BRITISH STANDARD

BS 1790:1961

Incorporating
Amendment No. 1

Specification for

Length bars and their accessories —

(Imperial Units)

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:

Admiralty
Air Ministry
Associated Offices' Technical Committee
Association of Consulting Engineers (Incorporated)
British Chemical Plant Manufacturers' Association
British Compressed Air Society
British Electrical and Allied Manufacturers' Association
British Engineers' Association
British Gear Manufacturers' Association
British Internal Combustion Engine Manufacturers' Association
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Locomotive and Allied Manufacturers' Association of Great Britain
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Ministry of Labour (Factory Inspectorate)
Ministry of Power
Ministry of Transport
Ministry of Works
National Coal Board
National Physical Laboratory (D.S.I.R.)
Radio Industry Council
War Office

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Amendments issued since publication

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Contents

Foreword

This Standard makes reference to the following British Standards:

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

BS 1133, *Packaging Code — Section 6: Temporary prevention of corrosion of metal surfaces (during transportation and storage) — Section 19: Use of desiccants in packaging.*

This revised British Standard for length bars has been prepared under the authority of the Mechanical Engineering Industry Standards Committee in response to a request received from the National Physical Laboratory. It forms one of a series of standards for engineers' precision measuring tools which has been prepared with the co-operation of the manufacturers and in close collaboration with the National Physical Laboratory.

From experience gained since its original publication in 1952, and having regard to research work carried out at the National Physical Laboratory which has resulted in the introduction of a refined screwed connection[1)] for length bars, it has been considered desirable to revise this Standard.

The more important features of this revision are as follows:

i) A new calibration grade of bar has been introduced into the standard so that four grades of accuracy are now provided, viz., reference, calibration, inspection and workshop. The basis of the respective tolerances on length for these grades of bars follows closely that of the corresponding grades for slip (or block) gauges laid down in BS 888.

ii) Modern end measuring machines are now provided with universally adjustable supports; in consequence, the squareness tolerance between the measuring faces of a bar and the common axis of its Airy positions has been relaxed and an enlarged uniform tolerance has been assigned to all grades of bars. This has led to the elimination of the raised Airy bands specified for the original types of reference and inspection bars; the Airy positions on all grades of bars are now indicated by pairs of circumferential lines scribed round the bar.

iii) The opportunity has also been taken to rationalize the requirements for accessories by standardizing one type only.

iv) The refined screwed connection referred to above has been introduced into the Standard. By means of this connection the change in the length of a built-up combination of bars, arising from stresses set up at each joint during hand assembly, has been reduced to about one micro inch (0.000 001 in) per joint.

The original screwed connection designed for use with workshop grade bars and their associated accessories is quite satisfactory for workshop accuracy and has therefore been retained in the revised Standard. By employing the refined connection, however, it is now possible to build bars of higher grade accuracy into a combination without any appreciable loss of overall inherent accuracy and this facility has accordingly been extended to inspection grade bars. It is essential that the refined joint be employed on all inspection grade bars, but for workshop grade bars the choice of screwed connection, refined or original type, is optional.

[1)] For details of the refinement in the design of the screwed connection see references to published papers given in Appendix B of this Standard.

The improved type of screwed connection is the subject of a patent No. 819921 by The Department of Scientific and Industrial Research. The British Standards Institution has been assured by D.S.I.R. that licenses to manufacture the connections will be granted to approved intending manufacturers on reasonable conditions.

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 18, 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.

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1 Scope

This British Standard relates to length bars of the cylindrical type, in inch sizes up to 48 in, having parallel end faces finished by lapping.

If longer bars are required, they shall be uniform in diameter and straight overall to the limits laid down in Clauses **7** a) and b); tolerances for flatness and parallelism of faces shall be proportionate to those specified in the appropriate Table 1, Table 3, Table 5 and Table 7, and their lengths shall conform to the requirements of Clause **7** d) ii).

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 1 provides for four grades of accuracy, namely:

i) Reference

ii) Calibration

iii) Inspection

iv) Workshop.

Reference grade bars, as their name implies, are intended for use as reference standards. They have completely plane faces and embody the highest order of accuracy as regards both their end faces and the finishing of their actual lengths to their nominal sizes.

It is recommended that they should be supplied with a certificate by the National Physical Laboratory which confirms their full accordance with this British Standard and gives the deviations from their nominal lengths to an appropriately high order of accuracy.

To derive the maximum benefit from these very high grade reference bars they should be used only in standards rooms which are temperature controlled at 68 ± 1 °F (20 ± $^1/_2$ °C) and with comparators of suitably high sensitivity.

Calibration grade bars possess the same degree of perfection in their completely plane end faces as the reference grade bars. They differ only in the somewhat wider tolerances allowed in the adjustment of their lengths to the nominal sizes, which thus permits them to be produced more economically than reference grade bars. It is recommended, however, that calibration grade bars should, like those of reference grade, be supplied and used with a N.P.L. certificate giving the actual deviation in the length of each bar from its nominal size.

NOTE The wider tolerances permitted on the lengths of calibration grade bars render them no less serviceable than reference grade bars when used as standards for the accurate measurement of other bars.

As already mentioned for reference grade bars, calibration grade bars require to be used under suitable conditions of temperature and with appropriate comparators if the fullest advantage is to be gained of the very high accuracy associated with their certified sizes.

Inspection grade 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.

Workshop grade bars also have internally threaded ends and can be used with slip gauges, comparators and their own accessories for measuring gauges, jigs, work pieces, etc. As their name implies, they are intended for use in workshops.

General dimensions, tolerances on length and standards of accuracy for flatness, parallelism and squareness of faces are specified for all grades of bars.

Section 2 relates to the essential features of design and accuracy of accessories for use with inspection and workshop grade bars.

Recommended sets of inspection and workshop grade bars and the sources of papers on the refined type of screwed connection are given in Appendices.

2 Nomenclature and definitions

For the purpose of this standard the following definitions apply.

2.1
airy positions

the Airy positions are those points at which a bar of uniform cross section must be supported, when used with its axis horizontal, to bring the end faces of the bar parallel; when it is so supported, the flexure of the bar under its own weight is reduced almost to a minimum (see Figure 5)

2.2 Length

2.2.1
reference and calibration bars

the length of a reference or calibration grade bar is defined 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 and at a temperature of 68 °F (20 °C)

NOTE To reduce possible effects of small permissible errors in the flatness of the faces of a bar, the length should be measured first with one face and then the other wrung to the flat surface and the mean of the two results taken.

2.2.2
inspection and workshop bars

the length of an inspection or a workshop grade bar is defined as the mean of four measurements made parallel to the axis of the bar at quadrantal positions, and at the mean radius of its annular faces. These measurements are made at a temperature of 68 °F (20 °C)

if the bars are measured in a horizontal position they should be supported at the Airy positions described in Sub-clause **2.1**

2.3
flatness tolerance

the maximum permissible distance between two imaginary parallel planes within which the contour of a face can just be enclosed (see Figure 1)

2.4
parallelism tolerance

parallelism in this context is intended to refer to the maximum variation in the length of any one bar (see Figure 2)

2.5
squareness tolerance

the maximum permissible distance between two imaginary parallel planes normal to the axis of the Airy positions and just enclosing the face under consideration (see Figure 3)

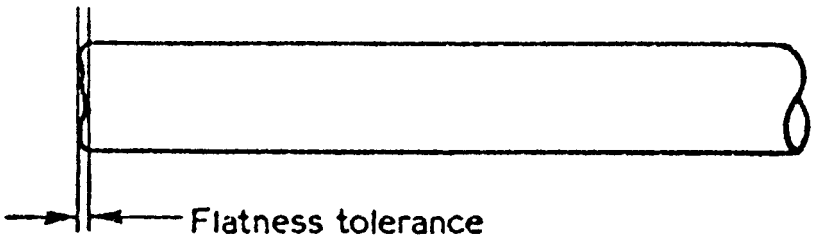

Figure 1 — Exaggerated illustration of flatness tolerance

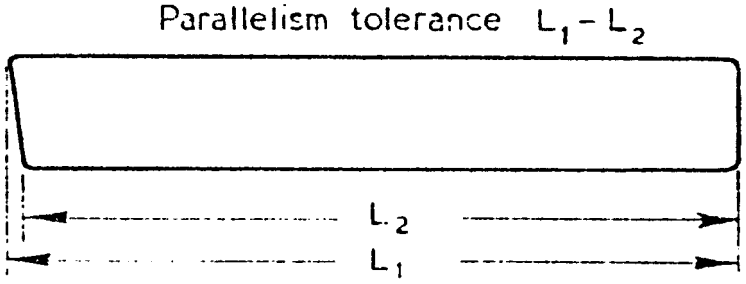

Figure 2 — Exaggerated illustration of parallelism tolerance

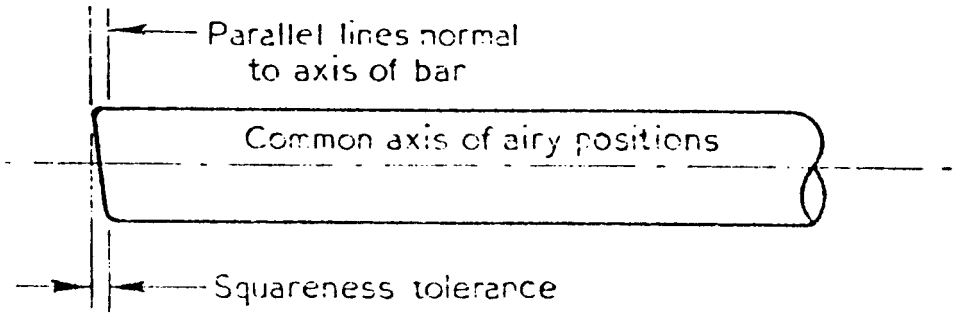

Figure 3 — Exaggerated illustration of squareness tolerance

Section 1. Length bars

3 General design

a) **Reference grade and calibration grade bars** (see Figure 5). Reference and calibration grade bars shall take the form of cylindrical bars $^{7}/_{8}$ inch in diameter and shall have completely plane end faces. The Airy positions on all bars 6 inches in length and over shall be indicated by two symmetrically spaced pairs of bold circumferential lines scribed around the bars, as shown in Figure 4. The lines shall not stand proud of the surface of the bar.

b) **Inspection grade and workshop grade bars** (see Figure 6 and Figure 7). Inspection grade and workshop grade bars shall take the form of cylindrical bars $^{7}/_{8}$ inch in diameter, internally threaded and recessed at one or both ends. It may be convenient to supply on occasion the 1 in bar solid throughout. The Airy positions on all bars 6 inches in length and over shall be indicated as for reference and calibration grade bars.

The threaded connections at the end of inspection bars shall be made in accordance with the dimensions and tolerances specified in Figure 8(a). Those at the ends of workshop bars shall preferably be made in accordance with the dimensions and tolerances specified in Figure 9(a); alternatively they may be made to the dimensions and tolerances given in Figure 8(a).

All threaded connections shall be assembled hand tight only.

NOTE 1 Bars screwed together in combination, and intended for use in the horizontal position, should be supported symmetrically on two supports at the calculated Airy positions for the total length, i.e. supports separated by a distance equal to 0.577 times the overall length of the combination, and the engraved lines on individual bars ignored.

NOTE 2 It has been considered desirable to retain the $^{3}/_{8}$ in — 16 B.S.W. screwed connection in order to permit assembly with bars made to the original standard. If, however, bars made to the original design are associated with bars made to the refined design, some loss of accuracy exceeding the value of 1 micro inch per joint associated with the refined connection will result.

4 Material

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

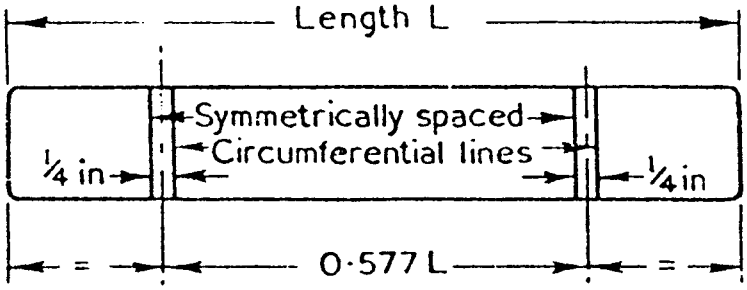

Figure 4 — Indication of airy positions

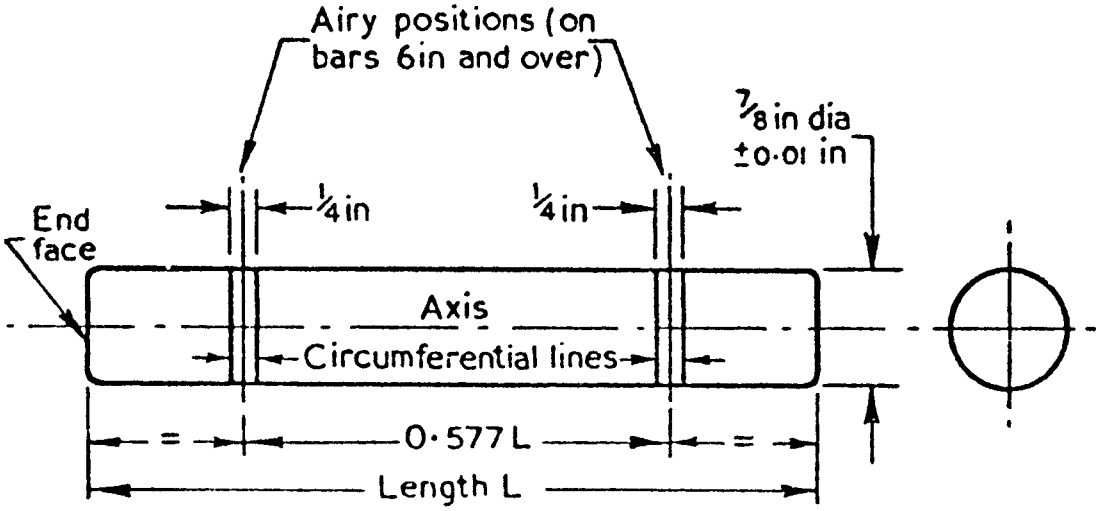

Figure 5 — Reference or calibration grade length bar

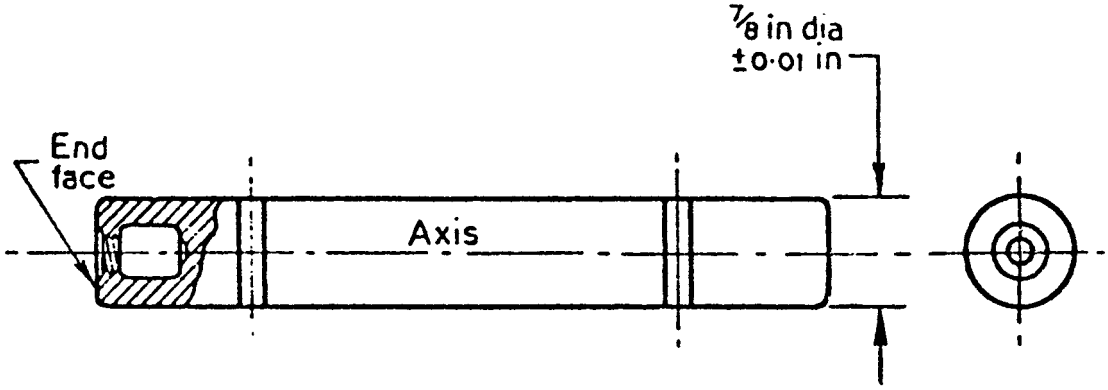

Figure 6 — Inspection grade length bar
For enlarged view of threaded end see Figure 8(a)

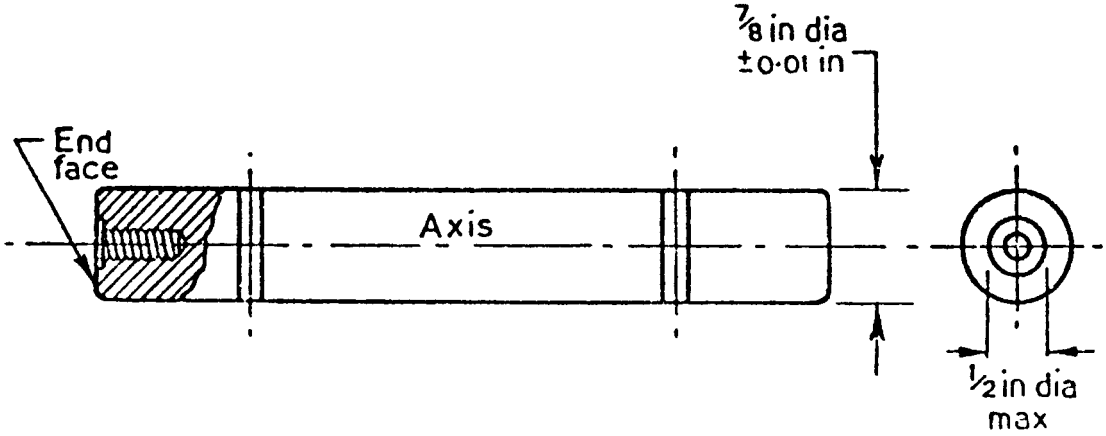

Figure 7 — Workshop grade length bar
For enlarged view of threaded end see Figure 9(a)
[alternatively may have threaded end as shown in Figure 8(a)]

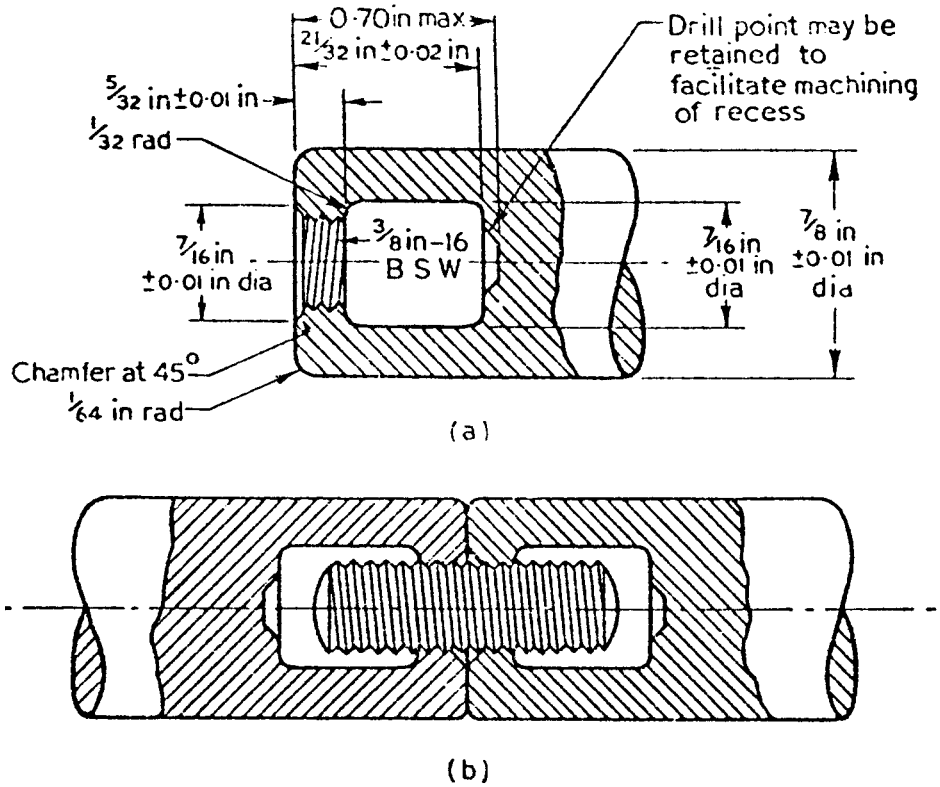

Figure 8 — New design of threaded connection for length bars

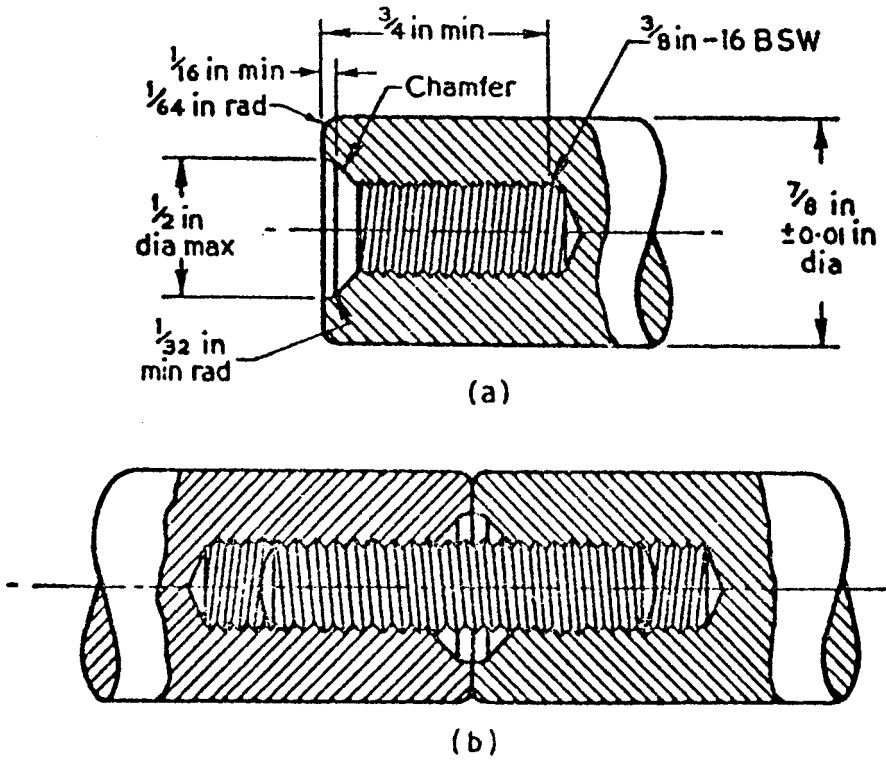

Figure 9 — Original type of screwed connection for length bars
[Suitable for Workshop grade length bars, see Clause **3**(b).]

5 Hardening and stabilizing

The 1 in bars shall be hardened throughout their length.

Bars over 1 in up to and including 5 in shall be hardened throughout their length or at the ends only for a distance of not less than $^{5}/_{32}$ in.

Longer bars shall be hardened for a distance of about $^{1}/_{4}$ in and not less than $^{5}/_{32}$ inch from each end.

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 hours followed by slow cooling.

The hardness number of the end faces of the finished bars shall be not less than 800 HV[2)].

6 Finish

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 property. They shall be free from scratches and blemishes of any noticeable character. The edges shall be radiused as shown in Figure 8 and Figure 9.

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

7 Accuracy

a) **Diameter.** The diameter of each bar shall be uniform within 0.0005 in for bars up to 12 in in length, 0.001 in for bars over 12 in and up to 24 in in length, and within 0.002 in for bars longer than 24 in.

b) **Straightness.** The body shall be straight within 0.0001 in per inch of length.

[2)] Diamond Pyramid Hardness Number, the approximate equivalent hardness number on the Rockwell C scale is 62 HRC.

c) **End faces.**

i) *Flatness and parallelism*. The tolerances on flatness and parallelism of end faces shall be as given in Table 1 to Table 8.

ii) *Squareness.* The end faces of all grades of bars shall be square with the common axis of the Airy positions to within 0.00005 in over the diameter of the face for bars up to and including 16 in in length and to within 0.0001 in for bars over 16 in in length.

d) **Length.**

i) *General*. The tolerances on length shall be as given in Table 1 to Table 8.

ii) *Basis of tolerances*. The tolerances on length are based on the following factors and are rounded where appropriate.

Reference grade ± 2 parts in a million (with a minimum of
± 0.000 003 in).

Calibration grade ± 5 parts in a million (with a minimum of
± 0.000 005 in).

Inspection grade $\left.{}^{+7}_{-3}\right)$ parts in a million (with a minimum of
± 0.000 007 in).

Workshop grade $\left.{}^{+10}_{-5}\right)$ parts in a million
(with a minimum of
± 0.000 01 in).

NOTE The relationship between the tolerances given in the tables on flatness, parallelism and length for the smaller bars may appear anomalous, but it will be realized that full advantage cannot be taken of all of them concurrently.

Table 1 — Reference grade length bars

Inch sizes **Tolerances**

1	2	3	4
Nominal size	**Tolerances on accuracy of faces**[a]		**Tolerance on length at 68 °F**
	Flatness	**Parallelism**	
in	in	in	in
1	0.000 003	0.000 003	± 0.000 003
2	0.000 003	0.000 004	± 0.000 004
3	0.000 004	0.000 007	± 0.000 006
4	0.000 004	0.000 007	± 0.000 008
5	0.000 005	0.000 01	± 0.000 010
6	0.000 005	0.000 01	± 0.000 012
7	0.000 005	0.000 01	± 0.000 014
8	0.000 005	0.000 01	± 0.000 016
9	0.000 005	0.000 01	± 0.000 018
10	0.000 005	0.000 01	± 0.000 020
11	0.000 005	0.000 01	± 0.000 022
12	0.000 005	0.000 01	± 0.000 025
15	0.000 005	0.000 01	± 0.000 030
18	0.000 005	0.000 01	± 0.000 035
23	0.000 005	0.000 01	± 0.000 045
24	0.000 005	0.000 01	± 0.000 050
30	0.000 005	0.000 01	± 0.000 060
31	0.000 005	0.000 01	± 0.000 06
36	0.000 005	0.000 01	± 0.000 07
48	0.000 005	0.000 01	± 0.000 10

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

[a] For tolerances on squareness see Sub-clause **7** c) ii).

Table 3 — Calibration grade length bars

Inch sizes **Tolerances**

1	2	3	4
Nominal size	**Tolerance on accuracy of faces**[a]		**Tolerance on length at 68 °F**
	Flatness	**Parallelism**	
in	in	in	in
1	0.000 003	0.000 003	± 0.000 005
2	0.000 003	0.000 004	± 0.000 010
3	0.000 004	0.000 007	± 0.000 015
4	0.000 004	0.000 007	± 0.000 020
5	0.000 005	0.000 01	± 0.000 025
6	0.000 005	0.000 01	± 0.000 030
7	0.000 005	0.000 01	± 0.000 035
8	0.000 005	0.000 01	± 0.000 040
9	0.000 005	0.000 01	± 0.000 045
10	0.000 005	0.000 01	± 0.000 050
11	0.000 005	0.000 01	± 0.000 055
12	0.000 005	0.000 01	± 0.000 060
15	0.000 005	0.000 01	± 0.000 075
18	0.000 005	0.000 01	± 0.000 09
23	0.000 005	0.000 01	± 0.000 12
24	0.000 005	0.000 01	± 0.000 12
30	0.000 005	0.000 01	± 0.000 15
31	0.000 005	0.000 01	± 0.000 16
36	0.000 005	0.000 01	± 0.000 18
48	0.000 005	0.000 01	± 0.000 24

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

[a] For tolerances on squareness see Sub-clause **7** c) ii).

Table 5 — Inspection grade length bars

Inch sizes **Tolerances**

1	2	3	4
Nominal size[a]	**Tolerance on accuracy of faces**[b]		**Tolerance on length at 68 °F**
	Flatness	**Parallelism**	
in	in	in	in
1	0.000 005	0.000 005	+ 0.000 007 – 0.000 007
2	0.000 005	0.000 005	+ 0.000 014 – 0.000 007
3	0.000 007	0.000 007	+ 0.000 020 – 0.000 010
4	0.000 007	0.000 007	+ 0.000 030 – 0.000 010
5	0.000 007	0.000 01	+ 0.000 035 – 0.000 015
6	0.000 007	0.000 01	+ 0.000 040 – 0.000 020
7	0.000 007	0.000 01	+ 0.000 050 – 0.000 020
8	0.000 007	0.000 01	+ 0.000 055 – 0.000 025
15	0.000 007	0.000 02	+ 0.000 105 – 0.000 045
23	0.000 007	0.000 02	+ 0.000 16 – 0.000 07
31	0.000 007	0.000 02	+ 0.000 22 – 0.000 09
(36)	0.000 007	0.000 02	+ 0.000 25 – 0.000 11
(48)	0.000 007	0.000 02	+ 0.000 34 – 0.000 14

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

[a] For an explanation of this selection of sizes, see Appendix A where details of recommended sets of Inspection and Workshop bars are given; sizes in brackets are non-preferred.

[b] For tolerances on squareness see Sub-clause **7** c) ii).

Table 7 — Workshop grade length bars

Inch sizes **Tolerances**

1	2	3	4
Nominal size[a]	**Tolerance on accuracy of faces**[b]		**Tolerance on length at 68 °F**
	Flatness	**Parallelism**	
in	in	in	in
1	0.000 007	0.000 010	+ 0.000 01 – 0.000 01
2	0.000 007	0.000 010	+ 0.000 02 – 0.000 01
3	0.000 01	0.000 015	+ 0.000 03 – 0.000 02
4	0.000 01	0.000 015	+ 0.000 04 – 0.000 02
5	0.000 01	0.000 015	+ 0.000 05 – 0.000 03
6	0.000 01	0.000 015	+ 0.000 06 – 0.000 03
7	0.000 01	0.000 015	+ 0.000 07 – 0.000 04
8	0.000 01	0.000 015	+ 0.000 08 – 0.000 04
15	0.000 01	0.000 020	+ 0.000 15 – 0.000 08
23	0.000 01	0.000 025	+ 0.000 23 – 0.000 12
31	0.000 01	0.000 025	+ 0.000 31 – 0.000 16
(36)	0.000 01	0.000 03	+ 0.000 36 – 0.000 18
(48)	0.000 01	0.000 03	+ 0.000 48 – 0.000 24

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

[a] For an explanation of this selection of sizes, see Appendix A where details of recommended sets of Inspection and Workshop bars are given; sizes in brackets are non-preferred.
[b] For tolerances on squareness see Sub-clause **7** c) ii).

8 Connecting screws for inspection and workshop bars

At least six unhardened connecting screws $^3/_8$ in — 16 B.S.W. shall be provided with each set of inspection or workshop bars for holding them together. They shall screw quite freely into the threaded holes in the bars and shall not prevent the wringing faces from coming into satisfactory contact.

NOTE Suitable tolerances for the type of fit required are Normal class for the holes and Medium class for the screws as specified in BS 84, "*Parallel screw threads of Whitworth form*".

9 Marking

Each bar shall have legibly and permanently marked upon it the following particulars:

a) Nominal length.

b) The number of this British Standard (BS 1790).

c) 20 °C.

d) An identification number.

e) Grade, i.e. Reference, Calibration, Inspection or Workshop.

f) The manufacturer's name or trade mark.

NOTE The National Physical Laboratory will accept length bars for test for conformity with this British Standard. Full particulars of the tests and the fees charged may be obtained on application to the Director, the National Physical Laboratory, Teddington, Middlesex.

10 Case

Each set of length bars shall be housed in one or more substantial cases. The cases shall be dust-proof and shall 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 held firmly in its seating.

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

11 Protection against climatic conditions

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

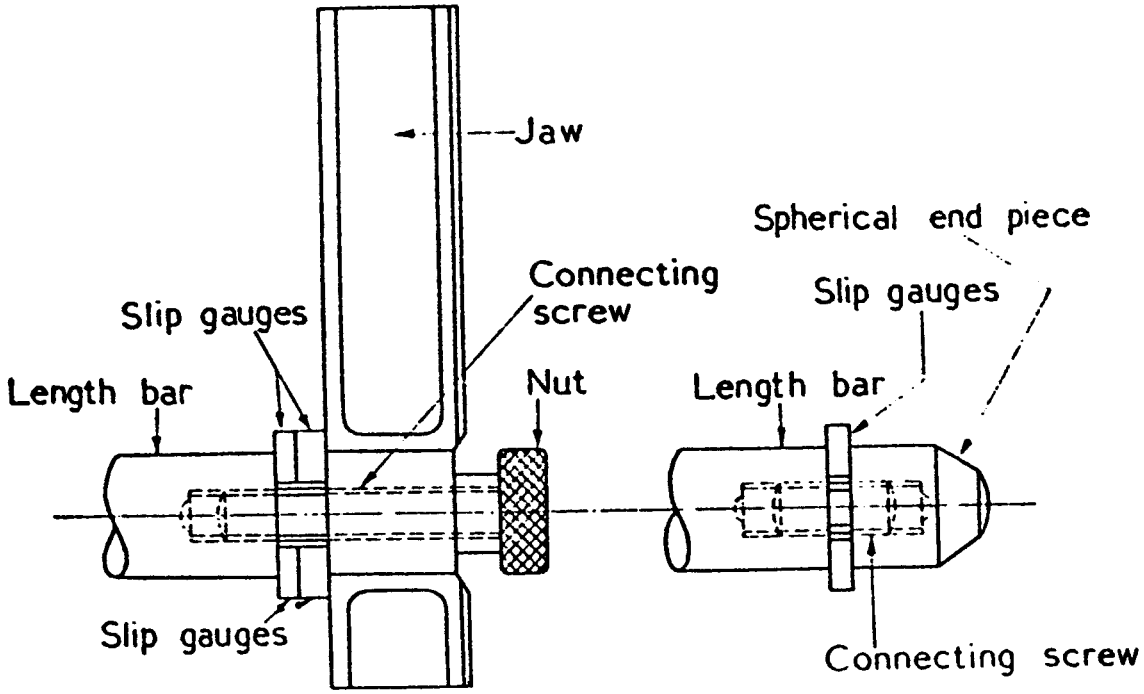

Figure 10 — Assembly of accessories

[3)] Temporary (easily removable) corrosion preventives are dealt with fully in BS 1133 "*Packaging Code*", Section 6, "*Temporary prevention of corrosion of metal surfaces*". Guidance on sealed packs with desiccants is given in Section 19, "*Use of desiccants in packaging*".

Section 2. Accessories for use with workshop length bars

NOTE Accessories may be used with Inspection grade bars but some loss of the accuracy associated with the refined connection will result.

12 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.

13 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 10 and Figure 11.

14 Base

a) **Design.** The base (see Figure 11) shall have a diameter of at least 5 in to provide adequate stability when used in conjunction with length bars up to 5 ft long.

b) **Finish.** The bearing surfaces of the base shall be finished by high quality lapping.

c) **Accuracy.**

i) *Flatness.* The upper and lower surfaces of the base shall be flat to within 0.000 01 in over the width of the annulus and to within 0.000 05 in over the full diameter of the base.

ii) *Parallelism.* The upper and lower surfaces of the base shall be parallel to one another within 0.000 01 in per inch.

iii) *Thickness.* The base shall have a thickness of 1 in, 25 mm, or 30 mm subject to a tolerance of ± 0.000 03 in.

15 Large radiused jaw

a) **General design.** The large radiused jaw shall be generally as shown in Figure 12.

b) **Finish.** One face of the jaw shall be lapped flat and the other face shall be lapped to cylindrical form with a radius of about 3 in. Sharp edges shall be removed and the unimportant surfaces left clean but dull.

c) **Accuracy.**

i) *Flatness.* The wringing face shall be flat within 0.000 01 in per inch of length.

ii) *Parallelism.* The gauging width of the jaw shall be parallel within 0.000 01 in per inch of length.

iii) *Width.* The effective width of the jaw shall be 1 in, 25 mm or 30 mm subject to a tolerance of ± 0.000 03 in.

iv) *Marking.* The jaw shall be marked "1 in" or "25 mm" or "30 mm" as applicable, in bold characters.

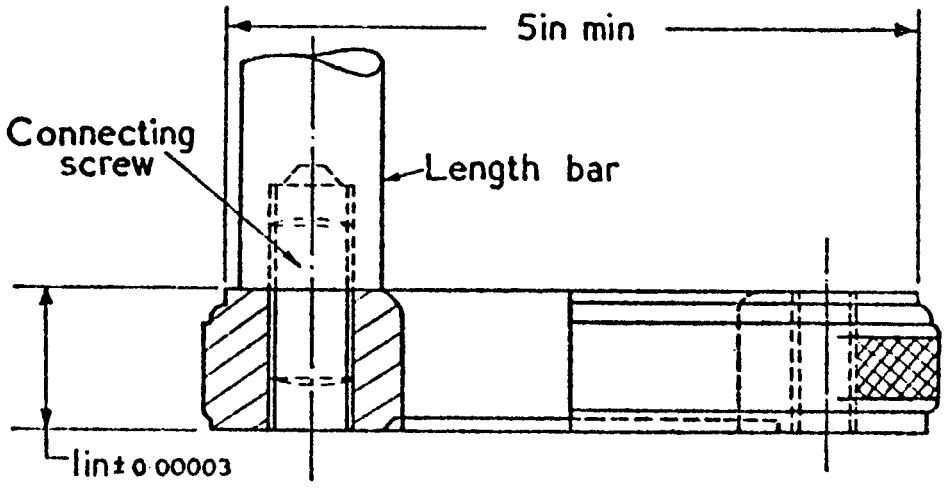

Figure 11 — Base

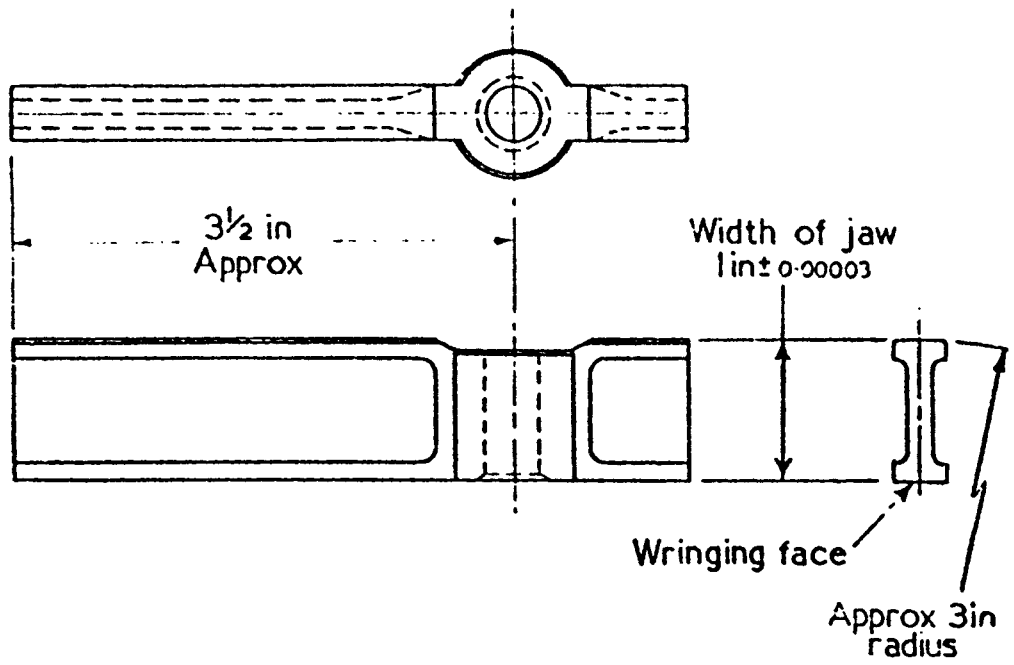

Figure 12 — Large radiused jaw

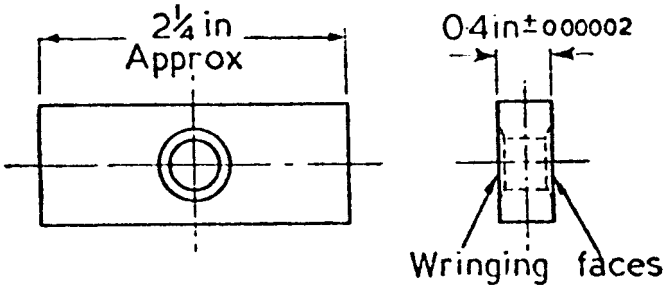

Figure 13 — Small plane-faced jaw

16 Small plane-faced jaw

a) **General design.** The general shape shall be as shown in Figure 13.

b) **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.

c) **Accuracy.**

i) *Flatness.* The wringing faces shall be flat within 0.000 01 in per inch of length.

ii) *Parallelism.* The wringing faces shall be parallel within 0.000 01 in per inch of length.

iii) *Width.* The effective width of the jaw shall be 0.4 in or 10 mm subject to a tolerance of ± 0.000 02 in.

iv) *Marking.* The jaw shall be marked "0.4 in" or "10 mm" as applicable, in bold characters.

17 Spherical end-piece

a) **General design.** The general form of the spherical end-piece shall be as shown in Figure 14.

b) **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.

c) **Radius.** The radius of the spherical end shall be approximately 1 in.

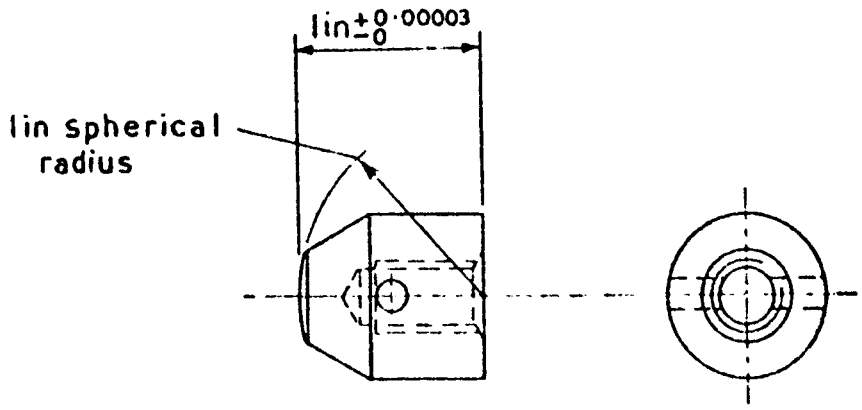

Figure 14 — Spherical end piece

d) **Accuracy.**

i) *Flatness.* The plane face of the spherical end-piece shall be flat within 0.000 01 in.

ii) *Length.* The overall length of the end-piece shall be 1 in subject to a tolerance of + 0.000 03 in – 0, or 25 mm or 30 mm + 0.000 8 mm – 0.

e) **Marking.** The end-piece shall be clearly marked with its nominal size, viz. "1 in", "25 mm" or "30 mm" as applicable.

18 Screws

Sufficient connecting screws for assembly shall be provided with each set of accessories.
(See Figure 10 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.

19 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.

20 Protection against climatic conditions

All surfaces of the accessories shall be protected against climatic conditions by being covered with a suitable corrosion preventive preparation[4)].

[4)] Temporary (easily removable) corrosion preventives are dealt with fully in BS 1133, "*Packaging Code*", Section 6, "*Temporary prevention of corrosion of metal surfaces*". Guidance on sealed packs with desiccants is given in Section 19, "*Use of desiccants in packaging*".

Appendix A Recommended sets of inspection and workshop grades of length bars

Inspection and workshop grades of length bars are designed to be used either singly or in combination. By using the bars in combination the number of bars in a set required to cover a particular range of sizes may be reduced and so result in considerable economies. This explains the selection of the particular series of nominal sizes given in Table 5 and Table 7 of this Standard.

The refined screwed connection makes it possible to use inspection grade bars in combination without any appreciable loss of the overall accuracy associated with this grade.

The original screwed connection is quite satisfactory for use in combining bars required for workshop accuracy.

The following recommended sets of bars are given as a guide to purchasers. Inspection sets are given in Table 9 and Workshop sets in Table 11. Alternative sets employing different combinations and numbers of bars can, of course, be worked out.

Table 9 — Inspection grade bars

Inch Sizes 14 Bars

Length	Type of bar
in 1	Solid at both ends
1 1 2 3 4 5 6 7 8	Screwed at one end only
8 15 23 31	Screwed at both ends
With the set of 14 bars listed in Table 9, the following composite bars, increasing in length by 1 in increments in the following size ranges, may be built up, each combination having solid end faces. Range 1 in to 15 in (using not more than 2 bars per combination). ,, 16 in to 46 in (,, ,, ,, ,, 3 ,, ,, ,,). ,, 47 in to 69 in (,, ,, ,, ,, 4 ,, ,, ,,).	

Table 11 — Workshop grade bars

Inch Sizes 11 Bars

Length	Type of bar
in	
1	
2	
3	
4	
5	
6	Screwed at both ends
7	
8	
15	
23	
31	
With the set of 11 bars listed in Table 11, the following composite bars increasing in length by 1 in increments in the following size ranges, may be built up: Range 1 in to 39 in (using not more than 2 bars per combination). ,, 40 in to 62 in (,, ,, ,, ,, 3 ,, ,, ,,).	

Appendix B

Papers on the influence of the screwed joints upon the overall length of a combination of length bar standards have been published in technical journals as follows:

Nickols, L. W. "The influence of screwed joints upon the overall length of a combination of length bar standards", *Machine Shop Magazine* 1956, **17**, 550; *Machinery* 1956, **89**, 473; *Metalworking Production* 1956, **100**, 1649.

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