quantity of lading in DOT 105A500W tank cars is 49,895 kg (110,000 pounds).

(f) Tank shell and head thickness for cargo tank motor vehicles and portable tanks must be at least 9.5 mm (0.375 inch) excluding lead lining.

(g) Except as provided in §173.244(a)(3), tank cars built on or after March 16, 2009 and used for the transportation of bromine must meet the applicable authorized tank car specification listed in the table in §173.244(a)(2).

[Amdt. 173–224, 55 FR 52663, Dec. 21, 1990, as amended at 56 FR 66275, Dec. 20, 1991; 68 FR 75745, Dec. 31, 2003; 69 FR 76174, Dec. 20, 2004; 74 FR 1800, Jan. 13, 2009; 75 FR 5395, Feb. 2, 2010]

Subpart G—Gases; Preparation and Packaging

§173.300 [Reserved]

§173.301 General requirements for shipment of compressed gases and other hazardous materials in cylinders, UN pressure receptacles and spherical pressure vessels.

(a) *General qualifications for use of cylinders.* Unless otherwise stated, as used in this section, the term ''cylinder'' includes a UN pressure receptacle. As used in this subpart, filled or charged means an introduction or presence of a hazardous material in a cylinder. A cylinder filled with a Class 2 hazardous material (gas) and offered for transportation must meet the requirements in this section and §§173.301a through 173.305, as applicable.

(1) Compressed gases must be in UN pressure receptacles built in accordance with the UN standards or in metal cylinders and containers built in accordance with the DOT and ICC specifications and part 178 of this subchapter in effect at the time of manufacture, and requalified and marked as prescribed in subpart C in part 180 of this subchapter, if applicable. The DOT and ICC specifications authorized for use are as follows:

Packagings
2P
2Q
ICC–3[1]
3A
3AA
3AL
3AX
3A480X
3AAX
3B
3BN
3E
3HT
3T
4AA480
4B
4B240ET
4BA
4BW
4D
4DA
4DS
4E
4L
8
8AL
39

(2) A cylinder must be filled in accordance with this part. Before each filling of a cylinder, the person filling the cylinder must visually inspect the outside of the cylinder. A cylinder that has a crack or leak, is bulged, has a defective valve or a leaking or defective pressure relief device, or bears evidence of physical abuse, fire or heat damage, or detrimental rusting or corrosion, may not be filled and offered for transportation. A cylinder may be repaired and requalified only as prescribed in subpart C of part 180 of this subchapter.

(3) Pressure relief devices must be tested for leaks before a filled cylinder is shipped from the cylinder filling plant. It is expressly forbidden to repair a leaking fusible plug device where the leak is through the fusible metal or between the fusible metal and the opening in the plug body, except by removal and replacement of the pressure relief device.

(4) A cylinder that previously contained a Class 8 material must be requalified in accordance with §180.205(e) of this subchapter.

(5) When a cylinder with a marked pressure limit is prescribed, another cylinder made under the same specification but with a higher marked pressure limit is authorized. For example, a

[1] Use of existing cylinders is authorized. New construction is not authorized.

cylinder marked ''DOT-4B500'' may be used when ''DOT-4B300'' is specified.

(6) No person may fill a cylinder overdue for periodic requalification with a hazardous material and then offer it for transportation. The prohibition against offering a cylinder for transportation that is overdue for periodic requalification does not apply to a cylinder filled prior to the requalification due date.

(7) A cylinder with an authorized service life may not be offered for transportation in commerce after its authorized service life has expired. However, a cylinder in transportation or a cylinder filled prior to the expiration of its authorized service life may be transported for reprocessing or disposal of the cylinder's contents. After emptying, the cylinder must be condemned in accordance with §180.205 of this subchapter.

(8) The pressure of the hazardous material at 55 °C (131 °F) may not exceed 5/4 of the service pressure of the cylinder. Sufficient outage must be provided so the cylinder will not be liquid full at 55 °C (131 °F).

(9) Specification 2P, 2Q, 3E, 3HT, spherical 4BA, 4D, 4DA, 4DS, and 39 cylinders must be packed in strong non-bulk outer packagings. The outside of the combination packaging must be marked with an indication that the inner packagings conform to the prescribed specifications.

(10) Any person who installs a valve into an aluminum cylinder in oxygen service must verify the valve and the cylinder have the same thread type.

(b) *Cylinder markings.* Required markings on a cylinder must be legible and must meet the applicable requirements of subpart C of part 180 of this subchapter. Additional information may be marked on the cylinder provided it does not affect the required markings prescribed in the applicable cylinder specification.

(c) *Toxic gases and mixtures.* Cylinders containing toxic gases and toxic gas mixtures meeting the criteria of Division 2.3 Hazard Zone A or B must conform to the requirements of §173.40 and CGA S–1.1 (compliance with paragraph 9.1.1.1 is not required) (IBR; see §171.7 of this subchapter) and CGA S–7 (IBR; see §171.7 of this subchapter). A DOT 39 cylinder, UN non-refillable cylinder, or a UN composite cylinder certified to ISO–11119–3 may not be used for a toxic gas or toxic gas mixture meeting the criteria for Division 2.3, Hazard Zone A or B.

(d) *Gases capable of combining chemically.* A filled cylinder may not contain any gas or material capable of combining chemically with the cylinder's contents or with the cylinder's material of construction, so as to endanger the cylinder's serviceability.

(e) *Ownership of cylinder.* A cylinder filled with a hazardous material may not be offered for transportation unless it was filled by the owner of the cylinder or with the owner's consent.

(f) *Pressure relief device systems.* (1) Except as provided in paragraphs (f)(5), (f)(6), and (l)(2) of this section, a cylinder filled with a gas and offered for transportation must be equipped with one or more pressure relief devices sized and selected as to type, location, and quantity, and tested in accordance with CGA S–1.1 (compliance with paragraph 9.1.1.1 is not required) and CGA S–7. The pressure relief device must be capable of preventing rupture of the normally filled cylinder when subjected to a fire test conducted in accordance with CGA C–14 (IBR, see §171.7 of this subchapter), or, in the case of an acetylene cylinder, CGA C–12 (IBR, see §171.7 of this subchapter).

(2) After December 31, 2003, a pressure relief device, when installed, must be in communication with the vapor space of a cylinder containing a Division 2.1 (flammable gas) material.

(3) For a specification 3, 3A, 3AA, 3AL, 3AX, 3AXX, 3B, 3BN, or 3T cylinder filled with gases in other than Division 2.2 (except oxygen and oxidizing gases transported by aircraft, see §§173.302(f) and 173.304(f)), beginning with the first requalification due after December 31, 2003, the burst pressure of a CG–1, CG–4, or CG–5 pressure relief device must be at test pressure with a tolerance of plus zero to minus 10%. An additional 5% tolerance is allowed when a combined rupture disk is placed inside a holder. This requirement does not apply if a CG–2, CG–3, or CG–9 thermally activated relief device or a CG–7 reclosing pressure valve is used on the cylinder.

(4) A pressure relief device is required on a DOT 39 cylinder regardless of cylinder size or filled pressure. A DOT 39 cylinder used for liquefied Division 2.1 materials must be equipped with a metal pressure relief device. Fusible pressure relief devices are not authorized on a DOT 39 cylinder containing a liquefied gas.

(5) A pressure relief device is not required on—

(i) A cylinder 305 mm (12 inches) or less in length, exclusive of neck, and 114 mm (4.5 inches) or less in outside diameter, except when the cylinder is filled with a liquefied gas for which this part requires a service pressure of 1800 psig or higher or a nonliquefied gas to a pressure of 1800 psig or higher at 21 °C (70 °F);

(ii) A cylinder with a water capacity of less than 454 kg (1000 lbs) filled with a nonliquefied gas to a pressure of 300 psig or less at 21 °C (70 °F), except for a DOT 39 cylinder or a cylinder used for acetylene in solution; or

(iii) A cylinder containing a Class 3 or a Class 8 material without pressurization, unless otherwise specified for the hazardous material.

(6) A pressure relief device is prohibited on a cylinder filled with a Division 2.3 or 6.1 material in Hazard Zone A.

(iv) A UN pressure receptacle transported in accordance with paragraph (k) or (l) or this section.

(g) *Manifolding cylinders in transportation.* (1) Cylinder manifolding is authorized only under conditions prescribed in this paragraph (g). Manifolded cylinders must be supported and held together as a unit by structurally adequate means. Except for Division 2.2 materials, each cylinder must be equipped with an individual shutoff valve that must be tightly closed while in transit. Manifold branch lines must be sufficiently flexible to prevent damage to the valves that otherwise might result from the use of rigid branch lines. Each cylinder must be individually equipped with a pressure relief device as required in paragraph (f) of this section, except that pressure relief devices on manifolded horizontal cylinders that are mounted on a motor vehicle or framework may be selected as to type, location, and quantity according to the lowest marked pressure limit of an individual cylinder in the manifolded unit. The pressure relief devices selected for the manifolded unit must have been tested in accordance with CGA S–1.1 and CGA S–7. Pressure relief devices on manifolded horizontal cylinders filled with a compressed gas must be arranged to discharge unobstructed to the open air. In addition, for Division 2.1 (flammable gas) material, the pressure relief devices (PRDs) must be arranged to discharge upward to prevent any escaping gas from contacting personnel or any adjacent cylinders. Valves and pressure relief devices on manifolded cylinders filled with a compressed gas must be protected from damage by framing, a cabinet or other method. Manifolding is authorized for cylinders containing the following gases:

(i) Nonliquefied (permanent) compressed gases authorized by § 173.302.

(ii) Liquefied compressed gases authorized by § 173.304. Each manifolded cylinder containing a liquefied compressed gas must be separately filled and means must be provided to ensure no interchange of cylinder contents can occur during transportation.

(iii) Acetylene as authorized by § 173.303.

(2) For the checking of tare weights or replacing solvent, the cylinder must be removed from the manifold. This requirement is not intended to prohibit filling acetylene cylinders while manifolded.

(h) *Cylinder valve protection.* UN pressure receptacles must meet the valve protection requirements in § 173.301b(c). A DOT specification cylinder used to transport a hazardous material must meet the requirements specified in this paragraph (h).

(1) The following specification cylinders are not subject to the cylinder valve protection requirements in this paragraph (h):

(i) A cylinder containing only a Division 2.2 material without a Division 5.1 subsidiary hazard;

(ii) A cylinder containing a Class 8 liquid corrosive only to metal;

(iii) A cylinder with a water capacity of 4.8 liters (293 in^3) or less containing oxygen, compressed;

(iv) A cylinder containing oxygen, refrigerated liquid (cryogenic liquid);

(v) A Medical E cylinder with a water capacity of 4.9 liters (300 in^3) or less;

(vi) A fire extinguisher; or

(vii) A ''B'' style cylinder with a capacity of 40 ft^3 (1.13 m^3) or an ''MC'' style cylinder with a capacity of 10 ft^3 (0.28m^3) containing acetylene.

(2) For cylinders manufactured before October 1, 2007, a cylinder must have its valves protected by one of the following methods:

(i) By equipping the cylinder with securely attached metal caps of sufficient strength to protect valves from damage during transportation;

(ii) By boxing or crating the cylinders so as to protect valves from damage during transportation;

(iii) By constructing the cylinder so that the valve is recessed into the cylinder or otherwise protected to the extent that it will not be subjected to a blow when the container is dropped onto a flat surface; or

(iv) By loading the cylinders in an upright position and securely bracing the cylinders in rail cars or motor vehicles, when loaded by the consignor and unloaded by the consignee.

(3) For cylinders manufactured on or after October 1, 2007, each cylinder valve assembly must be of sufficient strength or protected such that no leakage occurs when a cylinder with the valve installed is dropped 1.8 m (6 ft.) or more onto a non-yielding surface, such as concrete or steel, impacting the valve assembly or protection device at an orientation most likely to cause damage. The cylinder valve assembly protection may be provided by any method meeting the performance requirement in this paragraph (h)(3). Examples include:

(i) Equipping the cylinder with a securely attached metal cap.

(ii) Packaging the cylinder in a box, crate, or other strong outer packaging conforming to the requirements of §173.25.

(iii) Constructing the cylinder such that the valve is recessed into the cylinder or otherwise protected.

(i) *Cylinders mounted in motor vehicles or in frames.* (1) MEGCs must conform to the requirements in §173.312. DOT specification cylinders mounted on motor vehicles or in frames must conform to the requirements specified in this paragraph (i).

(2) Seamless DOT specification cylinders longer than 2 m (6.5 feet) are authorized for transportation only when horizontally mounted on a motor vehicle or in an ISO framework or other framework of equivalent structural integrity in accordance with CGA TB–25 (IBR, see §171.7 of this subchapter). The pressure relief device must be arranged to discharge unobstructed to the open air. In addition, for Division 2.1 (flammable gas) material, the pressure relief devices must be arranged to discharge upward to prevent any escaping gas from contacting personnel or any adjacent cylinders.

(3) Cylinders may not be transported by rail in container on freight car (COFC) or trailer on flat car (TOFC) service except under conditions approved by the Associate Administrator for Safety, Federal Railroad Administration.

(j) *Non-specification cylinders in domestic use.* Except as provided in §§171.12(a) and 173.23(g) of this subchapter, a filled cylinder manufactured to other than a DOT specification or a UN standard in accordance with part 178 of this subchapter, or a DOT exemption or special permit cylinder or a cylinder used as a fire extinguisher in conformance with §173.309(a), may not be transported to, from, or within the United States.

(k) *Metal attachments.* Metal attachments to cylinders must have rounded or chamfered corners, or be otherwise protected, so as to prevent the likelihood of causing puncture or damage to other hazardous materials packages. This requirement applies to anything temporarily or permanently attached to the cylinder, such as metal skids.

(o) *Cylinders made of aluminum alloy 6351–T6.* A DOT 3AL cylinder manufactured of aluminum alloy 6351–T6 may not be filled and offered for transportation or transported with pyrophoric gases. The use of UN cylinders manufactured of aluminum alloy 6351–T6 is prohibited.

[67 FR 51643, Aug. 8, 2002]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting §173.301, see the List of CFR Sections Affected, which appears in the

Finding Aids section of the printed volume and on GPO Access.

§ 173.301a Additional general requirements for shipment of specification cylinders.

(a) *General.* The requirements in this section are in addition to the requirements in § 173.301 and apply to the shipment of gases in specification cylinders.

(b) *Authorized cylinders not marked with a service pressure.* For authorized cylinders not marked with a service pressure, the service pressure is designated as follows:

Specification marking	Service Pressure psig
3	1800
3E	1800
8	250

(c) *Cylinder pressure at 21 °C (70 °F).* The pressure in a cylinder at 21 °C (70 °F) may not exceed the service pressure for which the cylinder is marked or designated, except as provided in § 173.302a(b). For certain liquefied gases, the pressure at 21 °C (70 °F) must be lower than the marked service pressure to avoid having a pressure at a temperature of 55 °C (131 °F) that is greater than permitted.

(d) *Cylinder pressure at 55 °C (131 °F).* The pressure in a cylinder at 55 °C (131 °F) may not exceed 5/4 times the service pressure, except:

(1) For a cylinder filled with acetylene, liquefied nitrous oxide, or carbon dioxide.

(2) For a cylinder filled in accordance with § 173.302a(b), the pressure in the cylinder at 55 °C (131 °F) may not exceed 5/4 times the filling pressure.

(3) The pressure at 55 °C (131 °F) of Hazard Zone A and, after December 31, 2003, Hazard Zone B materials, may not exceed the service pressure of the cylinder. Sufficient outage must be provided so that the cylinder will not be liquid full at 55 °C (131 °F).

(e) *Grandfather clause.* A cylinder in domestic use prior to the date on which the specification for the cylinder was first made effective may be used if the cylinder has been properly tested and otherwise conforms to the requirements applicable to the gas with which it is charged.

[67 FR 51645, Aug. 8, 2002, as amended at 67 FR 61289, Sept. 30, 2002; 68 FR 24661, May 8, 2003]

§ 173.301b Additional general requirements for shipment of UN pressure receptacles.

(a) *General.* The requirements of this section are in addition to the requirements in § 173.301 and apply to the shipment of gases in UN pressure receptacles. A UN pressure receptacle, including closures, must conform to the design, construction, inspection and testing requirements specified in parts 178 and 180 of this subchapter, as applicable. Bundles of cylinders must conform to the requirements in § 178.70(e) of this subchapter.

(1) A UN pressure receptacle may not be filled and offered for transportation when damaged to such an extent that the integrity of the UN pressure receptacle or its service equipment may be affected. Prior to filling, the service equipment must be examined and found to be in good working condition (see § 178.70(d) of this subchapter). In addition, the required markings must be legible on the pressure receptacle.

(2) The gases or gas mixtures must be compatible with the UN pressure receptacle and valve materials as prescribed for metallic materials in ISO 11114–1 (IBR, see § 171.7 of this subchapter) and for non-metallic materials in ISO 11114–2 (IBR, see § 171.7 of this subchapter).

(3) A refillable UN pressure receptacle may not be filled with a gas or gas mixture different from that previously contained in the UN pressure receptacle unless the necessary operations for change of gas service have been performed in accordance with ISO 11621 (IBR, see § 171.7 of this subchapter).

(4) When a strong outer packaging is prescribed, for example as provided by paragraph (c)(2)(vi) or (d)(1) of this section, the UN pressure receptacles must be protected to prevent movement. Unless otherwise specified in this part, more than one UN pressure receptacle may be enclosed in the strong outer packaging.

(b) *Individual shut-off valves and pressure relief devices.* Except for Division 2.2 permanent gases, each UN pressure receptacle must be equipped with an individual shutoff valve that must be tightly closed while in transit. Each UN pressure receptacle must be individually equipped with a pressure relief device as prescribed by §173.301(f), except that pressure relief devices on bundles of cylinders or manifolded horizontal cylinders must have a set-to-discharge pressure that is based on the lowest marked pressure of any cylinder in the bundle or manifolded unit.

(c) *Pressure receptacle valve requirements.* (1) When the use of a valve is prescribed, the valve must conform to the requirements in ISO 10297 (IBR, see §171.7 of this subchapter).

(2) A UN pressure receptacle must have its valves protected from damage that could cause inadvertent release of the contents of the UN pressure receptacle by one of the following methods:

(i) By constructing the pressure receptacle so that the valves are recessed inside the neck of the UN pressure receptacle and protected by a threaded plug or cap;

(ii) By equipping the UN pressure receptacle with a valve cap conforming to the requirements in ISO 11117 (IBR, see §171.7 of this subchapter). The cap must have vent-holes of sufficient cross-sectional area to evacuate the gas if leakage occurs at the valve;

(iii) By protecting the valves by shrouds or guards conforming to the requirements in ISO 11117;

(iv) By using valves designed and constructed with sufficient inherent strength to withstand damage in accordance with Annex B of ISO 10297;

(v) By enclosing the UN pressure receptacles in frames, e.g., bundles of cylinders; or

(vi) By packing the UN pressure receptacles in a strong outer package, such as a box or crate, capable of meeting the drop test specified in §178.603 of this subchapter at the Packing Group I performance level.

(d) *Non-refillable UN pressure receptacles.* Non-refillable UN pressure receptacles must conform to the following requirements:

(1) The receptacles must be transported as an inner package of a combination package;

(2) The receptacle must have a water capacity not exceeding 1.25 L when used for a flammable or toxic gas; and

(3) The receptacle is prohibited for Hazard Zone A material.

(e) *Pyrophoric gases.* A UN pressure receptacle must have valves equipped with gas-tight plugs or caps when used for pyrophoric or flammable mixtures of gases containing more than 1% pyrophoric compounds.

(f) *Hydrogen bearing gases.* A steel UN pressure receptacle bearing an ''H'' mark must be used for hydrogen bearing gases or other embrittling gases that have the potential of causing hydrogen embrittlement.

(g) *Composite cylinders in underwater use.* A composite cylinder certified to ISO–11119–2 or ISO–11119–3 may not be used for underwater applications unless the cylinder is manufactured in accordance with the requirements for underwater use and is marked ''UW'' as prescribed in §178.71(o)(17) of this subchapter.

[71 FR 33882, June 12, 2006, as amended at 71 FR 54395, Sept. 14, 2006]

§173.302 Filling of cylinders with non-liquefied (permanent) compressed gases.

(a) *General requirements.* A cylinder filled with a non-liquefied compressed gas (except gas in solution) must be offered for transportation in accordance with the requirements of this section and §173.301. In addition, a DOT specification cylinder must meet the requirements in §§173.301a, 173.302a and 173.305, as applicable. UN pressure receptacles must meet the requirements in §§173.301b and 173.302b, as applicable. Where more than one section applies to a cylinder, the most restrictive requirements must be followed.

(b) *Aluminum cylinders in oxygen service.* Each aluminum cylinder filled with oxygen must meet all of the following conditions:

(1) Metallic portions of a valve that may come into contact with the oxygen in the cylinder must be constructed of brass or stainless steel.

(2) Except for UN cylinders, each cylinder opening must be configured with straight threads only.

(3) Each UN pressure receptacle must be cleaned in accordance with the requirements of ISO 11621 (IBR, see §171.7 or this subchapter). Each DOT cylinder must be cleaned in accordance with the requirements of GSA Federal Specification RR–C–901D, paragraphs 3.3.1 and 3.3.2 (IBR, see §171.7 of this subchapter). Cleaning agents equivalent to those specified in Federal Specification RR–C–901D may be used provided they do not react with oxygen. One cylinder selected at random from a group of 200 or fewer and cleaned at the same time must be tested for oil contamination in accordance with Federal Specification RR–C–901D, paragraph 4.3.2, and meet the specified standard of cleanliness.

(4) The pressure in each cylinder may not exceed 3000 psig at 21 °C (70 °F).

(c) Notwithstanding the provisions of §§173.24(b)(1) and paragraph (f) of this section, an authorized cylinder containing oxygen continuously fed to tanks containing live fish may be offered for transportation and transported.

(d) Shipment of Division 2.1 materials in aluminum cylinders is authorized for transportation only by motor vehicle, rail car, or cargo-only aircraft.

(e) *DOT 3AL cylinders manufactured of 6351–T6 aluminum alloy.* Suitable safeguards should be provided to protect personnel and facilities should failure occur while filling cylinders manufactured of aluminum alloy 6351–T6 used in self-contained underwater breathing apparatus (SCUBA), self-contained breathing apparatus (SCBA) or oxygen service. The cylinder filler should allow only those individuals essential to the filling process to be in the vicinity of the cylinder during the filling process.

(f) *Compressed oxygen and oxidizing gases by aircraft.* A cylinder containing oxygen, compressed; compressed gas, oxidizing, n.o.s.; or nitrogen trifluoride is authorized for transportation by aircraft only when it meets the following requirements:

(1) Only DOT specification 3A, 3AA, 3AL, 3E, 3HT, and 39 cylinders, and UN pressure receptacles ISO 9809–1, ISO 9809–2, ISO 9809–3 and ISO 7866 cylinders are authorized.

(2) Cylinders must be equipped with a pressure relief device in accordance with §173.301(f) and, for DOT 39 cylinders offered for transportation after October 1, 2008, for the other DOT specification cylinders with the first requalification due after October 1, 2008, or for the UN pressure receptacles prior to initial use:

(i) The rated burst pressure of a rupture disc for DOT 3A, 3AA, 3AL, 3E, and 39 cylinders, and UN pressure receptacles ISO 9809–1, ISO 9809–2, ISO 9809–3 and ISO 7866 cylinders must be 100% of the cylinder minimum test pressure with a tolerance of plus zero to minus 10%; and

(ii) The rated burst pressure of a rupture disc for a DOT 3HT cylinder must be 90% of the cylinder minimum test pressure with a tolerance of plus zero to minus 10%.

(3) The cylinder must be placed in a rigid outer packaging that—

(i) Conforms to the requirements of either part 178, subparts L and M of this subchapter at the Packing Group I or II performance level or the performance criteria in Air Transport Association (ATA) Specification No. 300 for a Category I Shipping Container;

(ii) After September 30, 2009, is capable of passing, as demonstrated by design testing, the Flame Penetration Resistance Test in Appendix E to part 178 of this subchapter; and

(iii) Prior to each shipment, passes a visual inspection that verifies that all features of the packaging are in good condition, including all latches, hinges, seams, and other features, and that the packaging is free from perforations, cracks, dents, or other abrasions that may negatively affect the flame penetration resistance and thermal resistance characteristics of the packaging.

(4) After September 30, 2009, the cylinder and the outer packaging must be capable of passing, as demonstrated by design testing, the Thermal Resistance Test specified in Appendix D to part 178 of this subchapter.

(5) The cylinder and the outer packaging must both be marked and labeled in accordance with part 172, subparts D and E of this subchapter. The additional marking ''DOT31FP,'' is allowed

to indicate that the cylinder and the outer packaging are capable of passing, as demonstrated by design testing, the Thermal Resistance Test specified in Appendix D to part 178 of this subchapter.

(6) A cylinder of compressed oxygen that has been furnished by an aircraft operator to a passenger in accordance with 14 CFR §§121.574, 125.219, or 135.91 is excepted from the outer packaging requirements of paragraph (f)(3) of this section.

[67 FR 51646, Aug. 8, 2002, as amended at 67 FR 61289, Sept. 30, 2002; 68 FR 75745, Dec. 31, 2003; 71 FR 33883; June 12, 2006; 71 FR 51127, Aug. 29, 2006; 72 FR 55098, Sept. 28, 2007]

§173.302a Additional requirements for shipment of nonliquefied (permanent) compressed gases in specification cylinders.

(a) *Detailed filling requirements.* Nonliquefied compressed gases (except gas in solution) for which filling requirements are not specifically prescribed in §173.304a must be shipped subject to the requirements in this section and §§173.301, 173.301a, 173.302, and 173.305 in specification cylinders, as follows:

(1) DOT 3, 3A, 3AA, 3AL, 3B, 3E, 4B, 4BA and 4BW cylinders.

(2) DOT 3HT cylinders. These cylinders are authorized for aircraft use only and only for nonflammable gases. They have a maximum service life of 24 years from the date of manufacture. The cylinders must be equipped with frangible disc type pressure relief devices that meet the requirements of §173.301(f). Each frangible disc must have a rated bursting pressure not exceeding 90 percent of the minimum required test pressure of the cylinder. Discs with fusible metal backing are not permitted. Specification 3HT cylinders may be offered for transportation only when packaged in accordance with §173.301(a)(9).

(3) *DOT 39 cylinders.* When the cylinder is filled with a Division 2.1 material, the internal volume of the cylinder may not exceed 1.23 L (75 in^3).

(4) DOT 3AX, 3AAX, and 3T cylinders are authorized for Division 2.1 and 2.2 materials and for carbon monoxide. DOT 3T cylinders are not authorized for hydrogen. When used in methane service, the methane must be a nonliquefied gas with a minimum purity of 98.0 percent methane and commercially free of corroding components.

(5) Aluminum cylinders manufactured in conformance with specifications DOT 39 and 3AL are authorized for oxygen only under the conditions specified in §173.302(b).

(b) *Special filling limits for DOT 3A, 3AX, 3AA, 3AAX, and 3T cylinders.* A DOT 3A, 3AX, 3AA, 3AAX, and 3T cylinder may be filled with a compressed gas, other than a liquefied, dissolved, Division 2.1, or Division 2.3 gas, to a pressure 10 percent in excess of its marked service pressure, provided:

(1) The cylinder is equipped with a frangible disc pressure relief device (without fusible metal backing) having a bursting pressure not exceeding the minimum prescribed test pressure.

(2) The cylinder's elastic expansion was determined at the time of the last test or retest by the water jacket method.

(3) Either the average wall stress or the maximum wall stress does not exceed the wall stress limitation shown in the following table:

Type of steel	Average wall stress limitation	Maximum wall stress limitation
I. Plain carbon steels over 0.35 carbon and medium manganese steels	53,000	58,000
II. Steels of analysis and heat treatment specified in spec. 3AA	67,000	73,000
III. Steels of analysis and heat treatment specified in spec. DOT-3T	87,000	94,000
IV. Plain carbon steels less than 0.35 carbon made prior to 1920	45,000	48,000

(i)(A) The average wall stress must be computed from the elastic expansion data using the following formula:

$$S = 1.7EE / KV - 0.4P$$

Where:

S = wall stress, pounds per square inch;
EE = elastic expansion (total less permanent) in cubic centimeters;
K = factor $\times 10^{-7}$ experimentally determined for the particular type of cylinder being tested or derived in accordance with CGA C–5 (IBR, see §171.7 of this subchapter);
V = internal volume in cubic centimeter (1 cubic inch = 16.387 cubic centimeters);
P = test pressure, pounds per square inch.

(B) The formula in paragraph (b)(3)(i)(A) of this section is derived

from the formula in paragraph (b)(3)(ii) of this section and the following:

$EE = (PKVD^2) / (D^2 - d^2)$

(ii) The maximum wall stress must be computed from the formula:

$S = (P(1.3D^2 + 0.4d^2)) / (D^2 - d^2)$

Where:

S = wall stress, pounds per square inch;
P = test pressure, pounds per square inch;
D = outside diameter, inches;
d = D–2t, where t=minimum wall thickness determined by a suitable method.

(iii) Compliance with average wall stress limitation may be determined by computing the elastic expansion rejection limit in accordance with CGA C–5, by reference to data tabulated in CGA C–5, or by the manufacturer's marked elastic expansion rejection limit (REE) on the cylinder.

(4) An external and internal visual examination made at the time of test or retest shows the cylinder to be free from excessive corrosion, pitting, or dangerous defects.

(5) A plus sign (+) is added following the test date marking on the cylinder to indicate compliance with paragraphs (b) (2), (b)(3), and (b)(4) of this section.

(c) *Carbon monoxide.* Carbon monoxide must be offered in a DOT 3, 3A, 3AX, 3AA, 3AAX, 3AL, 3E, or 3T cylinder having a minimum service pressure of 1800 psig. The pressure in a steel cylinder may not exceed 1000 psig at 21 °C (70 °F), except that if the gas is dry and sulfur free, the cylinder may be filled to 5/6 of the cylinder's service pressure or 2000 psig, whichever is less. A DOT 3AL cylinder may be filled to its marked service pressure. A DOT 3AL cylinder is authorized only when transported by motor vehicle, rail car, or cargo-only aircraft.

(d) *Diborane and diborane mixtures.* Diborane and diborane mixed with compatible compressed gas must be offered in a DOT 3AL1800 or 3AA1800 cylinder. The maximum filling density of the diborane may not exceed 7 percent. Diborane mixed with compatible compressed gas may not have a pressure exceeding the service pressure of the cylinder if complete decomposition of the diborane occurs. Cylinder valve assemblies must be protected in accordance with § 173.301(h).

(e) *Fluorine.* Fluorine must be shipped in specification 3A1000, 3AA1000, or 3BN400 cylinders without pressure relief devices and equipped with valve protection cap. The cylinder may not be charged to over 400 psig at 21 °C (70 °F) and may not contain over 2.7 kg (6 lbs) of gas.

[67 FR 51646, Aug. 8, 2002, as amended at 68 FR 75745, Dec. 31, 2003; 70 FR 34075, June 13, 2005; 71 FR 54395, Sept. 14, 2006; 72 FR 4455, Jan. 31, 2007; 72 FR 55098, Sept. 28, 2007]

§ 173.302b Additional requirements for shipment of non-liquefied (permanent) compressed gases in UN pressure receptacles.

(a) *General.* A cylinder filled with a non-liquefied gas must be offered for transportation in UN pressure receptacles subject to the requirements in this section and § 173.302. In addition, the requirements in §§ 173.301 and 173.301b must be met.

(b) *UN pressure receptacles filling limits.* A UN pressure receptacle is authorized for the transportation of non-liquefied compressed gases as specified in this section. Except where filling limits are specifically prescribed in this section, the working pressure of a UN pressure receptacle may not exceed ⅔ of the test pressure of the receptacle. Alternatively, the filling limits specified for non-liquefied gases in Table 1 of P200 of the UN Recommendations (IBR, see § 171.7 of this subchapter) are authorized. In no case may the internal pressure at 65 °C (149 °F) exceed the test pressure.

(c) *Fluorine, compressed, UN 1045 and Oxygen diflouride, compressed, UN 2190.* Fluorine, compressed and Oxygen difluoride, compressed must be packaged in a UN pressure receptacle with a minimum test pressure of 200 bar and a maximum working pressure not to exceed 30 bar. A UN pressure receptacle made of aluminum alloy is not authorized. The maximum quantity of gas authorized in each UN pressure receptacle is 5 kg.

(d) *Diborane and diborane mixtures, UN 1911.* Diborane and diborane mixtures must be packaged in a UN pressure receptacle with a minimum test pressure of 250 bar and a maximum filling ratio dependent on the test pressure not to exceed 0.07. Filling should be further

limited so that if complete decomposition of diborane occurs, the pressure of diborane or diborane mixtures will not exceed the working pressure of the cylinder. The use of UN tubes and MEGCs is not authorized.

(e) *Carbon monoxide, compressed UN 1016.* Carbon monoxide, compressed is authorized in UN pressure receptacles. The settled pressure in a steel pressure receptacle containing carbon monoxide may not exceed ⅓ of the pressure receptacle's test pressure at 65 °C (149 °F) except, if the gas is dry and sulfur-free, the settled pressure may not exceed ½ of the marked test pressure.

[71 FR 33883, June 12, 2006]

§ 173.303 Charging of cylinders with compressed gas in solution (acetylene).

(a) *Cylinder, filler and solvent requirements.* (Refer to applicable parts of Specification 8 and 8AL). Acetylene gas must be shipped in Specification 8 or 8AL cylinders (§ 178.59 or § 178.60 of this subchapter). The cylinders shall consist of metal shells filled with a porous material, and this material must be charged with a suitable solvent. The cylinders containing the porous material and solvent shall be successfully tested in accordance with CGA C–12 (IBR, see § 171.7 of this subchapter). Representative samples of cylinders charged with acetylene must be successfully tested in accordance with CGA C–12.

(b) *Filling limits.* For DOT specification cylinders, the pressure in the cylinder containing acetylene gas may not exceed 250 psig at 70 °F. If cylinders are marked for a lower allowable charging pressure at 70 °F., that pressure must not be exceeded. For UN cylinders, the pressure in the cylinder may not exceed the limits specified in § 173.304b(b)(2).

(c) *Data requirements on filler and solvent.* Cylinders containing acetylene gas must not be shipped unless they were charged by or with the consent of the owner, and by a person, firm, or company having possession of complete information as to the nature of the porous filling, the kind and quantity of solvent in the cylinders, and the meaning of such markings on the cylinders as are prescribed by the Department's regulations and specifications applying to containers for the transportation of acetylene gas.

(d) *Verification of container pressure.* (1) Each day, the pressure in a container representative of that day's compression must be checked by the charging plant after the container has cooled to a settled temperature and a record of this test kept for at least 30 days.

(e) *Prefill requirements.* Before each filling of an acetylene cylinder, the person filling the cylinder must visually inspect the outside of the cylinder in accordance with the prefill requirements contained in CGA C–13, Section 3 (IBR, see § 171.7 of this subchapter).

(f) *UN cylinders.* (1) UN cylinders and bundles of cylinders are authorized for the transport of acetylene gas as specified in this section. Each UN acetylene cylinder must conform to ISO 3807–2 (IBR, see § 171.7 of this subchapter), have a homogeneous monolithic porous mass filler and be charged with acetone or a suitable solvent as specified in the standard. UN acetylene cylinders must have a minimum test pressure of 52 bar and may be filled up to the pressure limits specified in ISO 3807–2. The use of UN tubes and MEGCs is not authorized.

(2) UN cylinders equipped with pressure relief devices or that are manifolded together must be transported upright.

[29 FR 18743, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting § 173.303, see the List of CFR Sections Affected which appears in the Finding Aids section of the printed volume and on GPO Access.

§ 173.304 Filling of cylinders with liquefied compressed gases.

(a) *General requirements.* A cylinder filled with a liquefied compressed gas (except gas in solution) must be offered for transportation in accordance with the requirements of this section and the general requirements in § 173.301. In addition, a DOT specification cylinder must meet the requirement in §§ 173.301a, 173.304a, and 173.305, as applicable. UN pressure receptacles must be

shipped in accordance with the requirements in 173.301b and 173.304b, as applicable.

(1) A DOT 3AL cylinder may not be used for any material with a primary or subsidiary hazard of Class 8.

(2) Shipments of Division 2.1 materials in aluminum cylinders are authorized only when transported by motor vehicle, rail car, or cargo-only aircraft.

(b) *Filling limits.* Except for carbon dioxide; 1,1-Difluoroethylene (R–1132A); nitrous oxide; and vinyl fluoride, inhibited, the liquid portion of a liquefied gas may not completely fill the packaging at any temperature up to and including 55 °C (131 °F). The liquid portion of vinyl fluoride, inhibited, may completely fill the cylinder at 55 °C (131 °F) provided the pressure at the critical temperature does not exceed 1.25 times the service pressure of the cylinder.

(c) *Mixture of compressed gas and other material.* A mixture of compressed gas must be shipped in accordance with § 173.305.

(d) Refrigerant and dispersant gases. Nontoxic and nonflammable refrigerant or dispersant gases must be offered for transportation in cylinders prescribed in § 173.304a, or in DOT 2P and 2Q containers (§§ 178.33, 178.33a of this subchapter). DOT 2P and 2Q containers must be packaged in a strong wooden or fiberboard box of such design as to protect valves from damage or accidental functioning under conditions incident to transportation. Pressure in the inside metal containers may not exceed 87 psia at 21 °C (70 °F). Each completed metal container filled for shipment must be heated until its contents reach a minimum temperature of 55 °C (131 °F) without evidence of leakage, distortion, or other defect. Each outside package must be plainly marked ''INSIDE CONTAINERS COMPLY WITH PRESCRIBED SPECIFICATIONS''.

(e) *Engine starting fluid.* Engine starting fluid containing a flammable compressed gas or gases must be shipped in a cylinder as prescribed in § 173.304a or as follows:

(1) Inside non-refillable metal containers having a capacity not greater than 500 mL (32 in^3). The containers must be packaged in strong, tight outer packagings. The pressure in the container may not exceed 145 psia at 54 °C (130 °F). If the pressure exceeds 145 psia at 54 °C (130 °F), a DOT 2P container must be used. In either case, the metal container must be capable of withstanding, without bursting, a pressure of 1.5 times the pressure of the contents at 54 °C (130 °F). The liquid content of the material and gas may not completely fill the container at 54 °C (130 °F). Each container filled for shipment must have been heated until its contents reach a minimum temperature of 54 °C (130 °F), without evidence of leakage, distortion, or other defect. Each outside shipping container must be plainly marked, ''INSIDE CONTAINERS COMPLY WITH PRESCRIBED SPECIFICATIONS''.

(2) [Reserved]

(f) *Oxidizing gases by aircraft.* A cylinder containing carbon dioxide and oxygen mixture, compressed; liquefied gas, oxidizing, n.o.s.; or nitrous oxide is authorized for transportation by aircraft only when it meets the following requirements:

(1) Only DOT specification 3A, 3AA, 3AL, 3E, 3HT, and 39 cylinders, and UN pressure receptacles ISO 9809–1, ISO 9809–2, ISO 9809–3 and ISO 7866 cylinders are authorized.

(2) Cylinders must be equipped with a pressure relief device in accordance with § 173.301(f) and, for DOT 39 cylinders offered for transportation after October 1, 2008, for the other DOT specification cylinders with the first requalification due after October 1, 2008, or for the UN pressure receptacles prior to initial use:

(i) The rated burst pressure of a rupture disc for DOT 3A, 3AA, 3AL, 3E and 39 cylinders, and UN pressure receptacles ISO 9809–1, ISO 9809–2, ISO 9809–3 and ISO 7866 cylinders must be 100% of the cylinder minimum test pressure with a tolerance of plus zero to minus 10%; and

(ii) The rated burst pressure of a rupture disc for a DOT 3HT cylinder must be 90% of the cylinder minimum test pressure with a tolerance of plus zero to minus 10%.

(3) The cylinder must be placed in a rigid outer packaging that—

(i) Conforms to the requirements of either part 178, subparts L and M, of this subchapter at the Packing Group I or II performance level, or the performance criteria in Air Transport Association (ATA) Specification No. 300 for a Category I Shipping Container;

(ii) After September 30, 2009, is capable of passing, as demonstrated by design testing, the Flame Penetration Resistance Test specified in part III of Appendix E to part 178 of this subchapter; and

(iii) Prior to each shipment, passes a visual inspection that verifies that all features of the packaging are in good condition, including all latches, hinges, seams, and other features, and the packaging is free from perforations, cracks, dents, or other abrasions that may negatively affect the flame penetration resistance and thermal resistance characteristics of the container.

(4) After September 30, 2009, the cylinder and the outer packaging must be capable of passing, as demonstrated by design testing, the Thermal Resistance Test specified in Appendix D to part 178 of this subchapter.

(5) The cylinder and the outer packaging must both be marked and labeled in accordance with part 172, subparts D and E of this subchapter. The additional marking ''DOT31FP,'' is allowed to indicate that the cylinder and the outer packaging are capable of passing, as demonstrated by design testing, the Thermal Resistance Test specified in Appendix D to part 178 of this subchapter.

(6) A cylinder of compressed oxygen that has been furnished by an aircraft operator to a passenger in accordance with 14 CFR 121.574, 125.219, or 135.91 is excepted from the outer packaging requirements of paragraph (f)(3) of this section.

[67 FR 51647, Aug. 8, 2002, as amended at 68 FR 24661, May 8, 2003; 71 FR 33883, June 12, 2006; 72 FR 55098, Sept. 28, 2007; 74 FR 53188, Oct. 16, 2009]

§ 173.304a Additional requirements for shipment of liquefied compressed gases in specification cylinders.

(a) *Detailed filling requirements.* Liquefied gases (except gas in solution) must be offered for transportation, subject to the requirements in this section and §§ 173.301 and 173.304, in specification cylinders, as follows:

(1) DOT 3, 3A, 3AA, 3AL, 3B, 3BN, 3E, 4B, 4BA, 4B240ET, 4BW, 4E, 39, except that no DOT 4E or 39 packaging may be filled and shipped with a mixture containing a pyrophoric liquid, carbon bisulfide (disulfide), ethyl chloride, ethylene oxide, nickel carbonyl, spirits of nitroglycerin, or toxic material (Division 6.1 or 2.3), unless specifically authorized in this part.

(2) For the gases named, the following requirements apply (for cryogenic liquids, see § 173.316):

Kind of gas	Maximum permitted filling density (percent) (see Note 1)	Packaging marked as shown in this column or of the same type with higher service pressure must be used, except as provided in §§ 173.301(l), 173.301a(e), and 180.205(a) (see notes following table)
Anhydrous ammonia	54	DOT-3A480; DOT-3AA480; DOT-3A480X; DOT-4AA480; DOT-3; DOT-3E1800; DOT-3AL480.
Bromotrifluoromethane (R–13B1 or H–1301)	124	DOT-3A400; DOT-3AA400; DOT-3B400; DOT-4AA480; DOT-4B400; DOT-4BA400; DOT-4BW400; DOT-3E1800; DOT-39; DOT-3AL400.
Carbon dioxide (*see* Notes 4, 7, and 8)	68	DOT-3A1800; DOT-3AX1800; DOT-3AA1800; DOT-3AAX1800; DOT-3; DOT-3E1800; DOT-3T1800; DOT-3HT2000; DOT-39; DOT-3AL1800.
Carbon dioxide, refrigerated liquid (*see* paragraph (e) of this section).		DOT-4L.
Chlorine (*see* Note 2)	125	DOT-3A480; DOT-3AA480; DOT-3; DOT-3BN480; DOT-3E1800.
Chlorodifluroethane or 1-Chloro-1, 1-difluoroethane (R–142b).	100	DOT-3A150; DOT-3AA150; DOT-3B150; DOT-4B150; DOT-4BA225; DOT-4BW225; DOT-3E1800; DOT-39; DOT-3AL150.
Chlorodifluoromethane (R–22) (*see* Note 8)	105	DOT-3A240; DOT-3AA240; DOT-3B240; DOT-4B240; DOT-4BA240; DOT-4BW240; DOT-4B240ET; DOT-4E240; DOT-39; DOT-3E1800; DOT-3AL240.

Kind of gas	Maximum permitted filling density (percent) (see Note 1)	Packaging marked as shown in this column or of the same type with higher service pressure must be used, except as provided in §§ 173.301(l), 173.301a(e), and 180.205(a) (see notes following table)
Chloropentafluorethane (R–115)	110	DOT-3A225; DOT-3AA225; DOT-3B225; DOT-4BA225; DOT-4B225; DOT-4BW225; DOT-3E1800; DOT-39; DOT-3AL225.
Chlorotrifluoromethane (R–13) (*see* Note 8)	100	DOT-3A1800; DOT-3AA1800; DOT-3; DOT-3E1800; DOT-39; DOT-3AL1800.
Cyclopropane (*see* Note 8)	55	DOT-3A225; DOT-3A480X; DOT-3AA225; DOT-3B225; DOT-4AA480; DOT4B225; DOT-4BA225; DOT-4BW225; DOT-4B240ET; DOT-3; DOT-3E1800; DOT-39; DOT-3AL225.
Dichlorodifluoromethane (R–12) (*see* Note 8)	119	DOT-3A225; DOT-3AA225; DOT-3B225; DOT-4B225; DOT-4BA225; DOT-4BW225; DOT-4B240ET; DOT-4E225; DOT-39; DOT-3E1800; DOT-3AL225.
Dichlorodifluoromethane and difluoroethane mixture (constant boiling mixture) (R–500) (*see* Note 8).	Not liquid full at 131 °F	DOT-3A240; DOT-3AA240; DOT-3B240; DOT-3E1800; DOT-4B240; DOT-4BA240; DOT-4BW240; DOT-4E240; DOT-39.
1,1-Difluoroethane (R–152a) (*see* note 8)	79	DOT-3A150; DOT-3AA150; DOT-3B150; DOT-4B150; DOT-4BA225; DOT-4BW225; DOT-3E1800; DOT-3AL150.
1,1-Difluoroethylene (R–1132A)	73	DOT-3A2200; DOT-3AA2200; DOT-3AX2200; DOT-3AAX2200; DOT-3T2200; DOT-39.
Dimethylamine, anhydrous	59	DOT-3A150; DOT-3AA150; DOT-3B150; DOT-4B150; DOT-4BA225; DOT-4BW225; ICC–3E1800.
Ethane (*see* Note 8)	35.8	DOT-3A1800; DOT-3AX1800; DOT-3AA1800; DOT-3AAX1800; DOT-3; DOT-3E1800; DOT-3T1800; DOT-39; DOT-3AL1800.
Ethane (*see* Note 8)	36.8	DOT-3A2000; DOT-3AX2000; DOT-3AA2000; DOT-3AAX2000; DOT-3T2000; DOT-39; DOT-3AL2000.
Ethylene (*see* Note 8)	31.0	DOT-3A1800; DOT-3AX1800; DOT-3AA1800; DOT-3AAX1800; DOT-3; DOT-3E1800; DOT-3T1800; DOT-39; DOT-3AL1800.
Ethylene (*see* Note 8)	32.5	DOT-3A2000; DOT-3AX2000; DOT-3AA2000; DOT-3AAX2000; DOT-3T2000; DOT-39; DOT-3AL2000.
Ethylene (*see* Note 8)	35.5	DOT-3A2400; DOT-3AX2400; DOT-3AA2400; DOT-3AAX2400; DOT-3T2400; DOT-39; DOT-3AL2400.
Hydrogen chloride, anhydrous	65	DOT-3A1800; DOT-3AA1800; DOT-3AX1800; DOT-3AAX1800; DOT-3; DOT-3T1800; DOT-3E1800.
Hydrogen sulfide (*see* Notes 10 and 14)	62.5	DOT-3A; DOT-3AA; DOT-3B; DOT-4A; DOT-4B; DOT-4BA; DOT-4BW; DOT-3E1800; DOT-3AL.
Insecticide, gases liquefied (*see* Notes 8 and 12)	Not liquid full at 131 °F	DOT-3A300; DOT-3AA300; DOT-3B300; DOT-4B300; DOT-4BA300; DOT-4BW300; DOT-3E1800.
Liquefied nonflammable gases, other than classified flammable, corrosive, toxic & mixtures or solution thereof filled w/nitrogen, carbon dioxide, or air (*see* Notes 7 and 8)..	Not liquid full at 131 °F	Specification packaging authorized in paragraph (a)(1) of this section and DOT-3HT; DOT 4D; DOT-4DA; DOT-4DS.
Methyl acetylene-propadiene, mixtures, stabilized; (*see* Note 5)..	Not liquid at 131 °F	DOT-4B240 without brazed seams; DOT-4BA240 without brazed seams; DOT-3A240; DOT-3AA240; DOT-3B240; DOT-3E1800; DOT-4BW240; DOT-4E240; DOT-4B240ET; DOT-3AL240.
Methyl chloride	84	DOT-3A225; DOT-3AA225; DOT-3B225; DOT-4B225; DOT-4BA225; DOT-4BW225; DOT-3; DOT-3E1800; DOT-4B240ET. Cylinders complying with DOT-3A150; DOT-3B150; and DOT-4B150 manufactured prior to Dec. 7, 1936 are also authorized.
Methyl mercaptan	80	DOT-3A240; DOT-3AA240; DOT-3B240; OT-4B240; DOT-4B240ET; DOT-3E1800; DOT-4BA240; DOT-4BW240.
Nitrosyl chloride	110	DOT-3BN400 only.

Kind of gas	Maximum permitted filling density (percent) (see Note 1)	Packaging marked as shown in this column or of the same type with higher service pressure must be used, except as provided in §§ 173.301(l), 173.301a(e), and 180.205(a) (see notes following table)
Nitrous oxide (*see* Notes 7, 8, and 11)	68	DOT-3A1800; DOT-3AX1800; DOT-3AA1800; DOT-3AAX1800; DOT-3; DOT-3E1800; DOT-3T1800; DOT-3HT2000; DOT-39; DOT-3AL1800.
Nitrous oxide, refrigerated liquid (*see* paragraph (e) of this section.).		DOT-4L.
Refrigerant gas, n.o.s. or Dispersant gas, n.o.s. (*see* Notes 8 and 13).	Not liquid full at 130 °F	DOT-3A240; DOT-3AA240; DOT-3B240; DOT-3E1800; DOT-4B240; DOT-4BA240; DOT-4BW240; DOT-4E240; DOT-39; DOT-3AL240.
Sulfur dioxide (*see* note 8)	125	DOT-3A225; DOT-3AA225; DOT-3B225; DOT-4B225; DOT-4BA225; DOT-4BW225; DOT-4B240ET; DOT-3; DOT-39; DOT-3E1800; DOT-3AL225.
Sulfur hexafluoride	120	DOT-3A1000; DOT-3AA1000; DOT-AAX2400; DOT-3; DOT-3AL1000; DOT-3E1800; DOT-3T1800.
Sulfuryl fluoride	106	DOT-3A480; DOT-3AA480; DOT-3E1800; DOT-4B480; DOT-4BA480; DOT-4BW480.
Tetrafluoroethylene, stabilized	90	DOT-3A1200; DOT-3AA1200; DOT-3E1800.
Trifluorochloroethylene, stabilized	115	DOT-3A300; DOT-3AA300; DOT-3B300; DOT-4B300; DOT-4BA300; DOT-4BW300; DOT-3E1800.
Trimethylamine, anhydrous	57	DOT-3A150; DOT-3AA150; DOT-3B150; DOT-4B150; DOT-4BA225; DOT-4BW225; DOT-3E1800.
Vinyl chloride (*see* Note 5)	84	DOT-4B150 without brazed seams; DOT-4BA225 without brazed seams; DOT-4BW225; DOT-3A150; DOT-3AA150; DOT-3E1800; DOT-3AL150.
Vinyl fluoride, stabilized	62	DOT-3A1800; DOT-3AA1800; DOT-3E1800; DOT-3AL1800.
Vinyl methyl ether, stabilized(*see* Note 5)	68	DOT-4B150, without brazed seams; DOT-4BA225 without brazed seams; DOT-4BW225; DOT-3A150; DOT-3AA150; DOT-3B1800; DOT-3E1800.

NOTE 1: ''Filling density'' means the percent ratio of the weight of gas in a packaging to the weight of water that the container will hold at 16 °C (60 °F). (1 lb of water=27.737 in^3 at 60 °F.).

NOTE 2: Cylinders purchased after Oct. 1, 1944, for the transportation of chlorine must contain no aperture other than that provided in the neck of the cylinder for attachment of a valve equipped with an approved pressure relief device. Cylinders purchased after Nov. 1, 1935, and filled with chlorine may not contain over 68.04 kg (150 lb) of gas.

NOTE 3: [Reserved]

NOTE 4: Special carbon dioxide mining devices containing a heating element and filled with not over 2.72 kg (6 lb) of carbon dioxide may be filled to a density of not over 85 percent, provided the cylinder is made of steel with a calculated bursting pressure in excess of 39000 psig, fitted with a frangible disc that will operate at not over 57 percent of that pressure, and is able to withstand a drop of 10 feet when striking crosswise on a steel rail while under a pressure of at least 3000 psig. Such devices must be shipped in strong boxes or must be wrapped in heavy burlap and bound by 12-gauge wire with the wire completely covered by friction tape. Wrapping must be applied so as not to interfere with the functioning of the frangible disc pressure relief device. Shipments must be described as ''liquefied carbon dioxide gas (mining device)'' and marked, labeled, and certified as prescribed for liquefied carbon dioxide.

NOTE 5: All parts of valve and pressure relief devices in contact with contents of cylinders must be of a metal or other material, suitably treated if necessary, that will not cause formation of any acetylides.

NOTE 6: [Reserved]

NOTE 7: Specification 3HT cylinders for aircraft use only, having a maximum service life of 24 years. Authorized only for nonflammable gases. Cylinders must be equipped with pressure relief devices of the frangible disc type that meet the requirements of § 173.301(f). Each frangible disc must have a rated bursting pressure that does not exceed 90 percent of the minimum required test pressure of the cylinder. Discs with fusible metal backing are not permitted. Cylinders may be offered for transportation only when packaged in accordance with § 173.301(a)(9).

NOTE 8: *See* § 173.301(a)(9).

NOTE 9: [Reserved]

NOTE 10: Each valve outlet must be sealed by a threaded cap or a threaded solid plug.

NOTE 11: Must meet the valve and cleaning requirements in § 173.302(b).

NOTE 12: For an insecticide gas that is nontoxic and nonflammable, *see* § 173.305(c).

NOTE 13: For a refrigerant or dispersant gas that is nontoxic and nonflammable, *see* § 173.304(d).

NOTE 14: The use of DOT specification cylinder with a marked service pressure of 480 psi is authorized until December 31, 2003.

(b) [Reserved]

(c) *Verification of content in cylinder.* Except as noted in paragraph (d)(4) of this section, the amount of liquefied gas filled into a cylinder must be by weight or, when the gas is lower in pressure than required for liquefaction, a pressure-temperature chart for the

specific gas may be used to ensure that the service pressure at 55 °C (131 °F) will not exceed 5/4 of the service pressure at 21 °C (70 °F). The weight of liquefied gas filled into the cylinder also must be checked, after disconnecting the cylinder from the filling line, by the use of an accurate scale.

(d) Requirements for liquefied petroleum gas. (1) Filling density limits are as follows:

Minimum specific gravity of liquid material at 60 °F	Maximum the filling density in percent of the water-weight capacity of the cylinder
0.271 to 0.289	26
0.290 to 0.306	27
0.307 to 0.322	28
0.323 to 0.338	29
0.339 to 0.354	30
0.355 to 0.371	31
0.372 to 0.398	32
0.399 to 0.425	33
0.426 to 0.440	34
0.441 to 0.452	35
0.453 to 0.462	36
0.463 to 0.472	37
0.473 to 0.480	38
0.481 to 0.488	39
0.489 to 0.495	40
0.496 to 0.503	41
0.504 to 0.510	42
0.511 to 0.519	43
0.520 to 0.527	44
0.528 to 0.536	45
0.537 to 0.544	46
0.545 to 0.552	47
0.553 to 0.560	48
0.561 to 0.568	49
0.569 to 0.576	50
0.577 to 0.584	51
0.585 to 0.592	52
0.593 to 0.600	53
0.601 to 0.608	54
0.609 to 0.617	55
0.618 to 0.626	56
0.627 to 0.634	57

(2) Subject to § 173.301a(d), any filling density percentage prescribed in this section is authorized to be increased by a factor of 2 for liquefied petroleum gas in DOT 3 cylinders or in DOT 3A cylinders marked for 1800 psig, or higher, service pressure.

(3) Liquefied petroleum gas must be shipped in specification cylinders as follows:

(i) DOT 3, 3A, 3AA, 3B, 3E, 3AL, 4B, 4BA, 4B240ET, 4BW, 4E, or 39 cylinders. Shipments of flammable gases in DOT 3AL cylinders are authorized only when transported by motor vehicle, rail car, or cargo-only aircraft.

(ii) Additional containers may be used within the limits of quantity and pressure as follows:

Type of container	Maximum capacity (cubic inches)	Maximum filling pressure (psig)
DOT-2P or DOT-2Q (see Note 1)	31.83	45 psig at 70 °F and 105 psig at 130 °F (see Note 2).
DOT-2P or DOT-2Q (see Note 1)	31.83	35 psig at 70 °F and 100 psig at 130 °F.

NOTE 1: Containers must be packed in strong wooden or fiber boxes of such design as to protect valves from damage or accidental functioning under conditions normally incident to transportation. Each completed container filled for shipment must have been heated until its contents reach a temperature of 54 °C (130 °F), without evidence of leakage, distortion, or other defect. Each outside shipping container must be plainly marked ''INSIDE CONTAINERS COMPLY WITH PRESCRIBED SPECIFICATIONS'.

NOTE 2: A container must be equipped with a pressure relief device that will prevent rupture of the container and dangerous projection of a closing device when exposed to fire.

(4) *Verification of content.* A cylinder with a water capacity of 90.72 kg (200 lb) or more and for use with a liquefied petroleum gas with a specific gravity of 0.504 or greater at 16 °C (60 °F) may have the quantity of its contents determined by using a fixed length dip tube gauging device. The length of the dip tube must be such that when a liquefied petroleum gas, with a specific volume of 0.03051 cu. ft./lb. at a temperature of 40 °F, is filled into the container, the liquid just reaches the bottom of the tube. The weight of this liquid may not exceed 42 percent of the water capacity of the container, which must be stamped on the cylinder. The length of the dip tube, expressed in inches carried out to one decimal place and prefixed with the letters ''DT'', must be stamped on the container and on the exterior of removable type dip tube. For the purpose of this requirement, the marked length must be expressed as the distance measured along the axis of a straight tube from the top of the boss through which the tube is

inserted to the proper level of the liquid in the container. The length of each dip tube must be checked when installed by weighing each container after filling except when installed in groups of substantially identical containers, in which case one of each 25 containers must be weighed. The quantity of liquefied gas in each container must be checked by means of the dip tube after disconnecting from the filling line. The outlet from the dip tube may not be larger than 0.1016 centimeters (0.040 inch; No. 54 drill bit size orifice). A container representative of each day's filling at each filling plant must have its contents checked by weighing after disconnecting from the filling line.

(e) *Carbon dioxide, refrigerated liquid or nitrous oxide, refrigerated liquid.* (1) The following provisions apply to carbon dioxide, refrigerated liquid, and nitrous oxide, refrigerated liquid:

(i) DOT 4L cylinders conforming to the provisions of this paragraph are authorized.

(ii) Each cylinder must be protected with at least one pressure relief device and at least one frangible disc conforming to §173.301(f) and paragraph (a)(2) of this section. The relieving capacity of the pressure relief device system must be equal to or greater than that calculated by the applicable formula in paragraph 5.8.3 of CGA S–1.1 (IBR, see §171.7 of this subchapter).

(iii) The temperature and pressure of the gas at the time the shipment is offered for transportation may not exceed −18 °C (0 °F) and 290 psig for carbon dioxide and −15.6 °C (+4 °F) and 290 psig for nitrous oxide. Maximum time in transit may not exceed 120 hours.

(2) The following pressure relief device settings, design service temperatures and filling densities apply:

Pressure relief device setting maximum start—to discharge gauge pressure in psig	Maximum permitted filling density (percent by weight)	
	Carbon dioxide, refrigerated liquid	Nitrous oxide, refrigerated liquid
105 psig	108	104
170 psig	105	101
230 psig	104	99
295 psig	102	97
360 psig	100	95
450 psig	98	83
540 psig	92	87
625 psig	86	80
Design service temperature °C(°F)	−196 °C(−320 °F)	−196 °C(−320 °F)

[67 FR 51647, Aug. 8, 2002, as amended at 68 FR 24661, May 8, 2003; 68 FR 57632, Oct. 6, 2003; 68 FR 75742, Dec. 31, 2003; 70 FR 34076, June 13, 2005; 72 FR 4456, Jan. 31, 2007; 72 FR 55098, Sept. 28, 2007; 73 FR 4719, Jan. 28, 2008]

EDITORIAL NOTE: At 70 FR 34076, June 13, 2005, §173.304a was amended in the table in paragraph (a)(2) by removing the phrase ''DOT–4A480'' from the entry ''Hydrogen sulfide''; however, the amendment could not be incorporated because that phrase does not exist in the entry.

§173.304b Additional requirements for shipment of liquefied compressed gases in UN pressure receptacles.

(a) *General.* Liquefied gases and gas mixtures must be offered for transportation in UN pressure receptacles subject to the requirements in this section and §173.304. In addition, the general requirements applicable to UN pressure receptacles in §§173.301 and 173.301b must be met.

(b) *UN pressure receptacle filling limits.* A UN pressure receptacle is authorized for the transportation of liquefied compressed gases and gas mixtures as specified in this section. When a liquefied compressed gas or gas mixture is transported in a UN pressure receptacle, the filling ratio may not exceed the maximum filling ratio prescribed in this section and the applicable ISO standard. Compliance with the filling limits may be determined by referencing the numerical values and data in Table 2 of P200 of the UN Recommendations (IBR,

see §171.7 of this subchapter). Alternatively, the maximum allowable filling limits may be determined as follows:

(1) For high pressure liquefied gases, in no case may the filling ratio of the settled pressure at 65 °C (149 °F) exceed the test pressure of the UN pressure receptacle.

(2) For low pressure liquefied gases, the filling factor (maximum mass of contents per liter of water capacity) must be less than or equal to 95 percent of the liquid phase at 50 °C. In addition, the UN pressure receptacle may not be liquid full at 60 °C. The test pressure of the pressure receptacle must be equal to or greater than the vapor pressure of the liquid at 65 °C.

(3) For high pressure liquefied gases or gas mixtures, the maximum filling ratio may be determined using the formulas in (3)(b) of P200 of the UN Recommendations.

(4) For low pressure liquefied gases or gas mixtures, the maximum filling ratio may be determined using the formulas in (3)(c) of P200 of the UN Recommendations.

(c) Tetraflouroethylene, stabilized, UN1081 must be packaged in a pressure receptacle with a minimum test pressure of 200 bar and a working pressure not exceeding 5 bar.

(d) Fertilizer ammoniating solution with free ammonia, UN1043 is not authorized in UN tubes or MEGCs.

[74 FR 2265, Jan. 14, 2009]

§ 173.305 Charging of cylinders with a mixture of compressed gas and other material.

(a) *Detailed requirements.* A mixture of a compressed gas and any other material must be shipped as a compressed gas if the mixture is a compressed gas as designated in §173.115 and when not in violation of §173.301(a).

(b) *Filling limits.* (See §173.301.) For mixtures, the liquid portion of the liquefied compressed gas at 131 °F. plus any additional liquid or solid must not completely fill the container.

(c) *Nonpoisonous and nonflammable mixtures.* Mixtures containing compressed gas or gases including insecticides, which mixtures are nonpoisonous and nonflammable under this part must be shipped in cylinders as prescribed in §173.304(a) or as follows:

(1) Specification 2P (§178.33 of this subchapter). Inside metal containers equipped with safety relief devices of a type examined by the Bureau of Explosives and approved by the Associate Administrator, and packed in strong wooden or fiber boxes of such design as to protect valves from damage or accidental functioning under conditions incident to transportation. Pressure in the container may not exceed 85 psia at 70 °F. Each completed metal container filled for shipment must be heated until content reaches a minimum temperature of 130 °F., without evidence of leakage, distortion or other defect. Each outside shipping container must be plainly marked ''INSIDE CONTAINERS COMPLY WITH PRESCRIBED SPECIFICATIONS.''

(2) [Reserved]

(d) *Poisonous mixtures.* A mixture containing any poisonous material (Division 6.1 or 2.3) in such proportions that the mixture would be classed as poisonous under §173.115 or §173.132 must be shipped in packagings as authorized for these poisonous materials.

[29 FR 18743, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 173–70, 38 FR 5309, Feb. 27, 1973, Amdt. 173–94, 41 FR 16079, Apr. 15, 1976; 45 FR 32697, May 19, 1980; Amdt. 173–224, 56 FR 66275, 66279, Dec. 20, 1991; 66 FR 45379, Aug. 28, 2001; 67 FR 61013, Sept. 27, 2002; 67 FR 51651, Aug. 8, 2002; 68 FR 24662, May 8, 2003]

§ 173.306 Limited quantities of compressed gases.

(a) Limited quantities of compressed gases for which exceptions are permitted as noted by reference to this section in §172.101 of this subchapter are excepted from labeling, except when offered for transportation or transported by air, and, unless required as a condition of the exception, specification packaging requirements of this subchapter when packaged in accordance with the following paragraphs. For transportation by aircraft, the package must also comply with the applicable requirements of §173.27 of this subchapter and only hazardous materials authorized aboard passenger-carrying aircraft may be transported as a limited quantity. In addition, shipments are not subject to subpart F

(Placarding) of part 172 of this subchapter, to part 174 of this subchapter except §174.24, and to part 177 of this subchapter except §177.817. Each package may not exceed 30 kg (66 pounds) gross weight.

(1) When in containers of not more than 4 fluid ounces capacity (7.22 cubic inches or less) except cigarette lighters. Special exceptions for shipment of certain compressed gases in the ORM-D class are provided in paragraph (i) of this section.

(2) When in metal containers filled with a material that is not classed as a hazardous material to not more than 90 percent of capacity at 70 °F. and then charged with nonflammable, nonliquefied gas. Each container must be tested to three times the pressure at 70 °F. and, when refilled, be retested to three times the pressure of the gas at 70 °F. Also, one of the following conditions must be met:

(i) Container is not over 0.95 L (1 quart) capacity and charged to not more than 11.17 bar (482.63 kPa, 170 psig) at 21 °C (70 °F), and must be packed in a strong outer packaging, or

(ii) Container is not over 30 gallons capacity and charged to not more than 75 psig at 70 °F.

(3) When in a metal container for the sole purpose of expelling a nonpoisonous (other than a Division 6.1 Packing Group III material) liquid, paste or powder, provided all of the following conditions are met. Special exceptions for shipment of aerosols in the ORM-D class are provided in paragraph (i) of this section.

(i) Capacity must not exceed 1 L(61.0 cubic inches).

(ii) Pressure in the container must not exceed 180 psig at 130 °F. If the pressure exceeds 140 psig at 130 °F., but does not exceed 160 psig at 130 °F., a specification DOT 2P (§178.33 of this subchapter) inside metal container must be used; if the pressure exceeds 160 psig at 130 °F., a specification DOT 2Q (§178.33a of this subchapter) inside metal container must be used. In any event, the metal container must be capable of withstanding without bursting a pressure of one and one-half times the equilibrium pressure of the content at 130 °F.

(iii) Liquid content of the material and gas must not completely fill the container at 130 °F.

(iv) The container must be packed in strong outside packagings.

(v) Each container must be subjected to a test performed in a hot water bath; the temperature of the bath and the duration of the test must be such that the internal pressure reaches that which would be reached at 55 °C (131 °F) (50 °C (122 °F) if the liquid phase does not exceed 95% of the capacity of the container at 50 °C (122 °F)). If the contents are sensitive to heat, the temperature of the bath must be set at between 20 °C (68 °F) and 30 °C (86 °F) but, in addition, one container in 2,000 must be tested at the higher temperature. No leakage or permanent deformation of a container may occur.

(vi) Each outside packaging must be marked ''INSIDE CONTAINERS COMPLY WITH PRESCRIBED REGULATIONS.''

(4) Gas samples must be transported under the following conditions:

(i) A gas sample may only be transported as non-pressurized gas when its pressure corresponding to ambient atmospheric pressure in the container is not more than 105 kPa absolute (15.22 psia).

(ii) Non-pressurized gases, toxic (or toxic and flammable) must be packed in hermetically sealed glass or metal inner packagings of not more than one L (0.3 gallons) overpacked in a strong outer packaging.

(iii) Non-pressurized gases, flammable must be packed in hermetically sealed glass or metal inner packagings of not more than 5 L (1.3 gallons) and overpacked in a strong outer packaging.

(5) For limited quantities of Division 2.2 gases with no subsidiary risk, when in a plastic container for the sole purpose of expelling a liquid, paste or powder, provided all of the following conditions are met. Special exceptions for shipment of aerosols in the ORM–D class are provided in paragraph (i) of this section.

(i) Capacity must not exceed 1 L (61.0 cubic inches).

(ii) Pressure in the container must not exceed 160 psig at 130 °F. If the pressure in the container is less than

140 psig at 130 °F, a non-DOT specification container may be used. If the pressure in the container exceeds 140 psig at 130 °F but does not exceed 160 psig at 130 °F, the container must conform to specification DOT 2S. All non-DOT specification and specification DOT 2S containers must be capable of withstanding, without bursting, a pressure of one and one-half times the equilibrium pressure of the contents at 130 °F.

(iii) Liquid content of the material and gas must not completely fill the container at 130 °F.

(iv) The container must be packed in strong outside packagings.

(v) Except as provided in paragraph (a)(5)(vi) of this section, each container must be subjected to a test performed in a hot water bath; the temperature of the bath and the duration of the test must be such that the internal pressure reaches that which would be reached at 55 °C (131 °F) or 50 °C (122 °F) if the liquid phase does not exceed 95% of the capacity of the container at 50 °C (122 °F). If the contents are sensitive to heat, or if the container is made of plastic material which softens at this test temperature, the temperature of the bath must be set at between 20 °C (68 °F) and 30 °C (86 °F) but, in addition, one container in 2,000 must be tested at the higher temperature. No leakage or permanent deformation of a container may occur except that a plastic container may be deformed through softening provided that it does not leak.

(vi) As an alternative to the hot water bath test in paragraph (a)(5)(v) of this section, testing may be performed as follows:

(A) *Pressure and leak testing before filling.* Each empty container must be subjected to a pressure equal to or in excess of the maximum expected in the filled containers at 55 °C (131 °F) (or 50 °C (122 °F) if the liquid phase does not exceed 95 percent of the capacity of the container at 50 °C (122 °F). This must be at least two-thirds of the design pressure of the container. If any container shows evidence of leakage at a rate equal to or greater than 3.3×10^{-2} mbar L/s at the test pressure, distortion or other defect, it must be rejected; and

(B) *Testing after filling.* Prior to filling, the filler must ensure that the crimping equipment is set appropriately and the specified propellant is used before filling the container. Once filled, each container must be weighed and leak tested. The leak detection equipment must be sufficiently sensitive to detect at least a leak rate of 2.0×10^{-3} mbar L/s at 20 °C (68 °F). Any filled container which shows evidence of leakage, deformation, or excessive weight must be rejected.

(vi) Each outside packaging must be marked ''INSIDE CONTAINERS COMPLY WITH PRESCRIBED REGULATIONS.''

(b) *Exceptions for foodstuffs, soap, biologicals, electronic tubes, and audible fire alarm systems.* Limited quantities of compressed gases (except Division 2.3 gases) for which exceptions are provided as indicated by reference to this section in §172.101 of this subchapter, when accordance with one of the following paragraphs, are excepted from labeling, except when offered for transportation or transported by aircraft, and the specification packaging requirements of this subchapter. For transportation by aircraft, the package must comply with the applicable requirements of §173.27 of this subchapter; the net quantity per package may not exceed the quantity specified in column (9A) of the Hazardous Materials Table in §172.101 of this subchapter; and only hazardous materials authorized aboard passenger-carrying aircraft may be transported as a limited quantity. In addition, shipments are not subject to subpart F (Placarding) of part 172 of this subchapter, to part 174 of this subchapter, except §174.24, and to part 177 of this subchapter, except §177.817. Special exceptions for shipment of certain compressed gases in the ORM–D class are provided in paragraph (i) of this section.

(1) Foodstuffs or soaps in a nonrefillable metal or plastic container not exceeding 1 L (61.0 cubic inches), with soluble or emulsified compressed gas, provided the pressure in the container does not exceed 140 psig at 130 °F. Plastic containers must only contain Division 2.2 non-flammable soluble or emulsified compressed gas. The metal

or plastic container must be capable of withstanding, without bursting, a pressure of one and one-half times the equilibrium pressure of the contents at 130 °F.

(i) Containers must be packed in strong outside packagings.

(ii) Liquid content of the material and the gas must not completely fill the container at 130 °F.

(iii) Each outside packaging must be marked ''INSIDE CONTAINERS COMPLY WITH PRESCRIBED REGULATIONS.''

(2) Cream in refillable metal or plastic containers with soluble or emulsified compressed gas. Plastic containers must only contain Division 2.2 non-flammable soluble or emulsified compressed gas. Containers must be of such design that they will hold pressure without permanent deformation up to 375 psig and must be equipped with a device designed so as to release pressure without bursting of the container or dangerous projection of its parts at higher pressures. This exception applies to shipments offered for transportation by refrigerated motor vehicles only.

(3) Nonrefillable metal or plastic containers charged with a Division 6.1 Packing Group III or nonflammable solution containing biological products or a medical preparation which could be deteriorated by heat, and compressed gas or gases. Plastic containers must only contain 2.2 non-flammable soluble or emulsified compressed gas. The capacity of each container may not exceed 35 cubic inches (19.3 fluid ounces). The pressure in the container may not exceed 140 psig at 130 °F, and the liquid content of the product and gas must not completely fill the containers at 130 °F. One completed container out of each lot of 500 or less, filled for shipment, must be heated, until the pressure in the container is equivalent to equilibrium pressure of the contents at 130 °F. There must be no evidence of leakage, distortion, or other defect. The container must be packed in strong outside packagings.

(4) Electronic tubes, each having a volume of not more than 30 cubic inches and charged with gas to a pressure of not more than 35 psig and packed in strong outside packagings.

(5) Audible fire alarm systems powered by a compressed gas contained in an inside metal container when shipped under the following conditions:

(i) Each inside container must have contents which are not flammable, poisonous, or corrosive as defined under this part,

(ii) Each inside container may not have a capacity exceeding 35 cubic inches (19.3 fluid ounces),

(iii) Each inside container may not have a pressure exceeding 70 psig at 70 °F. and the liquid portion of the gas may not completely fill the inside container at 130 °F., and

(iv) Each nonrefillable inside container must be designed and fabricated with a burst pressure of not less than four times its charged pressure at 130 °F. Each refillable inside container must be designed and fabricated with a burst pressure of not less than five times its charged pressure at 130 °F.

(c)–(d) [Reserved]

(e) *Refrigerating machines.* (1) New (unused) refrigerating machines or components thereof are excepted from the specification packaging requirements of this part if they meet the following conditions. In addition, shipments are not subject to subpart F of part 172 of this subchapter, to part 174 of this subchapter except §174.24 and to part 177 of this subchapter except §177.817.

(i) Each pressure vessel may not contain more than 5,000 pounds of Group A1 refrigerant as classified in ANSI/ASHRAE Standard 15 or not more than 50 pounds of refrigerant other than Group A1.

(ii) Machines or components having two or more charged vessels may not contain an aggregate of more than 2,000 pounds of Group I refrigerant or more than 100 pounds of refrigerant other than Group I.

(iii) Each pressure vessel must be equipped with a safety device meeting the requirements of ANSI/ASHRAE 15 (IBR, see §171.7 of this subchapter).

(iv) Each pressure vessel must be equipped with a shut-off valve at each opening except openings used for safety devices and with no other connection. These valves must be closed prior to and during transportation.

(v) Pressure vessels must be manufactured, inspected and tested in accordance with ANSI/ASHRAE 15, or when over 6 inches internal diameter, in accordance with Section VIII of the ASME Code (IBR, see §171.7 of this subchapter).

(vi) All parts subject to refrigerant pressure during shipment must be tested in accordance with ANSI/ASHRAE 15.

(vii) The liquid portion of the refrigerant, if any, may not completely fill any pressure vessel at 130 °F.

(viii) The amount of refrigerant, if liquefied, may not exceed the filling density prescribed in §173.304.

(f) *Accumulators (Articles, pressurized pneumatic or hydraulic containing nonflammable gas).* The following applies to accumulators, which are hydraulic accumulators containing nonliquefied, nonflammable gas, and nonflammable liquids or pneumatic accumulators containing nonliquefied, nonflammable gas, fabricated from materials which will not fragment upon rupture.

(1) Accumulators installed in motor vehicles, construction equipment, and assembled machinery and designed and fabricated with a burst pressure of not less than five times their charged pressure at 70 °F., when shipped, are not subject to the requirements of this subchapter.

(2) Accumulators charged with limited quantities of compressed gas to not more than 200 p.s.i.g. at 70 °F. are excepted from labeling (except when offered for transportation by air) and the specification packaging requirements of this subchapter when shipped under the following conditions. In addition, shipments are not subject to subpart F of part 172 of this subchapter, to part 174 of this subchapter except §174.24 and to part 177 of this subchapter except §177.817.

(i) Each accumulator must be shipped as an inside packaging,

(ii) Each accumulator may not have a gas space exceeding 2,500 cubic inches under stored pressure, and

(iii) Each accumulator must be tested, without evidence of failure or damage, to at least three times its charged pressure of 70 °F., but not less than 120 p.s.i. before initial shipment and before each refilling and reshipment.

(3) Accumulators with a charging pressure exceeding 200 p.s.i.g. at 70 °F. are excepted from labeling (except when offered for transportation by air) and the specification packaging requirements of this subchapter when shipped under the following conditions:

(i) Each accumulator must be in compliance with the requirements stated in paragraph (f)(2), (i), (ii), and (iii) of this section, and

(ii) Each accumulator must be designed and fabricated with a burst pressure of not less than five times its charged pressure at 70 °F. when shipped.

(4) Accumulators intended to function as shock absorbers, struts, gas springs, pneumatic springs or other impact or energy-absorbing devices are not subject to the requirements of this subchapter provided each:

(i) Has a gas space capacity not exceeding 1.6 L and a charge pressure not exceeding 280 bar, where the product of the capacity expressed in liters and charge pressure expressed in bars does not exceed 80 (for example, 0.5 L gas space and 160 bar charge pressure);

(ii) Has a minimum burst pressure of 4 times the charge pressure at 20°C for products not exceeding 0.5 L gas space capacity and 5 times the charge pressure for products greater than 0.5 L gas space capacity;

(iii) Design type has been subjected to a fire test demonstrating that the article relieves its pressure by means of a fire degradable seal or other pressure relief device, such that the article will not fragment and that the article does not rocket; and

(iv) Accumulators must be manufactured under a written quality assurance program which monitors parameters controlling burst strength, burst mode and performance in a fire situation as specified in paragraphs (f)(4)(i) through (f)(4)(iii) of this section. A copy of the quality assurance program must be maintained at each facility at which the accumulators are manufactured.

(5) Accumulators not conforming to the provisions of paragraphs (f)(1) through (f) (4) of this section, may only be transported subject to the approval of the Associate Administrator.

(g) *Water pump system tank.* Water pump system tanks charged with compressed air or limited quantities of nitrogen to not over 40 psig for single-trip shipment to installation sites are excepted from labeling (transportation by air not authorized) and the specification packaging requirements of this subchapter when shipped under the following conditions. In addition, shipments are not subject to subpart F of this subchapter, to part 174 of this subchapter except §174.24 and part 177 except §177.817.

(1) The tank must be of steel, welded with heads concave to pressure, having a rated water capacity not exceeding 120 gallons and with outside diameter not exceeding 24 inches. Safety relief devices not required.

(2) The tank must be pneumatically tested to 100 psig. Test pressure must be permanently marked on the tank.

(3) The stress at prescribed pressure must not exceed 20,000 psi using formula:

$$S = Pd / 2t$$

where:

S = wall stress in psi:
P = prescribed pressure for the tank of at least 3 times charged pressure at 70 °F or 100 psig, whichever is greater;
d = inside diameter in inches;
t = minimum wall thickness, in inches.

(4) The burst pressure must be at least 6 times the charge pressure at 70 °F.

(5) Each tank must be overpacked in a strong outer packaging in accordance with §173.301(h).

(h) *Lighter refills.* (1) Lighter refills (see §171.8 of this subchapter) must not contain an ignition element but must contain a release device. Lighter refills offered for transportation under this section may not exceed 4 fluid ounces capacity (7.22 cubic inches) or contain more than 65 grams of a Division 2.1 fuel. For transportation by highway or rail, lighter refills must be tightly packed and secured against movement in strong outer packagings. For transportation by aircraft or vessel, lighter refills must be tightly packed and secured against movement in any rigid specification outer packaging authorized in Subpart L of Part 178 of this subchapter at the Packing Group II performance level.

(2) *Exceptions.* For highway transportation, when no more than 1,500 lighter refills covered by this paragraph are transported in one motor vehicle, the requirements of subparts C through H of part 172, and Part 177 of this subchapter do not apply. Lighter refills covered under this paragraph must be packaged in rigid, strong outer packagings meeting the general packaging requirements of subpart B of this part. Outer packagings must be plainly and durably marked, on two opposing sides or ends, with the word ''LIGHTER REFILLS'' and the number of devices contained therein in letters measuring at least 20 mm (0.79 in) in height. No person may offer for transportation or transport the lighter refills or prepare the lighter refills for shipment unless that person has been specifically informed of the requirements of this section.

(i) *Consumer commodities.* A limited quantity which conforms to the provisions of paragraph (a)(1), (a)(3), (a)(5), or (b) of this section and is a ''consumer commodity'' as defined in §171.8 of this subchapter, may be renamed ''consumer commodity'' and reclassed as ORM–D material. Each package may not exceed 30 kg (66 pounds) gross weight. In addition to the exceptions provided by paragraphs (a) and (b) of this section—

(1) Outside packagings are not required to be marked ''INSIDE CONTAINERS COMPLY WITH PRESCRIBED REGULATIONS'';

(2) Shipments of ORM–D materials are not subject to the shipping paper requirements of subpart C of part 172 of this subchapter, unless the material meets the definition of a hazardous substance, a hazardous waste, or a marine pollutant or unless offered for transportation or transported by aircraft; and

(3) Shipments of ORM–D materials are eligible for the exceptions provided in §173.156.

(j) *Aerosols and receptacles small, containing gas with a capacity of less than 50 mL.* Aerosols, as defined in §171.8 of this subchapter, and receptacles small,

containing gas, with a capacity not exceeding 50 mL (1.7 oz.) and with a pressure not exceeding 970 kPa (141 psig) at 55 °C (131 °F), containing no hazardous materials other than a Division 2.2 gas, are not subject to the requirements of this subchapter. The pressure limit may be increased to 2,000 kPa (290 psig) at 55 °C (131 °F) provided the aerosols are transported in outer packages that conform to the packaging requirements of Subpart B of this part. This paragraph (j) does not apply to a self-defense spray (*e.g.*, pepper spray).

(k) *Aerosols for recycling or disposal.* Aerosols, as defined in §171.8 of this subchapter, containing a limited quantity which conforms to the provisions of paragraph (a)(3), (a)(5), (b)(1), (b)(2), or (b)(3) of this section are not subject to the 30 kg (66 pounds) gross weight limitation when transported by motor vehicle for purposes of recycling or disposal under the following conditions:

(1) The strong outer packaging and its contents must not exceed a gross weight of 500 kg (1,100 pounds);

(2) Each aerosol container must be secured with a cap to protect the valve stem or the valve stem must be removed; and

(3) The packaging must be offered for transportation or transported by—

(i) Private or contract motor carrier; or

(ii) Common carrier in a motor vehicle under exclusive use for such service.

(l) For additional exceptions, also see §173.307.

(l) For additional exceptions, also see §173.307.

[Amdt. 173–94, 41 FR 16079, Apr. 15, 1976]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting §173.306, see the List of CFR Sections Affected which appears in the Finding Aids section of the printed volume and on GPO Access.

§173.307 Exceptions for compressed gases.

(a) The following materials are not subject to the requirements of this subchapter:

(1) Carbonated beverages.

(2) Tires when inflated to pressures not greater than their rated inflation pressures. For transportation by air, tires and tire assemblies must meet the conditions in §175.8(b)(4) of this subchapter.

(3) Balls used for sports.

(4) Refrigerating machines, including dehumidifiers and air conditioners, and components thereof, such as precharged tubing containing:

(i) 12 kg (25 pounds) or less of a non-flammable, non-toxic gas;

(ii) 12 L (3 gallons) or less of ammonia solution (UN2672);

(iii) Except when offered or transported by air, 12 kg (25 pounds) or less of a flammable, non-toxic gas;

(iv) Except when offered or transported by air or vessel, 20 kg (44 pounds) or less of a Group A1 refrigerant specified in ANSI/ASHRAE Standard 15 (IBR, see §171.7 of this subchapter); or

(v) 100 g (4 ounces) or less of a flammable, non-toxic liquefied gas.

(5) Manufactured articles or apparatuses, each containing not more than 100 mg (0.0035 ounce) of inert gas and packaged so that the quantity of inert gas per package does not exceed 1 g (0.35 ounce).

(b) [Reserved]

[Amdt. 173–94, 41 FR 16081, Apr. 15, 1976, as amended by Amdt. 173–135, 45 FR 13090, Feb. 28, 1980; 65 FR 50462, Aug. 18, 2000; 68 FR 45038, July 31, 2003; 68 FR 75745, Dec. 31, 2003; 69 FR 76174, Dec. 20, 2004; 71 FR 14604, Mar. 22, 2006; 74 FR 2266, Jan. 14, 2009]

§173.308 Lighters.

(a) *General requirements.* No person may offer for transportation or transport a lighter (see §171.8 of this subchapter) containing a Division 2.1 (flammable gas) material except under the following conditions:

(1) The lighter must contain a fuel reservoir not exceeding 4 fluid ounces capacity (7.22 cubic inches), and must contain not more than 10 grams (0.35 ounce) of flammable gas.

(2) The maximum filling density may not exceed 85 percent of the volumetric capacity of each fluid reservoir at 15 °C (59 °F).

(3) Each lighter design, including closures, must be capable of withstanding, without leakage or rupture, an internal pressure of at least two times the pressure of the flammable gas at 55 °C (131 °F).

(4) Each appropriate lighter design must be examined and successfully tested by a person or agency (authorized testing agency) who is authorized by the Associate Administrator to perform such examination and testing under the provisions of subpart E of part 107 of this chapter and who—

(i) Has the equipment necessary to perform the testing required to the level of accuracy required;

(ii) Is able to demonstrate, upon request, the knowledge of the testing procedures and requirements of the HMR relative to lighters;

(iii) Does not manufacture or market lighters, is not financially dependent or owned in whole or in part, by any entity that manufactures or markets lighters;

(iv) Is a resident of the United States; and

(v) Performs all examination and testing in accordance with the requirements of paragraph (b)(3) and (4) of this section.

(5) The Associate Administrator will assign an identification code to each person who is authorized to examine and test lighters. This identification code must be incorporated into a unique test report identifier for each successfully tested lighter design.

(b) *Examination and testing of lighter design types*—(1) *Lighter design type definition.* A new lighter design is one that has never been examined and tested or one that differs from a previous design in any manner that may affect the escape (leakage) of gas. Lighter characteristics that may affect the escape of gas include changes in materials of construction, ignition mechanism, burner valve design, wall thickness, sealing materials, and type of fuel (e.g., vapor pressure differences).

(2) *Lighter samples submitted for examination and testing.* Samples of a new lighter design are excepted from the requirements of (a)(4) and (d) of this section and may be offered for transportation and transported under the following conditions:

(i) The samples must be transported only to an authorized testing agency;

(ii) No more than 12 lighters may be packaged in a single outer packaging;

(iii) Inner packagings must conform to the requirements of paragraph (c)(1) of this section. For transportation by aircraft, intermediate or outer packagings must meet the pressure differential requirements of §173.27(c) of this part;

(iv) The outer packaging must conform to the requirements of Subpart M of Part 178 of this subchapter at the Packing Group I performance level and to the requirements of §173.24 of this subpart;

(v) The word ''sample'' must appear on the shipping paper as part of the proper shipping name or in association with the basic description; and

(vi) In addition to other required markings and labels, the package must be marked ''SAMPLE FOR EXAMINATION AND TESTING.''

(vii) All other applicable requirements of this subchapter must be met.

(3) *Examination and testing of sample lighters by an authorized testing agency.* Each sample lighter must be examined for conformance with paragraph (a) of this section by a person authorized by the Associate Administrator. In addition, lighters must be subjected to the following leakage test:

(i) A minimum of six lighters must be examined and tested at one time. Store the lighters in a desiccator for 24 hours. After drying, weigh each lighter on an analytical balance capable of accurately measuring to within 1/10 of a milligram (0.0001 grams).

(ii) After weighing, place the lighters together in an explosion-proof, controlled-temperature laboratory oven capable of maintaining 38 ± 1 °C (100 ± 2 °F) for 96 continuous hours (4 days). At the end of 96 hours, remove the lighters from the oven and place them in the same desiccator and allow the lighters to cool to ambient temperature.

(iii) After cooling, weigh each lighter and determine the net weight differences for each lighter tested (subtract the mass after oven exposure from the original mass before oven exposure).

(iv) Weight losses must be assessed to determine the quantity of gas that leaked from the lighters and from the weight change as a result of absorbed moisture. If the net weight has increased, the test facility must run the required test using six empty lighters

in parallel with the six filled lighters. The parallel tests are conducted to determine the weight of moisture absorbed in the plastic in order to determine the weight loss of the lighters from gas leakage.

(v) If the net weight loss for any one of the six lighters exceeds 20 milligrams (0.020 grams), the design must be rejected.

(vi) Lighters manufactured to a rejected lighter design may not be offered for transportation or transported in commerce unless approved in writing by the Associate Administrator.

(4) *Recordkeeping requirements.* (i) Following the examination of each new lighter design, the person or agency that conducted the examination and test must prepare a test report and make that test report available to the manufacturer. At a minimum, the test report must contain the following information:

(A) Name and address of test facility;

(B) Name and address of applicant;

(C) A test report identifier, that is, the authorized person or agency identifier code immediately followed by an alpha/numeric identifier of four or more characters assigned to the specific lighter design by the authorized person or agency (e.g., ''LAA****,'' where, ''LAA'' is the identification code assigned to the authorized person or agency by the Associate Administrator and ''****'' is replaced with the unique test report identifier assigned to the specific lighter design by the authorized person or agency);

(D) Manufacturer of the lighter. For a foreign manufacturer, the U.S. agent or importer must be identified;

(E) Description of the lighter design type (e.g., model, dimensions, ignition mechanism, reservoir capacity, lot/batch number) in sufficient detail to ensure conformance with paragraph (b)(4)(iii) of this section; and

(F) A certification by the authorized testing agency that the lighter design conforms to paragraph (a) of this section and passes or does not pass the required leakage test in paragraph (b) of this section.

(ii) For as long as any lighter design is in production and for at least three years thereafter, a copy of each lighter's test report must be maintained by the authorized testing agency that performed the examination and testing and the manufacturer of the design. For a foreign manufacturer, each test report must be maintained in accordance with this paragraph by the foreign manufacturer's U.S. agent or importer.

(iii) Test reports must be traceable to a specific lighter design and must be made available to a representative of the Department upon request.

(5) *Transitional provisions.* Until January 1, 2012, approval numbers issued by the Associate Administrator prior to January 1, 2007 may continue to be marked on packages and annotated on shipping papers, where applicable. After that time, previously issued approvals (*i.e.,* T-***) will no longer be valid and each lighter design currently in production must be re-examined and tested under the provisions of this section.

(c) *Packaging requirements*—(1) *Inner containment.* Lighters must be placed in an inner packaging that is designed to prevent movement of the lighters and inadvertent ignition or leakage. The ignition device and gas control lever of each lighter must be designed, or securely sealed, taped, or otherwise fastened or packaged to protect against accidental functioning or leakage of the contents during transport. If lighters are packed vertically in a plastic tray, a plastic, fiberboard or paperboard partition must be used to prevent friction between the ignition device and the inner packaging.

(2) *Outer packaging.* Lighters and their inner packagings must be tightly packed and secured against movement in any rigid specification outer packaging authorized in Subpart L of Part 178 of this subchapter at the Packing Group II performance level.

(d) *Shipping paper and marking requirements.* (1) In addition to the requirements of subpart C of part 172, shipping papers must be annotated with the lighter design test report identifier (see paragraph (b)(4)(i)(C) of this section) traceable to the test report assigned to the lighters or, if applicable, the previously issued approval number (*i.e.,* T***), in association with the basic description.

(2) In addition to the requirements of subpart D of part 172, a lighter design

test report identifier (see paragraph (b)(4)(i)(C) of this section) or, if applicable, the previously issued approval number (*i.e.*, T***), must be marked on a package containing lighters.

(3) For transportation by vessel in a closed transport vehicle or a closed freight container, the following warning must be affixed to the access doors:

WARNING—MAY CONTAIN EXPLOSIVE MIXTURES WITH AIR—KEEP IGNITION SOURCES AWAY WHEN OPENING

The warning must be on a contrasting background and must be in letters measuring at least 12.7 mm (0.5 inch) in height.

(e) *Exceptions*—(1) *Common or contract carriage.* For highway transportation by common or contract carrier, when no more than 1,500 lighters covered by this section are transported in one motor vehicle, the requirements of subparts C through H of part 172, and Part 177 of this subchapter do not apply. Lighters transported in accordance with this paragraph are also excepted from the specification packaging, shipping paper, and marking requirements specified in §§173.308(c) and (d). Inner packagings must conform to paragraph (c)(1) of this section. Lighters must be further packaged in rigid, strong outer packagings meeting the general packaging requirements of subpart B of part 173. Outer packagings must be plainly and durably marked, on two opposing sides or ends, with the word ''LIGHTERS'' and the number of devices contained therein in letters measuring at least 20 mm (0.79 in) in height. In addition, the package must include the test report identifier for each lighter design as specified in paragraph (b)(4)(i)(C) of this section or, if applicable, the previously issued approval number (*i.e.*, T***). The test report identifier or approval number must be durable, legible, in English, and located in, attached to, or marked directly on the package. No person may offer for transportation or transport the lighters or prepare the lighters for shipment unless that person has been specifically informed of the requirements of this section.

(2) *Private carriage.* For highway transportation by a private carrier, lighters that have been examined and successfully tested in accordance with this section are not subject to any other requirements of this subchapter under the following conditions:

(i) No person may offer for transportation or transport the lighters or prepare the lighters for shipment unless that person has been specifically informed of the requirements of this section;

(ii) Lighters must be placed in an inner packaging that is designed to prevent accidental activation of the ignition device or valve, release of gas, and movement of the lighters (*e.g.*, tray, blister pack, etc.);

(iii) Inner packagings must be placed in a securely closed rigid outer packaging that limits movement of the inner packagings and protects them from damage;

(iv) The outer package may contain not more than 300 lighters;

(v) A transport vehicle may carry not more than 1,500 lighters at any one time;

(vi) The lighters may not be placed in an outer packaging with other hazardous materials; and

(vii) Outer packagings must be plainly and durably marked with the words ''LIGHTERS, excepted quantity.''

[71 FR 3427, Jan. 23, 2006, as amended at 73 FR 57006, Oct. 1, 2008]

§173.309 Fire extinguishers.

(a) Fire extinguishers charged with a limited quantity of compressed gas to not more than 1660 kPa (241 psig) at 21 °C (70 °F) are excepted from labeling (except when offered for transportation by air) and the specification packaging requirements of this subchapter when shipped under the following conditions. In addition, shipments are not subject to subpart F of part 172 of this subchapter, to part 174 of this subchapter except §174.24 or to part 177 of this subchapter except §177.817.

(1) Each fire extinguisher must have contents which are nonflammable, nonpoisonous, and noncorrosive as defined under this subchapter.

(2) Each fire extinguisher must be shipped as an inner packaging.

(3) Nonspecification cylinders are authorized subject to the following conditions:

(i) The internal volume of each cylinder may not exceed 18 L (1,100 cubic inches). For fire extinguishers not exceeding 900 mL (55 cubic inches) capacity, the liquid portion of the gas plus any additional liquid or solid must not completely fill the container at 55 °C (130 °F). Fire extinguishers exceeding 900 mL (55 cubic inches) capacity may not contain any liquefied compressed gas;

(ii) Each fire extinguisher manufactured on and after January 1, 1976, must be designed and fabricated with a burst pressure of not less than six times its charged pressure at 21 °C (70 °F) when shipped;

(iii) Each fire extinguisher must be tested, without evidence of failure or damage, to at least three times its charged pressure at 21 °C (70 °F) but not less than 825 kPa (120 psig) before initial shipment, and must be marked to indicate the year of the test (within 90 days of the actual date of the original test) and with the words ''MEETS DOT REQUIREMENTS.'' This marking is considered a certification that the fire extinguisher is manufactured in accordance with the requirements of this section. The words ''This extinguisher meets all requirements of 49 CFR 173.306'' may be displayed on fire extinguishers manufactured prior to January 1, 1976; and

(iv) For any subsequent shipment, each fire extinguisher must be in compliance with the retest requirements of the Occupational Safety and Health Administration Regulations of the Department of Labor, 29 CFR 1910.157.

(4) Specification 2P or 2Q (§§ 178.33 and 178.33a of this subchapter) inner nonrefillable metal packagings are authorized for use as fire extinguishers subject to the following conditions:

(i) The liquid portion of the gas plus any additional liquid or solid may not completely fill the packaging at 55 °C (130 °F);

(ii) Pressure in the packaging shall not exceed 1250 kPa (181 psig) at 55 °C (130 °F). If the pressure exceeds 920 kPa (141 psig) at 55 °C (130 °F), but does not exceed 1100 kPa (160 psig) at 55 °C (130 °F), a specification DOT 2P inner metal packaging must be used; if the pressure exceeds 1100 kPa (160 psig) at 55 °C (130 °F), a specification DOT 2Q inner metal packaging must be used. The metal packaging must be capable of withstanding, without bursting, a pressure of one and one-half times the equilibrium pressure of the contents at 55 °C (130 °F); and

(iii) Each completed inner packaging filled for shipment must have been heated until the pressure in the container is equivalent to the equilibrium pressure of the contents at 55 °C (130 °F) without evidence of leakage, distortion, or other defect.

(b) Specification 3A, 3AA, 3E, 3AL, 4B, 4BA, 4B240ET or 4BW (§§ 178.36, 178.37, 178.42, 178.46, 178.50, 178.51, 178.55 and 178.61 of this subchapter) cylinders are authorized for use as fire extinguishers.

[Amdt. 173–235, 58 FR 50503, Sept. 27, 1993, as amended by Amdt. 173–138, 59 FR 49134, Sept. 26, 1994; Amdt. 173–258, 61 FR 51240, Oct. 1, 1996; 66 FR 45380, 45381, Aug. 28, 2001; 71 FR 54395, Sept. 14, 2006]

§ 173.310 Exceptions for radiation detectors.

Radiation detectors, radiation sensors, electron tube devices, or ionization chambers, herein referred to as ''radiation detectors,'' that contain only Division 2.2 gases, are excepted from the specification packaging in this subchapter and, except when transported by air, from labeling and placarding requirements of this subchapter when designed, packaged, and transported as follows:

(a) Radiation detectors must be single-trip, hermetically sealed, welded metal inside containers that will not fragment upon impact.

(b) Radiation detectors must not have a design pressure exceeding 4.83 MPa (700 psig) and a capacity exceeding 355 fluid ounces (641 cubic inches). They must be designed and fabricated with a burst pressure of not less than three times the design pressure if the radiation detector is equipped with a pressure relief device, and not less than four times the design pressure if the detector is not equipped with a pressure relief device.

(c) Radiation detectors must be shipped in a strong outer packaging capable of withstanding a drop test of at least 1.2 meters (4 feet) without breakage of the radiation detector or rupture

of the outer packaging. If the radiation detector is shipped as part of other equipment, the equipment must be packaged in strong outer packaging or the equipment itself must provide an equivalent level of protection.

(d) Emergency response information accompanying each shipment and available from each emergency response telephone number for radiation detectors must identify those receptacles that are not fitted with a pressure relief device and provide appropriate guidance for exposure to fire.

[75 FR 27215, May 14, 2010]

§ 173.312 Requirements for shipment of MEGCs.

(a) *General requirements.* (1) Unless otherwise specified, a MEGC is authorized for the shipment of liquefied and non-liquefied compressed gases. Each pressure receptacle contained in a MEGC must meet the requirements in §§ 173.301, 173.301b, 173.302b and 173.304b, as applicable.

(2) The MEGC must conform to the design, construction, inspection and testing requirements prescribed in § 178.75 of this subchapter.

(3) No person may offer or accept a hazardous material for transportation in a MEGC that is damaged to such an extent that the integrity of the pressure receptacles or the MEGC's structural or service equipment may be affected.

(4) No person may fill or offer for transportation a pressure receptacle in a MEGC if the pressure receptacle or the MEGC is due for periodic requalification, as prescribed in subpart C to part 180 of this subchapter. However, this restriction does not preclude transportation of pressure receptacles filled and offered for transportation prior to the requalification due date.

(5) Prior to filling and offering a MEGC for transportation, the MEGC's structural and service equipment must be visually inspected. Any unsafe condition must be corrected before the MEGC is offered for transportation. All required markings must be legible.

(6) Except for Division 2.2 permanent gases, each pressure receptacle must be equipped with an individual shutoff valve that must be tightly closed while in transit. For Division 2.1, Division 2.2 liquefied gases and 2.3 gases, the manifold must be designed so that each pressure receptacle can be filled separately and be kept isolated by a valve capable of being closed during transit. For Division 2.1 gases, the pressure receptacles must be isolated by a valve into assemblies of not more than 3,000 L.

(b) *Filling.* (1) A MEGC may not be filled to a pressure greater than the lowest marked working pressure of any pressure receptacle. A MEGC may not be filled above its marked maximum permissible gross mass.

(2) After each filling, the shipper must verify the leakproofness of the closures and equipment. Each fill opening must be closed by a cap or plug.

(c) *Damage protection.* During transportation, a MEGC must be protected against damage to the pressure receptacles and service equipment resulting from lateral and longitudinal impact and overturning as prescribed in § 178.75 of this subchapter.

[71 FR 33884, June 12, 2006]

§ 173.313 UN Portable Tank Table for Liquefied Compressed Gases.

The UN Portable Tank Table for Liquefied Compressed Gases is referenced in § 172.102(c)(7)(iii) of this subchapter for portable tanks that are used to transport liquefied compressed gases. The table applies to each liquefied compressed gas that is identified with Special Provision T50 in Column (7) of the § 172.101 Table. In addition to providing the UN identification number and proper shipping name, the table provides maximum allowable working pressures, bottom opening requirements, pressure relief device requirements, and degree of filling requirements for liquefied compressed gas permitted for transportation in a T50 portable tank. In the minimum test pressure column, ''small'' means a portable tank with a diameter of 1.5 meters or less when measured at the widest part of the shell, ''sunshield'' means a portable tank with a shield covering at least the upper third of the shell, ''bare'' means no sunshield or insulation is provided, and ''insulated'' means a complete cladding of sufficient

thickness of insulating material necessary to provide a minimum conductance of not more than 0.67 w/m²/k. In the pressure relief requirements column, the word ''Normal'' denotes that a frangible disc as specified in §178.276(e)(3) of this subchapter is not required.

UN PORTABLE TANK TABLE FOR LIQUEFIED COMPRESSED GASES

UN No.	Non-refrigerated liquefied compressed gases	Minimum design pressure (bar) small; bare; sunshield; insulated	Openings below liquid level	Pressure relief requirements (*See* §178.276(e))	Maximum filling density (kg/l)
1005	Ammonia, anhydrous	29.0 25.7 22.0 19.7	Allowed	§178.276(e)(3)	0.53
1009	Bromotrifluoromethane or Refrigerant gas R 13B1.	38.0 34.0 30.0 27.5	Allowed	Normal	1.13
1010	Butadienes, stabilized	7.5 7.0 7.0 7.0	Allowed	Normal	0.55
1011	Butane	7.0 7.0 7.0 7.0	Allowed	Normal	0.51
1012	Butylene	8.0 7.0 7.0 7.0	Allowed	Normal	0.53
1017	Chlorine	19.0 17.0 15.0 13.5	Not Allowed	§178.276(e)(3)	1.25
1018	Chlorodifluoromethane or Refrigerant gas R 22.	26.0 24.0 21.0 19.0	Allowed	Normal	1.03
1020	Chloropentafluoroethane or Refrigerant gas R 115.	23.0 20.0 18.0 16.0	Allowed	Normal	1.06
1021	1-Chloro-1,2,2,2-tetrafluoroethane or Refrigerant gas R 124.	10.3 9.8 7.9 7.0	Allowed	Normal	1.2
1027	Cyclopropane	18.0 16.0 14.5 13.0	Allowed	Normal	0.53
1028	Dichlorodifluoromethane or Refrigerant gas R 12.	16.0 15.0 13.0 11.5	Allowed	Normal	1.15
1029	Dichlorofluoromethane or Refrigerant gas R 21.	7.0 7.0 7.0 7.0	Allowed	Normal	1.23
1030	1,1-Difluoroethane or Refrigerant gas R 152a.	16.0 14.0 12.4 11.0	Allowed	Normal	0.79
1032	Dimethylamine, anhydrous	7.0 7.0 7.0 7.0	Allowed	Normal	0.59

UN PORTABLE TANK TABLE FOR LIQUEFIED COMPRESSED GASES—Continued

UN No.	Non-refrigerated liquefied compressed gases	Minimum design pressure (bar) small; bare; sunshield; insulated	Openings below liquid level	Pressure relief requirements (*See* § 178.276(e))	Maximum filling density (kg/l)
1033	Dimethyl ether	15.5 13.8 12.0 10.6	Allowed	Normal	0.58
1036	Ethylamine	7.0 7.0 7.0 7.0	Allowed	Normal	0.61
1037	Ethyl chloride	7.0 7.0 7.0 7.0	Allowed	Normal	0.8
1040	Ethylene oxide with nitrogen up to a total pressure of 1MPa (10 bar) at 50 °C.	Only authorized in 10 bar insulated portable tanks—	Not Allowed	§ 178.276(e)(3)	0.78
1041	Ethylene oxide and carbon dioxide mixture with more than 9% but not more than 87% ethylene oxide.	See MAWP definition in § 178.276(a)	Allowed	Normal	*See* § 173.32(f)
1055	Isobutylene	8.1 7.0 7.0 7.0	Allowed	Normal	0.52
1060	Methyl acetylene and propadiene mixture, stabilized.	28.0 24.5 22.0 20.0	Allowed	Normal	0.43
1061	Methylamine, anhydrous	10.8 9.6 7.8 7.0	Allowed	Normal	0.58
1062	Methyl bromide	7.0 7.0 7.0 7.0	Not Allowed	§ 178.276(e)(3)	1.51
1063	Methyl chloride *or* Refrigerant gas R 40	14.5 12.7 11.3 10.0	Allowed	Normal	0.81
1064	Methyl mercaptan	7.0 7.0 7.0 7.0	Not Allowed	§ 178.276(e)(3)	0.78
1067	Dinitrogen tetroxide	7.0 7.0 7.0 7.0	Not Allowed	§ 178.276(e)(3)	1.3
1075	Petroleum gas, liquefied	See MAWP definition in § 178.276(a)	Allowed	Normal	See § 173.32(f)
1077	Propylene	28.0 24.5 22.0 20.0	Allowed	Normal	0.43
1078	Refrigerant gas, n.o.s.	See MAWP definition in § 178.276(a)	Allowed	Normal	See § 173.32(f)
1079	Sulphur dioxide	11.6 10.3 8.5 7.6	Not Allowed	§ 178.276(e)(3)	1.23
1082	Trifluorochloroethylene, stabilized *or* Refrigerant gas R 1113.	17.0 15.0 13.1 11.6	Not Allowed	§ 178.276(e)(3)	1.13
1083	Trimethylamine, anhydrous	7.0 7.0	Allowed	Normal	0.56

UN PORTABLE TANK TABLE FOR LIQUEFIED COMPRESSED GASES—Continued

UN No.	Non-refrigerated liquefied compressed gases	Minimum design pressure (bar) small; bare; sunshield; insulated	Openings below liquid level	Pressure relief requirements (*See* § 178.276(e))	Maximum filling density (kg/l)
		7.0			
		7.0			
1085	Vinyl bromide, stabilized	7.0	Allowed	Normal	1.37
		7.0			
		7.0			
		7.0			
1086	Vinyl chloride, stabilized	10.6	Allowed	Normal	0.81
		9.3			
		8.0			
		7.0			
1087	Vinyl methyl ether, stabilized	7.0	Allowed	Normal	0.67
		7.0			
		7.0			
		7.0			
1581	Chloropicrin and methyl bromide mixture.	7.0	Not Allowed	§ 178.276(e)(3)	1.51
		7.0			
		7.0			
		7.0			
1582	Chloropicrin and methyl chloride mixture.	19.2	Not Allowed	§ 178.276(e)(3)	0.81
		16.9			
		15.1			
		13.1			
1858	Hexafluoropropylene compressed *or* Refrigerant gas R 1216.	19.2	Allowed	Normal	1.11
		16.9			
		15.1			
		13.1			
1912	Methyl chloride and methylene chloride mixture.	15.2	Allowed	Normal	0.081
		13.0			
		11.6			
		10.1			
NA, 1954	Insecticide gases, *flammable*, n.o.s.	See MAWP definition in § 178.276(a)	Allowed	Normal	§ 173.32(f)
1958	1,2-Dichloro-1,1,2,2-tetrafluoroethane or Refrigerant gas R 114.	7.0	Allowed	Normal	1.3
		7.0			
		7.0			
		7.0			
1965	Hydrocarbon gas, mixture liquefied, n.o.s..	See MAWP definition in 178.276(a)	Allowed	Normal	See § 173.32(f)
1969	Isobutane	8.5	Allowed	Normal	0.49
		7.5			
		7.0			
		7.0			
1973	Chlorodifluoromethane and chloropentafluoroethane mixture with fixed boiling point, with approximately 49% chlorodifluoromethane or Refrigerant gas R 502.	28.3	Allowed	Normal	1.05
		25.3			
		22.8			
		20.3			
1974	Chlorodifluorobromomethane *or* Refrigerant gas R 12B1.	7.4	Allowed	Normal	1.61
		7.0			
		7.0			
		7.0			
1976	Octafluorocyclobutane *or* Refrigerant gas RC 318.	8.8	Allowed	Normal	1.34
		7.8			
		7.0			
		7.0			
1978	Propane	22.5	Allowed	Normal	0.42
		20.4			

UN PORTABLE TANK TABLE FOR LIQUEFIED COMPRESSED GASES—Continued

UN No.	Non-refrigerated liquefied compressed gases	Minimum design pressure (bar) small; bare; sunshield; insulated	Openings below liquid level	Pressure relief requirements (*See* § 178.276(e))	Maximum filling density (kg/l)
		18.0			
		16.5			
1983	1-Chloro-2,2,2-trifluoroethane or Refrigerant gas R 133a.	7.0	Allowed	Normal	1.18
		7.0			
		7.0			
		7.0			
2035	1,1,1-Trifluoroethane compressed or Refrigerant gas R 143a.	31.0	Allowed	Normal	0.76
		27.5			
		24.2			
		21.8			
2424	Octafluoropropane or Refrigerant gas R 218.	23.1	Allowed	Normal	1.07
		20.8			
		18.6			
		16.6			
2517	1-Chloro-1,1-difluoroethane or Refrigerant gas R 142b.	8.9	Allowed	Normal	0.99
		7.8			
		7.0			
		7.0			
2602	Dichlorodifluoromethane and difluoroethane azeotropic mixture with approximately 74% dichlorodifluoromethane or Refrigerant gas R 500.	20.0	Allowed	Normal	1.01
		18.0			
		16.0			
		14.5			
3057	Trifluoroacetyl chloride	14.6	Not allowed	§ 178.276(e)(3)	1.17
		12.9			
		11.3			
		9.9			
3070	Ethylene oxide and dichlorodifluoromethane mixture with not more than 12.5% ethylene oxide.	14.0	Allowed	§ 178.276(e)(3)	1.09
		12.0			
		11.0			
		9.0			
3153	Perfluoro (methyl vinyl ether)	14.3	Allowed	Normal	1.14
		13.4			
		11.2			
		10.2			
3159	1,1,1,2-Tetrafluoroethane or Refrigerant gas R 134a.	17.7	Allowed	Normal	1.04
		15.7			
		13.8			
		12.1			
3161	Liquefied gas, flammable, n.o.s.	See MAWP definition in § 178.276(a)	Allowed	Normal	§ 173.32(f)
3163	Liquefied gas, n.o.s.	See MAWP definition in § 178.276(a)	Allowed	Normal	§ 173.32(f)
3220	Pentafluoroethane or Refrigerant gas R 125.	34.4	Allowed	Normal	0.95
		30.8			
		27.5			
		24.5			
3252	Difluoromethane or Refrigerant gas R 32.	43.0	Allowed	Normal	0.78
		39.0			
		34.4			
		30.5			
3296	Heptafluoropropane or Refrigerant gas R 227.	16.0	Allowed	Normal	1.2
		14.0			
		12.5			
		11.0			

UN PORTABLE TANK TABLE FOR LIQUEFIED COMPRESSED GASES—Continued

UN No.	Non-refrigerated liquefied compressed gases	Minimum design pressure (bar) small; bare; sunshield; insulated	Openings below liquid level	Pressure relief requirements (*See* § 178.276(e))	Maximum filling density (kg/l)
3297	Ethylene oxide and chlorotetrafluoroethane mixture, with not more than 8.8% ethylene oxide.	8.1 7.0 7.0 7.0	Allowed	Normal	1.16
3298	Ethylene oxide and pentafluoroethane mixture, with not more than 7.9% ethylene oxide.	25.9 23.4 20.9 18.6	Allowed	Normal	1.02
3299	Ethylene oxide and tetrafluoroethane mixture, with not more than 5.6% ethylene oxide.	16.7 14.7 12.9 11.2	Allowed	Normal	1.03
3318	Ammonia solution, relative density less than 0.880 at 15 °C in water, with more than 50% ammonia.	See MAWP definition in § 178.276(a)	Allowed	§ 178.276(e)(3)	§ 173.32(f)
3337	Refrigerant gas R 404A	31.6 28.3 25.3 22.5	Allowed	Normal	0.84
3338	Refrigerant gas R 407A	31.3 28.1 25.1 22.4	Allowed	Normal	0.95
3339	Refrigerant gas R 407B	33.0 29.6 26.5 23.6	Allowed	Normal	0.95
3340	Refrigerant gas R 407C	29.9 26.8 23.9 21.3	Allowed	Normal	0.95

[69 FR 76174, Dec. 20, 2004, as amended at 70 FR 34399, June 14, 2005]

§ 173.314 Compressed gases in tank cars and multi-unit tank cars.

(a) *Definitions.* For definitions of compressed gases, see § 173.115.

(b) *General requirements.* (1) Tank car tanks containing compressed gases must not be shipped unless they were loaded by or with the consent of the owner thereof.

(2) Tank car tanks must not contain gases capable of combining chemically and must not be loaded with any gas which combines chemically with the gas previously loaded therein, until all residue has been removed and interior of tank thoroughly cleaned.

(3) For tanks of the DOT-106A and 110A class, the tanks must be placed in position and attached to car structure by the shipper.

(4) Wherever the word ''approved'' is used in this part of the regulations, it means approval by the Association of American Railroads Committee on Tank Cars as prescribed in § 179.3 of this subchapter.

(5) Each tank car used for the transportation of anhydrous ammonia or any material that meets the criteria of Division 2.1 or 2.3 must have gaskets for manway cover plates and for mounting of fittings designed (for temperature, application, media, pressure, and size) to create a positive seal so that, under conditions normally incident to transportation, there will not be an identifiable release of the material to the environment. The use of sealants to install gaskets is prohibited.

(c) *Authorized gases, filling limits for tank cars.* A compressed gas in a tank car or a multi-unit tank car must be offered for transportation in accordance with §173.31 and this section. The gases listed below must be loaded and offered for transportation in accordance with the following table:

Proper shipping name	Outage and filling limits (see note 1)	Authorized tank car class (see note 11)	Authorized tank car specification (see note 12)
Ammonia, anhydrous, or ammonia solutions > 50 percent ammonia.	Notes 2, 10	105, 112, 114, 120	105J500I, 112J500I
	Note 3	106.	
Ammonia solutions with > 35 percent, but ≤ 50 percent ammonia by mass.	Note 3	105, 109, 112, 114, 120.	
Argon, compressed	Note 4	107.	
Boron trichloride	Note 3	105, 106.	
Carbon dioxide, refrigerated liquid	Note 5	105.	
Chlorine	Note 6	105	105J600I
	125	106.	
Chlorine trifluoride	Note 3	106, 110.	
Chlorine pentafluoride	Note 3	106, 110.	
Dimethyl ether	Note 3	105, 106, 110, 112, 114, 120.	
Dimethylamine, anhydrous	Note 3	105, 106, 112.	
Dinitrogen tetroxide, inhibited	Note 3	105, 106, 112	105J500I
Division 2.1 materials not specifically identified in this table.	Notes 9, 10	105, 106, 110, 112, 114, 120.	
Division 2.2 materials not specifically identified in this table.	Note 3	105, 106, 109, 110, 112, 114, 120.	
Division 2.3 Zone A materials not specifically identified in this table.	None	See §173.245.	105J600I
Division 2.3 Zone B materials not specifically identified in this table.	Note 3	105, 106, 110, 112, 114, 120.	105J600I
Division 2.3 Zone C materials not specifically identified in this table.	Note 3	105, 106, 110, 112, 114, 120.	105J500I
Division 2.3 Zone D materials not specifically identified in this table.	Note 3	105, 106, 109, 110, 112, 114, 120.	105J500I, 112J500I
Ethylamine	Note 3	105, 106, 110, 112, 114, 120.	
Helium, compressed	Note 4	107.	
Hydrogen	Note 4	107.	
Hydrogen chloride, refrigerated liquid	Note 7	105	105J600I, 112S600I
Hydrogen sulfide	Note 3	105, 106, 110, 112, 114, 120.	105J600I
Hydrogen sulfide, liquefied	68	106.	
Methyl bromide	Note 3	105, 106	105J500I
Methyl chloride	Note 3	105, 106, 112.	
Methyl mercaptan	Note 3	105, 106	105J500I
Methylamine, anhydrous	Note 3	105, 106, 112.	
Nitrogen, compressed	Note 4	107.	
Nitrosyl chloride	124	105	105J500I
	110	106.	
Nitrous oxide, refrigerated liquid	Note 5	105.	
Oxygen, compressed	Note 4	107.	
Phosgene	Note 3	106.	
Sulfur dioxide, liquefied	125	105, 106, 110	105J500I
Sulfuryl fluoride	120	105.	
Vinyl fluoride, stabilized	Note 8	105.	

NOTES: 1. The percent filling density for liquefied gases is hereby defined as the percent ratio of the mass of gas in the tank to the mass of water that the tank will hold. For determining the water capacity of the tank in kilograms, the mass of 1 L of water at 15.5 °C in air is 1 kg. (the mass of one gallon of water at 60 °F in air is 8.32828 pounds).

2. The liquefied gas must be loaded so that the outage is at least two percent of the total capacity of the tank at the reference temperature of 46 °C (115 °F) for a noninsulated tank; 43 °C (110 °F) for a tank having a thermal protection system incorporating a metal jacket that provides an overall thermal conductance at 15.5 °C (60 °F) of no more than 10.22 kilojoules per hour per square meter per degree Celsius (0.5 Btu per hour/per square foot/per degree F) temperature differential; and 41 °C (105 °F) for an insulated tank having an insulation system incorporating a metal jacket that provides an overall thermal conductance at 15.5 °C (60 °F) of no more than 1.5333 kilojoules per hour per square meter per degree Celsius (0.075 Btu per hour/per square foot/per degree F) temperature differential.

3. The requirements of §173.24b(a) apply.

4. The gas pressure at 54.44 °C (130 °F.) in any non-insulated tank car may not exceed 7/10 of the marked test pressure, except that a tank may be charged with helium to a pressure 10 percent in excess of the marked maximum gas pressure at 54.44 °C (130 °F.) of each tank.

5. The liquid portion of the gas at -17.77 °C (0 °F.) must not completely fill the tank.

6. The maximum permitted filling density is 125 percent. The quantity of chlorine loaded into a single unit-tank car may not be loaded in excess of the normal lading weights nor in excess of 81.65 Mg (90 tons).

7. 89 percent maximum to 80.1 percent minimum at a test pressure of 6.2 Bar (90 psig).

8. 59.6 percent maximum to 53.6 percent minimum at a test pressure of 7.2 Bar (105 psig).

9. For a liquefied petroleum gas, the liquefied gas must be loaded so that the outage is at least one percent of the total capacity of the tank at the reference temperature of 46 °C (115 °F) for a noninsulated tank; 43 °C (110 °F) for a tank having a thermal protection system incorporating a metal jacket that provides an overall thermal conductance at 15.5 °C (60 °F) of no more than 10.22 kilojoules per hour per square meter per degree Celsius (0.5 Btu per hour/per square foot/per degree F) temperature differential; and 41 °C (105 °F) for an insulated tank having an insulation system incorporating a metal jacket that provides an overall thermal conductance at 15.5 °C (60 °F) of no more than 1.5333 kilojoules per hour per square meter per degree Celsius (0.075 Btu per hour/per square foot/per degree F) temperature differential.

10. For liquefied petroleum gas and anhydrous ammonia, during the months of November through March (winter), the following reference temperatures may be used: 38 °C (100 °F) for a noninsulated tank; 32 °C (90 °F) for a tank having a thermal protection system incorporating a metal jacket that provides an overall thermal conductance at 15.5 °C (60 °F) of no more than 10.22 kilojoules per hour per square meter per degree Celsius (0.5 Btu per hour/per square foot/per degree F) temperature differential; and 29 °C (85 °F) for an insulated tank having an insulation system incorporating a metal jacket and insulation that provides an overall thermal conductance at 15.5 °C (60 °F) of no more than 1.5333 kilojoules per hour per square meter per degree Celsius (0.075 Btu per hour/per square foot/per degree F) temperature differential. The winter reference temperatures may only be used for a tank car shipped directly to a consumer for unloading and not stored in transit. The offeror of the tank must inform each customer that the tank car was filled based on winter reference temperatures. The tank must be unloaded as soon as possible after March in order to retain the specified outage and to prevent a release of hazardous material which might occur due to the tank car becoming liquid full at higher temperatures.

11. For materials poisonous by inhalation, the single unit tank car tanks authorized are only those cars approved by the Tank Car Committee for transportation of the specified material and built prior to March 16, 2009.

12. Except as provided by paragraph (d) of this section, for materials poisonous by inhalation, fusion-welded tank car tanks built on or after March 16, 2009 used for the transportation of the PIH materials noted, must meet the applicable authorized tank car specification and must be equipped with a head shield as prescribed in § 179.16(c)(1).

(d) *Alternative tank car tanks for materials poisonous by inhalation.* (1) As an alternative to the authorized tank car specification noted in the column 4 of the table in paragraph (c) of this section, a car of the same authorized tank car specification but of the next lower test pressure, as prescribed in column 5 of the table at § 179.101–1, may be used provided both of the following conditions are met:

(i) The difference between the alternative and the required minimum plate thicknesses, based on the calculation prescribed in § 179.100–6 of this subchapter, is added to the alternative tank car jacket and head shield. When the jacket and head shield are made from any authorized steel with a minimum tensile strength from 70,000 p.s.i. to 80,000 p.s.i., but the required minimum plate thickness calculation is based on steel with a minimum tensile strength of 81,000 p.s.i., the thickness to be added to the jacket and head shield must be increased by a factor of 1.157. Forming allowances for heads are not required to be considered when calculating thickness differences as prescribed in this paragraph.

(ii) The tank car jacket and head shield must be manufactured from carbon steel plate as prescribed in § 179.100–7(a) of this subchapter.

(e) *Verification of content.* The amount of liquefied gas loaded into each tank may be determined either by measurement or calculation of the weight. If by measurement, the weight must be checked after disconnecting the loading line by the use of proper scales. If by calculation, the weight of liquefied petroleum gas, methylacetylene propadiene, stabilized, dimethylamine, methylamine anhydrous, or trimethylamine may be calculated using the outage tables supplied by the tank car owners and the specific gravities as determined at the plant, and this computation must be checked by determination of specific gravity of product after loading. Carriers may verify calculated weights by use of proper scales. The use of a fixed tube gauge device is authorized for determining the weight of methyl mercaptan in Specification 105A300W tanks instead of weighing.

(f) [Reserved]

(g) Special requirements for hydrogen chloride, refrigerated liquid, and vinyl fluoride,stabilized.

(1) The shipper shall notify the Federal Railroad Administration whenever a tank car is not received by the consignee within 20 days from the date of shipment. Notification to the Federal Railroad Administration may be made by e-mail to *Hmassist@fra.dot.gov* or telephone call to (202) 493–6229.

(2) A tank car containing hydrogen chloride, refrigerated liquid must have the auxiliary valve on the pressure relief device closed during transportation.

(3) See § 179.102–17 of this subchapter for additional requirements.

(4) Tank cars containing hydrogen chloride, refrigerated liquid, must be unloaded to such an extent that any residue remaining in the tank at a reference temperature of 32 °C (90 °F) will not actuate the reclosing pressure relief device.

(h)–(i) [Reserved]

(j) *Special requirements for materials having a primary or secondary Division 2.1 (flammable gas) hazard.* For single unit tank cars, interior pipes of loading and unloading valves, sampling devices, and gauging devices with an opening for the passage of the lading exceeding 1.52 mm (0.060 inch) diameter must be equipped with excess flow valves. For single unit tank cars constructed before January 1, 1972, gauging devices must conform to this paragraph by no later than July 1, 2006. The protective housing cover must be provided with an opening, with a weatherproof cover, above each pressure relief valve that is concentric with the discharge of the pressure relief valve and that has an area at least equal to the valve outlet area. Class DOT 109 tank cars and tank cars manufactured from aluminum or nickel plate are not authorized.

(k) *Special requirements for chlorine.* Tank cars built after September 30, 1991, must have an insulation system consisting of 5.08 cm (2 inches) glass fiber placed over 5.08 cm (2 inches) of ceramic fiber. Tank cars must have excess flow valves on the interior pipes of liquid discharge valves. Tank cars constructed to a DOT 105A500W specification may be marked as a DOT 105A300W specification with the size and type of reclosing pressure relief valves required by the marked specification.

(l) *Special requirements for hydrogen sulphide.* Each multi-unit tank car must be equipped with adequate pressure relief devices of the fusible plug type having a yield temperature not over 76.66 °C (170 °F.), and not less than 69.44 °C (157 °F.). Each device must be resistant to extrusion of the fusible alloy and leak tight at 55 °C (130 °F.). A threaded solid plug must seal each valve outlet. In addition, a metal cover must protect all valves.

(m) *Special requirements for nitrosyl chloride.* Single unit tank cars and their associated service equipment, such as venting, loading and unloading valves, and reclosing pressure relief valves, must be made of metal or clad with a material that is not subject to rapid deterioration by the lading. Multi-unit tank car tanks must be nickel-clad and have reclosing pressure relief devices incorporating a fusible plug having a yield temperature of 79.44 °C (175 °F.). Reclosing pressure relief devices must be vapor tight at 54.44 °C (130 °F.).

(n) *Special requirements for hydrogen.* Each tank car must be equipped with one or more pressure relief devices. The discharge outlet for each pressure relief device must be connected to a manifold having a non-obstructed discharge area of at least 1.5 times the total discharge area of the pressure relief devices connected to the manifold. All manifolds must be connected to a single common header having a non-obstructed discharge pointing upward and extending above the top of the car. The header and the header outlet must each have a non-obstructed discharge area at least equal to the total discharge area of the manifolds connected to the header. The header outlet must be equipped with an ignition device that will instantly ignite any hydrogen discharged through the pressure relief device.

(o) *Special requirements for carbon dioxide, refrigerated liquid and nitrous oxide, refrigerated liquid.* Each tank car must have an insulation system so that the thermal conductance is not more than 0.613 kilojoules per hour, per square meter, per degree Celsius (0.03 B.t.u. per square foot per hour, per degree Fahrenheit) temperature differential. Each tank car must be equipped with one reclosing pressure relief valve having a start-to-discharge pressure not to exceed 75 percent of the tank test pressure and one non-reclosing pressure relief valve having a rupture disc design to burst at a pressure less than the tank test pressure. The discharge capacity of each pressure relief device must be sufficient to prevent building up of pressure in the tank in excess of 82.5 percent of the test pressure of the tank. Tanks must be equipped with two regulating valves set to open at a pressure not to exceed 24.1 Bar (350 psi) on DOT 105A500W tanks and at a pressure not to exceed 27.6 Bar (400 psi) on DOT 105A600W tanks. Each regulating valve and pressure relief device must have its final discharge piped to the outside of the protective housing.

[Amdt. 173–224, 55 FR 52665, Dec. 21, 1990]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting § 173.314, see the List of CFR Sections Affected which appears in the Finding Aids section of the printed volume and on GPO Access.

§ 173.315 Compressed gases in cargo tanks and portable tanks.

(a) Liquefied compressed gases that are transported in UN portable tanks, DOT specification portable tanks, or cargo tanks must be prepared in accordance with this section, § 173.32, § 173.33 and subpart E or subpart G of part 180 of this subchapter, as applicable. For cryogenic liquid in cargo tanks, see § 173.318. For marking requirements for portable tanks and cargo tanks, see § 172.326 and § 172.328 of this subchapter, as applicable.

(1) *UN portable tanks:* UN portable tanks must be loaded and offered for transportation in accordance with portable tank provision T50 in § 172.102 of this subchapter.

(2) *Cargo tanks and DOT specification portable tanks:* Cargo tanks and DOT specification portable tanks must be loaded and offered for transportation in accordance with the following table:

Kind of gas	Maximum permitted filling density		Specification container required	
	Percent by weight (see Note 1)	Percent by volume (see par. (f) of this section)	Type (see Note 2)	Minimum design pressure (psig)
Ammonia, anhydrous or Ammonia solutions with greater than 50 percent ammonia (see Notes 14 and 17).	56	82, See Note 5	DOT-51, MC–330, MC–331; See Notes 12, 17 and 27.	265; See Note 17.
Ammonia solutions with more than 35 percent but not more than 50 percent ammonia.	See par. (c) of this section.	See Note 7	DOT-51, MC–330, MC–331; see Note 12.	100; See par. (c) of this section.
Bromotrifluoromethane (R–13B1 or H–1301); (See Note 9).	133	See Note 7	DOT-51, MC–330, MC–331.	365.
Butadiene, stabilized	See par. (b) of this section.	See par. (b) of this section.	DOT-51, MC–330, MC–331.	100.
Carbon dioxide, refrigerated liquid	See par. (c)(1) of this section.	95	.....do	200; see Note 3.
Chlorine	125	See Note 7	DOT-51, MC–330, MC–331.	225; See Notes 4 and 8.
Chlorodifluoroethane (R–142b) (1-Chloro 1,1-difluoroethane); (See Note 9).	100	See Note 7	DOT-51, MC–330, MC–331.	100.
Chlorodifluoromethane (R–22); (See Note 9).	105	See Note 7	DOT-51, MC–330, MC–331.	250.
Chloropentafluoroethane (R–115); (See Note 9).	See par. (c) of this section.	See Note 7	DOT-51, MC–330, MC–331.	See par. (c) of this section.
Chlorotrifluoromethane (R–13); (See Note 9).	See par. (c) of this section.	See Note 7	DOT-51, MC–330, MC–331.	See par. (c) of this section.
Dichlorodifluoromethane (R–12); (See Note 9).	119	See Note 7	DOT-51, MC–330, MC–331.	150.
Difluoroethane (R–152a); (See Note 9)	79	See Note 7	DOT-51, MC–330, MC–331.	150.
Dimethyl ether (see Note 16)	59	.....do	.....do	200.
Dimethylamine, anhydrous	59	See Note 7	DOT-51, MC–330, MC–331.	150.
Division 2.1, materials not specifically provided for in this table.	See par. (c) of this section.	See Note 7	DOT-51, MC–330, MC–331.	See Note 18.
Division 2.2, materials not specifically provided for in this table.	See par. (c) of this section.	See Note 7	DOT-51, MC–330, MC–331.	See Note 19.
Division 2.3, Hazard Zone A, materials not specifically provided for in this table.	See par. (c) of this section.	See Note 7	DOT-51, MC–330, MC–331; See Note 23.	See Note 20.
Division 2.3, Hazard Zone B, materials not specifically provided for in this table.	See par. (c) of this section.	See Note 7	DOT-51, MC–330, MC–331; See Note 23.	See Note 20.
Division 2.3, Hazard Zone C, materials not specifically provided for in this table.	See par. (c) of this section.	See Note 7	DOT-51, MC–330, MC–331; See Note 24.	See Note 21.
Division 2.3, Hazard Zone D, materials not specifically provided for in this table.	See par. (c) of this section.	See Note 7	DOT-51, MC–330, MC–331; See Note 25.	See Note 22.
Ethane, refrigerated liquid		See par. (c) of this section.	MC–331, MC–338	100; see Note 11.

Kind of gas	Maximum permitted filling density		Specification container required	
	Percent by weight (see Note 1)	Percent by volume (see par. (f) of this section)	Type (see Note 2)	Minimum design pressure (psig)
Ethane-propane mixture, refrigerated liquid.	.....	See par. (c) of this section.	MC–331, MC–338	275; see Note 11.
Hexafluoropropylene	110	See Note 7	DOT-51, MC–330, MC–331.	250.
Hydrogen chloride, refrigerated liquid	103.0	See Note 7	MC–331, MC–338	100; see Note 11.
	91.6	.....do	.....do	300; see Note 11.
	86.7	.....do	.....do	450; see Note 11.
Liquefied petroleum gas (see Note 15)	See par. (b) of this section.	See par. (b) of this section.	DOT-51, MC–330, MC–331; See Note 26.	See par. (c) of this section.
Methylacetylene-propadiene, stabilized (see Note 13).	53	90	DOT 51, MC 330, MC 331.	200.
Methylamine, anhydrous	60	See Note 7	DOT-51, MC–330, MC–331..	
Methyl chloride	84	88.5	.....do	150.
Methyl chloride (optional portable tank 2,000 pounds water capacity, fusible plug).	.....do	See Note 6	DOT-51	225.
Methyl mercaptan	80	90	DOT-51, MC–330, MC–331; See Note 23.	100.
Nitrous oxide, refrigerated liquid	See par. (c)(1) of this section.	95	DOT-51, MC–330, MC–331.	200; See Note 3.
Refrigerant gas, n.o.s. or Dispersant gas, n.o.s. (See Note 9).	See par. (c) of this section.	See Note 7	DOT-51, MC–330, MC–331.	See par. (c) of this section.
Sulfur dioxide (tanks not over 1,200 gallons water capacity).	125	87.5	DOT-51, MC–330, MC–331; See Note 24.	150; See Note 4.
Sulfur dioxide (tanks over 1,200 gallons water capacity).	125	87.5	DOT-51, MC–330, MC–331; See Note 24.	125; See Note 4.
Sulfur dioxide (optional portable tank 1,000–2,000 pounds water capacity, fusible plug).	125	See Note 6	DOT-51; See Note 24.	225.
Trimethylamine, anhydrous	57	See Note 7	DOT-51, MC–330, MC–331.	150.
Vinyl chloride	84 (see Note 13) ...	See Note 7	MC–330, MC–331	150.
Vinyl fluoride, stabilized	66	.....do	.....do	250; see Note 11.
Vinyl methyl ether	68	See Notes 7 and 13.	.....do	100.

NOTE 1: Maximum filling density for liquefied gases is hereby defined as the percent ratio of the weight of gas in the tank to the weight of water that the tank will hold. For determining the water capacity of the tank in pounds, the weight of a gallon (231 cubic inches) of water at 60 °F. in air shall be 8.32828 pounds.

NOTE 2: See § 173.32 for authority to use other portable tanks and for manifolding cargo tanks, see paragraph (q) of this section. Specifications MC 330 cargo tanks may be painted as specified for MC 331 cargo tanks.

NOTE 3: If cargo tanks and portable tank containers for carbon dioxide, refrigerated liquid, and nitrous oxide, refrigerated liquid, are designed to conform to the requirements in Section VIII of the ASME Code for low temperature operation (IBR, see § 171.7 of this subchapter), the design pressure may be reduced to 100 psig or the controlled pressure, whichever is greater.

NOTE 4: Material must be steel. Packagings must have a corrosion allowance of 20 percent or 0.10 inch, whichever is less, added to the metal thickness. The minimum wall thickness for chlorine packagings is 0.300 inch for stainless steel or 0.625 inch for carbon steel, including corrosion allowance.

NOTE 5: Unlagged cargo tanks and portable tank containers for liquid anhydrous ammonia may be filled to 87.5 percent by volume provided the temperature of the anhydrous ammonia being loaded into such tanks is determined to be not lower than 30 °F. or provided the filling of such tanks is stopped at the first indication of frost or ice formation on the outside surface of the tank and is not resumed until such frost or ice has disappeared.

NOTE 6: Tanks equipped with fusible plugs must be filled by weight.

NOTE 7: Tanks must be filled by weight.

NOTE 8: Chlorine packagings may be shipped only if the contents are to be unloaded at one unloading point.

NOTE 9: This gas may be transported in authorized cargo tanks and portable tanks marked ''DISPERSANT GAS,'' or ''REFRIGERANT GAS.''

NOTE 10: [Reserved]

NOTE 11: MC–330, MC–331 and MC–338 cargo tanks must be insulated. Cargo tanks must meet all the following requirements. Each tank must have a design service temperature of minus 100 °F., or no warmer than the boiling point at one atmosphere of the hazardous material to be shipped therein, whichever is colder, and must conform to the low-temperature requirements in Section VIII of the ASME Code. When the normal travel time is 24 hours or less, the tank's holding time as loaded must be at least twice the normal travel time. When the normal travel time exceeds 24 hours, the tank's holding time as loaded must be at least 24 hours greater than the normal travel time. The holding time is the elapsed time from loading until venting occurs under equilibrium conditions. The cargo tank must have an outer jacket made of steel when the cargo tank is used to transport a flammable gas.

NOTE 12: No aluminum, copper, silver, zinc or an alloy of any of these metals shall be used in packaging construction where it comes into contact with the lading.

NOTE 13: All parts of valves and safety devices in contact with contents of tank must be of a metal or other material suitably treated if necessary, which will not cause formation of any acetylides.

NOTE 14: Specifications MC 330 and MC 331 cargo tanks constructed of other than quenched and tempered steel ''(NQT)'' are authorized for all grades of anhydrous ammonia. Specifications MC 330 and MC 331 cargo tanks constructed of quenched and tempered steel ''(QT)'' (see marking requirements of § 172.328(c) of this subchapter) are authorized for anhydrous ammonia having a minimum water content of 0.2 percent by weight. Any tank being placed in anhydrous ammonia service or a tank which has been in other service or has been opened for inspection, test, or repair, must be cleaned of the previous product and must be purged of air before loading. See § 172.203(h) of this subchapter for special shipping paper requirements.

NOTE 15: Specifications MC 330 and MC 331 cargo tanks constructed of other than quenched and tempered steel (NQT) are authorized for all grades of liquefied petroleum gases. Only grades of liquefied petroleum gases determined to be ''noncorrosive'' are authorized in Specification MC 330 and MC 331 cargo tanks constructed of quenched and tempered steel (QT). ''Noncorrosive'' means the corrosiveness of the gas does not exceed the limitations for classification 1 of the ASTM Copper Strip Classifications when tested in accordance with ASTM D 1838, ''Copper Strip Corrosion by Liquefied Petroleum (LP) Gases'' (IBR, see § 171.7 of this subchapter). (For (QT) and (NQT) marking requirements, see § 172.328(c) of this subchapter. For special shipping paper requirements, see § 172.203(h) of this subchapter.)

NOTE 16: Openings, inlets, and outlets on MC 330 and MC 331 cargo tanks must conform to § 178.337–8(a) of this subchapter. MC 330 and MC 331 cargo tanks must be equipped with emergency discharge control equipment as specified in § 178.337–11(a) of this subchapter.

NOTE 17: A Specification MC-330 or MC-331 cargo tank or a nonspecification cargo tank meeting, and marked in conformance with, the edition of the ASME Code in effect when it was fabricated, may be used for the transportation of anhydrous ammonia if it:

(1) Has a minimum design pressure not lower than 250 psig;

(2) Was manufactured in conformance with the ASME Code prior to January 1, 1981, according to its ASME name plate and manufacturer's data report;

(3) Is painted white or aluminum;

(4) Complies with Note 12 of this paragraph;

(5) Has been inspected and tested in accordance with subpart E of part 180 of this subchapter as specified for MC 331 cargo tanks.

(6) Was used to transport anhydrous ammonia prior to January 1, 1981;

(7) Is operated exclusively in intrastate commerce (including its operation by a motor carrier otherwise engaged in interstate commerce) in a state where its operation was permitted by the laws of that State (not including the incorporation of this subchapter) prior to January 1, 1981; and

(8) Is operated in conformance with all other requirements of this subchapter.

NOTE 18: The minimum packaging design pressure must not be less than the vapor pressure at the reference temperature of the lading plus one percent or 173.4 kPa (25 psig), whichever is less.

NOTE 19: The minimum packaging design pressure must not be less than the vapor pressure at the reference temperature of the lading.

NOTE 20: The minimum packaging design pressure must not be less than 1.5 times the vapor pressure of the lading at 46 °C (115 °F).

NOTE 21: The minimum packaging design pressure must not be less than 1.3 times the vapor pressure of the lading at 46 °C (115 °F).

NOTE 22: The minimum packaging design pressure must not be less than 1.1 times the vapor pressure of the lading at 46 °C (115 °F).

NOTE 23: Packagings must be made of stainless steel except that steel other than stainless steel may be used in accordance with the provisions of § 173.24b(b) of this part. Thickness of stainless steel for shell and heads must be the greater of 7.62 mm (0.300 inch) or the thickness required for the packaging at its minimum design pressure.

NOTE 24: Packagings must be made of stainless steel except that steel other than stainless steel may be used in accordance with the provisions of § 173.24b(b) of this part. Thickness of stainless steel for shell and heads must be the greater of 6.35 mm (0.250 inch) or the thickness required for the packaging at its minimum design pressure. For sulphur dioxide, this Note does not apply until October 1, 1994.

NOTE 25: Packagings must be made of stainless steel except that steel other than stainless steel may be used in accordance with the provisions of § 173.24b(b) of this part. Thickness for shell and heads must be as calculated for the packaging at its minimum design pressure.

NOTE 26: Non-specification cargo tanks may be used for the transportation of liquefied petroleum gas, subject to the conditions prescribed in paragraph (k) of this section.

NOTE 27: Non-specification cargo tanks may be used for transportation of Ammonia, anhydrous and ammonia solutions with greater than 50% ammonia, subject to the conditions prescribed in paragraph (m) of this section.

(b) Maximum permitted filling densities for cargo and portable tank containers for transportation of butadiene, stabilized, and liquefied petroleum gas are as follows:

Maximum specific gravity of the liquid material at 60 °F.	Maximum permitted filling density in percent of the water-weight capacity of the tanks (percent) See Note 1	
	1200 gallons or less	Over 1200 gallons
0.473 to 0.480	38	41
0.481 to 0.488	39	42
0.489 to 0.495	40	43
0.496 to 0.503	41	44
0.504 to 0.510	42	45
0.511 to 0.519	43	46
0.520 to 0.527	44	47
0.528 to 0.536	45	48
0.537 to 0.544	46	49
0.545 to 0.552	47	50
0.553 to 0.560	48	51
0.561 to 0.568	49	52
0.569 to 0.576	50	53
0.577 to 0.584	51	54
0.585 to 0.592	52	55
0.593 to 0.600	53	56
0.601 to 0.608	54	57
0.609 to 0.617	55	58
0.618 to 0.626	56	59
0.627 and over	57	60

NOTE 1: Filling is permitted by volume provided the same filling density is used as permitted by weight, except when using fixed length dip tube or other fixed maximum liquid level indicators (paragraph (f) of this section), in which case the maximum permitted filling density shall not exceed 97 percent of the maximum permitted filling density by weight contained in the table.

(1) *Odorization.* All liquefied petroleum gas shall be effectively odorized as required in Note 2 of this paragraph to indicate positively, by a distinctive odor, the presence of gas down to a concentration in air of not over one-fifth the lower limit of combustibility provided, however, that odorization is not required if harmful in the use or further processing of the liquefied petroleum gas, or if odorization will serve no useful purpose as a warning agent in such use or further processing.

NOTE 1: The lower limits of combustibility of the more commonly used liquefied petroleum gases are: Propane, 2.15 percent; butane, 1.55 percent. These figures represent volumetric percentages of gas-air mixtures in each case.

NOTE 2: The use of 1.0 pound of ethyl mercaptan, 1.0 pound of thiophane, or 1.4 pounds of amyl mercaptan per 10,000 gallons of liquefied petroleum gas shall be considered sufficient to meet the requirements of §173.315(b)(1). This note does not exclude the use of any other odorant in sufficient quantity to meet the requirements of §173.315(b)(1).

(c) Except as otherwise provided, the loading of a liquefied gas into a cargo tank or portable tank shall be determined by weight or by a suitable liquid level gauging device. The vapor pressure (psig) at 115 °F. must not exceed the design pressure of the cargo tank or portable tank container. The outage and filling limits for liquefied gases must be as prescribed in §173.24b of this part, except that this requirement does not apply to:

(1) *A tank containing carbon dioxide, refrigerated liquid or nitrous oxide, refrigerated liquid.* Such tank is required to be equipped with suitable pressure control valves and may not be filled to a level exceeding 95 percent of the volumetric capacity of the tank.

(2) *A tank containing ethane, refrigerated liquid; ethane-propane mixture, refrigerated liquid; or hydrogen chloride, refrigerated liquid.* Such tank must be filled to allow at least two percent outage below the inlet of the pressure relief valve or pressure control valve under conditions of incipient opening, with the tank in a level attitude.

(d) If the loading of cargo tanks and portable tank containers with liquefied gases is to be determined by weight, the gross weight shall be checked after the filling line is disconnected in each instance. The gross weight shall be calculated from the tank capacity and tare weight set forth on the metal plate required by the specification, and the maximum filling density permitted for the material being loaded into the tank as set forth in the table, paragraph (a) of this section.

(e) If the loading of cargo tanks and portable tank containers with liquefied gases is to be determined by adjustable liquid level device, each tank and each compartment thereof shall have a thermometer well, so that the internal liquid temperature can easily be determined, and the amount of liquid in the tank shall be corrected to a 60 °F. basis. Liquid levels shall not exceed a level corresponding to the maximum filling density permitted for the material being loaded into the tank as set forth in the table in paragraph (a) of this section.

(f) When the loading of cargo tanks and portable tank containers with liquefied gases is determined only by fixed length dip tube or other fixed maximum liquid level indicator, the device shall be arranged to function at a level not to exceed the maximum permitted volume prescribed by the table, paragraph (a) of this section. Loading shall be stopped when the device functions.

(g) Containers, the liquid level of which has been determined by means of a fixed length dip tube gauging device, shall not be acceptable for stowage as cargo on vessels in commerce subject to the jurisdiction of the United States Coast Guard. Nothing contained in this section shall be so construed as to prohibit the transportation on car floats or car ferries of motor vehicles laden with containers nor cargo tanks the liquid level of either of which has been determined by means of fixed length dip tube devices.

(h) Each cargo tank and portable tank, except a tank filled by weight, must be equipped with one or more of the gauging devices described in the following table which indicate accurately the maximum permitted liquid level. Additional gauging devices may be installed but may not be used as primary controls for filling of cargo tanks and portable tanks. Gauge glasses are

not permitted on any cargo tank or portable tank. Primary gauging devices used on cargo tanks of less than 3500 gallons water capacity are exempt from the longitudinal location requirements specified in paragraphs (h)(2) and (3) of this section provided: The tank length does not exceed three times the tank diameter; and the cargo tank is unloaded within 24 hours after each filling of the tank.

Kind of gas	Gaging device permitted for filling purposes
Anhydrous ammonia	Rotary tube; adjustable slip tube; fixed length dip tube.
Anhydrous dimethylamine	None.
Anhydrous monomethylamine	Do.
Anhydrous trimethylamine	Do.
Aqua ammonia solution containing anhydrous ammonia.	Rotary tube; adjustable slip tube; fixed length dip tube.
Butadiene, stabilized	Do.
Carbon dioxide, refrigerated liquid	Do.
Chlorine	None.
Dichlorodifluoromethane	Do.
Difluoroethane	Do.
Difluoromonochloroethane	Do.
Dimethyl ether	Do.
Ethane, refrigerated liquid	Rotary tube; adjustable slip tube; fixed length dip tube.
Ethane-propane mixture, refrigerated liquid.	Do.
Hexafluoropropylene	None.
Hydrogen chloride, refrigerated liquid.	Do.
Liquefied petroleum gases	Rotary tube; adjustable slip tube; fixed length dip tube.
Methyl chloride	Fixed length dip tube.
Methyl mercaptan	Rotary tube; adjustable slip tube; fixed length dip tube.
Monochlorodifluoromethane	None.
Nitrous oxide, refrigerated liquid	Rotary tube; adjustable slip tube; fixed length dip tube.
Methylacetylenepropadiene, stabilized.	Do.
Refrigerant gas, n.o.s. or Dispersant gas, n.o.s.	None.
Sulfur dioxide	Fixed length dip tube.
Vinyl chloride	None.
Vinyl fluoride, inhibited	Do.

(1) The design pressure of the liquid level gauging devices shall be at least equal to the design pressure of the tank.

(2) If the primary gauging device is adjustable, it must be capable of adjustment so that the end of the tube will be in the location specified in paragraph (h)(3) of this section for at least one of the ladings to be transported, at the filling level corresponding to an average loading temperature. Exterior means must be provided to indicate this adjustment. The gauging device must be legibly and permanently marked in increments not exceeding 20 Fahrenheit degrees (or not exceeding 25 p.s.i.g. on tanks for carbon dioxide, refrigerated liquid or nitrous oxide, refrigerated liquid), to indicate the maximum levels to which the tank may be filled with liquid at temperatures above 20 °F. However, if it is not practicable to so mark the gauging device, this information must be legibly and permanently marked on a plate affixed to the tank adjacent to the gauging device.

(3) A dip tube gauging device consists of a pipe or tube with a valve at its outer end with its intake limited by an orifice not larger than 0.060 inch in diameter. If a fixed length dip tube is used, the intake must be located midway of the tank both longitudinally and laterally and at maximum permitted filling level. In tanks for liquefied petroleum gases, the intake must be located at the level reached by the lading when the tank is loaded to maximum filling density at 40 °F.

(4) Except on a tank used exclusively for the transportation of carbon dioxide, refrigerated liquid or nitrous oxide, refrigerated liquid, each opening for a pressure gauge must be restricted at or inside the tank by an orifice no larger than 0.060 inch in diameter. For carbon dioxide, refrigerated liquid or nitrous oxide, refrigerated liquid service, the pressure gauge need only be used during the filling operation.

(i) Each tank must be provided with one or more pressure relief devices which, unless otherwise specified in this part, must be of the spring-loaded type. Each valve must be arranged to discharge upward and unobstructed to the outside of the protective housing to prevent any impingement of escaping gas upon the tank. For each chlorine tank the protective housing must be in compliance with the requirements set forth in the applicable specification.

(1) The safety relief valves on each tank must meet the following conditions:

(i) The total relieving capacity, as determined by the flow formulas contained in Section 5 of CGA S–1.2 (IBR, see §171.7 of this subchapter), must be

sufficient to prevent a maximum pressure in the tank of more than 120 percent of the design pressure;

(ii) The flow capacity rating, testing and marking must be in accordance with Sections 5, 6 and 7 of CGA Pamphlet S–1.2.

(iii) For an insulated tank, the required relieving capacity of the relief devices must be the same as for an uninsulated tank, unless the insulation will remain in place and will be effective under fire conditions. In this case, except for UN portable tanks, each insulated tank must be covered by a sheet metal jacket of not less than 16 gauge thickness. For UN portable tanks where the relieving capacity of the valves has been reduced on the basis of the insulation system, the insulation system must remain effective at all temperatures less than 649 °C (1200.2 °F) and be jacketed with a material having a melting point of 700 °C (1292.0 °F) or greater.

(iv) An MC 330 cargo tank that has relief valves sized by Fetterly's formula dated November 27, 1928, may be continued in service.

(2) Each safety relief valve must be arranged to minimize the possibility of tampering. If the pressure setting or adjustment is external to the valve, the safety relief valve must be provided with means for sealing the adjustment and it must be sealed.

(3) Each safety relief valve on a portable tank, other than a UN portable tank, must be set to start-to-discharge at pressure no higher than 110% of the tank design pressure and no lower than the design pressure specified in paragraph (a) of this section for the gas transported. For UN portable tanks used for liquefied compressed gases and constructed in accordance with the requirements of §178.276 of this subchapter, the pressure relief device(s) must conform to §178.276(e) of this subchapter.

(4) Except for UN portable tanks, each safety relief valve must be plainly and permanently marked with the pressure in p.s.i.g. at which it is set to discharge, with the actual rate of discharge of the device in cubic feet per minute of the gas or of air at 60 °F (15.6 °C) and 14.7 p.s.i.a., and with the manufacturer's name or trade name and catalog number. The start-to-discharge valve marking must be visible after the valve is installed. The rated discharge capacity of the device must be determined at a pressure of 120% of the design pressure of the tank. For UN portable tanks, each pressure relief device must be clearly and permanently marked as specified in §178.274(f)(1) of this subchapter.

(5) Each safety relief valve must have direct communication with the vapor space in the tank.

(6) Each connection to a safety relief valve must be of sufficient size to provide the required rate of discharge through the safety relief valve.

(7) [Reserved]

(8) Each pressure relief valve outlet must be provided with a protective device to prevent the entrance and accumulation of dirt and water. This device must not impede flow through the valve. Pressure relief devices must be designed to prevent the entry of foreign matter, the leakage of liquid and the development of any dangerous excess pressure.

(9) On tanks for carbon dioxide, refrigerated liquid or nitrous oxide, refrigerated liquid each safety relief device must be installed and located so that the cooling effect of the contents will not prevent the effective operation of the device. In addition to the required safety relief valves, these tanks may be equipped with one or more pressure controlling devices.

(10) Each tank for carbon dioxide, refrigerated liquid also may be equipped with one or more non-reclosing pressure relief devices set to function at a pressure not over two times nor less than 1.5 times the design pressure of the tank.

(11) Each portion of connected liquid piping or hose that can be closed at both ends must be provided with a safety relief valve without an intervening shut-off valve to prevent excessive hydrostatic pressure that could burst the piping or hose.

(12) Subject to conditions of paragraph (a) of this section for the methyl chloride and sulfur dioxide optional portable tanks, one or more fusible plugs examined by the Bureau of Explosives and approved by the Associate Administrator may be used on these

tanks in place of safety relief valves of the spring-loaded type. The fusible plug or plugs must be in accordance with CGA Pamphlet S–1.2, to prevent a pressure rise in the tank of more than 120 percent of the design pressure. If the tank is over 30 inches long, each end must have the total specified safety discharge area.

(13) A safety relief valve on a chlorine cargo tank must conform to one of the following standards of The Chlorine Institute, Inc.: Type 1 ½ JQ225, Dwg. H51970 (IBR, see §171.7 of this subchapter); or Type 1 ½ JQ225, Dwg. H50155 (IBR, see §171.7 of this subchapter).

(j) Storage containers for liquefied petroleum gas for permanent installation on consumer premises may be shipped by private motor carrier only under the following conditions:

(1) Each container must be constructed in compliance with the requirements in Section VIII of the ASME Code (containers built in compliance with earlier editions starting with 1943 are authorized) and must be marked to indicate compliance in the manner specified by the respective Code.

(2) Each container must be equipped with safety devices in compliance with the requirements for safety devices on containers as specified in NFPA 58 (IBR, see §171.7 of this subchapter).

(3) The containers must be braced or otherwise secured on the vehicle to prevent relative motion while in transit. Valves or other fittings must be adequately protected against damage during transportation. (See §177.834(a) of this subchapter.)

(4) Except as provided in paragraph (j)(5) of this section, containers shall not be shipped when charged with liquefied petroleum gas to more than 5 percent of their water capacity.

(5) Storage containers of less than 1,042 pounds water capacity (125 gallons) may be shipped when charged with liquefied petroleum gas in compliance with DOT filling density.

(k) A nonspecification cargo tank meeting, and marked in conformance with, the edition of Section VIII of the ASME Code in effect when it was fabricated may be used for the transportation of liquefied petroleum gas provided it meets all of the following conditions:

(1) It must have a minimum design pressure no lower than 250 psig.

(2) It must have a capacity of 13,247.5 L (3,500 water gallons) or less.

(3) It must have been manufactured in conformance with Section VIII of the ASME Code prior to January 1, 1981, according to its ASME name plate and manufacturer's data report.

(4) It must conform to the applicable provisions of NFPA 58, except to the extent that provisions in NFPA 58 are inconsistent with requirements in parts 178 and 180 of this subchapter.

(5) It must be inspected, tested, and equipped in accordance with subpart E of part 180 of this subchapter as specified for MC 331 cargo tank motor vehicles.

(6) Except as provided in this paragraph (k), it must be operated exclusively in intrastate commerce, including its operation by a motor carrier otherwise engaged in interstate commerce, in a state where its operation was permitted by law (not including the incorporation of this subchapter) prior to January 1, 1981. A cargo tank motor vehicle operating under authority of this section may cross state lines to travel to and from a qualified assembly, repair, maintenance, or requalification facility. The cargo tank need not be cleaned and purged, but it may not contain liquefied petroleum gas in excess of five percent of the water capacity of the cargo tank. If the vehicle engine is supplied fuel from the cargo tank, enough fuel in excess of five percent of the cargo tank's water capacity may be carried for the trip to or from the facility.

(7) It must have been used to transport liquefied petroleum gas prior to January 1, 1981.

(8) It must be operated in conformance with all other requirements of this subchapter.

(l) Anhydrous ammonia must not be offered for transportation or transported in specification MC 330 and MC 331 cargo tanks constructed of quenched and tempered (''QT'') steel except as provided in this paragraph.

(1) The ammonia must have a minimum water content of 0.2 percent by weight. Any addition of water must be

made using steam condensate, deionized, or distilled water.

(2) Except as otherwise provided in this paragraph, each person offering for transportation or transporting anhydrous ammonia shall perform a periodic analysis for prescribed water content in the ammonia. The analysis must be performed:

(i) From a sample of the ammonia in storage taken at least once every 7 days, or each time ammonia is added to the storage tanks, whichever is less frequent; or

(ii) At the time the cargo tanks are loaded, then a sample of the ammonia taken from at least one loaded cargo tank out of each 10 loads, or from one cargo tank every 24 hours, whichever is less frequent; or

(iii) At the same frequency as described in paragraph (l)(2)(ii) of this section, from a sample taken from the loading line to the cargo tank.

(3) If water is added at the time of loading:

(i) The sample for analysis must be taken from a point in the loading line between the water injection equipment and the cargo tank; and

(ii) Positive provisions must be made to assure water injection equipment is operating.

(4) If water injection equipment becomes inoperative, suitable corrective maintenance must be performed after which a sample from the first loaded cargo tank must be analyzed for prescribed water content.

(5) The analysis method for water content must be as prescribed in CGA G–2.2, ''Tentative Standard Method for Determining Minimum of 0.2 percent water in Anhydrous Ammonia,'' (IBR, see §171.7 of this subchapter).

(6) Records indicating the results of the analysis taken, as required by this paragraph, must be retained for 2 years and must be open to inspection by a representative of the Department.

(7) Each person receiving anhydrous ammonia containing 0.2 per cent water by weight may offer for transportation or transport that ammonia without performing the prescribed analysis for water content provided:

(i) The ammonia received was certified as containing 0.2 percent water as prescribed in §§172.203(h)(l)(i) and 177.817(a) of this subchapter; and

(ii) The amount of water in the ammonia has not been reduced by any means.

(m) A cargo tank (commonly known as a nurse tank and considered an implement of husbandry) transporting anhydrous ammonia, and operated by a private carrier exclusively for agricultural purposes does not have to meet the specification requirements of part 178 of this subchapter if it:

(1) Has a minimum design pressure of 250 psig and meets the requirements of the edition of Section VIII of the ASME Code in effect at the time it was manufactured and is marked accordingly;

(2) Is equipped with safety relief valves meeting the requirements of CGA pamphlet S1.2;

(3) Is painted white or aluminum;

(4) Has capacity of 3,000 gallons or less;

(5) Is loaded to a filling density no greater than 56 percent;

(6) Is securely mounted on a farm wagon; and

(7) Is in conformance with the requirements of part 172 of this subchapter except that shipping papers are not required; and it need not be marked or placarded on one end if that end contains valves, fittings, regulators or gauges when those appurtenances prevent the markings and placard from being properly placed and visible.

(n) *Emergency discharge control for cargo tank motor vehicles in liquefied compressed gas service*—(1) *Required emergency discharge control equipment.* Each cargo tank motor vehicle in liquefied compressed gas service must have an emergency discharge control capability as specified in the following table:

§ 173.315(n)(1)(*)	Material	Delivery service	Required emergency discharge control capability
(i)	Division 2.2 materials with no subsidiary hazard, excluding anhydrous ammonia.	All	None.
(ii)	Division 2.3 materials	All	Paragraph (n)(2) of this section.
(iii)	Division 2.2 materials with a subsidiary hazard, Division 2.1 materials, and anhydrous ammonia.	Other than metered delivery service.	Paragraph (n)(2) of this section.
(iv)	Division 2.2 materials with a subsidiary hazard, Division 2.1 materials, and anhydrous ammonia in a cargo tank motor vehicle with a capacity of 13,247.5 L (3,500 water gallons) or less.	Metered delivery service	Paragraph (n)(3) of this section.
(v)	Division 2.2 materials with a subsidiary hazard, Division 2.1 materials, and anhydrous ammonia in a cargo tank motor vehicle with a capacity greater than 13,247.5 L (3,500 water gallons).	Metered delivery service	Paragraph (n)(3) of this section, and, for obstructed view deliveries where permitted by § 177.840(p) of this subchapter, paragraph (n)(2) or (n)(4) of this section.
(vi)	Division 2.2 materials with a subsidiary hazard, Division 2.1 materials, and anhydrous ammonia in a cargo tank with a capacity of greater than 13,247.5 L (3,500 water gallons).	Both metered delivery and other than metered delivery service.	Paragraph (n)(2) of this section, provided the system operates for both metered and other than metered deliveries; otherwise, paragraphs (n)(2) and (n)(3) of this section.

(2) *Cargo tank motor vehicles in other than metered delivery service.* A cargo tank motor vehicle in other than metered delivery service must have a means to automatically shut off the flow of product without the need for human intervention within 20 seconds of an unintentional release caused by a complete separation of a liquid delivery hose (passive shut-down capability).

(i) Designed flow of product through a bypass in the valve is acceptable when authorized by this subchapter.

(ii) The design for the means to automatically shut off product flow must be certified by a Design Certifying Engineer. The certification must consider any specifications of the original component manufacturer and must explain how the passive means to shut off the flow of product operates. It must also outline the parameters (e.g., temperature, pressure, types of product) within which the passive means to shut off the flow of product is designed to operate. All components of the discharge system that are integral to the design must be included in the certification. A copy of the design certification must be provided to the owner of the cargo tank motor vehicle on which the equipment will be installed.

(iii) Installation must be performed under the supervision of a Registered Inspector unless the equipment is installed and removed as part of regular operation (e.g., a hose). The Registered Inspector must certify that the equipment is installed and tested, if it is possible to do so without damaging the equipment, in accordance with the Design Certifying Engineer's certification. The Registered Inspector must provide the certification to the owner of the cargo tank motor vehicle.

(3) *Cargo tank motor vehicles in metered delivery service.* When required by the table in paragraph (n)(1) of this section, a cargo tank motor vehicle must have an off-truck remote means to close the internal self-closing stop valve and shut off all motive and auxiliary power equipment upon activation by a qualified person attending the unloading of the cargo tank motor vehicle (off-truck remote shut-off). It must function reliably at a distance of 45.72

m (150 feet). The off-truck remote shut-off activation device must not be capable of reopening the internal self-closing stop valve after emergency activation.

(i) The emergency discharge control equipment must be installed under the supervision of a Registered Inspector. Each wireless transmitter/receiver must be tested to demonstrate that it will close the internal self-closing stop valve and shut off all motive and auxiliary power equipment at a distance of 91.44 m (300 feet) under optimum conditions. Emergency discharge control equipment that does not employ a wireless transmitter/receiver must be tested to demonstrate its functioning at the maximum length of the delivery hose.

(ii) The Registered Inspector must certify that the remote control equipment is installed in accordance with the original component manufacturer's specifications and is tested in accordance with paragraph (n)(3)(i) of this section. The Registered Inspector must provide the owner of the cargo tank motor vehicle with this certification.

(4) *Query systems.* When a transmitter/receiver system is used to satisfy the requirements of paragraph (n)(1)(v) of this section, it must close the internal self-closing stop valve and shut off all motive and auxiliary power equipment unless the qualified person attending the unloading operation prevents it from doing so at least once every five minutes. Testing and certification must be as specified in paragraph (n)(3) of this section.

(5) *Compliance dates.* (i) Each specification MC 331 cargo tank motor vehicle with a certificate of construction issued two or more years after July 1, 1999, must have an appropriate emergency discharge control capability as specified in this paragraph (n).

(ii) No MC 330, MC 331, or nonspecification cargo tank motor vehicle authorized under paragraph (k) of this section may be operated unless it has an appropriate emergency discharge control capability as specified in this paragraph (n) no later than the date of its first scheduled pressure retest required after July 1, 2001. No MC 330, MC 331 or nonspecification cargo tank motor vehicle authorized under paragraph (k) of this section may be operated after July 1, 2006, unless it has been equipped with emergency discharge control equipment as specified in this paragraph (n).

(iii) No MC 330 or MC 331 cargo tank motor vehicle with a capacity over 13,247 L (3,500 gallons) used in metered delivery service may be operated unless it has an appropriate discharge control capability as specified in this paragraph (n) no later than July 1, 2003, or the date of its first scheduled pressure retest required after July 1, 2001, whichever is earlier.

(o) *Chlorine cargo tank motor vehicles.* Each cargo tank motor vehicle used for the transportation of chlorine must meet the requirements in the following:

(1) Any hose, piping, or tubing used for loading or unloading that is mounted or carried on the motor vehicle may not be attached to any valve and must be capped at all ends to prevent the entry of moisture, except at the time of loading or unloading. Except at the time of loading and unloading, the pipe connection of each angle valve must be closed with a screw plug which is chained or otherwise fastened to prevent misplacement.

(2) Each chlorine cargo tank motor vehicle angle valve must be tested to be leak free at not less than 225 psig using dry air or inert gas before installation and thereafter every 2 years when performing the required periodic retest in §180.407(c) of this subchapter. Prior to each loading, the cargo tank motor vehicle must be inspected and the angle valves and gasketed joints must be examined and tested at a pressure of not less than 50 psig to determine that they are not leaking and are in proper condition for transportation. Any leaks must be corrected before the cargo tank motor vehicle is offered for transportation.

(3) Excess flow valves on the cargo tank motor vehicle must meet the requirements of paragraph (n) of this section.

(p) *Fusible elements.* Each MC 330, MC 331, or nonspecification cargo tank authorized under paragraph (k) of this section must have a thermal means of closure for each internal self-closing

stop valve as specified in §178.337–8(a)(4) of this subchapter.

(q) Manifolding is authorized for cargo tanks containing anhydrous ammonia provided each individual cargo tank is equipped with a pressure relief device or valves and gauging devices as required by paragraphs (h) and (i) of this section. Each valve must be tightly closed while the cargo tank is in transit. Each cargo tank must be filled separately.

[29 FR 18743, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting §173.315, see the List of CFR Sections Affected which appears in the Finding Aids section of the printed volume and on GPO Access.

§ 173.316 Cryogenic liquids in cylinders.

(a) *General requirements.* (1) A cylinder may not be loaded with a cryogenic liquid colder than the design service temperature of the packaging.

(2) A cylinder may not be loaded with any material which may combine chemically with any residue in the packaging to produce an unsafe condition.

(3) The jacket covering the insulation on a cylinder used to transport any flammable cryogenic liquid must be made of steel.

(4) A valve or fitting made of aluminum with internal rubbing or abrading aluminum parts that may come in contact with oxygen in the cryogenic liquid form may not be installed on any cylinder used to transport oxygen, cryogenic liquid unless the parts are anodized in accordance with ASTM Standard B 580 (IBR, see §171.7 of this subchapter).

(5) An aluminum valve, pipe or fitting may not be installed on any cylinder used to transport any flammable cryogenic liquid.

(6) Each cylinder must be provided with one or more pressure relief devices, which must be installed and maintained in compliance with the requirements of this subchapter.

(7) Each pressure relief device must be installed and located so that the cooling effect of the contents during venting will not prevent effective operation of the device.

(8) The maximum weight of the contents in a cylinder with a design service temperature colder than −320 °F. may not exceed the design weight marked on the cylinder (see §178.35 of this subchapter).

(b) *Pressure control systems.* Each cylinder containing a cryogenic liquid must have a pressure control system that conforms to §173.301(f) and is designed and installed so that it will prevent the cylinder from becoming liquid full.

(c) *Specification cylinder requirements and filling limits.* Specification DOT-4L cylinders (§178.57 of this subchapter) are authorized for the transportation of cryogenic liquids when carried in the vertical position as follows:

(1) For purposes of this section, ''filling density,'' except for hydrogen, is defined as the percent ratio of the weight of lading in the packaging to the weight of water that the packaging will hold at 60 °F. (1 lb. of water = 27.737 cubic inches at 60 °F.).

(2) The cryogenic liquids of argon, nitrogen, oxygen, helium and neon must be loaded and shipped in accordance with the following table:

Pressure control valve setting (maximum start-to-discharge pressure psig)	Maximum permitted filling density (percent by weight)					
	Air	Argon	Nitrogen	Oxygen	Helium	Neon
45	82.5	133	76	108	12.5	109
75	80.3	130	74	105	12.5	104
105	78.4	127	72	103	12.5	100
170	76.2	122	70	100	12.5	92
230	75.1	119	69	98	12.5	85
295	73.3	115	68	96	12.5	77
360	70.7	113	65	93	12.5	.....
450	65.9	111	61	91	12.5	.....
540	62.9	107	58	88	12.5	.....
625	60.1	104	55	86	12.5	.....
Design service temperature (°F.)	−320	−320	−320	−320	−452	−411

(3) Hydrogen (minimum 95 percent parahydrogen) must be loaded and shipped as follows:

Column 1	Column 2
Design service temperature	Minus 423 °F. or colder.
Maximum permitted filling density, based on cylinder capacity at minus 423 °F (see Note 1).	6.7 percent.
The pressure control valve must be designed and set to limit the pressure in the cylinder to not more than.	17 psig.

NOTE 1: The filling density for hydrogen, cryogenic liquid is defined as the percent ratio of the weight of lading in a packaging to the weight of water that the packaging will hold at minus 423 °F. The volume of the packaging at minus 423 °F is determined in cubic inches. The volume is converted to pounds of water (1 lb. of water = 27.737 cubic inches).

(i) Each cylinder must be constructed, insulated and maintained so that during transportation the total rate of venting shall not exceed 30 SCF of hydrogen per hour.

(ii) In addition to the marking requirements in §178.35 of this subchapter, the total rate of venting in SCF per hour (SCFH) shall be marked on the top head or valve protection band in letters at least one-half inch high as follows: ''VENT RATE**SCFH'' (with the asterisks replaced by the number representing the total rate of venting, in SCF per hour).

(iii) Carriage by highway is subject to the conditions specified in §177.840(a) of this subchapter.

(d) *Mixtures of cryogenic liquid.* Where charging requirements are not specifically prescribed in paragraph (c) of this section, the cryogenic liquid must be shipped in packagings and under conditions approved by the Associate Administrator.

[Amdt. 173–166, 48 FR 27695, June 16, 1983, as amended by Amdt. 173–166, 49 FR 24314, June 12, 1984; Amdt. 173–180, 49 FR 42735, Oct. 24, 1984; Amdt. 173–201, 52 FR 13041, Apr. 20, 1987: Amdt. 173–250, 61 FR 25942, May 23, 1996; Amdt. 173–261, 62 FR 24741, May 6, 1997; 66 FR 45379, Aug. 28, 2001; 67 FR 16013, Sept. 27, 2002; 68 FR 75742, Dec. 31, 2003; 69 FR 54046, Sept. 7, 2004]

§173.318 Cryogenic liquids in cargo tanks.

(a) *General requirements.* (1) A cargo tank may not be loaded with a cryogenic liquid colder than the design service temperature of the packaging.

(2) A cargo tank may not be loaded with any material that may combine chemically with any residue in the packaging to produce an unsafe condition (see §178.338–15).

(3) The jacket covering the insulation on a tank used to transport a cryogenic liquid must be made of steel if the cryogenic liquid:

(i) Is to be transported by vessel (see §176.76(g) of this subchapter); or

(ii) Is oxygen or a flammable material.

(4) A valve or fitting made of aluminum with internal rubbing or abrading aluminum parts that may come in contact with oxygen in the cryogenic liquid form may not be installed on any cargo tank used to transport oxygen, cryogenic liquid unless the parts are anodized in accordance with ASTM Standard B 580 (IBR, see §171.7 of this subchapter).

(5) An aluminum valve, pipe or fitting, external to the jacket that retains lading during transportation may not be installed on any cargo tank used to transport oxygen, cryogenic liquid or any flammable cryogenic liquid.

(6) A cargo tank used to transport oxygen, cryogenic liquid must be provided with a manhole (see §178.338–6 of this subchapter).

(b) *Pressure relief systems and pressure control valves*—(1) *Types of pressure relief systems*—(i) *Tanks in oxygen and flammable cryogenic liquid service.* Except as otherwise provided in this paragraph, each tank in oxygen and flammable cryogenic liquid service must be protected by two independent pressure relief systems which are not connected in series, namely:

(A) A primary system of one or more pressure relief valves; and

(B) A secondary system of one of more frangible discs or pressure relief valves. For a tank in carbon monoxide service, the secondary system must be pressure relief valves only.

(ii) *Tanks in helium and atmospheric gas (except oxygen) cryogenic liquid service.* For a tank used in helium and atmospheric gas (except oxygen) cryogenic liquid service, the tank must be protected by at least one pressure relief system consisting of:

(A) One or more pressure relief valves; or

(B) A combination of one or more pressure relief valves and one or more frangible discs.

(2) *Capacities of pressure relief systems*—(i) *Tanks in oxygen or flammable cryogenic liquid service.* For tanks in oxygen or flammable cryogenic liquid service, the primary system and the secondary system of pressure relief devices must each have a flow capacity equal to or greater than that calculated by the applicable formula in paragraph 5.3.2 or paragraph 5.3.3 of CGA S–1.2 (IBR, see §171.7 of this subchapter). In addition:

(A) The primary pressure relief system must have a total flow capacity at a pressure not exceeding 120 percent of the tank's design pressure.

(B) The secondary pressure relief system must have a total flow capacity at a pressure not exceeding 150 percent of the tank's design pressure.

(C) The flow capacity and rating must be verified and marked by the manufacturer of the device in accordance with CGA Pamphlet S–1.2.

(ii) *Tanks in helium and atmospheric gas (except oxygen) cryogenic liquid service.* For tanks in helium and atmospheric gas (except oxygen) cryogenic liquid service, the pressure relief system must have a flow capacity equal to or greater than that calculated by the applicable formula in paragraphs 5.3.2 or 5.3.3 of CGA Pamphlet S–1.2. If the pressure relief system consists of a combination of pressure relief valves and frangible discs, the pressure relief valves must have a total venting capacity equal to or greater than that calculated by the applicable formula in paragraph 4.1.10.1.1 of CGA Pamphlet S–1.2. The pressure relief system must have this total flow capacity at a pressure not exceeding 150 percent of the tank's design pressure. The flow capacity and rating must be verified and marked by the manufacturer of the device in accordance with CGA Pamphlet S–1.2.

(3) *Type and construction of pressure relief devices.* (i) Each pressure relief device must be designed and constructed for a pressure equal to or exceeding the tank's design pressure at the coldest temperature reasonably expected to be encountered.

(ii) Pressure relief devices must be either spring-loaded pressure relief valves or frangible discs. Pressure relief valves must be of a type that automatically open and close at predetermined pressures.

(4) *Setting of pressure relief devices.* (i) On a tank used in oxygen or flammable cryogenic liquid service, the pressure relief devices must perform as follows.

(A) Each pressure relief valve in the primary relief system must be set-to-discharge at a pressure no higher than 110 percent of the tank's design pressure.

(B) Each pressure relief device in the secondary pressure relief system must be designed to commence functioning at a pressure no lower than 130 percent and no higher than 150 percent of the tank's design pressure.

(ii) On a tank used in helium and atmospheric gas (except oxygen) cryogenic liquid service, the pressure relief devices in the pressure relief system must be designed to commence functioning at no higher than 150 percent of the tank's design pressure.

(5) *Optional pressure relief devices and pressure control valves.* In addition to the required pressure relief devices, a cargo tank in cryogenic liquid (except carbon monoxide) service may be equipped with one or both of the following:

(i) One or more pressure control valves set at a pressure below the tank's design pressure.

(ii) One or more frangible discs set to function at a pressure not less than one and one-half times or more than two times the tank's design pressure.

(6) *Maximum filling rate.* (i) For a tank used in oxygen and flammable cryogenic liquid service, the maximum rate at which the tank is filled must not exceed the liquid flow capacity of the primary pressure relief system rated at a pressure not exceeding 120 percent of the tank's design pressure.

(ii) On a tank used in helium and atmospheric gas (except oxygen) cryogenic liquid service, the maximum rate at which the tank is filled must not exceed the liquid flow capacity of the pressure relief valves rated at 150 percent of the tank's design pressure.

(7) *Arrangement and location of pressure relief devices.* (i) The discharge from any pressure relief system must be directed upward and be unobstructed to the outside of the protective housing in such a manner as to prevent impingement of gas upon the jacket or any structural part of the vehicle.

(ii) Each pressure relief valve must be arranged or protected to prevent the accumulation of foreign material between the relief valve and the atmospheric discharge opening in any relief piping. The arrangement must not impede flow through the device.

(iii) Each pressure relief valve must be designed and located to minimize the possibility of tampering. If the pressure setting or adjustment is external to the valve, the valve adjustment must be sealed.

(iv) Each pressure relief device must have direct communication with the vapor space of the tank at the midlength of the top centerline.

(v) Each pressure relief device must be installed and located so that the cooling effect of the contents during venting will not prevent the effective operation of the device.

(8) *Connections.* (i) Each connection to a pressure relief device must be of sufficient size to allow the required rate of discharge through the pressure relief device. The inlet connection must be not less than one-half inch nominal pipe size.

(ii) A shut-off valve may be installed in a pressure relief system only when the required relief capacity is provided at all times.

(9) *Pressure relief devices for piping hose and vacuum-insulated jackets.* (i) Each portion of connected liquid piping or hose that can be closed at both ends must be provided with either a hydrostatic pressure relief valve without an intervening shut-off valve, or a check valve permitting flow from the pipe or hose into the tank. If used, the relief valve must be located so as to prevent its discharge from impinging on the tank, piping, or operating personnel.

(ii) On a vacuum-insulated cargo tank the jacket must be protected by a suitable relief device to release internal pressure. The discharge area of this device must be at least 0.00024 square inch per pound of water capacity of the tank. This relief device must function at a pressure not exceeding the internal design pressure of the jacket, calculated in accordance with Section VIII of the ASME Code (IBR, see §171.7 of this subchapter), or 25 psig, whichever is less.

(10) *Tank inlet, outlet, pressure relief device and pressure control valve markings.* (i) Each tank inlet and outlet, except pressure relief devices and pressure control valves, must be permanently marked to indicate whether it communicates with ''vapor'' or ''liquid'' when the tank is filled to the maximum permitted filling density.

(ii) Each pressure relief valve must be plainly and permanently marked with the pressure, in psig, at which it is set-to-discharge, the discharge rate of the device in SCF per minute (SCFM) of free air, and the manufacturer's name or trade name and catalog number. The marked set-to-discharge pressure valve must be visible with the valve in its installed position. The rated discharge capacity of the device must be determined at a pressure of 120 percent of the design pressure of the tank.

(iii) Each pressure control valve must be plainly and permanently marked with the pressure, in psig, at which it is set-to-discharge.

(c) *Weight of lading requirements.* The weight of a cryogenic liquid in the tank must be determined by weighing or by the use of a liquid level gauging device authorized in §178.338–14(a) of this subchapter, and may not exceed the lesser of:

(1) The weight of lading in the tank, based on the water capacity stamped on the nameplate (§178.338–18(a)(4) of this subchapter) and the appropriate maximum permitted filling density specified in paragraph (f) of this section; or

(2) The maximum weight of lading for which the cargo tank was designed, as marked on the specification plate (see §178.338–18(b) of this subchapter).

(d) *Outage.* Except for a cargo tank containing helium, cryogenic liquid, a cargo tank offered for transportation must have an outage of at least two percent below the inlet of the pressure relief device or pressure control valve,

under conditions of incipient opening, with the tank in a level attitude.

(e) *Temperature.* A flammable cryogenic liquid in a cargo tank at the start of travel must be at a temperature sufficiently cold that the pressure setting of the pressure control valve or the required pressure relief valve, whichever is lower, will not be reached in less time than the marked rated holding time for the cryogenic liquid (see paragraph (g)(3) of this section and § 178.338–9(b) of this subchapter).

(f) *Specification MC–338 (§ 178.338 of this subchapter) cargo tanks* are authorized for the shipment of the following cryogenic liquids subject to the following additional requirements:

(1) For purposes of this section, ''filling density'' is defined as the percent ratio of the weight of lading in the tank to the weight of water that the tank will hold at the design service temperature (one pound of water=27.737 cubic inches at 60 °F., or one gallon of water = 231 cubic inches at 60 °F. and weighs 8.32828 pounds).

(2) *Air, argon, helium, nitrogen, and oxygen, cryogenic liquids* must be loaded and shipped in accordance with the following table:

PRESSURE CONTROL VALVE SETTING OR RELIEF VALVE SETTING

Maximum set-to-discharge pressure (psig)	Maximum permitted filling density (percent by weight)				
	Air	Argon	Helium	Nitrogen	Oxygen
26			12.5		
30	80.3	129	12.5	74	105
40	79.2		12.5		
50	78.0		12.5		
55	77.3	125	12.5	71	102
60	76.9		12.5		
80	75.3		12.5		
85	75.1	121	12.5		99
100	73.0		12.5		
105	73.7		12.5	67	
120	72.2		12.5		
140	71.4		12.5		
145	70.9	115	12.5	64	94
180	68.3		12.5		
200	67.3	110	12.5	61	91
250	63.3	106	12.5	57	87
275	62.3	105	12.5	56	86
325	59.4	101		53	83
Design service temperature.	−320 °F	−320 °F	−452 °F	−320 °F	−320 °F

(3) *Carbon monoxide, hydrogen (minimum 95 percent para-hydrogen), ethylene, and methane or natural gas, cryogenic liquids* must be loaded and shipped in accordance with the following table:

PRESSURE CONTROL VALVE SETTING OR RELIEF VALVE SETTING

Maximum set-to-discharge pressure (psig)	Maximum permitted filling density (percent by weight)			
	Carbon monoxide	Ethylene	Hydrogen	Methane or natural gas
13			6.6	
15	75.0		6.6	40.5
17	74.0		6.6	
20		53.5		40.0
25	73.0			
30	72.0	52.7	6.3	39.1
35				
40		52.0		38.6
45	71.5			
50		51.4	6.0	38.2
55				
60		50.8		
70		50.2	5.7	37.5
90		49.2		

PRESSURE CONTROL VALVE SETTING OR RELIEF VALVE SETTING—Continued

Maximum set-to-discharge pressure (psig)	Maximum permitted filling density (percent by weight)			
	Carbon monoxide	Ethylene	Hydrogen	Methane or natural gas
95				
100		48.4	5.4	36.6
115		48.2		
125			5.0	
150			4.5	
175	62.5	45.8		
285	56.0			
Design service temperature.	−320 °F	−155 °F	−423 °F	−260 °F

(4) *Mixtures of cryogenic liquid.* Where charging requirements are not specifically prescribed in this paragraph (f), the cryogenic liquid must be shipped in packagings and under conditions approved by the Associate Administrator.

(g) *One-way travel time; marking.* The jacket of a cargo tank to be used to transport a flammable cryogenic liquid must be marked on its right side near the front, in letters and numbers at least two inches high, ''One-Way-Travel-Time ___ hrs.'', with the blank filled in with a number indicating the one-way travel time (OWTT), in hours, of the cargo tank for the flammable cryogenic liquid to be transported. A cargo tank that is partially unloaded at one or more locations must have additional marking ''One-Way-Travel-Time ___ hrs. ___ psig to ___ psig at ___ percent filling density,'' with the second blank filled in with the pressure existing after partial unloading and the third blank filled in with the set-to-discharge pressure of the control valve or pressure relief valve, and the fourth blank with the filling density following partial unloading. Multiple OWTT markings for different pressure levels are permitted. The abbreviation ''OWTT'' may be used in place of the words ''One-way-travel-time'' in the marking required by this paragraph.

(1) OWTT is based on the marked rated holding time (MRHT) of the cargo tank for the cryogenic liquid to be transported in the cargo tank. If the MRHT for the flammable cryogenic liquid is not displayed on or adjacent to the specification plate, this MRHT may be derived.

(2) The MRHT is converted to OWTT, in hours, as follows:

(i) For a tank with an MRHT of 72 hours or less,

$$OWTT = (MRHT - 24) / 2$$

(ii) For a tank with an MRHT greater than 72 hours,

$$OWTT = MRHT - 48$$

(3) Each cargo tank motor vehicle used to transport a flammable cryogenic liquid must be examined after each shipment to determine its actual holding time. The record required by §177.840(h) of this subchapter may be used for this determination. If the examination indicates that the actual holding time of the cargo tank, after adjustment to reflect an average ambient temperature of 85 °F, is less than 90 percent of the marked rated holding time (MRHT) for the cryogenic liquid marked on the specification plate or adjacent thereto (see §178.338–18(b) of this subchapter), the tank may not be refilled with any flammable cryogenic liquid until it is restored to its marked rated holding time value or it is remarked with the actual marked rated holding time determined by this examination. If the name of the flammable cryogenic liquid that was transported and its marked rated holding time is not displayed on or adjacent to the specification plate, this requirement may be met by deriving the MRHT of the cargo tank for that flammable cryogenic liquid and comparing that derived MRHT with the actual holding time after adjustment.

[Amdt. 173–166, 48 FR 27696, June 16, 1983]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting §173.318, see the List of CFR

Sections Affected which appears in the Finding Aids section of the printed volume and on GPO Access.

§ 173.319 Cryogenic liquids in tank cars.

(a) *General requirements.* (1) A tank car containing a flammable cryogenic liquid may not be shipped unless it was loaded by, or with the consent of, the owner of the tank car.

(2) The amount of flammable cryogenic liquid loaded into a tank car must be determined, either by direct measurement or by calculation based on weight, to verify that the tank has not been filled to a level in excess of the limits specified in paragraph (d)(2) of this section. The weight of any flammable cryogenic liquid loaded, except hydrogen, must be checked by use of scales after disconnecting the loading line.

(3) The shipper shall notify the Federal Railroad Administration whenever a tank car containing any flammable cryogenic liquid is not received by the consignee within 20 days from the date of shipment. Notification to the Federal Railroad Administration may be made by e-mail to *Hmassist@fra.dot.gov* or telephone call to (202) 493–6229.

(4) A tank car may not be loaded with any flammable cryogenic liquid:

(i) That may combine chemically with any residue in the tank to produce an unsafe condition,

(ii) That is colder than the design service temperature of the tank,

(iii) If the average daily pressure rise in the tank exceeded 3 psig during the prior shipment,

(iv) Unless it is marked with the name of contents, in accordance with § 172.330 of this subchapter.

(b) When a tank car containing a flammable cryogenic liquid is offered for transportation:

(1) At least 0.5 percent outage must be provided below the inlet of the pressure relief or pressure control valve at the start-to-discharge pressure setting of the valve, with the tank car in a level attitude, and

(2) The absolute pressure in the annular space must be less than 75 microns of mercury.

(c) *Temperature.* A flammable cryogenic liquid must be loaded into a tank car at such a temperature that the average daily pressure rise during transportation will not exceed 3 psig (see paragraph (a)(4)(iii) of this section).

(d) A Class DOT-113 tank car is authorized for the shipment of the following cryogenic liquids subject to the following additional requirements:

(1) For purposes of this section, ''filling density'' is defined as the percent ratio of the weight of lading in the tank to the weight of water that the tank will hold at the design service temperature (one pound of water = 27.737 cubic inches at 60 °F., or one gallon of water = 231 cubic inches at 60 °F. and weighs 8.32828 pounds).

(2) *Ethylene, and hydrogen (minimum 95 percent parahydrogen), cryogenic liquids* must be loaded and shipped in accordance with the following table:

PRESSURE CONTROL VALVE SETTING OR RELIEF VALVE SETTING

Maximum start-to-discharge pressure (psig)	Maximum permitted filling density (percent by weight)			
	Ethylene	Ethylene	Ethlyene	Hydrogen
17				6.60.
45	52.8			
75		51.1	51.1	
Maximum pressure when offered for transportation.	10 psig	10 psig	20 psig	
Design service temperature	Minus 260 °F	Minus 260 °F	Minus 155 °F	Minus 423 °F.
Specification (see § 180.507(b)(3) of this subchapter).	113D60W 113C60W	113C120W	113D120W	113A175W. 113A60W.

(e) *Special requirements for class DOT 113 tank cars*—(1) A class DOT-113 tank car need not be periodically pressure tested; however, each shipment must be monitored to determine the average daily pressure rise in the tank car. If the average daily pressure rise during any shipment exceeds 0.2 Bar (3 psig)

per day, the tank must be tested for thermal integrity prior to any subsequent shipment.

(2) *Thermal integrity test.* When required by paragraph (e)(1) of this section, either of the following thermal integrity tests may be used:

(i) *Pressure rise test.* The pressure rise in the tank may not exceed 0.34 Bar (5 psig) in 24 hours. When the pressure rise test is performed, the absolute pressure in the annular space of the loaded tank car may not exceed 75 microns of mercury at the beginning of the test and may not increase more than 25 microns during the 24-hour period; or

(ii) *Calculated heat transfer rate test.* The insulation system must be performance tested as prescribed in §179.400–4 of this subchapter. When the calculated heat transfer rate test is performed, the absolute pressure in the annular space of the loaded tank car may not exceed 75 microns of mercury at the beginning of the test and may not increase more than 25 microns during the 24-hour period. The calculated heat transfer rate in 24 hours may not exceed:

(A) 120 percent of the appropriate standard heat transfer rate specified in §179.401–1 of this subchapter, for DOT-113A60W and DOT-113C120W tank cars;

(B) 122.808 joules (0.1164 Btu/day/lb.) of inner tank car water capacity, for DOT-113A175W tank cars;

(C) 345.215 joules (0.3272 Btu/day/lb.) of inner tank car water capacity, for DOT-113C60W and 113D60W tank cars; or

(D) 500.09 joules (0.4740 Btu/day/lb.) of inner tank car water capacity, for DOT-113D120W tank cars.

(3) A tank car that fails a test prescribed in paragraph (e)(2) of this section must be removed from hazardous materials service. A tank car removed from hazardous materials service because it failed a test prescribed in paragraph (e)(2) of this section may not be used to transport a hazardous material unless the tank car conforms to all applicable requirements of this subchapter.

(4) Each rupture disc must be replaced every 12 months, and the replacement date must be marked on the car near the pressure relief valve information.

(5) Pressure relief valves and alternate pressure relief valves must be tested every five years. The start-to-discharge pressure and vapor tight pressure requirements for the pressure relief valves must be as specified in §179.401–1 of this subchapter. The alternate pressure relief device values specified in §179.401–1 of this subchapter for a DOT-113C120W tank car apply to a DOT-113D120W tank car.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53, app. A to part 1)

[Amdt. 173–166, 48 FR 27698, June 16, 1983, as amended by Amdt. 173–245, Sept. 21, 1995; 65 FR 58630, Sept. 29, 2000; 66 FR 45184, 45379, 45383, Aug. 28, 2001; 70 FR 34076, June 13, 2005]

§173.320 Cryogenic liquids; exceptions.

(a) Atmospheric gases and helium, cryogenic liquids, in Dewar flasks, insulated cylinders, insulated portable tanks, insulated cargo tanks, and insulated tank cars, designed and constructed so that the pressure in such packagings will not exceed 25.3 psig under ambient temperature conditions during transportation are not subject to the requirements of this subchapter when transported by motor vehicle or railcar except as specified in paragraphs (a)(1), (a)(2), and (a)(3) of this section.

(1) Sections 171.15 and 171.16 of this subchapter pertaining to the reporting of incidents, not including a release that is the result of venting through a pressure control valve, or the neck of the Dewar flask.

(2) Subparts A, B, C, D, G and H of part 172, (§§174.24 for rail and 177.817 for highway) and in addition, part 172 in its entirety for oxygen.

(3) Subparts A and B of part 173, and §§174.1 and 177.800, 177.804, and 177.823 of this subchapter.

(b) The requirements of this subchapter do not apply to atmospheric gases and helium:

(1) During loading and unloading operations (pressure rises may exceed 25.3 psig); or

(2) When used in operation of a process system; such as a refrigeration system (pressure may exceed 25.3 psig).

(c) For transportation aboard aircraft, see the ICAO Technical Instructions (IBR, see §171.7 of this subchapter), Packing Instruction 202 and the packaging specifications in part 6, chapter 5.

[Amdt. 173–201, 52 FR 13043, Apr. 20, 1987, as amended at 62 FR 51561, Oct. 1, 1997; 66 FR 33436, June 21, 2001; 67 FR 61014, Sept. 27, 2002; 68 FR 48570, Aug. 14, 2003; 68 FR 75746, Dec. 31, 2003]

§ 173.321 Ethylamine.

Ethylamine must be packaged as follows:

(a) In 1A1 drums which meet Packing Group I performance level requirements.

(b) In specification cylinders as prescribed for any compressed gas except acetylene.

[Amdt. 173–224, 55 FR 52667, Dec. 21, 1990]

§ 173.322 Ethyl chloride.

Ethyl chloride must be packaged in any of the following single or combination non-bulk packagings which meet Packing Group I performance level requirements:

(a) In 4C1, 4C2, 4D or 4F wooden boxes with glass, earthenware, or metal inner receptacles not over 500 g (17.6 ounces) capacity each;

(b) In 4G fiberboard boxes with glass, earthenware, or metal inner receptacles not over 500 g (17.6 ounces) capacity each. Outer packagings may not exceed 30 kg (66 pounds) gross weight;

(c) In 1A1 drums of not over 100 L (26 gallons) capacity each; or

(d) In specification cylinders as prescribed for any compressed gas except acetylene. Cylinders made of aluminum alloy are not authorized.

[Amdt. 173–224, 55 FR 52667, Dec. 21, 1990, as amended at 74 FR 2266, Jan. 14, 2009]

§ 173.323 Ethylene oxide.

(a) For packaging ethylene oxide in non-bulk packagings, silver mercury or any of its alloys or copper may not be used in any part of a packaging, valve, or other packaging appurtenance if that part, during normal conditions of transportation, may come in contact with ethylene oxide liquid or vapor. Copper alloys may be used only where gas mixtures do not contain free acetylene at any concentration that will form copper acetylene. All packaging and gaskets must be constructed of materials which are compatible with ethylene oxide and do not lower the auto-ignition temperature of ethylene oxide.

(b) Ethylene oxide must be packaged in one of the following:

(1) In hermetically sealed glass or metal inner packagings suitably cushioned in an outer package authorized by §173.201(b). The maximum quantity permitted in any glass inner packaging is 100 g (3.5 ounces), and the maximum quantity permitted in any metal inner packaging is 340 g (12 ounces). After filling, each inner packaging shall be determined to be leak-tight by placing the inner packaging in a hot water bath at a temperature, and for a period of time, sufficient to ensure that an internal pressure equal to the vapor pressure of ethylene oxide at 55 °C is achieved. The total quantity in any outer packaging shall not exceed 100 g (3.5 ounces), and the total quantity in any outer packaging containing only metal inner packagings shall not exceed 2.5 kg (5.5 pounds). Each completed package must be capable of passing all Packing Group I performance tests.

(2) In specification cylinders or UN pressure receptacles, as authorized for any compressed gas except acetylene. Pressurizing valves and insulation are required for cylinders over 4 L (1 gallon) capacity. Eductor tubes must be provided for cylinders over 19 L (5 gallons) capacity. Cylinders must be seamless or welded steel (not brazed) with a nominal capacity of no more than 115 L (30 gallons) and may not be liquid full below 82 °C (180 °F). Before each refilling, each cylinder must be tested for leakage at no less than 103.4 kPa (15 psig) pressure. In addition, each cylinder must be equipped with a fusible type relief device with yield temperature of 69 °C to 77 °C (157 °F to 170 °F). The capacity of the relief device and the effectiveness of the insulation must be such that the charged cylinder will not explode when tested by the method described in CGA Pamphlet C–14 or other equivalent method.

(3) In 1A1 steel drums of no more than 231 L (61 gallons) and meeting

Packing Group I performance standards. The drum must be lagged of all welded construction with the inner shell having a minimum thickness of 1.7 mm (0.068 inches) and the outer shell having a minimum thickness of 2.4 mm (0.095 inches). Drums must be capable of withstanding a hydrostatic test pressure of 690 kPa (100 psig). Lagging must be of sufficient thickness so that the drum, when filled with ethylene oxide and equipped with the required pressure relief device, will not rupture when exposed to fire. The drum may not be liquid full below 85 °C (185 °F), and must be marked ''THIS END UP'' on the top head. Before each refilling, each drum must be tested for leakage at no less than 103 kPa (15 psig) pressure. Each drum must be equipped with a fusible type relief device with yield temperature of 69 °C to 77 °C (157 °F to 170 °F), and the capacity of the relief device must be such that the filled drum is capable of passing, without rupture, the test method described in CGA Pamphlet C–14 or other equivalent method.

(c) When §172.101 of this subchapter specifies that a hazardous material be packaged under this section, only the following bulk packagings are authorized, subject to the requirements of subparts A and B of this part, the special provisions specified in column 7 of the §172.101 table, and paragraphs (d) through (j) of this section:

(1) *Tank cars.* Class DOT 105 tank cars:

(i) Each tank car built before March 16, 2009 must have a tank test pressure of at least 20.7 Bar (300 psig); and

(ii) Except as provided in §173.314(d), tank cars built on or after March 16, 2009 used for the transportation of ethylene oxide must meet the applicable authorized tank car specification listed in the table in §173.314(c).

(2) *Cargo tanks.* Specification MC 330 and MC 331 cargo tank motor vehicles.

(3) *Portable tanks.* DOT 51 portable tanks.

(d) The pressure relief devices must be set to function at 517 kPa (75 psig). Portable tanks fitted with non-reclosing devices made and in use prior to December 31, 1987, may continue to be used in ethylene oxide service.

(e) In determining outage, consideration must be given to the lading temperature and solubility of inert gas padding in ethylene oxide as well as the partial pressure exerted by the gas padding.

(f) Each tank, loaded or empty, must be padded with dry nitrogen or other suitable inert gas of sufficient quantity to render the vapor space of the tank nonflammable up to 41 °C (105 °F). The gas used for padding must be free of impurities which may cause the ethylene oxide to polymerize, decompose or undergo other violent chemical reaction.

(g) Copper, silver, mercury, magnesium or their alloys may not be used in any part of the tank or appurtenances that are normally in contact with the lading.

(h) Neoprene, natural rubber and asbestos gaskets are prohibited. All packing and gaskets must be made of materials which do not react with or lower the autoignition temperature of the lading.

(i) Each tank must be insulated with cork (at least 10 cm (4 inches) thick), or mineral wool, fiberglass or other suitable insulation material of sufficient thickness so that the thermal conductance at 16 °C (60 °F) is not more than 0.075 Btu per hour per square foot per degree F. temperature differential. Portable tanks made and in use prior to December 31, 1987 equipped with fusible plugs instead of a pressure relief valve or rupture disc, must have sufficient insulation so that the tank as filled for shipment will not rupture in a fire. The insulation on portable tanks or cargo tank motor vehicles must be protected with a steel jacket at least 2.54 mm (0.100 inch) thick, or as required by the specification.

(j) Tank car tanks built after December 30, 1971 must be equipped with a thermometer well.

[Amdt. 173–224, 55 FR 52667, Dec. 21, 1990, as amended at 56 FR 66279, Dec. 20, 1991; Amdt. 173–236, 58 FR 50237, Sept. 24, 1993; Amdt. 173–234, 58 FR 51532, Oct. 1, 1993; Amdt. 173–145, 60 FR 49076, Sept. 21, 1995; 66 FR 45380, 45383, Aug. 28, 2001; 68 FR 75746, Dec. 31, 2003; 69 FR 76178, Dec. 20, 2004; 71 FR 33884, June 12, 2006; 74 FR 1801, Jan. 13, 2009]

§ 173.334 Organic phosphates mixed with compressed gas.

Hexaethyl tetraphosphate, parathion, tetraethyl dithio pyrophosphate, tetraethyl pyrophosphate, or other Division 6.1 organic phosphates (including a compound or mixture), may be mixed with a non-flammable compressed gas. This mixture may not contain more than 20 percent by weight of organic phosphate and must be packaged in DOT 3A240, 3AA240, 3B240, 4B240, 4BA240, 4BW240 or UN cylinders meeting all of the following requirements:

(a) Each cylinder may be filled with not more than 5 kg (11.0 lb) of the mixture, to a maximum filling density of not more than 80 percent of the water capacity.

(b) No cylinder may be equipped with an education tube or a fusible plug.

(c) No cylinder may be equipped with any valve unless the valve is a type approved by the Associate Administrator.

(d) Cylinders must be overpacked in a box, crate, or other strong outer packaging conforming to the requirements of § 173.25 and arranged to protect each valve or other closing device from damage. Except as provided in paragraph (e) of this section, no more than four cylinders may be packed in a strong outer packaging. Each strong outer packaging with its closing device protection must be sufficiently strong to protect all parts of each cylinder from deformation or leakage if the completed package is dropped 1.8 m (6 feet) onto a non-yielding surface, such as concrete or steel, impacting at the packaging's weakest point.

(e) Cylinders may be packed in strong wooden boxes with valves or other closing devices protected from damage, with not more than twelve cylinders in one outside wooden box. An outer fiberboard box may be used when not more than four such cylinders are to be shipped in one packaging. Valves must be adequately protected. Box and valve protection must be of sufficient strength to protect all parts of inner packagings and valves from deformation or breakage resulting from a drop of at least 1.8 m (6 feet) onto a non-yielding surface, such as concrete or steel, impacting at the weakest point.

[67 FR 51651, Aug. 8, 2002, as amended at 71 FR 54395, Sept. 14, 2006; 75 FR 5395, Feb. 2, 2010]

EDITORIAL NOTE: At 67 FR 61014, Sept. 27, 2002, § 173.334(f) was amended, however, paragraph (f) does not exist in this section.

§ 173.335 [Reserved]

§ 173.336 Nitrogen dioxide, liquefied, or dinitrogen tetroxide, liquefied.

(a) Nitrogen dioxide, liquefied, or dinitrogen tetroxide, liquefied, must be packaged in specification or UN cylinders as prescribed in § 173.192, except valves are not authorized. UN tubes and MEGCs are not authorized for use. Cylinders must be equipped with a stainless steel valve and valve seat that will not deteriorate in contact with nitrogen dioxide. Each valve opening must be closed by a solid metal plug with tapered thread properly luted to prevent leakage. Transportation in DOT 3AL cylinders is authorized only by highway and rail.

(b) Each UN pressure receptacle must be cleaned in accordance with the requirements of ISO 11621 (IBR, see § 171.7 of this subchapter). Each DOT specification cylinder must be cleaned according to the requirements of GSA Federal Specification RR–C–901D, paragraphs 3.3.1 and 3.3.2 (IBR, see § 171.7 of this subchapter). Cleaning agents equivalent to those specified in RR–C–901D may be used; however, any cleaning agent must not be capable of reacting with oxygen. One cylinder selected at random from a group of 200 or fewer and cleaned at the same time must be tested for oil contamination in accordance with Specification RR–C–901D, paragraph 4.3.2 (IBR, see § 171.7 of this subchapter) and meet the standard of cleanliness specified therein.

[71 FR 33885, June 12, 2006]

§ 173.337 Nitric oxide.

(a) Nitric oxide must be packaged in cylinders conforming to the requirements of § 173.40 and as follows:

(1) *DOT specification cylinder.* In a DOT 3A1800, 3AA1800, 3E1800, or 3AL1800 cylinder. A DOT specification cylinder must be charged to a pressure of not more than 5,170 kPa (750 psi) at

21 °C (70 °F). Transportation of nitric oxide in a DOT 3AL is cylinder is authorized only by highway and rail.

(2) *UN cylinder.* In a UN cylinder with a minimum test pressure of 200 bar. The maximum working pressure of the cylinder must not exceed 50 bar. The pressure in the cylinder at 65 °C (149 °F) may not exceed the test pressure. The use of UN tubes and MEGCs is not authorized.

(3) *Valves.* Cylinders must be equipped with a stainless steel valve and valve seat that will not deteriorate in contact with nitric oxide. Cylinders or valves may not be equipped with pressure relief devices of any type.

(b) Each UN cylinder must be cleaned in accordance with the requirements of ISO 11621 (IBR, see §171.7 of this subchapter). Each DOT specification cylinder must be cleaned in compliance with the requirements of GSA Federal Specification RR–C–901D, paragraphs 3.3.1 and 3.3.2 (IBR, see §171.7 of this subchapter). Cleaning agents equivalent to those specified in Federal Specification RR–C–901D may be used; however, any cleaning agent must not be capable of reacting with oxygen. One cylinder selected at random from a group of 200 or fewer and cleaned at the same time must be tested for oil contamination in accordance with Federal Specification RR–C–901D paragraph 4.3.2 and meet the standard of cleanliness specified therein.

[71 FR 33885, June 12, 2006]

§173.338 Tungsten hexafluoride.

(a) Tungsten hexafluoride must be packaged in specification 3A, 3AA, 3BN, or 3E (§§178.36, 178.37, 178.39, 178.42 of this subchapter) cylinders. Cylinders must be equipped with a valve protection cap or be packed in a strong outer packaging meeting the provisions of §173.40. Outlets of any valves must be capped or plugged. As an alternative, the cylinder opening may be closed by the use of a metal plug. Specification 3E cylinders must be shipped in an overpack that meets the provisions of §173.40.

(b) In place of the volumetric expansion test, DOT 3BN cylinders used in exclusive service may be given a complete external visual inspection in conformance with part 180, subpart C, of this subchapter, at the time such periodic requalification becomes due. Cylinders that undergo a complete external visual inspection, in place of the volumetric expansion test, must be condemned if removed from tungsten hexafluoride service.

[74 FR 16143, Apr. 9, 2009, as amended at 75 FR 5395, Feb. 2, 2010]

§173.340 Tear gas devices.

(a) Packagings for tear gas devices must be approved prior to initial transportation by the Associate Administrator.

(b) Tear gas devices may not be assembled with, or packed in the same packaging with, mechanically- or manually-operated firing, igniting, bursting, or other functioning elements unless of a type and design which has been approved by the Associate Administrator.

(c) Tear gas grenades, tear gas candles, and similar devices must be packaged in one of the following packagings conforming to the requirements of part 178 of this subchapter at the Packing Group II performance level:

(1) In UN 4C1, 4C2, 4D, or 4F metal-strapped wooden boxes. Functioning elements not assembled in grenades or devices must be in a separate compartment of these boxes, or in inner or separate outer boxes, UN 4C1, 4C2, 4D, or 4F, and must be so packed and cushioned that they may not come in contact with each other or with the walls of the box during transportation. Not more than 50 tear gas devices and 50 functioning elements must be packed in one box, and the gross weight of the outer box may not exceed 35 kg (77 pounds).

(2) In a UN 1A2 metal drum. Functioning elements must be packed in a separate inner packaging or compartment. Not more than 24 tear gas devices and 24 functioning elements must be packed in one outer drum, and the gross weight of the drum may not exceed 35 kg (77 pounds).

(3) In a UN 4G fiberboard box with inside tear gas devices meeting Specifications 2P or 2Q. Each inside packaging must be placed in fiberboard tubes fitted with metal ends or a fiber box with suitable padding. Not more than 30 inner packagings must be packed in

one outer box, and the gross weight of the outer box may not exceed 16 kg (35 pounds).

(4) In other packagings of a type or design which has been approved by the Associate Administrator.

(d) Tear gas devices may be shipped completely assembled when offered by or consigned to the U.S. Department of Defense, provided the functioning elements are so packed that they cannot accidentally function. Outer packagings must be UN 4C1, 4C2, 4D, or 4F metal-strapped wooden boxes.

[Amdt. 173–224, 55 FR 52669, Dec. 21, 1990, as amended 66 FR 45379, Aug. 28, 2001]

Subpart H [Reserved]

Subpart I—Class 7 (Radioactive) Materials

SOURCE: Amdt. 173–244, 60 FR 50307, Sept. 28, 1995, unless otherwise noted.

§ 173.401 Scope.

(a) This subpart sets forth requirements for the packaging and transportation of Class 7 (radioactive) materials by offerors and carriers subject to this subchapter. The requirements prescribed in this subpart are in addition to, not in place of, other requirements set forth in this subchapter for Class 7 (radioactive) materials and those of the Nuclear Regulatory Commission in 10 CFR part 71.

(b) This subpart does not apply to:

(1) Class 7 (radioactive) materials produced, used, transported, or stored within an establishment other than during the course of transportation, including storage in transportation.

(2) Class 7 (radioactive) materials that have been implanted or incorporated into, and are still in, a person or live animal for diagnosis or treatment.

(3) Class 7 (radioactive) material that is an integral part of the means of transport.

(4) Natural material and ores containing naturally occurring radionuclides which are not intended to be processed for use of these radionuclides, provided the activity concentration of the material does not exceed 10 times the values specified in § 173.436.

[Amdt. 173–244, 60 FR 50307, Sept. 28, 1995, as amended at 69 FR 3670, Jan. 26, 2004]

§ 173.403 Definitions.

For purposes of this subpart—

A_1 means the maximum activity of special form Class 7 (radioactive) material permitted in a Type A package. This value is either listed in § 173.435 or may be derived in accordance with the procedures prescribed in § 173.433.

A_2 means the maximum activity of Class 7 (radioactive) material, other than special form material, LSA material, and SCO, permitted in a Type A package. This value is either listed in § 173.435 or may be derived in accordance with the procedures prescribed in § 173.433.

Class 7 (radioactive) material See the definition of *Radioactive material* in this section.

Closed transport vehicle means a transport vehicle or conveyance equipped with a securely attached exterior enclosure that during normal transportation restricts the access of unauthorized persons to the cargo space containing the Class 7 (radioactive) materials. The enclosure may be either temporary or permanent, and in the case of packaged materials may be of the ''see-through'' type, and must limit access from top, sides, and bottom.

Consignment means a package or group of packages or load of radioactive material offered by a person for transport in the same shipment.

Containment system means the assembly of components of the packaging intended to retain the Class 7 (radioactive) material during transport.

Contamination means the presence of a radioactive substance on a surface in quantities in excess of 0.4 Bq/cm^2 for beta and gamma emitters and low toxicity alpha emitters or 0.04 Bq/cm^2 for all other alpha emitters. Contamination exists in two phases.

(1) *Fixed radioactive contamination* means radioactive contamination that cannot be removed from a surface during normal conditions of transport.

(2) *Non-fixed radioactive contamination* means radioactive contamination that can be removed from a surface during normal conditions of transport.