

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; or

(vii) By using valves designed and constructed in accordance with Annex A of ISO 17879:2017(E) (IBR, *see* § 171.7 of this subchapter) for UN pressure receptacles with self-closing valves with inherent protection (except those in acetylene service).

(d) *Non-refillable UN pressure receptacles.* (1) When the use of a valve is prescribed, the valve must conform to the requirements in ISO 11118:2015(E), (IBR, *see* § 171.7 of this subchapter). Manufacture of valves to ISO 13340:2001(E) is authorized until December 31, 2020;

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

(3) The receptacle must have a water capacity not exceeding 1.25 L when used for a flammable or toxic gas or 50 liters for receptacles used to contain chemical under pressure; and

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

(e) *Pyrophoric gases.* A UN pressure receptacle must have valve outlets equipped with gas-tight plugs or caps when used for pyrophoric or flammable mixtures of gases containing more than 1% pyrophoric compounds. When UN pressure receptacles are manifolded in a bundle, each of the pressure receptacles must be equipped with an individual valve that must be closed while in transportation, and the outlet of the manifold valve must be equipped with a pressure retaining gas-tight plug or cap. Gas-tight plugs or caps must have threads that match those of the valve outlets.

(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 pre-

scribed in § 178.71(q)(18) of this subchapter.

[71 FR 33882, June 12, 2006, as amended at 71 FR 54395, Sept. 14, 2006; 76 FR 3380, Jan. 19, 2011; 78 FR 1091, Jan. 7, 2013; 78 FR 65485, Oct. 31, 2013; 80 FR 1161, Jan. 8, 2015; 82 FR 15891, Mar. 30, 2017; 85 FR 27896, May 11, 2020; 85 FR 83400, Dec. 21, 2020; 87 FR 44996, July 26, 2022]

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

(a) *General requirements.* (1) Except as provided in § 171.23(a)(3) of this subchapter, 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 of this subpart. In addition, a DOT specification cylinder must meet the requirements in §§ 173.301a, 173.302a, and 173.305 of the subpart, as applicable. UN pressure receptacles must meet the requirements in §§ 173.301b and 173.302b of this subpart, as applicable. Where more than one section applies to a cylinder, the most restrictive requirements must be followed.

(2) *Adsorbed gas.* Except as provided in § 171.23(a)(3) of this subchapter, a cylinder filled with an adsorbed gas must be offered for transportation in accordance with the requirements of paragraph (d) of this section, and §§ 173.301, and 173.302c of this subpart. UN cylinders must meet the requirements in §§ 173.301b and 173.302b of this subpart, 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, 39 cylinders, 4E (filled to less than 200 psig at 21 °C (70 °F), 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 re-

qualification 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, and 3E 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%;

(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%; and

(iii) The rated burst pressure of a rupture disc for a DOT 39 cylinder must be not more than 80 percent of cylinder burst pressure but not less than 105 percent of cylinder test pressure. Cylinders filled and offered for transportation in accordance with the requirements of the section before January 27, 2021 may continue to be used for the life of the packaging.

(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) 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) 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; 76 FR 56317, Sept. 13, 2011; 80 FR 1161, Jan. 8, 2015; 80 FR 72927, Nov. 23, 2015; 81 FR 3676, Jan. 21, 2016; 85 FR 75714, Nov. 25, 2020; 85 FR 85416, Dec. 28, 2020]

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

(a) *Detailed filling requirements.* Non-liquefied 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, 4BW, and 4E 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 flammable gas, the internal volume of the cylinder may not exceed 1.23 L (75 in³). For chemical under pressure (see § 172.102 of this subchapter (special provision 362)), the internal volume may

not exceed the size limits of the specification as provided in § 178.65(a)(1) of this subchapter.

(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 non-liquefied 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, 3AL and 4E are authorized for oxygen only under the conditions specified in § 173.302(b).

(6) DOT 4E cylinders- DOT 4E cylinders with a maximum capacity of 43L (11 gal) must have a minimum rating of 240 psig and be filled to no more than 200 psig at 21 °C (70 °F).

(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:

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