

Gas meters —

Part 5: Specification for diaphragm meters for working pressures up to 7 bar

Committees responsible for this British Standard

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- British Gas plc
- British Non-ferrous Metals Federation
- Chief and Assistant Chief Fire Officers' Association
- Department of Energy (Gas and Oil Measurement Branch)
- Institution of Gas Engineers
- Society of British Gas Industries

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Foreword

This Part of BS 4161 has been prepared under the direction of the Gas Standards Policy Committee it is a revision of BS 4161-5:1977, which is withdrawn.

BS 4161-5 was first published in 1977 as the fifth in a series relating to meters for gaseous fuels used for registering the volume of gas passed. This revision updates Part 5, widens its scope and takes account of further legislative changes.

In the preparation of this standard, account has been taken both of commercial factors associated with export and of European harmonization by incorporating relevant requirements of the following.

Statutory Instrument 1983: No. 684: The Gas (Meters) Regulations 1983.

Statutory Instrument 1988: No. 186: The Measuring Instruments (EEC Requirements) Regulations 1988.

Statutory Instrument 1988: No. 296: The Measuring Instruments (EEC Requirements) (Gas Volume Meters) Regulations 1988 which implement EEC Council Directive 71/318/EEC and its subsequent technical progress amendments.

Although primarily intended for 1st or 2nd family gases, the meters may be used for other gases, but the suitability of a meter for such a purpose should be verified with the manufacturer.

Meters may be fitted with electrical instrumentation; such devices for the type of meter specified in this standard are generally additional to the mechanical index.

NOTE A meter used for the sale of gas has to comply with statutory requirements. The addition of electrical instrumentation to such a meter may mean that the system no longer complies with statutory requirements.

Information that should be supplied by the purchaser is listed in Appendix A.

These meters may be fitted with a volume corrector; such devices for the type of meter specified in this standard are generally interchangeable with, or additional to, the index.

All pressures quoted in this standard are gauge pressures.

The other Parts of BS 4161, covering temperature and pressure compensating devices and other types of gas meter are as follows.

- *Part 1: Meters of plate construction up to 1 000 cubic feet per hour rating (obsolescent);*
- *Part 2: Meters of plate construction above 1 000 cubic feet (28 cubic metres) per hour rating (obsolescent);*
- *Part 3: Specification for diaphragm meters of 6 cubic metres (or 212 cubic feet) per hour rating for working pressures up to 50 mbar;*
- *Part 4: Plate constructed positive displacement diaphragm meters for a pressure of 350 mbar (5 lbf/in²) and up to 170 cubic metres (6 000 cubic feet) per hour rating (obsolescent);*
- *Part 6: Specification for rotary displacement and turbine meters for gas pressures up to 100 bar;*
- *Part 7: Mechanical volume correctors (obsolescent);*
- *Part 8: Specification for electronic volume correctors.*

Installation of these meters is the subject of BS 6400 and of “Recommendations on gas measurement practice IGE/GMI/1 Gas meter installations for pressures not exceeding 100 bar”, published by the institution of Gas Engineers.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 40, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Section 1. General

1 Scope

This Part of BS 4161 specifies requirements for the construction, performance and marking of positive displacement diaphragm meters for use with 1st and 2nd family gases and for all specified gas working pressures up to 7.0 bar¹⁾. It also includes certain requirements for fire resistance.

NOTE 1 For use with gases other than 1st and 2nd family gases see the foreword.

Meters covered by this standard are all suitable for pressures up to 75 mbar.

NOTE 2 The information to be supplied by the purchaser when ordering or enquiring about meters is given in Appendix A.

NOTE 3 Requirements specific to meters rated at 6 m³/h (212 ft³/h) and for working pressures up to 50 mbar, are given in BS 4161-3.

NOTE 4 The titles of the publications referred to in this standard are listed on pages 40 and 41.

2 Definitions

For the purposes of this Part of BS 4161, the definitions given in BS 746 and BS 1179 apply.

3 Meter designation and rating

3.1 Meter designation

A meter shall be designated by the letter “U” followed by its rating in cubic metres per hour (see Table 1).

3.2 Meter rating

A meter shall be rated according to one of the $Q_{\max}$ (maximum flow) values given in Table 1.

NOTE The badged rating as defined in BS 1179 is determined using air.

Table 1 — Meter designations and ratings

Meter designation	$Q_{\max}$	
	m ³ /h	ft ³ /h
U2.5	2.5	88
U4	4	141
U6	6	212
U10	10	353
U16	16	565
U25	25	883
U40	40	1 413
U65	65	2 296
U100	100	3 530
U160	160	5 650

3.3 Pressure rating

The pressure rating is the maximum working pressure specified by the manufacturer (see 8.1).

The minimum rated pressure shall be 75 mbar.

NOTE Other rated pressures may be specified with preferred ratings of 2 bar and 7 bar.

The operating temperature range shall be – 5 °C to + 35 °C.

¹⁾ 1 bar = 10⁵ N/m² = 10⁵ Pa.

Section 2. General requirements

4 Materials and finish

4.1 Materials

The meter shall be constructed of materials complying with the appropriate British Standards. Materials shall be such that they satisfy this Part of BS 4161.

Sample plaques shall be made from the same grade and thickness of material, pretreated and coated in the same way as the component. This thickness of any coating and the method of measurement shall be declared by the meter manufacturer to the test authorities.

4.2 Decorative finish

If meters have a decorative finish it shall be of a colour complying with BS 4800 or BS 381C and shall comply with the following requirements.

- a) After 7 days from the time of application of the external finish, the external finish layer of the meter or sample plaque thereof when tested in accordance with Appendix B, shall not be fully penetrated. The spring force shall be 9.8 N. The external finish shall be visually examined for penetration. Jagged edges shall not extend by more than 1 mm from any scratch mark.
- b) After testing in accordance with item a), the external surface finish of the meter or sample plaques thereof when tested in accordance with Appendix C, shall not show evidence of lifting, blistering or deterioration, although blooming of the surface finish is acceptable.

NOTE Test b) may be carried out on a separate sample or on the original sample with the original scratch protected.

- c) Immediately after testing in accordance with Appendix C the external finish of the same test piece shall be tested in accordance with Appendix B, shall be examined and shall resist penetration in accordance with item a).

4.3 Corrosion resistance of meter components

NOTE Appendix D is a guide to the relationship between the requirements and associated tests for corrosion resistance.

4.3.1 Test pieces. The tests shall be carried out either on sample plaques, or on the components themselves. A sample plaque shall be used in place of a component only if no forming operations are carried out on the component after the protection is applied, if a sample plaque is used, its minimum area shall be as defined in BS 3900-E1 or BS 3900-E2, as appropriate. Attack at the edges of a sample plaque shall be ignored if the component under consideration has no exposed edges when installed.

Items submitted for test shall have been fully dried and aged.

4.3.2 External surfaces of the meter

4.3.2.1 General. External surfaces of the meter other than those of any components made from austenitic stainless steel, shall comply with the following requirements.

- a) *Finish.* Any external finish shall comply with items a), b) and c) of 4.2.
- b) *Humidity.* When tested in accordance with Appendix C there shall be no signs of significant corrosion to the base material. Attack on the edge or up to 2 mm from it shall be ignored if the component under consideration has no exposed edges when installed.
- c) *Chemical resistance.* When tested in accordance with E.2 there shall be no signs of blistering, lifting, loss of adhesion or significant corrosion. Attack on the edge or up to 2 mm from it shall be ignored if the component under consideration has no exposed edges when installed.

4.3.2.2 Protective coatings. When tested in accordance with E.1.2, all coatings providing corrosion protection shall show no signs of cracking or loss of adhesion.

If the corrosion protection of the surface is provided solely by means of an organic coating, when tested in accordance with E.1.1, the coating shall show no signs of cracking or loss of adhesion, and when tested in accordance with E.1.3, the classification of the test results shall be 0, i.e. there shall be no detachment of the coating.

NOTE In the test described in E.1.1, an area 3 mm from the edges of the sample may be ignored.

4.3.2.3 Gas-containing components, meter band and index cover. All external surfaces of gas-containing components, meter band and the index cover shall comply with the following requirements.

- a) *Salt spray.* When tested in accordance with E.2.4 there shall be no signs of significant corrosion.

Attack on the cross cuts and up to 2 mm from then shall be ignored. Attack on the edge or up to 2 mm from it shall be ignored only if the component under consideration has no exposed edges when installed.

Where a formed component is too small for the cross cuts to be applied, the component shall be tested without cross cuts and an additional test shall be carried out on a sample plaque to which cross cuts have been applied.

b) *Scratch resistance*. When tested using either the method given in Appendix B with a spring force of 29.4 N or the method given in BS 3900-E2 with the same load, there shall be no penetration of the surface resulting in the exposure of corrodible base material.

If, during the test, exposure of corrodible base material is established by visual inspection or electrical contact, the scratched surface shall then be subjected to a salt spray test in accordance with BS 3900-F4 for 24 h. After this test there shall be no sign of significant corrosion.

4.3.2.4 Gas-containing components made of austenitic stainless steel. Gas-containing components made of austenitic stainless steel shall either be stress free, no cracks being visible when they are tested in accordance with E.3, or be protected on their external surface by a coating complying with 4.2.

4.3.3 Internal surfaces of the meter

4.3.3.1 Internal surfaces in contact with gas. Surfaces in contact with gas during normal use shall comply with the following.

- a) *Humidity*. The requirements given in item b) of 4.3.2.1 shall apply.
- b) *Chemical resistance*. The requirements given in item c) of 4.3.2.1 shall apply, except that item g) of E.2.2 shall not be used.

4.3.3.2 Internal surfaces exposed to atmosphere. Surfaces exposed to atmosphere and normally concealed shall comply with 4.3.2 as if they were external surfaces.

4.3.3.3 Protective coatings. The requirements given in 4.3.2.2 shall apply.

4.4 Diaphragms

4.4.1 General. Diaphragms shall be manufactured either from a synthetic material or from leather.

4.4.2 Leather diaphragms. Leather diaphragms shall comply with type 1 of BS 2797. The dressing shall be non-acid, covering the surface and filling the pores and shall be suitable for the gas for which the meter is to be used. The dressed leather shall be impermeable to air at a differential pressure of 5 mbar.

NOTE Leather diaphragms are not suitable for 3rd family gases.

4.4.3 Synthetic diaphragms

4.4.3.1 Identification. The manufacturer, composition and date of manufacture shall be indicated on the diaphragm.

4.4.3.2 Test pieces. Test pieces shall be taken from a diaphragm or from the diaphragm material; if from the latter, they shall be of the same thickness and cured under the same conditions as the diaphragm.

Unless otherwise stated, the test pieces shall be either square or circular and shall have a minimum length or diameter of 40 mm.

4.4.3.3 Tests on diaphragm material

4.4.3.3.1 Liquid phase immersion tests

4.4.3.3.1.1 Hydrocarbon mixture. When a test piece is immersed and allowed to swell freely in a mixture of toluene and heptane in the proportion 1 : 1 by volume at 20 ± 5 °C for 7 days, the change in area shall not be greater than 5 % of the original area.

After immersion and drying to constant mass at room temperature, the extracted material shall not exceed 12 % by mass of the original mass of the test piece, and the area shall not differ from the original area by more than 5 %.

The material shall not show any sign of delamination or blistering.

NOTE 1 The volume ratio of liquid to test piece should be not less than 50 : 1.

NOTE 2 To measure the change in area, it is recommended that the liquid-soaked test piece be placed quickly between two microscope slides.

4.4.3.3.1.2 Water. When the test piece is immersed in distilled or deionized water and allowed to swell freely at 20 ± 5 °C for 7 days, the change in area of the material shall not be greater than 5 % of the original area of the test piece.

After immersion and drying to constant mass in air at room temperature, the extracted material shall not exceed 12 % by mass of the original mass of the test piece and the area shall not differ from the original area by more than 5 %. The difference in relative humidity between taking the original and final mass and area measurements shall not exceed ± 10 %.

The material shall not show any sign of delamination or blistering.

4.4.3.3.2 Accelerated ageing. The stiffness of the test piece shall be measured at 20 ± 5 °C in accordance with Appendix F, using the Williamson torsion apparatus. The stiffness, when remeasured at 20 ± 5 °C, shall not have increased by more than 25 % after the test piece has been subjected to a temperature of 70 ± 2 °C in an air-circulating oven for 4 weeks. In addition, the test piece shall not show any sign of delamination, blistering or significant deterioration.

4.4.3.3.3 Low temperature flexibility. The stiffness of the test piece shall be measured at $20 \pm 5^\circ\text{C}$ in accordance with Appendix F, using the Williamson torsion apparatus. The stiffness when measured at $-5 \pm 1^\circ\text{C}$ shall not have increased by more than 25 % after the test piece has been subjected to this temperature in an environmental chamber for 20 min.

4.4.3.3.4 Porosity. When tested in accordance with Appendix G, no detectable movement shall be seen in the manometer tube.

NOTE With a thin soap film applied to the top surface of the test piece no bubbles should occur after 1 min.

4.4.3.4 Tests on components assembled in the meter

NOTE **Important.** A new sample is recommended for each test.

4.4.3.4.1 Vapour phase test. For the purposes of this test, one method for which is given in Appendix H, the meter registration shall be determined at $6\text{ m}^3/\text{h}$ (or $212\text{ ft}^3/\text{h}$) on test gas $\text{NGA}^{2)}$, nitrogen or air.

After determining the meter registration with a particular gas, the meter shall be operated at a temperature of $20 \pm 5^\circ\text{C}$ on the same test gas to which has been added 1.0 % V/V of toluene, and sufficient water vapour to give a relative humidity of $65 \pm 5\%$. The gas flow rate shall be not less than $30\text{ dm}^3/\text{h}$ ($1\text{ ft}^3/\text{h}$). Immediately following a test period of 264 h, the meter registration shall be determined, on the same untreated test gas that was used at the beginning of the test, and shall not have changed by more than 2 units of percentage from the previously determined value. The meter shall then continue to be operated on the untreated test gas for a further period of at least 168 h at $1.5\text{ m}^3/\text{h}$ ($50\text{ ft}^3/\text{h}$) in an ambient temperature of $20 \pm 5^\circ\text{C}$. The meter shall then comply with 9.1.

NOTE 1 When air is used as the carrier gas, the mixture of air and toluene vapour should be exhausted externally to atmosphere (not burnt) via a flame trap.

NOTE 2 The concentration of toluene vapour is equivalent to a 34.7 % saturation level at 20°C .

4.4.3.4.2 Ambient temperature tests. The meter shall comply with clauses 8 and 9 when tested in an ambient temperature of $20 \pm 2^\circ\text{C}$ after each of the following periods of operation:

- 400 h on air at $0.5 \times Q_{\text{max}}$ in an ambient temperature of $-5 \pm 1^\circ\text{C}$;
- 400 h on air at $0.5 \times Q_{\text{max}}$ in an ambient temperature of $+35 \pm 1^\circ\text{C}$.

NOTE Care should be taken to prevent condensation in the meter.

4.5 Index windows

4.5.1 General. The index window shall be made of any material which satisfies the following requirements.

Both as supplied, and after being subjected to the accelerated ageing tests specified in 4.5.6, samples of window panes or moulding shall comply with 4.5.2, 4.5.3 and 4.5.4. The accelerated ageing tests shall be performed on samples that have not previously been subjected to the flammability test.

4.5.2 Visual inspection. The window pane or moulding shall show no crazing or blisters. The portion through which the index is viewed shall be transparent, and shall not cause visual distortion of the matter to be viewed within an angle of 15° from the normal to the window.

4.5.3 Rigidity. With the window fitted on the meter as in operation, and at a temperature of $30 \pm 2^\circ\text{C}$, a 10 mm diameter timber rod applied normal to any external part of the window or moulding with a force of 200 N shall not cause it to touch any moving part of the mechanism.

4.5.4 Impact. The window, fitted in the meter as in operation and at a temperature of $-5 \pm 1^\circ\text{C}$, shall withstand the impact of a 25 mm diameter solid steel ball dropped three times from a height of 350 mm and striking the centre of the window normal to its plane.

4.5.5 Flammability. The window shall be tested in accordance with BS 2782:Method 140E:1982. For this test, the test piece shall be positioned centrally with its external face downwards on the centre of the wire grid.

The material shall comply with the following requirements.

- The period of time for which the test piece glows or flames from the instant the ethanol burns out shall not exceed 5 s.
- Any material that may have dropped from the specimen shall not continue to burn.
- The percentage of the area of the underside of the test piece that is charred or scorched shall not exceed 20 %.
- The length of that part of any edge of the underside of the test piece that is charred or scorched shall not exceed 50 mm.

²⁾ Full details of test gases are given in BS 4947.

4.5.6 Accelerated ageing tests

4.5.6.1 General. Subject one sample window pane or moulding to the ageing tests specified in 4.5.6.2. Subject another sample to the tests specified in 4.5.6.3. After these ageing tests, and before being given the flammability test, the samples shall still fit the meter.

4.5.6.2 Effects of ultraviolet light and loss of volatile plasticizer

4.5.6.2.1 Radiation test. The window pane or moulding shall be exposed for five periods each of 8 h duration to the radiation of a suspended sun lamp that has been in use for not less than 50 h and not more than 400 h. The light source shall be a combination tungsten filament mercury arc enclosed in glass that has a low-transmission below 280 nm. The glass envelope shall be conical and silvered internally to form a reflector. The lamp shall be rated at 275 W to 300 W. The window pane or moulding shall be positioned, as designed, on its index with its outer face towards the lamp and 400 mm from the bottom and on the axis of the lamp. The surrounding air shall not be confined and shall be free to circulate.

After each exposure except the last, the sample shall be immersed completely in distilled water for 16 h. It shall be cleaned and carefully dried with cotton wool after each immersion period.

4.5.6.2.2 Loss of volatile plasticizer. The sample shall be heated in air at 100 ± 3 °C for 24 h. In this test the window pane or moulding shall be reasonably supported so as not to encourage deformation.

4.5.6.3 Resistance to chemical substances. The sample shall be constrained as it will be in the meter and then totally immersed, in turn and in the order listed, in the following technically pure substances at 20 ± 3 °C:

- a) sodium carbonate (20 % *m/m*) for 2 h;
- b) paint thinners (approximately 50 % aromatic and 50 % aliphatic hydrocarbons, e.g. 50 % *o*-xylene and 50 % *n*-heptane) for 1 h.

The sample shall be cleaned with distilled water and carefully dried with cotton wool after each immersion.

4.6 Bearings

All linkage, pivot and other bearings shall comply with the corrosion, wear resistance and shock tests specified in 4.4.3.4.1, 10.1, 10.4, and Appendix M.

4.7 Valves

The valve grids shall be made of material that is compatible with that of the valve covers, i.e. either the valve cover or the grids shall be made of material with self-lubricating properties, e.g. made of, or faced with, phenolformaldehyde with an inert filler and graphite impregnated, or of a material having equivalent properties, such as wear resistance, strength, impact resistance and low coefficient of friction.

4.8 Gearing

The gearing shall be made of materials that are compatible, i.e. wear resistance and dimensional stability shall comply with the requirements given in 4.4.3.4.1, 10.1, 10.4 and Appendix M.

4.9 Grease

Where grease is used for lubricating bearings and gears it shall not contain solids unless the solids have lubricating properties. Metallic soap-base greases shall not be used.

4.10 Seals and sealing glands

4.10.1 General. Seals and sealing glands shall be made of materials complying with 4.10.2. Internal and external sealing glands shall comply with 4.10.3. Seals and sealing glands shall comply with the requirements of BS 6505 for the appropriate temperature range and gas family.

4.10.2 Chemical resistance. The material of construction of the seal or sealing gland shall be deemed to be suitable if the following series of requirements are satisfied.

When tested in accordance with J.1.2.1, the meter shall comply with the internal leakage requirements specified in 8.2. It shall also withstand a static internal air pressure equal to the maximum working pressure or 345 mbar, whichever is the greater, without permanent distortion or external leakage.

When subsequently tested in accordance with J.1.2.2, the same meter shall comply with the following in the given order:

- a) the internal leakage requirements specified in 8.2;
- b) it shall withstand a static internal air pressure of 345 mbar without external leakage, when tested using one of the methods given in Appendix N.
- c) the total mean pressure loss requirement specified in 9.2;
- d) the mechanical pressure loss requirement specified in 9.3.

4.10.3 Wear resistance. When tested in accordance with **J.2**, the internal and external sealing glands shall show no sign of deterioration or permanent deformation. In addition, the turning resistance, measured using a torque meter, shall not exceed 0.015 N m or vary by more than 80 % of the initial value.

4.11 Motion wires and components

Where fitted, motion wires and their guides shall comply with the corrosion, wear resistance and shock tests specified in **4.4.3.4.1**, **10.1**, **10.4** and Appendix M.

4.12 Meter connections

The meter connections shall be made and finished in accordance with BS 746 or BS 4504, as appropriate.

4.13 Adhesive

The performance of adhesives used for fixing components shall comply with the tests described in this standard. The adhesive shall be effective throughout the design life of the meter (see **5.11**).

5 Design and dimensions

5.1 Assembled meter

The meter case shall comply with the dimensions given in Figure 1. The inlet connection of the meter shall be on the left-hand side when viewed from the front.

The external surfaces of the gas-containing components of the assembled meter shall, at any point, withstand the impact test in accordance with **10.3.1.2**.

External holes for screws, pins etc., which are used for the attachment of data badges or for the assembly of parts of the meter, shall not penetrate gas ways. The minimum wall case thickness shall be maintained between these holes and gas ways.

5.2 Clearances

There shall always be clearance between moving components and stationary parts of the meter not intended to make contact.

5.3 Pressure test point

5.3.1 General. All meters up to and including U40 shall be provided with a pressure test point in the form of a nipple, as shown in Figure 2, for the temporary connection of a pressure test gauge. This nipple shall be fitted either in the outlet connection, positioned as shown in Figure 3, or in that face of the meter from which the meter index is read.

A meter connection test nipple shall be either soldered into position or securely fixed by the use of a suitable adhesive and a visible means of mechanical locking.

A meter body test nipple shall be sited to indicate outlet gas pressure, positioned to minimize the risk of accidental damage and be easily accessible.

The strength of the securing joint of the nipple fitted in either position shall be such that it complies with the appropriate requirements of **8.1** after:

- a) applying a torque of 4 N m and;
- b) a mass of 0.5 kg has been dropped from a height of 250 mm through a vertical tube onto the body diameter.

NOTE Both tests need not be applied to the same sample.

5.3.2 Working pressures up to 75 mbar

5.3.2.1 Test nipples. Test nipples for use in meters having working pressures up to 75 mbar shall be in the form shown in Figure 2. They shall be manufactured from brass complying with alloy CZ 121 of BS 2874.

5.3.2.2 Sealing screw. A sealing screw as shown in Figure 2(c) shall be used to seal off the nipple gas way when not in use.

5.3.2.3 Seating and finish. The machining, particularly that of the cone seating of the screw and body, shall be of a fine finish, free from scores and tool marks.

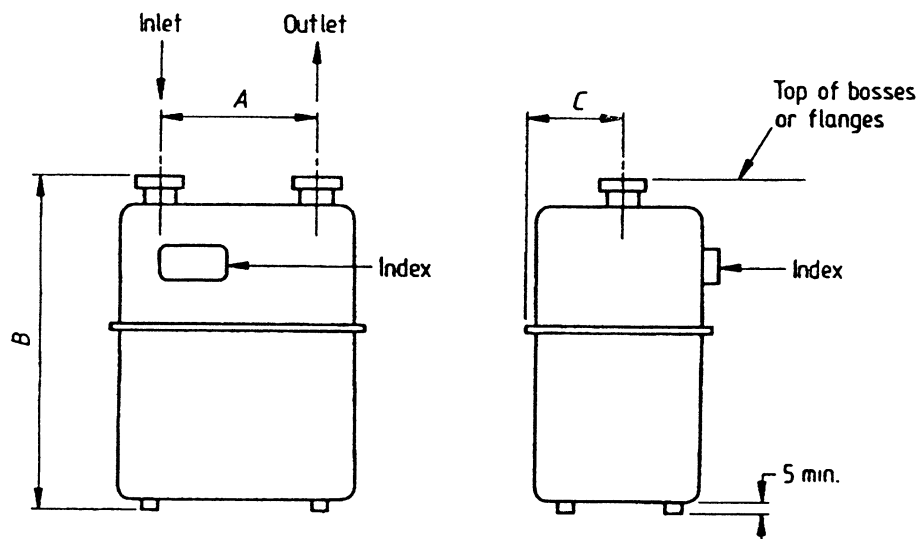
To ensure a sound seating of the coned faces the screw shall not bottom and the cones and mating threads shall all be coaxial. The pressure test nipple shall be free from burrs, sharp edges, swarf or other foreign matter.

5.3.2.4 Soundness of nipple and sealing screw. The assembled pressure test nipple, with the screw tightened to a torque of 0.5 ± 0.1 N.m, shall be sound when the meter is subjected to the pressure test specified in **8.1** subsequent to the test specified in **10.2**.

NOTE A smear of light oil complying with ISO viscosity grade 10 of BS 4231 may be applied to the cone seating.

5.3.3 Working pressures above 75 mbar. For meters having working pressures above 75 mbar an appropriate proprietary high pressure test nipple shall be used.

NOTE For meters with flanged connections (U65 and above) it is customary to fit appropriate pressure test nipples in the installation pipe work.

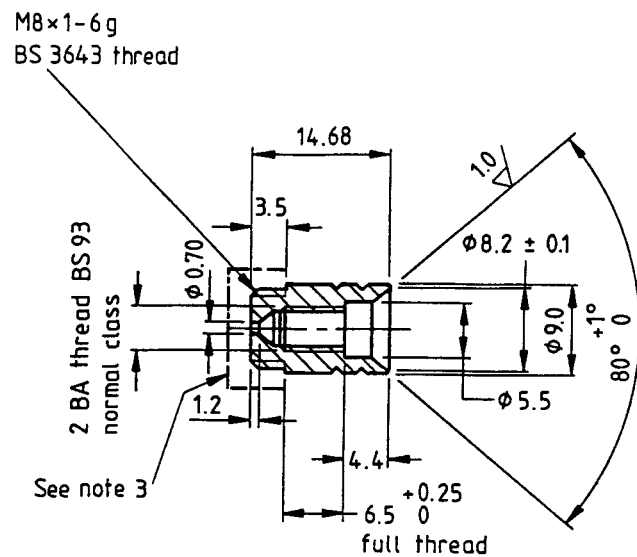


Dimension is in millimetres.

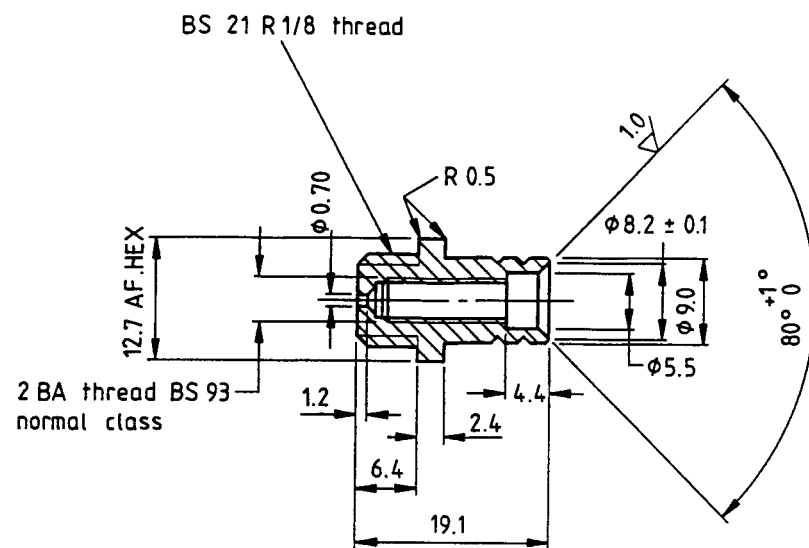
Meter designation	Connection: nominal size	Connection centres A (nominal)	Overall height B (maximum)	Rear of meter casing to connection centre C (maximum)
	mm in	mm	mm	mm
	Threaded BS 746			
U2.5	½	—	—	—
U4	1	110	—	—
U6	1	152.4	282	85
U10	1	152.4	415	110
U16	1 ¼	152.4	415	160
U25	2	250	415	160
U40	2	280	500	180
	Flanged BS 4504			
U65	*65	335	550	200
U100	80	430	630	275
U160	100	430	670	290

*Non-preferred size of pipe, but adaptors if used should be upwards to 3 in and not downwards to 2 in.
A 3 in flange complying with Table D of BS 10:1962 matches exactly the 65 mm PN10 or PN16 meter flanges complying with BS 4504.

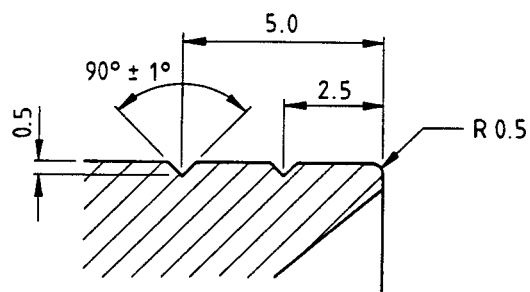
Figure 1 — Diagrammatic illustration of meters showing connections and index with tabulated connection end case dimensions



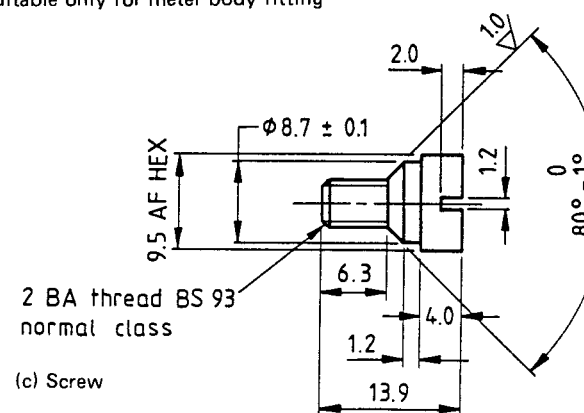
(a) Nipple suitable for boss or body fitting



(b) Alternative nipple suitable only for meter body fitting



Enlarged detail of front lip



(c) Screw

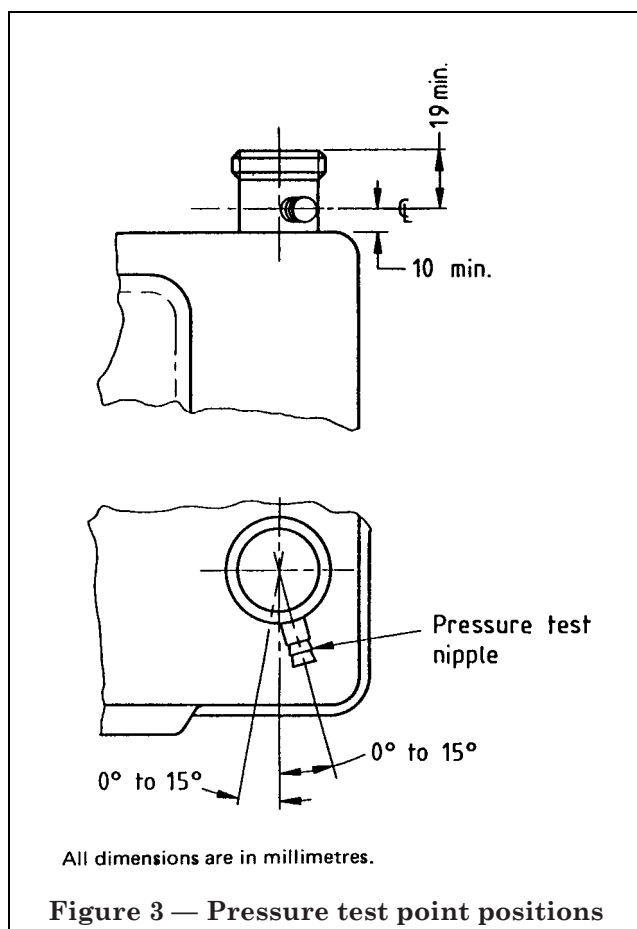
NOTE 1 The grooves are to facilitate the gripping of the tube.

NOTE 2 Unlimited dimensions to be correct to within ± 0.254 . Concentricity on threads to cones to have total indicator reading (TIR) of 0.127.

NOTE 3 External dimensions and configuration shown by the area marked thus — — — may be altered to suit the application, except for the $0.7 \phi \times 1.2$ deep hole.

All dimensions are in millimetres.

Figure 2 — Pressure test nipple



5.4 Feet

The meter shall be supported on four firmly attached feet and the method of attachment shall comply with the corrosion test as specified in items b) and c) of 4.3.2.1. The minimum height of the feet shall be 5 mm. The feet shall be designed either to be insulating or to accept an insulating cap, which shall be fitted (see also 10.6).

5.5 Index

5.5.1 General. The index of the meter shall be sealed from the gas inside the meter and shall be vented to atmosphere.

When the meter is in an upright position the method of venting shall allow any condensate inside the index to drain and minimize the possibility of water ingress. The index cover, window and frame shall prevent unauthorized access to the index and its drive.

The details on the index face shown in Figure 4 and Figure 5 shall have black printing on a white background, except the red zero or red portion of the visor.

The index face and all markings shall remain legible after the test specified in 4.5.6.2.1.

The recording numerals shall be arranged as shown in Figure 4 and Figure 5. They shall be of uniform size. Except as specified in 5.5.3, they shall be white in colour on a black background and surrounded by a black visor as shown in the appropriate figure.

NOTE Colour code. The recording numerals shown on Figure 4 and Figure 5 have been chosen as a means of identifying the colours to be used for the index and these are as follows:

- 1 and 7 black drum, white numerals, black visor
- 5 black drum, white numerals, red visor
- 4 black drum, red numerals, no visor
- 3 black drum, white numerals, white graduations, red visor
- 0 red on white background

The numerals shall move in an upward direction and shall be clearly visible at an angle of 15° to the normal.

A complete revolution of a drum shall, during the last one-tenth of its travel, i.e. from 9 to 0, cause the advance of the next higher drum by one unit.

5.5.2 Cyclic volume. The difference between the actual value of the cyclic volume of the meter and the value of this volume specified on the meter shall not exceed 5 % of the latter.

5.5.3 Cubic metre index. The index for a meter with a badged rating in cubic metres shall comply with Figure 4 and shall have a test drum. This drum shall move continuously while the meter is recording. It shall have a minimum diameter of 16 mm and the interval between scale divisions shall be constant throughout and not less than 1 mm.

The value chosen for one complete revolution of the test drum shall be a whole number multiple of the cyclic volume given on the meter.

The unit divisions, commencing with the numeral 0, shall be distinguished from the subdivisions by longer lines.

These graduation lines shall be fine, uniformly drawn and white in colour [see enlarged view, Figure 4(b)]. For the application of photoelectric meter testing techniques it is permissible for the test drum to have a clearly distinguishable reference mark that shall not conceal the subdivisions or interfere with the accuracy of reading.

The window for the test drum shall have a projection or a reference mark as shown in Figure 4 to permit certain and easy reading.