BS 1054:1975

Specification for

Engineers' comparators for external measurement

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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 professional and industrial organizations:

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Department of Industry — National Physical Laboratory
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This British Standard, having been approved by the Mechanical Engineering Industry Standards Committee, was published under the authority of the Executive Board on
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The following BSI references relate to the work on this standard:
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Amendments issued since publication

Amd. No.	Date of issue	Comments

Contents

Foreword

This British Standard is one of the series of standards for engineers' precision measuring equipment for which metric versions are now being issued. It was first published as BS 1054 in 1942 and revised in 1954. As in the case of earlier editions, this standard is concerned mainly with the accuracy of performance of comparators and touches on features of design only where these are likely to have a direct effect on the accuracy.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 3 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 specifies requirements for comparators having magnification factors of 250 and over.

The type of comparator to which the requirements are primarily intended to apply is an instrument comprising a rigid stand supporting a measuring head over a work table.

The measuring head is provided with a measuring tip whose movements are amplified and indicated on a scale in metric units. The means of amplification may be mechanical, electrical, electronic, optical, fluid or pneumatic.

2 Definitions

For the purposes of this standard, the following definitions apply.

2.1
deviation from flatness

the minimum distance between two parallel planes which just envelop the measuring face (see Figure 1)

NOTE It may be necessary to control the maximum slope of the surface deviations with respect to the enclosing planes.

2.2
flatness tolerance

the maximum permissible deviation from flatness

3 Design features

The instrument shall be of rigid construction and first class workmanship throughout.

Particular attention should be paid to the rigidity of the vertical post or bracket which carries the measuring head and to the method of supporting the work table.

The distance between the measuring head and work table shall be adjustable to suit workpieces of different sizes within the stated capacity of the instrument.

The base shall be of rigid construction and shall be provided with three feet. It should provide facilities for interchanging work tables.

The measuring head shall be provided with a coarse adjustment for the accommodation of work within the capacity of the instrument. This coarse adjustment shall be smooth in operation and be provided with means of preventing free falling movement of the measuring head in the unclamped position.

Means shall also be provided for finely adjusting the relative position of the measuring head to the work table and for clamping this fine adjustment in such a way as to ensure that the setting is maintained within one tenth of a division of the scale.

The mechanism within the measuring head shall be provided with effective means of preventing damage to it in the event of the measuring tip being raised abnormally or suddenly released.

4 Work table

The work table shall be made of steel or of an alternative material of comparable wearing properties, for example, of granite or of steel with tungsten carbide inserts, with or without grooves.

Steel work tables shall be hardened over the working surface to not less than HV850 (Rockwell C63) and, after hardening, shall be suitably heat treated to give stability.

The surface of the work table shall be finished by lapping and shall be flat to within the following tolerances.

For comparators having a magnification factor of 600 or less: 0.001 mm

For comparators having a magnification factor of over 600 and up to 10 000: 0.0005 mm

For comparators having a magnification factor greater than 10 000: 0.0003 mm

The tolerances specified for flatness shall apply to the full working surface when the work table is 75 mm in diameter or smaller and to any area 75 mm in diameter for larger work tables.

Any deviation from flatness shall be such as to give a convex configuration (see Figure 1).

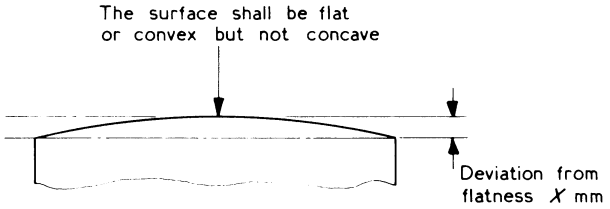

Figure 1 — Deviation from flatness

The lower surface of the work table, where it is a working surface, shall be parallel to the upper surface to within 0.01 mm per 25 mm.

5 Measuring tip

The measuring tip shall be of hardened steel having a hardness of not less than HV850 or shall be of an alternative material of comparable wearing properties.

The face of the measuring tip shall normally be rounded; a minimum radius of 8 mm is recommended.

If a flat face is fitted, means shall be provided whereby the user is able to adjust the face of the tip so that the required degree of parallelism can be obtained between the tip and the surface of the work table.

The measuring tip may be provided with a raising device.

6 Operating force

It is recommended that the force applied to the measuring tip to obtain zero reading on the instrument be of the order of 2 N to 2.5 N.

If a measuring force substantially different from this is required, it shall be stated in the purchaser's order.

The operating force shall be substantially constant throughout the working range; the maximum force shall not be more than 50 % greater than the minimum for instruments having magnification factors below 3 000 nor more than 25 % greater than the minimum for instruments having magnifications greater than 3 000.

7 Pointer

In dial reading instruments, the pointer shall be rigidly attached to its spindle in such a manner as to ensure that there will be no relative movement between them when the measuring tip is subject to rapid acceleration or deceleration, as in the event of the measuring tip being suddenly released and its motion being arrested by a fixed stop.

The pointer should be provided with a suitable damping device. The thickness of the pointer should be approximately the same as that of the scale marks. The design of the pointer and associated scale shall be such as to reduce to the lowest possible value any errors due to parallax. For instruments having pointers which pass over the scale, the pointer tips should overlap the scale marks by one fifth to one half of the length of the shortest scale marks.

8 Scale

The scale shall normally be graduated in metric units.

NOTE If required by the purchaser, the scale may be graduated in metric and imperial units, in which case the metric units shall predominate.

The scale shall consist of black marks on a white ground or such other combination of contrasting colours as will show up with equal clarity so that it can be conveniently read under ordinary workshop lighting conditions.

All scale marks shall have a clean sharp outline and be uniform in thickness. The recommended line thickness is 0.2 mm to 0.3 mm.

Both fifth and tenth scale intervals shall be indicated by a slightly longer mark. On single range scales, at least every tenth interval shall be numbered and the value of each scale interval shall be clearly marked within the scale area or be numbered at least every tenth interval and the half scale value shall be clearly marked at the plus and minus ends of the scale.

NOTE For illustrations of the terms "scale mark" and "scale interval", see Figure 2.

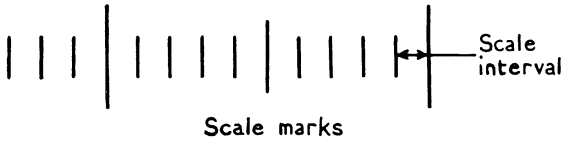

Figure 2 — Scale

On multi-range scales, at least every tenth interval shall be numbered and the value of each scale interval shall be clearly marked within the scale area using a suitable code to identify scale and scale interval values.

Fine subdivision of the scale is deprecated; it is recommended that no scale interval should be less than 1 mm.

The zero scale mark should preferably be at the centre of the scale. Scales requiring the zero position to be other than in the centre position should be the subject of agreement between the purchaser and the manufacturer of the instrument.

The relative movement of the pointer and scale should be such as to suggest to the observer the direction of movement of the measuring tip as the work is passed under it. For example, when the pointer moves over a fixed scale, an increase in the size of the work should be indicated by a movement of the pointer upwards on a vertical scale or to the right on a horizontal scale.

If the scale is in the form of an arc above the centre of rotation of the pointer, a clockwise movement of the pointer should indicate an increase in the work size. Where the scale is in the form of an arc below the centre of rotation of the pointer, an anticlockwise movement of the pointer should indicate an increase in work size.

The scale shall be boldly marked with plus and minus signs to indicate increases and decreases in the size of the measured work.

9 Performance

9.1 Consistency of reading. The consistency of reading of the comparator shall be examined by carrying out the following series of tests; the permissible errors are stated in Table 1 and are related to the magnification factor.

9.1.1 When the instrument is set to read on a workpiece and the measuring head is gently tapped, the maximum change in reading shall not exceed one half of the appropriate amount given in Table 1.

9.1.2 When a true cylinder is passed under the measuring tip

from the front,

from the rear,

from the LH side,

from the RH side,

the maximum difference in reading found shall not exceed one half of the values in Table 1.

9.1.3 The reading obtained when sliding a gauge block under the tip shall not differ from subsequent readings obtained by operating the lifting device by more than the appropriate amount given in Table 1.

Table 1 — Tolerances on consistency of reading

Magnification factor of measuring head			Tolerance on reading
			mm
From	250 up to and including	300	0.002 0
Above	300 up to and including	400	0.001 5
Above	400 up to and including	600	0.001 0
Above	600 up to and including	1 000	0.000 8
Above	1 000 up to and including	2 000	0.000 5
Above	2 000 up to and including	5 000	0.000 3
Above	5 000 up to and including	10 000	0.000 1
Above 10 000			0.000 05

9.2 Accuracy of scale. The accuracy of the scale of the instrument shall be tested by taking readings on a suitable series of calibrated gauge blocks, first over the positive half of the scale and then over the negative half of the scale, checking at each major division. No reading shall have an error exceeding ± 1 % of the reading or the appropriate amount (±) given in Table 1, whichever is greater.

For example, in the case of a comparator having a magnification factor of 1 000, the maximum permissible error over the range 0 to 0.05 mm would be ± 0.000 5 and, beyond this range, ± 1 % of the reading.

10 Marking

Each instrument shall be marked with the maker's name or recognized trademark and with a serial number.

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