

ISO Standards Summary as compared to US DOT 49 CFR

Recommendations for UN Model Regulation

ISO Standard 4706

Refillable Transportable Seamless Aluminum Alloy Cylinders - Design, Manufacture and Acceptance

| | ISO 4706 | 49 CFR 178.61(DOT4BW) |
|-----------------------------------|--|--|
| Safety Margin (Burst/Test) | 1.88 min | 2 min |
| Material | Carbon Steel in Accordance with ISO 4978, carbon 22% max., phosphorus 0.04% max., sulfur 0.04% max. | Carbon Steel, carbon 25% max., phosphorus 0.045% max., sulfur 0.05% max. |
| Wall thickness (min.) | >1.5 mm, >Outside Diameter/250+1mm Wall stress at test press. must be less than 75% of UTS when UTS <490 Mpa (71,000 PSI). Wall stress at test press. must be less than 85% of UTS when UTS >490 Mpa (71,000 PSI). | Over 6" Outside Diameter>0.078 inch (1.9 mm) Wall stress at test press. must be less than 50% of UTS. |
| Manufacturing method | Circumferential seams must be automatic process. Joint must be but welded | Circumferential seams must be electric-arc welding , Machine process including automatic feed. Joint must be but welded. |
| Design qualification tests | Mechanical testing, burst testing (minimum value is not specified) and radiographic examination all circumferential welds. | Mechanical testing, burst testing (4 times service pressure)and radiographic examination of weld in accordance with CGA pamphlet C-3. Tensile testing of the welded joints for each batch |
| Physical tests | Tensile testing of the welded joints for each batch: For two-piece cylinders, one tensile, one root and one face test. | (Tensile testing of the welded joints for each lot of 200: Welding qualification in accordance with CGA pamphlet C-3 |
| Tensile (min) | None | None |
| Yield Stress (Max.) | 0.75 of UTS<490 N/mm ² (71,050 psi) or 0.85% of Tensile for UTS >490 N/mm ² (71,050 psi) | 35,000 psi or 0.50 of UTS |
| Elongation | 29% for a>3mm & R _m <490 N/mm ² (71,050 psi) 20% for a>3mm & R _m >490 N/mm ² (71,050 psi) 22% for a<3mm & R _m <490 N/mm ² (71,050 psi) 15% for a<3mm & R _m >490 N/mm ² (71,050 psi) a = wall thickness, R _m = Actual tensile strength | 20% Tensile<50,000 psi (345 N/mm ²) 16% Tensile>80,000 psi (552 N/mm ²) |
| Bend Test | Yes, in accordance with ISO7438 | Yes, in accordance with CGA Pamphlet C-3 |
| Flattening | none | none |

| | | |
|--|---|--|
| Burst test | $P_b > (20a_b * R_g)/(D-a_b)$ approx. 1.88 times service pressure minimum acceptable volumetric expansion for a cylinder having $R_g < 360 \text{ N/mm}^2$: 20% if length is greater than diameter 14% if length of cylinder is equal or less than its diameter. minimum acceptable volumetric expansion for a cylinder having $360 \text{ N/mm}^2 < R_g < 490 \text{ N/mm}^2$: 15% if length is greater than diameter 10% if length of cylinder is equal or less than its diameter. P_b = Burst pressure, D = Diameter a = wall thickness, R_m = Actual tensile strength | Burst pressure ≥ 4 times service pressure |
| Hydrostatic test | (each cyl.) Subjected to P_h (test pressure) the cylinder shall hold the pressure for a period of time (not specified) | (each cyl.) Volumetric expansion test to 5/3 times service pressure. Permanent expansion must be less than 10% of total expansion. |
| Recommendations (i.e. accept as is, accept conditionally, reject) | Accept conditionally: Modification of sections 4.3, 6.1, 7.1, 8.1.3. See proposed modification for each section. | |

ISO 4706-1989 proposed modification of sections:

Section 4.3:

Add this sentence “The cylinder manufacturer must receive the confirmation of steels acceptance from the national authority of the country where the cylinder is to be used prior to stamp UN marking on the cylinder.”

Justification:

The statement “.... subject to the acceptance by the national authority of the country where the cylinder is to be used.” could create some difficulty in approving cylinders made to this standard for worldwide use. Because different national authorities made accept some materials and other national authorities may not accept these materials, it becomes difficult to accept this criteria. In addition, this statement requires acceptance in the country where the cylinder is used not where it is manufactured. This could create some difficulty in knowing which cylinders are accepted where. If this ISO standard is incorporated as is into the U.N. regulations, it will be necessary to specific somewhere in the approvals process the basis for determining what is acceptable. Otherwise, cylinders made to the lowest possible acceptance standards anyplace in the world will have to be acceptable to anyplace else in the world.

Section 6.1

Replace the first sentence of section 6.1 with “Each manufacturer, before proceeding with the production of a given design of cylinder, shall qualify the welding procedures and welders in accordance with ISO 3088:1975; applicable ISO standards 3834-1:1994, 3834-2:1994, 3834-3:1994, 3834-4:1994; ISO 9956-1:1995, 9956-

2:1995, 9956-3:1995, 9956-4:1995, 9956-5:1995, 9956-6:1995, 9956-7:1995, 9956-8:1995, 9956-9:1995, 9956-10:1996, 9956-11:1996; and ISO 5826:1983.

Justification:

The statement "... shall qualify the welding procedures and welders to an acceptable national standard." could create some difficulty in approving cylinders made to this standard for worldwide use. Acceptable to who? Because national standards for welding procedures and welders vary significantly for different countries there is no way of knowing what standards were used to manufacture the cylinders.

Section 7.1:

Replace the first sentence of section 7.1 with "Radiographic examination shall be in accordance with an applicable ISO 1106-1:1984, 1106-2:1985 or 1106-3:1984."

Justification:

The statement "... shall conform to techniques set forth in an acceptable national standard." could create some difficulty in approving cylinders made to this standard for worldwide use. Acceptable to who? Because national standards for radiographic examination vary significantly for different countries there is no way of knowing what standards were used to manufacture the cylinders. The acceptable standards must be better defined or a procedure must be defined in the approval documents to determine what is acceptable. Otherwise, cylinders made to the lowest possible acceptance standards anyplace in the world will have to be acceptable to anyplace else in the world.

Section 8.1.3:

Second sentence of section 8.3.1 shall be replaced with "the reduced rate of testing for large manufacturing volume (above 3000 cylinders) must be subject to a written agreement prior to the UN stamp marking by the national authority of the country where the cylinder is be used."

Justification:

The statement "... subject to the written agreement with the national authority ..." could create some difficulty in approving cylinders made to this standard for worldwide use.