

must pass all prescribed tests to be acceptable. Repair by welding is not authorized.

[Amdt. 178-114, 61 FR 25942, May 23, 1996, as amended by 66 FR 45185, 45386, 45388, Aug. 28, 2001; 67 FR 51652, Aug. 8, 2002; 68 FR 75748, Dec. 31, 2003]

§ 178.42 Specification 3E seamless steel cylinders.

(a) *Type, size, and service pressure.* A DOT 3E cylinder is a seamless steel cylinder with an outside diameter not greater than 2 inches nominal, a length less than 2 feet and a service pressure of 1,800 psig.

(b) *Steel.* Open-hearth or electric steel of uniform quality must be used. Content percent may not exceed the following: Carbon, 0.55; phosphorus, 0.045; sulphur, 0.050.

(c) *Identification of steel.* Materials must be identified by any suitable method.

(d) *Manufacture.* Cylinders must be manufactured by best appliances and methods. No defect is permitted that is likely to weaken the finished cylinder appreciably. A reasonably smooth and uniform surface finish is required. The thickness of the spun bottom is, under no condition, to be less than two times the minimum wall thickness of the cylindrical shell; such bottom thickness must be measured within an area bounded by a line representing the points of contact between the cylinder and floor when the cylinder is in a vertical position.

(e) *Openings in cylinders and connections (valves, fuse plugs, etc.) for those openings.* Threads conforming to the following are required on openings.

(1) Threads must be clean cut, even, without checks, and to gauge.

(2) Taper threads, when used, must be of length not less than as specified for American Standard taper pipe threads.

(3) Straight threads having at least 4 engaged threads are authorized. Straight threads must have a tight fit and a calculated shear strength of at least 10 times the test pressure of the cylinder. Gaskets, adequate to prevent leakage, are required.

(f) *Hydrostatic test.* Cylinders must be tested as follows:

(1) One cylinder out of each lot of 500 or less must be subjected to a hydrostatic pressure of 6,000 psig or higher.

(2) The cylinder referred to in paragraph (f)(1) of this section must burst at a pressure higher than 6,000 psig without fragmenting or otherwise showing lack of ductility, or must hold a pressure of 12,000 psig for 30 seconds without bursting. In which case, it must be subjected to a flattening test without cracking to six times wall thickness between knife edges, wedge shaped 60 degree angle, rounded out to a ½ inch radius. The inspector's report must be suitably changed to show results of latter alternate and flattening test.

(3) Other cylinders must be examined under pressure of at least 3,000 psig and not to exceed 4,500 psig and show no defect. Cylinders tested at a pressure in excess of 3,600 psig must burst at a pressure higher than 7,500 psig when tested as specified in paragraph (f)(2) of this section. The pressure must be maintained for at least 30 seconds and sufficiently longer to ensure complete examination.

(g) *Leakage test.* All spun cylinders and plugged cylinders must be tested for leakage by gas or air pressure after the bottom has been cleaned and is free from all moisture subject to the following conditions and limitations:

(1) A pressure, approximately the same as but not less than the service pressure, must be applied to one side of the finished bottom over an area of at least ¼ of the total area of the bottom but not less than ¾ inch in diameter, including the closure, for at least one minute, during which time the other side of the bottom exposed to pressure must be covered with water and closely examined for indications of leakage. Accept as provided in paragraph (h) of this section, a cylinder must be rejected if there is any leakage.

(2) A spun cylinder is one in which an end closure in the finished cylinder has been welded by the spinning process.

(3) A plugged cylinder is one in which a permanent closure in the bottom of a finished cylinder has been effected by a plug.

(4) As a safety precaution, if the manufacturer elects to make this test

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before the hydrostatic test, the manufacturer shall design the test apparatus so that the pressure is applied to the smallest area practicable, around the point of closure, and so as to use the smallest possible volume of air or gas.

(h) *Rejected cylinders.* Reheat treatment is authorized for rejected cylinders. Subsequent thereto, cylinders must pass all prescribed tests to be acceptable. Repair by welding or spinning is not authorized. Spun cylinders rejected under the provisions of paragraph (g) of this section may be removed from the spun cylinder category by drilling to remove defective material, tapping and plugging.

(i) *Marking.* Markings required by §178.35 must be stamped plainly and permanently on the shoulder, top head, neck or sidewall of each cylinder.

[Amdt. 178–114, 61 FR 25942, May 23, 1996, as amended by 66 FR 45386, Aug. 28, 2001]

§ 178.44 Specification 3HT seamless steel cylinders for aircraft use.

(a) *Type, size and service pressure.* A DOT 3HT cylinder is a seamless steel cylinder with a water capacity (nominal) of not over 150 pounds and a service pressure of at least 900 psig.

(b) *Authorized steel.* Open hearth or electric furnace steel of uniform quality must be used. A heat of steel made under the specifications listed in Table 1 in this paragraph (b), a check chemical analysis that is slightly out of the specified range is acceptable, if satisfactory in all other respects, provided the tolerances shown in Table 2 in this paragraph (b) are not exceeded. The maximum grain size shall be 6 or finer. The grain size must be determined in accordance with ASTM E 112–88 (IBR, see §171.7 of this subchapter). Steel of the following chemical analysis is authorized:

TABLE 1—AUTHORIZED MATERIALS

| Designation | AISI 4130 (percent) |
|------------------|---------------------|
| Carbon | 0.28/0.33 |
| Manganese | 0.40/0.60 |
| Phosphorus | 0.040 maximum |
| Sulfur | 0.040 maximum |
| Silicon | 0.15/0.35 |
| Chromium | 0.80/1.10 |
| Molybdenum | 0.15/0.25 |

TABLE 2—CHECK ANALYSIS TOLERANCES

| Element | Limit or maximum specified (percent) | Tolerance (percent) over the maximum limit or under the minimum limit | |
|----------------------------|--------------------------------------|---|--------------------|
| | | Under minimum limit | Over maximum limit |
| Carbon | Over 0.15 to 0.40 incl | .03 | .04 |
| Manganese | To 0.60 incl | .03 | .03 |
| Phosphorus ¹ .. | All ranges | | .01 |
| Sulphur | All ranges | | .01 |
| Silicon | To 0.30 incl | .02 | .03 |
| | Over 0.30 to 1.00 incl | .05 | .05 |
| Chromium | To 0.90 incl | .03 | .03 |
| | Over 0.90 to 2.10 incl | .05 | .05 |
| Molybdenum .. | To 0.20 incl | .01 | .01 |
| | Over 0.20 to 0.40 incl | .02 | .02 |

¹Rephosphorized steels not subject to check analysis for phosphorus.

(c) *Identification of material.* Material must be identified by any suitable method. Steel stamping of heat identifications may not be made in any area which will eventually become the side wall of the cylinder. Depth of stamping may not encroach upon the minimum prescribed wall thickness of the cylinder.

(d) *Manufacture.* Cylinders must be manufactured using equipment and processes adequate to ensure that each cylinder produced conforms to the requirements of this subpart. No fissure or other defect is permitted that is likely to weaken the finished container appreciably. The general surface finish may not exceed a roughness of 250 RMS. Individual irregularities such as draw marks, scratches, pits, etc., should be held to a minimum consistent with good high stress pressure vessel manufacturing practices. If the cylinder is not originally free of such defects or does not meet the finish requirements, the surface may be machined or otherwise treated to eliminate these defects. The point of closure of cylinders closed by spinning may not be less than two times the prescribed wall thickness of the cylindrical shell. The cylinder end contour must be hemispherical or ellipsoidal with a ratio of major-to-minor axis not exceeding two to one and with the concave side to pressure.

(e) *Welding or brazing.* Welding or brazing for any purpose whatsoever is prohibited, except that welding by