



Gas cylinders

Part 5: Filling, inspection and testing of refillable cylinders



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 - Australia New Zealand Industrial Gas Association
 - Australian Chamber of Commerce and Industry
 - Australian Gas Association
 - Australian Industry Group
 - Australian Steel Association
 - Department of the Premier and Cabinet, SafeWork SA
 - Fire Protection Association of Australia
 - International Association for Natural Gas Vehicles
 - LPG Australia
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 - Victorian WorkCover Authority
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Australian Standard[®]

Gas cylinders

Part 5: Filling, inspection and testing of refillable cylinders

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PREFACE

This Standard was prepared by the Australian members of Joint Standards Australia/Standards New Zealand Committee ME-002, Gas Cylinders, to supersede (in part) AS 2030.1—1999, *The verification, filling, inspection, testing and maintenance of cylinders for the storage and transport of compressed gases*, Part 1: *Cylinders for compressed gases other than acetylene*. After consultation with stakeholders in both countries, Standards Australia and Standards New Zealand decided to develop this Standard as an Australian Standard rather than an Australian/New Zealand Standard.

This Standard incorporates Amendment No. 1 (May 2015). The changes required by the Amendment are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure or part thereof affected.

This edition introduces the following changes:

- (a) The main title of the AS 2030 series has been changed and simplified to more accurately reflect the scope of the Standard.
- (b) To clarify the application of the AS 2030 series, the scope of the previous edition of AS 2030.1 has been divided between the new edition of AS 2030.1 and this new Standard, AS 2030.5. This Standard contains requirements previously located in Clauses 5 to 9 of AS 2030.1—1999.

AS 2030.1 applies to all gas cylinders, containing requirements for design, manufacture and inspection (including conformity assessment), requirements to be met prior to the first fill and other issues applicable to all cylinders.

AS 2030.5 applies to refillable cylinders (except for acetylene, which remains in AS 2030.2), and contains additional requirements for filling, inspection (periodic and non-periodic) and other issues related to refillable cylinders.

- (c) Many terms have been re-defined to harmonize with the terminology of the *Australian Code for the Transport of Dangerous Goods by Road and Rail* (ADG Code), which in turn takes its definitions from *UN Model Regulations on the Transport of Dangerous Goods*.

Of necessity, some terms have definitions which are not the same as the ADG Code. Of these the most significant are the following:

- (i) This Standard retains the generic term ‘gas cylinder’. The corresponding ADG Code term ‘transportable pressure receptacle’ is generally equivalent to a gas cylinder as defined in this Standard, except that a pressure receptacle may include certain vessels which are built to a general pressure vessel code, whereas such vessels are specifically excluded from the scope of this Standard.
- (ii) This Standard also retains the generic term ‘welded gas cylinder’, rather than the ADG Code term ‘pressure drum’, because ‘pressure drum’ may include general pressure vessels.

Appendix C of AS 2030.1 provides a comparison of the definitions used in this Standard, AS 2030.1—1999 and the ADG Code.

Note that some gases formerly classified as compressed (permanent) are now classified as high pressure liquefied gases.

- (d) Tables 1 to 4 have been extensively revised to harmonize as far as possible with the ADG Code.

Complete harmonization is not possible because Australian cylinder standards have, in the past, had a significantly different design philosophy from European cylinder standards. There are two practical differences arising from these philosophical differences:

- (i) In Europe, cylinders containing compressed gases do not (in general) have burst discs, and may be pressurized in service up to their test pressure. Australian Standards have for many years followed American practice in using burst discs, and these are required to operate at a pressure at or below the test pressure. Logically the maximum operating pressure must be limited to a value below the lowest release pressure of the safety device.
- (ii) In Europe, cylinders containing liquefied gases have traditionally been fitted with safety devices which release at a pressure between the test pressure and a tolerance above the TP. In Australia, the maximum service pressure is limited to specified percentages (between 80% and 90%) of the maximum test pressure.

Therefore, for certain compressed gas mixtures, the maximum filling pressure in Australia may be lower than for a cylinder of equal test pressure authorized for use in Europe, and for liquefied gases to achieve the same filling ratio, the required minimum test pressure in Australia will usually be higher than European practice. (Alternatively, lower filling ratio may be specified for the same test pressure).

- (e) Requirements for certified gas cylinder test stations (set out in AS 2337.1) have been clarified and some associated terminology has been updated to reflect current usage.

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.

Statements expressed in mandatory terms in notes to tables are deemed to be requirements of this Standard.

IT SHOULD BE NOTED THAT COMPLIANCE WITH THIS STANDARD MAY NOT NECESSARILY FULFILL ALL LEGAL OBLIGATIONS.

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STANDARDS AUSTRALIA

Australian Standard Gas cylinders

Part 5: Filling, inspection and testing of refillable cylinders

1 SCOPE

This Standard specifies requirements for the filling, inspection and testing of refillable gas cylinders for the storage and transport of compressed and liquefied gases, of water capacity ranging from 0.1 kg to 3000 kg.

This Standard does not apply to the following:

- (a) Acetylene cylinders.
- (b) Closed cryogenic receptacles.
- (c) Cylinders forming part of aircraft equipment and used solely in aircraft other than as a reference made in a direction pursuant to the Civil Aviation Regulations.
- (d) Pressure drums or vessels constructed to a pressure vessel standard.

The requirements for gas cylinders in fire extinguisher systems and fire extinguishers, apply only where suitable requirements are not given in another Australian Standard.

NOTES:

- 1 The term 'cylinder' is used interchangeably with 'gas cylinder' in this Standard.
- 2 AS 2030.1 sets out requirements for design, verification and manufacturing of all gas cylinders.
- 3 AS 2030.2 sets out requirements for compressed dissolved acetylene.
- 4 AS 2030.4 sets out requirements for closed cryogenic receptacles (formerly called welded cylinders-insulated).

2 REFERENCED DOCUMENTS

A list with titles of the documents referred to in this Standard is given in Appendix A.

3 DEFINITIONS

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

3.1 Automatic fill limiter (AFL) valve

A device in the filling system which automatically shuts off the filling when a pre-determined level in the gas cylinder has been reached.

3.2 Filling ratio definitions

3.2.1 Filling ratio

The ratio of the mass of gas to the mass of water at 15°C that is filled in a gas cylinder ready for use.

3.2.2 Maximum filling ratio

The maximum ratio of the mass of gas to the mass of water at 15°C that is permitted to be filled into a gas cylinder by Table 3 or 4 or the cylinder design.

3.3 Palletized cylinder

A cylinder located on a pallet, without any manifolds or piping connections to other cylinders.

3.4 Residual pressure valve (RPV)

A cylinder valve capable of retaining a specified pressure in a cylinder after its contents have been discharged.

NOTE: ISO 15996 provides suitable requirements for such valves.

3.5 Shall

Indicates that a statement is mandatory in order to comply with this Standard.

3.6 Should

Indicates a recommendation.

3.7 Valve with integrated pressure regulation (VIPR)

Device intended to be permanently fitted to a gas cylinder connection and comprising a shut-off valve system and pressure reduction system.

NOTE: A VIPR may have an unregulated gas outlet connection in addition to the regulated pressure outlet.

4 CYLINDER REQUIREMENTS

Cylinders shall comply with the requirements of AS 2030.1.

5 CYLINDER FITTINGS

5.1 Valves

5.1.1 General

Cylinder valves shall comply with the relevant part of AS 2473.

NOTE: For valves with integral pressure reduction (VIPR), suitable requirements are set out in ISO 22435 for industrial VIPR applications, and ISO 10524-3 for medical VIPR applications.

5.1.2 Stem threads

The valve stem (inlet) thread shall be compatible with the appropriate cylinder neck thread as specified in AS 2030.1.

5.1.3 Outlet connections

The valve outlet connection shall be one of the following in accordance with the intended contents and uses:

- (a) *Medical gases*
 - (i) For a non-pressure regulated outlet, the connection specified in AS 2473.3 for the particular gas within the pressure rating defined in that Standard.
 - (ii) For the pressure regulated outlet from a medical VIPR, the outlet connection specified in AS 3840.1.
- (b) *Other gases*
 - (i) For a non-pressure regulated outlet, the connection specified in AS 2473.2 for the particular gas and pressure range.

NOTE: For compressed gases the pressure range in AS 2473.2 refers to the working pressure, and for high pressure liquefiable gases refers to filling ratios resulting in equivalent maximum developed pressure as for compressed gases.

- (ii) For the pressure-regulated outlet from an industrial VIPR, the outlet connection specified in either AS 2473.2 or AS 4267 as appropriate.
- (c) *Cylinders imported full for use in Australia, and exported for refilling.*

The outlet shall be as specified in AS 2030.1—2008, Appendix B.

Outlet connection adaptors immediately downstream of a valve outlet connection are considered to be hazardous due to loss of non-interchangeability between outlets and the risk of leakage and inadvertent separation. Adaptors are used in Australian Department of Defence systems, where close control of the system is provided for. Use of adaptors in other systems shall be avoided.

5.1.4 *Dedicated filling connection*

Where the valve is fitted with a dedicated filling connection, which is separate from any gas outlet, the filling connection shall be designed to prevent gas withdrawal by the user.

NOTE: Dimensions for dedicated filling connections are not specified in this Standard.

5.2 Protection of valves

5.2.1 *General*

Cylinder valves shall be protected against damage from impact by one of the following methods:

- (a) A cap or guard complying with ISO 11117.
- (b) A shroud or protection ring permanently attached to the cylinder complying with the drop test requirements of the cylinder Standard, where that Standard requires drop testing of the shroud or protection ring.
- (c) A shroud or protection ring permanently attached to the cylinder complying with the drop test requirements of ISO 11117.
- (d) For non-flammable, non-toxic gases, inherent protection by compliance with the impact requirements of AS 2473.1.

The form of protection shall not impede escape of discharge from the safety device.

NOTES:

- 1 Transport Regulations may impose requirements for valve protection. Compliance with AS 2030.5 may not necessarily fulfil all such requirements.
- 2 Valves for high pressure flammable gases fitted with key operated valve mechanisms with the actuating spindle inside the valve envelope, and satisfying the impact requirements of AS 2473.1—2006, may continue in service for the cylinder package's remaining service life. This will apply to cylinders manufactured prior to the date of the issue of Amendment No. 1 to this Standard (see Preface).

5.2.2 *Toxic gases*

For cylinders containing toxic gases the valve shall additionally be protected against leakage by a gastight seal rated for the cylinder pressure screwed into the outlet of the valve.

5.3 Safety devices

5.3.1 *General*

All cylinders shall be fitted with safety devices, except for the following:

- (a) Safety devices shall not be fitted to cylinders containing either a medical compressed gas or a toxic gas.
- (b) Fitment of a safety device to a cylinder is optional for the following:
 - (i) Cylinders in non-underwater breathing applications, e.g. SCBA.

A1

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- A1 | (ii) Where the cylinder has a diameter of 115 mm or less, or a water capacity of 3.5 kg or less, and safety device T (see Table 6) is specified in Tables 2, 3 and 4 for the intended contents.
- (iii) Cylinders in a bundle which utilize one common safety device, in compliance with Clause 5.3.2.

Safety devices shall comply with AS 2613.

The fitment of safety devices shall be in accordance with Tables 2, 3 and 4, as appropriate to the intended contents. There shall be unimpeded escape of discharge from any safety device.

NOTE: Requirements for fitment of safety devices to cylinder valves are specified in AS 2473.1.

5.3.2 *Safety devices on bundles*

Where cylinders for non-flammable non-toxic gas are manifolded together, one common safety device of a rated capacity not less than the sum of the capacities required for all of the manifolded cylinders may be used in place of individual safety devices, provided that there is no shut-off valve between the common safety device and any of the cylinders.

5.3.3 *Composite gas cylinders*

- A1 | Where safety devices are fitted to composite gas cylinders, they shall be verified as being of suitable type and performance by testing of the complete cylinder.

5.3.4 *SCUBA cylinders*

A bursting disc type safety device with suitable protection against corrosion shall be fitted to all cylinders for SCUBA applications.

5.4 **Manifolds and valves for bundles**

Manifold piping and other fittings shall be protected from damage and shall lie wholly within the framework of the bundle.

Where cylinders for flammable or toxic gas are manifolded together during transport, there shall be a shut-off valve to isolate each cylinder.

6 **FILLING INSPECTIONS**

6.1 **General**

The cylinder filling inspections shall be carried out only by persons who have the appropriate competence to ensure that each cylinder is safe for continued use.

Each cylinder shall be subjected to the following inspections prior to, during and immediately after filling, as appropriate:

- (a) Verification of cylinder markings (see Clause 6.2).
- (b) Verification of serviceable condition (see Clause 6.3).
- (c) Identification of the previous contents, if required (see Clause 6.4).
- (d) Verification of internal cylinder condition, if required (see Clause 6.5).
- (e) Verification of integrity of permanent attachments (see Clause 6.6).
- (f) Verification of the integrity and suitability of the valve and safety device (see Clause 6.7).
- (g) Verification of correct filling pressure as applicable (see Clause 6.8).
- (h) Verification of correct filling mass as applicable (see Clause 6.9).
- (i) Verification of valve protection (see Clause 6.10).

- (j) Verification of correct identification and labelling (see Clause 6.11).

Cylinders filled for use outside Australia shall be subjected to the inspections in accordance with Clause 6.12.

Cylinders which do not satisfy the criteria listed above shall be clearly identified and handled in accordance with the relevant procedures of the filling organization.

6.2 Verification of cylinder markings

Before filling a cylinder the filler shall verify the following:

- (a) The markings that are necessary to establish the filling conditions are legible.
- (b) The cylinder carries a current, legible test mark of a certified test station.

NOTES:

- 1 Refer to Clause 10 for the marking and inspection requirements for cylinders to be filled for use outside Australia.
- 2 An informative list of current test marks is provided in MP 48.

6.3 Verification of serviceable condition

6.3.1 General criteria

Before filling a cylinder or bundle, the filler shall verify the following for each cylinder:

- (a) The external surface is sufficiently clean and free of foreign material to allow it to be assessed for defects.
- (b) It does not exhibit any mechanical damage, or other defects such as arc burns, bulging, severe corrosion, or heat/fire damage which may prevent it from being filled safely. The rejection criteria from AS 2337, Part 1 or 3 (as appropriate), shall be applied when assessing defects.
- (c) It has not exceeded the due date for periodic inspection and testing (see Clause 9).
- (d) It is compatible with the intended gas content and filling pressure (see Clause 7.1 and Tables 2, 3 and 4).
- (e) The intended gas contents correspond to any identification label and identification colours on the cylinder.

Cylinders judged to be unserviceable shall be clearly identified and isolated for further treatment, in accordance with AS 2337.1 and AS 2337.3.

NOTE: AS 4955.1, AS 4955.2, AS 2473.1, ISO 11114-4, and the special filling provisions of Tables 2, 3 and 4 provide guidance on material compatibility.

6.3.2 Bundle of cylinders

Before filling a bundle, the filler shall verify that—

- (a) the frame is free from damage which can affect its mechanical integrity;
- (b) the restraining systems that prevent the cylinders from moving are secure;
- (c) any lifting attachments and/or fork-lift slots are free from damage that can affect the integrity of the bundle;
- (d) the manifold and pipework are secure and undamaged;
- (e) flexible hoses, where fitted, are free from damage;
- (f) the visible surfaces of the cylinders are clean, free of foreign material and do not exhibit any defects that could render them unsafe (as per Clause 6.3.1);
- (g) the bundle does not show any signs of having been immersed in water or other liquids (e.g. cylinders covered in mud or other residue) or any signs of tampering (e.g. loosened bolts, missing panels);

- (h) valves are free from contamination, are undamaged, have the correct thread for the gas to be filled and operate properly;
- (i) any pressure relief devices, such as relief valves or bursting discs, are in place and have not been visibly damaged or altered; and
- (j) in the case of liquefied gases, the empty mass marking is legible.

6.3.3 Palletized cylinder

A pallet of cylinders may be filled without unloading the cylinders if the filler verifies that all cylinders have been inspected according to Clause 6.3.1.

6.4 Previous contents

The filler may require the cylinder owner to confirm the previous contents.

6.5 Internal cylinder condition

Internal corrosion can occur for certain combinations of the gas and cylinder material in the event of liquid ingress or other detrimental contamination, see AS 4955.1.

In such situations (e.g. steel cylinders containing oxygen, or CO₂ mixtures), filling stations shall identify and reject affected cylinders.

Cylinders without valves that prevent ingress of contamination (e.g. residual pressure valves) shall be checked, if there are doubts about their internal condition, by one or more of the following means:

- (a) A residual pressure check.
- (b) By checking the mass of the empty cylinder against the current tare mass.
- (c) By moisture analysis.
- (d) By another method that can confirm the presence of contamination.

If contamination is detected, or whenever the valve is removed, a visual internal inspection shall be performed by a competent person, in accordance with AS 2337.1.

6.6 Integrity of permanent attachments

Before filling a cylinder, the filler shall verify that the neck ring/threaded boss and guard (if fitted) are fit for the intended purpose, and that the neck ring, if one exists, is not loose. If there is a permanent valve guard or a welded-on shroud, this shall be checked to ensure that it is properly attached. Similarly, the integrity of the foot ring, if fitted, shall be checked.

6.7 Suitability and safety of valve and safety device

6.7.1 Prior to each fill

The filler shall verify that the valve outlet is suitable for the intended gas, in accordance with Clause 5.1.3, and it is in a satisfactory condition. As a minimum, it shall be established that—

- (a) the valve is easy to operate;
- (b) the valve is free from contaminants;
- (c) the handwheel or key-operated spindle is operable;
- (d) by external examination, the safety device is of the correct type and pressure rating in accordance with Clause 5.4, is free of corrosion, extrusion of fusible material or incorrect blockage of the discharge channels and damage to any connected piping;

NOTE: Bursting discs on SCUBA cylinders are particularly susceptible to corrosion.

- (e) the outlet thread and body are undamaged;
- (f) the residual pressure valve (RPV) if present, operates properly; and

- (g) the filling connector attaches correctly to the valve.

6.7.2 *During the filling cycle*

The filler shall verify that—

- (a) the valve operates satisfactorily;
- (b) the valve is not blocked (e.g. by checking the increase in mass or by temperature rise); and
- (c) the valve does not leak in the open position (e.g. by means of a gas-compatible leak test fluid).

If leakage from the valve is suspected, the bonnet or the gland nut should be checked.

6.7.3 *After filling*

After the valve is closed and disconnected from the filling connection, the filler shall test for leaks by means of a gas-compatible leak test fluid, or equivalent means, at the following locations:

- (a) The valve outlet and the stem thread connection to the cylinder.
- (b) The relief device openings, when fitted.

For welded cylinders, attention shall be paid to the welds to ensure that the cylinder is free from leaks.

6.8 Filling pressure

For cylinders filled by pressure, the filler shall verify that the filling pressure is consistent with the working pressure and labelled contents as specified in Clause 7.

6.9 Filling mass

For cylinders filled by mass, the mass of the filled cylinder shall be checked immediately after filling.

6.10 Valve protection

If a valve guard, valve cap or outlet cover nut is fitted prior to dispatch, a check shall be made for correct fitting.

6.11 Identification and labelling

The cylinder shall be checked to ensure that its contents are correctly identified and labelled.

6.12 Inspections for foreign cylinders imported for filling and immediate export

Cylinders that comply with Appendix B of AS 2030.1—2008 shall be subjected to the following:

- (a) Examination of the empty cylinder in accordance with Clause 9.5.
- (b) Identification of cylinder owner, if required.
- (c) Verification of the suitability and safe working condition of any required filling adaptor.
- (d) Suitability and safety of the valve and safety device (see Clause 6.7).
- (e) Verification of correct filling pressure or mass as applicable (see Clause 6.8 or 6.9).
- (f) Verification of valve protection (see Clause 6.10).
- (g) Verification of correct identification and labelling (see Clause 6.11).

7 FILLING

7.1 Filling conditions

7.1.1 General

A cylinder shall not be filled unless the cylinder and valve materials are compatible with the intended contents, and do not react with them to form harmful or dangerous compounds.

NOTE: AS 4955.1, AS 4955.2, AS 2473.1 and ISO 11114-4 provide guidance on material compatibility.

The filling conditions shall be in accordance with this Clause (7) and with the appropriate conditions specified in Tables 2, 3 and 4. Special filling provisions for certain gases are listed in Table 5. Safety device requirements are given in Table 6.

Where there is insufficient information to determine the maximum filling ratio, the filling ratio shall be calculated in accordance with Appendix E.

Under no conditions shall the internal pressure at 65°C exceed the test pressure.

The filling conditions shall not cause the developed pressure at 65°C to exceed the lower limit of the rated pressure of the safety device, where fitted.

The necessary steps shall be taken to prevent dangerous reactions (i.e. polymerization or decomposition) during transport. If necessary, stabilization or addition of an inhibitor shall be specified.

Toxic gases or gas mixtures shall not be filled into composite cylinders with non-metallic liners or without liners.

7.1.2 Compressed gases

The filler shall ensure that the working pressure does not exceed the lowest of—

- (a) the value specified for the gas in Table 2;
- (b) two thirds of the test pressure of the cylinder; and
- (c) a value such that the maximum developed pressure at 65°C does not exceed $(100 - T)\%$ of the marked test pressure, where T is the guaranteed tolerance of the safety device which shall not exceed 15%.

NOTES:

- 1 AS 2613 specifies performance requirements for safety devices.
- 2 Appendix B provides the temperature/pressure relationship for some common compressed gases.

7.1.3 Liquefied gases

The filler shall ensure that the cylinder complies with the minimum test pressure where given in Table 3 or 4. The maximum permissible gas contents shall be the product of the marked water capacity and the maximum filling ratio shown in Table 3 or 4 or the appropriate maximum filling ratio as follows:

- (a) For low pressure liquefied gases except LP Gas, the maximum filling ratio shall provide an ullage space of 3% minimum at a mean bulk liquid temperature of 57°C.
- (b) For LP Gas, the maximum filling ratio shall not exceed that given in AS/NZS 1596 for the appropriate density range. Where the density is not known, the filling ratio for the propane shall be used.
- (c) For high pressure liquefied gases except carbon dioxide, the maximum filling ratio shall result in a developed pressure at 65°C not exceeding 0.8 times the test pressure.
- (d) For carbon dioxide, the maximum filling ratio shall result in a developed pressure at 65°C not exceeding the lesser of—