BRITISH STANDARD

BS 5317:1976

Specification for

Metric length bars and their accessories

Confirmed February 2012

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Co-operating organizations

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

Associated Offices Technical Committee
Association of Consulting Engineers
Association of Hydraulic Equipment Manufacturers Ltd.
Association of Mining, Electrical and Mechanical Engineers
British Compressed Air Society
British Electrical and Allied Manufacturers' Association
British Gas Corporation
British Gear Manufacturers' Association
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British Mechanical Engineering Confederation
British Pump Manufacturers' Association
British Steel Corporation
British Steel Industry
Crown Agents for Oversea Governments and Administrations
Department of Employment (HM Factory Inspectorate)
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Department of Industry
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Electricity Supply Industry in England and Wales
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The Government department and scientific and industrial organization marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:

Department of Industry — National Physical Laboratory
Department of Prices and Consumer Protection — British Calibration Service
Gauge and Toolmakers' Association

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Amendments issued since publication

Amd. No.	Date of issue	Comments
3052	June 1979	Indicated by a sideline in the margin

Contents

Foreword

This British Standard, prepared under the authority of the Mechanical Engineering Industry Standards Committee, deals with metric length bars which have until now been included with inch bars in BS 1790. The latter was first published in 1952 and revised in 1961; among the features of the revision were the introduction of a calibration grade of bar and of a refined screw connection that had been developed by the National Physical Laboratory and enabled bars to be built into combinations without any appreciable loss of overall inherent accuracy. Although it was permissible to use the original type of connection with what were designated "workshop" grade bars, the "refined" type has been so generally adopted that it is the only one for which provision is made in the present standard.

Although four grades of length bars have been retained, it is considered that the descriptive terms "inspection" and "workshop" are misleading and they have been replaced by the designations "grade 1" and "grade 2".

Requirements for metric length bars and accessories have now been deleted from BS 1790 and that standard should now be regarded as obsolescent.

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 and ii, pages 1 to 10, an inside back cover and a back cover.

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

Section 1. General

1 Scope

This British Standard relates to length bars (end standards) of the cylindrical type having flat, parallel end faces finished by lapping in metric sizes up to 1 200 mm.

NOTE If longer bars are required they should be uniform in diameter and straight overall to the limits laid down in **8.1** and **8.2**; tolerances for flatness and parallelism of faces should be proportionate to those specified in the appropriate Table 1 to Table 4 and their lengths should comply with the requirements of **8.4.2**.

Provision is made for two designs of length bar, one with complete plane faces and the other with annular faces surrounding an internally threaded hole at one end or both ends of the bar.

Section 2 provides for length bars in four grades of accuracy, namely reference, calibration, grade 1 and grade 2. It gives general dimensions, tolerances on length and requirements for flatness, parallelism and squareness of faces for all grades of bars.

Manufacturers supply single length bars or sets of selected sizes.

Section 3 relates to the essential features of design and accuracy of accessories for use with grade 1 or grade 2 bars.

Appendix A deals with interchangeability between these bars and bars made in accordance with BS 1790.

2 References

The titles of the British Standards referred to in this standard are listed on the inside back cover.

3 Definitions

For the purposes of this British Standard the following definitions apply.

3.1
airy positions

those points at which a bar of uniform cross section has to be supported when used with its axis horizontal (See Figure 1.)

3.2
axis of the bar

the line passing through the centres of the cross sections at the Airy positions (See Figure 1.)

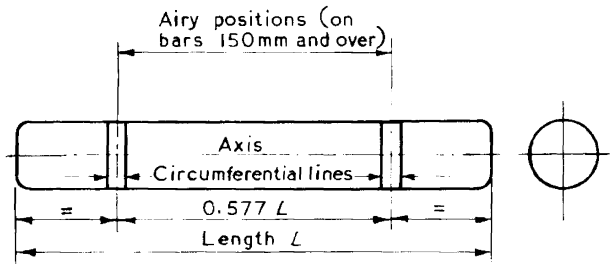


Figure 1 — Indication of Airy positions and axis

3.3
length

this is defined, with the bar mounted horizontally and referred to the standard reference temperature of 20 °C, as the distance from the centre of one of its faces to a flat surface in wringing contact with the opposite face, measured normal to the surface

NOTE 1 To realize this definition for the grade 1 and 2 types of bar it will be necessary to wring plane parallel end pieces of known thickness to one or both annular faces.

NOTE 2 It follows that when length measurements are made by comparison with a bar whose known length, as defined above, is traceable to the primary standard of length, the length so determined always refers to the horizontal position of support regardless of whether the *comparison* is made with the bars supported vertically or horizontally.

3.4
deviation from flatness

the minimum distance between two parallel planes which just envelop the measuring face

3.5
flatness tolerance

the maximum permissible deviation from flatness (See Figure 2.)

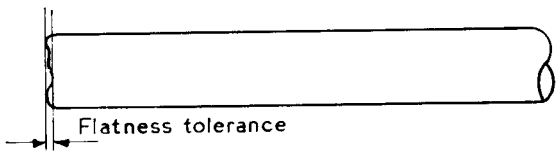


Figure 2 — Exaggerated illustration of flatness tolerance

3.6
deviation from parallelism

the difference between the maximum and minimum lengths at any points on the measuring faces measured perpendicular to the surface to which one face is wrung

3.7
parallelism tolerance

the maximum permissible deviation from parallelism (See Figure 3.)

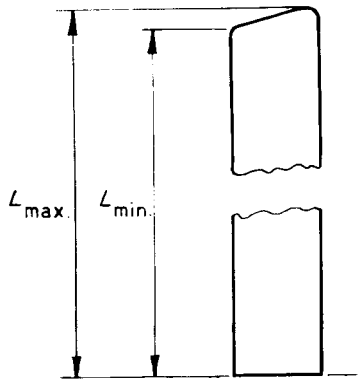


Figure 3 — Exaggerated illustration of parallelism tolerance

3.8
deviation from squareness

the minimum distance between two parallel planes normal to the axis of the bar which just envelop the measuring face under consideration (See Figure 3.)

3.9
squareness tolerance

the maximum permissible deviation from squareness (See Figure 4.)

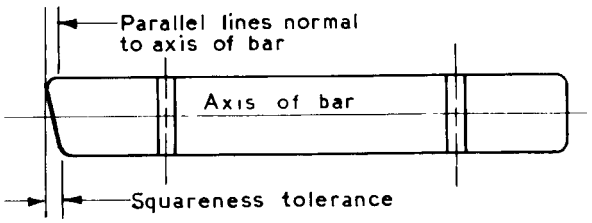


Figure 4 — Exaggerated illustration of squareness tolerance

Section 2. Length bars

4 Description and use: general design

4.1 Description and use

4.1.1 *Reference grade.* These bars are intended for use as reference standards and embody the highest order of accuracy as regards both the quality of their end faces and the finishing of their actual lengths to nominal size. They should be used only in "standards' rooms" that are temperature controlled at 20 °C with comparators of suitably high sensitivity.

They shall be measured by the National Physical Laboratory and supplied with a certificate of accuracy giving the deviations from their nominal lengths and confirming their full accordance with this standard.

4.1.2 *Calibration grade.* These bars are intended for use in the calibration of length measuring standards. They should be used only in "standards' rooms" that are temperature controlled at 20 °C and with comparators of suitably high sensitivity. They shall be measured either by interferometric methods or by comparison with calibrated standards and supplied with a certificate of accuracy giving the deviations from their nominal lengths and confirming their full accordance with this standard.

Certification of these bars may be carried out by the National Physical Laboratory or by a Laboratory approved by the British Calibration Service for this class of measurement.

4.1.3 *Grade 1.* These bars have internally threaded ends and can thus be used in combination with each other. They are intended for use in inspection rooms and tool rooms.

4.1.4 *Grade 2.* These bars also have internally threaded ends and can be used with gauge blocks, comparators or various accessories for measuring gauges, jigs, workpieces, etc.

4.2 General design

4.2.1 *Reference and calibration grades.* These shall take the form of cylindrical bars 22 mm in diameter and shall have completely plane end faces. The Airy positions on all bars 150 mm in length and over shall be indicated by two symmetrically spaced pairs of bold circumferential lines scribed around the bars as shown in Figure 1 and Figure 5. The lines shall not stand proud of the surface of the bar.

4.2.2 *Grade 1 and grade 2 bars* (see Figure 6). Grade 1 and grade 2 bars shall take the form of cylindrical bars 22 mm in diameter, internally threaded and recessed at both ends. The Airy positions on all bars 150 mm in length and over shall be as indicated for reference and calibration bars.

The threaded connections at the ends of these bars shall be made in accordance with the dimensions and tolerances specified in Figure 7. All threaded connections shall be assembled hand tight only.

NOTE Bars screwed together in combination and intended for use in the horizontal position should be supported on two supports at the calculated Airy positions for the total length, i.e. supports equidistant from the ends separated by a distance equal to 0.577 times the overall length of the combination, and the engraved lines on individual bars ignored. Under these conditions, adjustable supports are desirable.

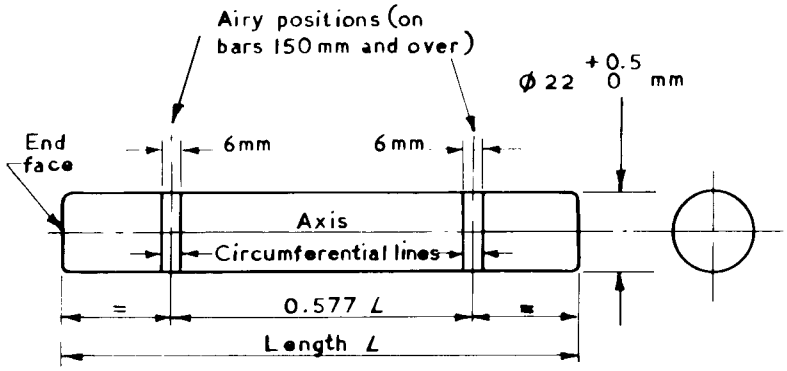
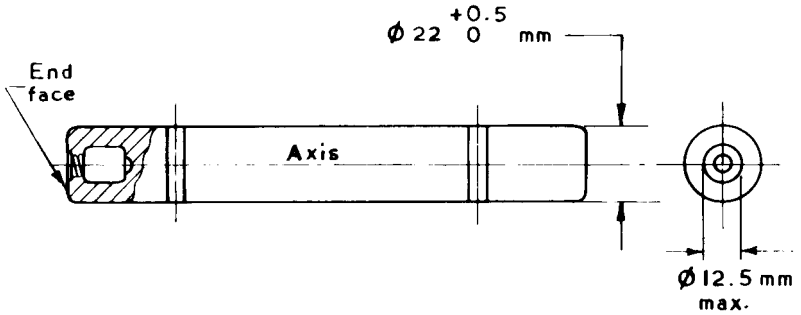


Figure 5 — Reference or calibration grade length bars



[For enlarged view of threaded end, see Figure 7(a)]

Figure 6 — Grade 1 or grade 2 length bar

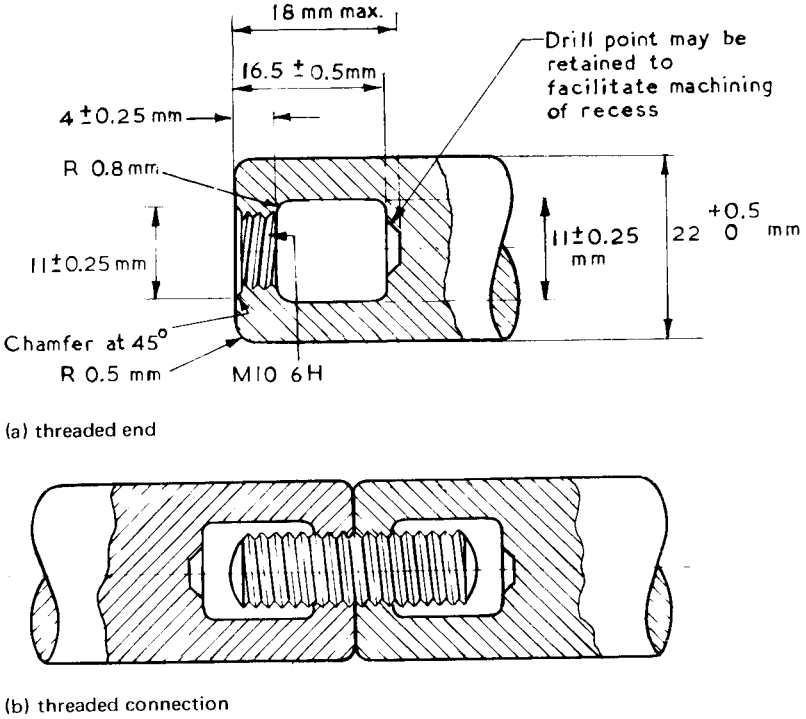


Figure 7 — Threaded connection for length bars

5 Material

The bars shall be made of high quality tool steel free from non-metallic inclusions.

6 Hardening and stabilizing

6.1 Hardening. 25 mm bars shall be hardened throughout their length.

Bars over 25 mm up to and including 125 mm shall be hardened either throughout their length or at the ends only for a distance of not less than 4 mm.

Longer bars shall be hardened at the ends only for a distance of about 6 mm and not less than 4 mm from each end.

The hardness number of the end faces of the finished bars shall be not less than 750 HV[1)].

6.2 Stabilizing. The bars shall be stabilized after hardening and due attention shall be given to scale removal, particularly from any threaded holes.

A recommended stabilizing treatment is to heat the bars to 150 °C and maintain them at this temperature for approximately 10 h followed by slow cooling.

7 Finish

7.1 The body of each bar shall be finished all over by fine grinding.

The end faces of the bars shall be lapped to provide a finish of the highest quality both for appearance and wringing quality. They shall be free from scratches and blemishes of any noticeable character. The edges of all bars shall be radiused as shown in Figure 7(a).

Threaded holes and screws, when provided, shall be cleanly finished and all sharp edges shall be removed.

8 Accuracy

8.1 Diameter. The diameter of each bar shall be uniform within 15 μm for bars up to 300 mm in length, 25 μm for bars over 300 mm up to and including 600 mm in length, and within 50 μm for bars longer than 600 mm.

8.2 Straightness. The body shall be straight within 10 μm per 100 mm of length.

[1)] Diamond Pyramid Hardness Number. The approximate equivalent hardness number on the Rockwell C Scale is 62 HRC.

8.3 End faces

8.3.1 *Flatness and parallelism*. The tolerances on flatness and parallelism of the end faces shall be as given in Table 1 to Table 4.

8.3.2 *Squareness*, The end faces of all grades of bars shall be square with the axis of the bar to within 1.2 µm over the diameter of the face for bars up to and including 400 mm in length and to within 2.5 µm for bars over 400 mm in length.

8.4 Length

8.4.1 *Tolerances.* The tolerances on length shall be as given in Table 1 to Table 4.

8.4.2 *Basis of tolerances.* The tolerances on length are based on the following formulae and rounded according to the convention adopted by ISO for gauge blocks.

Reference grade $\pm (0.05 + 0.0015\angle)\mu m$

Calibration grade $\pm (0.10 + 0.003\angle)\mu m$

Grade 1 $\begin{matrix}+1.4\\-0.6\end{matrix} \times (0.20 + 0.004\angle)\mu m$

Grade 2 $\begin{matrix}+1.4\\-0.6\end{matrix} \times (0.40 + 0.006\angle)\mu m$

where $\angle$ is the length of bar in millimetres.

NOTE The tolerances on the lengths of grade 1 and grade 2 bars are apportioned 7/10 plus and 3/10 minus of the total tolerance.

Table 1 — Tolerances on reference grade length bars

1	2	3	4
Nominal length	Tolerances on accuracy of faces[a]		Tolerance on length at 20 °C
	Flatness	Parallelism	
mm	µm	µm	µm ±
Up to 25	0.08	0.08	0.08
50	0.08	0.10	0.12
75	0.10	0.16	0.15
100	0.10	0.16	0.20
125	0.10	0.20	0.25
150	0.10	0.20	0.30
175	0.15	0.20	0.30
200	0.15	0.20	0.35
225	0.15	0.20	0.40
250	0.15	0.30	0.40
275	0.15	0.30	0.45
300	0.15	0.30	0.50
400	0.15	0.30	0.65
500	0.15	0.30	0.80
600	0.15	0.30	0.95
700	0.15	0.30	1.10
800	0.15	0.30	1.25
900	0.15	0.30	1.40
1 000	0.15	0.30	1.55
1 200	0.15	0.30	1.85

NOTE Bars of intermediate sizes should be made to the same tolerances as those for the next smaller size

[a] For tolerances on squareness see **8.3.2**.

Table 2 — Tolerances on calibration grade length bars

1	2	3	4
Nominal length	Tolerances on accuracy of faces[a]		Tolerance on length at 20 °C
	Flatness	Parallelism	
mm	µm	µm	µm ±
Up to 25	0.08	0.08	0.15
50	0.08	0.10	0.20
75	0.10	0.16	0.30
100	0.10	0.16	0.35
125	0.10	0.20	0.45
150	0.10	0.20	0.50
175	0.15	0.20	0.60
200	0.15	0.20	0.65
225	0.15	0.20	0.70
250	0.15	0.30	0.80
275	0.15	0.30	0.90
300	0.15	0.30	0.95
400	0.15	0.30	1.30
500	0.15	0.30	1.60
600	0.15	0.30	1.90
700	0.15	0.30	2.20
800	0.15	0.30	2.50
900	0.15	0.30	2.80
1 000	0.15	0.30	3.10
1 200	0.15	0.30	3.70

NOTE Bars of intermediate sizes should be made to the same tolerances as those for the next smaller size.

[a] For tolerances on squareness see **8.3.2**.

Table 3 — Tolerances on grade 1 length bars

1	2	3	4
Nominal length	Tolerances on accuracy of faces[a]		Tolerance on length at 20 °C
	Flatness	Parallelism	
mm	µm	µm	µm
Up to 25	0.15	0.16	+ 0.40 – 0.20
50	0.15	0.18	+ 0.60 – 0.20
75	0.15	0.18	+ 0.70 – 0.30
100	0.18	0.20	+ 0.85 – 0.35
125	0.18	0.20	+ 1.00 – 0.40
150	0.18	0.20	+ 1.10 – 0.50
175	0.20	0.25	+ 1.25 – 0.55
200	0.20	0.25	+ 1.40 – 0.60
375	0.20	0.35	+ 2.40 – 1.00
400	0.20	0.35	+ 2.50 – 1.10
575	0.20	0.40	+ 3.50 – 1.50
600	0.20	0.40	+ 3.65 – 1.55
775	0.20	0.50	+ 4.60 – 2.00

NOTE Bars of intermediate sizes should be made to the same tolerances as those for the next smaller size.

[a] For tolerances on squareness see **8.3.2**.

Table 4 — Tolerances on grade 2 length bars

1	2	3	4
Nominal length	Tolerances on accuracy of faces[a]		Tolerance on length at 20 °C
	Flatness	Parallelism	
mm	µm	µm	µm
Up to 25	0.25	0.30	+ 0.75 – 0.35
50	0.25	0.30	+ 0.95 – 0.45
75	0.25	0.35	+ 1.20 – 0.50
100	0.25	0.35	+ 1.40 – 0.60
125	0.25	0.40	+ 1.60 – 0.70
150	0.25	0.40	+ 1.80 – 0.80
175	0.25	0.40	+ 2.00 – 0.90
200	0.25	0.40	+ 2.20 – 1.00
375	0.25	0.50	+ 3.70 – 1.60
400	0.25	0.50	+ 3.90 – 1.70
575	0.25	0.70	+ 5.40 – 2.30
600	0.25	0.70	+ 5.60 – 2.40
775	0.25	0.80	+ 7.10 – 3.00

NOTE Bars of intermediate sizes should be made to the same tolerances as those for the next smaller size.

[a] For tolerances on squareness see **8.3.2**.

9 Connecting screws for grade 1 and grade 2 bars

At least six unhardened connecting screw M10 × 1.5 – 6 g shall be provided with each set of grade 1 or grade 2 bars for holding them together. They shall screw quite freely into the threaded holes in the bars and shall allow the wringing faces to come into satisfactory contact.

NOTE These connecting screws are not interchangeable with those specified in BS 1790 which are 3/8 BSW. (See Appendix A).

10 Marking and essential particulars

10.1 Marking. Each bar shall be legibly and permanently marked with the following particulars:

a) the nominal length and grade, e.g. 75 mm. Grade 1;

b) the number of this British Standard (BS 5317);

c) reference and calibration bars with an identification number and grade 1 and 2 bars with their set number;

d) 20 °C;

e) the manufacturer's name or trade mark.

10.2 Essential particulars. The manufacturer shall supply the following particulars with each set:

a) a statement that the length bars contained in a set have been given a treatment to promote stability of size;

b) for reference and calibration grade length bars, a calibration chart giving the measured size of each bar.

NOTE For calibration requirements, see **4.1.1** and **4.1.2**.

11 Case

Each set of length bars shall be housed in one or more substantial cases. The cases shall be dust-proof and have a separate compartment for each bar. Provision shall be made for easy removal of the bars from the case. When the lid of the case is closed and fastened, each bar shall be firmly held in its seating. The lid shall be hinged and shall be secured with at least two strong hasps or clips.

12 Protection against climatic conditions

All surfaces of the bars shall be protected against climatic conditions by a suitable corrosion preventive[2)].

Section 3. Accessories

NOTE Various accessories have been designed to extend the possible applications of length bars. However, it should be appreciated that some loss of accuracy in length measurement may result from their use due to factors such as offset from the measuring axis, the cumulative effect of tolerances, etc.

13 Material

The accessories other than connecting screws shall be made of high grade steel. Where possible, they shall be hardened throughout or case hardened and suitably stabilized by heat treatment.

14 Method of attachment

Accessories shall be attached to the bars by means of connecting screws provided for the purpose.

Diagrammatic illustrations of the assembly of accessories are given in Figure 8 and Figure 9.

15 Base

15.1 Design. The base (see Figure 9) shall have a diameter of at least 125 mm to provide adequate stability when used in conjunction with length bars up to 1 500 mm long.

15.2 Finish. The bearing surfaces of the base shall be finished by high quality lapping.

15.3 Accuracy

15.3.1 *Flatness.* The upper and lower surfaces of the base shall be flat to within 0.2 µm per 20 mm and to within 1.5 µm over the full diameter of the base.

[2)] See BS 1133, Sections 6 and 19.

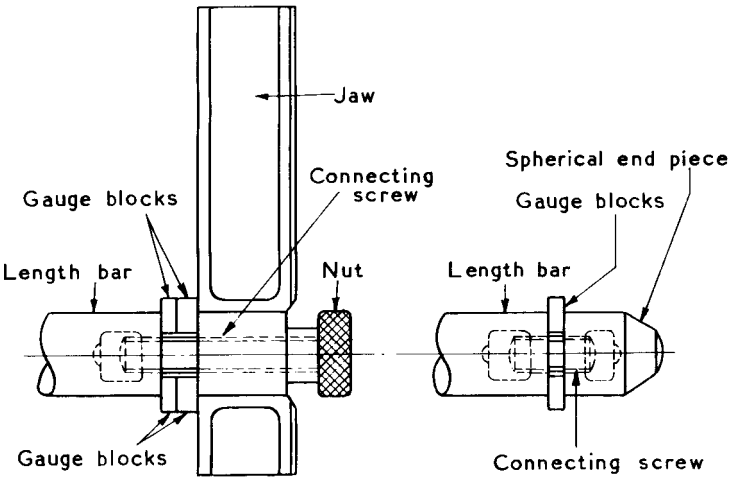


Figure 8 — Assembly of accessories

15.3.2 *Parallelism.* The upper and lower surfaces of the base shall be parallel to one another to within 0.2 µm per 20 mm.

15.3.3 *Thickness.* The base shall have a thickness of 25 mm subject to a tolerance of ± 1 µm.

15.4 Marking. The base shall be marked with the nominal thickness of 25 mm in bold characters and with an identification number.

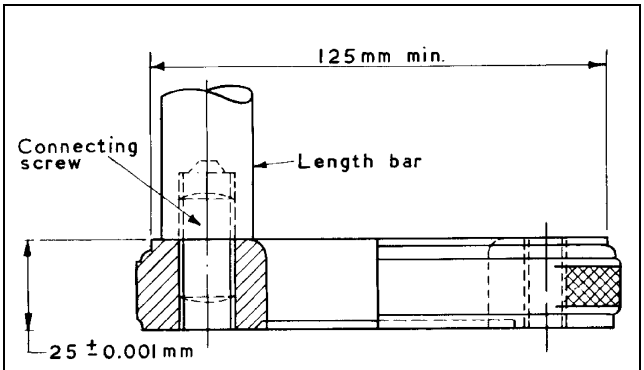


Figure 9 — Base

16 Large radiused jaw

16.1 General design. The design of the large radiused jaw shall be generally as shown in Figure 10.

NOTE In the case of internal measurement, this jaw should only be used for diameters greater than 150 mm.

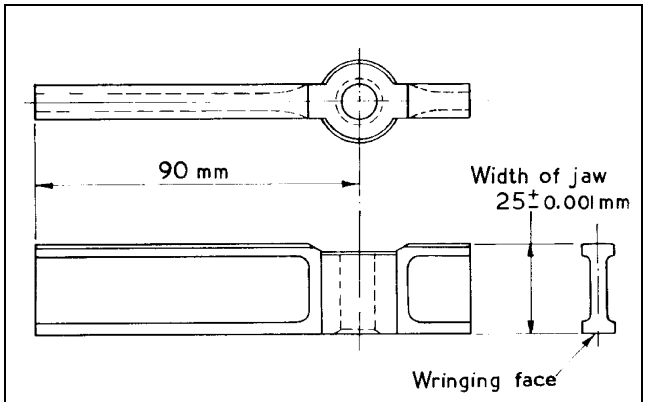


Figure 10 — Large radiused jaw

16.2 Finish. One face of the jaw shall be lapped flat and the other, face shall be lapped to cylindrical form with a radius not greater than 75 mm. Sharp edges shall be removed and the unimportant surfaces left clean but dull.

16.3 Accuracy

16.3.1 *Flatness.* The wringing face shall be flat within 0.2 µm per 20 mm of length.

16.3.2 *Parallelism.* The gauging width of the jaw shall be parallel within 0.2 µm per 20 mm of length.

16.3.3 *Width.* The effective width of the jaw shall be 25 mm subject to a tolerance of ± 1 µm.

16.3.4 *Centrality of radius to thickness.* The radius shall be central to the thickness of the jaw to within 100 µm. (See Figure 11.)

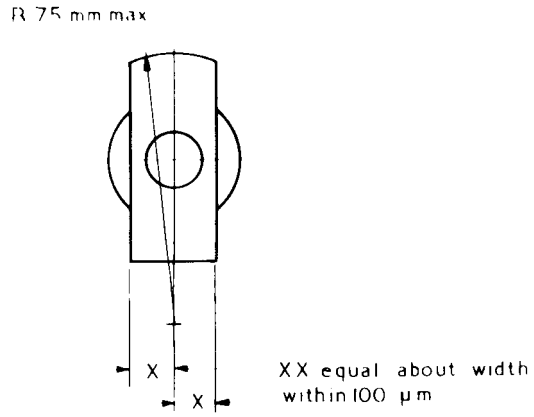
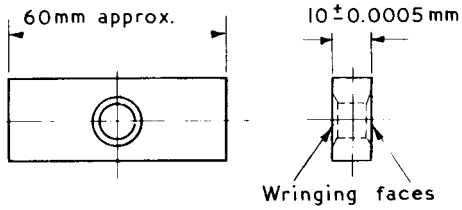


Figure 11 — Centrality of radius to thickness

16.4 Marking. The jaw shall be marked with the nominal width of 25 mm in bold characters and with an identification number.

17 Small plane-faced jaw

17.1 General design. The general shape shall be as shown in Figure 12.



NOTE Width to be below minimum diameter of bar.

Figure 12 — Small plane-faced jaw

17.2 Finish. The working faces of the jaw shall be finished by high grade lapping. Sharp edges shall be removed and the unimportant surfaces left clean but dull.

17.3 Accuracy

17.3.1 *Flatness.* The wringing faces shall be flat within 0.2 µm per 20 mm of length.

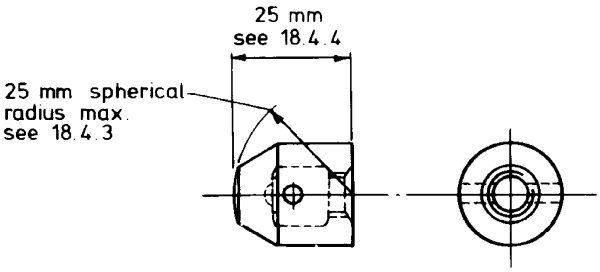
17.3.2 *Parallelism.* The wringing faces shall be parallel within 0.2 µm per 20 mm of length.

17.3.3 *Width.* The mean width of the jaw shall be 10 mm subject to a tolerance of ± 0.5 µm.

17.4 Marking. The jaw shall be marked with the nominal width of 10 mm in bold characters and with an identification number.

18 Spherical end piece

18.1 General design. The general form of the spherical end piece shall be as shown in Figure 13.



NOTE Outside diameter to be smaller than minimum outside diameter of bar.

Figure 13 — Spherical end piece

18.2 Finish. The plane face of the spherical end piece shall be finished by high grade lapping and the other face shall be ground to spherical form and lapped to a high polish. Sharp edges shall be removed and the remaining faces ground all over.

18.3 Radius. The radius of the spherical end shall be 25 mm maximum.

18.4 Accuracy

18.4.1 *Flatness.* The plane face of the spherical end piece shall be flat within 0.25 µm.

18.4.2 *Squareness.* The end face shall be square with the axis of the end piece to within 1.2 µm over the diameter of the face.

18.4.3 *Centrality of radius.* The centre line of the 25 mm spherical end shall coincide with the centre line of the end piece to within 15 µm F.I.M.

18.4.4 *Length.* The overall length of the end piece shall be 25 mm subject to a tolerance of 1 µm, – 0.

18.5 Marking. The end piece shall be marked with its nominal size of 25 mm in bold characters and with an identification number.

19 Screws

Sufficient M10 × 1.5 – 6 g connecting screws for assembly shall be provided with each set of accessories. (See Figure 8 for illustration of a typical assembly.)

The screws shall assemble the accessories quite freely with the length bars. They shall be well finished all over and all sharp edges shall be removed.

20 Case

Each set of accessories shall be provided with a substantial well made case. The case shall be dust-proof and shall have a separate compartment for each accessory. When the lid of the case is closed and fastened, each accessory shall be held firmly in its seating.

The lid shall be hinged and shall be secured with at least two strong hasps or clips.

21 Protection against climatic conditions

All surfaces of the accessories shall be protected against climatic conditions by being covered with a suitable corrosion preventive preparation[3)].

[3)] See BS 1133, Sections 6 and 19.

Appendix A Interchangeability with bars to BS 1790:1961

The connecting screws specified in this standard are threaded M10 × 1.5 – 6 g and are not interchangeable with the screws specified in BS 1790:1961 which are 3/8 in – 16 BSW. If interchangeability with bars to BS 1790:1961 is desired, double-ended connecting screws will be needed, threaded metric M10 × 1.5 – 6 g at one end and 3/8 – 16 BSW at the other. A short plain portion (not greater than 7 mm in diameter) will be necessary between the threads to clear the smaller minor diameter.

When supporting such a combination of bars, allowance has to be made for the difference in diameter i.e. 7/8 in (22.23 mm) and 22 mm. It is desirable that the supports used should be adjustable.

Publications referred to

This standard makes reference to the following British Standards:
BS 1133, *Packaging code.*
BS 1133-6, *Temporary protection of metal surfaces against corrosion (during transport and storage).*
BS 1133-19, *Use of desiccant in packaging.*
BS 1790, *Length bars and their accessories — Inch units.*

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