

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 2/3 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 difluoride, 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

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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  $\frac{1}{3}$  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  $\frac{1}{2}$  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

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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