DEPARTMENT OF TRANSPORTATION
HAZARDOUS MATERIALS REGULATIONS BOARD
WASHINGTON, D.C. 20590

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[49 CFR Parts 172, 173, 179]

[Docket No. HM-91; Notice No. 71-25]

TRANSPORTATION OF HAZARDOUS MATERIALS

Cold Compressed Gases in Tank Cars

The Hazardous Materials Regulations Board is considering amendment of the Department's Hazardous Materials Regulations to provide for the shipment of ethylene, hydrogen, methane, natural gas, and inhibited vinyl fluoride in a cold liquefied gas state in certain tank cars.

The movement of several liquefied compressed gases at low temperatures in insulated tank cars equipped with safety relief valves to permit venting, if the commodity remains in the tank for an extended period of time, has proved to be a safe method of transportation. Under the provisions of § 173.314, inhibited vinyl fluoride is authorized to be so shipped in certain tank cars with start-of-shipment commodity temperature of not over 0° F. Each tank is required to be insulated to insure that at least 30 days will pass before the pressure of the contents reaches the level of the safety relief valve setting.

For several years, these commodities have been transported under similar conditions, authorized by special permits. The experience reported by the special permit holders relating to the changes proposed has been satisfactory.

This proposal is based on a petition to incorporate the terms of these permits into the regulations. The proposal also would amend the regulations relating to conditions for transportation of inhibited vinyl fluoride, and those relating to present specification requirements for certain insulated tank cars. In addition, new tank car specifications 113C120W and 113D120W would be added to the regulations.

The petition for rule change also included a request to amend the regulations to allow the shipment of cold anhydrous ammonia in a proposed specification 119A60W tank car, and to provide proposed new specifications 113B60W, 113C60W, and 113D60W. The small amount of experience obtained under special permits thus far for these items is considered too limited to serve as a basis for rule change. In addition, actual operating difficulties encountered with the proposed 113D60W specification tank car have raised serious doubts regarding use of the "60-pound car". The Board, therefore, is not proposing these requested changes at this time.

In consideration of the foregoing, it is proposed to amend 49 CFR Parts 172, 173, and 179 as follows:

I. Part 172:

In § 172.5 paragraph (a), the Commodity List would be amended as follows:

§ 172.5 List of hazardous materials.

(a) * * *

Article	Classed as—	Exemption and packing (see sec.)	Label required if not exempt	Maximum quantity in 1 outside container by rail express
(add)				
Ethylene, liquefied	F.G	No exemption, 173.317	Red gas	Not accepted.
Hydrogen chloride, cold	Nonf. G	No exemption, 173.317	Green	Do.
Methane, liquefied	F.G	No exemption, 173.317	Red gas	Do.
Natural gas, liquefied	F.G	No exemption, 173.317	do	Do.
Vinyl fluoride, inhibited, cold	F.G	No exemption, 173.317	do	Do.

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II. Part 173:

(A) In Part 173 Table of Contents, § 173.317 would be added to read as follows:

Sec.

173.317 Cold compressed gases in tank cars where venting is undesirable, but which will vent if left indefinitely.

(B) In § 173.314 paragraph (c) Table, the following entry would be deleted:

Vinyl fluoride, inhibited	58			DOT–105A600W, Note 17"

Note 17 following the table would be canceled.

(C) Section 173.317 would be added to read as follows:

§ 173.317 Cold compressed gases in tank cars where venting is undesirable, but which will vent if left indefinitely.

(a) Cold compressed gases must be shipped as provided in § 173.314 (b) and (e), § 173.432, and the following table:

Kind of gas	Filling density percent—note 4		Maximum shipping pressure—note 1 (p.s.i.g.)	Required tank car, notes 2, 3, 5, 6, 7
	Maximum	Minimum		
Ethylene, liquefied	51.1	45.9	25	DOT–113C120W, DOT–113D120W.
Hydrogen, chloride, cold	39.0	80.1	80	DOT–105A600W.
Methane, liquefied	38.3	34.4	10	DOT–113C120W.
Natural gas, liquefied	38.3	34.4	10	DOT–113C120W.
Vinyl fluoride (inhibited), cold	59.6	53.6	115	DOT–105A600W.

NOTE 1: The maximum shipping pressure is that pressure which must not be exceeded when car is offered for transportation.

NOTE 2: The loading temperature must not be colder than the minimum temperature stenciled on the jacket.

NOTE 3: Special commodity stencil is required.

NOTE 4: The liquid portion of the cold compressed gas must not completely fill the tank at a temperature that will result in a pressure equal to the start-to-discharge pressure of the safety relief valve. For definition of filling density see § 173.314(c) Note 1.

NOTE 5: Prior to return of empty cars, liquid must be drained from cars and pressure must be reduced to less than 10 p.s.i.g.

NOTE 6: For special commodity requirements see § 179.102 and § 179.402.

NOTE 7: The shipper shall notify the Bureau of Explosives whenever the car is not received by the consignee within 20 days after shipment.

III. Part 179:

(A) In Part 179 Table of Contents, Subpart F heading and §§ 179.400, 179.401 would be amended; § 179.402 would be added to read as follows:

Subpart F—Specifications for Insulated Tank Car Tanks Consisting of an Inner Container Supported Within an Outer Shell (Class DOT–113)

Sec.

179.400 General specifications applicable to cryogenic tank car tanks (minus 100° F. to minus 423° F.) with 30-day holding time, consisting of an inner container supported within an outer shell.

179.401 Individual specification requirements applicable to low temperature tank car tanks.

179.402 Special commodity requirements for low temperature tank car tanks.

(B) Section 179.102–4 would be amended; § 179.102–18 would be added to read as follows:

§ 179.102 Special commodity requirements for pressure tank car tanks.

§ 179.102–4 Vinyl fluoride, inhibited, cold.

(a) Tank cars used to transport cold vinyl fluoride, inhibited, must comply with the following special requirements:

(1) Each tank must comply with specification DOT–105A600W and must be designed for loading at 0° F.

(2) All plates for the tank, manway nozzle, and anchor must be made of steel complying with ASTM Specification A516–70, Grade 70, ASTM Specification A537–69, Grade A, or AAR Specification TC128–70, Grade B and further meeting the requirements of ASTM Specification A300–68, Class 1. However, impact specimens must be Type A Charpy V-notch as shown in ASTM Specification A370–68 and must meet the impact requirements at minus 50° F. Production welded test plates prepared as required by W4.00 of AAR Specifications for Tank Cars, Appendix W, must include impact test specimens of weld metal and heat affected zone, prepared and tested in accordance with W9.00 of AAR Specifications for Tank Cars, Appendix W, and these must meet the same impact requirements as the plate material at minus 50° F.

(3) Insulation must be of approved material and must be self-extinguishing.

(4) Tank must be equipped with one safety relief valve, set for the start-to-discharge pressure listed in § 179.101, and one safety vent of approved design, set to function at a pressure less than the tank test pressure, and not less than 75 percent of the tank test pressure. The discharge capacity of each of these safety relief devices must be sufficient to prevent building up pressure in tank in excess of 82½ percent of the tank test pressure.

(5) Each safety relief device must have its discharge piped to the outside of the protective housing.

(6) Excess flow valves must be applied under all liquid and vapor valves.

(7) Thermometer well must be applied.

(8) Gaging device is not required but may be applied. Fixed length dip tubes may be used for gaging.

(9) A pressure gage must be applied.

(10) No aluminum, copper, silver, zinc, or alloy of any of these metals shall be used in the tank construction, or fittings in contact with the lading.

(11) The jacket must be stenciled adjacent to the water capacity stencil with the minimum operating temperature of the car.

(12) The tank car and insulation must be designed to prevent the lading from increasing from the maximum allowable shipping pressure to the start-to-discharge pressure of the safety relief valve within 30 days at an ambient temperature of 90° F.

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§ 179.102–18 Hydrogen chloride, cold.

(a) Tank cars used to transport cold hydrogen chloride must comply with the following special requirements:

(1) Each tank must comply with Specification DOT–105A600W and be designed for loading at minus 50° F.

(2) All plates for the tank, manway nozzle, and anchor must be made of steel complying with ASTM Specification A516–70, Grade 70, ASTM Specification A537–69, Grade A, or AAR Specification TC128–70, Grade B and further meeting the requirements of ASTM Specification A300–68, Class 1. However, impact specimens must be Type A Charpy V-notch as shown in ASTM Specification A370–68 and must meet the impact requirements at minus 50° F. Production welded test plates prepared as required by W4.00 of *AAR Specification for Tank Cars, Appendix W*, must include impact test specimens of weld metal and heat affected zone, prepared and tested in accordance with W9.00 of AAR Specifications for Tank Cars, Appendix W, and these must meet the same impact requirements as the plate material at minus 50° F.

(3) Tanks may be equipped with exterior cooling coils on top of the tank shell.

(4) Safety valves must be monel trimmed and must be equipped with frangible disc of silver, or teflon coated monel or tantalum. Discharge must be piped to outside of the protective housing.

(5) Loading and unloading valves must be Hastelloy B or C or monel trim, identified as "Vapor" or "Liquid". Excess flow valves must be applied under all liquid and vapor valves.

(6) Thermometer well must be applied.

(7) Sump in the bottom of the tank under liquid pipes must be applied.

(8) All gaskets must be teflon or teflon jacketed.

(9) Gaging device is not required but may be applied. Fixed length dip tubes may be used for gaging.

(10) Insulation must be of approved material and must be self-extinguishing.

(11) The jacket must be stenciled adjacent to the water capacity stencil "Minimum Operating Temperature ---- F".

(12) The tank car and insulation must be designed to prevent the lading from increasing from the maximum allowable shipping pressure to the start-to-discharge pressure of the safety relief valve within 30 days at an ambient temperature of 90° F.

(C) The Subpart F heading would be amended to read as follows:

Subpart F—Specifications for Insulated Tank Car Tanks Consisting of an Inner Container Supported Within an Outer Shell (Class DOT–113)

(D) Section 179.400 would be amended to read as follows:

§ 179.400 General specifications applicable to cryogenic tank car tanks (minus 100° F. to minus 423° F.) with 30-day holding time, consisting of an inner container supported within an outer shell.

§ 179.400–1 Tanks built under these specifications must meet the requirements of §§ 179.400, 179.401, and when applicable § 179.402.

§ 179.400–2 Approval.

For procedure for securing approval, see § 179.3.

§ 179.400–3 Type.

(a) Each tank built under these specifications must consist of an inner container suitably supported within an outer shell. The tank car must be equipped with piping systems for vapor venting and transfer of lading and with safety relief devices, controls, gages and valves prescribed herein.

(b) The annular space must contain a suitable insulation. Tanks must be circular in cross section, with heads designed convex outward. The permissible out of roundness of the cylindrical portion of the inner and outer shell must be no greater than that permitted in section VIII, division 1, of the ASME Boiler and Pressure Vessel Code (1968 Edition) Paragraph UG–80.

(c) When the tank is divided into compartments each compartment must be treated as a separate tank.

§ 179.400–4 Insulation.

(a) The insulation system must be such that the total heat transfer from the atmosphere at 90° F. to the lading at the average temperature between the maximum temperature at the time of shipment and the temperature at the safety valve start-to-discharge pressure does not exceed the value given in § 179.401–1(a). The insulation requirements are based upon a 30-day holding time. The total heat transfer must include the heat transferred through the insulation, support system and the piping.

(1) The permissible heat transfer is based upon the maximum filling density for the commodity as described in § 173.314(c) of this chapter and is calculated from:

$$q=0.004\,(U_2-U_1)\,D$$

where:

U_1 and U_2 = internal energy in B.t.u./lb. for the combined liquid and vapor lading at the maximum shipping pressure and start-to-discharge pressure, respectively.

D = density of lading at start-to-discharge pressure, lb./gallon;

q = heat transfer, B.t.u./day/lb. water capacity.

Alternatively, the permissible heat transfer can be approximated by:

$$q=\frac{(h_2-h_1)\left(\frac{D}{8.328}\right)-\frac{144\,v\,(P_2-P_1)}{778}}{H.T.}$$

where:

h_2 = enthalpy of liquid at start-to-discharge pressure, B.t.u./lb.;

h_1 = enthalpy of liquid at maximum shipping pressure, B.t.u./lb.;

D = density of lading at start-to-discharge pressure, lb./gallon;

v = volume of 1 lb. of water = 0.016 cu. ft./lb.;

P_2 = start-to-discharge pressure, p.s.i.g.;

P_1 = maximum shipping pressure, p.s.i.g.;

$H.T.$ = holding time, days;

q = heat transfer, B.t.u./day/lb. water capacity.

(b) If the inner vessel is divided into compartments, the total heat transfer must be calculated for each compartment with adjoining compartments empty and at a temperature of 90° F.

(c) Insulation must be self-extinguishing as defined in ASTM D1692–68.

§ 179.400–5 Bursting and buckling pressure.

(a) The minimum required bursting pressure of the inner container is listed in § 179.401–1(a).

(b) If the insulation system is an evacuated type, the outer container must be designed in accordance with § 179.400–6(d) in addition to the loads specified in AAR Specifications for Tank Cars, AAR.23 and the loads transferred to the outer container through the support system.

§ 179.400–6 Thickness of plates.

(a) The wall thickness after forming of the inner container and 2:1 ellipsoidal heads must be not less than that specified in § 179.401–1(a), nor less than that calculated by the following formula:

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

where:

d = inside diameter in inches;

E = 0.9 welded joint efficiency; also $E=1.0$ for seamless heads;

P = minimum required bursting pressure in p.s.i.;

S = minimum tensile strength of plate material in p.s.i. as prescribed in AAR Specifications for Tank Cars, Appendix M, Table M1;

t = minimum thickness of plate in inches after forming.

(b) The wall thickness after forming of inner container 3:1 ellipsoidal heads must be not less than specified in § 179.401–1(a), nor that calculated by the following formula:

$$t=\frac{Pd}{2SE}\times 1.83$$

where:

d = inside diameter inches;

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

P = minimum required bursting pressure in p.s.i.;

S = minimum tensile strength of plate material in p.s.i. as prescribed in AAR Specifications for Tank Cars, Appendix M, Table M1;

t = minimum thickness of plate in inches after forming.

(c) The wall thickness after forming of a flanged and dished head of the inner container must be not less than specified in § 179.401–1(a), nor less than that calculated by the following formula:

$$t=\frac{PL}{8SE}\left(3+\sqrt{L/r}\right)$$

where:

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

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

P = minimum required bursting pressure in p.s.i.;

S = minimum tensile strength of plate material in p.s.i. as prescribed in AAR Specifications for Tank Cars, Appendix M, Table M1;

r = inside knuckle radius in inches;

t = minimum thickness of plate in inches after forming.

(d) For the outer container the wall thickness after forming of the shell and heads must be not less than 7/16 inch. In addition, if the annular space is to be evacuated, the cylindrical portion of the outer shell between heads or between stiffening rings, if used, must be designed to withstand an external pressure of 37.5 p.s.i.g. (critical collapsing pressure) as determined by the following formula:

$$P_c=\frac{2.6E\,(t/D)^{2.5}}{L/D-0.45\sqrt{(t/D)}}$$

where:

P_c = critical collapsing pressure (37.5 p.s.i. minimum);

E = modulus of elasticity of shell material in p.s.i.;

t = minimum thickness of shell material after forming in inches;

D = outside diameter of shell in inches;

L = distance between stiffening ring centers in inches. (The heads may be considered as stiffening rings located one-third of the head depth from the head tangent line.)

(e) If stiffening rings are used in designing the cylindrical portion of the outer shell for external pressure, they must be attached to the shell by means of fillet welds. Outside stiffening ring attachment welds must be continuous on each side of the ring. Inside stiffening ring attachment welds may be intermittent welds on each side of the ring with the total length of weld on each side not less than one-third of the circumference of the tank. The maximum space between welds must be eight times the tank wall thickness.

(1) A portion of the outer shell may be included when calculating the moment of inertia of the ring. The effective width of shell plate on each side of the attachment of the stiffening ring is given by the following formula:

$$W = 0.78\sqrt{Rt}$$

where:

W = width of shell effective on each side of the stiffening ring in inches;
R = outside radius of the outer shell in inches;
t = plate thickness after forming of the outer shell in inches.

(2) Where a stiffening ring is used which consists of a closed section having two webs attached to the outer shell, the shell plate between the webs may be included up to the limit of twice the value of W defined above. The outer flange of the closed section must be subject to the same limitations with W based on the R and t of the flange. Where two separate members, such as two angles, are located less than $2W$ apart they may be treated as a single stiffening ring member. (The maximum length of shell plate which may be considered effective is $4W$.)

(3) The stiffening ring must have a moment of inertia large enough to support the critical collapsing pressure as determined by either of the following formulae:

$$I = \frac{0.035\, D^3 L P_c}{E}$$

$$I' = \frac{0.046\, D^3 L P_c}{E}$$

where:

I = required moment of inertia of stiffening ring about the centroidal axis parallel to the vessel axis in inches to the fourth power;
I' = required moment of inertia of combined section of stiffening ring and effective width of shell plate about the centroidal axis parallel to the vessel axis in inches to the fourth power;
D = outside diameter of the outer shell in inches;
L = one-half of the distance from the centerline of the stiffening ring to the next line of support on one side plus one-half of the distance from the centerline to the next line of support on the other side of the stiffening ring. Both distances are measured parallel to the axis of the vessel in inches. (A line of support is: (1) A stiffening ring which meets the requirements of this paragraph, or (2) a circumferential line of a head at one-third the depth of the head from the head tangent line.)
P_c = critical collapsing pressure (37.5 p.s.i.g. minimum);
E = modulus of elasticity of stiffening ring material in p.s.i.

(4) Where loads are applied to the outer shell or to stiffening rings from the support system used to support the inner container within the outer shell, additional stiffening rings or an increased moment of inertia of the stiffening rings designed for the external pressure must be provided to carry the support loads.

(f) Bottom of inner container may be equipped with a sump and siphon bowl welded or pressed into the shell. Such sumps or siphon bowls, if applied, are not limited in size. They must be made of cast, forged, or fabricated metal and be of good welding quality in conjunction with the metal of the inner container. When the sump and siphon bowl are pressed in the bottom of the shell, the wall thickness must not be less than that specified for the inner container. The section of a circular cross section inner container to which a sump and siphon bowl is attached need not comply with the out-of-roundness requirement specified in appendix W, W14.06 of the AAR Specifications for Tank Cars. Any portion of a sump and siphon bowl not forming a part of a cylinder of revolution must have walls of such thickness and be so reinforced that the stresses in the walls caused by a given internal pressure are no greater than the circumferential stress which would exist under the same internal pressure in the wall of a tank of circular cross section designed in accordance with § 179.400–6(a). However, the wall thickness must not be less than that specified in § 179.401–1(a).

§ 179.400–7 Materials.

(a) Plate material used to fabricate the inner container and appurtenances must be as specified in § 179.401–1(a). It must be suitable for use at the temperature of the lading and compatible with the lading.

(b) Carbon steel plate used to fabricate the outer shell and heads must comply with one of the following specifications and with the indicated minimum tensile strength and elongation in the welded condition. The maximum allowable carbon content must be 0.31 percent when the individual specification allows carbon content greater than this amount. The plates may be clad with other approved materials:

Specifications	Minimum tensile strength (p.s.i.) welded condition [1]	Minimum elongation in 2 inches (percent) welded condition (longitudinal)
ASTM A 515–69, Gr. 55	55,000	28
ASTM A 515–69, Gr. 60	60,000	25
ASTM A 515–69, Gr. 65	65,000	20
ASTM A 515–69, Gr. 70	70,000	20
ASTM A 285–69, Gr. A	45,000	29
ASTM A 285–69, Gr. B	50,000	20
ASTM A 285–69, Gr. C	55,000	20
ASTM A 516–70, Gr. 55	55,000	28
ASTM A 516–70, Gr. 60	60,000	25
ASTM A 516–70, Gr. 65	65,000	20
ASTM A 516–70, Gr. 70	70,000	20
AARTC 128–70, Gr. A&B	81,000	19

[1] Maximum stresses to be used in calculations.

(1) All steel castings, steel forgings and steel structural shapes must be of material to an approved specification. See AAR Specifications for Tank Cars, appendix M, M4.05 for approved material specifications for castings for fittings.

(2) Rivets must be of steel as specified in AAR Specifications for Tank Cars, appendix M, M4.04.

§ 179.400–8 Tank heads.

(a) Tank heads of the inner container, compartments and outer shell must be of approved contour, and may be flanged and dished or ellipsoidal.

(b) Flanged and dished heads must have a main inside dish radius not greater than the outside diameter of the straight flange. The inside knuckle radius must be not less than 6 percent of the outside diameter of the straight flange but in no case less than three times the head thickness.

§ 179.400–9 Compartment tanks.

(a) When two or more compartments are desired, the inner container must consist of two or more separate tanks each having two heads designed convex outward. If the tanks are joined together they must be connected by a cylinder made with plate of the same material as the vessels and having a thickness not less than that required for the tank shell. The joining cylinder must be applied to the outside surface of the tank head straight flanges with a tight fit. The cylinder must contact the head flange for a distance of at least two times the plate thickness, or a minimum of 1 inch, whichever is greater. The cylinder must be joined to the head flange by a full fillet weld. The distance from the head seam to cylinder must not be less than 1½ inches or three times the plate thickness, whichever is greater.

(b) Voids created by the space between inner tank heads joined together to form a compartment tank must be provided with at least one drain hole at their lowest point which must not be closed. Provisions must be made to avoid the transfer of insulation into or from this void.

(c) When two or more inner containers are provided, the outer shell may be divided into compartments.

§ 179.400–10 Welding.

(a) All joints must be fusion-welded in compliance with the requirements of AAR Specifications for Tank Cars, appendix W.

(b) Impact test specimens must be removed from the welded test plate (figure W1B of the AAR Specification for Tank Cars, appendix W) and subjected to the tests prescribed in § 179.401–1(a).

(c) All joints of the inner and outer containers must be double-welded butt joints, except closures for access openings. No more than two circumferential closing joints in the cylindrical portion of each outer container or compartment, including head to shell joints, may be single-welded butt joints using a backing strip on the inside of the joint. If the outer container is separated into two or more compartments by internal heads, the heads must be attached inside the outer shell by fillet welding as shown in

AAR Specifications for Tank Cars, appendix E.

§ 179.400–11 Postweld heat treatment.

(a) Postweld heat treatment of the inner container is not a specification requirement.

(b) The cylindrical portion of the outer shell with the exception of the circumferential closing seams must be postweld heat treated in accordance with the requirements of the AAR Specifications for Tank Cars, appendix W, W17.00. All items welded to this portion of the outer shell must be attached before postweld heat treatment. Welds securing the inner container support system to the outer shell, connections at piping penetrations, closures for access openings, and the tank heads at each end of the shell need not be postweld heat treated when it is not practicable due to final assembly procedures.

(c) When cold formed heads are used on the outer shell they must be heat treated before welding to shell if postweld heat treatment is not practicable due to assembly procedures.

§ 179.400–12 Support system for inner container.

(a) The inner container must be supported within the outer shell by a support system of approved design. The system and its areas of attachment to the outer shell must have adequate strength and ductility at operating temperatures to support the inner container when filled with lading to any level incident to transportation.

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

Longitudinal	7G
Transverse	3G
Vertical	3G

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

§ 179.400–13 Cleaning of inner container.

The interior of the inner container and all lines connecting to it must be thoroughly cleaned and dried. Proper precautions must be taken to avoid contamination of the system after cleaning.

§ 179.400–14 Radioscopy.

All longitudinal and circumferential joints of the inner container and all longitudinal and circumferential double-welded butt joints of the outer shell must be examined throughout their entire length in compliance with requirement of the AAR Specification for Tank Cars, appendix W, W19.00.

§ 179.400–15 Access to inner container.

(a) The inner container must be provided with a means of access having a minimum inside diameter of 16 inches. Reinforcement of the access opening must be made of the same material as used in the inner container. The access closure must be of an approved material and design.

(b) If a welded closure is used, it must be designed to allow it to be reopened by grinding or chipping and to be closed again by rewelding, preferably without a need for new parts. A cutting torch must not be used.

§ 179.400–16 Inner container piping.

(a) *Product lines.* The piping system for vapor and liquid phase transfer and venting must be made from material compatible with the product and having satisfactory properties at the lading temperature. The outlets of all vapor phase and liquid phase lines must be located so that accidental discharge from these lines will not impinge on any metal of the outer shell, car structures, trucks or safety appliances. Suitable provision must be made to allow for thermal expansion and contraction.

(1) *Loading and unloading line.* A liquid phase transfer line must be provided which will have a manually operated shutoff valve located as close as practical to the outer shell, plus a secondary closure that is liquid and gas tight. This closure must be such that trapped pressure will bleed off before the closure can be removed completely. A vapor trap must be incorporated in the line and located as close as practical to the inner shell.

(2) *Vapor-phase line.* A vapor-phase line of sufficient size to permit safety relief devices covered in § 179.400–18 connected to this line to operate at their design capacity without excessive pressure buildup in the tank must connect to the inner container. The vapor-phase line must have a manually operated shutoff valve located as close as practical to the outer shell, plus a secondary closure that is liquid and gas tight. This closure must be such that trapped pressure will bleed off before the closure can be removed completely.

(3) *Vapor phase blowdown line.* A blowdown line must be provided. It may be attached to the vapor-phase line specified in subparagraph (2) of this paragraph upstream of the shutoff valve in that line. A bypass line with a manually operated shutoff valve must be provided to permit reduction of the inner vessel pressure when the vapor-phase line is connected to a closed system. The discharge from this line must be outside the housing.

(b) *Pressure-building system.* Not a specification requirement. If a pressure-building system is provided for the purpose of pressurizing the vapor space of the inner container to facilitate unloading the liquid lading, the system must be of approved design.

§ 179.400–17 Control valves and gages.

(a) *Control valves.* Manually operated shutoff valves and control valves must be provided wherever needed for control of vapor-phase pressure, vapor-phase venting, liquid transfer, and liquid flow rates. All valves must be made from approved materials compatible with the product and having satisfactory properties at the lading temperature.

(1) Liquid control valves must be of extended stem design.

(2) Packing, if used in these valves, must be satisfactory for use in contact with the lading and must be of approved materials which will effectively seal the valve stem without causing difficulty of operation.

(3) Control valves and shutoff valves must be installed so that they can be readily operated. These valves must be mounted so that operation of the valves will not transmit excessive forces to the piping system.

(b) *Gages.* Instruments necessary for the effective and safe operation of the tank when transporting, transferring or storing the commodity for which the car is designed must be provided. Instruments, except portable instruments, must be securely mounted within suitable protective housings and must include the following:

(1) *Liquid-level gage.* Connections must be provided for a liquid-level gage of approved design to indicate the quantity of liquefied lading within the inner container. The gage, if not portable, must be mounted in a position where it will be readily visible to an operator during transfer operations or storage. This connection for a portable gage must be readily accessible.

(2) *Fixed-length dip tube.* A fixed-length dip tube must be provided with a manually operated shutoff valve located as close as possible to the outer shell and within a suitable housing. It must be installed to indicate the maximum liquid level for the allowable filling density. The inner end of the dip tube must be installed so that it is located on the longitudinal centerline of the tank and within 4 feet of the transverse centerline of the tank in either direction.

(3) *Vapor-phase pressure gage.* A vapor-phase pressure gage of approved design must be provided to indicate the vapor pressure within the inner container. The gages must be mounted so as to be readily visible to an operator.

§ 179.400–18 Safety relief devices.

(a) The tank must be provided with safety relief devices for the protection of the tank assembly and piping system. The discharge from these devices must be directed away from operating personnel, principal load bearing members of the outer shell, car structure, trucks, and safety appliances. Vent or weep holes in safety relief devices are prohibited. All main safety relief devices must discharge to the outside of the protective housings in which they are located. This provision does not apply to small safety relief

valves installed to protect isolated sections of lines between the final valve and end closure.

(b) Materials: Materials used in safety relief devices must be suitable for use at the temperature of the lading and must be compatible with the lading in the liquid or vapor phase.

(c) Inner container: Safety relief devices for the inner container must be attached to piping connected to the vapor phase of the inner container and mounted so as to remain at ambient temperature prior to operation. Additional requirements are as follows:

(1) *Safety vent.* The inner container must be equipped with a safety vent without an intervening shutoff valve and must be designed to function at the pressure specified in § 179.401–1(a). The safety vent capacity must be sufficient to limit the pressure within the inner container to not over the test pressure during all conditions of operation, both normal and abnormal, including fire with loss of vacuum, when the insulation space is filled with air or gaseous lading (whichever requires the greater capacity) at atmospheric pressure.

(2) *Safety relief valve.* The inner container must be equipped with a safety relief valve without an intervening shutoff valve and set to operate at the pressure specified in § 179.401–1(a). The safety relief valve capacity must be sufficient to limit the pressure within the inner container to the flow rating pressure specified in § 179.401–1(a) when the insulation space is filled with air or gaseous lading (whichever requires the greater capacity) at atmospheric pressure and the outer shell is at 130° F. The minimum size relief valve body must be three-fourths inch IPS. The relief valve discharge capacity must be calculated in accordance with AAR Specifications for Tank Cars, appendix A.

(3) *Evaporation control.* The routine release of vaporized lading must be controlled or prevented as specified in § 179.401–1(a).

(4) *Safety interlock.* Not a specification requirement. If a safety interlock is provided for the purpose of allowing transfer of lading at a pressure higher than the pressure control device setting but less than the safety relief valve setting, the design must be such that the safety interlock will not affect the discharge path of the safety relief valve or safety vent at any time. The safety interlock must automatically provide an unrestricted discharge path for the pressure control device at all times when the tank car is in transport service.

(d) Outer shell: The outer shell must be provided with a suitable safety relief device to prevent the buildup of annular space pressure in excess of the external pressure for which the inner container was designed, but not to exceed 16 p.s.i. The discharge capacity of the relieving device must be sufficient to vent pressure accumulating within the annular space. If a safety vent is used, it must be designed to prevent distortion of the frangible disc when the annular space is evacuated.

(e) Piping system: Additional safety relief valves must be installed in each piping circuit where the system can be isolated by closing the shutoff valve so that a dangerous pressure cannot be built up. These safety relief valves must be designed to open at a pressure sufficiently low to prevent damage to the component or system affected.

§ 179.400–19 Test of safety relief valves.

(a) Each valve must be tested by air or gas for compliance with § 179.401–1(a) before being put into service.

§ 179.400–20 Evacuated insulation.

(a) If the performance of the insulation depends on evacuation to meet the heat transfer requirements, the outer shell must be provided with fittings to permit effective evacuation of the annular space between the outer shell and the inner container.

(b) If an evacuated insulation system is used, connections must be provided for a vacuum gage of approved design to indicate the absolute pressure in the annular space. The gage, if not portable, must be mounted in a position where it will be readily visible to an operator. The connection for a portable gage must be readily accessible.

§ 179.400–21 Protective housings.

(a) All valves, gages, closures, and safety relief valves with the exception of secondary relief valves for the protection of isolated piping, must be enclosed within protective housings. The protective housings must be adequate to protect the enclosed components from direct solar radiation, mud, sand, adverse environmental exposure, and mechanical damage incidental to normal operation of the tank car. They must be designed so as to provide reasonable access to the enclosed components for operation, inspection, and maintenance, and so that vapor concentrations cannot build up to a dangerous level inside the housing in the event of valve leakage or safety relief valve operation. The enclosures must be operable by personnel wearing heavy gloves and must incorporate provisions for locks or seals. Protective housings and their covers must be constructed of metal not less than 0.119 inch in thickness.

§ 179.400–22 Test of tank.

(a) After all items to be welded to the inner container have been welded in place, the inner container must be pressure tested to the test pressure prescribed in § 179.401(a). The temperature of the pressurizing medium must not exceed 100° F. during the test. The container must hold the prescribed pressure for a period of not less than 10 minutes without leakage or evidence of distress. After the container has passed the pressure test, the container and piping must be emptied of all water and purged of all water vapor if water is used for testing.

(1) Calking of welded joints to stop leaks developed during the test is prohibited. Repairs to welded joints must be made as prescribed in AAR Specifications for Tank Cars, appendix W.

(b) Pressure testing of the outer shell is not a specification requirement.

§ 179.400–23 Operating instructions.

(a) All valves and gages must be clearly identified with corrosion resistant nameplates. A plate of corrosion-resistant material bearing precautionary instructions for the safe operation of the equipment during storage and transfer operations must be securely mounted where it will be readily visible to an operator. Such an instruction plate must be mounted in each housing containing operating equipment and controls for product handling. These instruments must include a diagram of the tank and its piping system with its various gages, control valves, and safety relief devices clearly identified and located.

§ 179.400–24 Stamping.

(a) To certify that the tank complies with all specifications requirements, each tank must be plainly and permanently stamped in letters and figures at least three-eighth inch high into the metal near the center of the head of the outer shell at the "B" end of the car as follows:

	Example of required stamping
Specification	Dot–113A60W.
Minimum loading temperature.	Minus 423° F.
Inner container	Inner container.
Material	ASTM A–240–304.
Shell thickness	Shell 3/16 inch.
Head thickness	Head 3/16 inch.
Inside diameter	ID 107 inches.
Tank builder's initials	ABC.
Date of original test and initials of party conducting original test.	00–0000GHK.
Water capacity	00000 lbs.
Outer shell	Outer shell.
Car assembler (if other than tank builder).	DEF.
Material	ASTM A515–70
Tank builder's initials	XYZ.

(b) Any marking, stenciling, or stamping on the shell or heads of the inner container is prohibited.

(c) In place of the stamping required by paragraph (a) of this section, the specified markings may be incorporated on a data plate of corrosion-resistant metal fillet welded in place on the head of the outer shell at the "B" end of the car.

§ 179.400–25 Stenciling.

(a) The outer shell of the tank must be stenciled in compliance with the requirements of AAR Specifications for Tank Cars, appendix C.

(1) The date on which the frangible disc was replaced and the initials of the party making the replacement must be stenciled on the outer shell in letters and figures 1 inch high.

(2) The name of the commodity, followed by the word "ONLY" must be indicated by stenciling in letters 1½ inches high on the outer shell immediately adjacent to the housing containing the control valves.

(3) The minimum loading temperature and maximum lading weight must be stenciled in letters at least 1½ inches high adjacent to the commodity name stencil.

(4) Water capacity stencil is required.

(b) If an evacuated insulation system is required in order to meet the heat transfer requirements, the outer shell must be stenciled "VACUUM JACKETED" in letters 1½ inches high below the car classification.

§ 179.400–26 Certificate of construction.

(a) See § 179.5

(D) Section 179.401 would be amended to read as follows:

§ 179.401 Individual specification requirements.

(a) In addition to § 179.400 the individual specification requirements for the inner container and its appurtenances are as follows:

DOT Specification	113A60W	113A175W	113C120W	113D120W
Lading temperature (minimum F)	−423	−423	−260	−155
Material (see § 179.400–7(a))	179.401–3	179.401–3	179–401–3	179–401–4
Impact tests (welds and plate material [1])	Required	Required	Not required	[4] Required
Impact test valves	179.401–3(a)(1)	179.401–3(a)(1)	Not required	179.401–4(a)(1)
Maximum heat transfer (B.t.u. per day per lb. of water capacity max.) (see § 179.400–4(a))	179.402–1(a)	179.402–1(a)	[2] 0.4121	[3] 0.3641
Bursting pressure p.s.i.	240	440	300	300
Minimum plate thickness inches:				
Shell (see § 179.400–6(a))	3/16	5/16	3/16	3/16
Heads (see § 179.400–6(a), (b), and (c))	3/16	5/16	3/16	3/16
Test pressure p.s.i. (see § 179.400–22(a))	60	175	120	120
Safety vent bursting pressure (max. p.s.i.)	60	175	120	120
Valve start-to-discharge pressure p.s.i. (+3 p.s.i.)	30	115	75	75
Valve vapor tight pressure (minimum p.s.i.)	24	95	60	60
Valve flow rating pressure (maximum p.s.i.)	40	125	85	85
Pressure control device Start-to-vent (max. p.s.i.)	17	17	Not required	Not required
Relief device discharge restrictions (see § 179.400–18)	179.402–1(b)	179.402–1(b)		
Transfer line insulation (see § 179.400–16(a)(1))	179.401–2	179.401–2	179.401–2	179.401–2
	179.401–5	179.401–5	Not required	Not required

[1] Impact tests for test plate welds and plate material used for inner container and appurtenances must be in accordance with AAR Specifications for Tank Cars, Appendix W, W9.00.
[2] Determined for liquid methane at a maximum shipping pressure of 10 p.s.i.g. and a start-to-discharge pressure of 75 p.s.i.g.
[3] Determined for liquid ethylene at a maximum shipping pressure of 25 p.s.i.g. and a start-to-discharge pressure of 75 p.s.i.g.
[4] See § 179.401–4.

§ 179.401–2 Safety relief device discharge restrictions.

The discharge from all main safety relief devices and the vapor-phase blowdown line must discharge to the outside of the protective housing and must be directed upward and away from operating personnel. This provision does not apply to small safety relief valves installed to protect isolated sections of lines between the final valve and end closure.

§ 179.401–3 Material.

(a) High-alloy steel plate used for the inner container and its appurtenances must be Type 304 or 304L, as specified in AAR Specifications for Tank Cars, appendix M, M3.03(a). The plate must be in the annealed condition prior to fabricating, forming, and fusion welding.

(1) Impact tests of plate material must be longitudinal specimens. Impact test specimens from test plate welds and from plate material used for inner container and appurtenances must have impact test values not less than those specified in AAR Specifications for Tank Cars, appendix W, W9.01, at the minimum lading temperature.

(b) Nickel-alloy steel plate used for the inner container and appurtenances must be 9 percent nickel steel as specified in AAR Specifications for Tank Cars, appendix M, M3.05. The plate material must be either quenched and tempered or double normalized and tempered prior to fabricating, forming, and welding, except parts, including heads, that are heated for forming must be heat treated after forming in accordance with the procedure established in ASTM Specification A353–70 or A553–70. If the hot forming of double normalized and tempered material is performed after heating to a uniform temperature within the range of 1650° to 1750° F., the first normalize from 1650° F. may be omitted.

(1) Impact tests must be conducted at minus 175° F. for specification DOT–113D tank cars. Impact test specimens from plate material used for inner container and appurtenances must be transverse specimens and must meet the requirements shown in the following table. Impact test specimens from test plate welds must also meet the requirements shown in the following table. All impact tests must be made in accordance with W9.01 of appendix W of the AAR Specifications for Tank Cars. The report of impact test results required in W9.01(f) must include the lateral expansion data.

Size of specimen mm	Minimum impact value required for average of each set of 3 specimens (ft.-lb.) at minus 175° F.	Minimum impact value permitted on 1 specimen only of each set of 3 specimens (ft.-lb.) at minus 175° F.
10 x 10	35	20
10 x 7.5	30	17
10 x 6.6	28	15
10 x 5	24	14
10 x 2.5	12	6

NOTE: For all specimen sizes, the lateral expansion opposite the notch must be at least 0.015 inch (15 mils). If the value of lateral expansion for one specimen is below 0.015 inch, but not below 0.010 inch, and if the average value for the three specimens is not less than 0.015 inch, a retest of three additional specimens may be made, each of which must equal or exceed the specified minimum value of 0.015 inch. If the required values are not obtained upon retest, or if the values on the initial test are below the minimum required for retest, the plate may be reheat treated. After reheat treatment, a set of three specimens must be made, each of which must equal or exceed the specified minimum value of 0.015 inch.

(c) In place of nickel-alloy steel plate, high-alloy steel plate in compliance with paragraph (a) of this section may be used. When high-alloy steel plate is used in place of nickel-alloy steel plate, impact tests for specification DOT–113D tanks are not required.

(1) High-alloy steel plate may not be used to form a part of an inner container otherwise fabricated from nickel-alloy steel plate.

§ 179.401–4 Transfer line insulation.

(a) The loading and unloading line specified in § 179.400–16(a)(1) must be vacuum jacketed between the outer shell and the shutoff valve. The shutoff valve must be vacuum jacketed.

(E) Section 179.402 would be added to read as follows:

§ 179.402 Special commodity requirements for low-temperature tank car tanks.

(a) In addition to §§ 179.400 and 179.401 the following requirements are applicable:

§ 179.402–1 Hydrogen, liquefied.

(a) Tank cars used to transport liquefied hydrogen must have an insulation system such that the total heat transfer from the atmosphere at 90° F. to hydrogen at atmospheric pressure will not vaporize more than 5.2 pounds of liquified hydrogen per hour (1,000 standard cubic feet per hour) when the car is stationary.

(b) Tank cars used to transport liquefied hydrogen must have inner container equipped with an approved device to prevent the discharge of a mixture exceeding 50 percent of the lower flammable limit to the atmosphere under normal conditions of storage and transport. This device must be set to start-to-discharge at a pressure not greater

than 17 p.s.i. and must have sufficient capacity to limit the pressure within the inner container to 17 p.s.i. when the discharge is equal to twice the normal venting rate during transportation with normal vacuum and the outer shell at 130° F.

Interested persons are invited to give their views on this proposal. Communications should identify the docket number and be submitted in duplicate to the Secretary, Hazardous Materials Regulations Board, Department of Transportation, 400 Sixth Street SW., Washington, DC 20590. Communications received on or before January 18, 1972, will be considered before final action is taken on the proposal. All comments received will be available for examination by interested persons at the Office of the Secretary, Hazardous Materials Regulations Board, both before and after the closing date for comments.

This proposal is made under the authority of sections 831–835 of Title 18, United States Code, and section 9 of the Department of Transportation Act (49 U.S.C. 1657).

Issued in Washington, D.C., on October 8, 1971.

MAC E. ROGERS,
Board Member, for the
Federal Railroad Administration.

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