BRITISH STANDARD

BS 2795:1981
Incorporating Amendments Nos. 1 and 2 and corrigendum No. 1

Specification for

Dial test indicators (lever type) for linear measurement

ICS 17.040.30

BSI British Standards

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This British Standard, having been prepared under the direction of the Mechanical Engineering Standards Committee, was published under the authority of the Executive Board and comes into effect on 31March 1981

First published January 1957
First revision December 1971
Second revision March 1981

The following BSI references relate to the work on this standard:
Committee reference MEE/59
Draft for comment 80/70345 DC

ISBN 978 0 580 75599 6

Amendments issued since publication

Amd. No.	Date	Comments
4034	July 1983	Changes made to the Scope and Table 1.
17351	28 September 2007	Foreword updated. Publications referred to and references updated. Indicated by a sideline in the margin.
C1	30 June 2011	Foreword and publications referred to updated. References to BS EN ISO 463 replaced with reference to BS EN ISO 9493:2010

Contents

Foreword

BS 2795 was first published in 1957 and was concerned with both imperial and metric reading instruments.

The standard was revised in 1971 and issued in two Parts, Part 1 dealing with metric units and Part 2 with instruments reading in imperial units.

This second revision of this standard takes account of current practice and clarifies anomolies relating to tolerances on accuracy. It combines the 1971 editions by stating the requirements for instruments reading in metric units in the body of the standard and the requirements relating to imperial units in Appendix C, as these are still needed.

This standard is superseded by BS EN ISO 9493:2010, and remains current and obsolescent.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot 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 8, 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 dial test indicators of the lever type fitted with an adjustable stylus lever that may be displaced in either of two opposite directions. Unless otherwise stated, the indicators are intended for applications to the work in a direction normal to the stylus lever.

Requirements are specified for dial test indicators with metric graduations in scale divisions of 0.01 mm with a minimum magnification of × 70 or 0.002 mm with a minimum magnification of × 350, each having a measuring range of at least one revolution of the pointer.

Test methods are given in Appendix A, and notes on care and use are given in Appendix B.

Instruments reading in imperial units are dealt with in Appendix C.

2 References

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

3 Nomenclature and definitions

For the purposes of this British Standard, the nomenclature given in Figure 1, together with the following definitions, apply.

NOTE The general definitions given in BS 5233 have been modified as applicable to dial test indicators.

3.1
repeatability

the ability to give the same reading when a dial test indicator is used by the same person and in the same manner and under the same conditions

3.2
discrimination

change of reading for small displacements of the stylus contact. The displacement may be caused gradually, cyclically or abruptly

3.3
error of reading

the difference between a repeated known displacement applied normal to the stylus lever and the mean of the readings of the dial test indicator

4 General design

The general design shall be such that readings on the dial test indicator repeat satisfactorily under all ordinary methods of operation, and the workmanship and finish shall be in conformity with a precision instrument of this class.

5 Dimensions

In order to facilitate interchangeability, the clamping dimensions shall be in accordance with Figure 1.

NOTE 1 It is recommended that the associated location hole for the clamping stem should be 6 mm or 8 mm diameter, as appropriate, with a tolerance of H7 (see BS EN 20286).
NOTE 2 In order that knuckles and similar attachments purchased prior to 1970 may continue to be used, a $^{1}/_{4}$ in stem and dovetail, dimensions in accordance with the requirements of Appendix C, may be supplied at the purchasers request.

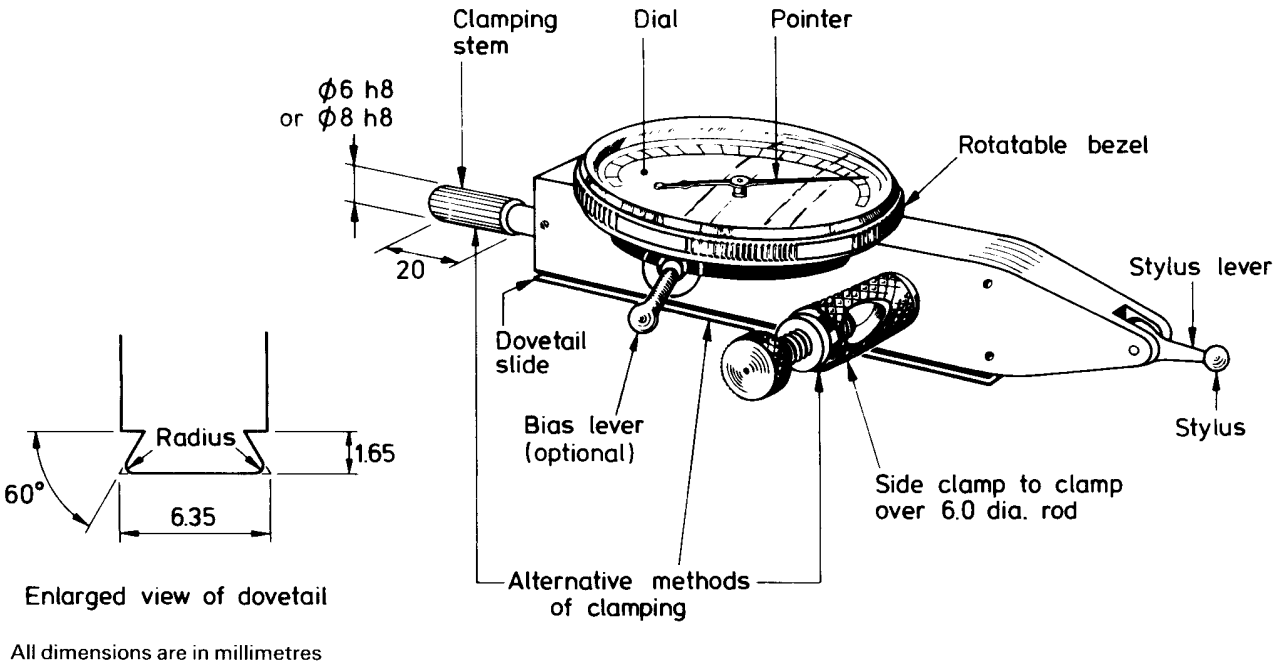


Figure 1 — Nomenclature and dimensions (see clause **3**)

6 Dial

6.1 The dial shall have marked upon it the nominal value of one division of the scale, i.e. 0.01 mm per division or 0.002 mm per division as appropriate.

6.2 The scale shall be marked with clear lines on a suitable background to enable easy reading.

6.3 Typical layouts of dials are shown in Figure 2.

6.4 The dial shall be rotatable for zero adjustment.

7 Pointer

7.1 The length of the pointer shall be such that its tip lies approximately over the centre of the length of the shortest graduation lines.

7.2 The width of that portion of the pointer overlapping the scale graduation lines shall not exceed one-fifth of the width of one division of the scale, and should preferably be of approximately the same width as the graduation lines.

7.3 The pointer shall be as close to the dial as practicable in order to minimize parallax between the pointer and the scale.

7.4 The movement of the pointer shall be free from jerkiness.

8 Stylus

8.1 For most purposes, the force required to operate the dial test indicator shall not exceed 0.8 N, but where special working forces are required, they shall be as specified by the purchaser.

8.2 The stylus shall be of spherical or involute form and shall be of hardened steel or other suitable hard material. It shall be well finished and free from flats or other irregularities that would affect accuracy.

8.3 The friction or ratchet attachment on the stylus lever arm shall be adequate to permit the use of the indicator under all normal methods of operation.

9 Performance

9.1 General. A dial test indicator shall comply with the requirements for accuracy within the tolerances given in Table 1:

a) for either direction of operation;

b) at any position within the range of the pointer movement excluding two divisions at the beginning and end of the travel;

c) without resort to tapping the indicators;

d) for an involute form of stylus, at any angle of application up to the maximum specified by the manufacturer.

9.2 Repeatability of reading. The indicator shall repeat its readings under all ordinary methods of operation to within the tolerance given for a) in Table 1.

9.3 Discrimination. The indicator shall be capable of indicating gradual, cyclical or abrupt changes of the order of one division to within the tolerance given for b) in Table 1.

9.4 Accuracy of readings. The errors of readings taken over various intervals of the scale shall not exceed the tolerance given for c) in Table 1.

The permissible error over an interval of reading may be either plus or minus and the tolerance shall not be exceeded for either direction of movement of the pointer.

Indicators with the involute form of stylus shall satisfy the above requirements of all angles of application up to the maximum specified by the manufacturer.

Table 1 — Tolerances for performance
(metric units)

Requirement	Tolerance	
	0.01 mm dial	0.002 mm dial
	mm	mm
a) Repeatability	0.001	0.0005
b) Discrimination		
Displacement of 0.01 mm	0.003	—
Displacement of 0.002 mm	—	0.0006
c) Error of reading over an interval of:		
any one division	0.002	0.0005
any five divisions	0.005	0.001
any half revolution	0.01	0.002

10 Packaging

The dial test indicator shall be packed in a suitable box that will protect the mechanism against shock arising from rough handling.

11 Marking

Each dial test indicator shall be legibly and permanently marked with the manufacturer's or vendor's name or trade mark.

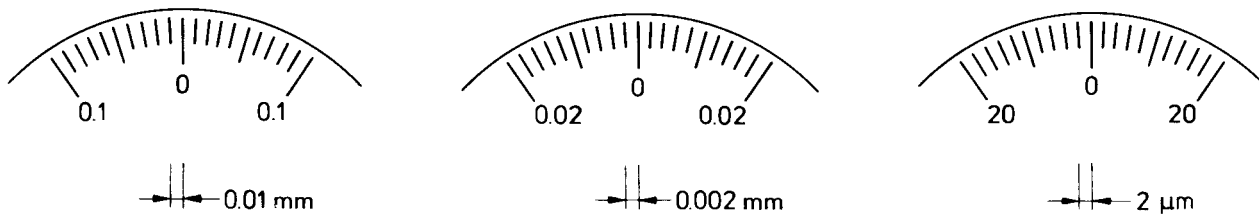


Figure 2 — Layout of dials

Appendix A Methods of test

A.1 General

Subclauses **A.2** and **A.3** describe some of the methods of test that may be used. Dial test indicators have two directions of operation and are usable under different conditions of displacement of the stylus lever. Although their versatility poses the testing of several variables, the tests can be organized economically. For example, the tests described for discrimination and error of reading can also inform about repeatability; the test on gauge blocks for repeatability checks discrimination.

A.2 Repeatability

The dial test indicator is securely fixed to a rigid stand that can be moved over a precision surface plate. The stylus on the dial test indicator is then applied, in turn to (1) a semi-circular block B and (2) two gauge blocks C of different sizes, all of which are wrung to a steel block A, the surfaces D, E and F of which are lapped (see Figure 3). The parts B and C are intended to simulate conditions of contact met with in practice. The stylus contact should approach B and C from various directions and the variation of reading compared with the prescribed tolerance.

It is recommended that the difference in size between two gauge blocks C should be the equivalent of one division movement of the pointer.

In order to test the indicator operating in the reverse direction, the jig can be inverted so that the lapped surface D is wrung to the surface plate, as illustrated in Figure 3 b).

A.3 Discrimination

A practical way of testing a dial test indicator for discrimination is to mount it on a rigid fixture with the stylus contact on the surface of an eccentric precision mandrel[1)] mounted on centres. The throw or total indicator reading (TIR) of the mandrel can be determined beforehand by means of a more sensitive indicator (preferably a high quality electronic instrument known to have a good discrimination) set to read on the mandrel surface. For this test the TIR should be of the order of one division of the dial test indicator under test.

When the dial test indicator is tested against such a mandrel it should indicate the known amount of throw present within the prescribed tolerance.

Another test is to move the dial test indicator along a sine bar tilted at a small angle and to observe the difference of the gradual displacement of the stylus lever from the change in indicator reading.

Lack of discrimination may be caused by stickiness, backlash or hysteresis. It is not usual to isolate each of these effects.

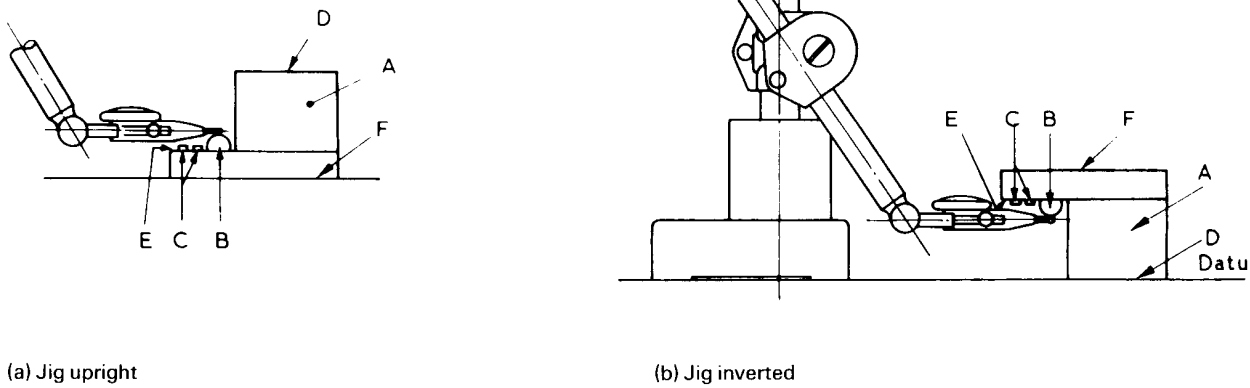
A.4 Errors of readings

The calibration of a dial test indicator can be carried out by using the jig illustrated in Figure 3 a) and b). Gauge blocks chosen to cover the measuring range of the indicator at suitable intervals are wrung to face E of the block and readings taken.

The errors of reading may be checked against a calibrated micrometer head as shown in Figure 4 a) and b). In this arrangement the dial test indicator is supported rigidly with the stylus lever nominally at right angles to the axis of the micrometer head.

In both methods of test the mean of several readings at each point should be used to compare with the prescribed tolerance.

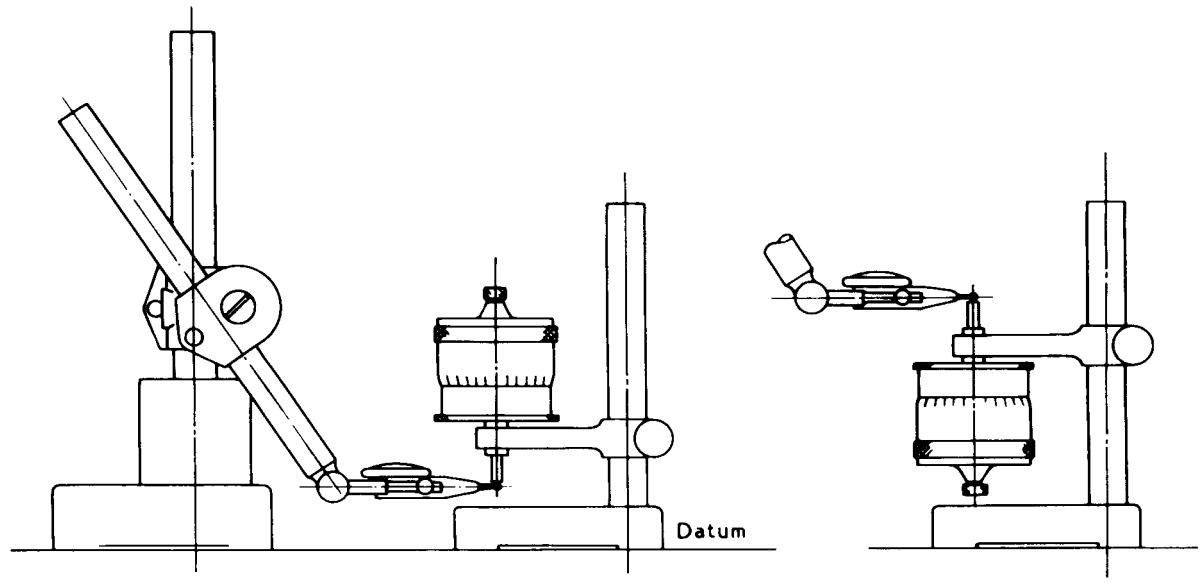
[1)] A convenient form of mandrel for this purpose can be produced by slightly off-setting the centre at one end only. It is then possible to select the required eccentricity by contacting the mandrel at the appropriate position along its length. The surface finish of the mandrel should not exceed 0.05 μm R_a at 0.25 mm cut-off.



(a) Jig upright

(b) Jig inverted

Figure 3 — Tests for repeatability of readings



(a) Micrometer head down

(b) Micrometer head up

Figure 4 — Tests for accuracy of readings

Appendix B Notes on care and use

B.1 General care

In order to retain the accuracy of reading of a dial test indicator, care should be taken to avoid its receiving a sharp blow or any similar mishap which might damage the pivots or bearings.

When not in use, the indicator should be kept in a closed case to avoid the entry of dust into the movement.

The manufacturer's instructions regarding care of the indicator should be carried out. If at any time the movement of an indicator is suspect, it is advisable for the indicator to be returned to the maker for attention.

B.2 Stands: clamping

An indicator should be attached to a robust stand having a mass that is large in proportion to the measuring force of the indicator. If the conditions of measurement require the stand to be moved, it should have a well finished base.

Overhang of the indicator from the clamping knuckles and from the base should be kept to a minimum.

B.3 Principles of use

When comparing an indicator reading on a standard with a reading on a workpiece, it is desirable to use a length standard made up as near as possible to the size of the workpiece to be determined and thus cause a minimum movement of the pointer.

As a general principle, the indicator stand should be kept stationary on a datum plane and the workpiece, brought to the indicator. Where, however, the indicator has to be brought on to the workpiece, on the whole more representative readings and a more reliable mean is obtained when the test indicator is successively withdrawn and re-offered to the surface under measurement.

It should be emphasized that the measurements described above depend upon the flatness of the datum plane on which the workpiece, length standard and stand are moved. Grade A surface plates complying with the requirements of BS 817 offer a suitable order of flatness for the 0.01 mm indicator in general; selected areas of the same plate may be used with the 0.002 mm indicator.

To avoid inaccuracies, dial test indicators should be applied to the work with the stylus lever normal to the direction of measurement. When this is not possible, and a spherical stylus is used, the observed measurement has to be multiplied by the cosine of the angle of inclination of the stylus lever to the correct position. However, if the stylus contact has involute form, the cosine correction is not to be applied, provided that the angle of inclination does not exceed the limit specified by the manufacturer.

Appendix C Dial test indicators reading in imperial units

C.1 General

Appendix C has been prepared for guidance when dial test indicators reading in imperial units are required. Apart from the information given below, the requirements shown in the remainder of the standard will apply.

C.2 Object

This appendix relates to dial test indicators with imperial graduations in scale divisions of 0.001 in with a minimum magnification of × 70, (sometimes subdivided into half-units of 0.0005 in) or 0.0001 in with a minimum magnification of × 350, each having a measuring range of at least one revolution of the pointer.

C.3 Dimensions

It is recommended that, in order to facilitate interchangeability, the clamping dimensions be in accordance with Figure 5.

C.4 Dial

The dial is marked with the nominal value of one division of the scale, i.e. 0.001 in or 0.0001 in per division, as appropriate. Layouts of the dials are shown in Figure 6.

C.5 Performance

Tolerances for performance are given in Table 2.

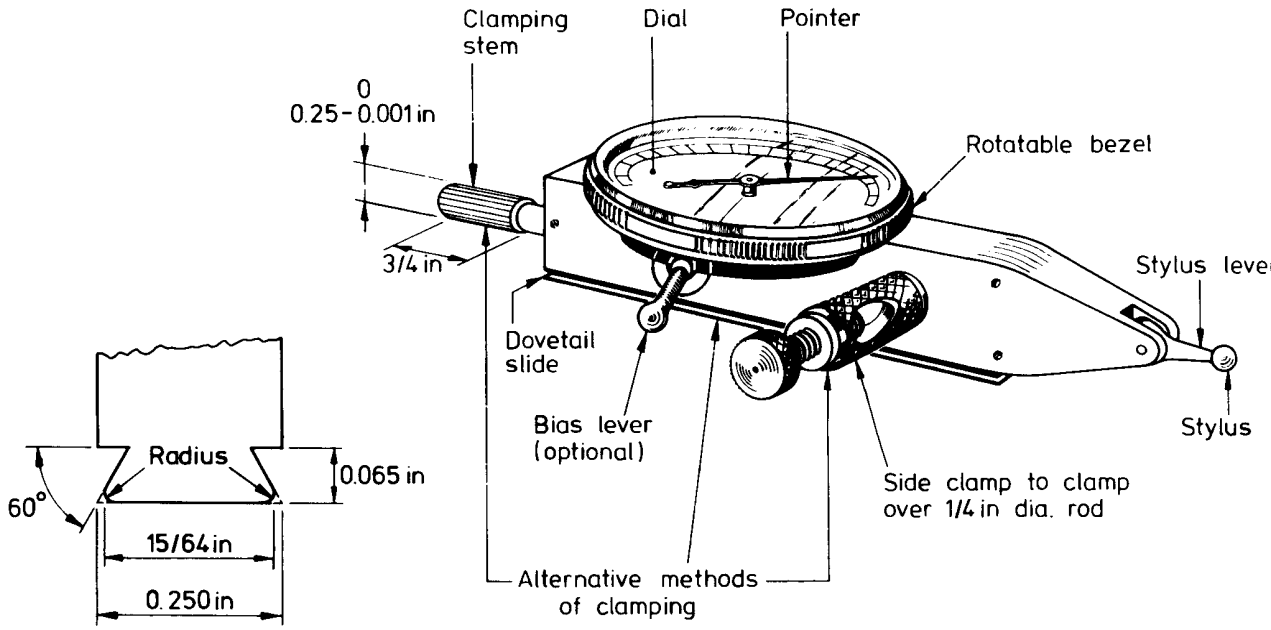


Figure 5 — Nomenclature and dimensions

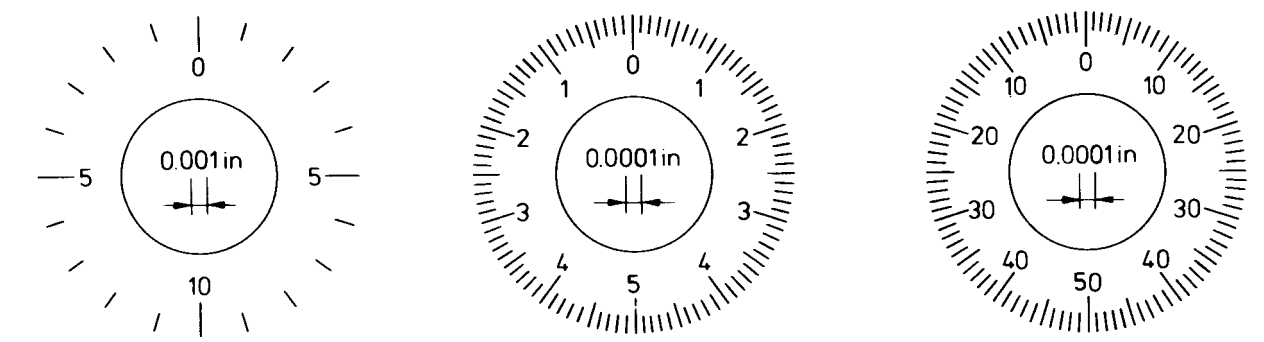


Figure 6 — Layout of dials

Table 2 — Tolerances for performance
(imperial units)

Requirement	Tolerance	
	0.001 in dial	**0.0001 in dial**
	in	in
a) Repeatability	0.0001	0.000025
b) Discrimination		
Displacement of 0.001 in	0.0003	—
Displacement of 0.0001 in	—	0.00003
c) Error of reading over an interval of:		
any one division	0.0002	0.00003
any five divisions	0.0005	0.00005
any half revolution	0.001	0.0001

Publications referred to

BS 817, *Surface plates and tables.*

BS 5233, *Glossary of terms used in metrology.*

BS EN 20286, *ISO system of limits and fits.*

BS EN ISO 9493:2010, *Geometrical product specifications (GPS) — Dimensional measuring equipment: Dial test indicators (lever type) — Design and metrological characteristics.*

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