BS 4069:1982

Specification for

Magnetic flaw detection inks and powders

UDC 667.4/.5:620.179.4

Cooperating organizations

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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 Board of BSI and comes into effect on
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Contents

Foreword

The preparation of BS 6072 indicated that it would be opportune to up-date the British Standard for magnetic flaw detection inks and powders. This revision of BS 4069 has been prepared under the direction of the Mechanical Engineering Standards Committee and due account accordingly has been taken of developments in the composition, functional testing and packaging of these products since the standard was first issued in 1966. In particular, improved apparatus for determining the solids content and general condition of magnetic inks and for carrying out functioning tests on both inks and powders has been introduced. This British Standard supersedes BS 4069:1966, which is withdrawn.

Although this standard specifies requirements for inks and powders, it should not be inferred that their composition does not require adjustment within the limits specified in order to render them more suitable for particular applications, and in such instances the recommendations of the manufacturer should be followed.

As is emphasized in BS 6072, the effectiveness of magnetic particle inspection rests on the technical competence of the personnel employed on such work and their ability to interpret the indications given by the various techniques.

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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 specifies the requirements for non-fluorescent and fluorescent inks, concentrates and powders used in magnetic particle flaw detection techniques. The methods of test by which the acceptability of these materials can be assessed are given in the appendices. Requirements are also given for the packaging of magnetic inks in aerosol containers.

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

2 Definitions

For the purposes of this British Standard, the terms and definitions given in BS 3683-2 apply.

3 Composition

3.1 Magnetic inks. Non-fluorescent and fluorescent inks, whether supplied ready for use or made-up from concentrates, shall consist of finely divided ferromagnetic particles and a suitable carrier liquid. They shall form a uniform suspension when agitated.

The composition of non-fluorescent and fluorescent inks, shall be as follows.

a) *Ferromagnetic particles* (including adherent non-magnetic pigments):

non-fluorescent inks:	not less than 1.25 % and not more than 3.5 % by volume;
fluorescent inks:	not less than 0.1 % and not more than 0.3 % by volume.

b) *Other solid constituents* (if present):

non-fluorescent inks fluorescent inks	not more than 10 % by mass of the ferromagnetic content.

c) *Carrier fluid* shall represent the remainder.

NOTE Certain other constituents and soluble additives may be introduced at the discretion of the manufacturer.

Inks shall not contain any constituents that are generally recognized or known to be likely to cause injury or discomfort to operators during or after use.

Inks shall not corrode steel or otherwise adversely affect the component under test.

3.2 Concentrates. Inks prepared from concentrates and diluted with the appropriate carrier fluid in accordance with the manufacturer's instructions shall comply with **3.1**.

3.3 Powders. Powders shall consist of finely divided ferromagnetic particles.

NOTE Certain other constituents may be present at the discretion of the manufacturer.

Powders shall not contain any constituents that are generally recognized or known to be likely to cause injury or discomfort to operators during or after use.

4 Materials

4.1 Ferromagnetic particles with other solid constituents

4.1.1 *Inks*. The particle size of ferromagnetic particles and any other solid constituents in inks, shall be such that, in at least 99 % of a representative sample, no particle shall exceed 100 μm in size.

4.1.2 *Powders*. The particle size of ferromagnetic particles and any other solid constituents in powders, shall be such that, in at least 99 % of a representative sample, no particle shall exceed 200 μm in size.

4.2 Carrier fluid. The flash point of the carrier fluid shall be not less than 65 °C, as determined by the Pensky-Martens closed cup test (see BS 2839).

NOTE In order to support magnetic particles in a water base, it is necessary to have additives that will enable this to be achieved but which may impair other functions of the carrier fluid, such as wetting the surface and protecting against corrosion.

5 Tests

When tested in accordance with the method described in **A.1** the total solids content in inks shall be as specified in **3.1** a) and b).

NOTE 1 Tests, for the user, to check the solids content of inks prior to and during use, and a special test for fluorescent inks are described in **A.2**, **A.3** and **A.4**.

NOTE 2 It is strongly recommended that, every working period before commencing testing, operators carry out a functioning test in accordance with appendix B. When one of the functioning tests described in appendix B is carried out the appropriate acceptance criterion should be met. If the test is not satisfactory, corrections should be made to the ink or powder prior to testing the components.

When ink is tested in accordance with the method described in appendix C, the steel bar shall not exhibit any evidence of corrosion or chemical attack.

6 Aerosol packaging of magnetic inks

NOTE Both coloured and fluorescent magnetic inks may be supplied in aerosol containers using appropriate propellants, valves and actuators, at the manufacturer's discretion.

All aerosol containers of magnetic ink shall contain a glass ball or other effective aid to agitation.

7 Marking and labelling

The packaging of all magnetic inks, concentrates and powders shall be marked with the number of this British Standard, i.e. BS 4069[1)].

Aerosol containers of magnetic inks shall also be labelled with the following:

a) the content of magnetic ink, including the propellant, either by mass or by volume;

b) the identity of the propellant;

c) instructions on the proper use of aerosol containers of magnetic ink, in accordance with appendix D.

[1)] Marking BS 4069 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is solely the claimant's responsibility. Such a declaration is not to be confused with third party certification of conformity, which may also be desirable.

Appendix A Methods of test for solids content and general condition of magnetic inks

A.1 Sampling of magnetic ink

NOTE For testing purposes the maximum volume of magnetic ink supplied in any one container should not exceed 5 L.

Agitate the container continuously for not less than 5 min. Place a sample of 100 mL into a settlement flask, of the type shown in Figure 1, and allow to settle for 60 min. Read off to the nearest 0.1 mL the level reached by the solids and record it as the solids content by volume.

A.2 Sampling of magnetic ink prior to use. Carry out the test described in **A.1**. If this is satisfactory agitate the container for a further 5 min before introducing the magnetic ink into a clean working receptacle. Place 100 mL of magnetic ink drawn from the working receptacle into a settlement flask, of the type shown in Figure 1, and leave for 60 min. Read off to the nearest 0.1 mL the level reached by the solids and record it as the solids content by volume.

Where the working receptacle holds less than 5 L carry out initial sampling only, as described in **A.1**.

A.3 Control test for in-service inks. Immediately after thoroughly mixing the ink, transfer a 100 mL sample to a settlement flask of the type shown in Figure 1, and allow the sample to stand for 60 min. Read off to the nearest 0.1 mL the level reached by the solids and record it as the solids content by volume.

A.4 Special test for fluorescent inks. Check fluorescent inks under black light for evidence of yellow-green fluorescence in the supernatant liquid. If fluorescence is observed, the ink should be discarded and the system cleaned and filled with fresh ink.

Appendix B Methods of test for proper functioning of magnetic inks and powders

B.1 General. When viewing fluorescent inks and powders use black light compatible with the ink or powder under test, under conditions of reduced ambient lighting not exceeding 10 lux.

B.2 Current flow technique for inks

B.2.1 *Apparatus*

B.2.1.1 *Test piece*, as shown in Figure 2, of the dimensions given in Table 1.

B.2.2 *Procedure*. Thoroughly degrease and demagnetize the test piece (**B.2.1.1**). Clamp the test piece within the machine's head and tailstocks. Pass an alternating current of 750 A (r.m.s.) and apply magnetic ink. With the hole nearest the surface in the 12 o'clock position, check the visibility of its indication on the outer surface of the ring. Move the second and third holes to the 12 o'clock position in turn and check the visibility of each hole's indication on the outer surface of the ring.

B.2.3 *Acceptance criterion.* At least two holes shall give recognizable indications with fluorescent or non-fluorescent ink.

B.3 Residual magnetism technique for powders

B.3.1 *Apparatus*

B.3.1.1 *Test piece,* as shown in Figure 3, of the dimensions given in Table 2.

B.3.1.2 *Applicator*, pear shaped and made of rubber.

B.3.2 *Procedure*. Thoroughly degrease and demagnetize the test piece (**B.3.1.1**). Remagnetize the test piece at 5 000 A d.c. on a threading bar having a length of 200 mm. Mount the ring on an insulated rod so that it can rotate freely. Weigh 20 g of the sample powder into the applicator (**B.3.1.2**). Create a cloud of magnetic powder at a distance of between 200 mm and 300 mm above the ring and slightly behind it, while rotating the ring forward. Position the ring so that the hole nearest the surface is in the 12 o'clock position and check the visibility of its indication on the outer surface of the ring.

Move each Of the other holes in turn to the 12 o'clock position and check the visibility of each hole's indication on the outer surface of the ring.

B.3.3 *Acceptance criterion*. At least five holes shall give recognizable indications with powder.

B.4 Magnetic flow technique for inks and powders

B.4.1 *Apparatus*

B.4.1.1 *Test piece*, as shown in Figure 4.

B.4.2 *Procedure*. Thoroughly degrease and demagnetize the test piece (**B.4.1.1**). Clamp the test piece between the machine's pole pieces, or alternatively, place it centrally in the coil parallel to the coil's axis. Apply ink or powder, energize the equipment and check the visibility of the hole. Record the test conditions.

B.4.3 *Acceptance criterion*. The hole shall give a recognizable indication with either ink or powder.

Appendix C Method of test for corrosion

C.1 Apparatus

C.1.1 *A machined, low carbon steel bar,* approximately 150 mm long and not less than 12.5 mm diameter, having a surface texture of 3.2 μm R_a.

C.2 Procedure. Partially immerse in a sample of the ink a low carbon steel bar (**C.1.1**). Maintain the ink at a temperature of 25 ± 5 °C for an immersion time of not less than 12 h.

At the end of the immersion period, remove the bar from the ink, shake off all excess liquid and visually examine for any signs of corrosion on the surface that formed the interface with the ink.

Appendix D Operation of aerosol containers

D.1 Procedure. Aerosol containers of magnetic ink are very convenient for site work and for the inspection of large structures. They should always be used in accordance with the manufacturer's instructions.

Batches of aerosol containers should be sampled (see **A.1**) on the basis of one can in twenty.

Attention is drawn to the fact that aerosol containers not only contain magnetic ink but also propellant.

For the proper use of aerosol containers, the precautions listed below should be observed.

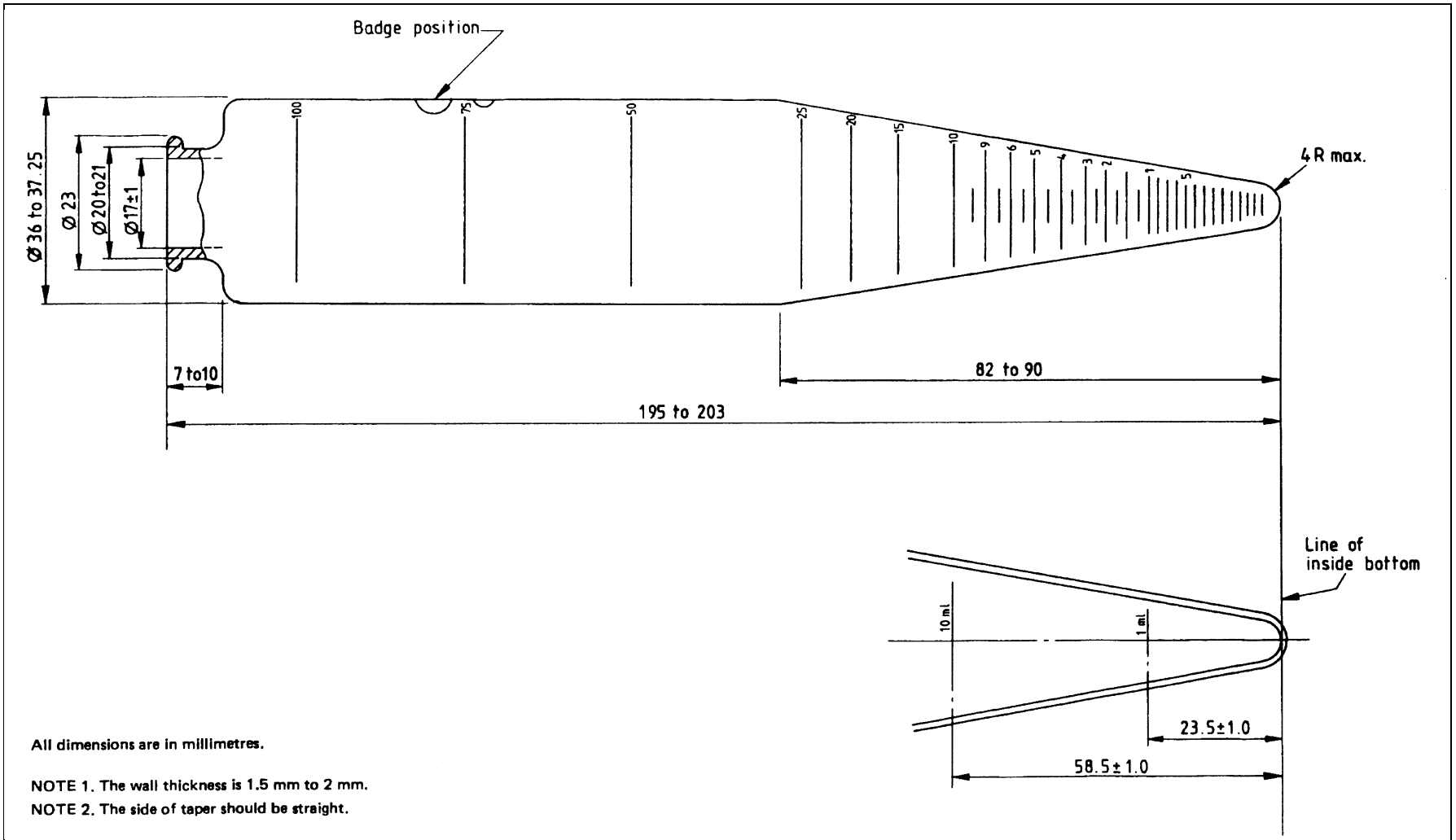
a) *Agitation*. Aerosol containers of magnetic inks should be agitated by shaking or by some other means for at least 60 s prior to spraying, if the aerosol has not been sprayed properly during the last 10 min.

b) *Temperature*. Aerosol containers lose in effectiveness as the temperature falls. The aerosol container should be agitated vigorously before attempting to use it at temperatures lower than 10 °C.

c) *Distance between spray head and target*. Aerosol containers are pressurized and if the spray head is too close to the target, surface indications of defects may be destroyed by physical blowing away. The minimum distance between spray head and target should be 300 mm.

D.2 Safety. Two types of hazard exist as a result of spraying aerosols of non-destructive testing products in confined spaces. The first is due to the creation of a mist which at low concentrations is a nuisance particulate (see "Threshold Limit Values 1976", Guidance Note EH 15/76, from the Health and Safety Executive). The second is the result of evaporation of propellant and contents to form a gaseous contamination.

The mist problem is solved by the use of face masks capable of absorbing the mist while working in confined spaces. The vapour/gas contamination requires fan extraction from a confined space and a knowledge of the threshold limit value (T.L.V.) of the aerosol contents. The minimum volume of a confined space into which an aerosol can be discharged without exceeding the T.L.V., can be estimated by methods that are detailed in "Threshold Limit Values 1976".



All dimensions are in millimetres.

NOTE 1. The wall thickness is 1.5 mm to 2 mm.

NOTE 2. The side of taper should be straight.

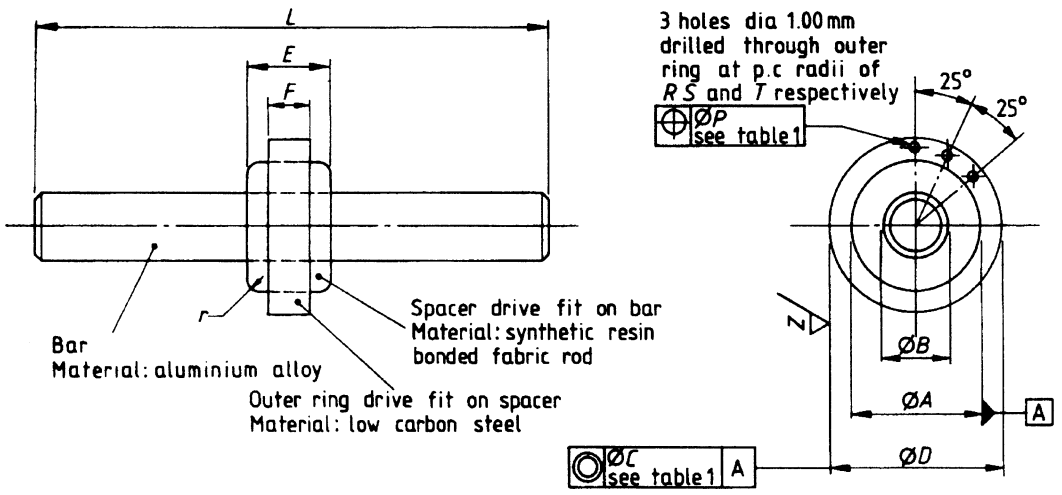
Figure 1 — Centrifuge tube settlement flask

Table 1 — Dimensions of standard current flow test piece

	Outer ring bore	Bar diameter	Outer ring concentricity tolerance	Outer ring diameter	Spacer length	Outer ring length	Bar length[a]	Hole positional tolerance	Hole pitch circle radii			Spacer	Surface texture R_a[b]
Dimension	*A*	*B*	*C*	*D*	*E*	*F*	*L*	*P*	*R*	*S*	*T*	*t*	*Z*
mm	nominal	± 0.05	diameter	± 0.025	± 0.4	± 0.24	nominal	diameter	true position	true position	true position	nominal	1.6 µm to 3.2 µm
	38.00	19.00	0.05	50.00	25.00	12.50	150.0	0.05	23.50	23.00	22.50	5.0	

[a] Length of bar may be varied to suit individual circumstances.

[b] In accordance with BS 1134.



NOTE 1. All components to be centrally disposed on bar.

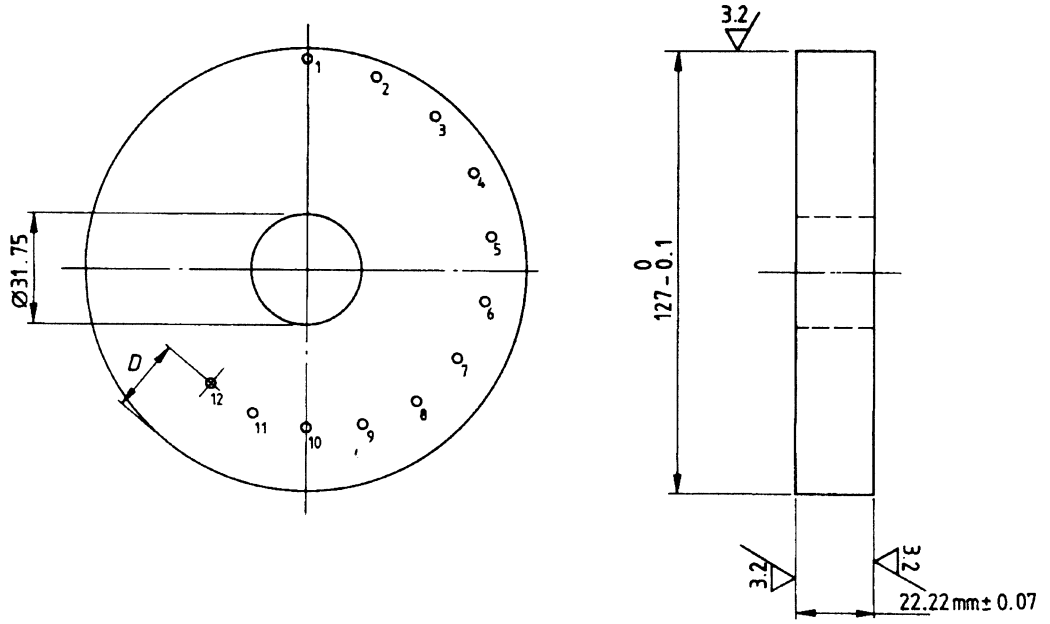
NOTE 2. Circumference of Ø *D* to be vapour-blasted with grit in the range G12 to G24 in accordance with BS 2451 to produce the surface finish specified.

NOTE 3. This apparatus and technique are also described in BS 6072.

Figure 2 — Standard current flow test piece

Table 2 — Dimensions of standard test piece for tests with powders

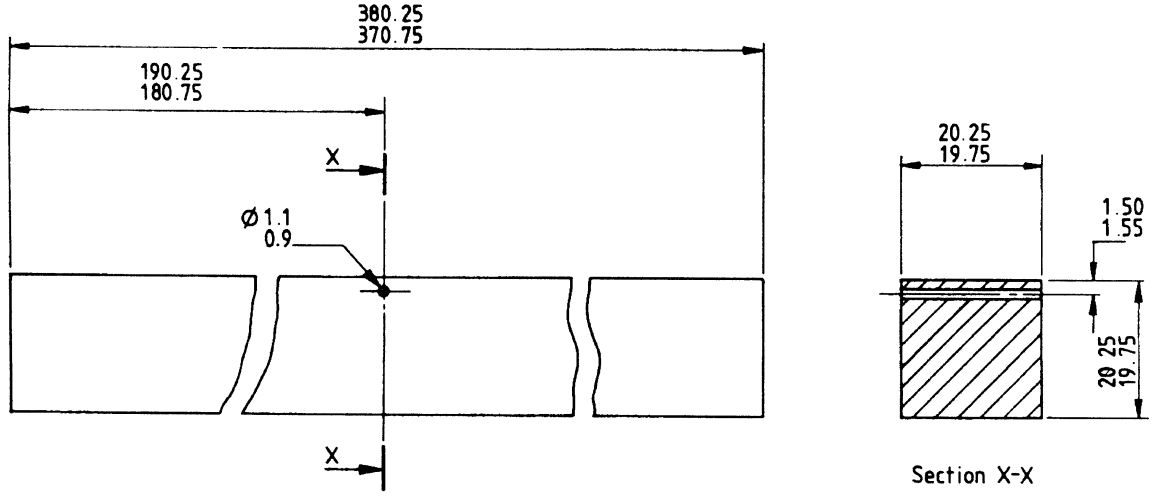
Hole	1	2	3	4	5	6	7	8	9	10	11	12
Diameter	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75
D	1.73	3.5	5.3	7.1	8.9	10.6	12.4	14.2	16.0	17.8	19.5	21.3



All dimensions are in millimetres.

NOTE 1. Unless otherwise stated, the general tolerance is ± 0.5.
NOTE 2. For holes (see table 2), use 1.75 mm drill size.
NOTE 3. Material: tool steel to BS 4659, designation BO 1 in the annealed condition, or equivalent.

Figure 3 — Standard test piece for tests with powders



All dimensions are in millimetres.

NOTE 1. Roughness grade limits N7/N6.
NOTE 2. ∇ All over.
NOTE 3. Material: low carbon steel complying with the requirements of BS 970.
NOTE 4. This apparatus and technique are also described in BS 6072.

Figure 4 — Standard magnetic flow test piece

blank

Publications referred to

BS 970, *Wrought steels in the form of blooms, billets, bars and forgings.*
BS 1134, *Method for the assessment of surface texture.*
BS 2451, *Chilled iron shot and grit.*
BS 2839, *Method for determination of flash point of petroleum products by Pensky-Martens closed tester.*
BS 3683, *Glossary of terms used in non-destructive testing.*
BS 3683-2*, Magnetic particle flaw detection.*
BS 4659, *Tool steels.*
BS 6072, *Method for magnetic particle flaw detection.*

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