

(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) 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 re-

quirements 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; 76 FR 56317, Sept. 13, 2011; 78 FR 60754, Oct. 2, 2013; 81 FR 3676, Jan. 21, 2016; 85 FR 75714, Nov. 25, 2020; 85 FR 85416, Dec. 28, 2020]

**§ 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 requirements in table 1 to paragraph (a)(2) apply (for cryogenic liquids, *see* § 173.316):

TABLE 1 TO PARAGRAPH (a)(2)

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 the following notes after the 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 (see Notes 4, 7, and 8).	70.3 .....	DOT-3A2000, DOT-3AA2000, DOT-3AX2000, DOT-3AAX2000, DOT-3T2000.
Carbon dioxide (see Notes 4, 7, and 8).	73.2 .....	DOT-3A2265, DOT-3AA2265, DOT-3AX2265, DOT-3AAX2265, DOT-3T2265.
Carbon dioxide (see Notes 4, 7, and 8).	74.5 .....	DOT-3A2400, DOT-3AA2400, DOT-3AX2400, DOT-3AAX2400, DOT-3T2400.
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.
Chlorodifluoroethane 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.
Chloropentafluoroethane (R-115).	110 .....	DOT-3A225; DOT-3AA225; DOT-3B225; DOT-4BA225; DOT-4B225; DOT-4BW225; DOT-3E1800; DOT-39; DOT-3AL225.

TABLE 1 TO PARAGRAPH (a)(2)—Continued

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 the following notes after the table)
Chlorotrifluoromethane (R–13) (see Note 8).	100 .....	DOT–3A1800; DOT–3AA1800; DOT–3; DOT–3E1800; DOT–39; DOT–3AL1800.
Cyclopropane (see Notes 8 and 9).	55 .....	DOT–3A225; DOT–3A480X; DOT–3AA225; DOT–3B225; DOT–4AA480; DOT–4B225; 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 Notes 8 and 9).	35.8 .....	DOT–3A1800; DOT–3AX1800; DOT–3AA1800; DOT–3AAX1800; DOT–3; DOT–3E1800; DOT–3T1800; DOT–39; DOT–3AL1800.
Ethane (see Notes 8 and 9).	36.8 .....	DOT–3A2000; DOT–3AX2000; DOT–3AA2000; DOT–3AAX2000; DOT–3T2000; DOT–39; DOT–3AL2000.
Ethylene (see Notes 8 and 9).	31.0 .....	DOT–3A1800; DOT–3AX1800; DOT–3AA1800; DOT–3AAX1800; DOT–3; DOT–3E1800; DOT–3T1800; DOT–39; DOT–3AL1800.
Ethylene (see Notes 8 and 9).	32.5 .....	DOT–3A2000; DOT–3AX2000; DOT–3AA2000; DOT–3AAX2000; DOT–3T2000; DOT–39; DOT–3AL2000.
Ethylene (see Notes 8 and 9).	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 (Note 10).	62.5 .....	DOT–3A; DOT–3AA; DOT–3B; 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 <i>paragraph (a)(1)</i> of this section and DOT–3HT; DOT–4D; DOT–4DA; DOT–4DS.
Methyl acetylene and propadiene mixtures, stabilized; (see Note 5).	Not liquid full 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; DOT–4B240; DOT–4B240ET; DOT–3E1800; DOT–4BA240; DOT–4BW240.
Nitrosyl chloride .....	110 .....	DOT–3BN400 only.
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 (see Notes 7, 8, and 11).	70.3 .....	DOT–3A2000, DOT–3AA2000, DOT–3AX2000, DOT–3AAX2000, DOT–3T2000.
Nitrous oxide (see Notes 7, 8, and 11).	73.2 .....	DOT–3A2265, DOT–3AA2265, DOT–3AX2265, DOT–3AAX2265, DOT–3T2265.
Nitrous oxide (see Notes 7, 8, and 11).	74.5 .....	DOT–3A2400, DOT–3AA2400, DOT–3AX2400, DOT–3AAX2400, DOT–3T2400.
Nitrous oxide, refrigerated liquid (see <i>paragraph (e)</i> of this section.).	.....	DOT–4L.

TABLE 1 TO PARAGRAPH (a)(2)—Continued

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 the following notes after the table)
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 TO PARAGRAPH (A)(2): "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<sup>3</sup> at 60 °F).

NOTE 2 TO PARAGRAPH (A)(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 November 1, 1935, and filled with chlorine may not contain over 68.04 kg (150 lb.) of gas.

NOTE 4 TO PARAGRAPH (A)(2): 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 39,000 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 3,000 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 TO PARAGRAPH (A)(2): All parts of the 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 the formation of any acetylides.

NOTE 7 TO PARAGRAPH (A)(2): 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 TO PARAGRAPH (A)(2): See § 173.301(a)(9).

NOTE 9 TO PARAGRAPH (A)(2): When used for shipment of flammable gases, the internal volume of a specification 39 cylinder must not exceed 75 cubic inches.

NOTE 10 TO PARAGRAPH (A)(2): Each valve outlet must be sealed by a threaded cap or a threaded solid plug.

NOTE 11 TO PARAGRAPH (A)(2): Must meet the valve and cleaning requirements in § 173.302(b).

NOTE 12 TO PARAGRAPH (A)(2): For an insecticide gas that is nontoxic and nonflammable, see § 173.305(c).

NOTE 13 TO PARAGRAPH (A)(2): For a refrigerant or dispersant gas that is nontoxic and nonflammable, see § 173.304(d).

(3) A DOT 39 cylinder shall be equipped with a pressure relief device as defined by the commodity in CGA S-1.1, excluding paragraph 9.1.1 (IBR; see

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§171.7 of this subchapter). If the commodity is not listed in CGA S-1.1, a CG-7 pressure relief valve must be used.

(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 ¾ 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

Minimum specific gravity of liquid material at 60 °F	Maximum the filling density in percent of the water-weight capacity of the cylinder
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. The internal volume of a Specification 39 cylinder must not exceed 75 cubic inches. 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 deter-

mined 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)

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**§ 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