

Australian Standard™

**Steel cylinders for compressed gases—
Welded two-piece construction—0.1 kg
to 150 kg**



This Australian Standard was prepared by Committee ME-002, Gas Cylinders. It was approved on behalf of the Council of Standards Australia on 8 December 2004. This Standard was published on 4 January 2005.

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STANDARDS AUSTRALIA

RECONFIRMATION

OF

AS 2469—2005

Steel cylinders for compressed gases—Welded two-piece construction—0.1 kg to
150 kg

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NOTES

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PREFACE

This Standard was prepared by the Australian members of the Joint Standards Australia/Standards New Zealand Committee ME-002, Gas Cylinders to supersede AS 2469—1998, *Steel cylinders for compressed gases—Welded two-piece construction—0.1 kg to 35 kg*. After consultation with stakeholders in both countries, Standards Australia and Standards New Zealand decided to develop this Standard as an Australian, rather than an Australian/New Zealand Standard.

This Standard is one of a suite of three Standards for welded and brazed cylinders for compressed gases, the other Standards being as follows:

AS

- 2470 Steel cylinders for compressed gases—Welded three-piece construction with longitudinal joint—11 kg to 150 kg
- 3577 Steel cylinders for compressed gases—Welded—150 kg to 500 kg

This Standard provides for gas cylinders produced in large quantities. Users of this Standard should note that a competent person or body will require either quality control procedures to be employed at the point of manufacture in Australia, or, for cylinders manufactured overseas, sampling and testing at the point of entry into Australia. It should also be noted that before a gas cylinder can be first filled in Australia it must be stamped with a Certificated Gas Cylinder Test Station registered mark in accordance with the relevant Standard in the AS 2030 series.

The construction requirements now allow two piece welded cylinders to be made with capacities up to 150 kg water capacity. This brings this Standard into alignment with ISO 4706, *Refillable welded steel gas cylinders*.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the appendix to which they apply. A ‘normative’ appendix is an integral part of a Standard, whereas an ‘informative’ appendix is only for information and guidance.

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STANDARDS AUSTRALIA

Australian Standard

Steel cylinders for compressed gases—Welded two-piece construction—0.1 kg to 150 kg**1 SCOPE**

This Standard specifies requirements for welded carbon and stainless steel cylinders with no longitudinal joint and one circumferential joint, of water capacity not less than 0.1 kg nor more than 150 kg, which have test pressures from 1750 kPa to 7000 kPa and are intended for the storage and transport of compressed gases in accordance with AS 2030.1. Requirements for pneumatic testing are given in Appendix A.

NOTES:

- 1 A gas cylinder manufactured by welding but which includes any brazing of, or on, the pressure-retaining portions is for the purpose of this Standard considered to be a brazed gas cylinder.
- 2 Other Australian Standards for brazed and welded gas cylinders are AS 2468, AS 2470, and AS 3577.
- 3 Appendix B lists the suggested minimum information that should be supplied by the purchaser when ordering gas cylinders to this Standard.

2 REFERENCED DOCUMENTS

A list of documents referred to in this Standard is given in Appendix C.

3 DEFINITIONS

For the purpose of this Standard, the definitions given in AS 2030.1 and those below apply.

3.1 Attachment

Any fitting attached to the pressure-retaining sections of the cylinder by welding, including bosses, pads, valve protection rings, and footrings.

3.2 Inspection Body

A body responsible for inspection, which may cover any one or more of the following:

- (a) Design verification.
- (b) Fabrication inspection.
- (c) In-service inspection.

3.3 Inspector

A person, acceptable to the competent person or body, who ensures and certifies that all the inspections specified herein have been carried out and that the cylinders comply with all the requirements of this Standard.

4 MATERIAL**4.1 Steelmaking process**

The steel shall be made by the open hearth, basic oxygen, or an electric process, and shall be continuously cast. Production by the use of ingots is acceptable provided the steel is fully killed. Rimmed steels shall not be used for arc welded components.

4.2 Carbon steel

4.2.1 Cylinder halves

4.2.1.1 Cast analysis

The cast analysis shall conform to Table 1, except that where resistance-welded attachments are to be added to the cylinder the maximum carbon content of the pressure-retaining portion of the joint shall be 0.15%.

TABLE 1
CAST ANALYSIS

Elements (other than iron)	Cast analysis (max.), percent
Carbon	0.25
Manganese	1.70
Silicon	0.40
Micro-alloying elements (total)	0.15
Sulfur	0.040
Phosphorus	0.040

NOTES:

- 1 Grain-refining elements, i.e. titanium (up to 0.040%) and aluminium (up to 0.1%), may be added.
- 2 Examples of micro-alloying elements are titanium (where greater than 0.040%), niobium, and vanadium.
- 3 AS/NZS 1594 and equivalent overseas Standards specify some acceptable grades of steel with conforming cast analyses.
- 4 Residual elements up to the following individual amounts or a sum of 0.7% of all listed elements are considered to be incidental:

Chromium.....	0.30%
Copper.....	0.35%
Molybdenum.....	0.10%
Nickel.....	0.35%

4.2.1.2 Residual elements

Elements not shown in Table 1 shall not be intentionally added to the steel, other than for the purpose of finishing the heat.

All reasonable precautions shall be taken to prevent the addition of such elements during manufacture, and the quantities present shall not be detrimental to the application of steel for a welded gas cylinder.

4.2.1.3 Weldability

The steel shall be of a weldable quality.

4.2.1.4 Mechanical properties

When a completed gas cylinder is tested in accordance with Clause 8.3, the yield and tensile strength values obtained shall be not less than the values used in the equations in Clause 5.1.1.

When determined in accordance with Clause 8.3, the elongation shall be not less than 20% minus one percentage unit for each increment of 50 MPa by which the measured tensile strength exceeds 350 MPa, but in any case not less than 16%.

4.2.1.5 *Attachments*

Attachments shall be of steel complying with the requirements of Clause 4.1, except that for resistance-welded attachments the steel of both components of the joint shall be weldable and be subject to a maximum carbon content of 0.15%.

4.3 **Stainless steel**

4.3.1 *Cylindrical halves*

4.3.1.1 *Cast analysis*

The cast analysis shall comply with the chemical composition requirements of grades 304/304L or 316/316L as specified in ASTM A240/240M and ASTM A480/A480M, except that the maximum carbon content shall not exceed 0.05%.

4.3.1.2 *Test certificates*

Test certificates shall be provided by the stainless steel supplier, with each completed order to indicate the material and mechanical properties of the stainless steel supplied.

For temper rolled stainless steel, tensile specimens shall be taken from both ends of each coil. For test certificate purposes, all specimens shall be taken at a sufficient distance from coil ends in order to be fully representative of the coil.

4.3.1.3 *Mechanical properties*

All tests specified in Section 8 are required. When a completed cylinder is tested in accordance with Clause 8.3 of this Standard, the yield and tensile strength values obtained shall not be less than those values used in the equations in Clause 5.1.1 of this Standard.

When determined in accordance with Clause 8.3 of this Standard, the elongation shall be not less than 20% minus one percentage unit for each increment of 50 MPa by which the measured tensile strength exceeds 350 MPa, but in any case not less than 16%.

4.3.1.4 *Attachments*

Attachments, including fittings, data plates, lugs, handles, valve guards and footrings, shall be of stainless steel complying with the grades 304/304L or 316/316L of ASTM A240/240M, ASTM A276 and ASTM A480/A480M.

4.3.1.5 *Intergranular corrosion test*

These intergranular corrosion tests shall comply with the requirements of AS 2038. For welded variables, materials and welding procedures shall be qualified by testing a specimen from a least one cylinder randomly selected from each batch of 200 cylinders or part batch thereof.

Test pieces shall be prepared to provide representative weld metal and heat affected parent metal of each of the following:

- (a) Circumferential joint.
- (b) Pad or boss attachment weld.
- (c) Representative attachment welds of any attachment described in Clause 4.3.1.4.

At least one of the test pieces shall be taken from the position of maximum heat input and maximum number of runs.

Test pieces may be taken from cylinders used for other tests provided these other tests on the cylinder have been completed with successful results.

5 DESIGN AND CONSTRUCTION

5.1 Minimum thickness

5.1.1 Cylinder halves

The wall thickness of a cylindrical half shall be not less than 1.75 mm for carbon steel and not less than 1.5 mm for stainless steel, nor less than the greater of those calculated from the following equations:

$$t = 2.5 \left(\frac{D_i}{R_m} \right)^{1/2} \quad \dots 5.1.1(1)$$

$$t = \frac{p_h D_o}{2f + p_h} \quad \dots 5.1.1(2)$$

where

t = minimum finished thickness of the cylinder, in millimetres

D_i = nominal internal diameter, in millimetres

D_o = nominal outside diameter of cylindrical section, in millimetres

p_h = test pressure (the design test pressure specified in AS 2030.1), in megapascals

f = for carbon steel maximum permissible stress, to be taken as 90% of the minimum yield strength of the steel, but not exceeding 60% of the minimum tensile strength of the steel, in megapascals. For calculation purposes, a maximum value for f of 320 MPa shall apply for carbon steel;

= for stainless steel maximum permissible stress, to be taken as 90% of the minimum yield strength of the steel, but not exceeding 53% of the minimum tensile strength of the steel, in megapascals. For calculating purposes, a maximum value for f of 360 MPa shall apply for stainless steel

R_m = minimum tensile strength of the steel, in megapascals

NOTE: Minimum yield strength and minimum tensile strength are those values determined in accordance with Clause 8.3, i.e. following any forming and heat treatment.

5.1.2 After forming

Where thinning has occurred in the formed portion of the end owing to the forming operation(s), the minimum thickness at that thinned section shall be not less than 90% of the thickness established in Clause 5.1.1.

5.2 Form of ends

Ends shall be concave to pressure, and shall have a spherical or ellipsoidal form (see Figure 1).

The ends shall have a cylindrical portion of length not less than four times the minimum thickness.

The ellipsoidal form shall be of not more than 2 to 1 ratio at the internal surface, i.e. the internal height of the end is 25% of the internal diameter. A template of true form shall be used internally or externally to check the deviation from the true form. Any deviation measured perpendicular to the surface shall not exceed 1.25% of the nominal external diameter of the cylinder (see Figure 1).

5.3 Footring

A cylinder intended to be freestanding and upright in service shall be fitted with a footring which shall be clear of, and in such position that will not obstruct the inspection of, any circumferential joint. The footring shall not entrap liquid when the cylinder is in the standing position, and the space enclosed by the footring shall be suitably ventilated.

NOTE: Clause 5.6.3 gives requirements for footring attachment.

5.4 Length to outside diameter ratio

The ratio of length over the ends to the outside diameter of the cylinder shall be not greater than 4.0 to 1, except where calculation or test shows to the satisfaction of a competent person or body that a greater ratio is suitable.

5.5 Valve protection

Where required by AS 2030.1, valve protection shall be provided in accordance with AS 2030.1. Valve protection shall be capable of withstanding the strength test specified in Clause 10.5.

5.6 Pressure-retaining joint

5.6.1 General

There shall be no longitudinal joint and only one circumferential joint. The welded circumferential joint shall be of a quality not inferior to that produced by electric arc welding by a machine process using automatic feed and welding guidance mechanism. Other equivalent automatic processes, with the exception of resistance welding, may be used.

The welded circumferential joint shall be made with weld variables verified by type testing in accordance with Clause 10, and, where welding procedures are changed, these shall be re-verified by further type testing in accordance with Clause 10.

Misalignment of mating butt edges shall not exceed the following percentages of the thicker nominal material thickness of the joint components:

- (a) Square butt joint 15%.
- (b) Joggle-butt joint 25%.

5.6.2 Welded circumferential joint

Some acceptable welded circumferential joints are as follows:

- (a) Butt joint (full penetration) as shown in Figure 2, or with a retained backing strip.
- (b) Joggle-butt joint of the proportions shown in Figure 3, with one member offset to form an integral internal backing strip.

Welded circumferential joggle-butt joint members shall be made with a uniform press fit at the weld root, and the offset shall be smooth and symmetrical without notches at position 'X' shown in Figure 3. The weld shall penetrate the root.