

Australian Standard™

Installation and maintenance of steel pipe systems for gas



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Australian Liquefied Petroleum Gas Association
Energy Networks Association
Energy Retailers Association of Australia
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Australian Standard™

Installation and maintenance of steel pipe systems for gas

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PREFACE

This Standard was prepared by the Standards Committee AG-008, Gas Distribution, to supersede AS 1697—1981, *SAA Gas Pipeline Code*.

It covers gas distribution networks covered by AS 4645 for operating pressures up to 1050 kPa. Operating pressures above 1050 kPa are covered by AS 2885.1. The responsibility for the superseded edition of AS 1697 was with the Standards Australia Committee ME-038. AG-008 was assigned the responsibility leading up to this edition.

Users of the Standard should note that AG 603 has been revised by AG-008 in parallel with the revision of AS 1697. The revised AG 603 is designated AS 4645, *Gas distribution network management*. AS 1697 relates to AS 4645 as depicted in Figure 1.1. AS 3723, *Installation and maintenance of plastics pipe systems for gas* (also shown in Figure 1.1) is under revision.

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.

The relationship between the gas distribution Standards is shown in Figure 1.1.

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

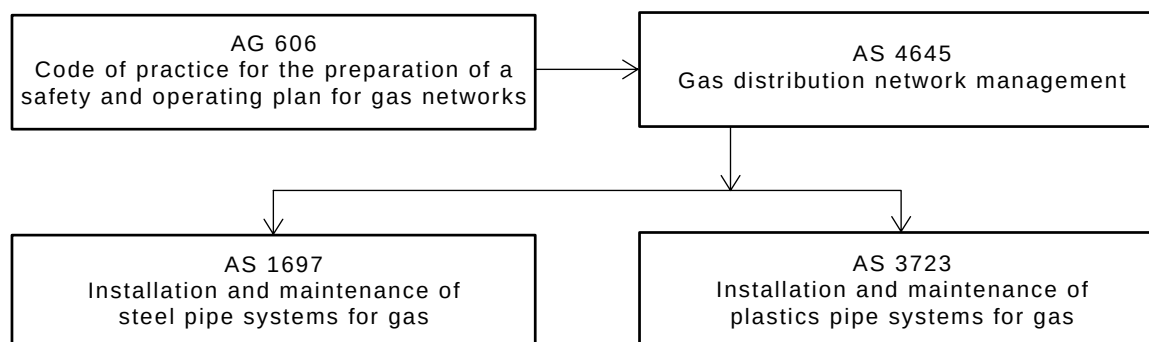


FIGURE 1.1 RELATIONSHIP BETWEEN GAS DISTRIBUTION STANDARDS

NOTES:

- 1 AG 606 (to be AS 4568) is used for preparation of SOP/SC as required by technical regulator (advisory only).
- 2 AS 4645 specifies safety management of a gas distribution network for its life cycle. Refers to AS 1697 for steel and AS 3723 for plastics (see Note 3).
- 3 AS 1697 and AS 3723 specify material specific requirements for construction and installation (and operation/repair where material specific).

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STANDARDS AUSTRALIA

Australian Standard

Installation and maintenance of steel pipe systems for gas

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard specifies materials, design, construction, installation, testing and maintenance requirements for steel piping systems covered by AS 4645, for the distribution of fuel gas suitable for domestic, commercial or industrial uses, where—

- (a) the pressure of the gas is not greater than 1050 kPa and the operating temperature range of the materials is from -30°C to 120°C ; or
- (b) where the hoop stress level is not greater than 20 % of the Specified Minimum Yield Stress (SMYS) of the pipe used in that system.

The Standard does not extend to the exclusions listed in Clause 1.2.

NOTES:

- 1 Some requirements of this Standard are suitable for consumer piping operating at >200 kPa, being not otherwise provided in AS 5601. The operator of such piping should decide which requirements are appropriate, and should obtain any necessary agreement from the regulator having jurisdiction over the operation of that piping.
- 2 The relevant technical regulator may regard this standard as appropriate for other than fuel gas.

1.2 EXCLUSIONS

This Standard does not apply to the following:

- (a) Gas steel piping systems that operate at pressures exceeding 1050 kPa or have a stress level of more than 20 % of the SMYS. (Pipes with such a stress level are covered by AS 2885.1.)
- (b) Piping from the outlet of the meter that measures gas to a consumer, and any other piping covered by AS 5601.

NOTE: Requirements for pipes downstream of the consumer's meter are generally provided in AS 5601, but where the operating pressure of the downstream pipe will be higher than provided for in AS 5601, the piping requirements of this Standard are appropriate according to the pressure (or AS 2885.1 for even higher pressures).

- (c) Piping associated with the handling and storage of liquefied petroleum gas (see AS/NZS 1596).
- (d) The design and manufacture of proprietary items (including meters).
- (e) Piping associated with gas manufacturing plants, petroleum processing plants, industrial plants or mines.
- (f) Pressure vessels (see AS 1210).
- (g) Piping for LP Gas in the liquid phase.

1.3 RETROSPECTIVE APPLICATION

It is not intended that this Standard should be applied retrospectively. The application of this Standard is limited to those requirements within the scope of the Standard (see Clause 1.1) commenced after its publication date. The requirements of this Standard apply to new and existing installations.

The relevant authority having jurisdiction may determine the extent of application of this Standard.

NOTE: 'Commenced' for the purpose of this Clause, means the point at which site or equipment construction has begun.

1.4 REFERENCED DOCUMENTS

The documents referred to in this Standard are listed in Appendix A.

1.5 RECORDS

Records shall be taken and maintained, sufficient to enable demonstration of effective management of all significant risks throughout the operating life.

The network operator shall ensure records of design, construction, testing, commissioning and operation are taken and maintained. The network operator shall establish appropriate record keeping criteria, including the retention time.

Consideration should be given to the as-built details, calibration records, test records, competencies, and all other relevant information. Records shall be made of all relevant operational activities necessary to provide information on the network safety status.

Records shall be made of modifications.

Buried asset location details shall be suitably recorded and maintained up-to-date with sufficient accuracy to provide for future location by the network operator and by others engaged in underground work near the asset.

The network operator shall record the details of decommissioned assets that could pose a future risk, and shall provide information on the location to anyone needing that information for safety reasons.

1.6 DEFINITIONS

For the purpose of this Standard, the definitions given in AS 2812, AS 2885.1, AS 2885.2 and those below apply.

1.6.1 Actual thickness

The measured thickness of the material or, where the thickness cannot be measured, the least thickness permitted within the manufacturing tolerance.

1.6.2 Approved

Approved by the network operator (see Clause 1.6.14) and also where legally required by the relevant statutory authority (see Clause 1.6.29).

1.6.3 Authority

For network operator, see Clause 1.6.14; for statutory authority, see Clause 1.6.29.

1.6.4 Casing

A pipe, through which a gas main passes, that is intended to protect the gas main from excessive external loads or to facilitate the installation or removal of a section of the gas main.

1.6.5 Consumer piping

Any piping downstream of a meter intended for billing a consumer.

1.6.6 Fuel gas

Any hydrocarbon gas or mixture of gases, possibly in combination with liquid petroleum condensates or water, and intended primarily as a fuel for residential or industrial use. It does not include hydrogen alone or any mixture with hydrogen in significant quantities.

1.6.7 Inspector

A person appointed by the network operator to carry out inspections required by the Standard.

1.6.8 Internal design pressure

The maximum internal pressure used for design purposes.

NOTES:

- 1 Internal design pressure is the nominated pressure used for design purposes. Each piping system has only one internal design pressure at any one time.
- 2 Pressure is expressed as gauge pressure in kilopascals, unless otherwise stated.

1.6.9 Liquefied petroleum gas/LP Gas

A gas composed predominantly of any of the following hydrocarbons, or any combination of them in the vapour phase: propane, propene (propylene), butane, butene (butylene).

1.6.10 Main

A pipe installed to convey gas to individual services or other distribution facilities.

1.6.11 Maximum allowable operating pressure (MAOP)

The maximum pressure at which a gas system may be operated in accordance with the provisions of this Standard.

1.6.12 Monitoring regulator

A pressure regulator installed in series with another pressure regulator for the purpose of automatically taking over the control of the downstream pressure should the latter pressure regulator fail.

1.6.13 Network

A gas distribution system comprising a pipe, or system of pipes, for transporting gas, but excluding consumer piping.

1.6.14 Network operator

A person or organization that owns or operates all, or part, of a network.

1.6.15 Nominal thickness

The thickness of material nominated in the material order, ignoring the manufacturing tolerance provided in the specification under which the pipe was manufactured. (The quantity symbol is δ_N .)

1.6.16 Odorization

The addition of an approved chemical substance to gas to enable its presence to be identified by smell.

1.6.17 Pressure

For internal design pressure, see Clause 1.6.8; for MAOP, see Clause 1.6.11.

1.6.18 Pressure design thickness

The thickness of material required for the material to be capable of withstanding internal pressure, as calculated according to the equations in the design section of this Standard. (The quantity symbol is δ_{dp} .)

1.6.19 Pressure-limiting station

An installation that provides over-pressure protection by reducing, restricting or cutting off the supply of gas flowing into a system, in order to prevent the outlet pressure exceeding a predetermined value.

1.6.20 Pressure-regulating station

An installation that automatically regulates the pressure in a downstream main.

1.6.21 Pressure-relief station

An installation that provides over-pressure protection in a piping system by discharging gas from the system, thus preventing the pressure in the system from exceeding a predetermined limit.

1.6.22 Regulator

For monitoring regulator, see Clause 1.6.12; for service regulator, see Clause 1.6.25.

1.6.23 Required thickness

The minimum thickness of material required for the material to be capable of withstanding applied stresses, as calculated according to the equations in the design section of this Standard (Quantity symbol: δ_{ds}).

1.6.24 Service

A pipe that carries gas from a main to a meter that measures gas delivered to a consumer.

1.6.25 Service regulator

A pressure regulator installed in a gas service to control the pressure of the gas delivered to a consumer.

1.6.26 Shall

Indicates that a statement is mandatory.

1.6.27 Should

Indicates a recommendation.

1.6.28 Specified minimum yield stress (SMYS)

The specified minimum yield stress to which the pipe is purchased.

1.6.29 Statutory authority

An authority with legislative powers relating to facilities within the scope of the Standard.

1.6.30 Thickness

For actual thickness, see Clause 1.6.1; for nominal thickness, see Clause 1.6.15; for pressure design thickness, see Clause 1.6.18; for required thickness, see Clause 1.6.23.

1.7 PRESSURE CLASSIFICATIONS

For the purposes of this Standard, the pressure classifications in Table 1.1 apply.

TABLE 1.1
PRESSURE CLASSIFICATIONS

Classification	Maximum allowable operating pressure (MAOP)	
	kPa	
Low pressure		≤ 7
Medium pressure	> 7	≤ 210
High pressure	> 210	≤ 1050

SECTION 2 MATERIALS AND COMPONENTS

2.1 NEW MATERIALS AND NEW COMPONENTS

New materials and new components shall comply with one or more of the following requirements:

- (a) One or more of the relevant Standards listed in Table 2.1.
- (b) Any approved Standard or specification.
- (c) The passing of any approved tests and investigations required to demonstrate an adequate degree of safety and fitness for purpose.

2.2 RECLAIMED MATERIALS AND RECLAIMED COMPONENTS

Any reclaimed materials and reclaimed components shall comply with one or more of the following requirements and shall be approved:

- (a) Be manufactured to one of the Standards listed in Table 2.1.
- (b) Have a known history.
- (c) Be suitable for the proposed service in light of the history of the material or component.
- (d) Be inspected since its previous use to reveal any defect that could impair its safety, strength or pressure tightness.

Components shall be cleaned and examined and, where necessary, reconditioned and tested, to ensure that they comply with this Standard.

Pipes shall be inspected for corrosion, denting, distortion, flattening, gouging, grooves, notches and every other harmful defect. Defects shall be repaired or removed in accordance with this Standard.

Where the strength of reclaimed pipe or reclaimed components have been reduced by corrosion or another type of deterioration, and where pipe or components comply with a Standard that does not specify the manufacturer's test, the pipe or components shall be pressure tested either individually in a test similar to a manufacturer's test or as part of the gas main to the test specified for the system.

Provided that consideration has been given to any adverse effects from conditions under which it had previously been used (e.g., fatigue, high cyclic stress), it may be treated as new to that same Standard.

2.3 IDENTIFICATION

Materials and components shall be identified in accordance with AS 4645.

TABLE 2.1
MATERIALS

Component	Standard
Pipe	See Table 2.2
Fittings	AS 1074, AS 3688, ASME B16.1, ASME B16.9, ASME B16.11, BS 143 and 1256, BS 1640-3, BS 1640-1, BS 3799 (see also Table 2.3)
Valves	ASME B16.34, API Spec 6A, API Spec 6D, API 600, API Std 602, API Std 603, MSS SP25, MSS SP67
Regulators	IGE/TD/13
Flanges	AS 2129, ASME B16.1, ASME B16.5, BS EN 1759-1
Gaskets	ASME B16.20, ASME B16.21, BS 3381
Bolting	AS 1110.1, AS 1111.1, AS 1112.1, AS 1112.2, AS 1112.3, AS 1112.4, AS 2528, ASME B16.5, ASME B18.2.1, ASME B18.2.2, ASTM A 193/A 193M, ASTM A 194/A 194M, ASTM A 307, ASTM A 320/320 M, ASTM A 325, ASTM A 354, ASTM A 449
Coatings and linings	AS/NZS 1518, AS/NZS 3862
Welding consumables	(See Section 4)

TABLE 2.2
MATERIALS FOR STEEL PIPES
(See Notes 1 and 2)

Standard	Grade	Additional limitations and specific requirements
AS 1074	Light, medium or heavy	Light pipe shall not be threaded.
AS 1579	C	
API Spec 5L	ERW—A25 ERW—A and B Electric fusion welded and seamless—all grades—A and B	
ASTM A 53/A 53 M	Seamless—Type SERW—Type ECW—Type F	

NOTES:

- 1 Suitable for a MAOP of 1050 kPa and a gas temperature of $>-30^{\circ}\text{C}$ and $<120^{\circ}\text{C}$.
- 2 Galvanized pipes shall not be welded until any external and internal galvanizing has been removed for a sufficient length to permit a sound weld.

TABLE 2.3
PIPE THREADS, THREADED PIPE FITTINGS, FLANGED PIPE JOINTS
AND WELDED PIPE JOINTS (See Note 1)

Specification No.	Item	Limitations on use	Other requirements
AS 1722.1	Pipe threads	For use on pipe to AS 1074	Taper male and parallel female threads shall not be used for high pressure
ASME B1.20.1	Pipe threads	For use on pipe to API and ASTM specification	Taper male and taper female threads may be used at all pressures. Threaded joints are not recommended on pipes over 100 mm nominal size. Threaded joints shall be made with approved jointing material. Parallel male threads shall not be used.
AS 1074	Steel pipes and tubulars	For use with pipe to AS 1074	
AS 3673	Malleable cast iron threaded pipe fittings	For use with pipe to AS 1074	
BS 3799	Forged steel pipe fittings screwed and socket welding for the petroleum industry	For use with pipe to API and ASTM specifications	
ASME B16.11	Forged steel fittings socket welding and threaded	For use with pipe to API and ASTM specifications	
AS 2129 (See Note 2)	Flanges and bolting for pipes, valves and fittings	For use with pipe to AS 1074	Raised faces are recommended for steel flanges. Screwed flange to pipe joints shall be taper male and taper female. Refer to Section 3 for specifications of jointing materials. All welding shall comply with the requirements of Section 4.
BS EN 1759-1 ASME B16.5	Steel pipe flanges and flanged fittings for petroleum industry (metric dimensions) Steel pipe flanges and flanged fittings	For use with pipe to API and ASTM specifications	
BS 1640-3	Wrought carbon and ferritic alloy steel fittings	For pipes to API and ASTM specification.	All fittings shall be at least standard weight.
BS 3799	Forged steel pipe fittings screwed and socket welding for petroleum industry		
ASME 16.9	Factory made wrought steel Butt welding fittings		All welding shall comply with the requirements of Section 4.
ASME B16.11	Forged steel fittings, socket		All welding shall comply with the requirements of Section 4.

NOTES:

- 1 Threaded joints are not recommended in buried locations.
- 2 Flange rating shall be in accordance with AS 2129, Table D for MAOP 700 kPa and Table E for MAOP 1050 kPa.

2.4 PIPE THREADS, THREADED PIPE FITTINGS, FLANGED PIPE JOINTS AND WELDED PIPE JOINTS

Pipe threads, threaded pipe fittings, flanged pipe joints and welded pipe joints shall comply with Table 2.3.

Special attention shall be given to prevention of electrolytic corrosion of dissimilar metals joined in buried systems.

Expansion joints should be avoided where possible, however, where an expansion joint is used, it shall be demonstrated to be fit for purpose and shall be installed in accordance with the manufacturer's instructions.

2.5 VALVES, REGULATORS, FITTINGS AND ACCESSORIES

2.5.1 General

Valves, regulators, fittings and accessories shall be manufactured in accordance with a design based on a nominated Standard (see Table 2.1) or an approved calculation criterion. A prototype or a production unit shall be tested or investigated to demonstrate that the item is suitable for use in the intended service and that it is capable of withstanding the field test pressure.

Where the component is to be joined by welding it shall be made of a steel that can be welded on site.

Valves, regulators, fittings and accessories shall be capable of withstanding the service conditions for which the system is designed and, where they are to be incorporated in the piping system after it has been pressure tested, shall—

- (a) be pressure tested to the same pressure as the piping system; or
- (b) have pressure and temperature ratings equivalent to those of the pipe to which they are to be attached.

2.5.2 Flanges and flanged fittings

Flanges and flanged fittings shall comply with a nominated Standard and the following requirements:

- (a) Stubs on welding neck flanges that have dimensions complying with ASME B16.5 to be taper bored where they are to be attached to thin wall pipe.
- (b) The flange thickness of slip-on flanges with a rectangular cross-section shall provide a strength of not less than that of the corresponding hubbed flange specified in ASME B16.5, as determined by calculations made in accordance with AS 1210.
- (c) Flanges not complying with a nominated Standard shall be checked for suitability as determined by calculation made in accordance with AS 1210.
- (d) Bolting of steel flanges complying with ASME B16.5 shall comply with ASME B16.5 or BS 4882. Bolting of flanges complying with AS 2129 shall comply with AS 2528.

2.5.3 Gaskets and ring joints

Gaskets and ring joints shall be resistant to the gases that will be and are likely to be in contact with them. They shall safely withstand the MAOP (see Clause 3.2) and the full range of operating temperatures to which they will be subjected and shall retain the physical and chemical properties necessary for safe use.

2.5.4 Valves and regulators

2.5.4.1 Valves and regulators complying with nominated Standards

Valves and regulators complying with nominated Standards shall comply with the following requirements:

- (a) Lubricants and sealants shall be suitable for the service conditions.
- (b) Working pressure ratings of steel parts of valves and regulators shall apply within the temperature range of -30°C to $+120^{\circ}\text{C}$.
- (c) Resilient or plastic materials used for seats and seals shall be capable of withstanding the design pressure and temperature.
- (d) Parts in contact with gas shall be of materials that are compatible with the gas.
- (e) The bodies of gate, ball, plug and non-return types of valves shall be pressure tested to the relevant requirements of API Spec 6D and shall not leak.
- (f) Other than non-return valves, valves shall have means for indicating the setting of the valve (e.g., closed, a third open).
- (g) Valves shall be indelibly marked, on the body or on a permanently attached nameplate, giving the following information:
 - (i) Manufacturer's name or trademark.
 - (ii) Class designation or the maximum working pressure for which the valve has been designed.
 - (iii) Body material designation (and the end connection material where more than one type is used).
 - (iv) Nominal valve size.

2.5.4.2 *Valves and regulators manufactured to Standards not nominated in this Standard*

Valves and regulators manufactured to a Standard not nominated in this Standard may be used, provided the valves and regulators have a strength and tightness not less than that required by this Standard. The valve or regulator shall be capable of withstanding the same test requirements as are specified in the nominated Standards and the structural features shall comply with the material specifications and test requirements of valves and regulators in a similar service as specified in an equivalent nominated Standard.

SECTION 3 DESIGN

3.1 GENERAL

The requirements of this Section are to be applied within the general design requirements of AS 4645 and are intended to ensure the safety of the general public and all persons engaged in gas main construction and operation, under conditions usually encountered in gas distribution systems to the extent that safety is affected by—

- (a) basic design;
- (b) quality of materials and workmanship;
- (c) testing requirements; and
- (d) maintenance and operation.

Extra protection shall be provided where necessary, particularly to prevent damage from unusual conditions such as may arise at road, rail or river crossings, bridges, areas of heavy traffic, long self-supported spans, from vibration, weight of special attachments or the possibility of ground subsidence or other abnormal forces.

3.2 MAXIMUM ALLOWABLE OPERATING PRESSURE (MAOP)

The MAOP of a steel main or service shall be no greater than the test pressure divided by 1.4. The MAOP shall be calculated and recorded for each pressure system.

3.3 MAXIMUM ALLOWABLE HOOP STRESS

The pipe hoop stress at the MAOP shall be less than or equal to 20% SMYS.

Hoop stress shall be determined by the following equation:

$$\sigma_h = \frac{PD}{2\delta_a}$$

where

σ_h = hoop stress, in megapascals

P = MAOP, in megapascals

D = outside diameter, in millimetres

δ_a = actual wall thickness, in millimetres

3.4 WALL THICKNESS

3.4.1 Steel casing

The minimum wall thickness of steel casing for mains and services shall be sufficient to provide the necessary protection for the planned life of the main or service, and shall not be less than the values in Table 3.1.

3.4.2 Pipe

The pipe wall thickness shall be designed to take into account the following:

- (a) Stresses due to internal pressure and external loads.
- (b) Any allowances for material loss.
- (c) Construction loads.

TABLE 3.1
MINIMUM NOMINAL WALL THICKNESS
OF STEEL CASING

Nominal outside diameter of casing pipe (mm)	Minimum nominal wall thickness (mm)	
	Roads	Railways
≤114.3	3.18	3.18
144.3	3.96	3.96
168.3	4.78	4.78
219.1	4.78	4.78
273.0	4.78	4.78
323.9	4.78	4.78
355.6	4.78	5.56
406.4	4.78	5.56
457.0	4.78	6.35
508.0	4.78	7.11
559.0	4.78	7.92
610.0	6.35	8.74
660.0	6.35	9.52
711.0	6.35	10.31
762.0	6.35	10.31
813.0	6.35	11.13
864.0	6.35	11.91
914.0	6.35	11.91
965.2	7.92	12.70
1016.0	7.92	12.70
1068.8	7.92	12.70

3.5 CORROSION MITIGATION

3.5.1 General

Measures shall be taken to mitigate corrosion of steel mains and services, so as to maintain asset integrity, safety and reliability. When determining necessary measures, consideration shall be given to the potential for both internal and external corrosion and degradation. Implicit with and central to a corrosion mitigation strategy is the design of corrosion and condition monitoring programs to provide assurance that the measures implemented are successfully achieving their objectives.

The design, installation, operation and maintenance of corrosion mitigation systems shall be carried out by, or under the direction of, persons qualified by experience and training in the appropriate aspects of corrosion mitigation in pipelines or distribution systems. Where the pipes will be influenced by stray electrical currents, the persons shall have had experience with the mitigation of the effects of such currents.

Corrosion of buried steel pipework is an identified risk to the continuing integrity and safe operation of the network and network elements, and all of the following matters should be considered:

- (a) Coating, and lining.
- (b) Traction current drainage.
- (c) Cathodic protection.
- (d) Electrical isolation.
- (e) Electrical surge protection/induced voltages.