

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

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The following BSI references relate to the work on this standard:  
Committee reference GSE/25  
Draft for comment 66/5245

ISBN 0 580 09103 1

## Amendments issued since publication

| Amd. No. | Date of issue | Comments                              |
|----------|---------------|---------------------------------------|
| 449      | February 1970 |                                       |
| 4214     | April 1983    | Indicated by a sideline in the margin |
|          |               |                                       |
|          |               |                                       |

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## 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<sup>3</sup>/h rating*", and

BS 4161-3, "*Unit construction meter of 212 ft<sup>3</sup>/h (6m<sup>3</sup>/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<sup>3</sup>/h and prepayment meters below 400 ft<sup>3</sup>/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<sup>1)</sup>.

**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<sup>2)</sup> apply.

### 1.3 Rating

**1.3.1** The badged rating of the meter shall be a multiple of 50 ft<sup>3</sup>/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<sup>3</sup>/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<sup>2</sup> (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<sup>2</sup> (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<sup>2</sup> 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<sup>3)</sup> 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 <sup>1</sup>/<sub>4</sub> in (minimum) plate glass or material of equivalent properties.

The index window, when assembled in a meter, shall withstand the impact of a <sup>7</sup>/<sub>8</sub> 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.

<sup>1)</sup> CP 331, "Installation of pipes and meters for town gas", Part 2, "Metering and meter control".

<sup>2)</sup> BS 1179, "Glossary of terms used in the gas industry".

<sup>3)</sup> 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 <sup>a</sup> | Total thickness of tin and steel (minimum) |
|---------------------------------------|--------------------------------------------|
|                                       | in                                         |
| P.1 and P.2                           | 0.027                                      |
| P.4                                   | 0.031                                      |
| P.7                                   | 0.035                                      |

<sup>a</sup> 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<sup>2</sup> 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  $1\frac{3}{16} \pm \frac{1}{16}$  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  $\frac{5}{8} \pm \frac{3}{64}$  in, arranged and sub-divided as shown in Figure 4 or Figure 5.

The hand of the dial with the 100 ft<sup>3</sup> 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<sup>3</sup> 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  $\frac{13}{64}$  in high and  $\frac{5}{32}$  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) |
|--------------------------------------|-----------------------------------|
| Index                                | $\frac{3}{4}$ in                  |
| Internal glands between compartments | $\frac{3}{8}$                     |

**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  $\frac{3}{16}$  in.

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

- Self-lubricated type.* The gears shall either be enclosed or provided with a dust cover.
- 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  $1\frac{1}{2}^\circ$ .

### 2.4 Connections

**2.4.1** Each meter shall be provided with an inlet and outlet boss complying with the requirements of BS 746<sup>4)</sup> 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  $\frac{1}{5}$  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  $\frac{1}{5}$  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.

<sup>4)</sup> 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 |
|---------------------------|---------------|
| ft³/h                     | ft³/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<sup>5)</sup> No. 9-097 or BS 381C<sup>6)</sup> 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.

<sup>5)</sup> BS 2660, "Colours for building and decorative paints".  
<sup>6)</sup> BS 381C, "Colours for specific purposes".

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.

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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/ft² (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/ft².