be equipped with an indicator device to detect any accumulation of pressure between the disc and the spring-loaded valve. The device must be a needle valve, try cock, or telltale indicator, which must remain closed during transportation.

Regulating (regulator) valves (called a pressure control device for cryogenic liquid tank cars) are required on pressure tank cars transporting carbon dioxide and nitrous oxide, and cryogenic liquid tank cars transporting liquefied argon, nitrogen, or oxygen.

These spring-loaded PRDs, with start-to-discharge pressures lower than the other PRDs (a pressure relief valve and a safety vent), are intended to vent vapor during transportation to maintain internal pressure (through auto-refrigeration) below that of other PRDs.

Tank cars equipped with these devices must be stenciled REGULATING VALVE(S) VENTING NORMAL on both sides.

Vacuum-relief valves (also called vacuum breakers) are applied to some nonpressure tank cars to admit air into the tank to prevent excessive internal vacuum that may result in a collapse (implosion) of the tank. This danger exists during closed-system unloading operations using pumps, where the tank is not vented to allow air to enter or, in extreme cases, where an empty tank is subjected to wide temperature variations (hot to cold); e.g., steaming or steam-cleaning a tank car.

Vacuum-relief valves (As information, “foot valve” is an inappropriate term for a vacuum-relief valve.) are typically set at negative 0.75 psig or lower. A vacuum-relief valve should not be depressed to determine if there is pressure in the tank, because doing so may dislodge the O-ring seal causing the device to leak.

Breather vents (also called continuous vents) are devices equipped with a permeable disc, such as pumice stone or a plastic-type membrane. Breather vents are typically applied to nonpressure tank cars transporting hydrogen peroxide solutions to prevent pressure buildup within the tank by allowing the venting of oxygen, which is generated as the material naturally decomposes.

Totally contained commodities are commodities like corn syrup that have been authorized by the AAR Tank Car Committee to be shipped in tank cars not equipped with PRDs. Such tank cars must be stenciled

with an AAR specification (a DOT exemption or special permit is required for DOT specification tank cars.)

Further, tank cars must be marked with the name of the commodity it is carrying in 4-inch minimum lettering and the words NO PRESSURE RELIEF DEVICE in 2-inch minimum lettering beneath the name of the commodity.

Pressure Relief Device Settings

For nonpressure and pressure tank cars, governmental regulations prescribe that the start-to-discharge (STD) pressure of a reclosing PRD may not be lower than 75 psig or exceed 33 percent of the tank's minimum burst pressure. For example, a tank car with a 300 psig tank test pressure (750 psig minimum burst pressure), must have the pressure relief valve's STD set between a minimum of 75 psig and a maximum of 247.5 psig (33% of 750 psig).

A reclosing valve must have a vapor-tight pressure (VTP) of at least 80 percent of the STD pressure. For example, the minimum VTP for a 75 psig valve would be

60 psig, and the minimum VTP for a 247.5 psig valve would be 198 psig.

Tanks built prior to October 1, 1997, having a minimum burst pressure of 500 psig or less may be equipped with reclosing valve(s) having an STD pressure of no less than 14.5 percent of the minimum burst pressure, but no more than 33 percent of the minimum burst pressure. For example, on a tank with a 60 psig tank test pressure (240 psig) minimum burst pressure, the pressure relief valve must be set between 34.8 (35) and

Note: The AAR Specifications for Tank Cars prescribe that tank cars in regulated commodity service equipped with 35 psig STD pressure relief valves must be upgraded to 75 psig STD pressure relief valves no later than the next valve qualification date.

79.2 (80) psig.

For a nonreclosing safety vent, the rupture disc must be designed to burst at a pressure equal to the

greater of either 100 percent of the tank's test pressure or 33 percent of the tank's burst pressure. For example, on a tank car with a 100 psig tank test pressure (500 psig minimum burst pressure), the disc must burst at the greater of 100 psig or 165 psig (33% of 500 psig); therefore, the disc must be designed to burst at 165 psig.

For a combination PRD, the breaking pin must be designed to fail or the rupture disc burst at the pressure prescribed for a reclosing PRD/PRV. Further, the reclosing PRV must be set to discharge at a pressure not greater than 95 percent of the STD pressure. For example, on a tank car with a 500 psig tank test pressure (1250 psig minimum burst pressure), the breaking pin must fail or the rupture disc must burst between 75 and 412.5 psig, and, depending upon the pin or disc's fail point, the reclosing valve must be set to discharge between 71.25 and 391.9 psig.

Tank cars transporting carbon dioxide and nitrous oxide are equipped with three types of PRDs: (1) a

reclosing PRV having a STD pressure not exceeding 75 percent of the tank test pressure, (2) a nonreclosing safety vent designed to burst at a pressure less than the tank test pressure, and (3) two regulating valves set to open at a pressure not to exceed 350 psig on a 500 psig test pressure tank or 400 psig on a 600 psig test pressure tank. In addition, the final discharge of each PRD must be piped outside of the protective housing.

Cryogenic liquid tank cars transporting atmospheric gases are equipped with one or more pressure relief valves, safety vents, and regulating valves. The regulating valve is normally set to limit internal pressure to no more than 25.3 psig under ambient temperature conditions. Some tank cars may have a second safety vent in series with the first. They are connected to the tank by means of a crossover valve so that only one safety vent is on line at a time.

SECTION 3: TANK CAR STENCILING AND MARKING

There is a considerable amount of information required by DOT, TC, and/or AAR to be stenciled or marked on the exterior of a tank car. There are standards as to the location and size of the required stenciling.

The information most useful is the tank car's reporting mark (also called initials) and the car number. The reporting mark, usually three to four letters, identifies the car's owner (marks ending with an X denote that the car is not owned by a railroad) and is followed by up to six digits; e.g., AARX 2010. The reporting mark and number are the tank car's unique identifier and are required to be marked on each side of the car to the far left of center and in the center of each end.

Many tank cars are also marked with the reporting mark and number on the top of the car and/or diagonally positioned on the ends.

In an emergency, you may identify the contents of a car, from a safe distance, by looking up its reporting mark and number on the train consist/train list/wheel report or other shipping document.

Stenciled below the reporting mark and number will be the tank car's load limit (LD LMT) and light weight (LT WT). The load limit is the maximum weight of lading that may be loaded into the tank car. The light weight is the weight of the tank car when empty. The tank's volumetric capacity, in gallons and liters, is stenciled centered on each end. (The capacity may also be shown in imperial gallons.)

The tank car's specification is required to be marked on both sides to the far right of center. The following information can be used to identify the type and characteristics of the tank car.

DOT Tank Car Classes (some specifications marked may be marked TC):

- Nonpressure Tank Cars: 111 and 115
- Pressure Tank Cars: 105, 109, 112, 114, and 120
- Cryogenic Liquid Tanks Cars: 113

AAR Tank Car Classes:

- Nonpressure Tank Cars: 206 and 211
- Cryogenic Liquid Tank Cars: 204

The DOT regulations require that the specification, material, cladding material (if any), tank builder's initials, date of original test, and car assembler (if other than tank builder) must be permanently stamped into the metal, near the center of both outside heads, on DOT nonpressure and pressure tank cars.

For Class DOT-113 cryogenic liquid tank cars, the stamping must be on the B-end (the end of the car with the hand-brake wheel) outer jacket and show additional

information, such as design service pressure, tank shell, and head thickness.

Because the head stamping may be covered by paint, thermal protection, or a jacket, the AAR now requires tank cars (those ordered after December 31, 2003) to be equipped with two identical stainless steel identification plates. These plates are to be permanently mounted on diagonal (AR and BL) body bolster webs and are to include the car builder's name and serial number, the certificate of construction or exemption (special permit) number, tank specification, tank shell/head material, insulation (thermal protection and/or insulation) materials, insulation thickness, underframe/stub sill type, and date built. For example:

| | |
|---|----------------------------|
| Car builder's name: | Allied Tank Car Co. |
| Builder's serial number: | 2009 - 01110 |
| Certificate of construction/exemption: | A010209 |
| Tank specification: | DOT 111A100W1 |
| Tank shell material/head material: | TC128 GR B / A516 |
| Insulation materials: | Fiberglass |
| Insulation thickness: | 3.5 inches |
| Underframe/stub-sill type: | RPM-101 |
| Date built: | May 2009 |

Other information will be displayed as well on both sides of the tank near the specification marking, on a qualification stencil; e.g., required periodic inspections and testing of the tank, PRDs, interior heater system, and lining/coating.

At the time of construction, tank car tanks are subject to an initial hydrostatic pressure test corresponding to its specification; e.g., the tank test pressure for a specification DOT 111A100W2 tank car is 100 psig. (Some tank car builders are testing nonpressure cars to 33 percent of the minimum burst pressure; i.e., 165 psig for a tank with a 500 psig minimum burst pressure.)

Prior to 1998, governmental regulations prescribed periodic internal visual inspections, hydrostatic testing of the tank and internal heater coils (if so equipped), and testing of the PRV. Beginning in 1998 (for tank cars without metal jackets) and 2000 (for tank cars with a metal jacket or thermal protection system), all single-unit tank cars (other than Class DOT-113 cryogenic

liquid tank cars) used to transport hazardous materials/dangerous goods became subject to periodic “continuing qualification” inspection and testing requirements in lieu of periodic hydrostatic retesting.

The frequency of continuing qualification inspections is based on whether or not the tank car transports commodities that are corrosive to the tank, and whether or not the tank has an interior lining or coating. By regulation, qualification intervals for the tank may not exceed 10 years; for the service equipment, qualification intervals are 5 or 10 years, unless a greater period is approved by the Federal Railroad Administration.

The current periodic qualification inspections include the following:

- Internal and external visual examinations of the tank
- Structural integrity inspections of various tank welds

- Tank thickness tests
- Safety system inspections, including thermal, head and skid protection, reclosing PRD, and service equipment (valves and fittings)
- Marking inspections
- Lining and coating inspections
- Leakage pressure tests

In addition, the AAR requires periodic inspections of the tank car's trucks and coupler/draft gear components (88.B.2 Inspection) and stub sills (Stub Sill Inspection).

The qualification/test dates and the due date for the next inspections (year only, in four digits) are recorded on a standardized qualification stencil (measuring 44 11/16 inches by 18 3/4 inches) applied to both sides of the tank. The following is an example of a qualification stencil:

| | | STATION STENCIL | QUALIFIED | DUE |
|-----------------------------|--------|-----------------|-----------|------|
| TANK QUALIFICATION | | ALM | 2009 | 2019 |
| THICKNESS TEST | | ALM | 2009 | 2019 |
| SERVICE EQUIPMENT | | ALM | 2009 | 2014 |
| PRD: VALVE | 75 PSI | ALM | 2009 | 2019 |
| INT HTRS | | JBK | 2009 | 2019 |
| LINING | | JBK | PP | None |
| 88.B.2 INSPECTION | | CJW | 2009 | 2019 |
| STUB-SILL INSPECTION | | CJW | 2009 | 2019 |

Note: The following is an explanation of some of the information found in the qualification stencil.

Station stencil: an alpha code assigned by the AAR to the tank car facility performing the inspection.

Service equipment: filling/discharge, venting, safety (other than pressure relief devices), heating, and measuring devices.

PRD: pressure relief device.

Valve: reclosing pressure relief valve.

Vent: nonreclosing safety vent with rupture disc.

Comb PRD: combination pressure relief device (reclosing valve with a rupture disc or breaking pin).

None: no pressure relief device (total containment).

INT HTRS: interior heater system. Exterior heater systems do not require requalification.

Lining PP: indicates the lining is applied to maintain product purity, not to protect the tank from the corrosive effects of the lading. PP linings do not require requalification.

The date the tank car was built (BLT) and type of air brake valves are shown on a consolidated stencil applied to each side of the tank.

In addition to placards and identification number markings, governmental regulations require that the proper shipping name or an authorized common name of certain hazardous materials/dangerous goods must be marked on each side of the tank car in letters at least 3.9 inches high. For shipments originating in the United States, these commodities are listed in §§172.325(b) and 172.330(a)(1)(ii) of Title 49, Code of Federal Regulations (CFR).

Other markings that may be required on tank cars include:

- Marine Pollutant mark for Marine Pollutants.
- HOT for Elevated Temperature Materials.
- INHALATION HAZARD for commodities that are poisonous/toxic by inhalation.

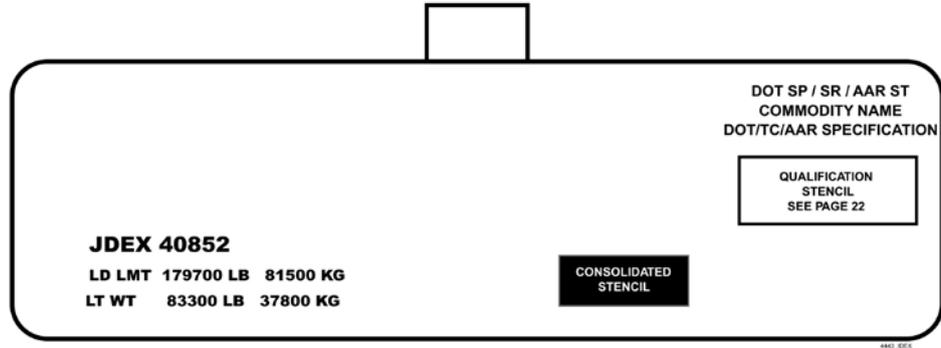
- NON-ODORIZED or NOT ODORIZED for shipments of unodorized Liquefied Petroleum Gases (LPGs). These markings may appear on a tank car used for both unodorized and odorized LPG.
- REGULATING VALVE(S) VENTING NORMAL, REGULATING VALVE(S), RELIEF VALVE, or RUPTURE DISC, as appropriate, over/under the discharge pipe for tank cars in argon, carbon dioxide, nitrogen, and oxygen service.
- DOT-SP***** for a tank car operating under the provisions of a DOT Special Permit. (DOT-SP***** replaces DOT-E*****, which stood for DOT Exemption.)
- SR-**** for a tank car that is operating under the provisions of a Canadian Safety Permit–Rail.
- AAR ST-*** for a tank car that is operating under an AAR Service Trial.

- EXS shown to the right side of the built date for a tank car authorized for extended service life (the car is allowed to remain in service beyond its prescribed retirement date).

Some shipper's are equipping tank cars with remote monitoring equipment (RME) to monitor and record or transmit certain data regarding a shipment, such as location (via GPS), lading temperature and/or pressure, leak detection, impact detection, and loaded or empty status.

The AAR has established standards regarding the placement of such devices and wiring. Tank cars equipped with RME must display labels or stencils within 12 inches of the sensor, be bright yellow or orange with black lettering, and be at least 2 x 3 inches. The marking must describe the device and provide a telephone number to call for information on the device.

Location of Key Stenciling



Consolidated Stencil

Type of air brake valves →

DB - 10
DB - 20

Car built date →

BLT 10 - 09

4443

SECTION 4: NONPRESSURE TANK CARS

Nonpressure tank cars (also called general service or low-pressure tank cars) are used to transport a wide variety of regulated (hazardous materials/dangerous goods) as well as nonregulated commodities.

Classes DOT-111 and 115, and AAR-206 and 211 are nonpressure tank cars used to transport both regulated (hazardous materials/dangerous goods) and nonregulated commodities. The most common nonpressure tank cars in use today are Class DOT-111 and Class AAR-211.

Class DOT-111 tank cars made of carbon or alloy (stainless) steel are required to have a minimum shell thickness of 7/16 inch, and those made of aluminum alloy are required to have a minimum shell thickness of 1/2 inch (60 psig tank test pressure) or 5/8 inch (100 psig tank test pressure). Regardless of the material of

construction, Class DOT-111 tank car tanks with a 60 psig tank test pressure are required to have a minimum burst pressure of 240 psig, and those with a 100 psig tank test pressure are required to have minimum burst pressure of 500 psig.

Note: Classes DOT-103 and 104 and AAR-203 are distinguished by an expansion dome on the top of the tank (not to be confused with a protective housing) and may continue in service if they meet the applicable requirements of the DOT Hazardous Materials Regulations (Title 49 CFR) in effect on September 30, 2003. However, no new construction is authorized.

AAR Class 203W tank cars, similar to Class DOT-103 tank cars, are authorized for the transportation of certain hazardous materials/ dangerous goods. Due to their age, few, if any, Class 103, 104, and 203 tank cars remain in service.

Class AAR-211 tank cars are similar to Class DOT-111 tank cars, and, with certain exceptions, must be built in accord with the applicable DOT/TC specification; e.g., a specification AAR-211A100W1 tank car must be built to the requirements for a specification DOT-111A100W1 tank car. The main differences between an AAR tank car and its DOT-specification counterpart are:

- Class AAR-211 tank car tanks require only partial post-weld heat treatment at the time of construction. Class DOT-111 carbon and alloy steel tanks and welded attachments must be post-weld heat treated as a unit. Tank car tanks made of aluminum alloy are not allowed to be post-weld heat treated.
- Class AAR-211 tank car tanks constructed of carbon and alloy steel do not require radioscopic examination of welded joints; however, welded joints of aluminum tanks must be examined.

- Additional/special fittings on AAR cars to meet user needs.

Most nonpressure cars have a low-profile manway nozzle on top of the tank, equipped with a gasketed hinged and bolted manway cover. The cover is opened for loading/unloading or for access into the tank for maintenance. Other styles of manway covers (such as those on sulfuric or hydrochloric acid tank cars) are semi-permanently attached to the manway nozzle and are equipped with a small gasketed hinged and bolted fill hole with a cover that is opened for loading or unloading.

Loading and unloading fittings are typically located in the general area of the manway and are often enclosed within a hinged combination housing called a protective housing by DOT regulations, but are commonly called a breadbox or mailbox. Some nonpressure tank cars may be equipped with a protective housing similar to those used on pressure tank cars to provide additional protection for the valves and fittings.

On nonpressure tank cars, the top-mounted loading/unloading equipment will usually include a 2- or 3-inch liquid eduction line (located along the centerline of the tank). The liquid eduction line consists of a liquid valve (or other closure) and eduction (or siphon) pipe that extends to the bottom of the tank. The eduction pipe may extend into a sump.

A sump is a formed depression (or bowl) in the bottom of the tank where the lading will drain, allowing more complete emptying of the tank.

There may also be a smaller eduction line (typically 1 inch), called an air line, air inlet or vapor valve, used to introduce a compressed gas (e.g., air and nitrogen) to pressurize the tank for unloading through the liquid eduction line. This device may also be used to vent the tank during loading or unloading.

Other fittings may include a vacuum-relief valve, a 1/4-inch sample line and/or a gauging device (slip-tube or magnetic ball style, or a fixed-length telltale pipe with

a control [needle] valve). The interior of the tank may be equipped with an outage gauge (at the manway nozzle), usually graduated in inches of outage.

On nonpressure tank cars in some services (e.g., sulfuric acid), the liquid eduction line and air line fittings may not have control valves, because they are closed with pipe caps, plugs, or blind flanges.

PRDs (reclosing pressure relief valves or nonreclosing safety vents) may be attached to the top of the tank on separate nozzles or attached to the manway cover (or pressure plate).

Except for certain specifications, nonpressure tank cars may be equipped with bottom outlet valves for loading or unloading. These valves may be ball, wafer-sphere, or butterfly style valves that are operated from beneath the car. They may also be plug or clapper style valves that are operated from the top of the tank (see page 38).

The top-operated bottom outlet valve has a valve mounted on the bottom of the tank. A rod passes through the tank and connects to a stuffing-box body on top of the tank. The stuffing-box body is equipped with a combination cover and wrench (T-wrench or cone), used to open and close the valve.

Certain specification nonpressure tank cars may be equipped with a bottom washout that can be removed to facilitate cleaning of the tank's interior. It is not used in loading/unloading operations.

Depending upon their projection from the bottom of the tank shell, bottom outlet, blind flanges, washouts, and sumps (referred to as bottom discontinuities) applied to stub sill tank cars may be required to have bottom fittings protection.

Typically, this protection is provided by attaching skids to the bottom of the tank to protect the fittings in the event of a derailment. Some nonpressure tank cars are also equipped with skids to protect their top fittings.

Nonpressure tank cars may have insulation (typically fiberglass, mineral wool blankets, or foam) applied over the tank and enclosed within a metal jacket. For Classes DOT-115 and AAR-206, the insulation is applied between the inner and outer tanks. Per regulation, the jacket must be not less than 11 gauge (0.1196 inch) thick. Insulation is used to moderate the temperature of the lading during transportation; e.g., to keep the lading cool or warm, depending upon its characteristics and the season of the year or as an aid in heating the product for unloading.

Nonpressure tank cars may also be equipped with interior or exterior heater coils. Prior to unloading, steam, hot water, or hot oil lines are attached to the coil inlets and outlets. As the heating medium circulates through the coils, it heats the liquid or melts solidified ladings, such as phosphorus, sulfur, wax, and asphalts, to facilitate unloading. Interior heater coil inlet and outlet pipes are required to have caps or plugs applied during transportation. Exterior heater coils do not

require caps, and the car must be stenciled EXTERIOR HEATER PIPES – NO INLET OR OUTLET PIPE CAPS REQUIRED. Some nonpressure tank cars are equipped with electric-resistance heater systems in place of heater coils.

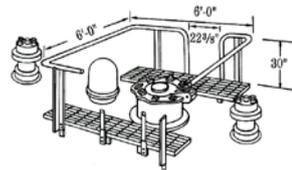
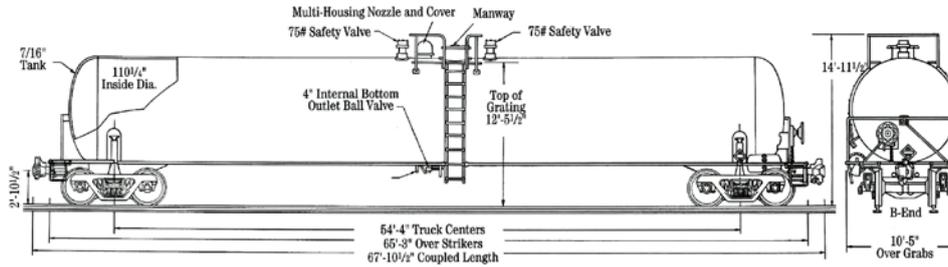
Nonpressure single-unit tank cars may be divided into compartments by inserting ellipsoidal heads into the tank shell (heads must be concave to the lading of each compartment) or by joining separately constructed tanks to make a single car structure. Each compartment will have its own loading/unloading fittings and PRD. Compartments must be identified numerically, beginning with the B-end (the end of the car with the hand brake wheel) compartment as number 1 and numbered consecutively toward the A-end (the end without the brake wheel).

Note: Unlike highway cargo tanks, tank car compartments are not constructed by applying interior walls within a single tank. Further, unlike some cargo tanks, tank cars do not have interior baffles to control lading surges.

Classes DOT-115 and AAR-206 nonpressure tank cars have an inner container (tank) constructed of carbon steel, alloy (stainless) steel, manganese molybdenum steel, or aluminum. The inner tank is supported within an outer shell (tank, not jacket).

The annular space between the inner tank and outer tank contains insulation. These cars are commonly referred to as tanks-within-a-tank as the outer shell (tank) is constructed in the same manner as a tank car tank, as it is not merely a metal jacket covering an insulated tank.

For Class DOT-115 cars, the outer tank may be fabricated of the same materials authorized for inner tanks and must be at least 7/16 inch thick. For Class AAR-206 cars, the outer tank must be fabricated from carbon steel. They may be divided into compartments, have a 60-psig tank test pressure, and, in addition to loading/unloading and pressure-relief devices, they may be equipped with a bottom outlet and/or bottom washout. These tank cars are normally used to transport temperature-sensitive commodities that require a highly efficient insulation system.



CAPACITY & WEIGHTS

Net Capacity @ 2% Outage – 29,348 gals.

Estimated Light Weight – 67,000 lbs.

Rail Load Limit (100 Ton Trucks) – 263,000 lbs.

COMMODITY MAXIMUM DENSITY

| Truck Cpty. | Wheel Base | Non-Coiled Comm. wt./gal. |
|-------------|------------|---------------------------|
| 100 Ton | 5'-10" | 6.68# |

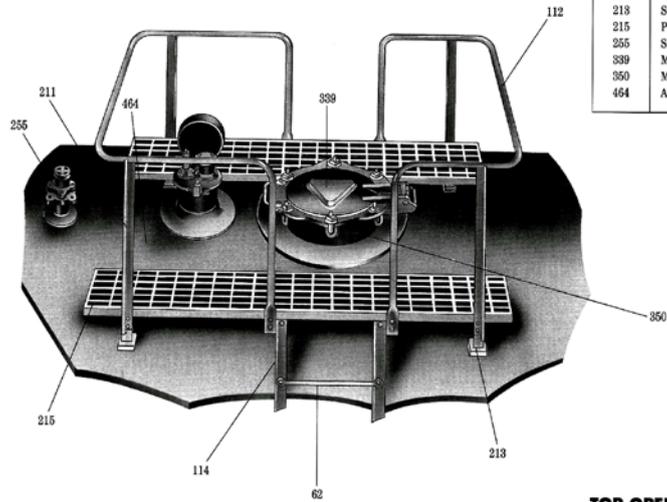
DOT-111A100W1

For Alcohol & Methanol Service

**29,947 GALLON CAPACITY -
NON-INSULATED (v. 1)**

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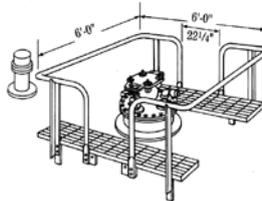
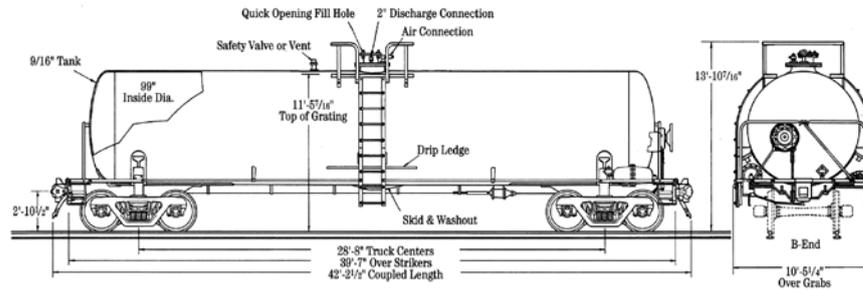
Note: Nomenclature used in the illustrations may not always be consistent with that used in the text of the field guide.



| Part No. | Description |
|----------|-----------------------|
| 62 | Step Tread |
| 112 | Handrail |
| 114 | Ladder Stile |
| 211 | Corner Post |
| 213 | Support Bracket |
| 215 | Platform Grating |
| 255 | Safety Valve Assembly |
| 339 | Manway Cover |
| 350 | Manway Ring |
| 464 | Anti-Skid Coating |

**TOP OPERATING PLATFORM FOR
GENERAL SERVICE CARS (POST 1982)**
(6' x 6' Shown - Other Lengths/Widths Available)

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CAPACITY & WEIGHTS

Nominal Capacity @ 2% Outage – 13,600 gals.
 Estimated Light weight (Non-Coiled) – 55,200 lbs.
 Rail Load Limit (100 Ton Trucks) – 263,000 lbs.

COMMODITY MAXIMUM DENSITY

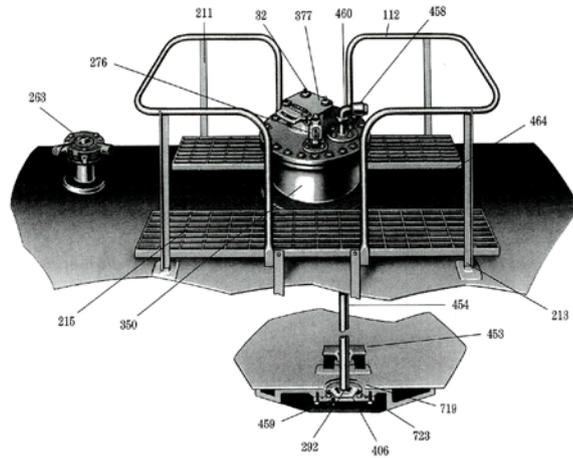
| Truck Cpty. | Wheel Base | Non-Coiled Comm. wt./gal. |
|-------------|------------|---------------------------|
| 100 Ton | 5'-10" | 15.2# |

DOT-111A100W2

For Sulfuric Acid Service

**13,946 GALLON CAPACITY –
 NON-INSULATED (v. 2)**

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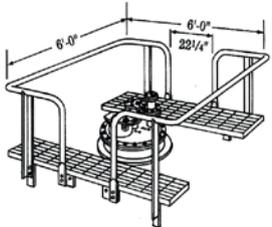
| Part No. | Description |
|----------|-------------------------|
| 32 | Eye Bolt |
| 112 | Hand Rail |
| 211 | Corner Post |
| 213 | Support Bracket |
| 215 | Platform Grating |
| 263 | Safety Vent Assembly |
| 276 | 1" Air Connection Valve |
| 292 | Washout Plug |
| 350 | Flued Manway Nozzle |
| 377 | 8" Fill Hole Cover |
| 406 | Washout Nozzle Flg. |
| 453 | Pipe Guide |
| 454 | Education Pipe |
| 458 | Pipe Cap |
| 459 | Tell-Tale Plug & Chain |
| 460 | Street Elbow |
| 464 | Anti-Skid Coating |
| 719 | "O" Ring |
| 723 | Gasket |

**LOADING AND UNLOADING
ARRANGEMENT AND TOP OPERATING
PLATFORM FOR SULFURIC ACID CARS**

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**20,429 GALLON CAPACITY -
NON-INSULATED (v. 2)**

DOT-111A100W5 (Rubber Lined)
For Hydrochloric Acid Service

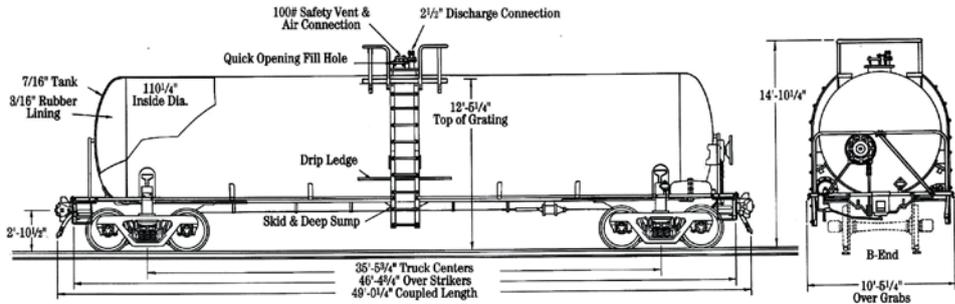


CAPACITY & WEIGHTS

Nominal Capacity @ 2% Outage - 20,000 gals.
Estimated Light Weight - 58,600 lbs.
Rail Load Limit (100 Ton Trucks) - 268,000 lbs.

COMMODITY MAXIMUM DENSITY

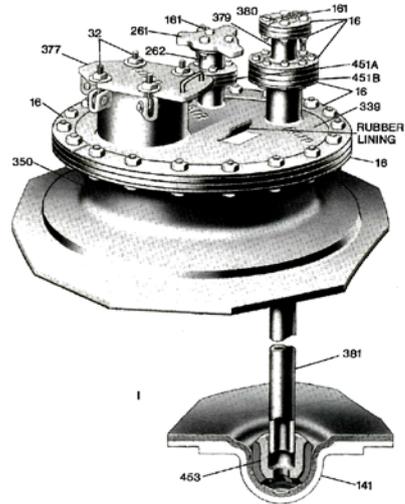
| Truck Cpty. | Wheel Base | Non-Coiled Comm. wt./gal. |
|-------------|------------|---------------------------|
| 100 Ton | 5'-10" | 10.20# |



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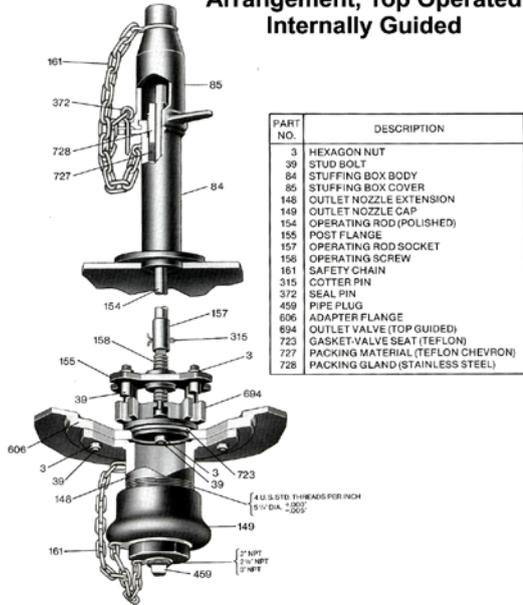
Loading and Unloading Arrangement for DOT-111A100W5 (Rubber Lined) Cars

| PART NO. | DESCRIPTION |
|----------|-----------------------------------|
| 16 | SEGMENTAL WASHERS |
| 32 | EYE BOLT ASSEMBLY |
| 141 | SUMP |
| 161 | SAFETY CHAIN |
| 261 | SAFETY VENT HOUSING |
| 262 | SAFETY VENT NOZZLE |
| 339 | MANWAY COVER PLATE |
| 350 | FLUJED MANWAY NOZZLE |
| 377 | FILL HOLE COVER |
| 379 | UNLOADING PIPE ADAPTER |
| 380 | UNLOADING CONNECTION BLIND FLANGE |
| 381 | DISCHARGE PIPE |
| 451A | AIR CONNECTION FLANGE |
| 451B | DISCHARGE PIPE FLANGE |
| 453 | DISCHARGE PIPE GUIDE |

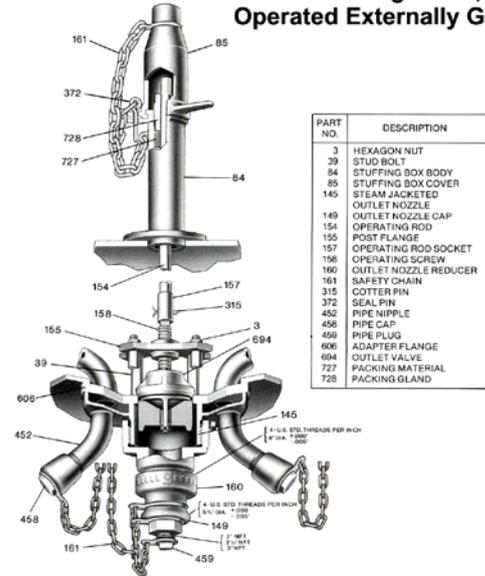


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**6-Inch Positive Internal
Type Bottom Outlet
Arrangement, Top Operated
Internally Guided**

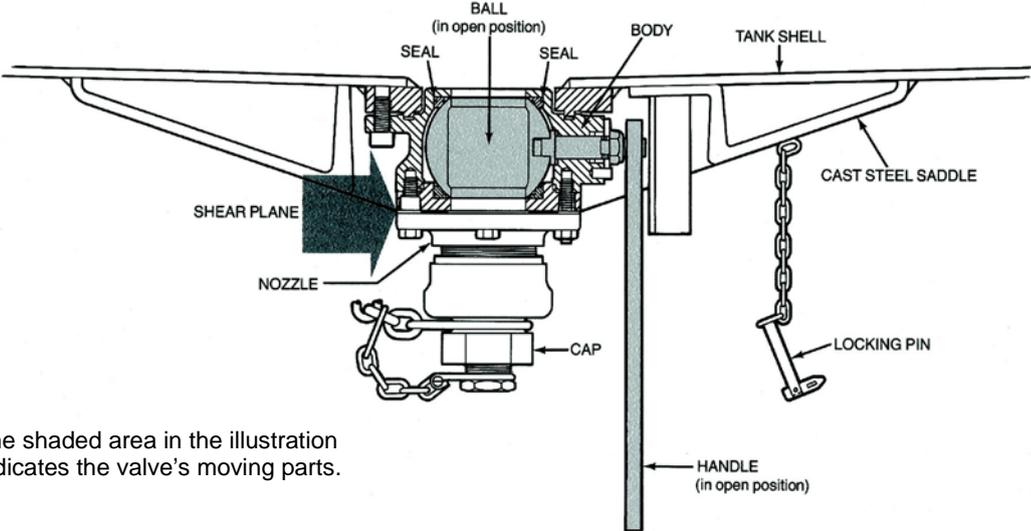


**6-Inch Positive Internal
Type, Jacketed, Bottom
Outlet Arrangement, Top
Operated Externally Guided**



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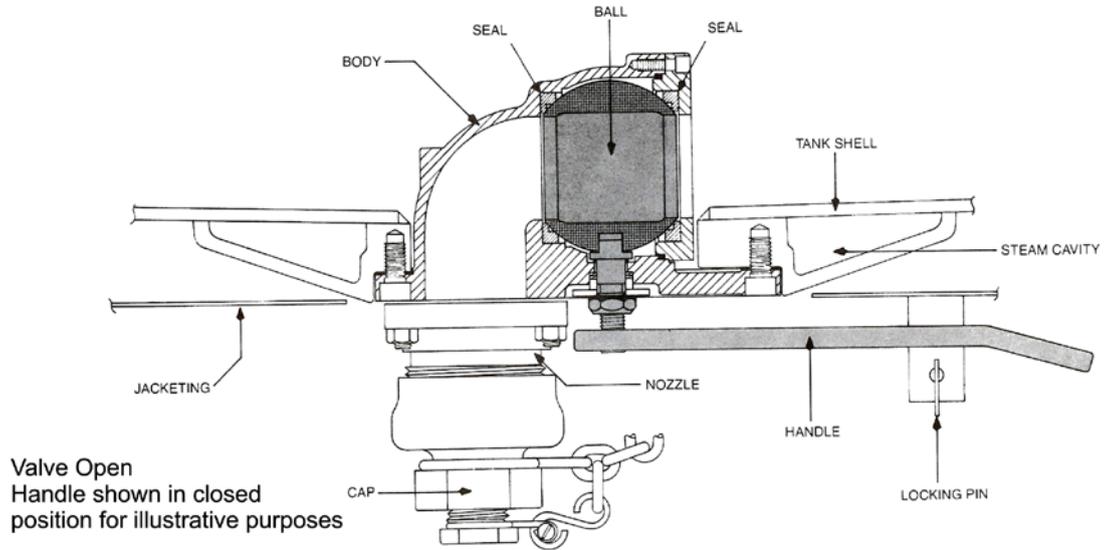
Bottom Outlet With Skid Protection



The shaded area in the illustration indicates the valve's moving parts.

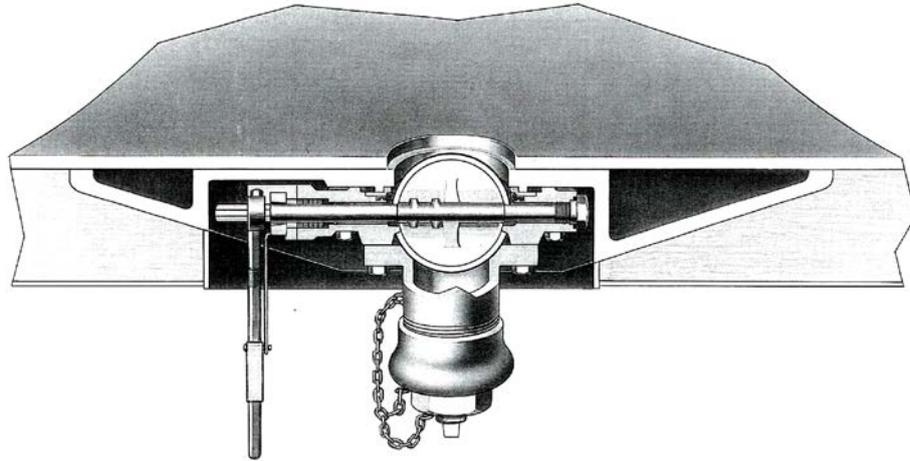
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Internal Ball Valve



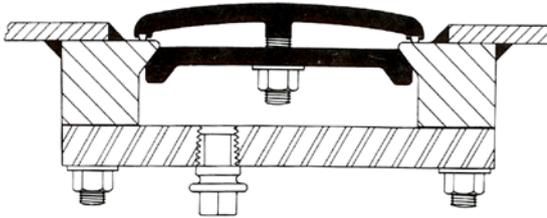
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**Jamesbury and Posi-Seal Bottom
External Butterfly-Type Valve**

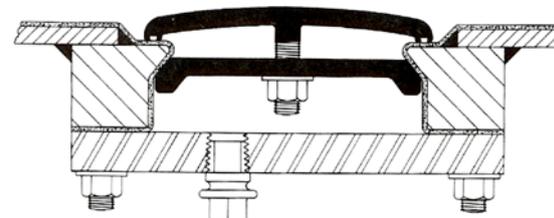


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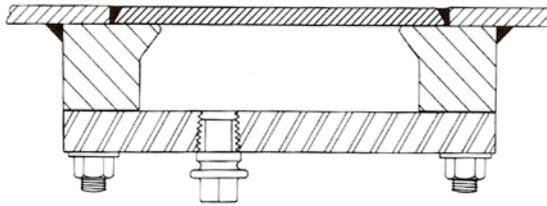
Typical Bottom Washout Arrangements



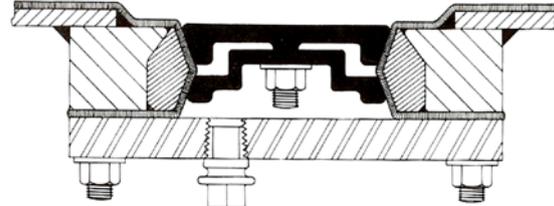
WASHOUT PLUG FOR UNCOATED, UNLINED CAR



WASHOUT PLUG FOR CHEMICALLY COATED CAR



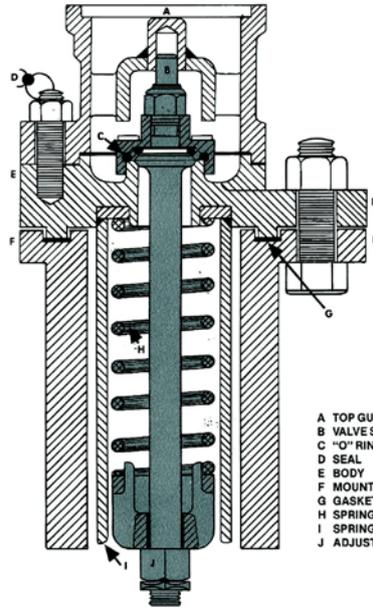
WELDED IN CLOSURE PLATE



WASHOUT PLUG FOR RUBBER LINED CAR

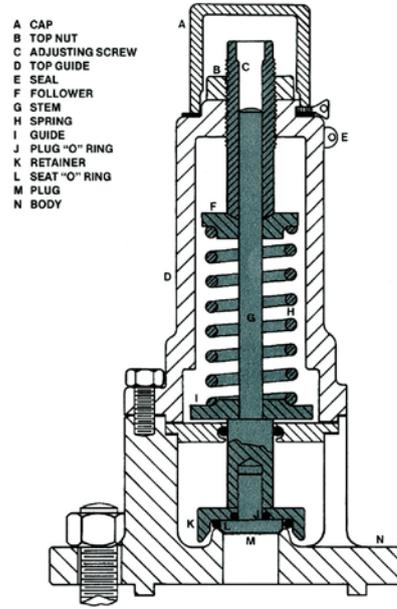
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Pressure Relief Valve



- A TOP GUIDE
- B VALVE STEM
- C "O" RINGS
- D SEAL
- E BODY
- F MOUNTING FLANGE
- G GASKET
- H SPRING
- I SPRING GUIDE
- J ADJUSTING NUT

Internal Valve

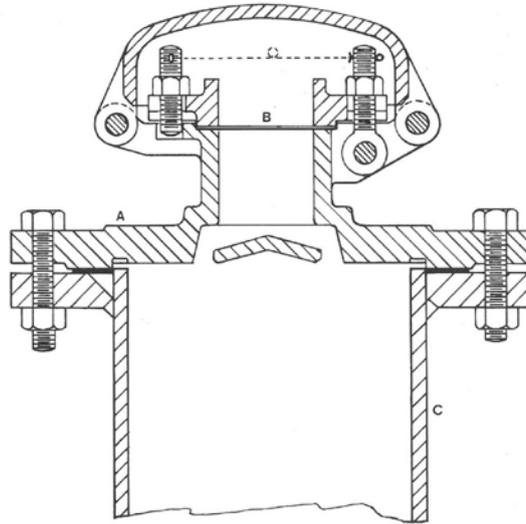


- A CAP
- B TOP NUT
- C ADJUSTING SCREW
- D TOP GUIDE
- E SEAL
- F FOLLOWER
- G STEM
- H SPRING
- I GUIDE
- J PLUG "O" RING
- K RETAINER
- L SEAT "O" RING
- M PLUG
- N BODY

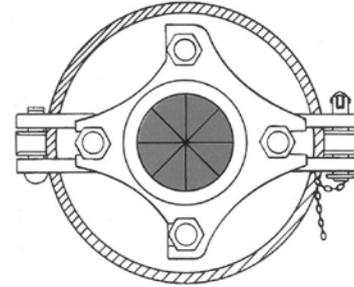
External Valve

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Safety Vent



Detail of Side View

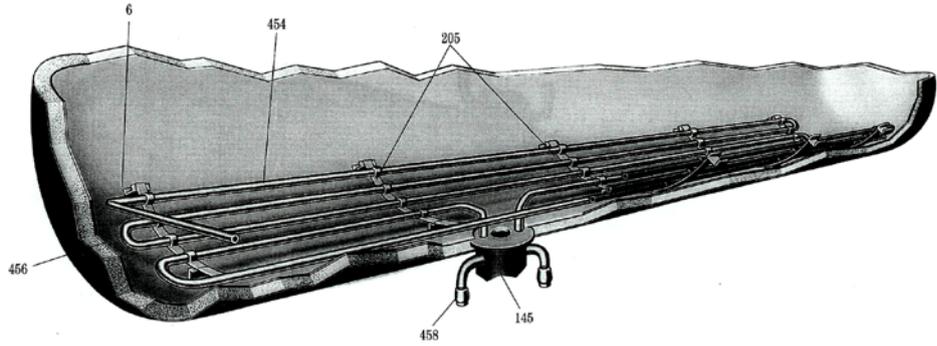


Cross Section
Showing Frangible Disc

- A Safety Vent Housing
- B Frangible Disc
- C Nozzle

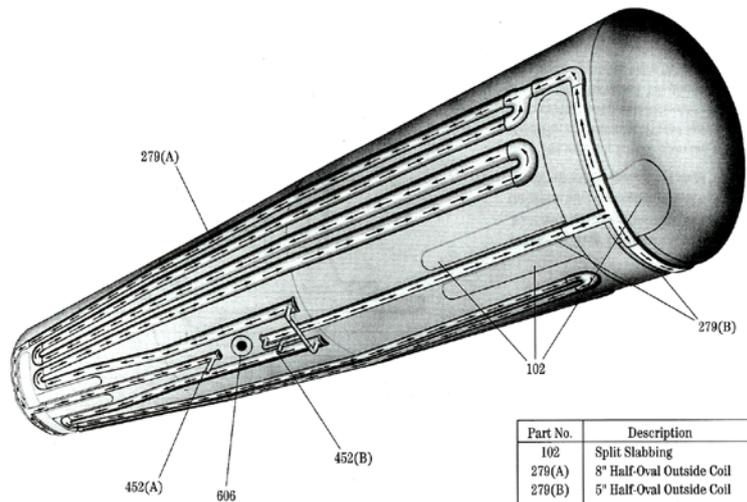
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| Part No. | Description |
|----------|------------------------------|
| 6 | Bar Support |
| 145 | Steam Jacketed Outlet Nozzle |
| 205 | Cradle Bar |
| 454 | Coil Pipe |
| 456 | Coil Return Bend |
| 458 | Pipe Cap |



**8 LINE INTERIOR HEATER COIL,
SIMPLEX SYSTEM, CONNECTIONS
AT BOTTOM OUTLET**

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| Part No. | Description |
|----------|---------------------------|
| 102 | Split Slabbing |
| 279(A) | 8" Half-Oval Outside Coil |
| 279(B) | 5" Half-Oval Outside Coil |
| 452(A) | Coil Inlet Nozzle |
| 452(B) | Coil Outlet Nozzle |
| 606 | Outlet Flange Adaptor |

**10L 2T SERPENTINE MANIFOLDED HALF-
OVAL OUTSIDE COIL (POST 1974)**

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SECTION 5: PRESSURE TANK CARS

Classes DOT-105, 109, 112, 114, and 120 are pressure tank cars used to transport liquefied compressed gases, poison/toxic inhalation hazard (PIH/TIH) materials, reactive materials, and/or corrosive materials requiring the additional protection afforded by a stronger car. There are no equivalent AAR type pressure tank car specifications.

Minimum tank plate thickness ranges from 1/2 inch to 11/16 inch for steel tanks (depending on tank diameter and tensile strength of plate used) and 5/8 inch for aluminum. Depending upon the specification, pressure tank cars have minimum burst strengths from 500 psig to 1500 psig.

Class DOT-105 insulated carbon or alloy (stainless) steel or aluminum pressure tank cars are designed for top loading and unloading. Bottom outlets and washouts are prohibited. Tank test pressures range

from 100 psig to 600 psig. These cars may be equipped with tank head puncture resistance and thermal protection systems.

Class DOT-109 insulated carbon steel or aluminum pressure tank cars are designed for top loading and unloading. Bottom washouts are authorized; however, bottom outlets are prohibited. Tank test pressures range from 100 psig to 300 psig. There are very few Class DOT-109 tank cars in service.

Class DOT-112 insulated or uninsulated carbon or alloy (stainless) steel pressure tank cars are designed for top loading. Bottom outlets and washouts are prohibited. These cars may be equipped with tank head puncture resistance and thermal protection systems. Tank test pressures range from 200 psig to 500 psig.

Class DOT-114 are insulated or uninsulated carbon or alloy (stainless) steel pressure tank cars with

tank test pressures of 340 or 400 psig. These cars may be constructed of noncircular cross section, and, except for the PRD, the valves and fittings may be located somewhere other than on top of the tank.

Class DOT-114 cars may be equipped with bottom outlets and washouts, and tank head puncture resistance and thermal protection systems. Currently, those in service are similar in appearance to Class DOT-112 tank cars. No noncircular cross section tank cars are in service.

Class DOT-120 tank cars are insulated steel or aluminum pressure tank cars with tank test pressures of 100 to 500 psig. Like Class DOT-114 tank cars, they may have valves and fittings located somewhere other than on top of the tank and may be equipped with bottom outlets and washouts and tank head puncture resistance and thermal protection systems. Few Class DOT-120 tank cars are in service.

Pressure tank cars are most readily identifiable by the presence of a protective housing on top of the tank (not to be confused with an expansion dome found on obsolete Classes DOT-103 and 104 and AAR-203 nonpressure tank cars).

With few exceptions, such as bottom outlet, bottom washout, and a dome-shaped pressure retaining hinged and bolted manway cover or pressure plate, the loading/unloading fittings and the PRD, PRV, or combination PRD will be mounted on a manway cover or pressure plate, and are enclosed within the protective housing.

Unlike nonpressure tank cars, which may be loaded or unloaded using an open system, pressure tank cars are loaded and unloaded using a closed system; i.e., the tank is not opened to the atmosphere during the process. The manway cover or pressure plate is removed only for maintenance purposes at a tank car repair facility.

Although rare, pressure tank cars may be equipped with heater coil systems.

Typically, in addition to the PRDs, a pressure tank car will have two liquid eduction lines running along the tank's longitudinal centerline with the valves facing the ends, eduction pipes reaching to the bottom of the tank, at least one vapor eduction line with the valve facing the side of the tank car, and an eduction pipe extending only into the top of the tank.

The valves for liquid and vapor eduction lines are commonly called angle valves (so called because product flow through the valve is at a right angle to the flow through the eduction line).

The angle valves may be either plug or quarter-turn ball style valves. Instead of angle valves, some pressure tank cars are equipped with ball valves designed for vertical flow of the product.

Depending upon the tank car's service, the following additional fittings may be found mounted on the pressure plate:

- **Sample Line:** may be used to obtain a sample of the tank's lading for laboratory analysis. The device consists of an open pipe extending into the tank that may or may not go to the bottom and is closed with a control (needle) valve on the outside. To obtain a sample, a hose is connected to the control valve's port, with the other end attached to a container for the sample (usually a small compressed gas cylinder). When the control valve is opened, lading will flow into the container.

The sample line valve may also be used to attach a pressure gauge to determine the pressure within the tank. Because the sample line's pipe may not extend completely to the bottom of the tank, it cannot be relied upon to

determine if there is any liquid remaining in an empty tank.

- Gauging Device: either a slip tube, commonly referred to as a spew rod or spit tube, or magnetic ball style used to measure the liquid level or vapor space (outage) within the tank.
 - Slip-Tube Style Gauging Device: utilizes a graduated (in inches) pipe (rod) that passes through a packing assembly. The end of the rod outside of the tank is closed with a control (needle) valve. To operate, the rod is extended fully upward, and then slowly pushed into the tank until liquid is discharged through the open control valve. Using a reference point on the device, the level of the liquid (from the top of the tank) is determined in inches (usually in 1/4-inch increments). Utilizing outage tables provided by the tank car builder, the measurement is converted to gallons of outage or

vacant/vapor space within the tank. Subtracting the outage from the tank's volumetric capacity will give the innage or number of gallons inside the tank.

Note: To reduce in-transit leaks from gauging devices, the AAR Tank Car Committee has directed that effective August 1, 2005, slip-tube gauging devices must be removed from tank cars no later than the next tank qualification event, which is typically 5 or 10 years for pressure tank cars.

- A magnetic-ball style gauging device consists of a hollow metallic pipe, capped at the end inside the tank. A metallic ball or float equipped with ring magnets is placed around the rod. The inside of the pipe is equipped with a composite-material rod, with a magnet on the lower end. As the tank is filled, the ball floats on the liquid,

and the magnetic force between the ball and the rod causes the rod to follow the ball, rising with the liquid level. As with the slip-tube device, the rod is graduated in inches, and the measurement can be converted to gallons of outage from the gauging tables. The advantage of the magnetic-style device is that there is no product released during the gauging operation, thus eliminating the safety and environmental concerns inherent with a slip-tube device. The slip-tube device is also subject to leakage through the packing around the rod or from the control valve.

In lieu of slip-tube or magnetic gauging devices, pressure tank cars may be equipped with electronic gauging devices or telltale (also called dip tube) gauging devices. Telltale gauges consist of a fixed open tube

that extends into the tank (but not to the bottom) with an outside control (needle) valve, similar in appearance to the control (needle) valve on the sample line.

The length of the tube(s) has been predetermined to typically correspond to 1 percent and/or 2 percent or up to 5 percent outage by volume.

Similar in operation to the slip-tube device, during loading, the control valve is open. When liquid is emitted, the designated outage has been reached.

- **Thermometer Well:** used to take the temperature of the lading. The device consists of a pipe (sealed at the bottom) filled with an antifreeze solution or oil that extends into the tank and is closed with a cap (not with a valve) on the outside. With the cap removed, a thermometer, which does not

travel with the car, is lowered into the tube. The temperature of the liquid in the tube will correspond to the temperature of the lading, which is transferred to the thermometer. The external pipe and/or the thermometer well cap are equipped with telltale holes that are intended to provide a warning should there be a failure of the internal pipe. Some pressure tank cars are equipped with electronic temperature sensing devices.

- Excess Flow Valves: required by governmental regulations for certain commodities. An excess flow valve (not to be confused with a check valve that only allows flow in one direction) is a device that closes automatically against the outward flow of the contents of a tank in case the external closure valve is broken off or removed during transit.

Excess flow valves may be equipped with a bypass feature that allows for pressure equalization. Excess flow valves are neither designed nor intended to stop the flow of a tank car's contents in the event of a failure of a loading/unloading system's piping or hoses.

For commodities that have a primary or subsidiary Division 2.1 (flammable gas) material hazard, the interior pipes of the loading and unloading valves, sample devices, and slip-tube gauging devices must be equipped with excess flow valves. Tank cars transporting chlorine must have excess flow valves only on the interior pipes of the liquid discharge valves.

Although not required by regulation, pressure tank cars transporting other commodities may be equipped with excess flow valves; e.g., a tank car may be in dual

service, wherein it transports LPG (Division 2.1) requiring excess flow valves during part of the year and anhydrous ammonia (Division 2.2), which does not require excess flow valves, during other times of the year.

Fittings for the Most Common Commodities Shipped in Pressure Tank Cars

- Liquefied Petroleum Gases (e.g., propane, butane, and propylene), Vinyl Chloride, Butadiene, and Anhydrous Ammonia:
 - B Two liquid education lines along the centerline of the tank with the education valves pointing towards the ends of the car.
 - B One vapor education line with the education valve pointing to the sides of the car.
 - B Pressure relief valve.

- B Thermometer well.
- B Sample line.
- B Slip-tube or magnetic gauging device.
- Chlorine and Sulfur Dioxide:
 - B Two liquid education lines along the centerline of the tank with the education valves pointing towards the ends of the car.
 - B Two vapor education lines with the education valves pointing to the sides of the car. Tank cars equipped with the enhanced fitting package will only have one vapor education line.
 - B Combination PRD (breaking pin or rupture disc beneath a pressure relief valve).
 - B No gauging device, sample line, or thermometer well.

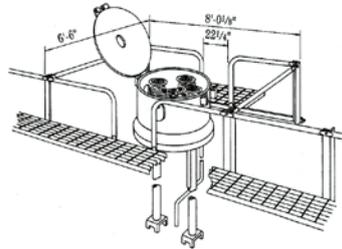
- Carbon Dioxide and Nitrous Oxide:
 - B One liquid education line with an education valve and one vapor education line with an education valve along the centerline of the tank with the valves pointing towards opposite ends of the car. Typically, these education valves will be identified on a plate inside the protective housing or by the letters L (for liquid) and V (for vapor) applied to the interior wall of the protective housing.
 - B Two pressure regulating valves.
 - B Pressure relief valve.
 - B Safety vent.
 - B Two or more fixed-length, telltale outage gauges.
 - B Thermometer well.

Note: Regulations require that the final discharge of the regulating valves, PRV, and safety vent must be piped to the outside of the protective housing and identified by stenciling REGULATING VALVES VENTING NORMAL, RELIEF VALVE, REGULATING VALVES, and/or RUPTURE DISC, as appropriate, over or under the discharge pipes from the respective devices. Under no circumstances should these discharge pipes be plugged or otherwise blocked.

**33,500 GALLON CAPACITY - NON-INSULATED -
THERMAL PROTECTED**

DOT-112J340W

For Liquefied Petroleum Gas & Anhydrous Ammonia Service



CAPACITY & WEIGHTS

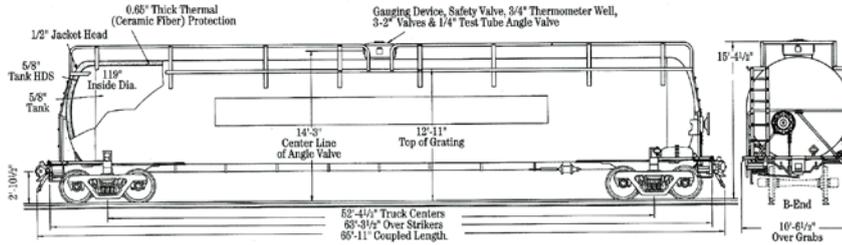
Nominal Capacity @ 58.28% Filling Density - 33,500 gals.

Estimated Light Weight - 59,500 lbs.

Ball Load Limit (100 Ton Trucks) (5'-10" Wheel Base) - 263,000 lbs.

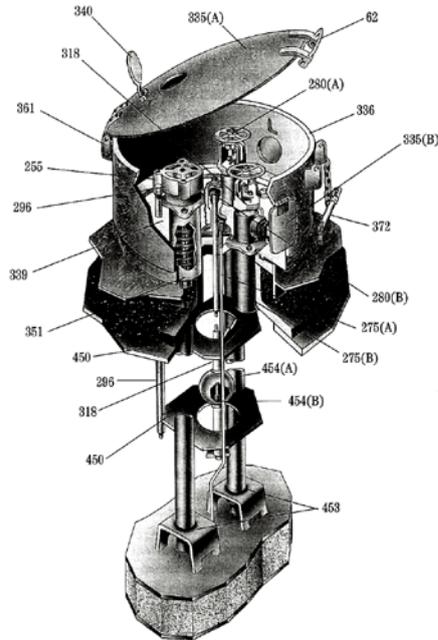
COMMODITY MAXIMUM DENSITY

| Truck Cpty. | Wheel Base | Commodity Density |
|-------------|------------|-------------------------|
| 100 Ton | 5'-10" | 58.28% Max Fill Density |



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Note: Nomenclature used in the illustrations may not always be consistent with that used in the text of the field guide.

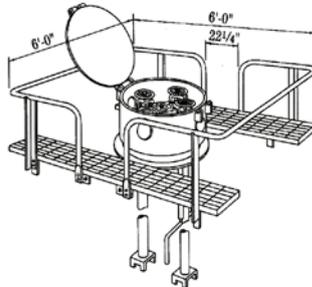
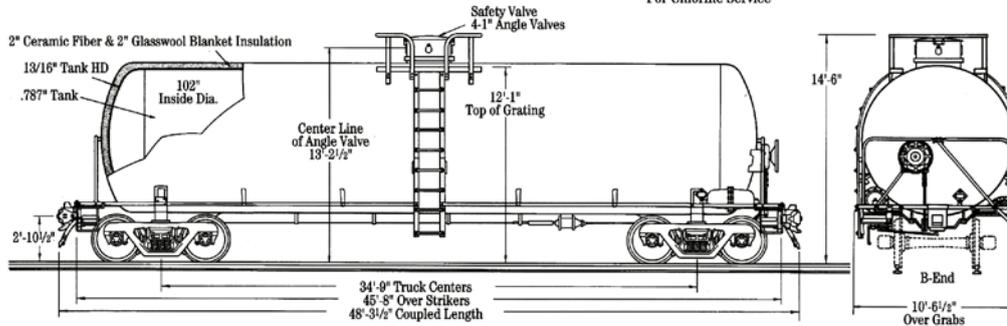


| Part No. | Description |
|----------|--------------------------|
| 62 | Bonnet Cover Handle |
| 255 | Safety Valve Assembly |
| 275(A) | 1/4" Check Valve |
| 275(B) | 3" Check Valve |
| 280(A) | 2" Angle Valve |
| 280(B) | 1/4" Angle Valve |
| 296 | Thermometer Well |
| 318 | Gauging Device Assembly |
| 335(A) | Manway Bonnet Cover |
| 335(B) | Manway Bonnet Side Cover |
| 336 | Manway Bonnet |
| 339 | Manway Cover Plate |
| 340 | Vent Cover |
| 351 | Manway Nozzle |
| 361 | Hinge |
| 372 | Seal Pin |
| 450 | Pipe Bracket |
| 453 | Pipe Guide |
| 454(A) | Discharge Pipe |
| 454(B) | Test/Sample Pipe |

**LOADING AND UNLOADING ARRANGEMENT
FOR LIQUEFIED PETROLEUM GASES AND
ANHYDROUS AMMONIA CARS WITH
THERMAL INSULATION AND MAGNETIC
FLOAT TYPE GAUGE DEVICE (POST 1979)**

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**90 TON CAPACITY - INSULATED -
THERMAL PROTECTED**
DOT-105S500W
For Chlorine Service



CAPACITY & WEIGHTS

Nominal Capacity @ 125% Filling Density - 90 tons

Estimated Light Weight - 79,700 lbs.

Rail Load Limit (100 Ton Trucks) -

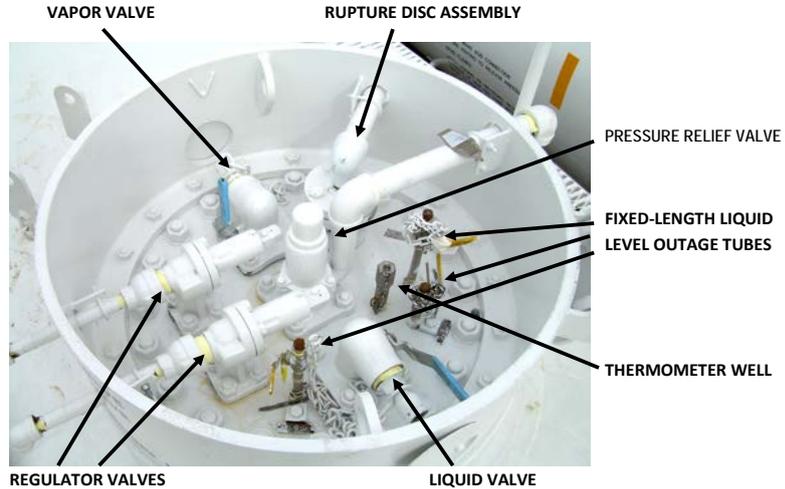
(5'-10" Wheel Base) - 263,000 lbs.

COMMODITY MAXIMUM DENSITY

| Truck Cpty. | Wheel Base | Non-Coiled Comm. wt./gal. |
|-------------|------------|---------------------------|
| 100 Ton | 5'-10" | 17,290 gal. max. |

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FITTINGS ARRANGEMENT FOR CARBON DIOXIDE AND NITROUS OXIDE



Tank cars transporting Carbon Dioxide and Nitrous Oxide will be stenciled "REGULATING VALVES VENTING NORMAL" on each side of the car.

The venting of vapor from the regulator valves is a normal function to reduce internal pressure through auto-refrigeration. DO NOT attempt to plug the discharge pipes of the pressure relief devices.

Top Fittings Protection Requirements for Tank Cars Transporting Materials Poisonous (Toxic) by Inhalation (PIH/TIH Materials)

As mentioned in Section 1: Tank Car Classification and Specifications, the U. S. DOT issued new rules in January 2009 requiring enhanced safety measures for tank cars transporting PIH/TIH materials.

A tank car built after March 16, 2009, for the transportation of a PIH/TIH material must have the service equipment enclosed within a protective housing and cover.

In addition, it must be equipped with a top fittings protection system and nozzle capable of sustaining, without failure, a rollover accident at a speed of 9 miles per hour, in which the rolling protective housing strikes a stationary surface assumed to be flat, level, and rigid.

Failure is deemed to occur when the deformed protective housing contacts any of the service

equipment, or when the tank retention capability is compromised.

As an alternative to the above top fittings protection, the tank may be equipped with a system that prevents release of the product from any top fitting in the case of an accident where any top fitting would be sheared off. See the illustrations on pages 61-63 for examples of these devices.

Enhanced Fittings Package for PIH/TIH Tank Cars

A coalition of tank car and valve manufacturers, chemical producers, and railroads have developed tank car design criteria to improve transportation safety of PIH/TIH materials, primarily chlorine. This design is referred to as the Next Generation Tank Car (NGRTC or Next Gen).

In addition to added safety features to the tank car structure itself, an enhanced fittings package has been developed that is designed to prevent the loss of

product should any top fitting be damaged or sheared-off in an accident.

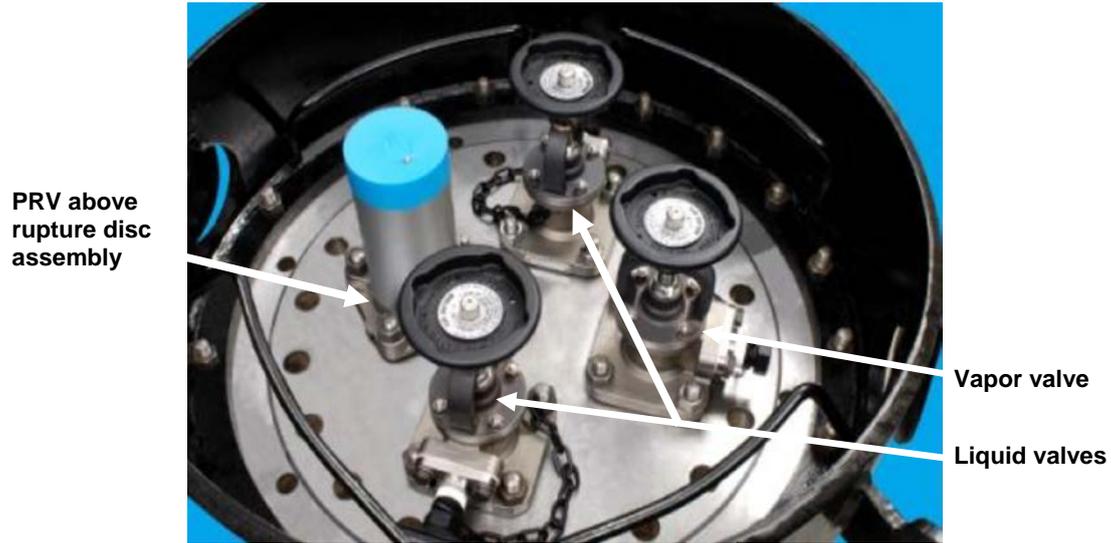
The enhanced fittings package differs from current chlorine fittings arrangements by:

- Equipping the car with one instead of two vapor lines and relocating the pressure relief valve from the center of the pressure plate to the side.
- Replacing product flow activated excess-flow valves with spring-loaded excess-flow and check valves that are closed when the eduction (angle) valves are closed.

When the valve is opened, the valve stem depresses the excess flow valve, allowing liquid or vapor to flow through the eduction pipes; therefore, if an eduction valve is sheared off, the excess flow valve remains closed, preventing the loss of product.

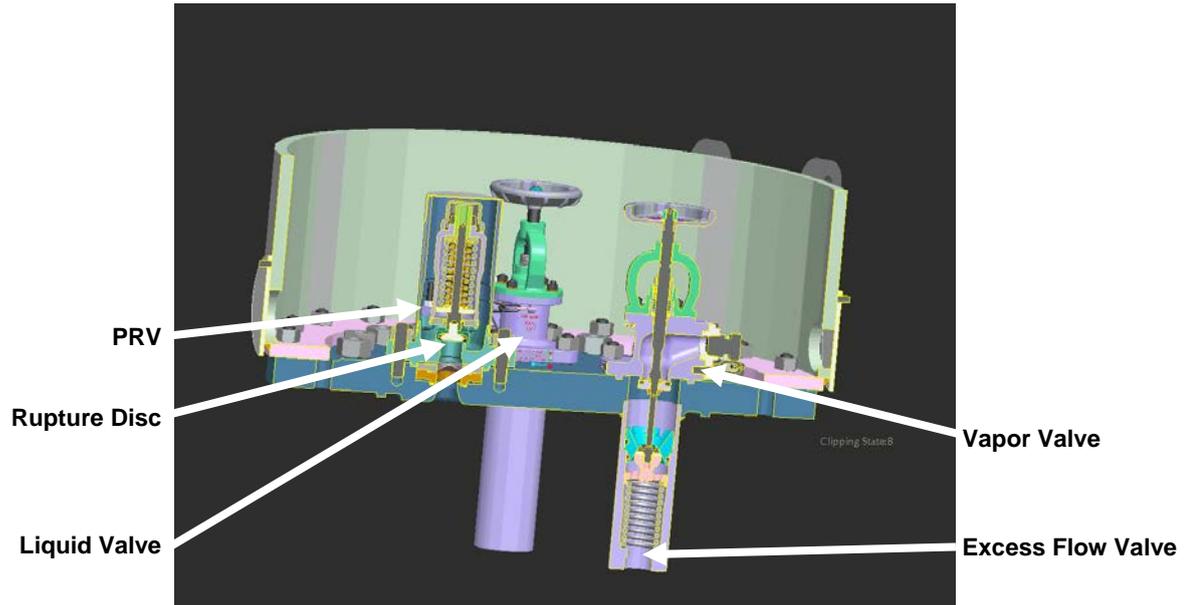
- Replacing the combination PRV (rupture disc/breaking pin assembly below a pressure relief valve) contained in one assembly with a spring-loaded pressure relief valve mounted above a rupture disc assembly that is embedded in the pressure plate.

Should the PRV be sheared off, the rupture-disc device, being the primary seal, will retain the product.



Enhanced Fittings Arrangement for Chlorine Tank Cars

Illustration courtesy of Midland Manufacturing Company, Skokie, Illinois.



Cutaway View of Enhanced Fittings Arrangement

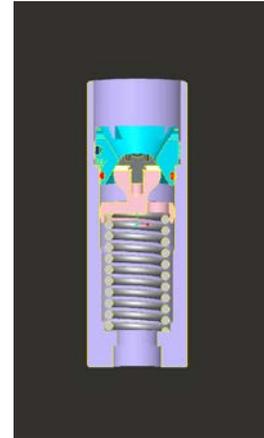
Illustration courtesy of Midland Manufacturing Company, Skokie, Illinois.



Rupture Disc Assembly Embedded in the Pressure Plate



Angle Valve with Stem to Open the Excess Flow Check Valve



Spring Loaded Excess Flow Check Valve

Illustrations courtesy of Midland Manufacturing Company, Skokie, Illinois.

SECTION 6: CRYOGENIC LIQUID TANK CARS

Classes DOT-113 and AAR-204 tank cars are designed as a vacuum-insulated inner container (tank) enclosed within an outer shell (tank, not jacket) and referred to as an outer jacket by the DOT to transport cryogenic liquids. (Refrigerated liquefied gases having a boiling point colder than minus 130°F at atmospheric pressure; e.g., liquid hydrogen, ethylene, oxygen, nitrogen, and argon.)

The annular space between the inner and outer tanks has a vacuum drawn and is equipped with an insulation system using granular perlite or an alternating wrap of multiple layers of aluminum foil and paper. These tank cars are frequently referred to as Thermos® bottle tank cars.

The insulation system (designed for the commodity being transported and meeting specified

performance standards) and vacuum controls the rate of heat input for normal transportation time periods.

Note: DOT regulations require the shipper to notify the Federal Railroad Administration whenever a tank car containing any flammable cryogenic liquid is not received by the consignee within 20 days from date of shipment. Typically, the insulation system will keep the commodity pressure from activating the PRDs for at least twice this 20-day period.

Specification DOT-113A60W tank cars have a design service temperature of minus 423°F, a minimum burst pressure of 240 psig, and a tank test pressure of 60 psig.

Specification DOT-113C120W tank cars have a design service temperature of minus 260°F, a minimum burst pressure of 300 psig, and a tank test pressure of 120 psig.

Specification AAR Class 204W tank cars must meet the specification requirements for Class DOT-113 tank cars, with some exceptions. The minimum required burst strength is 240 psig, with a 60 psig tank test pressure. Specification AAR Class 204W tank cars are not authorized for Division 2.1 (flammable gas) materials.

Cryogenic liquid tank cars are required to have two liquid-level gauges. One gauge measures the liquid level in the inner tank (this gauge may be a portable gauge that does not move with the car) and the other gauge, a fixed-length dip tube set, indicates the maximum allowable liquid level for the allowable filling density. In addition, the car must be equipped with a vapor-phase pressure gauge to indicate the pressure within the inner tank.

The cars must be equipped with various PRDs for the protection of the tank assembly and piping system. The discharge of the PRD must be directed away from operating personnel, the car structure, trucks, and safety

appliances; e.g., steps, handholds/grab irons, and handrails.

The inner tank must be equipped with at least one PRV and at least one safety vent, which may be replaced by an alternate PRV. The car may also be equipped with a pressure control device (regulator valve) and mixing device to control the routine release of vaporized lading during transportation. Tank cars in liquid hydrogen service must be equipped with a device that will instantly ignite any hydrogen that is discharged through the PRDs. The outer jacket/tank must be equipped with a system to prevent buildup of pressure within the annular space.

The loading/unloading valves and other fittings are required to be enclosed within a protective housing (not to be confused with protective housings on pressure tank cars), which appears to be a box or cabinet. The protective housing(s) is located on both sides at one end or, in rare cases, on the top of the car. The housing(s) must be adequate to protect the fittings

from direct solar radiation, mud, sand, adverse environmental exposure, and mechanical damage incident to normal operation.

The protective housings for the fittings must be equipped with precautionary instructions for the safe operation of the equipment during storage and transfer operations, and must include a diagram of the tank and piping system with the various gauges, control valves, and PRDs clearly identified, and their location indicated. In addition, all valves and gauges must be clearly identified with corrosion-resistant nameplates.

In addition to other stenciling, cryogenic liquid tank cars must be stenciled DO NOT HUMP OR CUT OFF WHILE IN MOTION and VACUUM JACKETED on both sides in lettering at least 1 1/2 inches high.



Photo courtesy of Charles J. Wright

Typical Cryogenic Liquid Tank Car (DOT Class 113)



Typical Cryogenic Liquid Tank Car Fittings Compartment

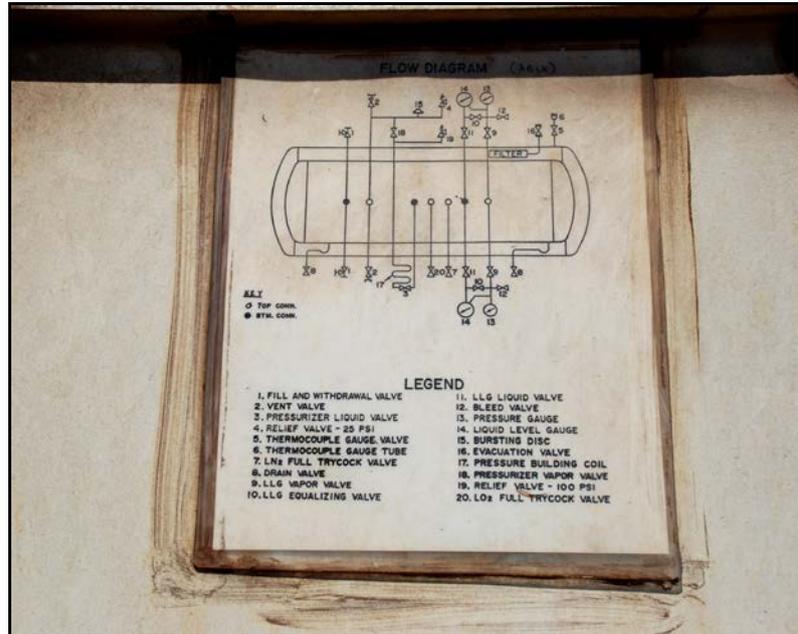


Photo courtesy of Tony Bacino

Cryogenic Liquid Tank Car Fittings Diagram

SECTION 7: GUIDELINES FOR INITIAL EMERGENCY RESPONSE

Accidents involving tank cars must be evaluated and approached with great care due to the possible presence of hazardous materials/dangerous goods. Absence of visible hazard warning labels, markings, or placards is not a guarantee that commodities involved are harmless. Careful, thorough evaluation, assessment, and initial response to an accident may make the difference between emergency and disaster.

It is possible that the scene of an accident involving hazardous materials/dangerous goods will present such a high degree of hazard that the only safe course is to evacuate ALL personnel from the area and allow the incident to run its own course without intervention. Furthermore, a severe situation may exist with or without the presence of fire, smoke, or fumes.

Initial Notification

If you are the first on scene of a transportation accident, your first step is to avoid endangering yourself and call for help. Immediately notify local emergency response personnel and the transportation carrier. After notifying the local emergency response agency, contingent on your circumstances, you may need to call one or more of the following agencies for assistance:

- CHEMTREC: 1-800-424-9300 toll free in the U.S., Canada, and the U.S. Virgin Islands. 1-703-527-3887 for calls originating elsewhere. Collect calls are accepted.
- CANUTEC: 1-613-996-6666, collect calls are accepted. *666, cellular in Canada only.
- SETIQ: 01-800-00-214-00 in the Mexican Republic. 5559-1588 for calls originating in

Mexico City and the Metropolitan Area. 011-52-555-559-1588 for calls originating elsewhere.

- National Response Center: 1-800-424-8802 toll free in the U.S., Canada, and U.S. Virgin Islands. 1-202-267-2675 in the District of Columbia.
- Association of American Railroads, Bureau of Explosives (BOE) in the U.S. and Railway Association of Canada (RAC) in Canada. Personnel are also available for emergency response and technical assistance for railroad incidents involving hazardous materials/dangerous goods. BOE and RAC respond upon request from a railroad.

Binoculars are recommended to assist responders in assessing the accident from a safe distance. Provide as much of the following information as you can when calling for assistance.

1. Your name, location, and telephone number.
2. Location of incident.
3. Type vehicle or container involved.
4. Wind direction and approximate speed.
5. Presence of injured people.
6. Presence of smoke, fire, or fumes.
7. Presence of markings, labels, or placards on containers or vehicle.
8. Carrier name.
9. Other pertinent information.

After the initial notification is made, isolate the scene by ensuring all unnecessary personnel are clear of the site. Make sure your vehicle is far enough away that the hot exhaust system does not provide a possible ignition sources. Turn off the vehicle's ignition. Do not smoke, use flares, fusees, lanterns, or open flames near the scene.

Resist the urge to rush into an accident site and rescue injured personnel until after the commodities are identified and the nature and severity of the hazard is assessed.

Initial Assessment

Remain a safe distance upwind from the site. Use binoculars to survey the site and surrounding area. Make notes and sketches, as necessary. Pay particular attention to:

- Location of injured personnel and their proximity to surrounding hazards.
- Location of potentially threatened personnel.
- Look for markings, labels, or placards on containers or vehicles that may aid in identifying commodities present.
- Note the number and types of containers or vehicles involved.

- Visible damage to and/or leakage from containers or vehicles (gas, vapor, liquid, or solid).
- Vehicle or container reporting marks (letters) and number.
- Accessibility to site and possible escape routes.
- Weather conditions.
- Topographical features of the site and surrounding areas, especially bodies of water.

Report the above information directly to other response organizations as soon as possible. When identifying chemical commodities, copy names and other information precisely. Even minor spelling errors can have serious consequences in determining the hazard properties of materials involved.

Identifying Materials

Before entering the incident site, identification of the commodities and containers or vehicles involved is essential. The shipping paper is the best source for this

information. For rail carriers, this information is typically contained in a document called a train consist, train list, or wheel report, which is in the possession of a member of the train crew. This information may also be available by contacting the railroad by phone.

The train consist, train list, or wheel report will identify whether the commodity is hazardous, and where the car is located in the train. In a rail yard, shipping paper information is available at the yard office.

In the absence of shipping papers, use binoculars from a safe distance upwind, try to locate any 4-digit identification numbers on the placards (or orange panels) applied to the containers or vehicles and/or labels on packages. This may help determine the presence of hazardous materials/dangerous goods.

If shipping papers, placards, markings, or labels are destroyed, the reporting marks and number on the railcar or intermodal container can often be used to

identify the commodities present. Railcar reporting marks are a series of letters (those ending with an X are privately owned; i.e., not owned by a railroad) followed by a series of numbers; e.g., BOEX 123456. Intermodal containers use a similar numbering pattern. Trailers have numbers, but may not have reporting marks. With this information, the carrier will be able to determine the vehicle's contents.

Attempting to retrieve shipping papers or obtain the commodity name from the containers should only be tried if it can be done without undue risk to personnel. Unidentified spilled commodities should be approached with caution. Use the maximum level of personal protective equipment necessary.

Tank Car Damage Assessment

Tank car damage assessment guidelines presented are intended only to allow those first on the scene to make an initial appraisal of railroad tank car tank damage for purposes of determining what actions should be taken until expert appraisal assistance is available.

These guidelines may not be appropriate for assessment of damage to other types of transportation and storage tanks, such as tank trucks, tank trailers, portable tanks, and stationary tanks.

Tank cars and other bulk containers involved in accidents may suffer severe damage without loss of lading. This damage may look impressive, even awesome, yet the car or container may still have sufficient strength to permit it to be carefully removed from the accident site for later transfer or unloading of its contents.

The most serious damage that can occur to tanks and other containers transporting compressed gases is caused by bending, denting, scoring, or gouging without resultant leaks. Time, pressure, and handling can result in delayed rupture. If this happens, there will almost always be enough heat caused by the metal tearing to ignite the released contents when they are flammable.

Virtually all liquefied gases are shipped in tank cars with jackets. Tank damage refers to damage to the tank itself, not to the surrounding jacket. The presence of a jacket may be determined by looking to see if ripped or torn metal reveals insulating materials. The jacket may also be noted by the flashing over the body bolster, flat spots on the sides or ends of tanks, and lap welds. The tank is found beneath the jacket. Never attempt to cut or remove the jacket to search for the tank.

Assessment of the tank damage is not a casual matter and requires the presence of trained specialists. Each visible dent, score, or gouge must be examined. As adjacent cars or surrounding materials are removed or as the tank car itself is moved, newly exposed surfaces must be examined as well. Dents in combination with scores, gouges, or cracks, and dents, which cross a weld seam, are the most dangerous, and the tighter or smaller the radius or curve of the dent, the more dangerous it is.

Dents that run lengthwise on the cylindrical section of the tank are usually considered to be more dangerous than large dents in the head. But even large head dents are dangerous, if they appear in conjunction with a gouge, score, or crack. Small head dents not exceeding 12 inches in diameter, especially in tightly bent edges, should be considered marginal and may justify unloading in place, usually by transferring material to another tank car or other container on site rather than attempting to move or rerail it.

Any crack in the base metal of a tank, especially if in combination with a dent or gouge, justifies unloading the tank before it is moved, except as may be necessary to get the valves upright or accessible. Scores or gouges are especially dangerous if they run lengthwise over a distance of 7 feet, cross a weld on the tank, and are greater than 1/16 inch in depth.

To repeat, assessment of tank damage is a skill that requires training and experience. Factors include evaluation of damage to the tank itself, outside air

temperature, material in the tank and its vapor pressure, and the internal pressure. In a questionable situation, the best course is to evacuate all personnel for a 1-mile radius.

When fire, especially a torch like flame, impinges on a tank, a high volume hose stream directed at the point of flame contact may prevent a dangerous heat and pressure buildup in the nonpunctured tank. Torch fires occur when a tank has been punctured or the pressure relief valve has functions, and flammable gas is burning out of the opening in a strongly projecting flame. With this kind of fire, a large standoff distance is required, and unmanned monitor nozzles provide greater protection for responders than hand lines.

Situations where flooding with water may be inappropriate occur when the water temperature is higher than the temperature of the material in the tank. This is often the case during winter months. Additional factors to consider before attempting to cool a tank with water include the tank's construction (may be

insulated and covered with a jacket), the supply of water, possible environmental damage from contaminated runoff, and ground saturation, which may prevent heavy equipment from entering the site to perform wreck clearing operations.

A water attack is almost never the first thing that emergency responders should attempt. The guidelines in this section, especially those relating to the initial notification, making an initial survey, collecting and interpreting hazard and response information, and reviewing the tank damage noted, should be followed prior to laying, charging, and using hose lines.

SECTION 8: GLOSSARY OF RAILROAD AND TANK CAR TERMS

AAR — the Association of American Railroads, a trade association comprised of North American railroads. The AAR, among other activities, issues specifications and rules regarding the interchange of railcars between the various railroads. The AAR's requirements for tank cars are contained in the AAR *Manual of Standards and Recommended Practices* (MSRP) C-III, Specification M-1002.

AAR Specification Tank Car — a tank car built, altered, or converted in accordance with the tank car specifications of the Association of American Railroads.

A-end — the end of a railcar, opposite the end equipped with the hand brake (see B-end.)

Ambient — the temperature and barometric pressure of the local environment.

B-end — the end of a railcar on which the hand brake is attached. If both ends of the railcar have a hand brake, the car will be stenciled A-END and B-END. When facing the B-end, the sides of the railcar are identified as the Right Side and Left Side, respectively.

Body Bolster — the structural members at each end of a carbody that support the car on its truck assemblies.

Bottom Outlet Valve — a valve located in the bottom of the tank for loading or unloading.

Bottom Washout — a plugged and flanged opening in the bottom of a tank to facilitate cleaning of a tank car that does not have a bottom outlet.

Brake Rigging — the assembly of cylinders, levers and/or rods under a railcar that provides and transmits braking action to the wheels.

Breather Vent — a device having an operating part that is a permeable disc or a disc having a breather hole or slit. Breather vents are typically applied to tank cars transporting hydrogen peroxide to allow vapors created by the commodities decomposition to be vented from the tank.

Burst Pressure (Disc) — the value of the inlet static pressure at which a safety vent or breaking-pin device functions.

Burst Pressure (Tank) — the internal pressure at which a tank will theoretically burst. For a tank car tank, the minimum burst pressure is a function of the tank's inside diameter, welding joint efficiency, minimum tensile strength of the plate material, and the minimum thickness of the plate after forming.

CANUTEC — acronym for the Canadian Transport Emergency Centre. CANUTEC is operated by the Transport of Dangerous Good Directorate of Transport Canada and provides a national bilingual

(English and French) advisory service, including emergency response advice for incidents involving dangerous goods. Call collect at 613-996-6666 (24 hours) or *666 cellular (Canada only). Call 613-992-4624 (24 hours) for nonemergency inquiries.

Capacity/CAPY — the volumetric capacity (stenciled in gallons and liters) of a tank car's tank. The capacity may also be shown in imperial gallons.

Center Sill — the center longitudinal structural member of a car underframe that forms the backbone of the underframe and transmits most of the buffing shocks from one end of the car to the other (also see Stub Sill Tank Car).

CHEMTREC® — acronym for the Chemical Transportation Emergency Center, a 24-hour emergency response service that provides assistance in the handling of incidents involving hazardous materials/dangerous goods. Call toll free at 800-424-

9300 in the U.S. and Canada (outside calls: collect at 703-527-3887).

C-Kit/Capping Kit — a set of components used to cap (cover) and contain leakage from a fitting on a tank car. C-Kits are specifically designed for use on chlorine and sulfur dioxide tank cars. Tank cars built or altered after December 1, 2003, and used for the transportation of Class 2 or Poison-Inhalation Hazard/Toxic Inhalation Hazard materials must have a manway cover (or pressure plate) designed to accommodate capping kits. This requirement does not apply to tanks cars transporting carbon dioxide or Class DOT-113 and Class AAR-204W cryogenic liquid tank cars.

Clad/Cladding — the bonding of dissimilar metal sheets to form a composite material. The more corrosion-resistant metal acts as an interior protective coating after a tank car tank is fabricated.

Class (Tank Car) — a general designation of tank cars, usually including several specifications; e.g., Class

DOT-111 or Class AAR-204. The word “Class” is used if the designation embraces several specifications.

Combination Pressure Relief Device — a PRD that incorporates a nonreclosing device (breaking pin or rupture disc assembly) in conjunction with an outboard reclosing pressure relief valve.

Commodity/Lading — the product inside a tank car.

Coupler Vertical Restraint System — see Double-Shelf Coupler.

Cryogenic Liquid Tank Car — a vacuum-insulated tank car, consisting of an inner container (tank) enclosed within an outer steel shell (tank, not jacket), designed for the transportation of refrigerated liquefied gases having a boiling point colder than minus 130°F at atmospheric pressure, such as liquid hydrogen, oxygen, ethylene, nitrogen and argon. These cars are built to the specifications contained in Subpart F, Part 179, Title 49CFR or Chapter 3, AAR MSRP Section C-III, Specification M-1002.

DOT — acronym for the Department of Transportation, which is the governmental department that regulates the transportation of hazardous materials within the United States.

DOT/TC Specification Tank Car — the U. S. Department of Transportation or Transport Canada specification to which a tank car was built, altered, or converted.

Double-Shelf Coupler/Coupler Vertical Restraint System — a railcar coupler having top and bottom shelves designed to prevent vertical disengagement of mating couplers in the event of an excessive end-to-end impact. Double-shelf couplers are fully compatible with all other railcar couplers and required by DOT regulation on all DOT specification tank cars and any tank car transporting hazardous materials/dangerous goods.

Eduction Line — the combination of the eduction valve and eduction pipe.

Eduction Pipe — the pipe that runs from the eduction valve into the tank.

Eduction Valve — a valve used to load or unload liquid product or to introduce or remove vapor from a tank car tank.

Excess Flow Valve — a device installed in a liquid, vapor, or sample line, or a gauging device rod designed to stop the outward flow of product in the event the fitting is removed during transportation, such as the device being sheared-off during an accident. When not in operation, the device allows the flow of liquid or vapor in two directions. Do not confuse this valve with a check valve, which is a device that allows the flow of liquid or vapor in only one direction.

Expansion Dome (Dome) — a cylindrical metal enclosure located on top of an obsolete nonpressure tank car tank intended to function as the expansion area for the lading during transportation. Do not confuse an expansion dome with protective housing, which is

found on pressure tank cars and some nonpressure tank cars.

Fill Hole — an opening in the manway cover, closed with a fill-hole cover, through which product may be loaded or unloaded. Typically found on tank cars in sulfuric or hydrochloric acid service.

Flange — a disc-shaped device that is part of a nozzle or fitting (valve, PRD), used to create a bolted attachment to the tank car. Also, it may be a solid disc (blind flange) or have a threaded hole for a plug or secondary valve bolted to the eduction valve to provide closure.

Frangible Disc — see Rupture Disc.

Gasket — material inserted in the joint between two mating surfaces to prevent leakage through the joint.

Gauging Device — a device used to measure the level of liquid or vapor space in a tank car tank, which may be a fixed gauge bar/outage scale or T-bar attached to

the top of the tank (in nonpressure tank cars), or a slip-tube, magnetic-ball, fixed-length (telltale) tube, or an electronic device.

Hand Brake — A device mounted on railcars and locomotives to provide a means for applying brakes manually without air pressure. Common types include vertical wheel, horizontal wheel, and lever type, so-named because of the configuration or orientation of their operating handles.

Head — one of the ellipsoidal ends of a tank car tank.

Head Shield — A method of providing tank head puncture-resistance by mounting a metal shield on the end of a tank car to protect against punctures from the coupler of another railcar. Head shields may be separate attachments or may be incorporated into a tank's jacket.

Heel — common term used for the product or residue remaining in a tank car tank after it has been unloaded.

Insulation — a material, typically fiberglass or foam, enclosed within a metal jacket, used to maintain or moderate the temperature or aid in the unloading of the lading contained within a tank car. For cryogenic liquid tank cars, in addition to a vacuum and insulation system, either perlite or an alternating wrap of multiple layers of aluminum foil and paper is used. Not all tank cars are insulated. Do not confuse insulation with thermal protection.

Internal Valve — a type of bottom outlet valve located inside a tank car tank to prevent damage in the event of an accident.

Jacket — a metal covering (minimal thickness of 11 gauge) surrounding a tank car tank designed to protect and secure the insulation and/or thermal protection systems on a tank car. A jacket is not an outer tank.

Light Weight/LT WT — empty weight or tare weight of cars or of the train. The light weight is stenciled in

pounds and kilograms on every rail freight car and is abbreviated LT. WT.

Liquid Education Line — a pipe, equipped with a valve, cap, or blind flange closure that extends to the bottom of a tank car tank for the loading and unloading of the lading.

Load Limit/LD LMT — the maximum weight of lading that can be loaded in a railcar. Load limit is stenciled in pounds and kilograms on every rail freight car and is abbreviated LD. LMT.

Manway — a general term designating the circular-shaped opening located at the top of a tank car tank to allow access into the tank's interior for maintenance, inspection, and loading or unloading. Depending upon a tank car's class or product service, the manway will be closed with either a hinged and bolted manway cover (typical for nonpressure tank cars) or a semi-permanently bolted manway cover or pressure plate, typical for pressure and cryogenic liquid tank cars.

Nitrogen Blanket/Nitrogen Pad — nitrogen gas inserted into a tank car tank to provide an inert atmosphere for a lading that may react with air in order to protect the lading's purity or to prevent the entry of moisture.

Nonpressure Tank Car — a tank car with a tank test pressure of 60 or 100 psig, built to the specifications contained in Subpart D, Part 179, Title 49CFR or Chapter 3, AAR *Manual of Standards and Recommended Practices*, Section C-III, Specification M-1002. Nonpressure tank cars are also referred to as general service or low-pressure tank cars.

Nozzle — a circular or oval-shaped attachment applied to openings in a tank for the application of a manway cover (or pressure plate), valves, pressure relief devices, and other fittings.

Outage — the vacant space left in a tank car tank after filling to allow for product expansion during transportation so it will not reach shell-full capacity

(maximum volume of a tank). Governmental regulations prescribe minimum outages for hazardous materials/dangerous goods at specified reference temperatures. In addition to minimum outage by volume, tank cars may not be loaded by weight in excess of their gross weight on rail limit as determined by their truck capacity. Another term for outage is ullage.

Packing — a general term denoting the various substances and devices used to prevent leakage of fluids or gases through openings (valve body and valve stem) that cannot be closed by ordinary contact of the parts concerned.

Packing Gland — the portion(s) of a device used to contain packing on a valve body or other fitting to prevent leakage.

PIH/TIH (Poison/Toxic Inhalation Hazard) — a gas or liquid that meets the definition of a “material

poisonous by inhalation” as defined in §171.8, Title 49 CFR (see TIH).

Pressure Plate — on a pressure tank car, the circular-shaped steel plate closing the manway nozzle to which the valves, pressure relief device(s), and other fittings are mounted. Some nonpressure tank cars may be equipped with a pressure plate assembly in lieu of a hinged and bolted manway cover.

Pressure Relief Device — a fitting that opens at a predetermined setting to reduce the pressure within a tank car tank resulting from exposure to abnormal conditions. PRDs may be reclosing (spring-loaded) pressure relief valves, regulating valves, nonreclosing (frangible/rupture disc) vents, or combination PRDs (incorporating both a frangible disc/breaking pin and a reclosing pressure relief valve).

Pressure Relief Valve (PRV) — a spring-loaded device, actuated by inlet static pressure, that relieves excess pressure and recloses after normal conditions are

restored. Pressure relief valve has replaced the term safety relief valve.

Pressure Tank Car — a tank car with a tank test pressure of 100 to 500 psig built to the specifications contained in Subpart C, Part 179, Title 49CFR.

Protective Housing — on pressure and on some nonpressure tank cars, a heavy, circular steel housing that surrounds the fittings to protect them in the event of an accident and from unauthorized access. Nonpressure tank cars may be equipped with light-gauge steel protective housings (referred to as combination housings, breadboxes or mailboxes) that provide weather and tamper protection. Do not confuse with an expansion dome as found on some (obsolete) nonpressure tank cars. The protective housings for cryogenic liquid tank cars are boxes or cabinets on the sides or end of the tank car.

Regulating (Regulator) Valve — a reclosing (spring-loaded) pressure relief device applied to tank cars

transporting certain refrigerated liquids (e.g., carbon dioxide and argon) to maintain internal pressure below a certain point. If the pressure exceeds a specific point, the valve will open, relieving vapor, which results in auto-refrigeration, lowering the product's temperature and pressure.

Reporting Mark and Number — the alphabetical initial stenciled (typically 3 or 4 letters ending with an X for nonrailroad owned cars, followed by 1 to 6 numerals; e.g., BOEX 2010) on the sides and ends of every freight car to identify the railroad or private car line that owns the car. Reporting marks are assigned by the Association of American Railroads.

Residue — the amount of commodity remaining in a tank car after it has been unloaded to the maximum extent practicable. Also referred to as “the heel.”

Rupture Disc — the operating part of a safety vent, also called a frangible disc. When used in conjunction

with a spring-loaded reclosing pressure relief valve, the device is called a combination pressure relief device.

Safety Relief Valve — See Pressure Relief Valve. Pressure relief valve has replaced the term safety relief valve.

Safety Vent (Rupture Disc Device) — a device consisting of a rupture disc and rupture disc holder. A nonreclosing pressure relief device actuated by static pressure and designed to function by the burst of a pressure-containing disc.

Sample Line — a pipe (typically 1/4 inch in diameter), equipped with a control valve that extends to near the bottom of a tank car tank for drawing a sample of the lading.

Shell — the cylindrical section of a tank car tank, without heads. Do not confuse with jacket. (See also Tank Car and Head.)

Service Equipment — equipment used for filling, sampling, emptying, venting, vacuum relief, pressure relief, heating (if internal to the tank), lading temperature measurement, or measuring the amount of lading within the tank. Commonly referred to as valves and fittings.

SETIQ — acronym for the Mexican Emergency Transportation System for the Chemical Industry, a service of the National Association of Chemical Industries (ANIQ). Responders in the Mexican Republic can call SETIQ (24 hours) 01-800-00-214-00. In Mexico and the metropolitan area, call 5559-1588. Elsewhere call,, call +52-55-5559-1588.

Shipping Paper (Hazardous Materials/Dangerous Goods) — a shipping order, bill of lading, manifest, or other shipping document serving a similar purpose and containing the information required by governmental regulations.

Skid Protection — a device attached to the bottom of a tank car to protect the bottom outlet, washout and/or sump (referred to as bottom discontinuities) from damage in the event of a derailment.

Specification — the specific designation within a tank car class; e.g., DOT 111A100W2.

STC Code or STCC — abbreviation for Standard Transportation Commodity Code, which is a 7-digit freight description coding system used by the North American railroad industry. For hazardous materials/dangerous goods, the STCC is referred to as the Hazmat Code, and begins with 49 or 48 for hazardous wastes. The Hazmat Code may be found on shipping papers and may be used to access computer-based emergency response information.

Stenciling — a term used to describe all forms of lettering on cars regardless of the actual method of application. Specific information that is required to be marked on the exterior surface of a tank car.

Stub Sill Tank Car — a tank car design with draft sills at each end of the tank instead of a continuous center sill that utilizes the tank as part of the car structure. (Also see Center Sill).

Stuffing Box — the portion of a top-operated bottom outlet valve assembly through which the valve operating rod passes to the exterior of the tank. The stuffing box contains packing that, when compressed by the packing gland nut, forms a seal around the rod to prevent leakage and keeps the rod from vibrating. The stuffing box cover, when removed and inverted, is used as a wrench to open and close the internal valve.

Sump or Siphon Bowl — a small depression located near the longitudinal center of a tank bottom where the liquid eduction line extends, thereby allowing the maximum amount of product to be removed from the tank.

Surge Pressure Reduction Device — a device designed to reduce the internal surge pressures of the

pressure relief devices. These devices are primarily used on tank cars equipped with nonreclosing pressure relief devices (safety vents) and are intended to reduce pressure surges that can cause the rupture disc to fail.

Tank Car/Tank Car Tank — a railcar that has a tank for its body for transporting liquids, solids, and liquefied gases, consisting of a shell and heads together with connections welded directly to it. In accordance with AAR specifications, “tank” means “tank car tank.” The head of a tank is one of the end closures. Tank cars may be pressure or nonpressure and are often equipped with special equipment to enhance their usefulness for handling specific commodities. For pressure class tank cars, the tank includes the manway nozzle as well. Note: Tanker or tanker car are inappropriate terms to describe a tank car.

Tank Test Pressure — the pressure (psig) at which a tank car tank is to be hydrostatically tested at the time of construction. Depending upon the specification, the tank test pressure varies from 20 percent to 40 percent

of the minimum burst pressure. Tank test pressure is also known as service pressure.

TC or Transport Canada — the governmental agency that regulates the transportation of dangerous goods in Canada.

Thermal Protection — a material or system applied to certain tank cars to limit the transfer of heat to the tank in the event of exposure to pool or torch fires. It is intended to reduce the likelihood of tank failure under such conditions. Thermal protection is not the same as insulation, which is intended to maintain or moderate lading temperature under ambient conditions.

Thermometer Well — a small diameter pipe, usually 3/4 inch, filled with an antifreeze solution or oil that extends into the tank and is closed at the top with a removable cap. The temperature of the lading transfers to the liquid in the pipe. A thermometer or probe is lowered into the pipe to obtain the lading's temperature.

TIH/PIH (Toxic/Poison Inhalation Hazard) — a gas or liquid that meets the definition of a “material poisonous by inhalation” as defined in §171.8, Title 49 CFR (see PIH).

Train Consist — for purposes here, a document (also referred to as a Train List or Wheel Report) that sequentially lists the location of each railcar in a train. A consist may also serve as the shipping paper for a railcar containing hazardous materials/dangerous goods, provided it contains all of the information required by governmental regulations.

Truck — the assembly of wheels, axles, roller bearings, springs, side bearings, side frames, and bolster that supports each end of a railcar and enables it to move on the rails.

Type (Tank Car) — for tank cars, designates the approving agency; e.g., AAR, DOT, and TC, which is the preferred form of designating.

Vacuum Relief Valve — a spring-loaded valve mounted at the top of some nonpressure tank cars, designed to open and allow air into the tank if an excessive vacuum is formed that may cause the tank to collapse. A vacuum relief valve should not be depressed to determine if there is pressure in the tank. Doing so may dislodge the sealing component causing the device to leak vapor or liquid.

Vapor Line — a pipe equipped with a valve, cap, or blind flange closure that extends to the top of the tank through which vapor is introduced or removed during loading or unloading. On a nonpressure tank car, this device is usually called an air line and is used to introduce compressed air or vapor, or an inert gas to unload the car.

Vapor Space — the space in a tank above the liquid; may also be referred to as outage.

For more definitions and terms used by the North American railway industry, the following publications are available through Simmons-Boardman Books, Inc.:

Dictionary of Railway Track Terms, by Christopher F. Schulte.

Railway Age's Comprehensive Railroad Dictionary.

The Car and Locomotive Cyclopedia

The Carman's Dictionary

The Railroad Dictionary of Car and Locomotive Terms

For appropriate content feedback go to http://www.ttcweb.com/BOE_Feedback.nsf.



Field Guide
To Tank Cars