

**BS 1685:2008**

*Incorporating Corrigendum No. 1*



**BSI Standards Publication**

# **Bevel protractors (mechanical and optical) – Requirements and test methods**

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### Summary of pages

This document comprises a front cover, an inside front cover, pages i to ii, pages 1 to 6, an inside back cover and a back cover.

## Foreword

### Publishing information

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

### Supersession

This British Standard supersedes BS 1685:1951, which is withdrawn.

### Information about this document

This new edition has been fully revised to bring it up to date.

The start and finish of text introduced or altered by Corrigendum No. 1 is indicated in the text by tags C1 C1.

### Presentational conventions

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

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

### Contractual and legal considerations

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.**

## 1 Scope

*COMMENTARY ON 1: The fitting of an acute angle attachment is optional.*

This standard relates to the following types of bevel protractors:

a) *Mechanical.*

*Type A.* With vernier graduated to read to five minutes of arc, and with slow motion device, and acute angle attachment.

*Type B.* With vernier graduated to read to five minutes of arc, but without slow motion device or acute angle attachment.

*Type C.* With scale graduated in degrees, without vernier or slow motion device or acute angle attachment.

b) *Optical.* With an internal circular scale which is graduated in divisions of 10 minutes of arc<sup>1)</sup> and read against a fixed index line or vernier by means of an optical magnifying system integral with the instrument, enabling readings to be taken, by estimation or otherwise, to approximately two minutes of arc.

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

## 2 Nomenclature

For the purpose of this standard the nomenclature indicated in Figure 1 and Figure 2 has been adopted for mechanical and optical types of bevel protractors respectively.

*NOTE* With the exception of the requirements for graduations, which are set out in detail in Clause 10, the following clauses apply both to mechanical and optical types of bevel protractors.

## 3 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

BS EN 12540, *Corrosion protection of metals — Electrodeposited coatings of nickel, nickel plus chromium, copper plus nickel and copper plus nickel plus chromium*

BS EN ISO 18265, *Metallic materials — Conversion of hardness values*

## 4 Material

All parts of the protractor which constitute working parts shall be made of good quality steel which may, if desired, be of the stainless type.

The working edges of the blade or blades and the acute angle attachment shall have a diamond pyramid hardness number of not less than 450 (45 Rockwell C scale) or equivalent according to BS EN ISO 18265.

<sup>1)</sup> Present known instruments are graduated to 10 minutes of arc but other suitable values of graduation arc permissible.

The blade section of the protractor shall be manufactured in one continuous length from carbon steel, carbon steel matt chrome plated in accordance with BS EN 12540 or rust-resisting steel. The steel shall be hardened and tempered and shall have a hardness of 450 to 550 HV or equivalent according to BS EN ISO 18265.

## 5 General design and workmanship

The general workmanship and finish shall be good throughout. The rotational movement shall be smooth and Type A protractors shall incorporate a thumb pinion or other suitable device to assist in fine setting. The design shall incorporate an effective clamp and no change in reading shall be observed on clamping.

## 6 Body

The protractor shall be so designed that the back of the body is flat and that there are no projections beyond the plane of the back. When the protractor is placed on its back on a surface plate or toolmakers' flat conforming to BS 869, there shall be no rocking perceivable to the naked eye.

When the protractor is placed with the working edge of the stock on a surface plate or toolmakers' flat conforming to BS 869 and the blade set at 90°, the side of the blade and the back of the protractor body shall be square laterally with the surface plate or toolmakers' flat to within 0.075 mm per 25 mm/0.003 in. per inch.

Figure 1 Nomenclature for mechanical bevel protractors

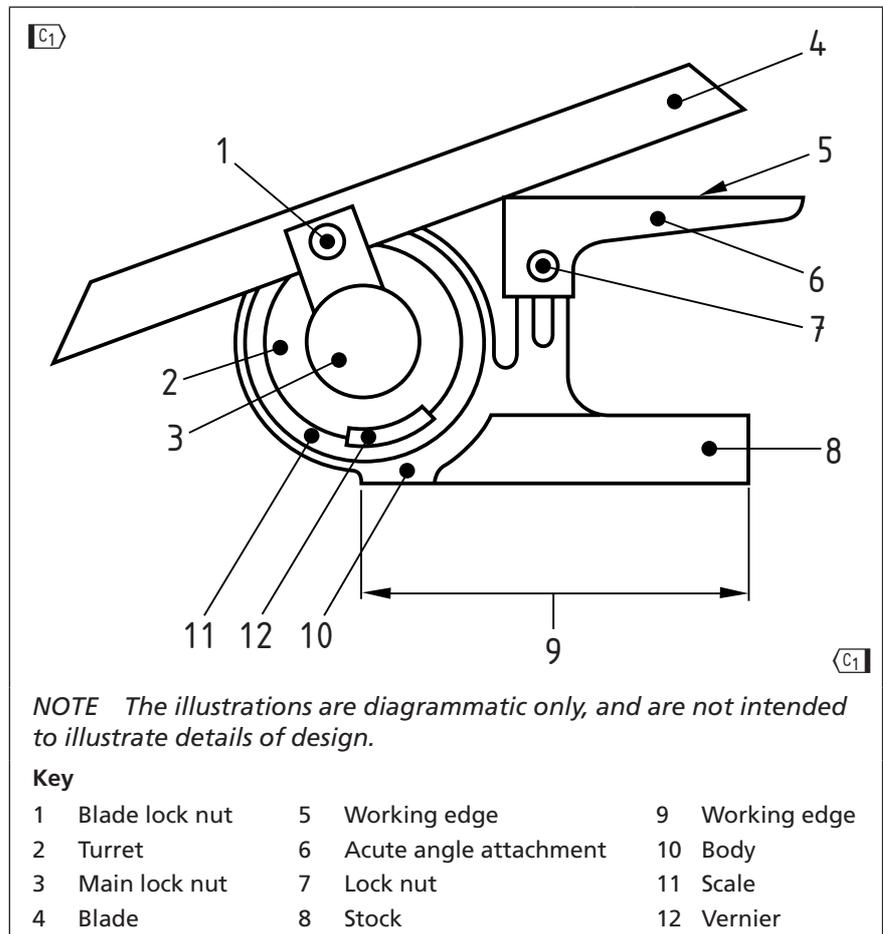


Figure 2 Nomenclature for optical bevel protractors

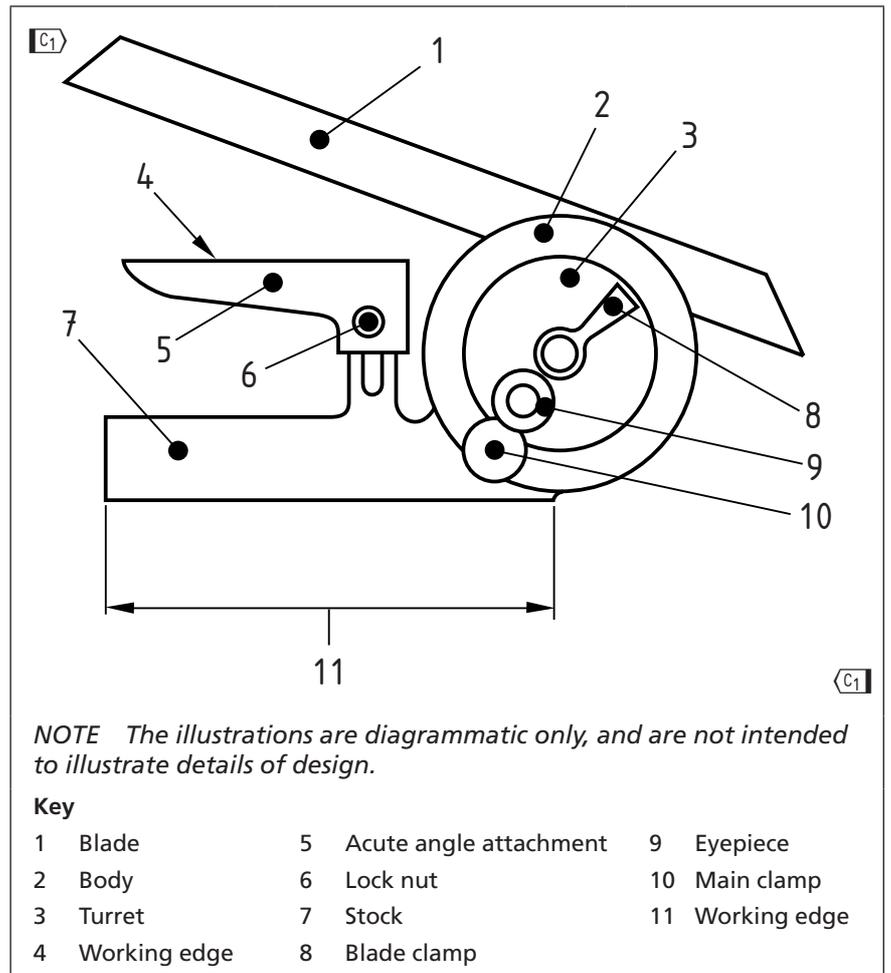
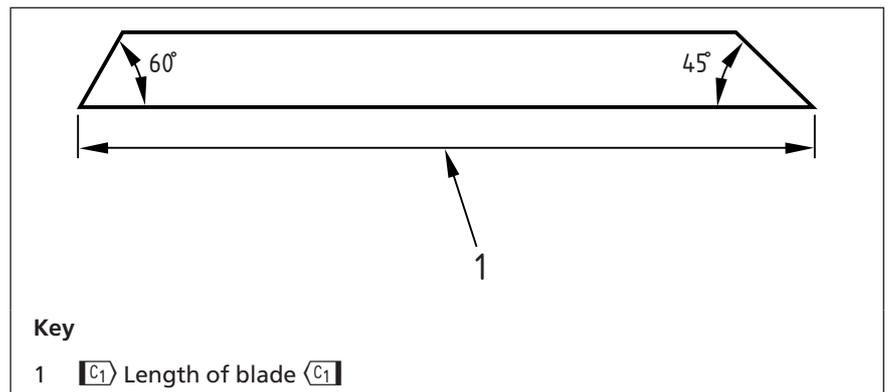


Figure 3 Blade



## 7 Stock

**NOTE** The thickness of 4.8 mm<sup>3</sup>/<sub>16</sub> in for mechanical types has been adopted to accommodate the present practice of manufacturers but it is desirable that the minimum thickness should be 6 mm<sup>1</sup>/<sub>4</sub> in.

The working edge of the stock shall be not less than 90 mm<sup>3</sup>/<sub>2</sub> in long and shall have a thickness of not less than 4.8 mm<sup>3</sup>/<sub>16</sub> inch in the case of mechanical types, and not less than 6 mm<sup>1</sup>/<sub>4</sub> in in the case of optical types. It shall be straight to 0.010 mm/0.000 4 in.

Any departure from true straightness shall be in the nature of a concavity, the extent of which shall not exceed 0.01 mm/0.000 4 in. when measured over the total span of the surface concerned.

## 8 Blade

The blade shall be either 150 mm/6 in or 300 mm/12 in long. The ends of the blade shall be bevelled in the manner illustrated in Figure 3 to 60° and 45° respectively, and shall be accurate to within  $\pm 5$  minutes of arc.

The blade shall be not less than 14 mm/ $17/32$  in wide and not less than 1.25 mm/0.05 in thick.

The blade shall be so designed that it can be moved along the turret throughout its whole length, and also be reversed. An effective method of clamping shall be provided.

The sides of the blade or blades shall be flat to within 0.125 mm/0.005 in and 0.25 mm/0.010 in for the 150 mm/6 in and 300 mm/12 in blades respectively.

The working edges of the 150 mm/6 in blades shall be straight to 0.010 mm/0.000 4 in and parallel to  $\square_{C_1}$  0.012 5 mm/0.000 5 in  $\square_{C_1}$  over their lengths.

The working edges of the 12 in/300 mm blades shall be straight to 0.020 mm/0.000 8 in and parallel to 0.025 0 mm/0.001 in over their lengths.

## 9 Acute angle attachment

The working edge of the acute angle attachment shall be not less than 75 mm/3 in long and the thickness shall correspond to that of the blade. The working edge shall be straight to within  $\square_{C_1}$  0.005 mm/0.000 2 in  $\square_{C_1}$  and, according to the type of attachment, shall be parallel with, or square to, the working edge of the stock to within 0.012 5 mm/0.000 5 in over the length of the attachment in all its positions.

## 10 Graduations

- a) *Mechanical types.* The diameter of the graduated circle shall be not less than 50 mm/2 in at the reading edge.

The protractor may be so designed that the scale is either on the body or on the turret.

The scale shall be graduated either as a full circle marked 0-90-0-90 (four quadrants) with one vernier, or alternatively as a semicircle marked 0-90-0 with two verniers 180° apart. All verniers shall read in both directions. One zero position shall be when the blade is parallel to the stock (see Figure 4). The acute angle reading shall then be zero, or 90°, according to the type of acute angle attachment with which the protractor is fitted.

All graduations shall be clearly engraved. The thickness of the graduations shall be neither less than 0.064 mm/0.002 5 in nor more than 0.09 mm/0.003 5 in. The thickness of the graduations of the vernier and main scale shall be equal, as observed by the eye.

The visible length of the shortest graduations on both the scale and vernier (dimensions  $L$ , Figure 5) shall be approximately equal to twice the width of the interval between adjacent lines.

The distance from the face of the scale to the face of the vernier or zero index (dimension  $T$ , Figure 6) shall not exceed 0.10 mm/0.004 in.

Figure 4 Zero position

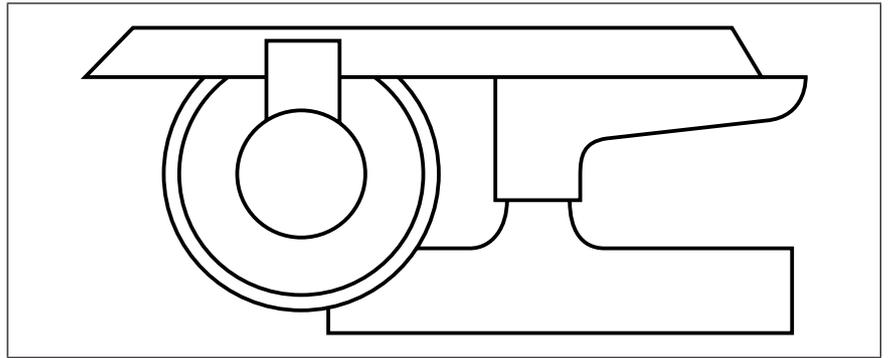


Figure 5 Length of graduations

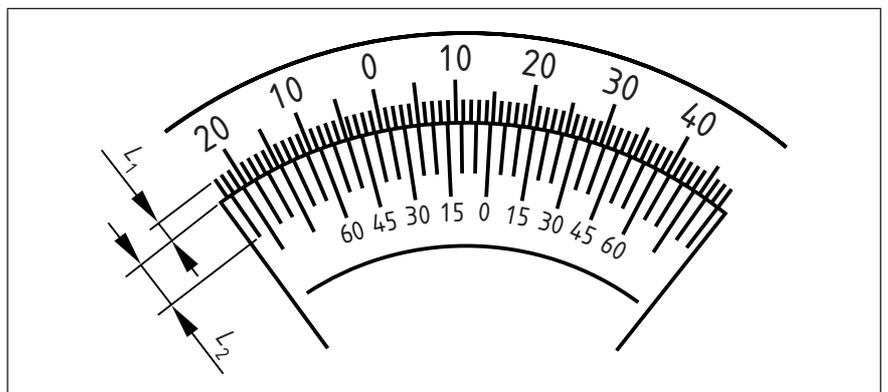
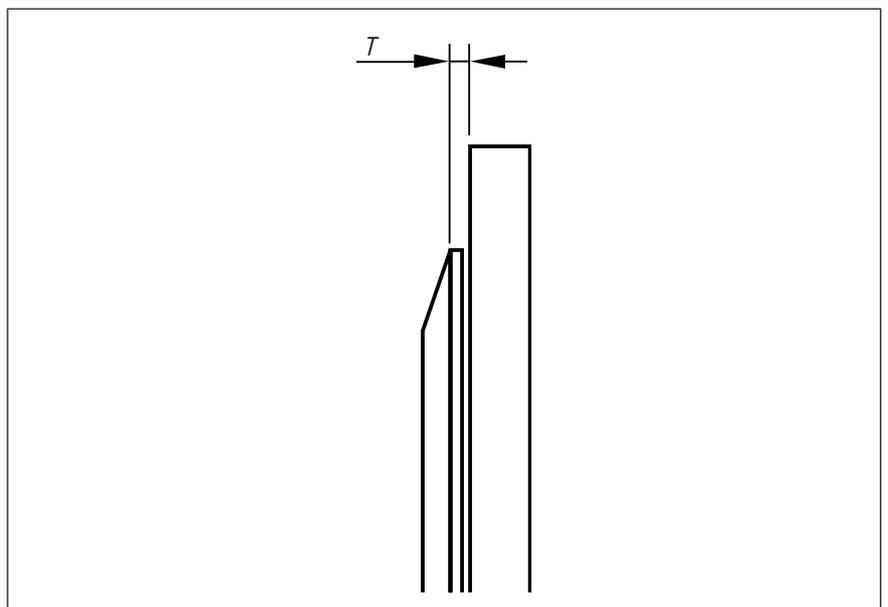


Figure 6 Section through scale and vernier



Protractors without verniers shall be graduated in degrees, and the error of indication in any position of the blade shall not exceed plus and minus one-fifth of a degree.

Protractors with verniers shall be graduated to read direct to five minutes of arc, and the error of indication in any position of the blade, including the use of the acute angle attachment if fitted, shall not exceed plus and minus five minutes of arc.

*NOTE* It is recommended that, for ease of reading, the scale and vernier should have a dull chromium finish.

- b) *Optical type.* The scale shall be graduated as a full circle marked 0-90-0-90 (four quadrants). The zero positions shall be when the blade is parallel to the stock. The acute angle reading shall then be zero or 90°, according to the type of acute angle attachment, when fitted.

All graduations shall be clearly defined. The thickness of the graduations shall be equivalent to not less than one minute and not more than two minutes of the circle. The thickness of the graduations of the scale and the index line or vernier shall be equal, as observed through the optical system.

The scale and index line or vernier shall be in focus in the optical system simultaneously.

It shall be possible to adjust the focus of the optical system to accommodate normal variations in eyesight (including vision corrected by spectacles, or contact lenses) and the field of view shall appear clearly illuminated when the instrument is held to a light.

The error of indication of the protractor in any position of the blade, including the use of the acute angle attachment if fitted, shall not exceed two minutes of arc.

## 11 Marking

Each protractor shall have legibly and permanently engraved upon it the manufacturer's name or trade mark and an identification number.

## 12 Case

Each protractor shall be supplied in a suitable protective case or box.



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