BRITISH STANDARD

BS 4161-1: 1967

Incorporating Amendment Nos. 1 and 2

Specification for

Gas meters —

Part 1: Meters of plate construction up to 1000 cubic feet per hour rating

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
21 April 1967

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

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449	February 1970	
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Contents

Foreword

This standard makes reference to the following British Standards:

BS 84, *Parallel screw threads of Whitworth form.*

BS 93, *British Association (B.A.) screw threads with tolerances for sizes 0 B.A. to 16 B.A.*

BS 249, *Leaded brass (58 % copper, 3 % lead) rods and sections (other than forging stock).*

BS 381C, *Colours for specific purposes.*

BS 746, *Gas meter unions and adaptors.*

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

BS 1250, *Domestic appliances burning town gas.*

BS 1250-1, *General requirements.*

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

BS 2797, *Leather for gas meter diaphragms.*

BS 2797-1, *E.I. sheep skin leather.*

BS 3900, *Method of test for paints.*

BS 3900-F2, *Resistance to humidity under condensation conditions.*

CP 331, *Installation of pipes and meters for town gas.*

CP 331-2, *Metering and meter control.*

This British Standard has been prepared under the authority of the Gas Industry Standards Committee and is the first part of a series relating to meters for gaseous fuels for registering the volume of gas consumed.

These meters may be used for metering gases other than gaseous fuels but the suitability of a meter for this purpose should be verified with the manufacturer.

Part 1 of this standard incorporates the Institution of Gas Engineers' specified domestic "D" series meters and the smaller industrial meters, all with two-pipe union connections to BS 746, "*Gas meter unions and adaptors*".

When combining these two ranges of meters it was necessary to replace the "D" letter reference, as an indication of domestic meter sizes, with another expression that would also cover the industrial meters and allow room for expansion with modern methods of meter manufacture and growing district demands for gas. The relationship between the old and the new case reference numbers is shown in Appendix N, and the method of ordering is given in Appendix A.

In preparing this standard full cognizance has been taken of the Institution of Gas Engineers' Specification for Domestic Gas Meters (1947 revision), Publication No. 319.

Further parts covering other capacities and types of gas meter are envisaged. Two of these are in course of preparation:

BS 4161-2, "*Meters of plate construction above 1 000 ft^3/h rating*", and
BS 4161-3, "*Unit construction meter of 212 ft^3/h (6m^3/h) rating*".

NOTE Factors for the conversion of British units to metric units are given in Appendix M. 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 25 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 General

1.1 Scope

1.1.1 This Part of BS 4161 covers the construction and performance of plate constructed, two-pipe connection credit meters up to and including 1 000 ft^3/h and prepayment meters below 400 ft^3/h for gaseous fuels up to 20 inch water gauge (in w.g.) working pressure.

1.1.2 Although case size meters smaller than the P.1 size are not mentioned in this standard, it is intended that such meters shall, apart from their test dial capacity, comply in general with the requirements of the standard.

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

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

1.2 Definitions

1.2.1 For the purposes of this British Standard, the definitions given in BS 1179[2)] apply.

1.3 Rating

1.3.1 The badged rating of the meter shall be a multiple of 50 ft^3/h and may be greater than the rating given in Appendix N, provided that the meter complies with the requirements for this specification.

NOTE The badged rating is the rate of air flow expressed in ft^3/h, at which the performance of a meter is certified by the manufacturer to be within statutory requirements or some other agreed requirement. This rate is indicated by a badge on the front of the meter.

2 Credit meters

2.1 Materials

2.1.1 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 use in that part of the meter in which they are used.

2.1.2 Tinning. All steel components, unless inherently corrosion resistant, shall be tinned as follows:

1) *Pretinned mild steel sheet for case and valve plate.* 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 0.000 5 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 its surface area (a coat thickness of 0.000 25 in).

2.1.3 Diaphragms. The diaphragms shall comply with the requirements of BS 2797-1 or BS 2797-2[3)] as appropriate. 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 2 in w.g.

The use of synthetic or reinforced synthetic diaphragms is not prohibited, but if such diaphragms are fitted they shall have a performance and useful life at least equal to that of dressed leather diaphragms and shall withstand the test requirements of Appendix B.

2.1.4 Index window. The index window shall be of $^1/_4$ in (minimum) plate glass or material of equivalent properties.

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

2.1.5 Linkage. All linkage pivot bearings shall be made of corrosion and wear resistant material and where these bearings are not self-lubricating they shall be lubricated with a grease conforming to the requirements specified in **2.1.7**.

[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 2797, "*Leather for gas meter diaphragms*", Part 1, "*E.I. sheep skin leather*", Part 2, "*Split hide leather*".

2.1.6 Valves. The valve covers shall be made of graphited phenolformaldehyde or of a material having equivalent properties, such as wear resistance, breakage resistance and a low coefficient of friction. The material shall be self lubricating and resistant to warping.

The valve grids shall be made of an alloy of tin, antimony and lead.

2.1.7 Grease. Lubricating grease shall not contain solids unless the solids have lubricating properties. Metal soap-based grease shall not be used.

2.1.8 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 a design incorporating any other type of seal having an equivalent performance and useful life.

2.2 Design and dimensions

2.2.1 ***Case***

2.2.1.1 The meter case shall conform to the dimensions given in Figure 1 and Table 7 and shall be made of pretinned mild steel sheet assembled by soft soldering.

2.2.1.2 The total thickness of the tinned mild steel sheet shall be not less than that shown in Table 1.

Table 1 — Case thickness

BS case reference number[a]	Total thickness of tin and steel (minimum)
	in
P.1 and P.2	0.027
P.4	0.031
P.7	0.035

[a] See Table 7.

2.2.1.3 When an internal pressure of 20 in w.g. is applied to the meter, each panel shall not flex at its centre by more than 0.008 in for each inch of its shortest side.

2.2.1.4 The outlet shall have a pressure test point in the form of a nipple conforming to Appendix C, screwed and soldered through the side pipe and the union boss, in the position shown in Figure 2.

2.2.1.5 The meter shall be supported by four feet firmly attached to the case. The feet shall be sealed around their securing joints to prevent the entry of water. They shall not cover a soldered seam and should preferably not be positioned under a flag rod bearing.

2.2.1.6 The meter shall withstand a load of 175 lb, applied without shock to any 4 in^2 of the top panel for one minute, and after removal of the load it shall not show deformation, nor shall it leak when subjected to the test required under **2.6**.

2.2.1.7 There shall be working clearance between moving components and all sections of the case, and between moving components not intended to make contact. These clearances shall make allowance for resetting of the tangent.

2.2.2 ***Index***

2.2.2.1 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 atmosphere by a small hole in the frame and positioned to prevent the entry of water.

2.2.2.2 The index shall have black printing on a white background and be of the dial or the direct reading type conforming to Figure 4, Figure 5, Figure 6 or Figure 7.

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

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

2.2.2.5 The individual requirements for both types are:

1) *Dial type.* The index shall have a test dial of diameter $1\ ^3/_{16} \pm\ ^1/_{16}$ in, positioned and subdivided as shown in the appropriate Figure 4 or Figure 5. The hand of this dial shall rotate in an anti-clockwise direction and its direction of rotation shall be indicated. The hand shall be red and be of sufficient length to indicate centrally between the two circles.

The index shall have five main dials of diameter $^5/_8 \pm\ ^3/_{64}$ in, arranged and sub-divided as shown in Figure 4 or Figure 5.

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

The hands of the main dials shall be black in colour, except that the hand of 10 ft^3 per division dial (Figure 4) shall be red. These hands shall indicate to the dial circumference.

2) *Direct reading type.* The index shall have a test dial. This test dial shall comply with the requirements of **2.2.2.5** 1) and be positioned and sub-divided as shown in the appropriate Figure 6 or Figure 7.

The recording numerals shall be arranged as shown in Figure 6 or Figure 7 and they shall cover the same range of consumption as the dial type index. A figure nought, or noughts, painted in red on a white background and in line with the aforementioned numerals, as shown in Figure 6 and Figure 7, shall be provided.

The numerals shall have minimum dimensions of $^{13}/_{64}$ in high and $^{5}/_{32}$ in wide and shall conform to the colours given in the code for Figure 6 and Figure 7.

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

2.2.3 ***Sealing gland assembly***

2.2.3.1 When dressed wads are used without any additional sealing material other than washers, the length of sealing space shall comply with Table 2 and the wads shall be under compression.

Table 2 — Sealing gland packing length

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

2.2.3.2 The threads of the gland nuts shall tighten in the direction of rotation of the spindle passing through them. For repair purposes, the gland nut of the index sealing gland shall be accessible from the outside of the gas carrying compartments of the meter.

2.2.3.3 The diameter of the spindle passing through the index sealing gland shall not exceed $^{3}/_{16}$ in.

2.2.4 Worm gear assembly. The assembly may be either of the following types:

a) *Self-lubricated type.* The gears shall either be enclosed or provided with a dust cover.

b) *Non-self lubricated type.* The gears shall be enclosed within a housing and lubricated with a grease conforming to the requirements specified in **2.1.7**. It shall be possible to apply the grease while the housing is fitted in the meter.

The assembly through its supporting members shall be firmly secured to the valve plate.

2.2.5 Diaphragm disk. The design of the diaphragm disks shall be such that there is no free movement of the diaphragm between the periphery of each pair of disks.

2.2.6 Valves. The valves shall be of the radial type, preferably, or straight type.

2.3 Assembly and workmanship

2.3.1 The interior of the meter shall be free from loose solder, swarf, grinding material and other foreign matter. All soldering flux or spirit shall be removed.

2.3.2 The diaphragm assembly shall be gas tight. The diaphragms shall be undamaged and free from puckers. Grease or other sealing medium shall not be applied to the diaphragm pans before assembling the diaphragms.

2.3.3 The assembled meter components shall have free and even movement.

2.3.4 Oil or other liquid shall not be applied to the valve covers or grids.

2.3.5 The inlet and outlet bosses shall be parallel to the vertical axis of the meter to within $1^{1}/_{2}°$.

2.4 Connections

2.4.1 Each meter shall be provided with an inlet and outlet boss complying with the requirements of BS 746[4)] of the size given in Table 7 of this specification.

2.4.2 The inlet shall be at the left-hand side of the meter as indicated in Figure 1.

2.5 Performance

2.5.1 Accuracy of registration. At the badged rating and at $^{1}/_{5}$ of this rating, the meter shall be accurate within the limits + 2 and – 3 % when tested on air by the method described in Appendix D.

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

2.5.2 Pressure loss. The mean pressure loss across the meter inlet and outlet bosses, when air is passed through the meter at its badged rating, shall not exceed 0.5 in w.g. when tested as described in Appendix E.

NOTE The pressure should be taken from points as close as practicable to the face of the bosses.

2.5.3 Pressure oscillation. When tested by the method described in Appendix E, the pressure oscillation at the badged rating and at $^{1}/_{5}$ of this rating shall not exceed 0.3 in w.g.

2.5.4 Noise. The meter shall be quiet in operation.

2.6 External leakage

2.6.1 When tested by one of the methods described in Appendix F, the meter shall not leak externally when subjected to an internal air pressure of 20 in w.g.

[4)] BS 746, "*Gas meter unions and adaptors*".

2.7 Internal leakage

2.7.1 The meter shall register when air is passed through it at the rate given in Table 3.

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

Table 3 — Internal leakage test rates

Badged rating	Air test rate
ft^3/h	ft^3/h
Up to 250	0.5
Above 250 and up to 750	1.0
Above 750 and up to 1 000	2.0

2.8 Finish

2.8.1 When a meter is required to be painted, the paint shall be of good quality, gloss finish, dark grey in colour to BS 2660[5] No. 9-097 or BS 381C[6] No. 632, or other colour as ordered, and it shall withstand the following requirements:

1) After 7 days, the paint, when tested by the method described in Appendix G, shall resist penetration. Any scratch mark shall be free from jagged edges of a width greater than 1 mm.

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

NOTE This test 2) may be carried out on a second sample, or on the previous sample used in 1) with the original scratch protected.

2.9 Transit cap

2.9.1 The meter bosses shall be provided with washerless screwed caps to protect the threads and prevent the entry of foreign matter during transit and storage.

2.10 Marking

2.10.1 The meter shall bear the word "INLET" as near as possible to the inlet connection, either in the form of an embossed metal badge securely fixed or embossed on the top panel of the meter.

2.10.2 Other markings shall take the form of badges shown in Figure 8, Figure 9 and Figure 10 and be attached to the front of the meter.

The escape badge, Figure 8, is only required when the meter is painted. This badge may be of the transfer type or self adhesive type with black and red letters on a yellow background.

The property and maker's badges, Figure 9 and Figure 10 shall be embossed in metal and firmly secured to the meter case. They shall be sealed around their edges to prevent the ingress of water.

2.10.3 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.

2.10.4 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. This marking is additional to the requirement in **2.10.3**.

3 Prepayment meters

3.1 General requirements

3.1.1 Compliance. The prepayment meter shall comply with the requirements of Sections 1 and 2 in addition to those of Section 3.

3.1.2 *Materials*

3.1.2.1 The tin coating on both sides of the prepayment attachment cover and the cash box shall have a combined minimum weight of 0.4 oz/ft^2 (a coat thickness each side of 0.000 33 in).

3.1.2.2 The front of the cash box may be of corrosion protected mild steel sheet, other than pretinned sheet, but the protection afforded against corrosion shall be at least equal to that given by a tinned coating of 0.4 oz/ft^2.

[5] BS 2660, "*Colours for building and decorative paints*".

[6] BS 381C, "*Colours for specific purposes*".

3.1.2.3 The prepayment valve pad shall be of leather complying with the requirements for leather diaphragms as specified in **2.1.3**. The use of a moulded synthetic rubber pad is not prohibited provided it will give at least an equal performance and have as useful a life. It shall withstand the rubber swelling test described in BS 746[7)].

3.2 Design and dimensions

3.2.1 External dimensions. The assembled meter and prepayment attachment shall conform to the dimensions in Table 7.

3.2.2 Prepayment attachment. On any prepayment meter of a given size it shall be possible to exchange the attachment type for type but accepting different coin values without unsoldering joints.

3.2.3 Prepayment valve. Means shall be provided to prevent foreign matter falling directly onto the prepayment valve.

3.2.4 Sealing glands. The prepayment valve and the attachment drive sealing glands shall comply with the requirements of **2.2.3** with minimum lengths of sealing space of $^{3}/_{8}$ in and $^{3}/_{4}$ in respectively. For repair purposes the gland nut of these sealing glands shall be accessible from the outside of the gas carrying compartments of the meter.

The spindle passing through the attachment drive sealing gland shall not exceed $^{5}/_{32}$ inch in diameter.

3.2.5 ***Mechanism***

3.2.5.1 Each subdivision of the prepaid indicator scale shall indicate not more than 25 ft^3 when the meter is for use with gas having a calorific value in the order of 500 Btu/ft^3. The subdivisions for meters for use with a gas having a calorific value in the order of 1 000 Btu/ft^3 or more shall be by arrangement between the manufacturer and the purchaser.

3.2.5.2 The prepaid scale and the mechanism to which it is attached shall be such that it is possible to prepay for at least 1 000 ft^3 when the meter is for use with gas having a calorific value in the order of 500 Btu/ft^3. When the meter is required for use with a gas having a calorific value in the order of 1 000 Btu/ft^3 or more, the prepayable volume shall be by arrangement between the manufacturer and the purchaser.

3.2.5.3 While a coin is in the coin carrier it shall not be possible to ratchet the mechanism to add to the prepaid volume.

3.2.5.4 A clutch or other overload device shall be provided to prevent any damage to the mechanism which could otherwise occur should the meter continue to register when the prepayment valve has nominally closed.

3.2.5.5 A stop device in the mechanism shall prevent the insertion of further coins when the prepaid indicator shows "FULL".

3.2.5.6 It shall not be possible to operate the mechanism with any current British coins other than those for which it is designed and then only when these are presented in a proper manner.

3.2.5.7 The overall length of the coining lever shall not exceed 3 in and the total maximum torque applied to the ends of the lever to turn it, excluding coin ejection, shall not exceed 6 lbf in. The coin ejection shall not increase this torque beyond 9 lbf in.

3.2.6 ***Coin carrier***

3.2.6.1 Where a prepayment mechanism is required to accept coins of two values there should be only one coin slot.

After a coin is inserted in the coinplate, a shield shall close the coin entrance and shall complete the full insertion of the coin before any movement is transmitted to the mechanism.

3.2.6.2 The coinplate shall have a coin combination and a range according to Table 4, as ordered.

It shall be graduated and clearly marked with setting increments in accordance with Table 4.

Each coinplate shall fit only the appropriate mechanism, or the coin carrier shall bear an identification mark indicating the mechanism to which the coinplate should be fitted.

NOTE For the wording on the coinplate, see **3.5.2**.

3.2.7 Attachment frame. The attachment frame shall be provided with a window for viewing the prepaid indicator.

The frame, unless otherwise ordered, shall be fitted with a hasp conforming to Figure 12 to retain the cash box.

7) BS 746, "*Gas meter unions and adaptors*".

Table 4 — Coinplate range

Approximate calorific value of the gas, Btu/ft³	Increments, ft³ per shilling	Range, ft³ for a shilling		Coin combination (as ordered)			
		From	To	1/-	6d. and 1/-[a]	1/- and 2/-	2/-
500	12[a]	36 or less	288 or more	[b]	[b]	—	—
500	6	18 or less	144 or more	[b]	—	[b]	[b]
1 000 or more	3	9 or less	72 or more	[b]	—	[b]	[b]
2 000 or more	By arrangement with the manufacturer						

[a] Non-preferred.
[b] Obtainable.

3.2.8 ***Cash box***

3.2.8.1 The cash box shall have a flat front not less than 0.062 in thick and the remainder of the box shall have a thickness of not less than 0.022 in. The cash box shall be free from sharp edges.

The cash box shall accept a hasp of the dimensions in Figure 12 or, if so ordered, be provided with an internal lock or a pocket for such a lock.

The dimensions of the internal lock pocket shall be such that the pocket will accept a lock having the dimensions given in Figure 13.

When the cash box is fitted, the assembly shall be such that:

1) *Hasp type.* With a $^{9}/_{32}$ in diameter rod inserted through the lockeye, the box front shall be close fitting and have the minimum of play; or

2) *Internal lock type.* With the lock bolted the box front shall be close fitting and have the minimum of play.

3.2.8.2 The cash box shall hold, at least once in the course of three attempts, a minimum of £35 in coins, or such an amount as may be agreed between the purchaser and manufacturer. The coins or combination of coins for which the attachment is designed shall be presented through the coinplate slot. It shall be possible to extract the box containing this value of coins.

3.2.9 Attachment cover. The attachment cover shall be of tinned mild steel sheet having a thickness of not less than 0.022 in.

It shall be securely fitted to the meter to prevent unauthorised access to the prepayment mechanism and the contents of the cash box.

3.3 Performance

3.3.1 General requirements. The performance requirements for the prepayment attachment shall be carried out using air. If the attachment is for use with two coins of different denominations, the smaller coin shall be used for the pressure loss test and both coins for the accuracy of prepaid volume test.

3.3.2 Accuracy of prepaid volume. When tested by the method described in Appendix J the prepaid volume shall be accurate within ± 2 % over a volume equivalent to at least one revolution of each coin wheel, or one coin wheel if the meter is for use with single value coins.

3.3.3 Pressure loss. The pressure loss shall not exceed 0.5 in w.g. at an air rate of 100 ft³/h when the prepayment valve is opened by one coin.

For this test the coinplate shall be set in accordance with Table 5, as appropriate.

Table 5 — Coinplate setting

Coinplate increments, ft³ per shilling	Setting, ft³ per shilling
12	48
6	24
3	12
Lower increments	By arrangement

3.3.4 Valve closing warning period. When tested by the method described in Appendix K the warning period shall not be less than 3 minutes and not more than 10 minutes when the meter has a coinplate with setting increments of 12 or 6 ft³ per shilling for use with gas having a calorific value in the order of 500 Btu/ft³. This warning period may be less when the meter has a coinplate with setting increments less than 6 ft³ per shilling.

3.3.5 Prepayment valve soundness. The prepayment valve when tested on air shall not allow air to pass at a rate greater than that shown in Table 3 when the prepayment valve is allowed to close normally and whilst the meter is still registering.

3.4 Finish

3.4.1 When the meter is ordered painted, the prepayment attachment cover and the exposed part of the cash box shall comply with the requirements of **2.8**.

3.5 Marking

3.5.1 Cashbox. The front of the cash box of a painted meter shall be provided with a transfer or self adhesive badge similar to that shown in Figure 11. The lettering shall be black on a yellow background.

3.5.2 Coinplate. The markings on the coinplate shall be permanent and shall include the words "Cubic feet per shilling". If ordered for two coins, the marking shall also indicate clearly the relationship between the volume of gas obtained per shilling and that to be obtained from the alternative coin.

Examples of marking recommended:

Cubic feet per shilling. Half quantity for 6d.

Cubic feet per shilling. Twice quantity for 2/-.

The coinplates shall be coloured in accordance with Table 6 to indicate the coins which it will accept; the colour being clearly distinguishable.

For any other coinplate coinage specially ordered, the identity colour shall be by arrangement between the manufacturer and purchaser, and shall not include any of the colours in Table 6 as a single colour, but the listed colours may be used in combination.

Table 6 — Coinplate identity colours

Coinage	Colour
1/- only	Yellow
6d. and 1/-[a]	Red
1/- and 2/-	Green
2/- only	Blue

[a] Non-preferred coin combination.

Appendix A Method of ordering

This British Standard specifies case sizes but leaves room for improvements in manufacture leading to higher capacities. With this in mind, and to ensure uniformity, the following method of ordering is recommended:

In addition to the BS number the information should be given in the following order, each item being separated from the next by a solidus:

1) BS case reference number (P) (see Table 7).
2) Credit or prepayment (Cr or Pp)
3) Badged rating (ft^3/h) (see **1.3**)
4) Nominal size of connections (in) (see Table 7)
5) Type of index (D for Dial type, N for Direct reading type) (see **2.2.2**).
6) Coinplate colour code (see Table 6) and (for prepayment meters only) increment (see Table 4)
7) Painted or unpainted (Ptd or Unptd) (see **2.8**)
8) Any special requirements (written in full).

Example (i) P.4/Cr/450/$1^1/_2$/D/Ptd. to BS 4161-1.

i.e. A 400 ft^3/h case size credit meter with a 450 ft^3/h badged rating, $1^1/_2$ in connections, dial type index, painted dark grey and complying with this standard.

Example (ii) P.2/Pp/200/1/N/ Green 6/Unptd to BS 4161-1.

i.e. A 200 ft^3/h case prepayment meter with 200 ft^3/h badged rating, 1 in connections, direct reading type index, 1/- and 2/- coinplate having 6 ft^3 per shilling setting increments, case unpainted and complying with this standard.

Appendix B Test requirements for synthetic diaphragms (See **2.1.3**)

NOTE Repeated inhalation of benzene vapour, even to a modest degree, can over a period of several months, result in fatal toxic effects. Any benzene process should be enclosed or carried out in a fume cupboard if practicable.

B.1 Chemical resistance

The diaphragms shall resist chemical attack and, if reinforced, delamination by any of the constituents of the gas for which the meter is intended, when exposed for a period of 100 hours.

B.2 Temperature effect on pressure loss and oscillation

When the meter is exposed to a variation in ambient temperature between – 10 °C and + 40 °C, the pressure loss and oscillation shall remain within the limits given in this specification.

B.3 Fatigue resistance

The diaphragm shall not show signs of cracking, perforation, permanent deformation or delamination after it has been subjected to ten million cycles of operation external to the meter. This cycling shall be effected by varying the pressure differential of the diaphragm by 0.5 in w.g. and the stroke shall be that which would be applicable when the diaphragm is incorporated in the meter for which it is designed. Air is used for the test.

B.4 Flexibility

When a meter fitted with a synthetic diaphragm is subject to a change of internal friction of the moving components the registration shall not be affected more than if it were fitted with a leather diaphragm.

B.5 Dimensional stability

(Additional requirement if the diaphragm is to be used in a meter for gas containing aromatic hydrocarbons). After a period of exposure of 100 hours working, at a minimum rate of flow of 10 ft^3/h, on a gaseous fuel, at a temperature of 18 ± 3 °C, containing $1^1/_4$ % by volume of benzene vapour and having a relative humidity of not less than 95 %, any change in diaphragm dimensions or flexibility shall not result in a change of meter registration on this test gas of more than ± 2 % at the badged rating.

For the purpose of this test, the initial registration at the badged rating shall be determined on the gaseous fuel before adding the stated benzene and water vapour.

Appendix C Schedule of requirements for the pressure test nipple for fitting on meters (See **2.2.1.4**)

C.1 Scope

This schedule deals with the requirements for the pressure test nipple for fitting to a meter to provide a temporary connection for a pressure test gauge.

C.2 Material

The nipple shall be made of brass conforming to BS 249[8)] Alloy CZ.121.

C.3 Design and dimensions

Each nipple shall conform in design and dimensions to Figure 3. As no tolerances are given all dimensions shall be worked to as far as practicable.

C.4 Threads

The thread in the body and on the screw shall be a No. 2 B.A. thread conforming to BS 93[9)]. The thread on the screw shall be a Normal class.

The thread on the body shall be a $^{5}/_{16}$ in B.S.F. conforming to BS 84[10)], Free class.

C.5 Design and dimensions

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 threads in the body and on the screw, and internal and external cones, shall be coaxial.

The nipple shall be free from burrs, sharp edges, swarf or other foreign matter.

C.6 Soundness

The assembled nipple with the screw turned to hand tightness shall be sound when subjected to an internal air pressure of 100 in w.g. while immersed in water. A smear of light oil may be applied to the cone seating.

Appendix D Accuracy test for registration (See **2.5.1**)

D.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 should 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.

D.2 Apparatus

A calibrated bell type holder maintaining 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 is provided with a flexible tube to which the inlet of the meter can be connected by means of an adaptor. A similar flexible tube and connecting adaptor should also be provided for the meter outlet boss. This outlet connection permits the metered air to pass through a rate control valve and an ON/OFF control valve (hereafter referred to as an outlet control) and hence to exhaust.

The inlet connecting adaptor should be as large as possible to keep its pressure loss to a minimum when a meter is tested at the maximum rate.

D.3 Procedure

Keep the meter in the room for a period of at least three hours before testing it for accuracy of registration. This test is carried out after the meter has passed the test required by **2.6**. In the case of dispute at least 10 ft^3 of room air should be passed through the meter prior to this test.

[8)] BS 249, "*Leaded brass (58 % copper, 3 % lead) rods and sections (other than forging stock)*"
[9)] BS 93, "*British Association (B.A.) screw threads with tolerances for sizes 0 B.A. to 16 B.A.*"
[10)] BS 84, "*Parallel screw threads of Whitworth form*".

Connect the adaptors to the meter inlet and outlet bosses. Close the outlet control and open the holder outlet valve. Leave the apparatus for two minutes. If the holder bell remains stationary during this period, showing that the connections to and from the meter are sound, continue the test.

Open the outlet control 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. Determine the volume of air 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.

$$\text{Percentage inaccuracy of registration} = \frac{(\text{Test dial reading} - \text{Actual volume of air passed}) \times 100}{\text{Actual volume of air passed}}$$

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

Appendix E Tests for pressure loss and pressure oscillation (See **2.5.2** and **2.5.3**)

E.1 Apparatus

The apparatus described in Appendix D may be used when determining the pressure loss and the pressure oscillation of a meter. The pressure gauge described in Appendix L is used as a differential gauge by connecting the meter to its limbs.

E.2 Procedure

E.2.1 *Pressure loss.* Connect the differential pressure gauge to the inlet and outlet of the meter by the adaptors. 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 these minimum and maximum readings.

E.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 F External leakage test (See **2.6**)

F.1 Method 1

F.1.1 *Apparatus.* An air supply or pump capable of supplying air up to 20 in w.g. is connected to a T-piece with a tap on its inlet. A suitable 20 in water column pressure gauge is connected to one of the T-piece outlets and means of connection to the meter inlet boss is provided on the other outlet. A suitable cap for sealing the meter outlet is also required.

F.1.2 *Procedure.* Connect the T-piece with the pressure gauge attached to the meter inlet boss and seal the meter outlet boss. Supply air to the meter through the tap on the T-piece, until a pressure of 20 in water column is registered on the pressure gauge.

Shut the tap. If at the end of one minute from the time of shutting off the tap no fall in pressure is registered in the next following two minutes, the meter is deemed to be sound.

F.2 Method 2

F.2.1 *Apparatus.* A 20 in w.g. air supply is connected to a bubble leak indicator, Figure 14, whose outlet is provided with a means of connection to the meter inlet boss. A means of sealing the meter outlet is also required.

F.2.2 *Procedure.* Connect the bubble leak indicator to the meter inlet and seal the meter outlet. Supply air to the meter through the main tap on the indicator and then open the taps to and from the glass tubes.

Shut the main tap. If at the end of one minute from the time of shutting off the main tap no bubble passes through the indicator in the next following two minutes, the meter is deemed to be sound.

Appendix G Paint scratch test [See **2.8.1** 1)]

G.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 15. Another apparatus is shown in BS 1250-1[11)].

G.2 Procedure

Clip the crocodile terminal to a meter boss. Draw the apparatus evenly over the surface under test at a speed of 3 cm/s 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.

Appendix H Paint resistance to humidity test [See **2.8.1** 2)]

H.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-F2[12)].

H.2 Procedure

Paint the unprotected edges of any test samples 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 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 G.

Appendix J Accuracy test for prepaid volume (See **3.3.2**)

J.1 Apparatus

A typical apparatus is shown in Figure 16. Its main features are an air flow restrictor and a pressure actuated switch in the air supply to the meter prepayment valve, and a motor to rotate the meter tangent and thus the index and prepayment attachment driving spindles.

The air supply is fitted with a pressure operated switch “A” to stop the motor should the supply fail; a governor to ensure a working pressure of approximately 2.5 in w.g.; a pressure operated switch “B” to stop the motor when a build up of pressure occurs in the prepayment valve box and a restrictor “C” to limit the rate of air flow into the prepayment valve box.

Included also is a pressure gauge to check the working pressure and a tap “D” to start and stop the test.

The motor, with a suitable clamp to hold the meter and carry the pulleys and revolutions counter, is arranged to revolve the meter tangent at approximately 200 rev/min.

J.2 Procedure

Remove the meter top panel and disconnect the top links from the tangent.

Position the meter and hold it in the clamp. Link the meter tangent to the pulley dog so that it will rotate freely and connect the meter inlet to the air supply.

Turn on the tap thus permitting the motor to start and the prepayment valve to close. The closing of this valve will stop the motor. Set the revolution counter at zero and insert a coin or coins in the coinplate. The motor will then rotate the meter tangent. When the motor stops note the number of revolutions made by the tangent and by calculation compare the prepaid volume with the volume hypothetically passed by the meter.

This may be repeated several times with further coins.

[11)] BS 1250, “*Domestic appliances burning town gas, Part 1, General requirements*”.
[12)] BS 3900, “*Method of test for paints*”, Part F2, “*Resistance to humidity under condensation conditions*”.

Appendix K Warning period test for prepayment valves (See **3.3.4**)

K.1 Apparatus

The apparatus required for this test is:

1) *Either* a test holder weighted to give an air supply pressure of 5 in w.g., *or* an air supply which can be maintained at a steady pressure of 5 in w.g.

2) An adaptor, for fitting to the outlet of a meter, and carrying a fixed orifice. The orifice size is such that it will pass 21 ft^3/h air at an inlet pressure of 4.9 in w.g. This pressure of 4.9 in w.g. makes allowance for a pressure loss of 0.1 in w.g. across the meter under test and the air rate of 21 ft^3/h is approximately equivalent to a gas rate of 30 ft^3/h, at a relative density of 0.5.

3) A pressure gauge conforming to the requirements of Appendix L with provision for measuring pressures between zero and 5 in w.g. and marked in steps of at least 0.1 in w.g. from zero to 3 in w.g.

K.2 Procedure

Connect the air supply to the meter inlet and the adaptor to the meter outlet. Connect the pressure gauge to the pressure test point on the meter.

Allow air to pass through the meter until it closes the prepayment valve. Then open the valve by inserting a coin in the coinplate with this plate set in accordance with Table 5. The pressure at the gauge under these conditions will remain at approximately 4.9 in w.g. until the valve nears its seating when it will commence to fall. Time the period it takes to fall from 2.5 in to 0.1 in w.g. This is the warning period.

Appendix L Requirements for the inclined pressure gauge [See Appendices **E.1** and **K.1** 3)]

L.1 General

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 17.

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

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

L.2 Cleaning

To clean the glass drain out 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 with distilled water and dry by means of an air stream.

Appendix M Conversion factors

British to metric		Metric to British	
1 in	2.540 cm	1 cm	0.393 7 in
1 in^2	6.451 6 cm^2	1 g	0.035 3 oz
1 ft^3	0.028 32 m^3	20 °C	68 °F
1 lbf in	0.011 5 kgf m or 0.113 0 N m	5 degC	9 degF
1 oz/ff^2	305 g/m^2		
1 Btu/ft^3	0.037 259 J/cm^3 or MJ/m^3		

Appendix N Notes on case sizes

The nomenclature standardized in this British Standard for the case size designation of meters is given as a "case reference number". For the guidance of those accustomed to the designation of meters in terms of the letter "D" followed by a suffix number or, with larger meters, by letters, the following table relating the nomenclature of both systems is given:

BS case reference number	I.G.E. designation	Original badged rating for these case sizes, ft^3/h
P.1	D.1	100
P.2	D.2	200
P.4	D.4	400
P.6	—	—
P.7	A/S	700

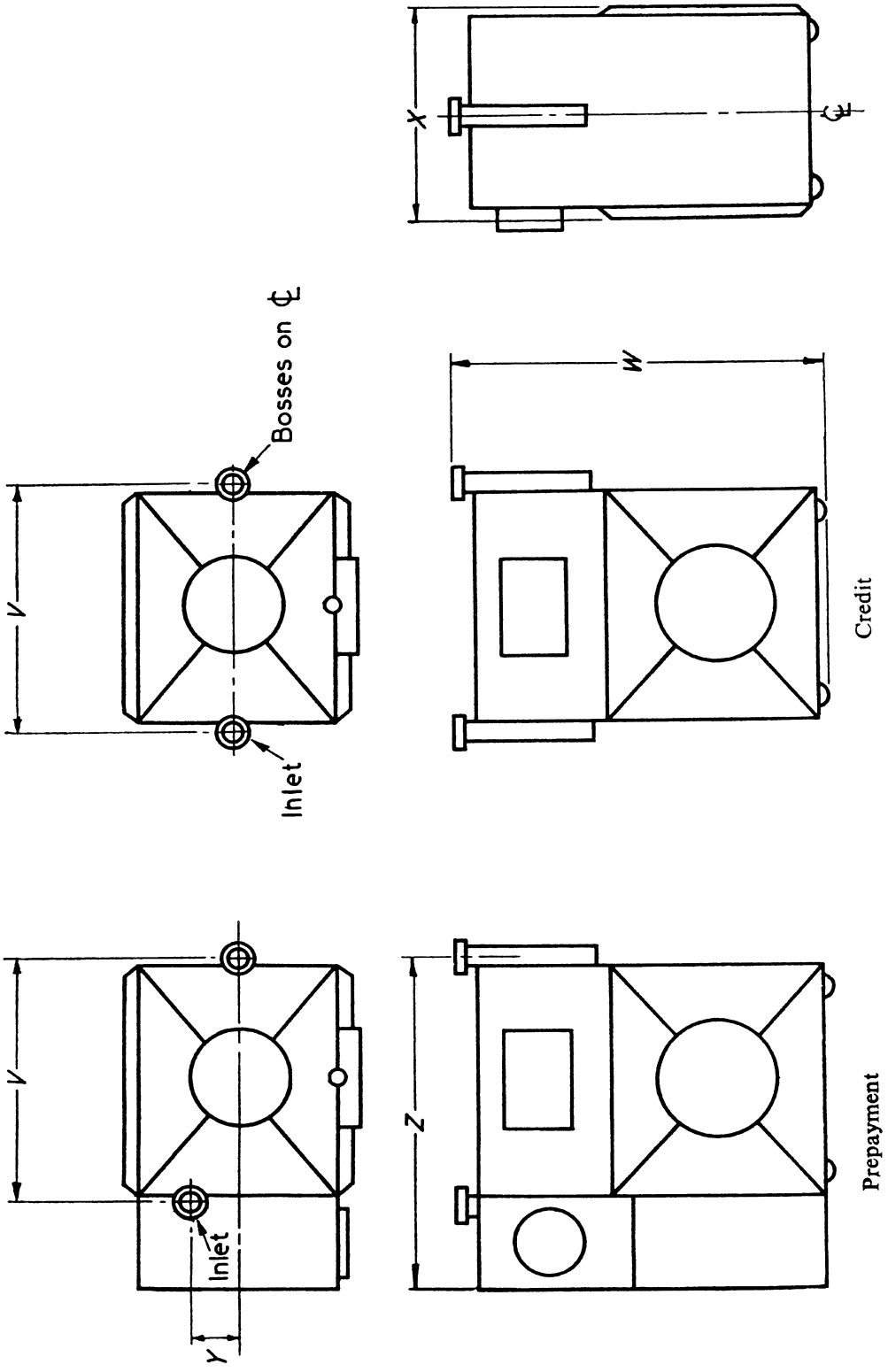


Figure 1 — Meter dimensions

Table 7 — BS case reference numbers and dimensions

BS case reference number	Nominal size of connections (inches)	Dimension of meter cases (inches)				
		V (width)	*W* (height)	*X* (depth)	*Y* (offset)	*Z* (width)
		Centre to centre of bosses	Including feet from ground to boss face	Back to front including panels but not bezel nor attached fittings	Prepayment meters only	
					Inlet boss, centre line meter to centre line of boss	Centre line of outlet boss to extreme left side of cash box
1	2	3	4	5	6	7
P.1	$^{3}/_{4}$	$8^{9}/_{32} \pm {}^{1}/_{8}$	$12 \pm {}^{1}/_{8}$	$7^{3}/_{8}$ max.	$2^{7}/_{16}$ max.	$12^{5}/_{16}$ max.
P.1	1	$8^{9}/_{32} \pm {}^{1}/_{8}$	$12^{3}/_{16} \pm {}^{1}/_{8}$	$7^{3}/_{8}$ max.	$2^{7}/_{16}$ max.	$12^{5}/_{16}$ max.
P.1	$1^{1}/_{4}$	$8^{5}/_{8} \pm {}^{1}/_{8}$	$12^{3}/_{8} \pm {}^{1}/_{8}$	$7^{3}/_{8}$ max.	$2^{7}/_{16}$ max.	$12^{5}/_{16}$ max.
P.2	1	$10^{15}/_{16} \pm {}^{1}/_{8}$	$15 \pm {}^{1}/_{8}$	9 max.	$2^{19}/_{32}$ max.	$15^{1}/_{32}$ max.
P.2	$1^{1}/_{4}$	$10^{15}/_{16} \pm {}^{1}/_{8}$	$15^{3}/_{16} \pm {}^{1}/_{8}$	9 max.	$2^{19}/_{32}$ max.	$15^{1}/_{32}$ max.
P.2	$1^{1}/_{2}$	$11^{13}/_{32} \pm {}^{1}/_{8}$	$15^{3}/_{8} \pm {}^{1}/_{8}$	9 max.	—	—
P.4	$1^{1}/_{4}$	$14^{1}/_{8} \pm {}^{1}/_{8}$	$18^{3}/_{4} \pm {}^{1}/_{8}$	$10^{3}/_{4}$ max.	—	—
P.4	$1^{1}/_{2}$	$14^{1}/_{4} \pm {}^{1}/_{8}$	$19^{3}/_{16} \pm {}^{1}/_{8}$	$10^{3}/_{4}$ max.	—	—
P.6	2	$17 \pm {}^{1}/_{4}$	$22^{1}/_{2} \pm {}^{1}/_{4}$	15 max.	—	—
P.7	2	$18^{3}/_{4} \pm {}^{1}/_{4}$	$25^{1}/_{4} \pm {}^{1}/_{4}$	15 max.	—	—

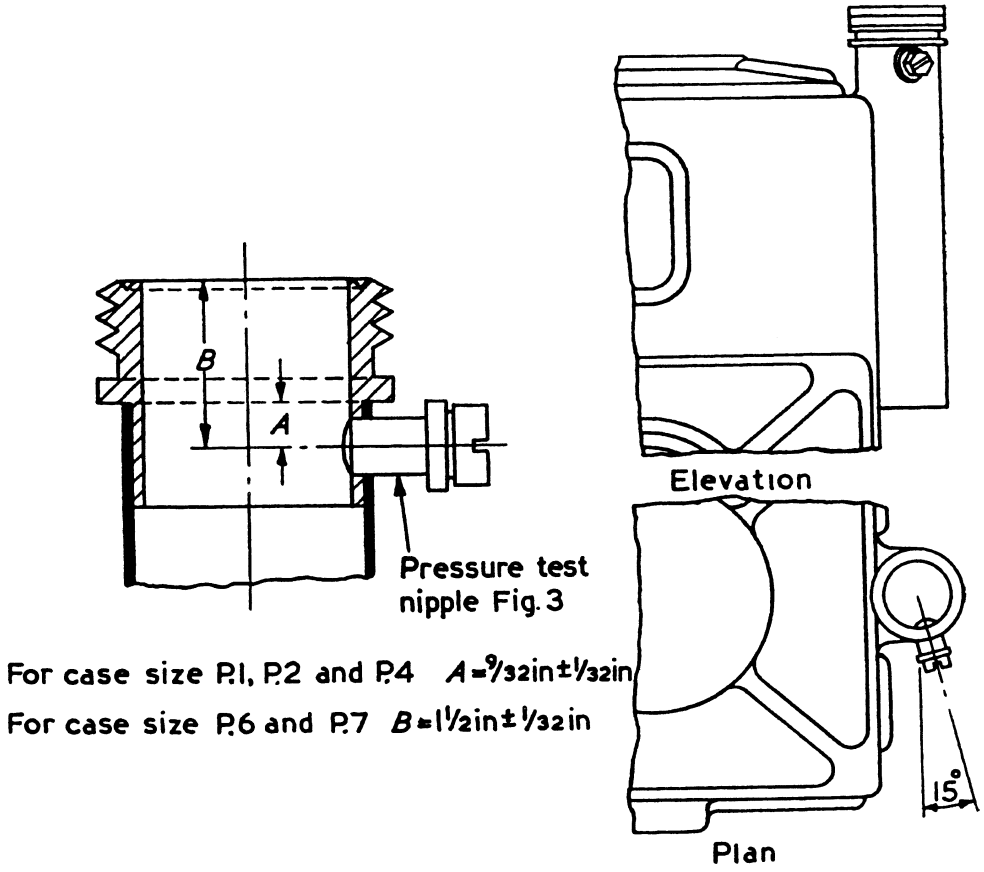


Figure 2 — Pressure test point position

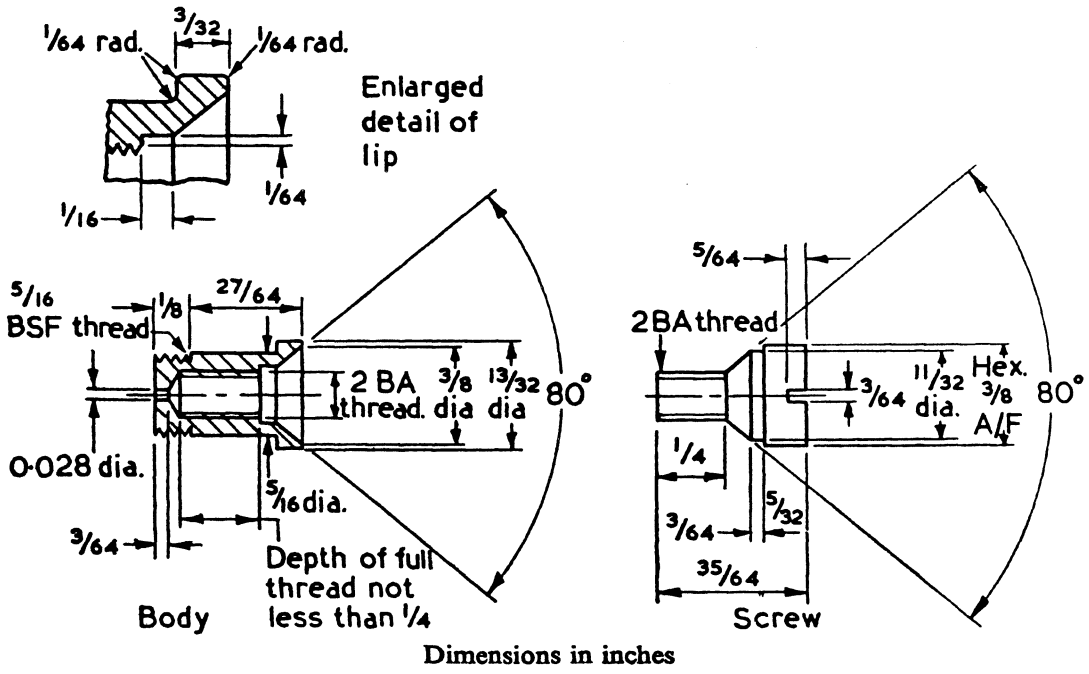


Figure 3 — Pressure test nipple

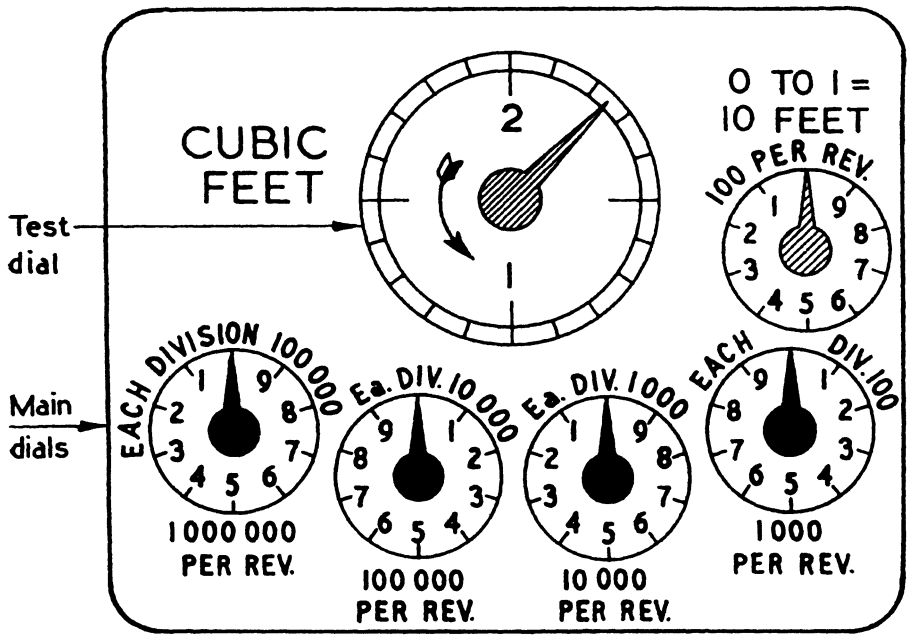


Figure 4 — Meter index, dial type, below 700 ft³/h badged rating

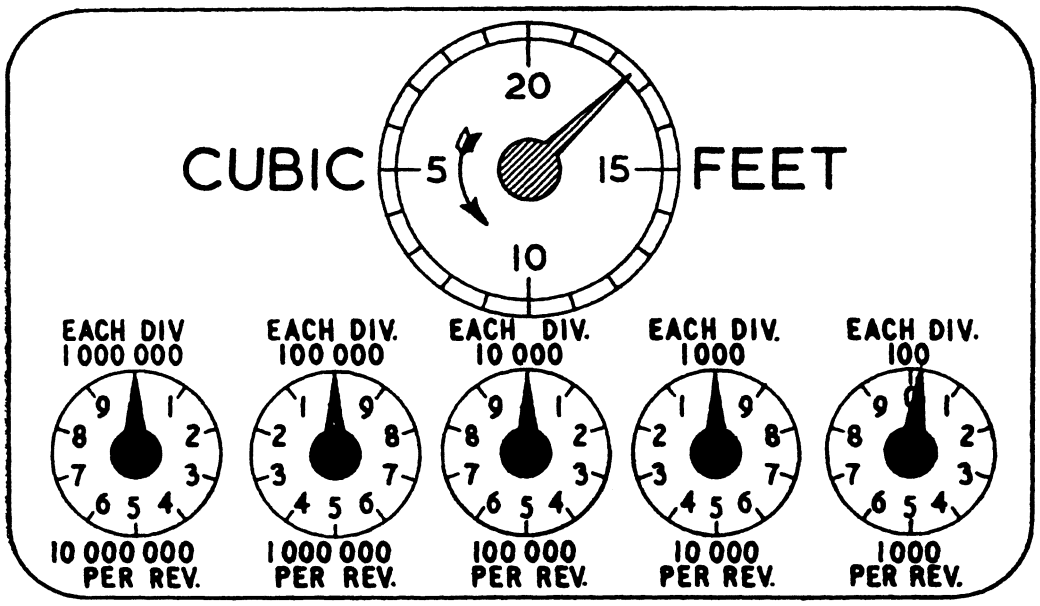
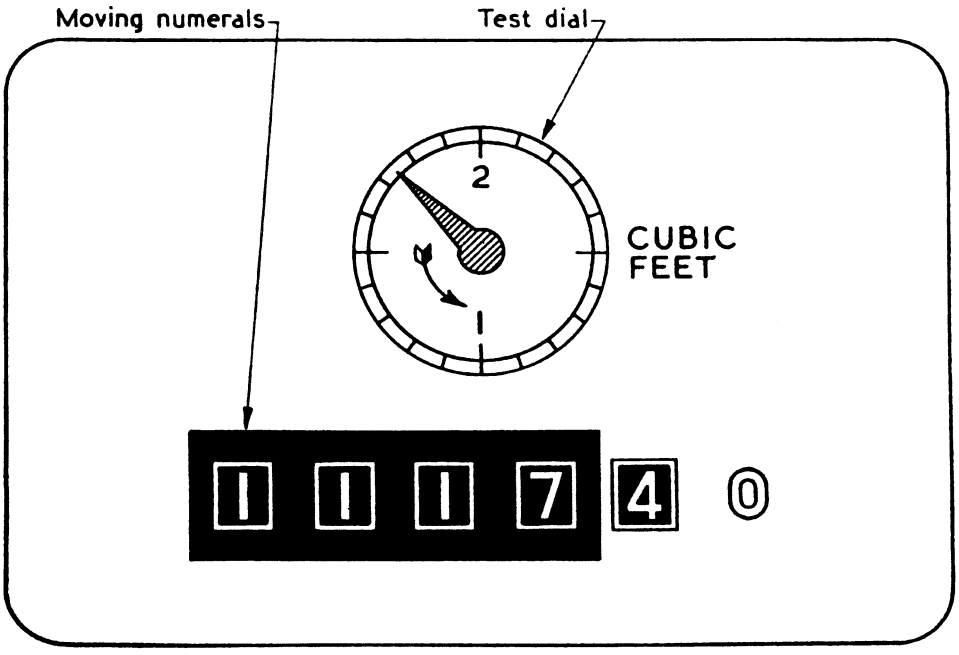


Figure 5 — Meter index, dial type, 700 to 1 000 ft³/h badged rating

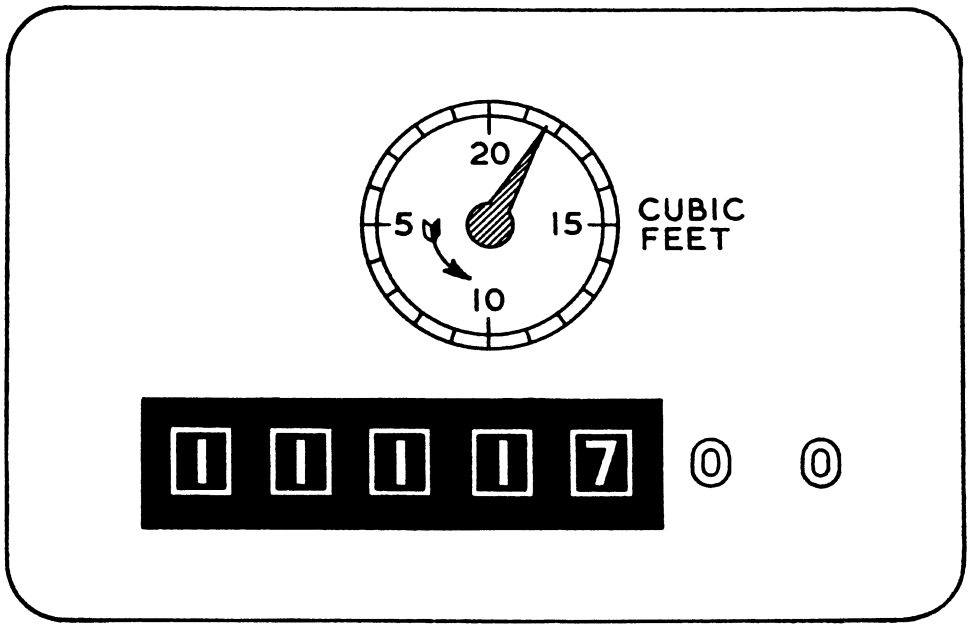


[a] *Colour code.* The moving numerals shown on Figure 6 have been chosen as a means of identifying the colours to be used for the index and these are as follows:

1 and 7 Black drum, white numerals, black visor.

4 Black drum, red numerals, no visor.

Figure 6 — Meter index, direct reading with test dial, below 700 ft³/h badged rating[a]



[a] *Colour code.* The moving numerals shown on Figure 7 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.

4 Black drum, red numerals, no visor.

Figure 7 — Meter index, direct reading with test dial, 700 to 1 000 ft³/h badged rating[a]

Figure 8 — Escape badge

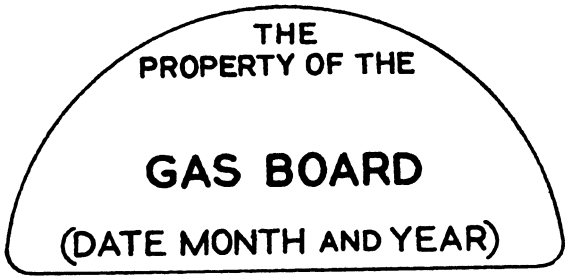


Figure 9 — Property badge

Figure 10 — Makers badge

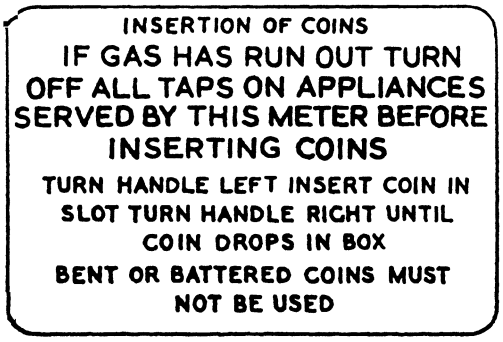
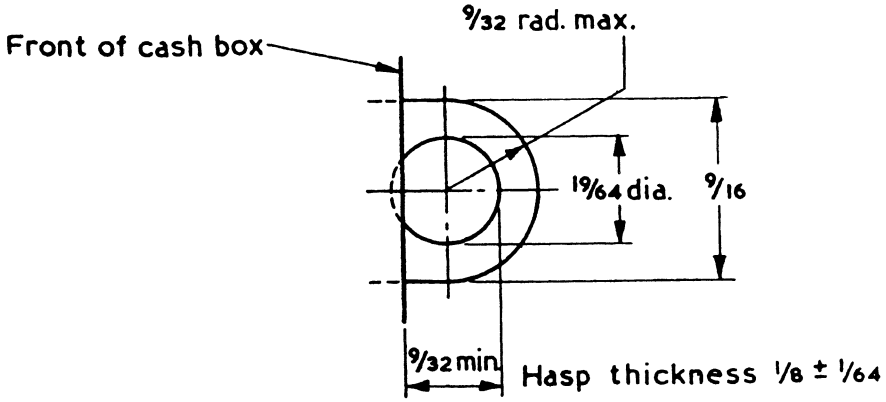


Figure 11 — Prepayment meter



Dimensions in inches

Figure 12 — Hasp of prepayment meter

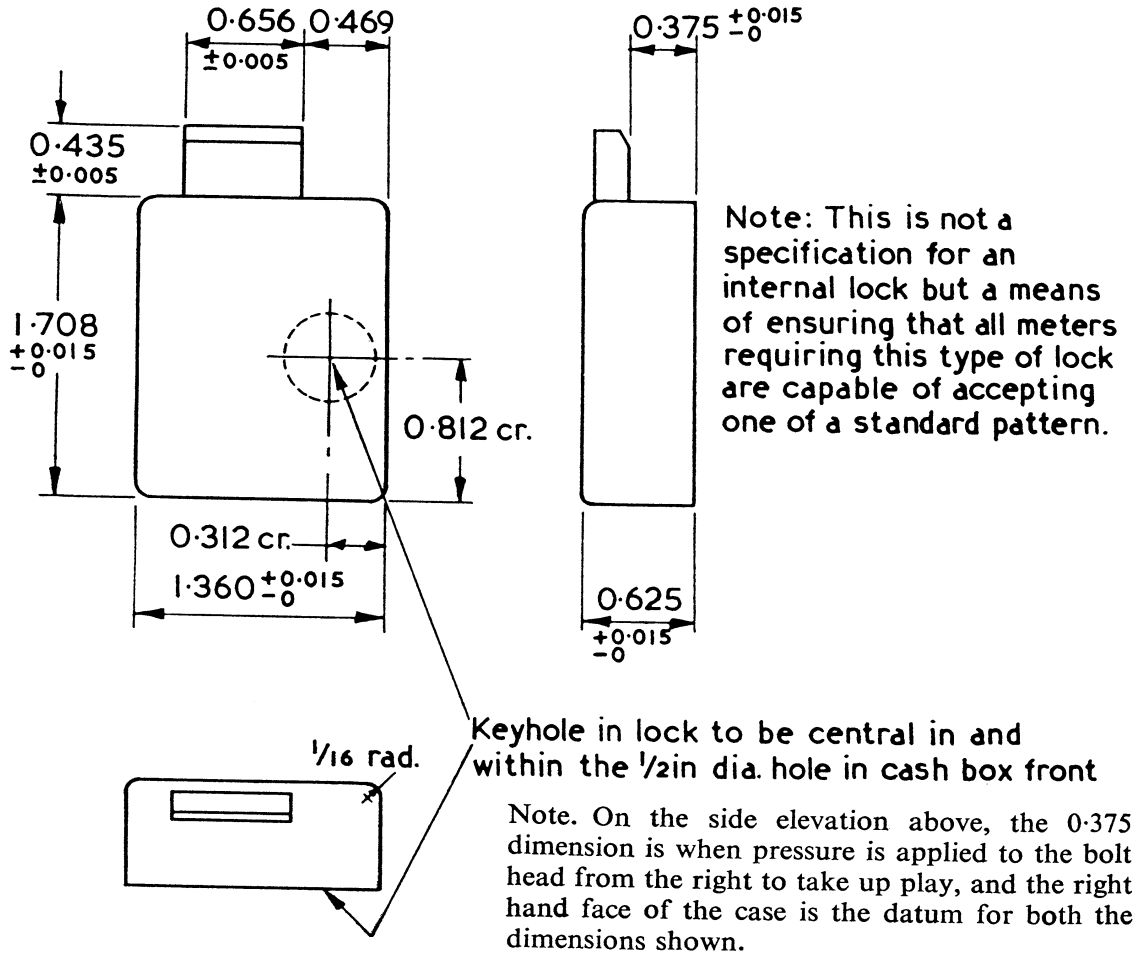


Figure 13 — Internal lock for prepayment meter

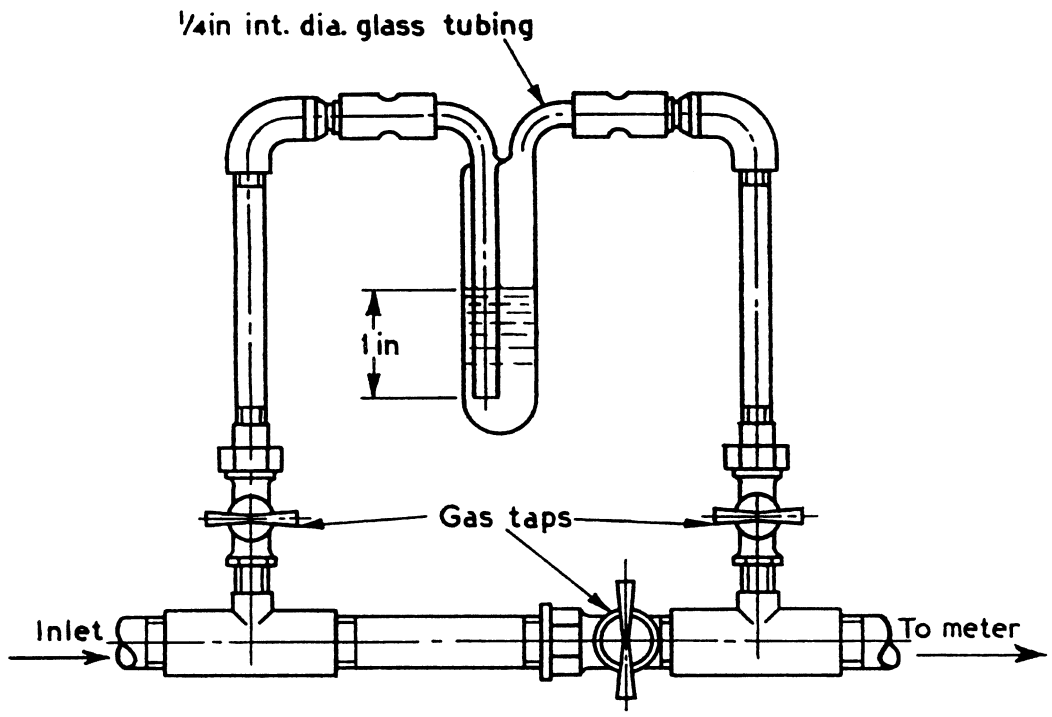


Figure 14 — Bubble leak indicator

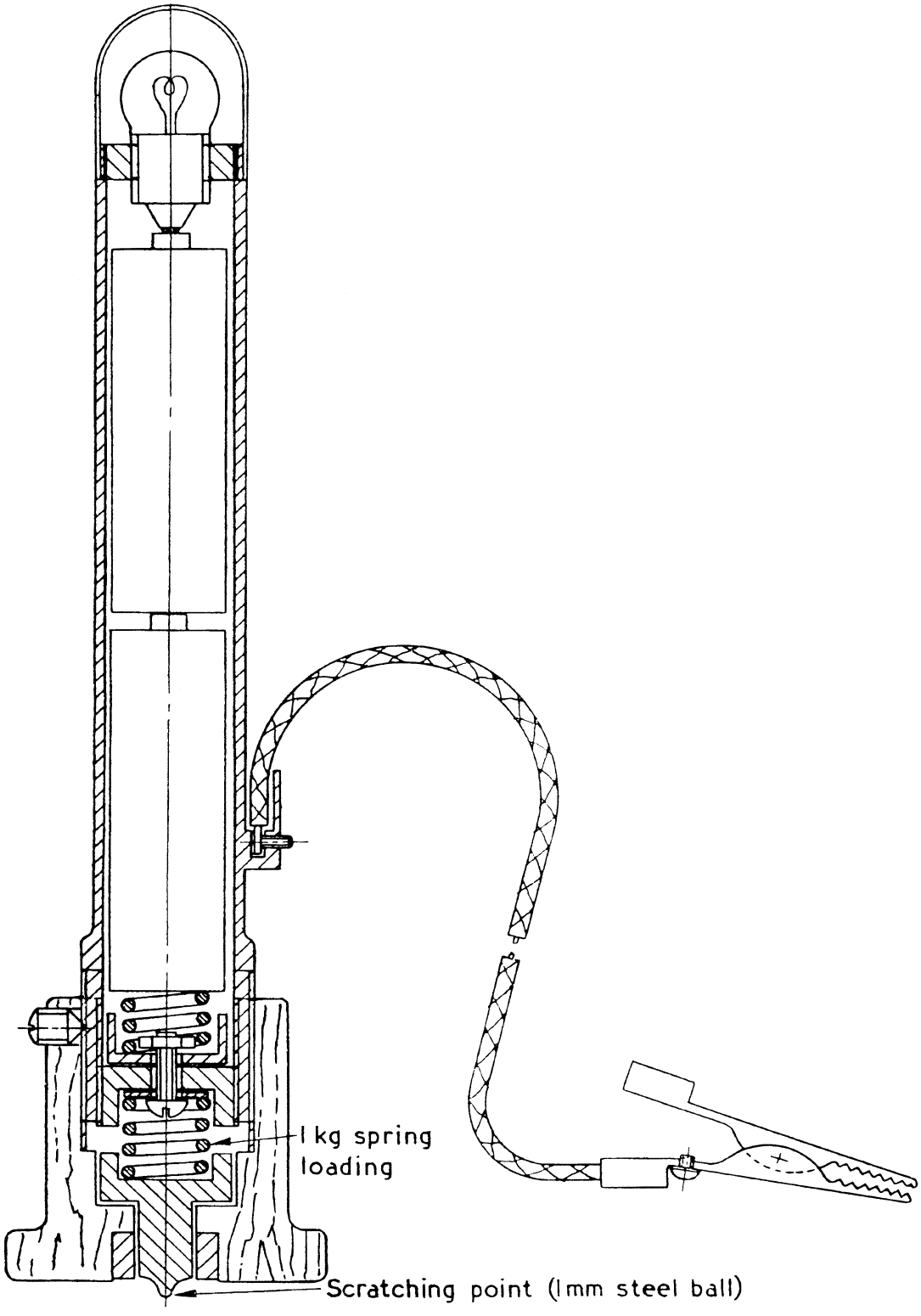


Figure 15 — Paint scratch test apparatus

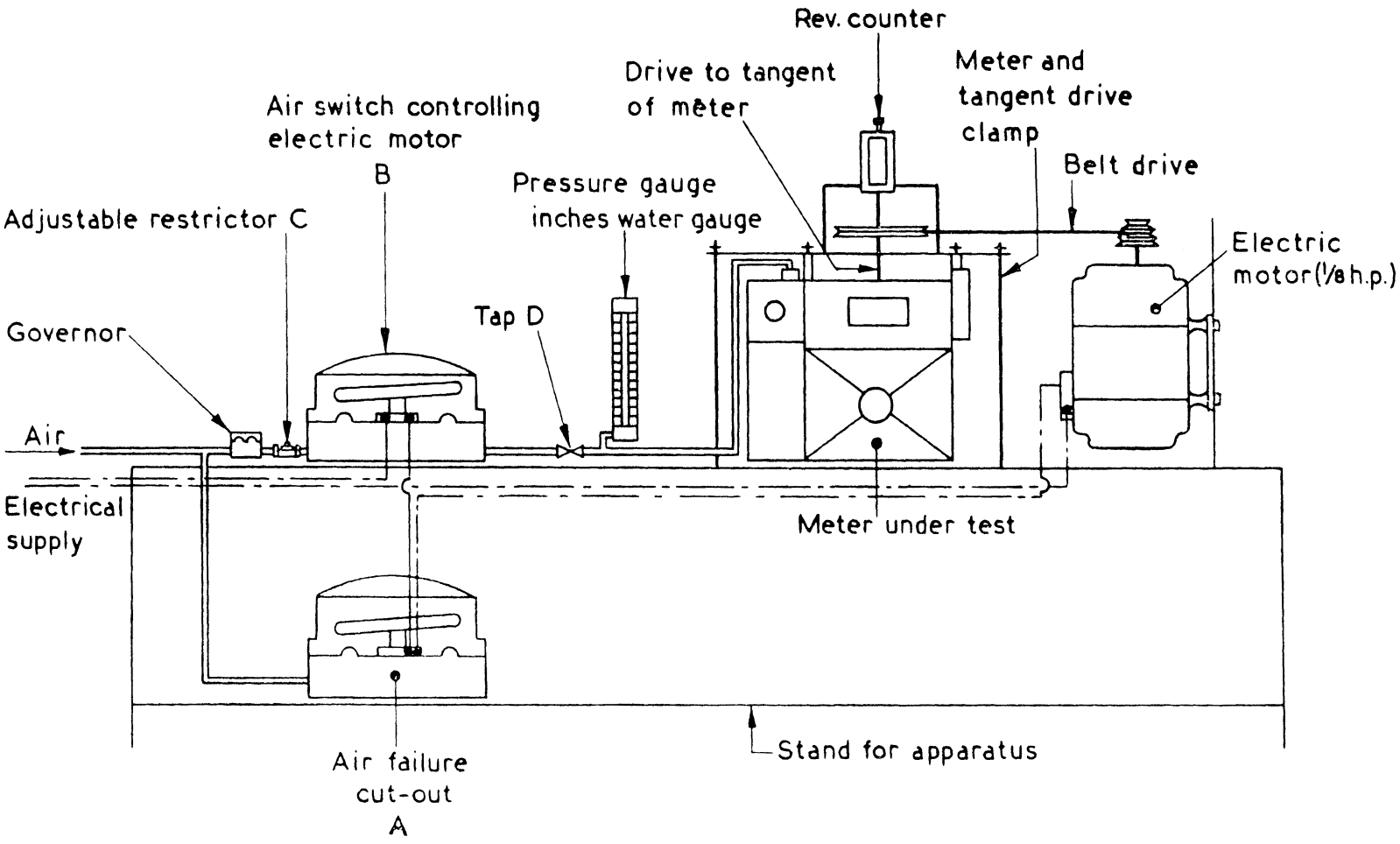


Figure 16 — Prepaid volume accuracy test apparatus

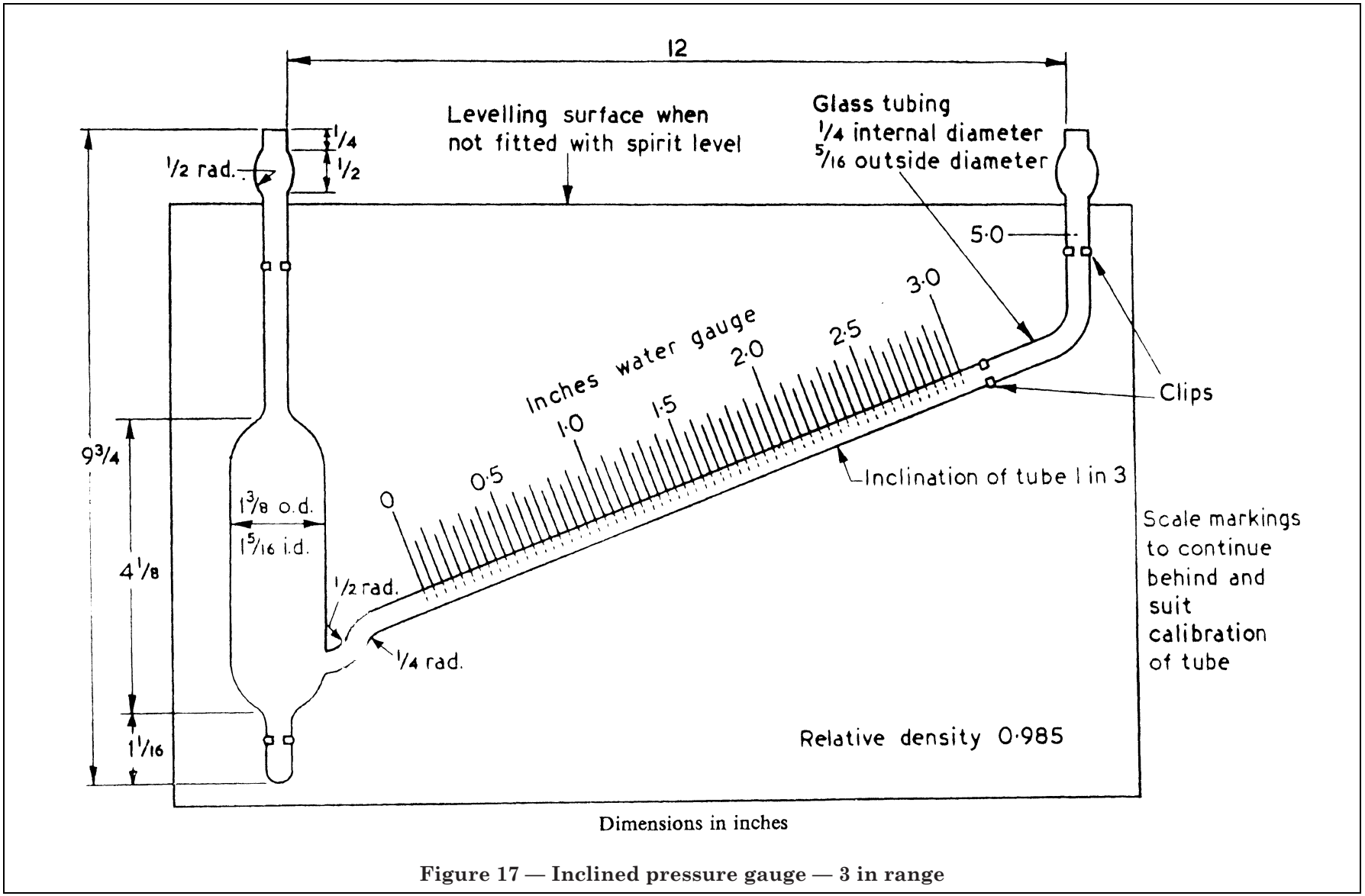


Figure 17 — Inclined pressure gauge — 3 in range

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