

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
- British Iron and Steel Federation
- British Railways, The British Transport Commission
- Crown Agents for Oversea Governments and Administrations
- D.S.I.R. — National Engineering Laboratory
- Electricity Council, the Generating Board and the Area Boards in England and Wales
- Engineering Equipment Users' Association
- Gas Council
- High Commission of India
- Institute of Marine Engineers
- Institute of Petroleum
- Institution of Civil Engineers
- Institution of Gas Engineers
- Institution of Heating and Ventilating Engineers
- Institution of Mechanical Engineers
- Institution of Mechanical Engineers (Automobile Division)
- Institution of Production Engineers
- Locomotive and Allied Manufacturers' Association of Great Britain
- Machine Tool Trades Association
- 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

This British Standard having been approved by the Mechanical Engineering Industry Standards Committee and endorsed by the Chairman of the Engineering Divisional Council, was published under the authority of the General Council on 31 January 1961

© BSI 01-2000

First published January 1952
First revision January 1961

The following BSI references relate to the work on this standard:
Committee reference MEE/59
Draft for comment CZ (MEE) 9353

ISBN 0 580 34126 7

Amendments issued since publication

Amd. No.	Date of issue	Comments
1957	April 1976	Indicated by a sideline in the margin

Contents

	Page
Co-operating organizations	Inside front cover
Foreword	ii
1 Scope	1
2 Nomenclature and definitions	1
Section 1. Length bars	
3 General design	3
4 Material	3
5 Hardening and stabilizing	6
6 Finish	6
7 Accuracy	6
8 Connecting screws for inspection and workshop bars	11
9 Marking	11
10 Case	12
11 Protection against climatic conditions	12
Section 2. Accessories for use with inspection and workshop length bars	
12 Material	13
13 Method of attachment	13
14 Base	13
15 Large radiused jaw	13
16 Small plane-faced jaw	14
17 Spherical end piece	14
18 Screws	15
19 Case	15
20 Protection against climatic conditions	15
Appendix A Recommended sets of inspection and workshop grades of length bars	16
Appendix B Details of published papers on screwed connections	17
Figure 1 — Exaggerated illustration of flatness tolerance	2
Figure 2 — Exaggerated illustration of parallelism tolerance	2
Figure 3 — Exaggerated illustration of squareness tolerance	2
Figure 4 — Indication of airy positions	3
Figure 5 — Reference or calibration grade length bar	4
Figure 6 — Inspection grade length bar	4
Figure 7 — Workshop grade length bar	5
Figure 8 — New design of threaded connection for length bars	5
Figure 9 — Original type of screwed connection for length bars	6
Figure 10 — Assembly of accessories	12
Figure 11 — Base	13
Figure 12 — Large radiused jaw	14
Figure 13 — Small plane-faced jaw	14
Figure 14 — Spherical end piece	15
Table 1 — Reference grade length bars	8
Table 3 — Calibration grade length bars	9
Table 5 — Inspection grade length bars	10
Table 7 — Workshop grade length bars	11
Table 9 — Inspection grade bars	16
Table 11 — Workshop grade bars	17

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 connection¹⁾ 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.

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 $68 \pm 1^\circ\text{F}$ ($20 \pm \frac{1}{2}^\circ\text{C}$) 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)

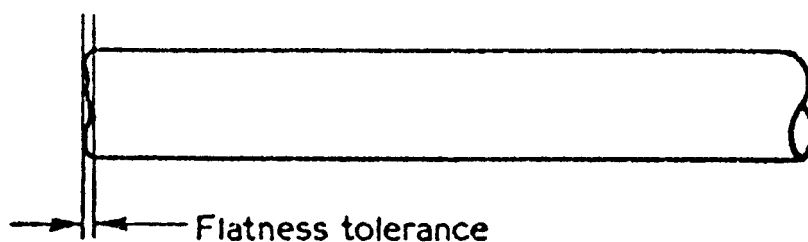


Figure 1 — Exaggerated illustration of flatness tolerance

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)

Parallelism tolerance $L_1 - L_2$

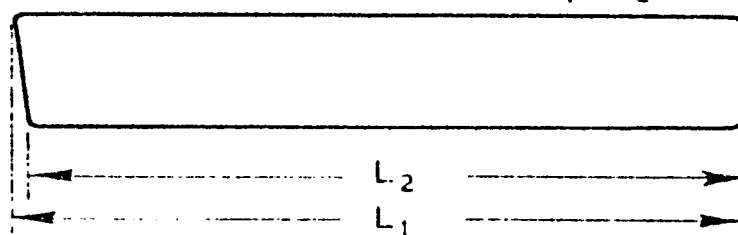


Figure 2 — Exaggerated illustration of parallelism tolerance

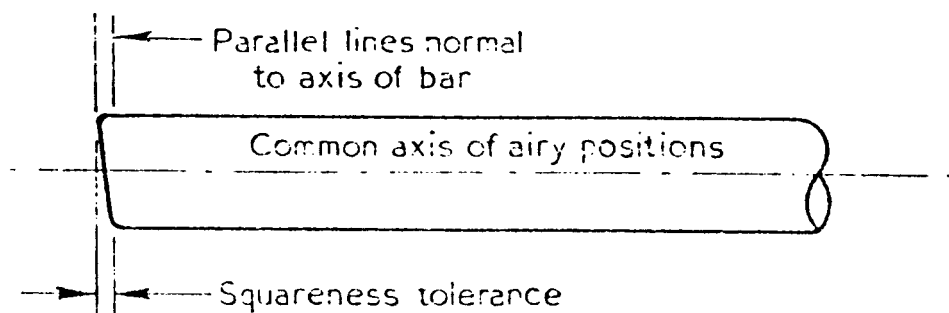


Figure 3 — Exaggerated illustration of squareness tolerance