

Australian Standard[®]

Diaphragm gas meters



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- Australian Pipeline Industry Association
 - Department of Economic Development, New Zealand
 - Energy Networks Australia
 - Gas Association of New Zealand
 - Gas Technical Regulators Committee
 - LPG Australia
 - New Zealand Institution of Gas Engineers
 - Plastics Industry Pipe Association of Australia
 - Plastics New Zealand
-

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Australian Standard[®]

Diaphragm gas meters

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PREFACE

This Standard has been prepared by the Australian Members of Joint Standards Australia/Standards New Zealand Committee AG-008, Gas Distribution Committee, to supersede AS 4647—2005, *Specification for domestic diaphragm gas meters*.

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.

The Standard provides basic requirements for diaphragm gas meters of maximum flow rate ($Q_{\max}$) up to 8 m³/h when tested on air at pressure absorption of 125 Pa, to ensure optimum performance, both—

- (a) when purchased; and
- (b) after extended service.

The Standard is not intended to provide a comprehensive list of requirements for pattern approval and thus does not address the performance of the meter against test gases other than air, or the application of any temperature or pressure corrections to the metered gas volume. However, it can be used to complement a pattern approval standard with the aim of providing a comprehensive set of requirements for pattern approval, purchase and market surveillance of diaphragm gas meters.

This Standard has no legal status in its own right but may acquire legal standing where adopted by a government or other authority having jurisdiction over meter specification.

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 the Standard, whereas an ‘informative’ appendix is only for information and guidance.

Statements expressed in mandatory terms in notes to tables and figures are deemed to be requirements of the Standard.

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STANDARDS AUSTRALIA

Australian Standard

Diaphragm gas meters

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard specifies requirements on the working environment, materials of construction and performance of diaphragm meters of maximum flow rate ($Q_{\max}$) up to 8 m³/h when tested on air at pressure absorption of 125 Pa. (Meters up to this capacity are generally produced in large quantities.) The design and construction requirements are intended to provide for an expected minimum working life of twenty years.

1.2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard.

AS

1199	Sampling procedures for inspection by attributes
1199.1	Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection
1580	Paints and related materials—Methods of test
1580.408.4	Part 405.4: Adhesion (crosscut)
1580.481.3	Part 481.3: Coatings—Exposed to weathering—Degree of corrosion of coated metal substrates
1834	Material for soldering
1834.1	Part 1: Solder alloys
1834.2	Part 2: Flux-cored solders
2331	Methods of test for metallic and related coatings
2331.3.1	Part 3.1: Corrosion and related property tests—Neutral salt spray (NSS) test
2706	Numerical values—Rounding and interpretation of limiting values
4564	Specification for general purpose natural gas
4670	Commercial propane and commercial butane for heating purposes

AS/NZS

1580	Paints and related materials—Methods of test
1580.405.1	Part 405.1: Determination of pencil hardness of paint film
1580.481.1.9	Part 481.1.9: Coatings—Exposed to weathering—Degree of blistering

4944	Gas meters—In-service compliance testing
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60079	Electrical apparatus for explosive gas atmospheres
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ISO/IEC

Guide 98	Uncertainty in measurement
Guide 98-3	Part 3: Guide to the expression of uncertainty in measurement

ISO	
2808	Paints and varnishes—Determination of film thickness
4892	Plastics—Methods of exposure to laboratory light sources
4892-3	Part 3: Fluorescent UV lamps
ASTM	
D494	Standard Test Method for Acetone Extraction of Phenolic Moulded or Laminated Products
D1003	Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics
D2247	Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity
UL	
94	Tests For Flammability Of Plastic Materials For Parts In Devices And Appliances
BS	
746	Specification for gas meter unions and adaptors
EAN	Australian User Manual, EAN.UCC Numbering and Bar Code

1.3 DEFINITIONS

1.3.1 Accelerated life

A test, under controlled conditions, simulating long-term operation and designed to confirm, within a relatively short period of time, the retention of performance characteristics.

1.3.2 Badge

A plate permanently affixed to the meter or a section of a cast meter body, readable from the front of the meter containing basic meter information.

1.3.3 Cyclic capacity, (*V*)

The volume of gas passed during one complete cycle of the diaphragm system within the meter.

1.3.4 Fast registration

Registration by a meter of a quantity greater than that actually passed.

1.3.5 Flow rate

1.3.5.1 Maximum flow rate (Q_{max})

The maximum flow rate of air expressed in m³/h declared by a meter supplier to be able to be passed through a meter at a specified pressure absorption.

1.3.5.2 Minimum flow rate (Q_{min})

The minimum flow rate of air expressed in m³/h declared by a meter supplier to be able to be measured by a gas meter within declared meter error.

1.3.6 Meter

A meter is a device which measures the quantity of gas passing through it.

NOTE: For the purpose of this Standard, this quantity is defined at inlet conditions. Subsequently, to convert quantity measured by a meter to quantity measured at standard inlet conditions, the measured volume as defined by meter inlet temperature and meter inlet pressure needs to be recalculated at standard conditions.

1.3.7 Metering pressure

The gauge pressure of gas applied to the inlet of the meter.

1.3.8 Meter connections

The integral inlet and outlet parts of the meter designed for attachment to meter unions, pipe or other piping components.

1.3.9 Meter error

1.3.9.1 Error (of indication)

Indicated volume minus the actual volume

1.3.9.2 Relative error (of indication)

Error (of indication) divided by the actual volume

1.3.9.3 Maximum permissible error (mpe)

The extreme values of the relative error (of indication) of a gas meter permitted by this Standard.

$$\text{Percentage meter error} = \frac{\text{Volume registered by meter} - \text{Actual volume passed}}{\text{Actual volume passed}} \times 100$$

1.3.10 Meter error trend

The difference between the meter error at $Q_{\max}$ and $0.2 Q_{\max}$.

1.3.11 Meter index

The mechanism that registers the volume of gas that has passed through the meter.

1.3.12 Maximum working pressure ($p_{\max}$)

The maximum internal pressure that a gas meter can withstand, within its rated operating conditions, without deterioration of its metrological performance or case soundness.

1.3.13 Operating temperature

1.3.13.1 Minimum operating temperature ($T_{\min}$)

The minimum temperature at which the performance of the meter is claimed by the manufacturer to be in accordance with the requirements of this Standard.

1.3.13.2 Maximum operating temperature ($T_{\max}$)

The maximum temperature at which the performance of the meter is claimed by the manufacturer to be in accordance with the requirements of this Standard.

1.3.14 Pressure absorption

The mean of the maximum and minimum indications of the pressure differential across the meter at any nominated flow rate during at least one complete cycle of the meter.

1.3.15 Pressure differential

The instantaneous difference in pressure between two points, one immediately before the inlet of a meter and one immediately after the outlet of the meter at the rate at which gas is passed through the meter.

NOTE: The range of differential pressure values measured is regarded as an indicator of lifetime and performance. The related performance requirements of this Standard have been derived from historical data which have been determined using inclined pressure gauges. Therefore, measurements of differential pressure should be time-averaged in a manner which would give consistent peak values of differential pressure to those given by an inclined pressure gauge.

1.3.16 Pressure oscillation

The difference between maximum and minimum pressure differential at any nominated flow rate of air over at least one complete cycle of the meter.

1.3.17 Proving dial

A graduated dial provided with a movable pointer (proving hand) on the meter index used for testing the meter and for indicating gas flow.

1.3.18 Proving drum

A graduated drum provided in the meter index used for testing the meter and for indicating gas flow.

1.3.19 Pulse value

The volume of gas under flowing conditions registered by the meter between two successive pulses.

1.3.20 Slow registration

Registration by a meter of a quantity less than that actually passed.

1.3.21 Standard conditions

A pressure of 101.325 kPa at a temperature of 15°C.

1.3.22 Test pressure

The gauge pressure applied to the inlet of the meter.

1.3.23 Type test

A test used to determine fitness for purpose of the component under test.

SECTION 2 WORKING ENVIRONMENT

2.1 GAS TYPE

The meters shall be made to be suitable for measuring any of the following gases:

- (a) Natural gas that complies with AS 4564.
- (b) Manufactured gases such as synthetic natural gas (SNG) and tempered liquefied petroleum gas (TLPG).
- (c) Liquefied petroleum gas that complies with AS 4670.
- (d) Air.
- (e) Other gases.

2.2 TEMPERATURE

The meters shall be suitable to operate in fully exposed ambient conditions with ambient temperatures and gas temperatures in the range $T_{\min}$ to $T_{\max}$. The temperature range is typically -10°C to 60°C .

2.3 WORKING PRESSURE

The meters shall be suitable for maximum working pressures ($p_{\max}$) of at least 25 kPa. Meters shall withstand internal test pressures of $1.5 \times p_{\max}$.

2.4 MOUNTING

The meters shall be mounted in accordance with manufacturers' specifications.

SECTION 3 METER CONSTRUCTION

3.1 MATERIALS OF CONSTRUCTION

3.1.1 General

A gas meter shall be made of such materials and be so constructed as to withstand the physical, chemical and thermal conditions to which they are likely to be subjected and to fulfil correctly their intended purposes throughout their life.

Meter components shall be designed, manufactured and assembled to provide for an expected minimum working life of twenty years.

The interior of the assembled meter shall be free from loose solder, swarf, grinding material, jointing material or any foreign matter.

3.1.2 Metal castings

Castings shall be of good quality, uniform in composition and free from flaws, blowholes, coldshut, slag inclusions, burrs, sharp edges and porosity. Means of repair or impregnation shall not be used to rectify faults or porous castings.

All casework protective coatings shall have—

- (a) a minimum thickness on significant surfaces of 40 µm, when testing in accordance with Paragraph F5.1;
- (b) a minimum Classification 1, when the surface is tested in accordance with Paragraph F5.2;
- (c) a pencil hardness value of not less than *F*, when tested in accordance with Paragraph F5.3;
- (d) no evidence of lifting, blistering, deterioration or penetration evident, when tested in accordance with Paragraph F5.4;
- (e) met the requirements specified in Table F1, when tested in accordance with Paragraph F5.5; and
- (f) met the requirements specified in Table F2, when tested in accordance with Paragraph F5.6.

Jointing surfaces shall be parallel to each other, evenly finished and of adequate width and strength to be correctly fitted and jointed.

3.1.3 Case jointing materials

Jointing material of cast and fabricated case meters shall be impervious to water, gas condensates and gas atmospheres. Jointing material shall be readily removed without damaging the jointing faces.

3.1.4 Valve covers and grids

Valve covers and grids, if fitted, shall be of a stable low-friction material combination which shall be resistant to wear, corrosion, warpage and breakage, not affected by absorption of water, gas condensates and gas atmospheres, and shall not contribute to noise levels.

Phenolic mouldings shall show no more than 2.5% of acetone extractable material when tested in accordance with ASTM D494.

Valve covers and grids shall be clean, uniform in composition and structure and free from cracks, flaws and similar imperfections.

Valve covers and grid faces shall be free from lubricants, sealing medium, grinding paste or similar material.

Valves shall be correctly ground, aligned, adequately retained, properly seated and synchronized, and dimensionally stable and not affected by gas components.

Grids requiring attachment to the valve plate shall be securely bonded over the whole contact area.

3.1.5 Sealing glands

Sealing glands shall be made of a fluoroelastomer such as nitrile or equivalent material appropriate for the type of gas to be passed through the meter.

A minimum quantity of lubricant may be used to assist the assembly of O-rings or similar seals.

3.1.6 Diaphragms

Diaphragms shall be made from a suitable fabric-reinforced synthetic rubber.

The material shall be resistant to deterioration from exposure to chemicals, extremes of temperature and repeated flexures. When tested in accordance with the relevant appendices, diaphragm material shall meet the following requirements:

- (a) When immersed in either normal pentane or water and tested in accordance with Appendix C, shall not have a change in area of more than 5% and the extracted material shall not exceed 12% by mass.
- (b) When the meter is tested in accordance with Appendix H the change in meter accuracy shall not exceed $\pm 1.5\%$, nor shall pressure absorption or oscillation increase by more than 25%.
- (c) The diaphragm material samples shall be impermeable to gas, and shall remain impermeable after 1 000 000 flexing cycles, when tested in accordance with Appendix I. The diaphragm is deemed to be impermeable to gas provided the pressure drop after one minute does not exceed 100 Pa and the product of system volume (in mL) and pressure drop (in Pa) does not exceed 10 000.

Diaphragm material samples when tested in accordance with Appendix H and Appendix I shall not show any visible delamination, blistering or other significant damage.

When assembled in the meter, the diaphragm shall be free from folds and undue puckering. Excess material over that required by the designed stroke setting shall be restricted so that the cyclic capacity cannot be varied by more than 20%.

The diaphragms shall be mechanically attached at the inner and outer locations.

All parts in the meter that may come into contact with the diaphragm shall be constructed and finished to ensure that the diaphragm is not damaged by that contact.

3.1.7 Gearing

All gearing shall be made of materials that are compatible, wear resistant and dimensionally stable. Gears and collars shall be a suitable fit on the shafts and mechanically secured.

3.1.8 Solder

Solder used in the assembly of meters shall comply with AS 1834.1 or AS 1834.2.

Soldered joints should be avoided wherever possible.

Non-corrosive flux shall be used where practicable for all soldering operations in the assembly of meters. All soldered joints shall be well filled and floated to a smooth finish.

If any links are soldered into position they shall be thoroughly sweated and cleaned.

3.1.9 Plastic components

Internal plastic components shall be made of materials that are compatible with the gases used, be wear resistant and dimensionally stable.

3.1.10 Resistance to exposure to solar radiation and weathering

All plastic components and coating surfaces exposed to sunlight during normal meter operation shall be UV stabilized.

When tested in accordance with Appendix B, the assembled meter, including labels, shall show—

- (a) no impairment in meter function;
- (b) no cracking, blistering, peel-off, significant fading or discolouration;
- (c) no reduction in the readability of markings or indicating devices; and
- (d) for index covers light transmission shall have a Haze[%]<15 in accordance with ASTM D1003.

3.1.11 Miscellaneous components

No steel component shall provide a bearing surface for another component made of steel.

All screws shall be made of stainless steel, steel plated with cadmium or zinc or other material that is designed to meet the required life of the meter.

The surface finish of all parts shall be compatible in all respects with the type of movement involved.

3.1.12 Meter connections

Meters shall have two '1 inch' sized (10 light) meter connections conforming to the requirements of BS 746.

The top internal bore of each connection shall have a diameter of 28 ± 1 mm to a minimum depth of 5 mm.

Distance between connection centres shall be 152.4 ± 0.2 mm for meters of 4 m³/h capacity and above.

NOTE: Connection dimensions and size for meters of lower capacity do not necessarily have to comply with the above.

The axis of the threads on the connections shall be perpendicular to the face of connections within 2°.

The faces of the connections shall be parallel to each other and shall not permit a gap exceeding 1.25 mm from a plane formed by a flat plate resting on both connections.

3.1.13 Reverse flow devices

Devices can be fitted to meters to either prevent registration of a reverse flow of gas through the meter, or to prevent the reverse flow of gas through the meter.

3.1.14 Pressure measuring point

A pressure measuring point shall be provided at the outlet of the meter.

3.1.15 Sealing of meters

The location of hardware seals shall be chosen in such a way that the dismantling of the seal results in permanent visible damage. A design which requires only one seal is preferred. The seal may bear an approved mark.

3.1.16 Protection of interior of meters

Meter connections shall be effectively sealed by means of dust and weatherproof covers in or on the inlet and outlet of the meters to prevent the entry of foreign matter during transit and storage.

3.1.17 Bearings

Bearings and bearing surfaces shall be so constructed and finished as to minimize friction, wear and frictional changes and obviate the need for re-lubrication during the service life of the meter. Self-aligning, dust proof and self-lubricating bearings shall be used where practicable. Multiple bearings for any one shaft shall be accurately aligned.

3.1.18 Entrained solids

Materials used and the performance of meters shall not be affected by entrained solids below 25 micron particle size.

Protection against entrained solids and condensate entry into bearings and other points where relative movement occurs shall be provided.

3.1.19 Uniformity of meters

The relative positions, angular placement and lengths of critical linkages of the metering mechanisms shall be accurately gauged and jigged to design tolerances. Parts shall be interchangeable between meters of the same make and model.

3.2 MECHANICAL STRENGTH

Meter cases shall be sufficiently rigid to show no sign of permanent distortion or leakage when subjected to an internal pressure of $1.5 \times p_{\max}$ and subjected to the meter case distortion test outlined in Appendix D. The meter case shall show no more than 3° of deflection under load and no more than 2° of permanent deflection when subjected to the meter case and connection rigidity test outlined in Appendix D.

Meters shall be drop tested in accordance with Appendix E and deemed to meet the requirements of this Standard provided—

- (a) there is no sign of physical damage;
- (b) the change in meter error, or meter error trend, between the results recorded at step (a) and steps (c), (e) or (g) of Paragraph E5 does not exceed $\pm 1.5\%$; and
- (c) the pressure absorption and pressure oscillation do not exceed the criteria specified in Clause 4.2.

3.3 HEAT RESISTANCE

After exposure to an ambient temperature of $80 \pm 5^\circ\text{C}$ for 24 h, the meter case leakage rate shall meet the leakage requirements of Clause 4.2 when subjected to an internal air pressure of $1.5 \times p_{\max}$.

3.4 METER INDEX

3.4.1 General

The meter index shall correctly reflect the volume of gas that has passed through the meter over the life of the meter.

The index assembly, including its housing and gasket, prior to flammability testing in accordance with Appendix A shall—

- (a) show no visible sign of deterioration, deformation, crazing or blistering; and