BS 869:1978

Specification for

Toolmakers' flats and high precision surface plates

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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 on 31 January 1978

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Amendments issued since publication

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Contents

Foreword

This British Standard, prepared under the direction of the Mechanical Engineering Standards Committee, was first published in 1939 when it specified toolmakers' flats and high precision surface plates in inch units. It has now been revised in accordance with the policy of producing fully metricated standards.

This standard prescribes standards of accuracy for steel toolmakers' flats and for small high precision cast iron or granite surface plates. The standard includes only such requirements as are essential to ensure that the flats and plates will be suitable for high precision work and be sufficiently robust to retain their original accuracy.

Inspection and certification of items in this standard may be undertaken by certain laboratories approved for this purpose by the British Calibration Service; addresses can be obtained on application to the Director, British Calibration Service, 26 Chapter Street, London SW1P 4NS.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 4, 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 is applicable to circular hardened steel toolmakers' flats having a maximum diameter of 200 mm, and to cast iron or granite high precision surface plates having a maximum diameter of 400 mm.

2 References

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

3 Material

3.1 Steel toolmakers' flats. Toolmakers' flats shall be of high quality steel, free from inclusions, and shall preferably be made from hammered and upset blanks. The flats shall be hardened and stabilized and shall then give a Vickers hardness of not less than 850 HV[1)], when tested in accordance with the requirements of BS 427-1.

3.2 Cast iron surface plates. Surface plates shall be of good quality close grained stabilized cast iron or alloy cast iron, sound and free from blow holes and porous patches.

NOTE Compositions for suitable steels and cast iron including methods of heat treatment are given in Appendix A.

3.3 Granite toolmakers' flats and surface plates. Granite may be used as a material for toolmakers' flats and surface plates. The rock shall be close grained and of uniform texture, sound and free from flaws and fissures and from inclusions of softer minerals.

The colour of the granite, which is dependent on the mineral composition, is of no importance, but the colour of any individual plate shall be uniform.

3.4 Defects. The repair of defects in the working surfaces of plates is not permitted.

4 Features of design and recommended sizes

4.1 Toolmakers' flats. Toolmakers' flats shall be circular and of solid steel or granite and of an overall thickness not less than that given in Table 1, column 3. Flats may have one or both surfaces finished as working surfaces. Any non-working surface may be recessed, as shown in Figure 1, to approximately the dimensions given in Table 1, columns 4 and 5. The base and the working face, or the two working faces, shall be parallel to within 0.0025 mm.

All sharp edges shall be removed.

It is recommended that a shallow groove be provided around the periphery of the larger flats to facilitate handling.

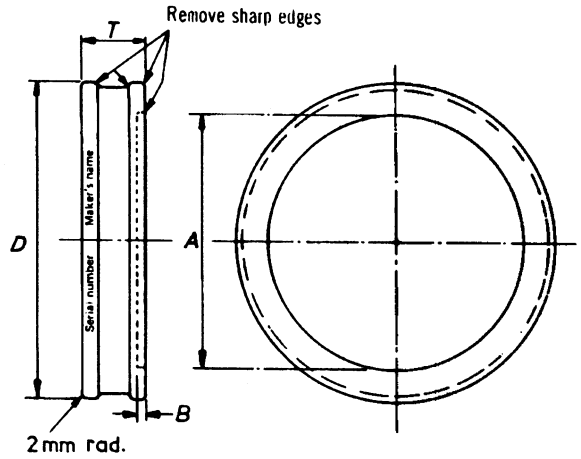

Figure 1 — Toolmakers' flat showing recess in base and groove round periphery

Table 1 — Dimensions of flats and plates

Dimensions in millimetres

1	2	3	4	5	6	7
Recommended size and diameter of flat or plate *D*		Minimum overall thickness of flat *T*	Recess		Minimum thickness of top of plate	Minimum total depth of plate
			Dia. *A*	Depth *B*		
Flats	63	16	40	2	—	—
	100	20	80	3	—	—
	160	32	120	6	—	—
	200	40	160	6	—	—
Plates	250	—	—	—	20	70
	400	—	—	—	30	100

4.2 High precision cast iron surface plates. Cast iron plates shall be circular and of robust design, with adequate framing and ribbing underneath, so that distortion when in use is reduced to a minimum.

Each plate shall be supported on three feet which shall be smoothly machined. The plane of the feet shall be parallel to the working face to within 0.012 mm unless means of adjustment of the feet is incorporated.

The top of each plate shall project slightly, to at least 20 mm depth, beyond the framing and shall be machined round the outside.

The thickness of the top of each plate after machining and finishing shall be not less than the appropriate amount given in Table 1, column 6.

[1)] The approximate equivalent hardness on the Rockwell C scale is 66 HRC. See BS 860.

The total depth of the top and framing of each plate shall be not less than the appropriate amount given in Table 1, column 7.

4.3 High precision granite surface plates. These plates shall be solid and machined all over. The top of each plate shall project slightly for convenience in lifting.

The total depth of each plate shall be not less than the appropriate amount given in Table 1, column 7.

4.4 Recommended sizes. The recommended sizes of flats and plates are listed in columns 1 and 2 of Table 1.

5 Finish

The working surface (or surfaces) of the flats and plates shall be finished by high grade lapping[2)] free from noticeable scratches.

Working surfaces shall be free from embedded abrasives.

All unmachined parts of cast iron plates shall be painted.

6 Accuracy

Each working surface (exclusive of the margin specified in Table 2) shall everywhere lie between two parallel planes whose distance apart does not exceed the amount given in column 3 of Table 2.

Table 2 — Tolerances

1	2	3
Diameter of flat or plate	**Marginal width which may be disregarded**	**Separation of limiting planes**
	mm	µm
Flats up to 200 mm	2	0.5
250 mm plates	6	0.8
400 mm plates	10	1.0

7 Cases for flats

Each flat shall be supplied in a case which shall provide adequate protection for the faces and edges of the flat.

8 Covers for plates

Each plate shall be supplied with a protective cover of a suitable material which shall be so constructed as to protect both the surface and the edges of the plate.

9 Preservation and packing

During storage and transit all finished surfaces and edges of flats and plates shall be protected against climatic conditions by being covered with a suitable corrosion preventative preparation[3)].

10 Marking

Each flat and plate shall have legibly and permanently marked on the side in characters not less than 3 mm high, the manufacturer's name or trademark and serial number.

Marking shall not be of such a nature as to impair the surface of the plate, e.g. stamping.

NOTE As an alternative to the marking of the manufacturer's name or trademark on the machined edge, the name or mark may, in cases of cast iron plates, be legibly cast on the framing.

[2)] A non-wringing surface (or surfaces) may be specified by the purchaser.

[3)] See BS 1133-6.

Appendix A Compositions of some typical steels and cast irons and notes on the appropriate methods of heat treatment

A.1 Carbon steel. The recommended chemical composition for carbon steel is as follows.

Carbon	1.00 % to 1.10 %
Manganese	0.30 % max.
Silicon	0.25 % max.

The flat is heated slowly and uniformly to a temperature between 770 °C and 780 °C, and is maintained sufficiently long at this temperature to ensure an even temperature through the flat. The flat is then quenched in a 5 % to 10 % solution of brine and is *immediately* tempered in a furnace or oil bath at a temperature of 150 °C. The flat is maintained at this temperature for a period between 4 h and 5 h and is then allowed to cool naturally in the furnace or tempering bath.

A.2 Carbon-chromium alloy steel no.1. The recommended chemical composition for carbon-chromium alloy steel no.1 is as follows.

Carbon	1.90 % to 2.00 %
Chromium	11.00 % to 13.50 %
Manganese	0.25 % max.
Silicon	0.30 % max.
Nickel	0.50 % max.

The flat is heated slowly and uniformly to a temperature between 950 °C and 960 °C, and is maintained at this temperature for a period between 30 min and 45 min. The flat is then quenched in oil, and is *immediately* tempered by the process described above for straight carbon steel.

A.3 Carbon-chromium alloy steel no.2. (Produced by the crucible or electric process.) The recommended chemical composition for carbon-chromium alloy steel no.2 is as follows.

Carbon	0.95 % to 1.10 %
Chromium	1.00 % to 1.50 %
Manganese	0.25 % to 0.40 %
Silicon	0.30 % max.

The flat is heated slowly and uniformly to a temperature between 830 °C and 840 °C, and is maintained at this temperature for a period between 30 min and 45 min. The flat is then quenched in water at about 20 °C and is *immediately* tempered by the process described above for straight carbon steel.

A.4 Cast iron. The recommended chemical composition for plain cast iron is as follows.

Total carbon	3.0 % to 3.5 %
Combined carbon	0.4 % to 0.7 %
Manganese	0.5 % to 1.2 %
Silicon	1.0 % to 1.6 %[a]
Sulphur	0.15 % max.
Phosphorus	1.2 % max.

[a] The higher silicon limits are intended for the lighter sectional castings.

The appropriate treatment for the dimensional stabilization by stress relieving of plates made from cast iron of the above composition is as follows.

The plates, after being rough machined and fully fettled, should be placed in an annealing furnace and be heated slowly to a temperature between 510 °C and 560 °C maximum, and be maintained at this temperature for a long period (25 h for best results). The casting has to be protected from the direct heat of the flames by means of suitable baffle plates and the heating should be as uniform as possible throughout. Also the casting should be supported in the furnace on the points on which it will subsequently stand in service.

For small castings, more uniform heating may be achieved by packing the castings in iron filings in boxes. Rigorous control of the cooling rate has to be exercised. The furnace should be "fired down" at a rate not exceeding 5 °C/h down to 100 °C before opening the furnace and allowing it to cool naturally.

A.5 Alloy cast iron. The recommended chemical composition for alloy cast iron is as follows.

Total carbon	2.8 % to 3.2 %
Silicon	0.8 % to 1.5 %[a]
Manganese	0.6 % to 1.0 %
Sulphur	0.12 % max.
Phosphorus	0.3 % max.
Nickel	1.4 % to 1.6 %
Chromium	0.4 % to 0.6 %

[a] The higher silicon limits are intended for the lighter sectional castings.

The stress relieving of plates made from alloy cast iron of the above composition is similar to that given above for plain cast iron, except that the castings should be slowly heated to a temperature between 560 °C and 590 °C maximum.

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Publications referred to

BS 427, *Method for Vickers hardness test.*
BS 427-1, *Testing of metals.*
BS 860, *Tables for comparison of hardness scales.*
BS 1133, *Packaging code.*
BS 1133-6, *Temporary protection of metal surfaces against corrosion (during transport and storage).*

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