BRITISH STANDARD

BS 1872:1984

Specification for

Electroplated coatings of tin

UDC 669.058.7:669.65:621.357.7

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Surface Coatings (other than Paints) Standards Committee (SRC/-) to Technical Committee SRC/3 upon which the following bodies were represented:

British Metal Finishing Suppliers' Association
British Telecommunications
Electronic Components Industry Federation
Electronic Engineering Association
Institute of Metal Finishing
International Tin Research Institute
Metal Finishing Association
Ministry of Defence
Telecommunication Engineering and Manufacturing Association (TEMA)

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Contents

Foreword

This British Standard has been prepared under the direction of the Surface Coatings (other than Paints) Standards Committee. It applies to coatings of tin applied by electroplating to fabricated articles of ferrous and non-ferrous metals to protect them from corrosion and to facilitate soldering.

It is a revision of the 1964 edition, which is withdrawn, the main changes from which are:

a) inclusion, as an appendix, of guidance notes drawing the attention of the user to factors which should be taken into account when electroplating with tin;

b) deletion of the post-electroplating heat treatment recommendations for relief of hydrogen embrittlement because tin is now known to be virtually impervious to hydrogen;

c) rationalization of the coating thicknesses recommended for different service conditions.

The electroplating processes used are not identified because, if the requirements of the specified tests are met, any of them may be considered suitable. The qualities of suitable chemicals for use in the electroplating of tin are specified in BS 1468.

Attention is drawn to the legislative requirements for tin coatings used in the food industry set out, for example, in Statutory Instrument (1972) No. 1957. Grade T2 of BS 3338 is suitable for this purpose.

It is essential, when specifying to BS 1872, that the purchaser should state the classification code and the other information listed in 3.1 (and, if appropriate, 3.2). Merely to ask for the electroplating to be carried out to BS 1872 without this information is insufficient.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself 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 10, 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 requirements for electroplated coatings of tin. The coatings may be dull or bright as electroplated, or may be flow-melted by fusion after electroplating.

These coatings are intended for use on ferrous and non-ferrous basis metals and also on printed wiring boards.

A classification scheme is included by which the nature of the basis metal and undercoat, if any, and the tin coating thickness can be defined.

This standard does not specify any requirements for the condition, finish or surface roughness of the basis material before electroplating (see **A.3**).

NOTE 1 Attention is drawn to BS 9760, which specifies capability approval procedure and rules for printed circuits of assessed quality.

The standard is not applicable to electroplating of:

a) threaded components (see BS 3382-5);

b) tin coated copper wire (see BS 4393);

c) sheet, strip (see BS 2920) or wire in the unfabricated form, or of coil springs;

d) steels with tensile strengths greater than 1 000 MPa because such steels require hydrogen embrittlement relief after plating (see clause **6**).

This standard does not apply to coatings applied by other processes, e.g. autocatalytic, immersion or “electroless” processes.

NOTE 2 The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this standard, the following definitions, together with those given for other terms in BS 5411-1, apply.

2.1
significant surface

the part of the article covered or to be covered by the coating and for which the coating is essential for serviceability and/or appearance

2.2
flow-melting

a process by which a coating is melted in order to impart desirable properties, such as brightness or improved solderability

NOTE 1 Less preferred terms applicable to this definition are “fusing”, “flow-brightening” and “reflowing”.

NOTE 2 See **A.6**.

3 Information to be supplied by the purchaser to the electroplater

3.1 Essential information. The following information shall be supplied by the purchaser to the electroplater:

a) the number of this standard, i.e. BS 1872;

b) the nature of the basis material;

c) the classification code of the coating required (see clause **4**);

d) the significant surface of the article to be electroplated, indicated, for example, by drawings or by the provision of suitably marked samples;

e) which method of adhesion testing from Appendix C is to be used (see **8.3**);

f) the sampling procedure to be adopted (see clause **5**);

g) the positions where unavoidable contact marks and other defects are acceptable (see **8.1**);

h) requirements, where they exist, regarding the purity of the coating.

3.2 Additional information. The following additional information may be required, and if so, shall be specified by the purchaser, if necessary in consultation with the electroplater:

a) whether any heat treatment, with the exception of that specified in clause **6** for certain steels, is required before electroplating;

b) whether, for coatings whose minimum thickness is 10 µm or greater, the porosity test of Appendix D is to be applied (see **8.4**), and if so:

  1) the type, number, shape and dimensions of the test specimens to be used and whether cut edges to test specimens are to be protected;

  2) the total exposed surface area of the specimen or specimens to be tested at one time, and the angle of inclination of flat test specimens, if other than that specified in **D.4**;

c) whether solderability testing is required, and if so, the test methods and conditions to be applied (see **8.5**);

d) undercoats:

  1) for a basis material of copper alloy, containing zinc as an alloying constituent, and where solderable properties are required, which method is to be used to determine the required undercoat thickness;

  2) whether an undercoat (or undercoats) is required for basis materials other than described in item d) 1) above, and if so:

    i) its nature and minimum local thickness (see **A.3** and **A.4**);

ii) which method is to be used to determine the required undercoat thickness;

e) which method is to be used to determine the required coating thickness (see **8.2**);

f) whether any special pretreatment is required.

If necessary, the purchaser shall supply a sample showing the required finish.

4 Coating classification

Coatings shall be classified by a code consisting of five parts, each of which shall be separated by an oblique stroke, as follows:

a/b/c/d/e

where

a indicates the chemical symbol for the basis metal (or for the main constituent if an alloy);

b indicates the undercoat, by the symbol “Ni” or “Cu” in the case of nickel or copper, or by the symbol “u” where other undercoat materials or systems are required [see **3.2** d)], or by the symbol “z” where an undercoat is not required;

c indicates the chemical symbol “Sn” for tin;

d indicates the minimum coating thickness, in µm;

e indicates the surface finish, by the symbol “m” if the coating is matt, or “b” if it is bright electroplated, or “f” if it is flow-melted.

Example. Fe/Ni/Sn/5/f represents a ferrous basis metal with a nickel undercoat, tin electroplated to a coating thickness of 5 µm and flow-melted.

5 Sampling

The method of sampling shall be selected from the procedures given in either BS 6001 or BS 6041.

NOTE The acceptance levels should be agreed between the purchaser and supplier.

6 Heat treatment of steel

Severely cold-worked steel parts shall be stress-relieved before electroplating by *either*:

a) heating for 1 h at a temperature of 190 °C to 230 °C;

or

b) where treatment as in item a) would impair some steels which have been carburized, flame-hardened or induction-hardened and subsequently ground, heating at a lower temperature, e.g. at 170 °C for not less than 1 h.

NOTE *Hydrogen embrittlement relief after electroplating.* Because diffusion of hydrogen through tin coating is very slow, heat treatment for hydrogen embrittlement relief after electroplating is impractical.

7 Undercoats

7.1 General. If the basis material is a copper alloy containing zinc as an alloying constituent, and solderable properties are required, a nickel or copper undercoat of minimum local thickness 2.5 µm shall be applied.

In other cases where an undercoat is specified, its nature and minimum local thickness shall be specified by the purchaser (see **A.3**, **A.4** and **A.5.2**).

7.2 Thickness. The thickness of any undercoat (or undercoats) shall be determined by *either*:

a) one of the methods given in Appendix B, as specified by the purchaser; *or*

b) any other method that the purchaser specifies, provided that it can be demonstrated to have an accuracy of 10 % or better of the true local thickness, or is as good as or better than the methods given in Appendix B for the particular application.

The method specified shall be the one that is expected to yield the most reliable results considering such factors as shape of component, size of component, undercoat material, basis material, etc.

In the case of dispute, the microscopical method referred to in **B.1.1** shall be used.

8 Coatings

8.1 Appearance. When examined by normal or corrected vision without other aid, the significant surface(s) of the electroplated article shall be clean, free from visible defects such as blisters, pits, roughness, nodules, cracks or unplated areas and shall not be stained or discoloured. Where fused, the surface shall be free from de-wetted areas.

The acceptability of defects on non-significant surfaces and the position of unavoidable contact marks shall be specified by the purchaser.

If necessary, a sample showing the required finish shall be supplied or approved by the purchaser.

8.2 Thickness. The minimum thickness of the tin coating shall be specified in the coating classification code (see **3.1** c), clause **4**, and **A.8**) from within the range 5 µm to 30 µm and the preferred thickness values shall be 5 µm, 10 µm, 20 µm and 30 µm.

The thickness of the coating shall be measured over a reference area (see BS 5411-1) on any part of the significant surface that can be touched with a 20 mm diameter ball. In the case of articles having a significant surface area of 100 mm^2 or greater, the minimum thickness shall be regarded as the minimum value of local thickness. In the case of articles having a significant surface area of less than 100 mm^2, the minimum thickness shall be regarded as the minimum value of average thickness (see **A.5.2**).

In the case of printed wiring boards with electroplated-through holes, the measurements shall also be carried out on the surfaces within the holes, and not only the areas that can be touched with a 20 mm diameter ball.

In the case of flow-melted coatings, the measurements shall be carried out on the as-electroplated condition, prior to flow-melting (see **A.6**).

The thickness of the coating shall be determined by *either*:

a) one of the methods given in Appendix B, as specified by the purchaser; *or*

b) any other method the purchaser specifies, provided that it can be demonstrated to have an accuracy of 10 % or better of the true thickness, or is as good as or better than the methods given in Appendix B for the particular application.

The method specified shall be one that is expected to yield the most reliable results considering such factors as coating thickness, shape of component, size of component, coating material, basis material, etc.

In the case of dispute, the microscopical method referred to in **B.1.1** shall be used.

8.3 Adhesion. Coatings shall be subjected to one of the adhesion tests described in Appendix C, when there shall be no evidence of poor coating adhesion.

8.4 Porosity. If specified by the purchaser, coatings having a minimum thickness of 10 µm or greater shall be subjected to a porosity test as follows:

a) for ferrous basis material, the test given in BS 5466-1;

b) for non-ferrous basis material, the test given in Appendix D.

In either case, there shall be no evidence of corrosion of the substrate when viewed with a magnification of × 3 (see **A.2.1**).

8.5 Solderability

8.5.1 *General materials and piece parts.* If specified by the purchaser, solderability testing on general materials and piece parts shall be carried out in accordance with method 1 of test Ta of BS 2011-2.1T:1981, using non-activated flux.

If accelerated ageing is specified, the steam-ageing procedure (ageing 1 of test Ta of BS 2011-2.1T:1981) shall be used but the exposure time shall be 24 h.

8.5.2 *Printed wiring boards.* If solderability testing is required on printed wiring boards, they shall be tested in accordance with test Tc of BS 2011-2.1T:1981.

If accelerated ageing is specified, the purchaser shall prescribe either a steam/oxygen or damp heat procedure.

Appendix A Guidance information

A.1 General. The information in this appendix is intended to draw the attention of the user to:

a) certain properties of tin which, if not appreciated, may lead to inappropriate use of the coating;

b) properties and preparation of the basis material;

c) electroplating practice.

A.2 Properties of the coating

A.2.1 *General.* Tin coatings are soft and easily abraded. Some corrosion of tin may be expected in certain outdoor exposure conditions and, therefore, deposit thicknesses considerably greater than those specified for a given service condition may be required. In normal indoor exposure, tin gives protection to most metals except, especially on ferrous metals, at discontinuities and pore sites in the coating. The porosity of an electroplated coating is governed not only by the thickness of the coating but also by such variables as the condition of the substrate and the general electroplating practice, and this should be borne in mind when specifying the porosity test.

Electroplated coatings covered by this standard can provide thicker coatings than those normally obtained by hot-dipping.

A.2.2 *Whisker growth.* Electroplated tin is liable to the spontaneous growth of metal "whiskers" (filaments), especially on stressed coatings. If the possibility of whisker growth is considered to be a liability, flow-melting of the coatings or the use of tin/lead alloy coatings should be considered. The use of suitable undercoats, for example nickel, may retard the growth of whiskers.

A.2.3 *Allotropic changes.* High-purity tin coatings are liable to allotropic change (to α- or grey-tin) if subjected to sub-zero temperatures. If this is considered to be a liability, the use of tin/lead or other suitable tin alloy coatings should be considered.

A.3 Properties and preparation of the basis material

A.3.1 *Surface condition.* The surface condition of the coating will depend partly on the surface condition of the basis material.

A.3.2 *Formation of intermetallic compounds.* The inter-diffusion of the coating with copper and copper-base alloys by a solid/solid diffusion process is time- and temperature-dependent, and with thin coatings can lead to darkening and poor solderability after long periods of storage.

A.3.3 *Diffusion of zinc.* Zinc, from zinc-containing alloys such as brass, diffuses through the tin coating to the surface and degrades the solderability.

A.3.4 *"Difficult" basis materials.* The surfaces of some basis materials, e.g. phosphor-bronze, beryllium-copper and nickel-iron alloys, are difficult to prepare chemically clean because of the nature of the surface oxide film. If solderability is a requirement of the tin coating, an undercoat of nickel or copper of a minimum local thickness of 2.5 µm can be advantageous.

A.3.5 *Aluminium-, magnesium- and zinc-base basis materials.* These alloys are readily attacked by dilute acids and/or alkalis. Special pre-treatments, including the deposition of a relatively thick (10 µm to 25 µm) undercoat of copper, bronze or nickel are therefore required before the article can be electroplated with tin.

A.4 Undercoats. Undercoats may be necessary on any basis material for the following reasons:

a) to prevent diffusion (see **A.3.2** and **A.3.4**);

b) to improve solderability and its retention;

c) to ensure adhesion;

d) to improve corrosion resistance;

Care should be taken to select an undercoat or undercoat system that will not confer undesirable properties such as embrittlement of the basis material or finished article. For example, the use of highly stressed or brittle nickel should be avoided.

A.5 Electroplating practice

A.5.1 *Post-electroplating rinse.* If solderability is a requirement of the coating, a rinse with an approximately 3 % (V/V) solution of citric or tartaric acid should be included in the rinse cycle to ensure removal of hydrated tin salts, which, if allowed to dry on the surface of the coating, can be deleterious to the solderability of that surface.

A.5.2 *Deposit thickness.* Except where otherwise defined in BS 5411-1, it should be noted that the deposit thicknesses specified in this standard are minimum local and not average thicknesses. The average thickness required to give a minimum local thickness on the significant surfaces will depend upon the geometry both of the article being electroplated and of the electroplating bath with regard to the positions of the electrodes. It should also be borne in mind that with barrel electroplating (especially of small parts), the variation in coating thickness conforms to a Normal (Gaussian) distribution.

Table 1 — Service condition and related recommended coating thickness

Service condition number	Description of service condition	Recommended minimum thickness
		µm
4	*Exceptionally severe,* e.g. service outdoors in severe corrosive conditions or contact with food or drink where a complete cover of tin has to be maintained against corrosion and abrasion (see **A.5**)	30
3	*Severe,* e.g. service outdoors in normal conditions	20
2	*Moderate,* e.g. service indoors with some condensation	10
1	*Mild,* e.g. service indoors in dry atmosphere or applications where solderability is the sole requirement	5

The thickness of tin coatings is affected by flow-melting because of the formation of a meniscus. In relevant cases, the performance can be assessed by the solderability test methods referred to in **8.5**.

A.5.3 *Co-deposition of organic matter.* If solderability is the main requirement of the coating, the co-deposition of excessive amounts of organic matter (from the bath additives) should be avoided as these lead to "out-gassing" or bubbling of the coating during the subsequent fusing or soldering operation. However, if sliding contacts are being electroplated, the presence of certain organic compounds may enhance the mechanical properties of the coating.

A.6 Flow-melting. Tin coatings may be readily flow-melted by immersion in hot oil or by exposure to infra-red radiation or to condensing hot vapour. It can be advantageous to flow-melt tin coatings as any defects in the substrate that would give rise to poor solderability will also result in de-wetting of the coating on flow-melting. Coating thicknesses in the region of 20 µm can be successfully flow-melted but, if there is a possibility of the melted coating draining to an edge during the flow-melting, the deposit thickness should be limited to about 8 µm to avoid the formation of "blips" on the edge of the work. Flow-melting is not recommended for electroplated tin coatings that are already bright.

A.7 Tin coatings in contact with food

A.7.1 *Organic brighteners.* If bright coatings are to be used in contact with food the possibility of co-deposited organic material being extracted should be borne in mind as this could lead to contamination of the food.

A.7.2 *Tin content.* Tin coatings for use in contact with food should contain not less than 99.75 % of tin and should not contain more than 0.2 % of lead. Other national legislative requirements may also be applicable in particular countries.

A.8 Service condition number and related coating thickness. The more severe the service condition to which the tin coating is to be subjected, the thicker the coating required. The recommended value of minimum thickness for each service condition is given in Table 1.

Appendix B Determination of undercoat thickness and coating thickness

B.1 Measurement of local thickness

B.1.1 *Microscopical method.* Use the method specified in BS 5411-5, with the overplating procedure, overplating with not less than 10 µm of copper.

NOTE This method is considered to have an accuracy of at least 10 % or ± 1.0 µm, whichever is the greater value.

B.1.2 *Coulometric method.* Use the method specified in BS 5411-4.

NOTE This method is considered to have an accuracy of better than 10 %.

B.1.3 *Beta backscatter method.* Use the method specified in BS 5411-12.

NOTE This method is considered to have an accuracy of 10 % or better, dependent on the mass per unit area of the coating and the effective atomic number of the basis material.

B.1.4 *X-ray spectrometric method.* Use the method specified in BS 5411-8.

NOTE This method is considered to have an accuracy of better than 10 % over the range of 0.5 µm to 7.5 µm.

B.2 Measurement of average thickness

NOTE The method given below is not suitable for coatings on certain metals (see **A.3.5**). In such cases, the average of a number of microsection determinations should be used.

B.2.1 *Principle.* A suitable coated specimen (or a number of specimens, if they are small) of known surface area is cleaned, weighed, stripped of its coating by chemical dissolution and reweighed.

B.2.2 ***Reagents***

B.2.2.1 *Solution for stripping from ferrous basis materials and nickel undercoats.* Dissolve 20 g of antimony trioxide in 1 000 mL of cold concentrated hydrochloric acid solution (ρ = 1.16 g/mL to 1.18 g/mL).

B.2.2.2 *Solution for stripping from copper basis materials.* Hot concentrated hydrochloric acid solution (ρ = 1.16 g/mL to 1.18 g/mL).

B.2.3 *Test specimen.* Use a test specimen or specimens of total surface area sufficient to give a mass loss of not less than 0.1 g, the area of which can be measured to an accuracy of 2 % or better. Remove all soil from the test specimen by washing it in a suitable organic solvent or by vapour degreasing.

B.2.4 ***Procedure***

B.2.4.1 *For ferrous basis materials.* Weigh the cleaned test specimen (**B.2.3**) to the nearest 0.001 g, immerse it in the stripping solution (**B.2.2.1**) and leave immersed for 2 min after the evolution of gas has ceased. Remove from the solution, wash thoroughly in running water, brushing off any smut. Dry and weigh to the nearest 0.001 g.

B.2.4.2 *For copper and cuprous basis materials.* Weigh the cleaned test specimen (**B.2.3**) to the nearest 0.001 g, immerse it in the stripping solution (**B.2.2.2**) and remove immediately the coating is completely dissolved. Wash thoroughly in running water, dry and weigh to the nearest 0.001 g.

B.2.5 *Calculation of result.* The coating thickness, in µm, is given by the following expression:

$$\frac{137 \times 10^3 (m_1 - m_2)}{A}$$

where

m_1 is the original mass of the specimen (in g);

m_2 is the final mass of the specimen (in g);

A is the area of coating (in mm^2).

NOTE 137 × 10^3 is a factor based on the density of tin, 7.30 g/cm^3.

Appendix C Adhesion tests

C.1 Burnishing test. Rub an area of not more than 600 mm^2 of the significant surface of the article, selected at the discretion of the inspector, rapidly and firmly for 15 s with a suitable burnishing tool (see note). Apply a pressure sufficient to burnish the coating metal at every stroke, but not so great as to cut the coating.

NOTE An agate dental spatula with a handle 60 mm to 100 mm long and agate blade 30 mm to 50 mm long, 5 mm to 10 mm wide, sharpened to slightly radiused edge has been found very satisfactory.

Examine the specimen for signs of blistering of the coating.

C.2 Bend test. Place the sample in a bend testing machine with a bending radius of 4 mm (or in the jaws of a suitable vice). Bend the sample through 90° and back to its original position. Carry out this procedure three times.

Examine the specimen for signs of detachment of the coating.

C.3 Thermal shock test. Heat an electroplated article for 1 h in an oven controlled at a temperature of 185 ± 10 °C. Then quench the article in water at room temperature, withdraw it, and examine the coating for blistering and other signs of poor adhesion.

CAUTION. This test may have an adverse effect on the mechanical properties of the article tested. Accordingly, do not use the test piece used in this test for other tests.

Appendix D Sulphur dioxide porosity test

D.1 Principle. Exposure of a test specimen to a moist atmosphere containing a low concentration of sulphur dioxide causes no corrosion of tin but causes spots of corrosion product to appear at discontinuities in the coating.

NOTE If the sulphur dioxide concentration in the atmosphere is too high, the corrosion product formed is too fluid to permit easy observation of pore sites. The method given here ensures suitable conditions for the development of immobile corrosion products at discontinuities.

D.2 Apparatus

D.2.1 *Test cabinet*

D.2.1.1 *Capacity.* The capacity of the test cabinet should preferably be 300 ± 10 L (see note).

NOTE Cabinets of capacities other than 300 ± 10 L may be used provided that the other test conditions to which the test specimens are submitted are the same. The details and instructions given in this appendix are, however, appropriate to cabinets of the preferred capacity and will require corresponding modifications for cabinets of other capacities.

D.2.1.2 *Construction and components.* The test cabinet shall have a door or hood capable of being closed hermetically, and shall be fitted with the following components:

a) *temperature-controlling device,* with its actuating element placed in the upper part of the cabinet;

b) *thermometer,* capable of being read from outside the cabinet with its bulb 150 mm from the roof and door/hood and 250 mm from one side;

c) *inlet tube,* through which gas can be introduced into the cabinet, placed approximately 50 mm above the base;

d) *valve,* by which excess pressure can be relieved, placed in or near the roof of the cabinet;

e) *drain-cock,* in the floor of the cabinet;

f) *heating device,* capable of heating the cabinet to a temperature of 40 ± 3 °C in 1.5 h and of maintaining the interior at this temperature.

NOTE A 1 kW electrically-heated hotplate is suitable for the preferred size of cabinet.

Typical cabinets, with a door or hood are shown in Figure 1 and Figure 2 respectively.

D.2.1.3 *Materials of construction.* All the materials used in the construction of the cabinet shall be resistant to the action of moist sulphur dioxide and shall themselves not emit any gas or vapour likely to influence corrosion of the test specimens.

The floor and lower parts of the walls shall be capable of being heated and shall be able to retain without leakage at least 2.5 L of water containing dissolved sulphur dioxide, this volume being required to flush the apparatus. Lead-clad constructional material is suitable for these parts and for the framework and fittings of the cabinet, but the greater part of the walls and door/hood shall be made of transparent sheet, such as glass or suitable plastics material.

D.2.1.4 *Shape.* Some variation in the shape of the cabinet can be tolerated, but the roof shall be shaped so that moisture condensing on it does not fall on test material in the cabinet. An inclination of the roof of approximately 12° to the horizontal provides a suitable safeguard.

D.2.1.5 *Ambient conditions.* The cabinet shall be installed in a room in which there is a clean atmosphere and shall be protected from large or rapid temperature fluctuations, strong direct sunlight and draughts.

D.2.1.6 *Conditioning of apparatus.* To reduce risks of contamination of the atmosphere by vapours from constructional materials, a new cabinet shall be operated at least once, without introduction of test specimens, by the procedure applicable to an atmosphere containing 2 L of sulphur dioxide, before it is brought into use for testing.

D.2.2 *Test specimen supports.* The supports for the test specimens shall be of non-metallic material such as glass, suitable plastics material or suitably coated wood. Any material used to suspend the test specimens in the cabinet shall be of suitable synthetic fibre or other inert insulating material; metallic materials shall not be used.

D.2.3 *Source of sulphur dioxide,* and means of measuring the volume of gas required for delivery into the test cabinet.

A container of liquid sulphur dioxide is the usual source, but the gas may be generated in a suitable apparatus by treating sodium sulphite with sulphuric acid.

Sulphur dioxide shall not be generated inside the cabinet.

The volume of gas delivered into the chamber may be measured by any suitable method, e.g.:

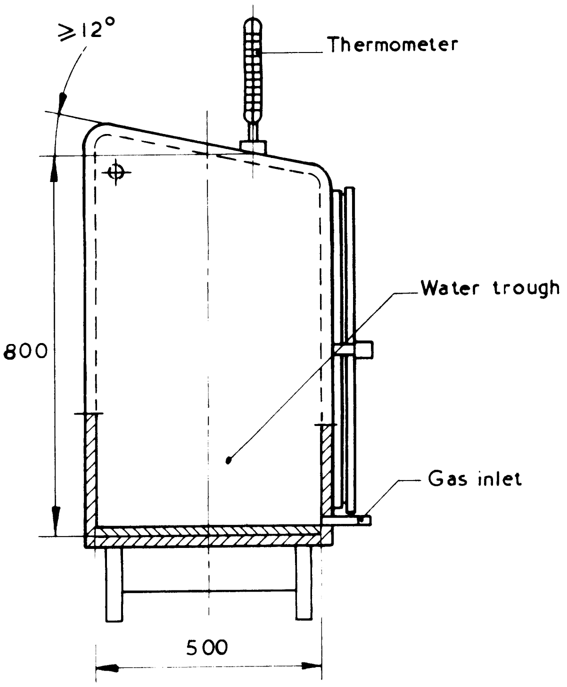
a) by means of a gas burette using viscous liquid paraffin as the pressure-controlling fluid; as the volume to be measured is usually about 0.2 L, measures shall be taken to avoid errors from causes such as air contained in delivery tubes between the burette and the chamber;

b) by means of a gas jar of known volume filled with sulphur dioxide and opened in the chamber;

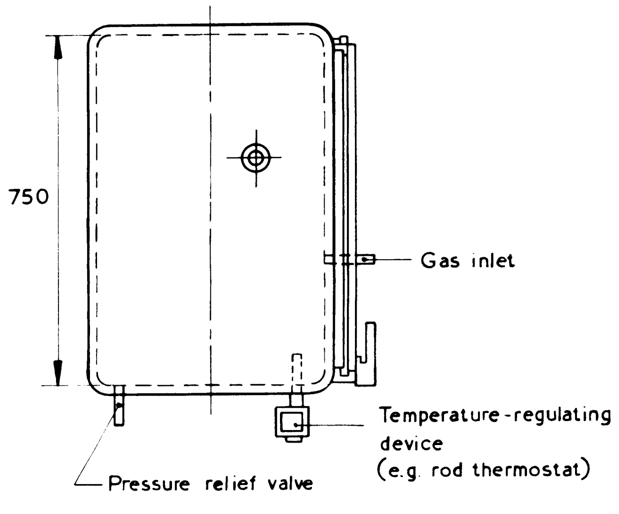
c) by means of a calibrated flowmeter.

Capacity: 300 ± 10 L

Side view

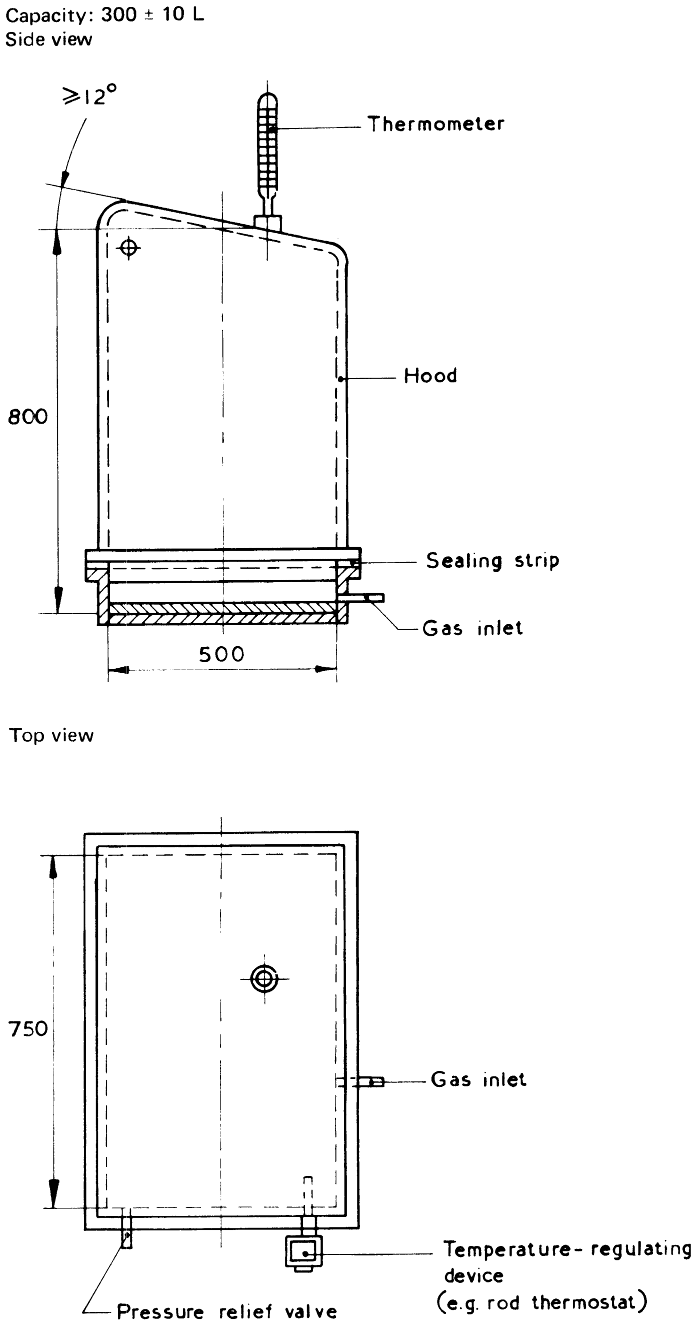


Top view



Dimensions in millimetres.

Figure 1 — Cabinet with door



Dimensions in millimetres.

Figure 2 — Hooded cabinet

D.3 Construction and cleaning of test specimens

NOTE The number and type of test specimens and their shape and dimensions are not specified: these should be agreed between interested parties (see also **D.4.3** and **D.4.4**).

D.3.1 If test specimens are cut from a larger coated article, the cutting shall be carried out in such a way that the coating is not damaged, especially in the area adjacent to the cut. Unless otherwise specified, the cut edges shall be adequately protected by coating them with a suitable medium that is stable under the conditions of the test, such as wax or adhesive tape.

D.3.2 The test specimens shall be thoroughly cleaned before testing. The cleaning method employed shall depend on the nature of the surface and the contaminants, but shall not include the use of any abrasives, solvents or other materials that may attack the surface of the test specimens. Care shall be taken that the test specimens are not recontaminated, after cleaning, by excessive or careless handling.

D.4 Method of exposure of test specimens

D.4.1 When in position in the cabinet, the test specimens shall be located so that no part of any specimen is within 20 mm of another specimen or within 100 mm of the walls or the roof of the cabinet or within 200 mm of the surface of the water in the base of the cabinet.

D.4.2 The test specimens shall be so arranged that any moisture condensing on any of them or on their supports does not fall on other specimens placed at lower levels.

D.4.3 The orientation of the exposed test surface is critical, and in the case of flat surfaces, the angle of inclination to the vertical, unless otherwise specified, shall be 15 ± 2°.

D.4.4 The total exposed surface area of the specimen or specimens tested at any one time shall be substantially the same and, unless otherwise agreed, shall be $0.5 \pm 0.1\ \text{m}^2$ for the cabinet of preferred capacity (see **D.2.1.1**) and proportionately changed for different sizes of cabinet.

D.5 Procedure

D.5.1 Introduce 2 ± 0.2 L of distilled water into the base of the cabinet.

NOTE The quantity of water in the cabinet depends on its size and shape. A proportional change for cabinets of different size is valid only for cabinets of similar shape.

D.5.2 Place the test specimens in position and close the door/hood of the cabinet completely.

D.5.3 Introduce 0.2 L of sulphur dioxide into the chamber.

D.5.4 Switch on the heater and raise the temperature inside the cabinet to 40 ± 3 °C in approximately 1.5 h. Maintain heating, under control, so as to keep the temperature inside the cabinet at 40 ± 3 °C for 24 h.

D.6 Inspection and cleaning of specimens after test.

At the end of the 24 h test duration, remove the test specimens from the cabinet and, before they are examined, allow them to hang freely in a normal indoor atmosphere until any liquid corrosion products have solidified. Examine all the test specimens first with all corrosion products in position. Any cleaning subsequently carried out shall depend on the criteria laid down for evaluation of the result of the test.

Publications referred to

BS 1468, *Tin anodes and tin salts for electroplating*[1].

BS 2011, *Basic environmental testing procedures.*

BS 2011-2.1T, *Test T. Solderability.*

BS 2920, *Cold-reduced tinplate and cold-reduced blackplate.*

BS 3338, *Methods for the sampling and analysis of tin and tin alloys*[1].

BS 3382, *Electroplated coatings on threaded components.*

BS 3382-5, *Tin on copper and copper alloy (including brass) components*[2].

BS 4393, *Tin or tin-lead coated copper wire.*

BS 5411, *Methods of test for metallic and related coatings.*

BS 5411-1, *Definitions and conventions concerning the measurement of thickness.*

BS 5411-4, *Coulometric method for the measurement of coating thickness.*

BS 5411-5, *Measurement of the local thickness of metal and oxide coatings by the microscopical examination of cross sections.*

BS 5411-8, *Measurement of coating thickness of metallic coatings: X-ray spectrometric methods.*

BS 5411-12, *Beta backscatter method for measurement of thickness.*

BS 5466, *Methods for corrosion testing of metallic coatings.*

BS 5466-1, *Neutral salt spray test (NSS test).*

BS 6001, *Sampling procedures and tables for inspection by attributes.*

BS 6041, *Method of sampling of electrodeposited metallic coatings and related finishes: procedures for inspection by attributes.*

BS 9760, *Specification for printed circuits of assessed quality: generic data and methods of test. Capability approval procedure and rules.*

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[1] Referred to in the foreword only.

[2] Contained in BS 3382-5 and BS 3382-6.

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