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Specification for internal micrometers (including stick micrometers)

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Contents

Summary of pages
This document comprises a front cover, an inside front cover, pages i to ii, pages 1 to 14, an inside back cover and a back cover.

Foreword

Publishing information

This British Standard is published by BSI and came into effect on 30 November 2008. It was prepared by Technical Committee TDW/4, *Technical product realization*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This British Standard supersedes BS 959:1950, which is withdrawn.

Information about this document

This British Standard has been fully revised to bring it up to date.

Text introduced by or altered by Corrigendum No. 1 is indicated in the text by tags [C1] 〈C1〉. Minor editorial corrections are not tagged.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

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1 Scope

This standard specifies requirements for internal micrometers comprising a measuring head, extension rods with or without spacing collars, and, in the smaller sizes, a handle.

Provision is made for three sizes of measuring heads, in both metric and inch units, as shown in Table 1 and Table 2.

NOTE Attention is drawn to the fact that metric dimensions are not necessarily direct conversions of the imperial dimensions.

Table 1 **Measuring heads – metric measurements**

Size of head	Length of graduated scale on barrel mm	Usual ranges of the instrument when used with extension rods mm
Size 1	5 or 6.5	25-50
Size 2	10 or 13	50-150 50-200 50-300
Size 3	25	200+

Table 2 **Measuring heads – inch measurements**

Size of head	Length of graduated scale on barrel in	Usual ranges of the instrument when used with extension rods in
Size 1	¼	1-2
Size 2	½ or 1	2-6 2-8 2-12
Size 3	1	8+

This standard also covers stick micrometers, which are designed for the measurement of longer internal lengths, and comprise the following parts:

a) a 150 mm or 300 mm or 6 in or 12 in micrometer unit, fitted with a micrometer of 25 mm or 1 in range, and having rounded terminal faces;

b) a series of extension rods which, together with the micrometer unit, permit a continuous range of measurement up to the maximum length required.

Annex A gives a method of test for the accuracy of internal micrometer readings.

2 Normative references

The following referenced document is indispensable for the application of this document. The latest edition of the referenced document (including any amendments) applies.

BS 84, *Parallel screw threads of Whitworth form – Requirements*

Section 1: Internal micrometers

3 Material of measuring head

The body of the measuring head shall be of a suitable quality of steel. Its spindle and terminal measuring face shall be of high grade tool steel. This measuring face of the anvil shall be hardened to give a diamond pyramid hardness number of not less than 800 (62 on the Rockwell C scale).

NOTE It is recommended that the measuring face be tipped with tungsten carbide or other suitable hard material, or be faced with a deposit of hard chromium.

4 Measuring face of measuring head

The radius of curvature of the measuring face shall be slightly less than half of the smallest measuring range of the micrometer.

5 Micrometer screw

5.1 The micrometer screw shall have a pitch of 0.5 mm or 1/40 in.

NOTE The threads of the screw and nut should be truncated so as to confine contact to the flanks of the thread.

5.2 The screw shall be lubricated with a thin, light, non-corrosive oil, and shall run smoothly throughout the length of its travel.

5.3 It shall be possible, either by means of the adjusting nut or by other means, to arrange for the thimble to be sufficiently tight for the micrometer to retain its reading after being set.

5.4 There shall be no perceptible backlash between the spindle screw and nut.

5.5 When the micrometer is at its maximum reading there shall be full engagement of the nut and micrometer screw.

NOTE The travel of the micrometer should be continued for at least one turn of the screw beyond each end of the graduated scale on the barrel.

5.6 A means shall be provided (e.g. a spanner or key) for compensating for wear between the screw and nut.

6 Thimble and barrel

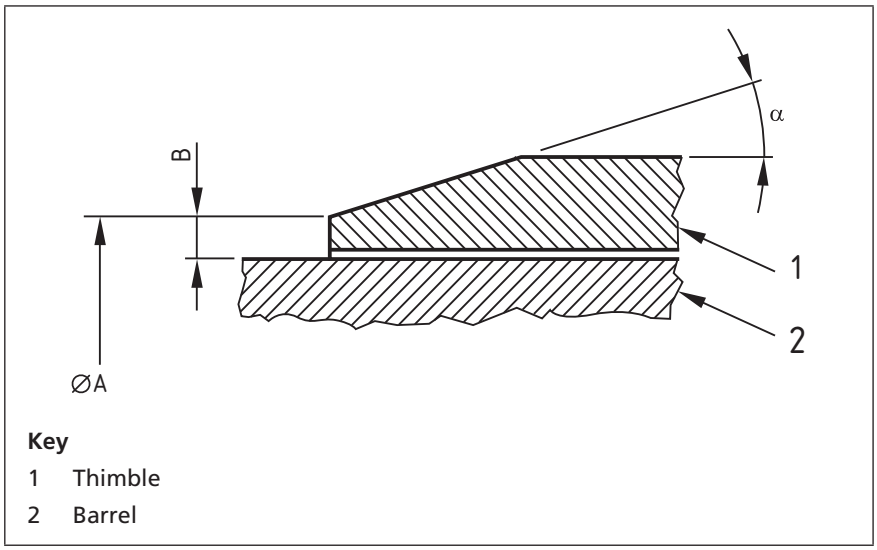
6.1 The diameter of the graduated edge of the thimble (Figure 1, dimension A) shall be no less than 10.32 mm or 13/32 in.

6.2 The angle of the bevel (Figure 1, angle α) shall be no more than 20°.

NOTE It is recommended that, for ease of reading, the angle of the bevel should be 15°.

6.3 The distance from the barrel to the reading end of the graduation on the thimble (Figure 1, dimension B) shall not exceed 0.381 mm or 0.015 in.

Figure 1 **Measurement of distance from barrel to reading end of graduation**



Key
1 Thimble
2 Barrel

6.4 All graduation lines shall be clearly cut. Those on the thimble and the fiducial line on the barrel shall have a width of 0.15 mm to 0.20 mm or 0.006 in to 0.008 in.

NOTE 1 Whilst the thickness of the remaining graduations on the barrel is not of prime importance, it is recommended that these graduations do not vary in thickness from the others by an obvious amount.

NOTE 2 It is recommended that, for ease of reading, the surfaces of the thimble and barrel should have a dull finish and that the graduation lines should be blackened.

6.5 The thimble and barrel shall be graduated as follows.

a) For metric reading micrometers, the thimble shall be graduated with 50 divisions, each representing 0.01 mm and numbered at 0, 5, 10, 15 etc., up to 45.

The barrel shall bear a longitudinal fiducial line which is parallel to the axis of the spindle and graduated in 0.5 mm intervals. The first, and every tenth, graduation shall be numbered 0, 5, 10, 15, 20 and 25 respectively. The graduation lines indicating full millimetres shall be distinguished from the graduation lines indicating half millimetres either by length or position.

b) For inch reading micrometers, the thimble shall be graduated with 25 divisions, each representing 0.001 in and numbered at 0, 5, 10, 15, and 20.

The barrel shall bear a longitudinal fiducial line which shall be graduated in 1/40 in intervals and be parallel to the axis of the spindle. Every 1/10 in graduation shall be numbered, and every 1/10 in and 1/20 in graduation shall be slightly extended either above or below the fiducial line.

7 Extension rods

7.1 Suitable extension rods shall be included to enable any measurement to be made throughout the range specified for the set, spacing collars being used where necessary.

NOTE Each rod can incorporate its own measuring anvil; alternatively, the rods can take the form of distance pieces to which a separate common anvil piece may be fitted.

7.2 The method of assembling the extension rods with the measuring head shall be simple, positive and accurate.

NOTE 1 In order to facilitate the assembling of the instrument for any desired range of measurement, each rod should be marked with the range of measurement for which it is applicable.

NOTE 2 In each joint of the assembly, one of the abutting faces should be provided with dirt clearance grooves.

7.3 The rods shall be made of good quality steel.

7.4 Each measuring face shall be hardened to give a diamond pyramid hardness number of not less than 800 (62 on the Rockwell C scale).

NOTE It is desirable that each measuring face be tipped with tungsten carbide or other hard alloy, or be faced with a deposit of hard chromium.

7.5 The radius of curvature of all measuring faces shall be slightly less than half of the smallest measuring range of the micrometer.

7.6 Each measuring face and each contact face shall be finished by lapping.

7.7 All sharp edges shall be removed.

NOTE The extension rods should be fitted with conveniently placed finger grips of heat-insulating material.

8 Spacing collars

The spacing collars shall be made of good quality steel. The ends shall be finished, preferably by lapping, in such a way that the end faces are flat and square to the axis. All sharp edges shall be removed.

At least one face of each spacing collar shall be provided with dirt clearance grooves.

9 Adjustment

Each micrometer shall be provided with a means for adjusting the zero setting (e.g. a spanner or key), such that, after resetting, the parts are secured and the original accuracy of the instrument is not impaired.

In micrometer sets in which each extension rod has its own measuring face, a suitable adjustment for zero setting shall be incorporated in each extension rod; for example, the attachment of the anvil by means of a friction-tight fine pitch thread.

NOTE In such types there should be no adjustment on the micrometer head. In micrometer sets in which the extension rods take the form of distance pieces to any one of which is added a separate common anvil piece, the adjustment for zero setting may be incorporated either in the anvil piece or in the measuring head.

10 Accuracy

At an ambient temperature of 20 °C, each measuring head with its associated extension rods (and collars if used) shall conform to the limits of error specified in Table 3, when the thimble reading is zero.

Table 3 **Maximum permissible errors**

Measuring range	Maximum permissible error in length
mm	mm
25⩽150	± 0.005
151⩽300	± 0.010
301⩽450	± 0.015
451⩽600	± 0.020
601⩽900	± 0.025
in	in
1⩽6	± 0.000 2
7⩽12	± 0.000 4
13⩽18	± 0.000 6
19⩽24	± 0.000 8
25⩽36	± 0.001 0

The measuring head shall not show a range of error in the traverse of the micrometer screw greater than 0.003 mm or 0.000 1 in.

NOTE The range of error in the calibration of the micrometer screw is independent of the zero setting; it represents the maximum difference between the ordinates of the curve of error in the readings obtained on calibrating the screw at a number of positions along its traverse. These positions check not only the progressive errors in the screw but also the accuracy of the graduations round the thimble and on the fiducial line.

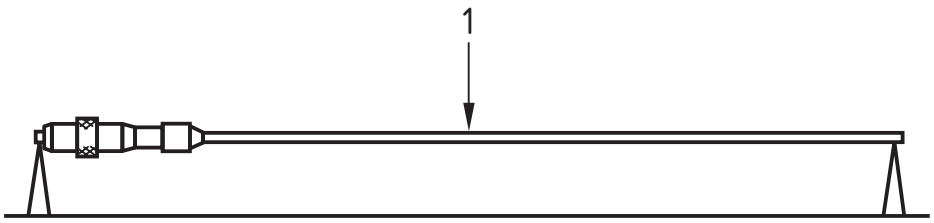
11 Rigidity

11.1 When tested in accordance with **11.2**, the deflection of the mid-point under the applied load shall not exceed 0.051 mm or 0.002 in for an assembly measuring 150 mm or 6 in in length.

With each increase in length of 25 mm or 1 in, the deflection shall be no more than 0.051 mm or 0.002 in, up to a maximum deflection of 1.27 mm or 0.050 in for an assembly measuring 760 mm or 30 in.

11.2 Assemble the micrometer using any combination of extension rods and spacing collars. Support the assembled unit at its ends, as shown in Figure 2, and apply a load of 0.5 kg or 1 lb.

Figure 2 **Application of load in testing for rigidity**



Key
1 0.5 kg or 1 lb mass

12 Handle

Each micrometer set for the measuring range 25 mm to 50 mm or 1 in to 2 in shall be supplied with a suitable detachable handle.

NOTE In micrometer sets for larger ranges of measurements a handle is optional.

13 Marking

Each measuring head and component in a set shall have a common serial number legibly and permanently marked upon it, in characters not less than 0.63 mm or 0.025 in high. The measuring head shall be similarly marked with the manufacturer's name or trade mark.

14 Case

Each micrometer set shall be supplied in a suitable protective case or box in which there is a separate compartment for each component. The case or box shall be so designed that when it is closed the components cannot become displaced.

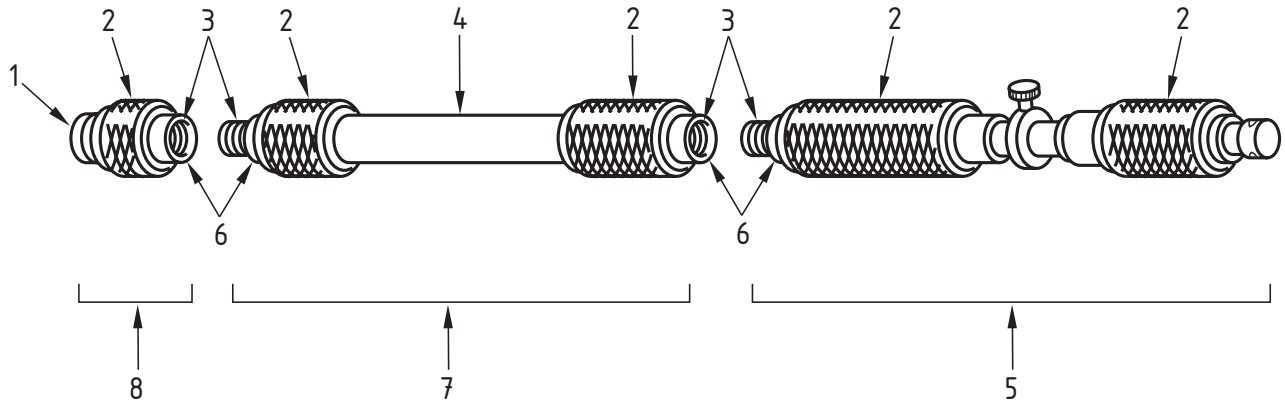
15 Packing

Each measuring head shall be coated with a suitable thin, non-corrosive, light oil and shall be securely wrapped. Each extension bar, collar and handle shall be coated with an anti-corrosive preparation (e.g. hard-drying lanolin).

Section 2: Stick micrometers

NOTE The components of a stick micrometer are illustrated in Figure 3.

Figure 3 **Stick micrometer components**



Key

1 Terminal face
2 Fixed insulating sleeve
3 Screwed joint ⅜ in × 26.t.p.i. Whit
4 Loose insulating sleeve
5 Micrometer unit
6 Abutment face
7 Extension rod
8 End piece

16 Terminal and abutment faces

The radius of curvature of the terminal faces of the micrometer unit shall be slightly less than half of the smallest measuring range of the micrometer unit.

The terminal faces shall be hardened to a diamond pyramid hardness number of not less than 800 (62 on the Rockwell C scale). The abutment faces shall be hardened to a diamond pyramid hardness number of not less than 700 (59 on the Rockwell C scale).

The abutment faces shall have a minimum radial width of 1.27 mm or 0.050 in.

The abutment faces shall be lapped flat and parallel to each other and shall be normal to the axis of the rod (defined as the line joining the centres of the finished ends) to within 0.005 mm or 0.000 2 in across their diameters.

17 Screwed joints

The screwed joints shall have threads of ⅜ in nominal diameter and with 26 t.p.i., in accordance with BS 84. There shall be sufficient play between the external and internal threads of the joints to permit the abutment faces of the various parts of the micrometer to butt together solidly.

NOTE 1 The female thread should be basic size, the necessary freedom being secured by a reduction of the diameter of the male thread.

NOTE 2 Manufacturers may supply adaptors of 25 mm or 1 in length having ⅜ in × 26 t.p.i. Whitworth form threads on one end and 9.5 mm × 0.5 mm pitch metric threads on the other end for compatibility purposes.

18 Extension rods

The extension rods shall be hollow and have a minimum external diameter of 12.5 mm or ½ in. All extension rods over 50 mm or 2 in in length shall be provided with heat-insulating sleeves.

19 Accuracy of micrometer unit

The micrometer unit, with terminal piece in position, shall be accurate throughout its range to within ⟦C1⟩ ± ⟨C1⟧ 0.005 mm or ± 0.000 2 in. The micrometer head shall incorporate a means of adjusting the zero setting.

20 Accuracy of extension rods

At an ambient temperature of 20 °C, the lengths of the extension rods shall agree with their nominal sizes within the tolerances given in Table 4.

Table 4 **Tolerances for extension rods**

Nominal length	Tolerance on mean axial length
mm	mm
⟦C1⟩ ⩽75	±0.003
76⩽150	±0.005
151⩽300	±0.008
301⩽610	±0.013
611⩽915 ⟨C1⟧	±0.018
in	in
⟦C1⟩ ⩽3	± 000 1
>3⩽6	± 000 2
>6⩽12	± 000 3
>12⩽24	± 000 5
>24⩽36 ⟨C1⟧	± 000 7

21 Rigidity

21.1 When tested in accordance with **21.2**, the deflection of the mid-point under the applied load shall not exceed 3.81 mm or 0.15 in.

21.2 Assemble a 1.8 m or six foot length of the micrometer using any combination of rods. Support the assembled unit at its ends as shown in Figure 2, and apply a load of 0.5 kg or 1 lb.

NOTE When lengths of between 1.2 m and 3.6 m or 4 feet and 12 feet are assembled for use, the unit should be supported at least at the ends and in the centre. For lengths over 3.6 m or 12 feet, the unit should be supported at regular intervals and the maximum separation between the supports should not exceed 1.8 m or 6 feet. Failure to support could result in damage to the instrument.

22 Marking

The micrometer unit shall be marked "150–175 mm (6–7 in) with end piece" or "300–325 mm (12–13 in) with end piece", and the micrometer head and each extension rod of a set legibly and permanently marked with a common identification number. The micrometer unit shall be similarly marked with the manufacturer's name or trade mark.

23 Gap setting gauges (see Figure 4)

When supplied, gap setting gauges shall have a gap of either 165 mm ± 0.003 mm/ 6½ in ± 0.000 1 in or 318 mm ± 0.005 mm/ 12½ in ± 0.000 2 in, according to the length of the micrometer unit. The faces of the gap shall be hardened and flat to within 0.003 mm or 0.000 1 in.

Figure 4 **Gap setting gauge**

24 Case

A suitable case shall be provided with each micrometer set.

25 Packing

Each measuring unit shall be coated with a suitable thin, non-corrosive light oil and shall be securely wrapped. Each extension rod (and gap setting gauge, if applicable) shall be coated with an anti-corrosive preparation (e.g. hard-drying lanolin).

Annex A (normative) Method of test for accuracy of internal micrometer readings

A.1 General

The checking of the accuracy of internal micrometer readings is carried out in two parts:

a) determine the accuracy of the traverse of the measuring head, then

b) determine the accuracy of the overall lengths when the measuring head, set to zero, is associated with the various extension rods in turn.

A.2 Apparatus

A.2.1 *Vee block*.

A.2.2 *Sensitivity indicator* (e.g. a 0.003 mm or 0.000 1 in dial gauge) with a flat contact face.

A.2.3 *Gauge block* measuring 2.5 mm or 0.1 in longer than the travel of the measuring head.

A.2.4 *Vertical comparator* consisting of a flat, horizontal base plate over which is supported a sensitive indicator having a flat contact face set accurately parallel to the base plate.

A.3 Procedure

A.3.1 Clamp the measuring head in the vee block with its axis in line with the sensitive indicator and the flat contact face juxtaposed to the rounded contact face of the measuring head.

A.3.2 Set the measuring head to read exactly zero.

A.3.3 Insert the gauge block between the two contact faces.

A.3.4 Set the indicator to read zero.

A.3.5 Test the measuring head at a number of readings along its traverse and at the series of readings shown in Table A.1. To test the accuracy of the reading of the head at any point, set the measuring head to the reading given in Table A.1; the initial size of the gauge block will be reduced in length by the value of the reading. Any error in the reading will be revealed by a corresponding departure of the indicator pointer from its zero position.

Table A.1 **Measuring head readings**

Travel of micrometer screw	**Series of readings**					
mm	mm					
5	0	1.4	2.3	3.2	4.1	5.0
6	0	1.3	2.6	3.9	5.4	6.5
10	0	5.9	6.8	7.7	8.6	10.0
13	0	1.3	2.6	3.9	5.2	6.5
	7.8	9.1	10.4	11.7	13.0	
25	0	2.4	5.1	7.7	10.3	12.5
	14.9	17.6	20.2	22.8	25.0	
in	in					
¼	0	0.045	0.090	0.135	0.180	0.250
½	0	0.105	0.210	0.315	0.420	0.500
1	0	0.105	0.210	0.315	0.420	0.500
	0.605	0.710	0.815	0.920	1.000	

A.3.6 To determine the accuracy of the various overall lengths, fix the vertical comparator at a height to suit the overall length to be measured.

A.3.7 Note the reading on the indicator when the internal micrometer is passed under it in the maximum position.

A.3.8 Take a comparative reading on an accurate length-gauge of the same nominal size. From the two readings and the known size of the gauge, determine the desired overall length.

Bibliography

BS 817, *Specification for surface plates*

BS 869, *Specification for toolmakers' flats and high precision surface plates*

BS 870, *Specification for external micrometers*

BS 887, *Specification for precision vernier callipers*

BS 906, *Specification for engineers' parallels*

BS 907, *Specification for dial gauges for linear measurements*

BS 939, *Engineers' squares (including cylindrical and block squares) – Specification*

BS 958, *Specification for spirit levels for use in precision engineering*

BS 1054, *Specification for engineers' comparators for external measurement*

BS 1643, *Specification for precision vernier height gauges*

BS 1685, *Specification for bevel protractors (mechanical and optical)*

BS 1734, *Specification for micrometer heads*

BS 1790, *Specification for length bars and their accessories (imperial units)*

BS 2795, *Specification for dial test indicators (lever type) for linear measurement*

BS 4311, *Gauge blocks manufactured to imperial specification – Specification, validation and accessories*

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