(ii) It meets the maximum filling density and service pressure requirements of this part.

(2) The bill of lading or other shipping paper must identify the cylinder and carry the following certification: ''This cylinder has [These cylinders have] been retested and refilled in accordance with DOT requirements for export.''

(k) *Outside packagings.* Specification 2P, 2Q, 3E, 3HT, 4BA spherical type, 4D, 4DA, 4DS, 9[1], 39, 40[1], and 41[1] must be shipped in strong outside packagings, except that the 4BA spherical type may be securely mounted on pallets to provide protection for the spheres and any attachments.

(1) Outside packaging must provide protection for the cylinder. Unless the cylinder has a protective collar or neck ring, the outside packaging must provide protection to the valve against accidental functioning and damage.

(l) Specifications 3AX, 3AAX, and 3T cylinders are authorized for transportation only when horizontally mounted on a motor vehicle or in an ISO framework or other framework of equivalent structural integrity. Cylinders may be transported in COFC or TOFC service only under conditions approved by the Associate Administrator for Safety, Federal Railroad Administration. Cylinder valves and safety devices must be protected as follows:

(1) Each cylinder must be fixed at one end of the vehicle or framework with provision for thermal expansion at the opposite end attachment.

(2) The valve and safety relief device protective structure must be sufficiently strong to withstand a force equal to twice the weight involved with a safety factor of four, based on the ultimate strength of the material used; and

(3) Each discharge for a safety relief device on a cylinder containing a flammable gas must be upward and unobstructed.

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

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.

[1] Use of existing cylinders authorized, but new construction not authorized.

§ 173.302 Charging of cylinders with non-liquefied compressed gases.

(a) *Detailed requirements.* Nonliquefied compressed gases (except gas in solution) for which charging requirements are not definitely prescribed in § 173.304(a)(2) must be shipped, subject to § 173.301, and § 173.305 in specification containers as follows:

(1) Specification 3,[1] 3A, 3AA, 3B, 3C,[1] 3D,[1] 3E, 4,[1] 4A,[1] 4B, 4BA, 4BW, 4C,[1] 25,[1] 26,[1] 33,[1] or 38,[1] (§§ 178.36, 178.37, 178.38, 178.42, 178.50, 178.51, 178.61 of this subchapter). See §§ 173.34 and 173.301(e).

NOTE 1: Authorized cylinders containing oxygen which is continuously fed to tanks containing live fish may be shipped irrespective of the provisions of § 173.24.

(2) Specification 3HT (§ 178.44 of this subchapter) cylinders for aircraft use only, having a maximum service life of 24 years. Authorized only for nonflammable gases. Cylinders must be equipped with safety relief devices only of the frangible disc type which meet the requirements of § 173.34(d). Each frangible disc must have a rated bursting pressure which does not exceed 90 percent of the minimum required test pressure of the cylinder. Discs with fusible metal backing are not permitted. Spec. 3HT cylinders may be shipped only when packed in strong outside packagings.

(3) Specification 3AX, 3AAX, or 3T (§§ 178.36, 178.37, 178,45 of this subchapter) cylinders are authorized only for the following nonliquefied gases: Air, argon, boron trifluoride, carbon monoxide, ethane, ethylene, helium, hydrogen, methane, neon, nitrogen, or oxygen, except that specification 3T is not authorized for hydrogen. As used in this paragraph methane is a nonliquefied gas which has a minimum purity of 98.0 percent methane and which is commerically free of corroding components.

(4) Specification 39 (§ 178.65 of this subchapter) cylinder. For flammable gases, internal volume may not exceed 75 cubic inches. Aluminum cylinders

[1] Use of existing cylinders authorized, but new construction not authorized.

are authorized for oxygen only under the following conditions:

(i) Cylinder threads must be straight threads;

(ii) Cylinder must be equipped only with brass or stainless steel valve; and

(iii) Each cylinder must be cleaned in compliance with the requirements of Federal Specification RR–C–901c, dated January 15, 1981, paragraphs 3.7.2 and 3.8.2. Cleaning agents equivalent to those specified in RR–C–901c, 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 less cleaned at the same time, must be tested for oil contamination in accordance with specification RR–C–901c, paragraph 4.4.2.3 and meet the standard of cleanliness specified.

(5) Specification 3AL (§178.46 of this subchapter) cylinders are authorized only for the following nonliquefied gases: air, argon, carbon monoxide, diborane, ethylene, helium, mercury free hydrogen, krypton, methane, nitrogen, neon, oxygen and xenon. Flammable gases shipped in 3AL cylinders are authorized only when transported by highway, rail and cargo–only aircraft. When used in oxygen service, aluminum cylinders must be in compliance with the following conditions:

(i) Cylinder must be equipped only with brass or stainless steel valve;

(ii) Cylinder must have only straight threads in the opening;

(iii) Each cylinder must be cleaned in compliance with the requirements of Federal Specification RR–C–901c, dated August 1, 1967, paragraphs 3.7.2, and 3.8.2. Cleaning agents equivalent to those specified in RR–C–901c 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 less, cleaned at the same time, must be tested for oil contamination in accordance with Specification RR–C–901c, paragraph 4.4.2.3, and meet the standard of cleanliness specified; and

(iv) The pressure in the cylinder may not exceed 3,000 psig at 70 °F.

(b) *Filling limits.* (See §173.301(e).)

(c) *Special filling limits for Specifications 3A, 3AX, 3AA, 3AAX, and 3T cylinders.* Specifications 3A, 3AX, 3AA, 3AAX, and 3T (§§178.36, 178.37, 178.45 of this subchapter) cylinders may be charged with compressed gases, other than liquefied, dissolved, poisonous, or flammable gases to a pressure 10 percent in excess of their marked service pressure, provided:

(1) That such cylinders are equipped with frangible disc safety relief devices (without fusible metal backing) having a bursting pressure not exceeding the minimum prescribed test pressure.

(2) That the elastic expansion shall have been determined at the time of the last test or retest by the water jacket method.

(3) That either the average wall stress or the maximum wall stress does not exceed the wall stress limitation shown in the following table (see Notes 1, 2 and 3):

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

NOTE 1: The average wall stress shall be computed from the elastic expansion data using the following formula:

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

where:

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

Formula derived from formula of Note 2 and the following:

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

NOTE 2: The maximum wall stress shall be computed from the formula:

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

where:

S = wall stress in psi;
P = test pressure in psig;
D = outside diameter, inches;
$d = D - 2t$, where t= minimum wall thickness determined by a suitable method

NOTE 3: Compliance with average wall stress limitation may be determined through computation of the elastic expansion rejection limit in accordance with CGA Pamphlet C–5 or through the use of the manufacturer's marked elastic expansion rejection limit (REE) on the cylinder.

(4) That 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) That a plus sign (+) be added following the test date marking on the cylinder to indicate compliance with paragraphs (c) (2), (3), and (4) of this section.

(d) *Fluorine.* Fluorine must be shipped in Specification 3A1000, 3AA1000, or 3BN400 (§178.36, §178.37 or §178.39 of this subchapter) cylinders without safety relief device and equipped with valve protection cap. Such containers must not be charged to over 400 p.s.i.g. at 70 °F. and must not contain over 6 pounds of gas.

(e) *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.

(f) *Carbon monoxide.* Carbon monoxide must be shipped in a Specification 3A, 3AX, 3AA, 3AAX, 3AL, 3, 3E, or 3T, (§§178.36, 178.37, 178.46, 178.42, 178.45 of this subchapter) cylinder having a minimum service pressure of 1,800 psig. The pressure in the cylinder must not exceed 1000 psig at 70 °F. except that if the gas is dry and sulfur free, the cylinder may be charged to five-sixths of the cylinder service pressure or 2000 psig, whichever is the lesser. Specification 3AL cylinders are authorized only when transported by highway, rail and cargo–only aircraft.

(g) *Diborane and diborane mixtures.* Diborane and diborane mixed with compatible compressed gas in Specification 3AA1800 (§178.37 of this subchapter), cylinders. The maximum filling density of the diborane shall not exceed 7 percent. Diborane mixed with compatible compressed gas must not have a pressure exceeding the service pressure of the cylinder if complete decomposition of the diborane occurs. Cylinder valves must be protected either by metal caps or by over packing cylinder in strong wooden boxes.

(h) *Poisonous mixtures.* Cylinders containing poison gases and poison gas mixtures meeting Division 2.3 *Hazard Zone A* must conform to the requirements of §173.40 of this part.

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

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting §173.302, see the List of CFR Sections Affected which appears in the Finding Aids section of the printed volume and on GPO Access.

§ 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 (§178.59 or §178.60 of this subchapter) cylinders. 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 tested with satisfactory results in accordance with CGA Pamphlet C–12. Representative samples of cylinders charged with acetylene shall be tested with satisfactory results in accordance with CGA Pamphlet C–12.

(1) The specific gravity of acetone solvent in acetylene cylinders must be 0.796 or over at 15.5 °C. (59.9 °F.).

(2) The amount of solvent added in the refilling operation must not cause the tare weight of the cylinder to exceed its marked tare weight. The tare weight includes the weight of the cylinder shell, porous filling, valve, safety relief devices and solvent, but without removable cap.

(b) *Filling limits.* The pressure in cylinders containing acetylene gas must not exceed 250 psig at 70 °F., and in case the cylinders are marked for a lower allowable charging pressure, at 70 °F., then that pressure must not be exceeded.

(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