BRITISH STANDARD

BS 4161-2: 1967

Incorporating Amendment Nos. 1 and 2

Specification for

Gas meters —

Part 2: Meters of plate construction above 1000 cubic feet (28 cubic metres) per hour rating

UDC 681.122

Co-operating organizations

The Gas Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government department and scientific and industrial organizations:

Gas Council*
Heating and Ventilating Contractors' Association
Institution of Gas Engineers*
Liquefied Petroleum Gas Industry Technical Committee*
Ministry of Power*
Society of British Gas Industries*

The Government department and scientific and industrial organizations marked with an asterisk in the above list were directly represented on the committee entrusted with the preparation of this British Standard.

This British Standard, having been approved by the Gas Industry Standards Committee and endorsed by the Chairman of the Engineering Divisional Council, was published under the authority of the General Council on 16 August 1967

The following BSI references relate to the work on this standard:
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Amendments issued since publication

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899	March 1972	
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Contents

Foreword

This standard makes reference to the following British Standards:

BS 10, *Flanges and bolting for pipes, valves and fittings.*

BS 21, *Pipe threads.*

BS 143, *Malleable cast iron and cast copper alloy pipe fittings for steam, air, water, gas and oil. Screwed BSP taper thread or API line pipe thread.*

BS 381C, *Colours for specific purposes.*

BS 1179, *Glossary of terms used in the gas industry.*

BS 1250, *Domestic appliances burning town gas — Part 1: General requirements.*

BS 1387, *Steel tubes and tubulars suitable for screwing to BS 21 pipe threads.*

BS 1452, *Grey iron castings.*

BS 1872, *Electroplated coatings of tin.*

BS 2045, *Preferred numbers.*

BS 2660, *Colours for building and decorative paints.*

BS 2797, *Leather for gas meter diaphragms — Part 1: E.I. sheep skin leather — Part 2: Split hide leather.*

BS 2920, *Cold-reduced tinplate and cold-reduced blackplate.*

BS 3900, *Methods of test for paints — Part F2: Resistance to humidity under condensation conditions.*

BS 4161, *Gas meters — Part 1: Meters of plate construction up to 1 000 ft^3/h rating.*

CP 331, *Installation of pipes and meters for town gas — Part 2: Metering and meter control.*

This British Standard is the second part of a series relating to gas meters for registering the volume of gaseous fuel consumed.

The method of ordering meters adopted in Part 1 has been extended to these larger meters and is explained in Appendix A.

The dimensions specified in this part embrace those recommended by the Institution of Gas Engineers for meters up to 15 000 ft^3/h badged rating. Since the majority of meters of these dimensions are now available with badged ratings higher than those previously recommended by the Institution of Gas Engineers, these higher ratings (in the past referred to as "Super Small Case") are adopted in this part. However, for guidance, Appendix G gives the relationship between the BS and the previous IGE designations.

The standard at present includes the following, either published or in course of preparation:

BS 4161-1, *Meters of plate construction up to 1 000 ft^3/h rating — Part 2: Meters of plate construction above 1 000 ft^3/h (28 m^3/h) rating — Part 3: Unit construction meter of 212 ft^3/h (6 m^3/h) rating.* (In course of preparation.)

Factors for the conversion of Imperial units to metric units are given in Appendix H. More accurate conversion should be based on the tables in BS 350, "*Conversion factors and tables*".

Obsolescent (by Amendment No. 2)

The need for the equipment covered by this Part of this British Standard has been reviewed and although it was decided not to amend or revise the text, the standard should be regarded as obsolescent and not therefore used for new designs. The standard will be withdrawn in due course.

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 16, 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.

1 Scope

1.1 This Part of BS 4161 covers the construction and performance of plate constructed credit meters above 1 000 ft^3/h (28 m^3/h) badged rating, with side connections, for gas pressures up to 20 in water gauge (w.g.). It includes the requirements for flanges and connector socket connections, together with provision for fitting a proprietary non-rigid coupling on one side of the meter.

The installation of meters is dealt with in British Standard Code of Practice CP 331-2[1)].

1.2 Notwithstanding the requirements specified in this standard, any new designs, materials and methods of assembly giving at least equivalent results are acceptable.

2 Definitions

2.1 The terms used in this British Standard are defined in BS 1179[2)].

3 Ratings

3.1 Ordered rating. The meter shall be rated in cubic feet or cubic metres as ordered.

3.2 Cubic feet rating. A meter registering in cubic feet shall be badged at one of the badged ratings shown in Table 1 or at another badged rating rounded to the nearest thousand ft^3/h and conforming to the R20 series of preferred numbers (see BS 2045[3)]).

NOTE The badged rating as defined in BS 1179[2)] is determined on air.

3.3 Cubic metre rating. A meter registering in cubic metres shall be badged in m^3/h, preferably at a badged rating conforming to the R40 series of preferred numbers (see BS 2045[3)]).

NOTE These meters are basically designed for registering in ft^3/h thus making it impossible for some meters to be modified to give an equivalent metric badged rating. For this reason no metric equivalents are specified in column 2 of Table 1.

4 Materials

4.1 General requirements. The meter shall be constructed of materials of good quality complying, where applicable, with British Standards. The materials used shall not be adversely affected by the conditions arising in that part of the meter in which they are used.

4.2 Tinning[4)]. All steel components, unless inherently corrosion resistant, shall be tinned as follows:

1) *Pretinned steel sheet for case and valve plate assembly.* The tinning shall be evenly applied on both sides, the two coatings having a combined weight of not less than 0.6 oz/ft^2 (a coat thickness each side of 0.0005 in).

2) *Internal mild steel sheet components.* The tinning shall be evenly applied on both sides, the two coatings having a combined weight of not less than 0.4 oz/ft^2 (a coat thickness each side of 0.000 33 in).

3) *Other steel components*, e.g. flag rods, which are tinned shall have an equivalent coating of tin of not less than 0.15 oz/ft^2 of the surface area (a coat thickness of 0.000 25 in).

4.3 Diaphragms. The diaphragms shall comply with the requirements of BS 2797, Part 1 or 2 as appropriate[5)]. The dressing shall be non-acid, covering the surface and filling the pores and any stitches, and it shall be suitable for the gas for which the meter is intended. The dressed leather, when fitted, shall be impermeable to air at a differential pressure of 2 in w.g.

Alternatively, synthetic or reinforced synthetic diaphragms may be used. These shall have a performance and useful life no less than that of dressed leather diaphragms and the material shall have the same properties as are given for synthetic diaphragms in BS 4161-1[6)], Appendix B.

4.4 Index window. The index window shall be of $^1/_4$ in (minimum) plate glass or material of equivalent properties, and it shall withstand the test in **11.2**.

4.5 Bearings. All linkage, pivot and other bearings shall be made of corrosion and wear resistant material.

4.6 Valves. The valve covers should preferably be made of or faced with graphited phenolformaldehyde, or a material having equivalent properties, such as wear resistance, dimensional stability and low coefficient of friction.

The valve grids shall be made of a material compatible with that of the valve covers. A suitable combination is graphited phenolformaldehyde for the valve covers and an alloy of tin, antimony and lead for the valve grids.

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1) CP 331, "*Installation of pipes and meters for town gas*", Part 2, "*Metering and meter control*".
2) BS 1179, "*Glossary of terms used in the gas industry*".
3) BS 2045, "*Preferred numbers.*"
4) See BS 1872, "*Electroplated coatings of tin*" and BS 2920, "*Cold-reduced tinplate and cold-reduced blackplate*".
5) BS 2797, "*Leather for gas meter diaphragms*", Part 1, "*E.I. Sheep skin leather*", Part 2, "*Split hide leather*".
6) BS 4161, "*Gas meters*", Part 1, "*Meters of plate construction up to 1 000 ft^3/h rating*".

4.7 Worm gears. The gears shall be made of materials which are wear resistant and they shall be dimensionally stable.

4.8 Grease. Where grease is used for lubricating bearings and gears, the grease shall not contain solids, unless the solids have lubricating properties. Metallic soap based greases shall not be used.

4.9 Sealing gland packing. The packing shall consist of a suitable permanent packing material, such as felt wads together with a non-acid grease, or the gland may be of a design incorporating a proprietary type seal having an equivalent performance and useful life.

4.10 Connector socket. The socket shall be made from cast iron to BS 1452[7] Grade 10 or of a material at least equivalent in mechanical strength and durability.

The longscrew material shall comply with the requirements of BS 1387[8].

4.11 Flanges. The flanges shall be made of cast iron complying with the requirements of BS 10[9].

5 Design and dimensions

5.1 Case. A meter shall have a case size conforming to Table 1.

Table 1 — Case dimensions and ratings

1	2	3	4	5	6	7	8
BS case reference no.	Badged rating[b]	Connection size BSP		Overall width (over connections)	Height of centre of connections	Overall height	Overall depth
		Flanges	Connector sockets				
	ft³/h	in	in	in	in	in	in
				limits, + 0, – 1/2	limits, + 0, – 1/2	max.	max.
P.12	1 200	3	3	24	17 1/4	25	15
P.18	1 800	3	3	27 1/4	20 1/4	29	17
P.30	3 000	4	4	30 1/4	20 1/4	34	24
P.60	6 000	6	4	34 3/4 35 1/4	27	43	27
P.90	9 000	6	6	42 3/4	34 3/4	52	33
				limits, + 0, – 1	limits, + 0, – 1		
P.120	12 000	6	6	49	41 1/2	61	36
P.150	15 000	8	6	53 1/2 56	48 1/2	66	40
P.200	20 000	8 10		61 1/4 59	49	72	46
P.250	25 000	8 10		61 1/2	49 1/2	75	49
P.300	30 000	10		65[a]	57 1/4	82	53
P.500	50 000 60 000 70 000	10 12 12 12		77	64 1/4	93	65

[a] This is the preferred width but at the time of publication some are made 66 in wide.
[b] For badged rating in m³/h see Note to **3.3**.

[7] BS 1452, "*Grey iron castings*".
[8] BS 1387, "*Steel tubes and tubulars suitable for screwing to BS 21 pipe threads*".
[9] BS 10, "*Flanges and bolting for pipes, valves and fittings*".

When looked at from the front, the inlet connection shall be located on the left-hand side of the meter and the outlet connection shall be on the right-hand side, both located on the vertical centre line of the side.

The meter case shall be made of pre-tinned steel sheet assembled by soft soldering. The total thickness of the tinned steel sheet shall not be less than that shown in Table 2.

Table 2 — Case thickness

BS case reference no.	Minimum thickness of tinned steel sheet
	in
P.12 and P.18	0.035
P.30 and P.60	0.049
P.90 up to and including P.500	0.062

When an internal pressure of 20 in w.g. is applied to the meter, no panel shall flex at its centre by more than 0.008 in for each inch of its shortest side.

The meter shall be supported on feet firmly attached to the case. The feet shall be sealed around their edges. They shall not be positioned over a soldered seam and preferably not under a flag rod bearing.

There shall be adequate working clearance between moving components and stationary parts of the meter not intended to make contact. These clearances shall make allowance for readjustment of the mechanism.

5.2 Purging point. The meter outlet flange, socket or non-rigid coupling fitted integral with the case shall be provided with a purging plug. The internal thread for this plug shall be screwed $^{1}/_{2}$ in BSP for a meter with a 3 in BSP outlet connection and screwed $^{3}/_{4}$ in for 4 in and larger BSP outlet connections (except where indicated in Figure 1 Table 6, Column 10). These threads shall conform to BS 21[10], and should be of taper form.

The purging plug shall be of malleable cast iron, complying with the requirements of BS 143[11], solid type, and shall be easily accessible. If so ordered, the purging point shall be extended by tubing to BS 1387[12] (medium or heavy), and capped with a screwed cap to BS 143[11].

5.3 Index

5.3.1 *General.* The index of the meter shall be sealed from the gas inside the meter by a sealing gland. The index window shall be sealed in its frame but the index may be vented to the atmosphere by a small hole in the frame, positioned to prevent the entry of water.

The cubic foot index face shall have black printing on a white background and shall be of the dial or direct reading type conforming to **5.3.2**.

The cubic metre index face shall have black printing (except the red portion of the visor) on a white background and conform to **5.3.3**.

All dial hands shall be sharply pointed and shall lie as close to the dial as practicable.

All index main dials or moving numerals shall be clearly visible at an angle of 15 ° to the normal to the glass when viewed from any direction from the front of the meter.

The gearing within the index shall be such that the correct relationship is ensured between the test dial and the remainder of the index.

5.3.2 ***Cubic foot indexes***

5.3.2.1 *Test dial.* The index shall have a test dial, the diameter of which shall be not less than $1^{1}/_{8}$ inches.

The test dial shall be positioned and subdivided as shown in the appropriate Figure 2, Figure 3, Figure 5 or Figure 6, except that for meters with a badged rating above 15 000 ft^3/h the test dial may comply with one of the alternative dials given in Figure 4.

The value (ft^3 per revolution) chosen from Figure 4 for this test dial shall permit one complete revolution of the test dial hand to indicate one or more full working cycles of the meter. Preferably it should be the smallest value consistent with this requirement.

The direction of rotation of the test dial hand shall be indicated and may be either clockwise or anti-clockwise. The hand shall be red and shall be of sufficient length to indicate centrally between the two concentric circles.

5.3.2.2 *Dial type index.* A dial type index shall have five main dials for meters up to 3 000 ft^3/h badged rating and six such dials for those above this rating. These dials shall be arranged and subdivided as indicated in Figure 2 or Figure 3 and shall have a uniform diameter of not less than $^{37}/_{64}$ in.

The hand of the 100 ft^3 per division dial shall rotate in a clockwise direction.

The hands of the main dials shall be black and shall indicate to the dial circumference.

[10] BS 21, "*Pipe threads*".
[11] BS 143, "*Malleable cast iron and cast copper alloy pipe fittings for steam, air, water, gas and oil. Screwed BSP taper thread or API line pipe thread*".
[12] BS 1387, "*Steel tubes and tubulars suitable for screwing to BS 21 pipe threads*".

5.3.2.3 *Direct reading index.* The moving numerals on a direct reading type index shall be arranged as shown in Figure 5 or Figure 6 and they shall cover the same range of consumption as the dial type index. Two noughts painted in red on a white background and in line with the aforementioned numerals shall represent 10 ft^3 and 100 ft^3 units.

The numerals which shall be of uniform size shall have minimum dimensions of $^{13}/_{64}$ in high and $^{5}/_{32}$ in wide. They shall be white in colour on a black background, surrounded by a black visor as shown in Figure 5 or Figure 6.

The numerals shall move in an upward direction and shall change from one value to the next during a half revolution of the test dial hand or less.

5.3.3 *Cubic metre indexes.* The index for a meter with a badged rating in cubic metres shall conform to Figure 12, Figure 13 or Figure 14 and shall have a test drum.

The recording numerals shall be arranged as shown in the appropriate Figure.

They shall be of uniform size and shall have minimum dimensions of 5 mm high and 2.6 mm wide. Except as specified below, they shall be white in colour on a black background and surrounded by a black visor as shown in the appropriate Figure.

The recording numerals for submultiples of m^3 shall be red in colour surrounded by a red visor and separated from recording numerals in m^3 by a clear decimal point.

The numerals shall move in an upward direction.

A complete revolution of a drum shall, during the last $^{1}/_{10}$ of its travel, i.e. from 9 to 0, cause the advance of the next higher drum by one unit.

The test drum shall move continuously while the meter is recording. It shall have a minimum diameter of 16 mm, with sub-divisions of uniform length 1 mm (minimum) apart.

The unit divisions, commencing with a numeral 0, shall be distinguished from the sub-visions by longer lines. These graduation lines shall be fine, uniformly drawn and white in colour (see enlarged view at Figure 12). For the application of photo-electric meter testing techniques, a white line as thick as practicable shall be drawn across the drum and positioned between any recording numerals.

The window for the test drum shall have a projection, with a horizontal lower edge, projecting two-thirds across the sub-divisions of the test drum (see enlarged view at Figure 12).

One revolution of the test drum should represent a multiple or sub-multiple of one or more full working cycles of the meter.

5.4 Sealing gland assembly. When dressed wads are used without any additional packing material other than washers, the length of sealed space shall comply with Table 3 and the wads shall be under compression.

Table 3 — Sealing gland packing length

Sealing gland	Length of sealed space (minimum)
	in
Index	$^{3}/_{4}$
Internal glands between compartments	$^{3}/_{8}$

The threads of the gland nuts shall tighten in the direction of rotation of the spindle passing through them, or shall be suitably locked to prevent slackening off. For repair purposes, the nut of the index sealing gland shall be accessible from the outside of the gas carrying compartments of the meter. All sealing glands shall be capable of easy re-packing.

5.5 Worm gear assembly. Where the gears of the worm gear assembly do not require external lubrication, they shall be enclosed within a housing. The assembly through its supporting members shall be firmly secured to the valve plate.

5.6 Lubrication. Either automatic or external manual means shall be provided for lubricating the gears, bearings and valves where non-self lubricating materials are used.

The means of replenishing the lubricant shall be accessible from outside the meter case. It shall be possible for the owner's seal to be affixed, if required to deter unauthorized access to the lubrication points.

5.7 Bonding. Adhesive, without additional mechanical means of fixing, shall not be relied upon to bond graphited phenolformaldehyde or other facing material to the valve covers, unless the bond is at least as strong as the facing material itself.

The adhesive shall be effective throughout the life of the meter, and it shall not be affected by the gas for which the meter is intended to be used, or by water vapour.

5.8 Valves. The valves shall be of the radial or straight type.

5.9 Drainage. Except as below, provision shall be made for the case and diaphragm chambers to be drained. All four chambers shall be drained individually to one and the same side of the meter where the four points should be capped or plugged.

There need be no provision for draining a P.12 meter unless this is specified by the purchaser.

6 Assembly and workmanship

6.1 The interior of the meter shall be free from loose solder and other foreign matter. All soldering flux or spirit shall be removed.

6.2 The diaphragm assembly shall be gas tight. The diaphragms shall be undamaged and evenly assembled to the diaphragm pans. Grease shall not be used to effect a seal between the dressed diaphragm and the diaphragm pan rim.

The diaphragms shall be equally divided in relation to the tangent stroke.

6.3 Oil or other liquid shall not be applied to valves incorporating self-lubricating valve covers.

6.4 The flag bracket shall be securely fitted to the diaphragm disk and any nuts shall be locked.

7 Connections

7.1 The connections shall comprise one of the following:

1) flanges conforming to Table A in BS 10[13)]

2) connector sockets complying with this specification and Figure 1

3) by arrangement between the purchaser and the supplier, a proprietary non-rigid coupling placed on one side only and the other connection as stated in 1) or 2) above.

The connector socket threads shall conform to BS 21[14)].

7.2 When longscrews are ordered with the meter, they shall comply with the requirements of BS 1387[15)] for single longscrews without a socket. They shall have a one-inch length of unthreaded pipe between the connecting threads. A longscrew shall run in its connector socket hand-tight without perceptible shake.

There shall be sufficient clearance within the meter for the connector socket to accept the full length of the longscrew parallel thread.

7.3 When companion flanges are ordered, their dimensions shall comply with BS 10[16)] and they shall be suitable for connection to the flanges provided on the meter. The size of the connecting threads shall be specified by the purchaser, but the threads shall comply with BS 21[17)] and shall be of parallel form.

8 External leakage

8.1 The meter shall not leak externally when subjected to an internal air pressure of 20 in w.g.

NOTE Where temperature differences and changes may affect test results significantly, testing should be carried out in a room having a controlled temperature and with the meter, apparatus and test air stabilized to room temperature. A period of three hours may be necessary to achieve this stability.

9 Internal leakage (See Note in **8.1**)

9.1 The meter shall register when air is passed through it at the rate given in Table 4.

For the purpose of this test, the volume of air passed as indicated by the test dial shall be not less than that equivalent to one working cycle of the diaphragms.

Table 4 — Internal leakage test rates

Badged rating	Air test rate
ft^3/h	ft^3/h
Up to 2 000 (56 m^3/h)	2
Above 2 000 (56 m^3/h)	5

10 Performance (See Note in **8.1**)

10.1 Accuracy of registration. At the badged rating of the meter, and at one-fifth of this rating, the meter shall be accurate within the limits + 2 % and – 3 % when tested with air by the method described in Appendix B.

The registration at the badged rating shall not differ from that at the lower rate by more than 2 %.

10.2 Pressure loss. The mean pressure loss of the meter when air is passing through it at its badged rating shall not exceed that given in Table 5 when tested by the method described in Appendix C.

The pressure loss shall be determined at points as close as practicable to the face of the flanges or alternative connections.

10.3 Pressure oscillation. The pressure oscillation at badged rating, and at one-fifth of this rating, shall not exceed that given in Table 5 when tested by the method described in Appendix C.

13) BS 10, "*Flanges and bolting for pipes, valves and fittings*".
14) BS 21, "*Pipe threads*".
15) BS 1387, "*Steel tubes and tubulars suitable for screwing to BS 21 pipe threads*".
16) BS 10, "*Flanges and bolting for pipes, valves and fittings*".
17) BS 21, "*Pipe threads*".

Table 5 — Pressure loss and oscillation

Badged rating	Pressure loss	Pressure oscillation
ft^3/h	in w.g.	in w.g.
Not exceeding 5 000 (140 m^3/h)	0.5	0.3
Exceeding 5 000 (140 m^3/h) but not exceeding 20 000 (566 m^3/h)	0.8	0.4
Exceeding 20 000 (566 m^3/h)	1.0	0.4

10.4 Noise. The meter shall be quiet in operation.

11 Mechanical strength

11.1 The meter shall withstand a load of 175 lb, applied without shock, to any 4 in^2 of the top panel for one minute. When the load is removed, the meter shall not be deformed; it shall also not leak externally when subjected to the test required under **8.1**.

11.2 The index window when assembled in the meter shall withstand the impact of a $^7/_8$ in diameter steel ball (44 g weight) dropped from a height of 15 in three times, striking the centre of the window and falling normal to its plane.

12 Finish

12.1 When a meter is required to be painted, the paint shall be of a good quality gloss finish, dark grey in colour to BS 2660[18] No. 9-097 or BS 381C[19] No. 632, or other colour as ordered, and it shall withstand the following requirements:

1) After 7 days, the painted meter (or sample part thereof), when tested by the method described in Appendix E, shall resist penetration. Any scratch shall be free from jagged edges of a width greater than 1 mm.

2) Following the previous test, the paint, when tested by the method described in Appendix F, shall not show evidence of lifting, blistering or deterioration of the paint finish after a minimum of 4 days' exposure.

NOTE This test may be carried out on a second sample or on the original sample with the scratch protected.

3) After the test 2) a repeat scratch test is applied as indicated in Appendix F.

13 Transit disk

13.1 The meter shall be provided with suitable disks to prevent the entry of foreign matter in transit and storage.

14 Marking

14.1 Inlet. The meter shall bear the word "Inlet" as near as possible to the inlet connection, either in the form of an embossed metal badge or embossed on an appropriate panel of the meter.

14.2 Escape, property and maker. Other markings shall take the form of badges shown in Figure 9, Figure 10 and Figure 11 and be attached to the front of the meter. The escape badge, Figure 9, is required only when the meter is painted. This badge may be of the transfer or self-adhesive type, with black and red letters on a yellow background.

The property and maker's badges, Figure 10 and Figure 11, shall be embossed in metal and soldered to the meter case, the solder being continuous around the edges of each badge.

14.3 Synthetic diaphragms. A meter provided with synthetic diaphragms shall be marked with a yellow transfer, to the right of the index, carrying the letter "S" in black and of minimum height 1 in.

14.4 Special conditions. The meter shall be suitably and permanently marked if it is designed for use on a gas other than gas containing aromatic hydrocarbons, where special conditions apply. Such marking, e.g. "Suitable for Natural Gas", shall be printed in $^1/_4$ in high black letters on a yellow background and fitted to the right of the index.

NOTE This marking is additional to the requirement in **14.3**.

[18] BS 2660, "*Colours for building and decorative paints*".
[19] BS 381C, "*Colours for specific purposes*".

Appendix A Method of ordering

This British Standard specifies case sizes but leaves room for improvements in manufacture leading to higher badged ratings. It also dispenses with the description "Small Case" and "Super Small Case" and similar terms.

To ensure uniformity, the following method of ordering is recommended:

Apart from the BS number, the information should be given in the following order, each item of it being separated by a solidus:

1) BS case reference number (see Table 1)
2) Badged rating (ft^3/h or m^3/h) (see **3.2** or **3.3**)
3) Size of connections (in) (see Table 1)
4) Flange or Connector socket (F or CS) (see Table 1)
5) (Applicable to ft^3/h meters only) Type of index (D — Dial type; N — Direct reading) (see **5.3.2**)
6) If required painted or unpainted (Ptd or Unptd) (see **12.1**)
7) Any special requirements (written in full)

Example. P.60/6000/4/CS/D/Ptd. to BS 4161, Part 2.

i.e. A P.60 case size meter with a 6 000 ft^3/h badged rating, 4 in connector sockets, dial type index, painted dark grey and complying with this standard.

Appendix B Accuracy test for registration (see 10.1)

B.1 Principle

A meter of the type covered by this specification should be tested for accuracy of registration by passing a known volume of air through it and comparing this volume with the volume as registered by the meter test dial.

This test should be carried out in a room having a controlled temperature of nominally 20 °C, but care must be taken to ensure that the temperature of the water in the holder, the ambient air and the meter under test does not differ by more than 1 degC.

B.2 Apparatus

A calibrated bell type holder, giving a pressure of 2 in w.g. and having sufficient capacity to allow at least one complete revolution of the test dial of the meter to be tested, or a calibrated positive displacement apparatus which will give at least equivalent results, is required for this test.

The holder or apparatus should be provided with a flexible tube to which the inlet of the meter can be connected. A similar flexible tube should also be provided for the meter outlet to permit the metered air to pass through a rate control valve, an ON/OFF control valve (hereinafter referred to as an outlet control) and hence to exhaust.

B.3 Procedure

After the meter has been stabilized to room temperature (Note. A period of three hours may be necessary for this) connect the flexible tubing to the meter inlet and outlet connections and pass sufficient room air through the meter to complete at least 100 working cycles of the diaphragms. Close the outlet control and close the holder outlet valve. Check the connections for soundness and, if sound, continue the test.

Open the outlet and outlet control valves and set the rate control valve to pass the required rate. When the test dial hand is positioned at a convenient point for reading, close the outlet control. Charge the holder with air. Note the scale reading of the holder. Open the outlet control and allow air to pass through the meter to complete one revolution of the test dial hand, then close the outlet control. Note the scale reading of the holder. Determine the volume of air which has passed by taking the difference between the two scale readings.

Calculate any inaccuracy of registration and express it as a percentage to the first place of decimals, i.e.

Percentage inaccuracy of registration =

$$\frac{\text{(Volume registered in one revolution of test dial hand} - \text{Actual volume of air passed)} \times 100}{\text{Actual volume of air passed}}$$

A negative answer indicates a slow meter and a positive answer a FAST meter.

In the case of a metric index where a test drum replaces a test dial, use sufficient revolutions of the drum to ensure adequate accuracy of measurements (see **5.3.3**).

Appendix C Tests for pressure loss and pressure oscillation (See **10.2** and **10.3**)

C.1 Apparatus

The apparatus described in Appendix B may be used when determining the pressure loss and the pressure oscillation of a meter. Both the inlet and outlet connections to the meter should be as large as possible to keep their pressure drop to a minimum. The pressure gauge described in Appendix D is used as a differential gauge by connecting the meter to its limbs.

C.2 Procedure

C.2.1 *Pressure loss.* Connect the differential pressure gauge close to the inlet and outlet of the meter by flexible tubing. Pass air through the meter at the required rate and observe the minimum and maximum readings of the gauge. Deduct the pressure loss caused by the inlet and outlet connections to the meter from the mean of the above minimum and maximum readings.

C.2.2 *Pressure oscillation.* Measure the pressure oscillation by recording the difference between the highest and the lowest readings of the differential gauge observed during the test for pressure loss.

If this exceeds the permissible pressure oscillation specified for a meter of that badged rating, disconnect the differential pressure gauge and connect its appropriate limb to the meter outlet. Measure the pressure oscillation by recording the difference between the highest and the lowest reading of the gauge.

Appendix D Requirements for the inclined pressure gauge (See **C.1**)

D.1 The design and the main dimensions for the inclined pressure gauge, in which di-butyl oxalate of 0.985 relative density is used, are shown in Figure 7.

Each new gauge should be calibrated with its glassware. It should be recalibrated if a new glass is fitted.

It is essential to level the gauge before calibration and use.

D.2 Cleaning

To clean the glass, drain the di-butyl oxalate and wash it out with carbon tetrachloride, benzene or petrol. Blow air through the tube to remove the solvent. Then wash the tube in strong washing soda solution or caustic soda solution. Flush the tube with tap water, rinse it with distilled water and dry it by means of an air stream.

Appendix E Paint scratch test [See **12.1** 1)]

E.1 Apparatus

For this test a suggested form of apparatus, in which a 1 mm diameter steel ball is mounted by soft soldering in a suitable housing, is shown in Figure 8. Another apparatus is shown in BS 1250-1[20)].

E.2 Procedure

Clip the crocodile terminal to an unpainted part of the meter and make good electrical contact. Draw the apparatus evenly over the surface under test at a speed of 3 to 4 cm/s, keeping it upright and pressed to the surface throughout the movement. If the indicator bulb lights, the surface is deemed to have been penetrated.

Clean the ball after each test and inspect it frequently to verify that it remains a 1 mm sphere.

Check periodically that the spring loading of 1 kg is accurate.

[20)] BS 1250, "*Domestic appliances burning town gas*", Part 1, "*General requirements*".

Appendix F Paint resistance to humidity test [See **12.1** 2)]

F.1 Apparatus

The apparatus consists of a closed cabinet, in which the relative humidity is maintained at approximately 100 % by cycling the temperature of a water bath continuously over a range from 42 °C to 48 °C thereby ensuring that copious condensation occurs on the samples under test.

Details of the cabinet and the temperature requirements are given in BS 3900, Part F2[21)].

F.2 Procedure

Paint the unprotected edges of any test sample which are not normally exposed in practice with a good protective paint. Vertically position the painted samples within the cabinet. Examine the samples after 48 hours and at the completion of the test for visual evidence of corrosion beneath the paint film or deterioration of this film.

After the samples have been finally removed from the cabinet, leave them to stand for 24 hours at room temperature. Then give them a further visual examination and a scratch test as described in Appendix E.

Appendix G Notes on case sizes

This British Standard gives the "Case reference number" for meters of each case size. For the guidance of those accustomed to referring to the case size in terms of a letter, the following table relating to both designations is given:

BS case reference no.	IGE letter designation for case size	IGE badged rating for case size	IGE case dimensions where different from BS case dimensions given in Table 1
		ft^3/h	
P.12	A	700	—
P.18	B	1 200	—
P.30	C	1 800	3 in (not 4 in) BSP flanges and connector sockets
P.60	D	3 000	4 in (not 6 in) BSP flanges Overall width $34^3/_4$ in only
P.90	E	4 500	4 in (not 6 in) BSP flanges and connector sockets. Overall width $42^1/_4$ in (not $42^3/_4$ in)
P.90	F	6 000	—
P.120	G	9 000	—
—	H	12 000	As P.150, but with 6 in (not 8 in) BSP flanges. Overall width $53^1/_2$ in only. Height of centre of connections $45^1/_2$ in (not $48^1/_2$ in)
P.150	J	15 000	—

Appendix H Conversion factors

Imperial to metric		Metric to Imperial	
1 in	25.4 mm	1 mm	0.039 4 in
1 ft	30.48 cm	1 cm	0.393 7 in
1 in^2	6.451 6 cm^2	1 l	0.035 3 ft^3
1 ft^3	28.316 8 dm^3	1 dm^3	0.035 3 ft^3
or	28.316 1 l	1 g	0.035 3 oz
1 oz	28.349 5 g	1 kg	2.204 6 lb
1 lb	0.453 6 kg		
1 oz/ft^3	3.05 g/dm^2		

[21)] BS 3900, "*Methods of test for paints*", Part F2, "*Resistance to humidity under condensation conditions*".

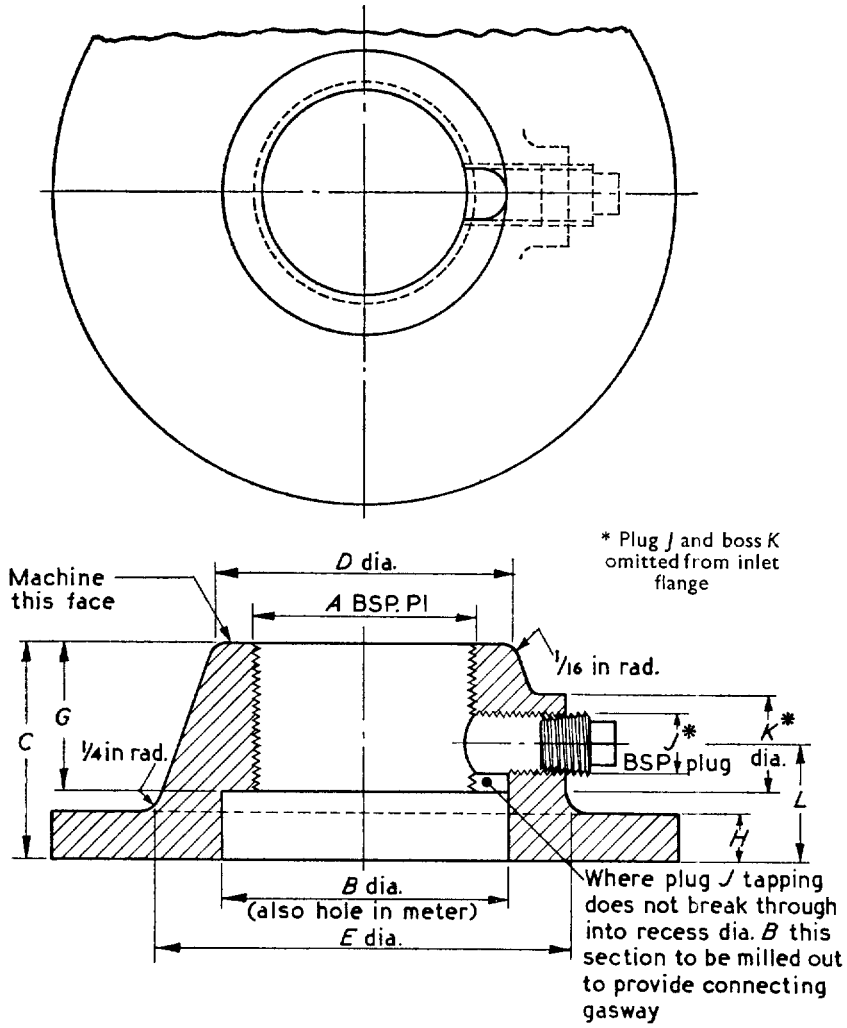


Table 6 — Dimensions in inches

1	2	3	4	5	6	7	8	9	10	11	12
BS case reference number	A	B	C		D	E	G	H	J*	K*	L
			min.	max.			min.				
P.12, P.18	3 BSP	4	$1\frac{7}{8}$	3	$4\frac{1}{2}$	$6\frac{1}{4}$	$1\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$1\frac{1}{4}$	$1\frac{1}{4}$
P.30, P.60	4 BSP	$5\frac{1}{4}$	$2\frac{3}{8}$	$3\frac{1}{2}$	$5\frac{1}{2}$	$7\frac{1}{2}$	$1\frac{3}{4}$	$\frac{5}{8}$	$\frac{1}{2}$	$1\frac{1}{4}$	$1\frac{1}{2}$
P.90 to P.150	6 BSP	$7\frac{1}{4}$	$2\frac{5}{8}$	$3\frac{3}{4}$	$7\frac{3}{4}$	$9\frac{1}{2}$	2	$\frac{3}{4}$	$\frac{3}{4}$	$1\frac{1}{2}$	$1\frac{3}{4}$

Dimensions not shown are arranged to suit meter

Figure 1 — Connector sockets

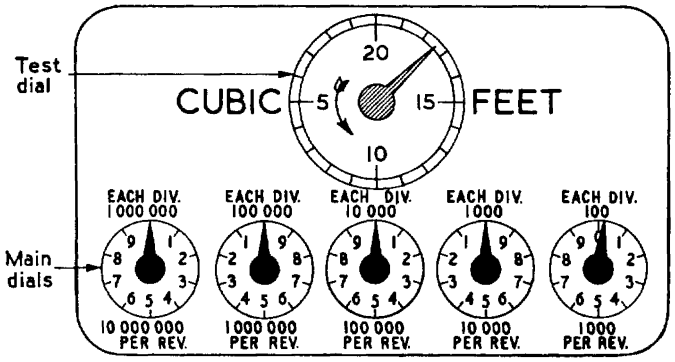


Figure 2 — Meter index, dial type, over 1 000 ft³/h up to 3 000 ft³/h badged rating (see 5.3)

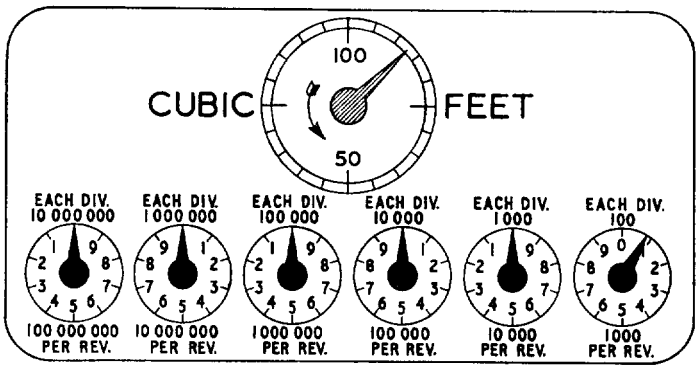


Figure 3 — Meter index, dial type, over 3 000 ft³/h badged rating (see 5.3)

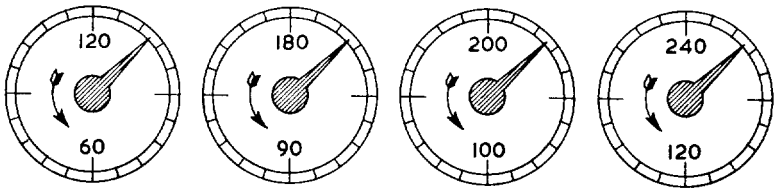


Figure 4 — Meter index; alternative test dials for meters having a badged rating over 15 000 ft³/h (see 5.3.2)

NOTE The test dial hand may rotate in either a clockwise or anti-clockwise direction. Its direction of rotation shall be indicated on the test dial.

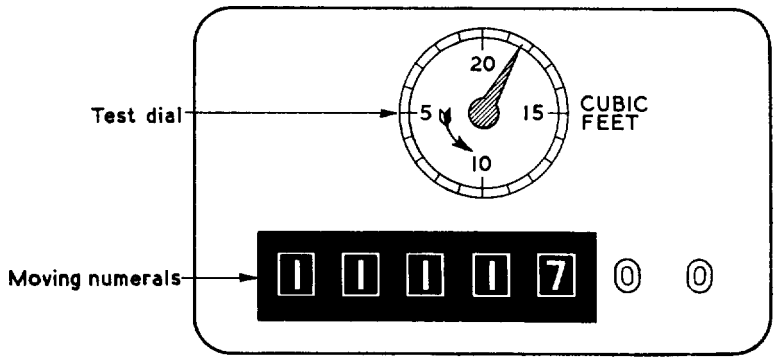


Figure 5 — Meter index, direct reading with test dial, over 1 000 ft³/h up to 3 000 ft³/h badged rating (see 5.3)

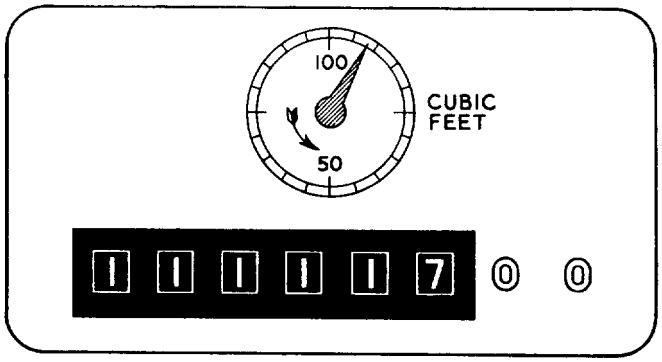


Figure 6 — Meter index, direct reading with test dial, over 3 000 ft³/h badged rating (see 5.3)

NOTE 1 For alternative test dials for meters having a badged rating over 15 000 ft³/h, see **5.3.2** and Figure 4.
NOTE 2 The test dial hand may rotate in either a clockwise or anti-clockwise direction. Its direction of rotation shall be indicated on the test dial.

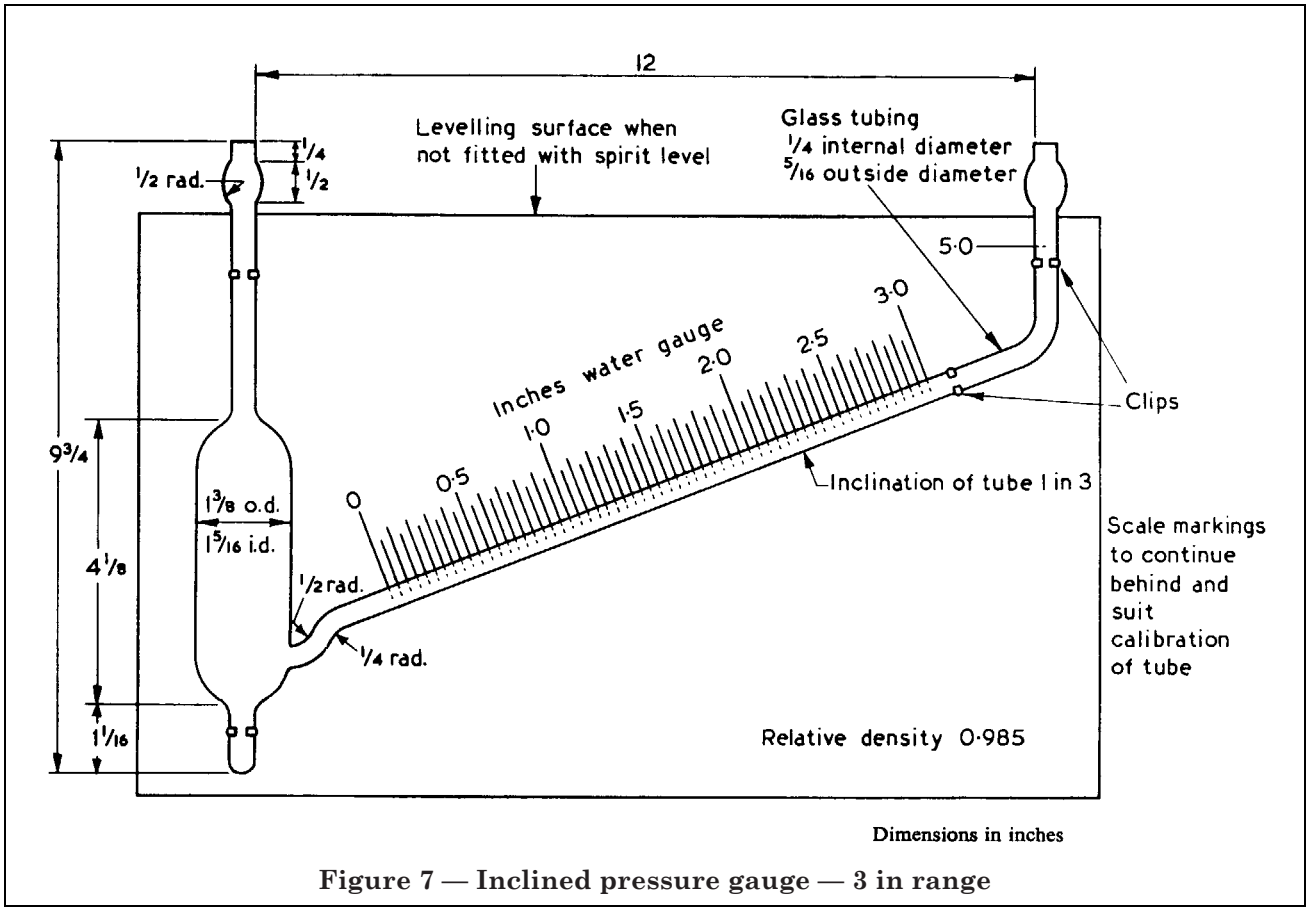


Figure 7 — Inclined pressure gauge — 3 in range

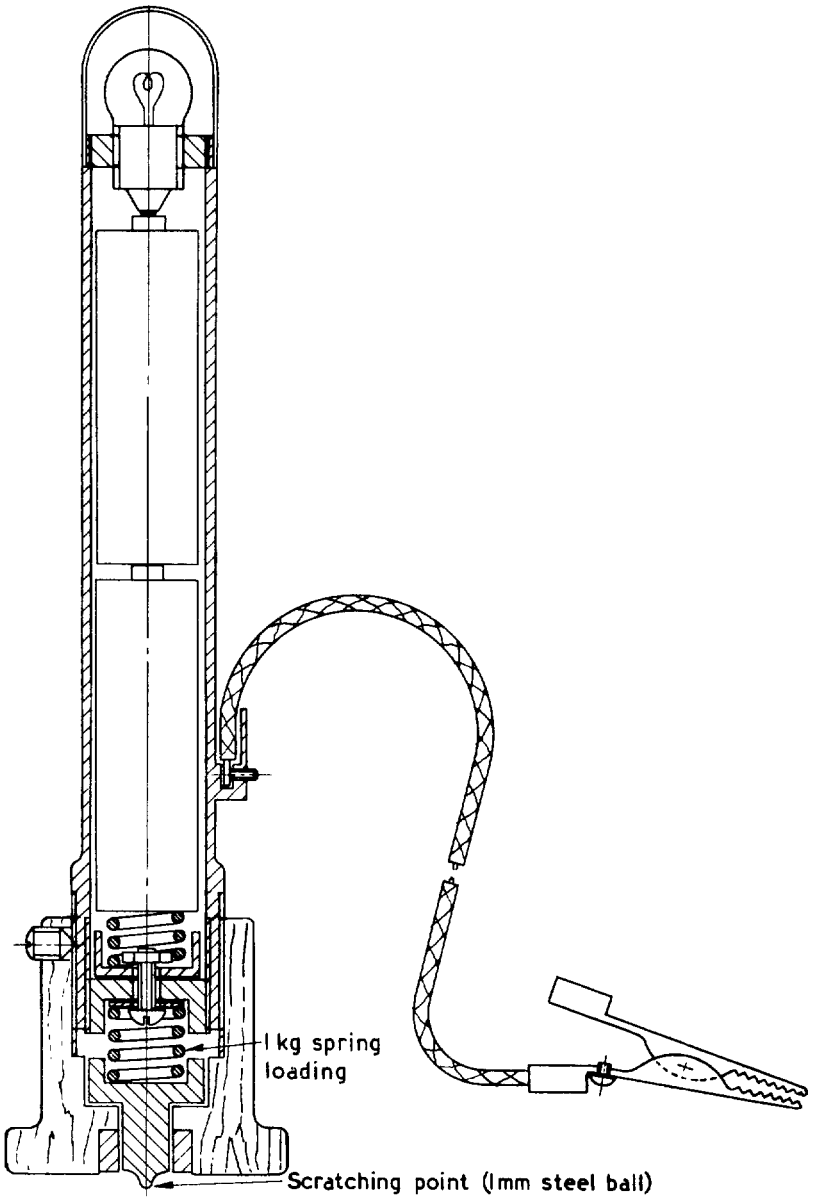


Figure 8 — Paint scratch test apparatus

Figure 9 — Escape badge

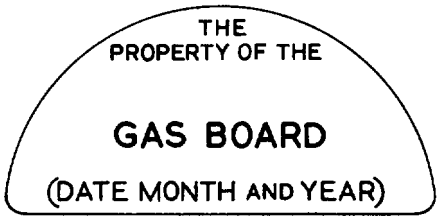


Figure 10 — Property badge

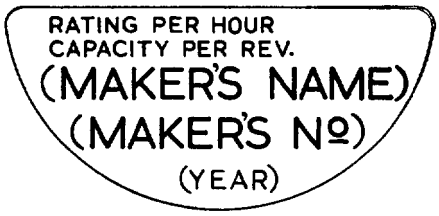
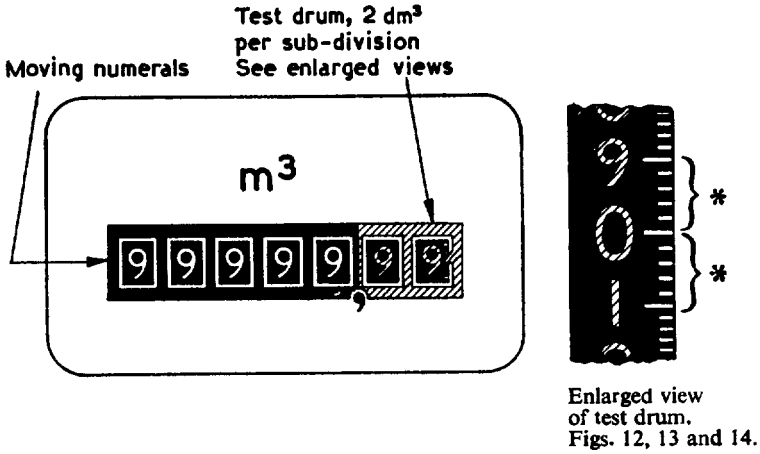


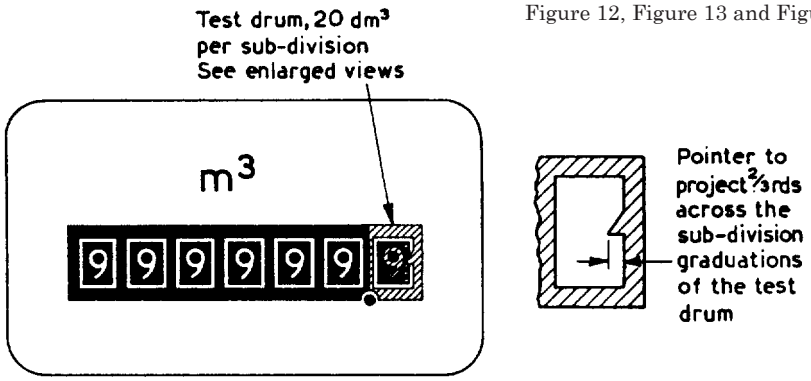
Figure 11 — Maker's badge



NOTE Red numerals on the drums recording in sub-multiples of m^3.

*Four sub-division graduations, each 1 mm (min.) apart, between each pair of unit division graduations.

Figure 12 — Meter index, direct reading with test drum from 28 m^3/h up to 100 m^3/h badged rating (see 5.3.1 and 5.3.3)



Enlarged view of test drum port hole, Figure 12, Figure 13 and Figure 14.

Figure 13 — Meter index, direct reading with test drum over 100 m^3/h up to 1 000 m^3/h rating (see 5.3.1 and 5.3.3)

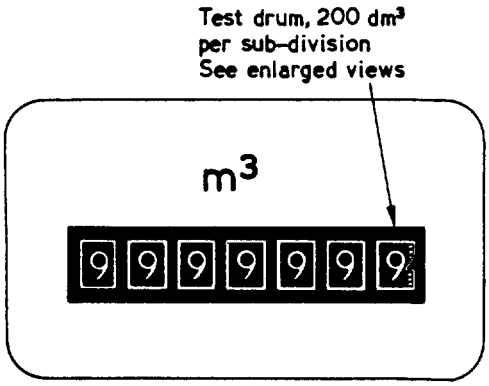


Figure 14 — Meter index, direct reading with test drum, over 1 000 m^3/h badged rating (see 5.3.1 and 5.3.3)

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