BRITISH STANDARD

BS 6220:1983

Specification for

Junction boxes for use in electrical installations with rated voltages not exceeding 250 V

UDC 621.315.687.2

Cooperating organizations

The Power Electrical Engineering Standards Committee, under whose direction this British Standard was prepared, consists of representatives from the following:

Associated Offices Technical Committee
Association of Short-circuit Testing Authorities*
British Electrical and Allied Manufacturers' Association (BEAMA)
British Railways Board
British Steel Corporation
Department of Energy (Electricity)
Department of Industry
Electrical Contractors' Association*
Electrical Contractors' Association of Scotland
Electricity Supply Industry in England and Wales*
Energy Industries Council
Era Technology Ltd*
Institute of Purchasing and Supply
Institution of Electrical Engineers*
Ministry of Defence
National Coal Board
National Economic Development Office*
Trades Union Congress

The organizations marked with an asterisk in the above list, together with the following, were directly represented on the Technical Committee entrusted with the preparation of this British Standard:

Association of Consulting Engineers
British Electrical Systems Association (BEAMA)
British Electrotechnical Approvals Board
British Plastics Federation
Consumer Standards Advisory Committee of BSI
Department of Health and Social Security
Department of Trade
Electrical Association for Women
Electrical Installation Equipment Manufacturers' Association (BEAMA)
Electrical Power Engineers' Association
Electricity Consultative Councils
Fire Offices Committee
Lighting Industry Federation Ltd
National Inspection Council for Electrical Installation Contracting

This British Standard, having been prepared under the direction of the Power Electrical Engineering Standards Committee, was published under the authority of the Board of BSI and comes into effect on
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The following BSI references relate to the work on this standard:
Committee reference PEL/4
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Amendments issued since publication

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Contents

Foreword

This British Standard has been prepared under the direction of the Power Electrical Engineering Standards Committee. This is the first British Standard specifically for junction boxes: previously, BS 5733 has been used.

This new standard is effective from the day of publication, but to allow manufacturers time to design and introduce any necessary changes, BS 5733 will continue to be an equally applicable standard for junction boxes until 29 July 1984.

Compliance with the Electrical Equipment (Safety) Regulations: 1975 will generally be assured if equipment complies with the requirements of BS 6220. For more precise details about the relevance of British Standards to the Regulations, reference should be made to the "Administrative Guidance on the Electrical Equipment (Safety) Regulations 1975" as amended by the "Electrical Equipment (Safety) (Amendment) Regulations 1976", available from HMSO.

Certification. Attention is drawn to the certification facilities described on the inside back cover of this standard.

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 14, 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.

Section 1. General

1 Scope

This British Standard specifies requirements for junction boxes of surface- or flush-mounting types for use in fixed wiring installations in a.c. and d.c. circuits where the rated voltage does not exceed 250 V and where the conductors are not subject to mechanical tension in normal use. It covers junction boxes having fixed terminals with capacity for the connection of PVC-insulated and sheathed cables complying with the requirements of BS 6004, and having copper conductors of cross-sectional area up to and including 10 mm^2.

This standard does not apply to junction boxes for use in conditions where special protection against the ingress of dust or moisture is required.

2 References

The titles of the standards publications referred to in this standard are listed on the page 14.

3 Definitions

For the purposes of this British Standard the following definitions apply.

3.1
junction box

an enclosure having fixed terminals for the purpose of connecting together electrical conductors

3.2
surface-type junction box

a junction box provided with a seating surface for mounting on a wall or other flat surface

3.3
flush-type junction box

a junction box consisting of a frontplate, terminals and associated box, intended to be recessed into a wall or other flat surface, so that the back of the frontplate is flush with the surface of the wall, etc. into which it is mounted

3.4
terminal

an assembly, including one or more screws or similar threaded devices, for connecting conductors of electric cables

3.5
pillar-type terminal

a terminal in which the conductor is inserted into a hole or cavity, where it is clamped by the screw or screws. The clamping pressure may be applied directly by the end of the screw or through an intermediate clamping member to which pressure is applied by the end of the screw

3.6
terminal housing

that part of the junction box which provides location and separation of the terminals and which may or may not be an integral part of the base or cover

3.7
accessible external surfaces

all surfaces that can be touched by test finger I of BS 3042 when the junction box is properly wired and installed as in normal service

3.8
protective conductor

a conductor used for some measures of protection against electric shock and intended for connecting together any of the following parts:

a) exposed conductive parts;

b) extraneous conductive parts;

c) the main earthing terminal;

d) earth electrode(s);

e) the earthed point of the source, or an artificial neutral.

3.9
type test

a test of one or more junction boxes to show that all junction boxes, made to the same specification and having the same essential details, would pass an identical test

4 Service conditions

Junction boxes shall be suitable for use under the following conditions of service:

a) an ambient temperature in the range – 15 °C to + 40 °C, the average value over 24 h not exceeding + 35 °C;

b) a situation not subject to exposure to direct radiation from the sun or other source of heat likely to raise temperatures above the limits specified in a);

c) an altitude not exceeding 2 000 m above sea level;

d) an atmosphere not subject to excessive pollution by smoke, chemical fumes, salt-laden spray, prolonged periods of high humidity or other abnormal conditions.

5 Classification

A junction box shall be classified according to:

a) the number of terminals as declared by the manufacturer;

b) the nominal conductor capacity of the terminals, as declared by the manufacturer, which shall be one of the capacities shown in column 1 of Table 2;

c) the method of mounting (e.g. surface or flush).

6 Marking

6.1 All junction boxes shall be durably and legibly marked with the following:

a) the number of this British Standard, i.e. BS 6220[1)];

b) the name or trade mark of the manufacturer or responsible vendor;

c) the nominal conductor capacity of the terminals, i.e. "n mm^2" or "n" □ where n is the conductor size in mm^2;

d) the rated voltage, e.g. "250 V".

Compliance shall be checked by inspection.

6.2 Any terminal intended exclusively for the use of a protective conductor shall be indicated by the symbol ⏚. Compliance shall be checked by inspection.

6.3 The durability of the marking shall be such that, after the test specified in **6.4**, the marking shall be easily legible; it shall not be possible easily to remove any marking plates and they shall show no curling.

NOTE In considering the durability of the marking, the effect of normal use should be taken into account. Thus, for example, marking by means of paint on parts that are likely to be cleaned frequently, may not be considered to be durable.

6.4 Rub the marking by hand for 15 s with a piece of cloth soaked in water and again for 15 s with a piece of cloth soaked in petroleum spirit.

NOTE A revision of this test is under consideration.

Section 2. Dimensions and performance requirements

7 General

7.1 Design and construction. Junction boxes shall be so designed and constructed that in normal use they function reliably and cause no danger to persons or surroundings when installed in the proper manner.

Products purporting to comply with this standard shall be capable of meeting all the relevant requirements and tests specified therein.

NOTE Where the standard is used for the purpose of granting nationally recognized certification marks, the designs or constructions, to which the tests specified cannot be precisely applied but which give an equivalent degree of safety and durability of safety, may be regarded as complying with the requirements of this standard, subject to the findings of a special investigation by the authority granting the certification mark and pending the issue of an amendment or extension to this standard.

7.2 General requirements for type tests. All tests specified in section 2 shall be type tests and shall be carried out in the order shown within a), b), c) and d) below.

Unless otherwise specified in the relevant clause, samples shall be tested as in normal use and at an ambient temperature of 20 ± 5 °C.

Inspections and tests shall be carried out on a total of 12 samples divided into groups as follows:

a) three samples for the tests specified in clauses **8**, **13**, **10**, **6** and **17**;

b) three samples for the tests specified in **14.2.2**, clause **11**, **12.2.1**, clause **15** and **6.4**;

c) three samples for the tests specified in **12.1**, **12.2.2** and **14.2.1**;

d) three samples for the tests specified in clause **16**.

Junction boxes shall be deemed to comply with this standard if no sample fails in the complete series of tests specified in groups a) to d) inclusive.

Alternatively, if one sample fails in the complete series of tests, specified in groups a) to d) inclusive, and this sample can be shown to be not representative of normal production or design, then a separate set of three samples shall be submitted to the test or tests in that particular group. If there is no failure in this re-test then junction boxes of that type shall be deemed to comply with this standard.

[1)] Marking BS 6220 on or in relation to a product is a claim by the manufacturer that the product has been manufactured in accordance with the requirements of the standard. The accuracy of such a claim is therefore solely the manufacturer's responsibility. Enquiries as to the availability of third party certification to support such claims should be addressed to the Director, Quality Assurance Division, British Standards Institution, Maylands Avenue, Hemel Hempstead, Herts HP2 4SQ in the case of certification marks administered by BSI or to the appropriate authority for other certification marks.

If more than one sample fails in the complete series of tests, specified in groups a) to d) inclusive, then junction boxes of that type shall be deemed to have failed to comply with this standard.

NOTE Where tolerances are not specified in these tests, the quantities are to be regarded as nominal.

8 Dimensions

The size of junction boxes shall be sufficient to accommodate a minimum length of 5 mm of cable sheath inside the box at all outlets when all conductors are correctly terminated.

The frontplate of flush-type junction boxes designed to be mounted in circular boxes complying with the requirements of BS 31 or BS 4568 shall have two fixing holes of 5.3 mm minimum diameter diametrically opposed on a pitch circle diameter of 50.8 ± 0.25 mm.

The frontplate of flush-type junction boxes designed to be mounted in square boxes complying with the requirements of BS 4662 shall have two fixing holes of 3.8 mm minimum diameter diametrically opposed on a pitch circle diameter of 60.3 ± 0.1 mm.

If conduit entries are provided they shall comply with the relevant dimensional requirements of BS 31, BS 4568, BS 4607 or BS 6099 as appropriate.

Compliance shall be checked by inspection and measurement.

9 Materials

Materials used in component parts shall be as given in Table 1.

Table 1 — Materials

Component part	Material
Terminals	Copper or a suitable alloy containing not less than 55 % copper
Parts made of insulating material	Vitrified ceramic material complying with the requirements of **14.1.1**, or plastics material complying with the requirements of **14.1.1** and clauses **15** and **16**
Enclosures or other parts of metal	Non-ferrous metal, or ferrous metal suitably protected to comply with the requirements of clause **17**

NOTE Attention is drawn to the range of British Standards for materials which may be suitable for the component parts of junction boxes.

10 Construction

10.1 Requirements

10.1.1 *General.* A junction box shall provide a complete enclosure for its associated terminals and current-carrying parts and for the joints in cables that may be connected to such terminals. In the case of flush-type junction boxes the enclosure shall be deemed to be completed by an appropriate mounting box.

The base of a surface-type junction box shall be designed to ensure proper seating on any flat surface.

Junction boxes shall incorporate suitable knock-outs or other forms of cable entries of sufficient size to accept the sheaths of the appropriate cables.

10.1.2 *Accessibility of live parts.* When properly wired and installed as for normal use, live parts shall not be accessible without the use of a tool.

Compliance shall be checked by inspection and by the test specified in **10.2.1**, during which the test finger or test pin shall not make electrical contact with any live part.

10.1.3 *Mechanical strength of the enclosure.* Surface-type junction boxes, and the exposed parts of flush-type junction boxes, shall have mechanical strength adequate to protect enclosed live parts in normal service.

Compliance shall be checked by the test specified in **10.2.2**. After the test, it shall be possible to remove and replace the cover of the sample, the protection against electric shock shall not be impaired when tested in accordance with **10.2.1**, and the creepage and clearance distances shall not be reduced. The appearance of cracks and the detachment of small pieces during the test shall not in themselves constitute failure to pass the test.

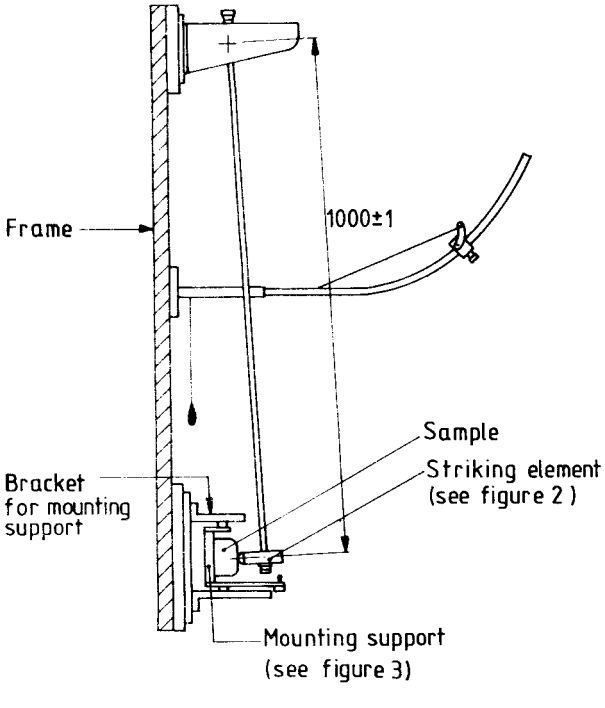
10.2 Tests

10.2.1 *Test for accessibility of live parts.* Apply test finger I of BS 3042:1971 without appreciable force to cable entries, and apply test pin I of BS 3042 without appreciable force to all other positions.

10.2.2 *Test for mechanical strength of the enclosure.*

10.2.2.1 *Apparatus.* The apparatus shall be as shown in Figure 1. The components of the apparatus are as follows.

a) The pendulum consists of a steel tube suspended in such a way that it swings only in a vertical plane. A hammer is fixed to the lower end of the tube with its axis 1 m from the axis of suspension. The striking element is of polyamide having a Rockwell hardness of HR 100, or hornbeam, with a hemispherical face of 10 mm radius and a mass of 0.15 kg (see Figure 2).



All dimensions are in millimetres.

Figure 1 — Pendulum impact test apparatus

b) The design of the apparatus is such that a force of between 1.9 N and 2.0 N has to be applied to the face of the striking element to maintain the pendulum in a horizontal position.

c) The sample is mounted on a sheet of plywood 8 mm thick and 175 mm square secured at its top and bottom edges to a mounting support. The mounting support (see Figure 3) has a mass of 10 ± 1 kg and is mounted on a rigid bracket by means of pivots. The bracket is mounted on a frame which is fixed to a solid wall.

d) The design of the mounting assembly is such that:

1) the sample can be so placed that the point of impact lies in the vertical plane through the axis of the pivot of the pendulum;

2) the sample can be moved horizontally and turned about an axis perpendicular to the surface of the plywood;

3) the plywood can be turned about a vertical axis.

10.2.2.2 *Procedure.* Mount surface-type junction boxes on the plywood support as in normal use. Mount flush-type junction boxes in or on an appropriate box that is recessed level with the surface of a block of hardwood, simulating the conditions of normal installation. Mount the hardwood block on the plywood support.

Place the sample so that the point of impact lies in the vertical plane containing the suspension axis of the pendulum. For all tests allow the hammer to fall from a height of 150 mm measured vertically between the point of impact on the sample and the face of the hammer at the point of release.

Apply ten blows to points evenly distributed over the sample, with one blow in the centre, one blow at each extremity and two more blows approximately midway between the previous blows, the sample being moved horizontally. Then apply five more blows in the same way after turning the sample through 90° about its axis perpendicular to the support. Do not apply to knockout areas.

11 Earthing

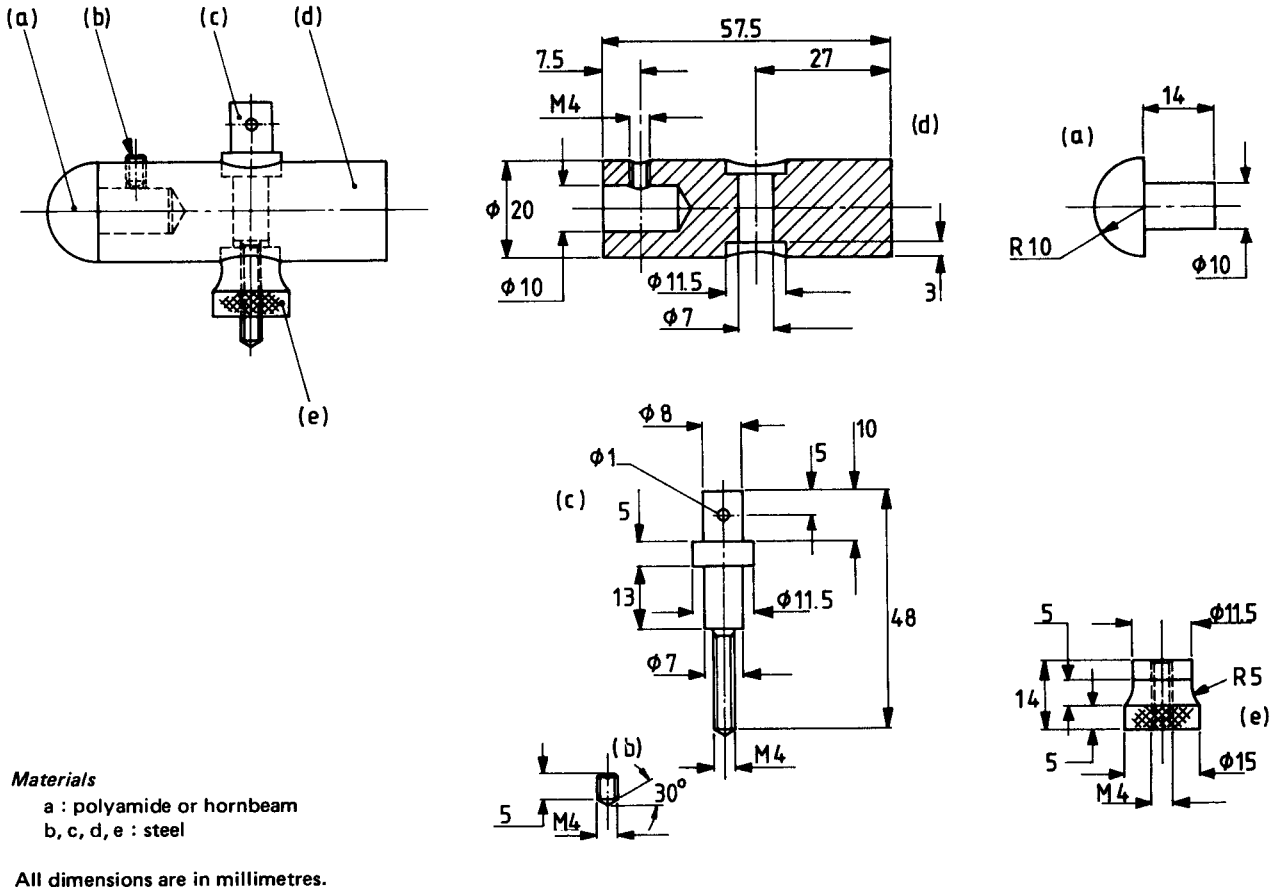
Where a junction box has accessible external parts of metal provision shall be made for connecting them to a protective conductor, except for metal components that are separated by non-conducting material in such a way that they cannot become live in normal use (see **14.1.2**). Such provision shall consist of either

a) an earthing terminal having at least the same capacity as the current-carrying terminals as declared by the manufacturer [see clause **5** b)], or

b) other adequate means, such as a screwed conduit entry for connection of the junction box to an earthed conduit system.

The construction of the junction box shall be such as to ensure that all parts to be earthed are in permanent electrical connection with the means provided for earthing when the junction box is installed as in normal use.

The resistance between any earthing terminal and any other metal required to be earthed shall not exceed 0.1 Ω at 25 A. Compliance shall be checked by inspection and measurement.



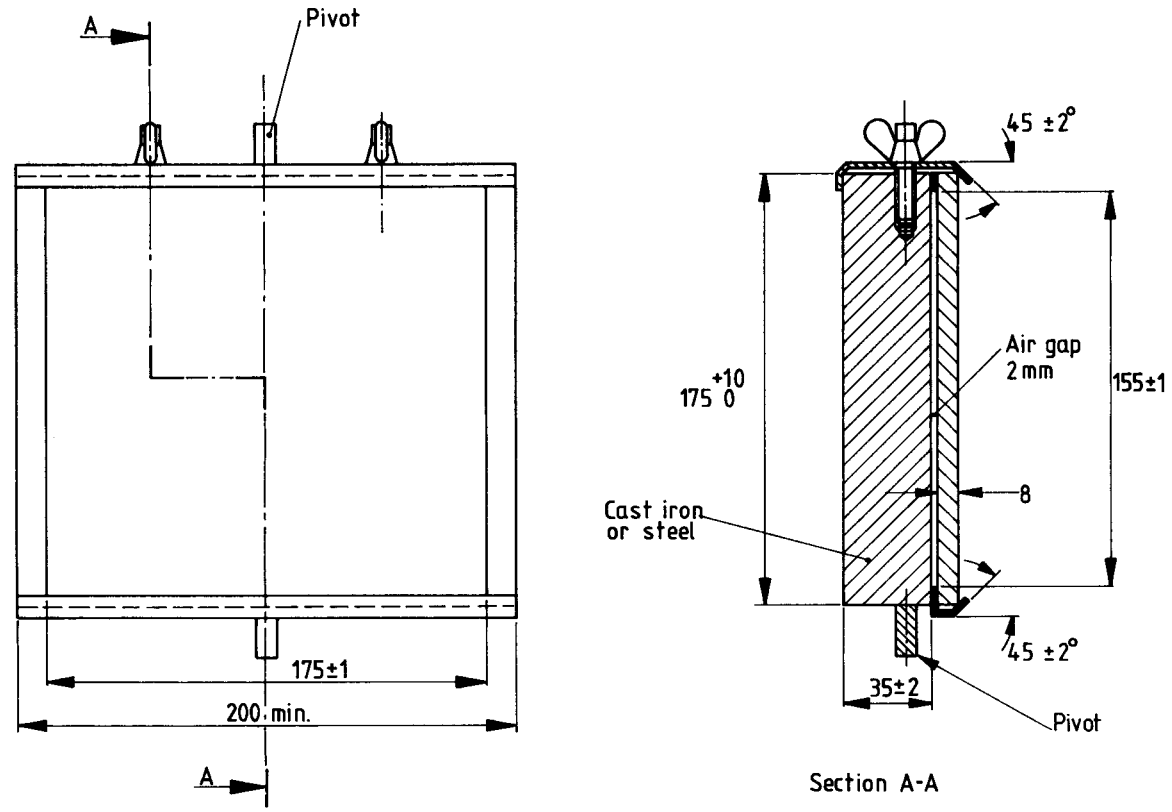
Materials

a : polyamide or hornbeam

b, c, d, e : steel

All dimensions are in millimetres.

Figure 2 — Constructional details of striking element



All dimensions are in millimetres.

Figure 3 — Mounting support for test samples

12 Terminals

12.1 Requirements. Terminals shall be of a type in which the contact pressure for gripping the conductors is neither dependent on nor transmitted through insulating materials that are liable to deteriorate or shrink in normal service.

Terminals shall provide adequate mechanical retention for the appropriate conductors that may be connected to them.

Terminals shall be so designed that they clamp the conductors reliably between metal surfaces without undue damage to them.

All terminals shall be so fixed or located that they are prevented from rotating.

Terminals shall be so designed that the conductors cannot slip out accidentally during the operation of the terminal screws or similar devices.

In a pillar-type terminal the size of the wire hole shall be such that the clearance between the hole and either side of the major diameter of the screw or the width of the intermediate clamping plate (if any) shall not exceed 0.4 mm.

In a pillar-type terminal the screw shall be long enough to extend to the far side of the conductor hole or slot. The end of the screw shall be suitably shaped and the wall of the hole or slot shall be unbroken or so shaped where the conductor is clamped as to minimize damage to the conductor.

The length of thread through which a terminal screw passes shall be not less than half the core diameter of the screw.

The capacity of terminals shall be as shown in Table 2.

NOTE Table 2 indicates the largest cables complying with the requirements of BS 6004, of which at least two conductors can be accommodated and clamped adequately either individually or together in one terminal, depending upon the design of the terminal.

Terminals shall be capable of accommodating and clamping at least two conductors two sizes smaller than the designated size, the conductors being solid or stranded.

Terminals in junction boxes shall be so designed and constructed that they provide satisfactory electrical connection for the appropriate cables without attaining excessive temperatures in normal use. Compliance shall be checked by the test specified in **12.2.1**, during which the temperature rise shall not exceed 45 K for any terminal.

Compliance with the other requirements of **12.1** shall be checked by inspection, by measurement and the tests specified in **12.2.2**. At the end of these tests, the following requirements shall be met:

a) no conductor shall have moved noticeably in its terminal during the pull-out test;

b) no screw or terminal shall have sustained damage such as to render it ineffective;

c) all terminals shall remain properly fixed or retained in the junction box;

d) no part of the base, cover or terminal housing shall have been damaged.

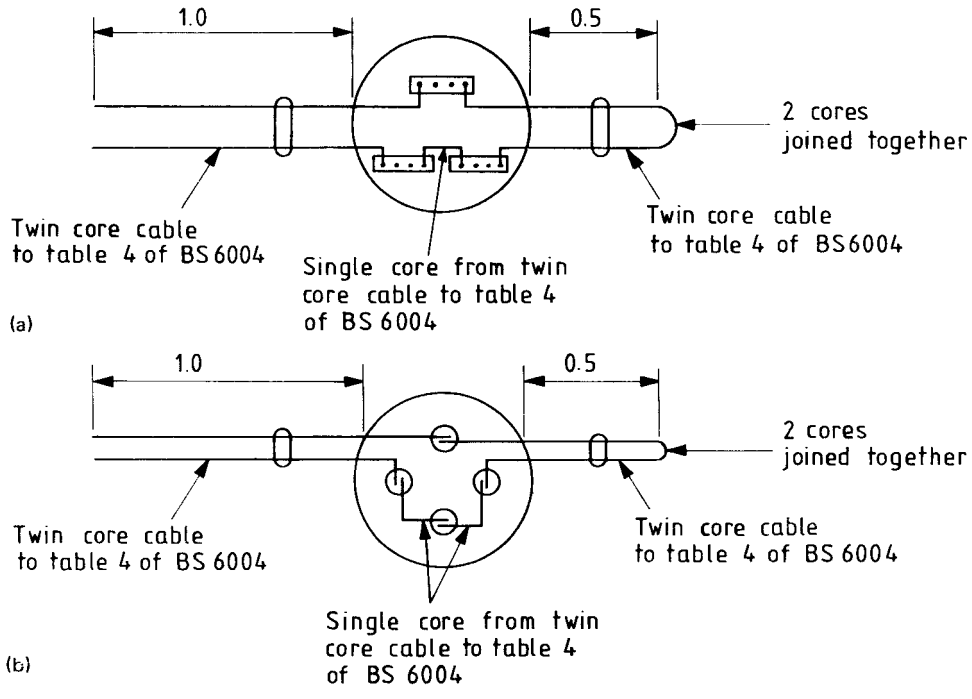
12.2 Tests

12.2.1 *Temperature rise test.* Carry out this test in surroundings free from external draughts.

Mount surface-type junction boxes, with any accompanying mounting block or backplate, on a vertical wood board 25 ± 1 mm thick having a flat surface extending at least 150 mm in every direction beyond the extremities of the junction box.

Mount flush-type junction boxes in a block of wood, simulating the conditions of normal use, so that the front edges of the associated box are 2.5 mm to 5 mm below the front surface of the block. The size of the block shall be such that there is a minimum of 25 mm of wood surrounding the box on all four sides and the back.

Pass the test current through all current-carrying terminals within the junction box in series. Make any necessary internal connection with the shortest convenient length of single core removed from a twin PVC-insulated cable complying with Table 4 of BS 6004:1975 and of the size declared by the manufacturer [see clause **5**b)]. Make external connections to the junction box with twin core supply cables complying with Table 4 of BS 6004:1975 (see Figure 4).



All dimensions are in millimetres.

Figure 4 — Examples of terminal test connections

If the terminal has more than one hole or slot, insert the ends of the conductors into the two holes or slots most distant from one another. If the terminal has a single hole or slot, the connections shall be separate conductors and rely on the terminal for their mechanical connection.

Tighten the terminal screws by applying a torque of two-thirds of the values given in Table 3.

Measure the temperature rise by thermocouples attached to the terminals by a low melting point solder, or some equally effective means of attachment, in such a way that the normal function of the terminals is not affected.

12.2.2 *Test of effectiveness of terminals.* Loosen the terminal screws and fit two copper conductors, of cables complying with Table 3 of BS 6004:1975 and of the largest size appropriate to the terminal as declared by the manufacturer [see clause **5** b)], into the terminal from opposite sides, leaving approximately 2 mm of conductor protruding beyond the terminal in each case. Alternatively, where a terminal has more than one hole or slot, insert a separate single copper conductor, as above, into each hole or slot.

Tighten the terminal screws by applying for 1 min the appropriate torque as shown in Table 3.

Loosen and retighten the terminal screws, as above, four more times.

Loosen the terminal screws. Remove the original copper conductors and replace them by new copper conductors, as specified above but of the next smaller size given in Table 2, all fitted from one side of the terminal. Retighten the screws to the original torques.

Hold the junction box firmly whilst applying axially a steady pull, as given in Table 2, to each of the conductors separately for 1 min.

Apply these tests to every terminal in each junction box tested.

Pass the appropriate test current given in Table 2 through all terminals and measure the temperature rise 4 h and 8 h after the start of the test.

Table 2 — Data for terminals

Nominal terminal capacity	Test current (see 12.2.1)	Pull-out force (see 12.2.2)
mm^2	A	N
2 × 1.5	21	40
2 × 2.5	30	50
2 × 4.0	38	60
2 × 6.0	49	80
2 × 10.0	68	100

Table 3 — Torque for terminal screws

Nominal diameter of screw thread	Torque	
	Screws without heads	Screws with heads or similar devices
mm	N m	N m
Up to and including 2.8	0.2	0.4
Over 2.8 up to and including 3.0	0.25	0.5
Over 3.0 up to and including 3.2	0.3	0.6
Over 3.2 up to and including 3.6	0.4	0.8
Over 3.6 up to and including 4.1	0.7	1.2
Over 4.1 up to and including 4.7	0.8	1.8
Over 4.7 up to and including 5.3	0.8	2.0
Over 5.3 up to and including 6.0	1.0	2.5
Over 6.0	1.4	3.5

13 Creepage distances and clearances

Creepage distances and clearances shall be not less than the values shown in Table 4. Compliance shall be checked by inspection and measurement.

NOTE 1 The relevant parts of a junction box are deemed to be protected against deposition of dirt if they are substantially enclosed within a housing forming part of the junction box. In junction boxes intended for mounting in flush enclosures, such a housing may have openings (e.g. for wiring access) but it should be such as to protect the relevant parts against the direct deposition of dirt by gravity.

NOTE 2 The contribution to the creepage distance of any groove less than 1 mm wide is limited to its width; any air gap less than 1 mm wide is ignored in computing the total clearance.

14 Electric strength and resistance to moisture

14.1 Requirements

14.1.1 *Ceramic and plastics parts.* Ceramic and plastics parts of junction boxes that support live parts shall be sufficiently non-hygroscopic. Their resistance to moisture shall not depend on glaze, varnish or similar surface treatment.

Table 4 — Creepage distances and clearances

Relevant parts of junction box	Clearance		Creepage	
	If protected against deposition of dirt	If not protected against deposition of dirt	Ceramics and like material	Other material
	mm	mm	mm	mm
Between live parts of different polarity	2.0	2.5	2.5	2.5
Between live parts and other metal parts	2.5	3.0	2.5	3.0
Between live metal parts and the enclosure or the surface on which the junction box is mounted, unless the holes containing such live parts are filled in with a non-hygroscopic insulant of at least 1 mm thickness that does not flow at 55 °C	3.0	3.0	—	—

Compliance shall be checked by the tests specified in **14.2.1**. After the test specified in **14.2.1.1**, the mass of ceramic parts shall not have increased by more than 0.5 %. After the test specified in **14.2.1.2**, plastics parts shall show no distortion, swelling, delamination or other deformation that could impair the functioning of the junction box.

14.1.2 *Junction boxes as a whole.* Junction boxes as a whole shall have adequate electric strength and shall be proof against humid conditions that may occur in normal service.

Compliance shall be checked by the tests specified in **14.2.2**. After the conditioning specified in **14.2.2.1**, and while the samples are still in the humidity cabinet or in a room where the specified temperature is maintained, insulation resistance and electric strength shall be adequate

a) between all terminals,

b) between all terminals and any other metal parts insulated from them, and

c) between all terminals and metallic foil in contact with the entire accessible surface.

Insulation resistance measured by the method specified in **14.2.2.2** shall be not less than 5 MΩ. During the test for electric strength specified in **14.2.2.3**, no breakdown or flashover shall occur, glow discharges without drop in voltage being disregarded for this purpose.

14.2 Tests

14.2.1 ***Ceramic and plastics parts***

14.2.1.1 *Ceramic parts.* Immerse weighed ceramic parts in distilled water for 24 h at a temperature of 20 ± 5 °C. At the end of this period remove the parts, wipe all visible water from their surfaces, and reweigh.

14.2.1.2 *Plastics parts.* Immerse plastics parts in distilled water for 48 h at a temperature of 20 ± 5 °C. At the end of this period remove the parts and wipe all visible water from their surfaces.

14.2.2 ***Junction boxes as a whole***

14.2.2.1 *Conditioning.* To suit the ambient conditions at the time of test, choose a convenient temperature t, between 20 °C and 30 °C, as a reference temperature. Bring the samples to a temperature in the range t °C to $(t + 4)$ °C and place them in a humidity cabinet at a relative humidity maintained between 91 % and 95 %. Maintain the temperature of the air at all positions within the cabinet where samples can be placed at $t \pm 1$ °C.

Keep the samples in the cabinet for 48 h.

NOTE 1 In most cases samples may be brought to the chosen reference temperature by keeping them at this temperature for at least 4 h.

NOTE 2 A relative humidity of between 91 % and 95 % can be obtained by placing in the humidity cabinet a saturated solution of potassium nitrate (KNO_3) or sodium sulphate ($Na_2 SO_4$) in water having sufficiently large contact surface with air. In order to achieve the specified conditions within the cabinet, it is necessary to ensure constant circulation of the air within, and in general to use a cabinet that is thermally insulated.

14.2.2.2 *Insulation resistance.* Immediately after conditioning the junction box as specified in **14.2.2.1**, apply a d.c. voltage of approximately 500 V for 1 min and measure the insulation resistance between the points listed in **14.1.2** a), b) and c) consecutively.

14.2.2.3 *Electric strength.* Immediately after the test specified in **14.2.2.2**, apply an a.c. voltage of approximately sine waveform, with a frequency of 50 Hz and an r.m.s. value of 2 000 V, for 1 min between the points listed in **14.1.2** a), b) and c) consecutively. Apply initially not more than half the specified voltage, then raise it rapidly to the full value.

NOTE 1 The high-voltage transformer used for the test should be so designed that, when the output terminals are short-circuited, after the output voltage has been adjusted to the appropriate test voltage, the output current is at least 200 mA.

NOTE 2 The over-current relay should not trip when the output is less than 100 mA.

NOTE 3 The r.m.s. value of the test voltage should be measured with care to ensure that it is within ± 3 % of the specified value.

15 Resistance to heat

15.1 Requirements. Component parts of plastics insulating material shall be sufficiently resistant to normal heat.

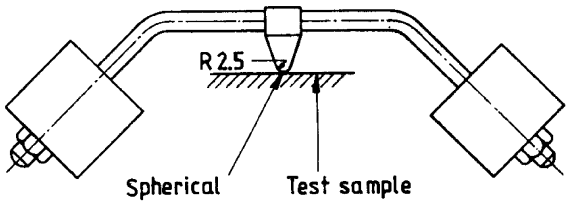
Compliance shall be checked by the tests specified in **15.2**. During the test specified in **15.2.1**, samples shall not undergo any change impairing their further use, and sealing compound shall not flow to such an extent that live parts are exposed. A slight displacement of the sealing compound shall be disregarded. After the test specified in **15.2.1**, the junction box shall comply with the requirements of clause **10**. After the test specified in **15.2.2**, the diameter of the impression made by the ball shall not exceed 2 mm.

15.2 Tests

15.2.1 *Exposure to heat.* Keep the samples for 1 h in a heating cabinet at a temperature of 100 ± 2 °C.

15.2.2 *Ball pressure test.* For component parts of insulating material necessary to retain current-carrying parts, carry out the following test at a temperature of 125 ± 2 °C. For component parts of insulating material not necessary to retain current-carrying parts, even though they may be in contact with them, carry out the following test at a temperature of 75 ± 2 °C.

Subject component parts of insulating material to a ball pressure test by means of the apparatus shown in Figure 5. Support the underside of the part being tested to withstand the test force and to minimize the risk of distortion. Before beginning the test, place the test load and the means of support in a heating cabinet at the appropriate temperature for a time sufficient to ensure that they have attained the test temperature.



The dimension is in millimetres.

Figure 5 — Ball pressure test apparatus

Place the component part in the heating cabinet at the test temperature, with the surface to be tested in a horizontal position. After 10 min, press a steel ball of 5 mm diameter against this surface with a force of 20 N for 1 h. Then remove the ball, cool the sample by immersion for at least 10 s in water at approximately room temperature, and measure the diameter of the impression caused by the ball.

If it is not possible to carry out the test on the sample itself, use a specimen of the same material not less than 2 mm thick.

16 Resistance to abnormal heat and to fire

16.1 Requirement. Parts of junction boxes shall be sufficiently resistant to abnormal heat and fire.

Compliance shall be checked as follows.

a) Parts of metal or ceramic material shall be deemed to comply with this requirement without further testing.

b) Parts of other materials, e.g. plastics insulating materials, shall be subjected to the test specified in **16.2**. Either there shall be no visible flame and no sustained glowing, or any flames and glowing at the specimen shall extinguish within 30 s after the removal of the glow-wire. There shall be no burning of the tissue paper or scorching of the board.

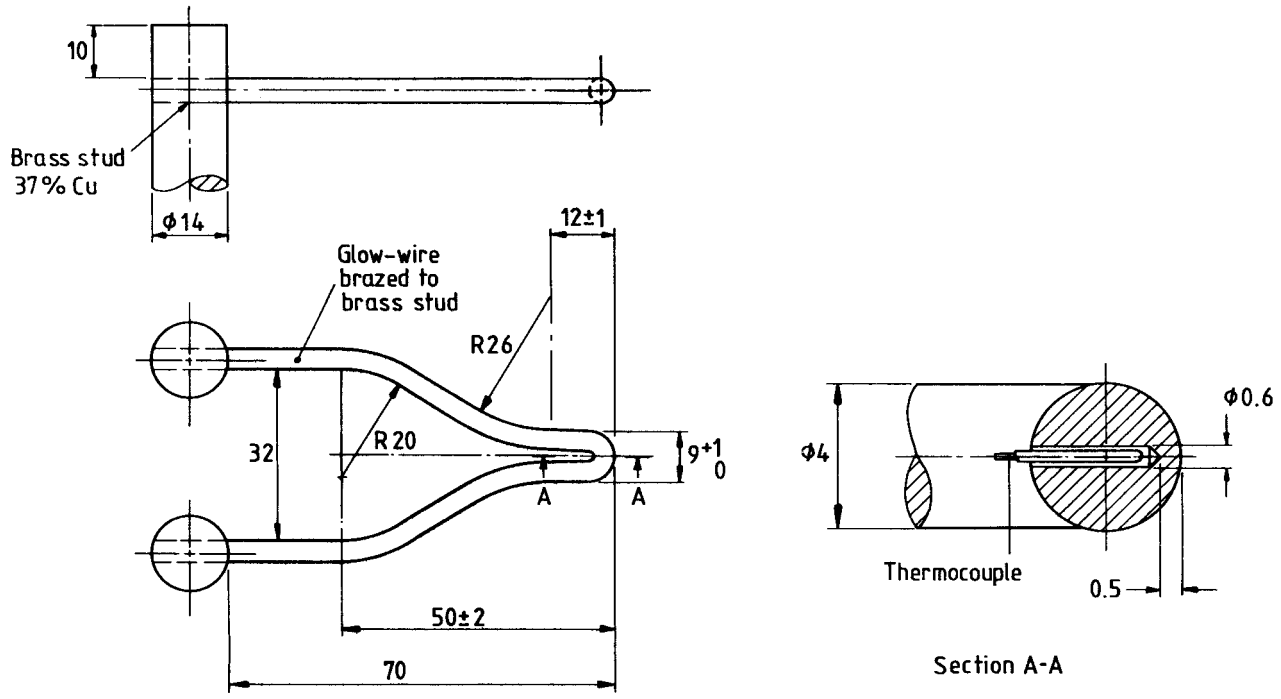


Figure 6 — Glow-wire with thermocouple

16.2 Glow-wire test

16.2.1 *Apparatus*

16.2.1.1 *Glow-wire*, consisting of a specified loop of 80/20 Ni/Cr wire (see Figure 6). When the loop is being formed, care shall be taken to avoid fine cracking at the tip. The glow-wire shall be electrically heated; the current necessary for heating the tip to a temperature of 960 °C shall be between 120 A and 150 A.

16.2.1.2 *Sheathed fine wire thermocouple* having an outside diameter of 0.5 mm, the wires consisting of nickel-chromium and nickel/aluminium. The sheath shall consist of a refractory metal resistant to a temperature of at least 960 °C. The thermocouple shall be arranged in a 0.6 mm diameter pocket hole drilled in the tip of the glow-wire as shown in section A–A of Figure 6.

The thermo-voltages shall comply with the international thermocouple tables specified in BS 4937-4, the characteristics being practically linear. The cold connections shall be kept in melting ice or in a compensation box.

16.2.1.3 *Voltmeter* for measuring the thermo-voltage, having an accuracy of class 0.5 as specified in BS 89.

16.2.1.4 *General.* The test apparatus shall be so designed that the glow-wire is kept horizontal and that a force of 1 N is maintained on the specimen when either the glow-wire or the specimen is moved horizontally towards the other over a distance of at least 7 mm.

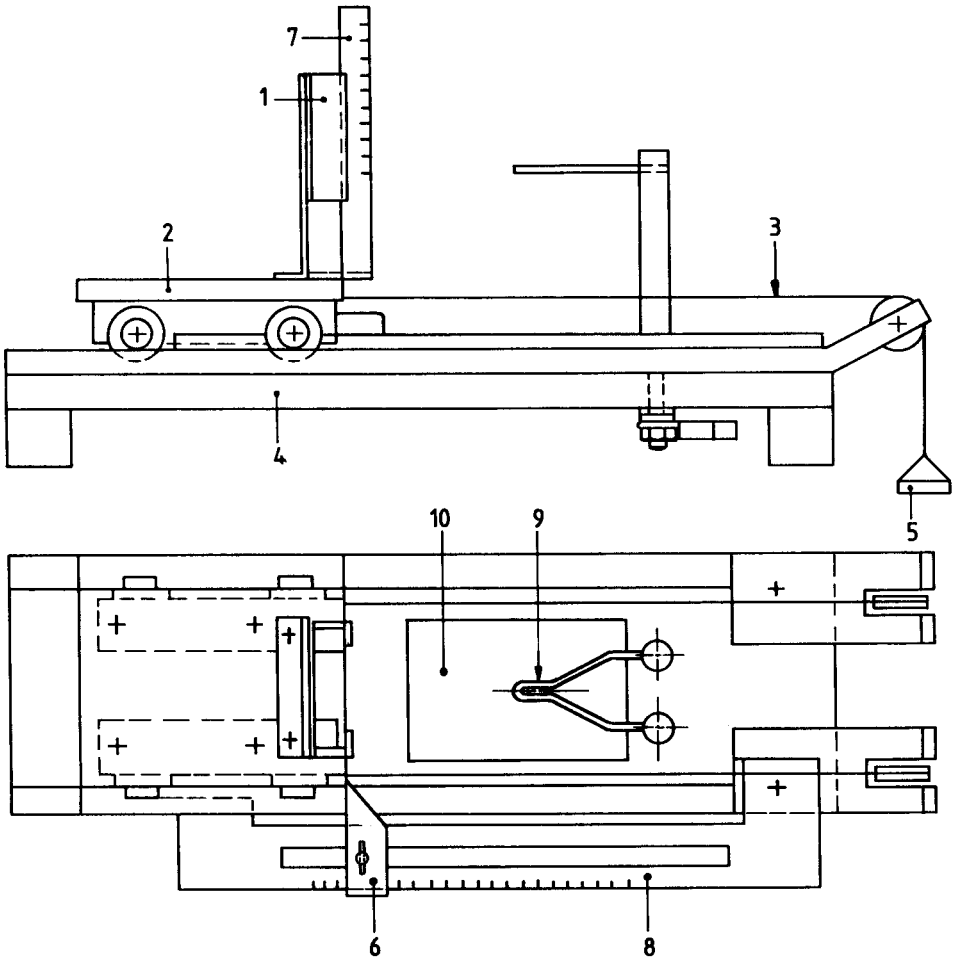
NOTE An example of the test apparatus is shown in Figure 7.

16.2.2 *Test specimen.* The test specimen shall be either a complete junction box or, if the test cannot be made on a complete box, a suitable part of one cut out for the purpose of the test.

The test specimen shall be conditioned for 24 h at a temperature in the range 15 °C to 35 °C and a relative humidity in the range 45 % to 75 %.

The test shall be made on one specimen and, in case of doubt, shall be repeated on two further specimens.

16.2.3 *Procedure.* Before starting the test, calibrate the thermocouple at a temperature of 960 °C, determined by the melting of a 2 mm × 2 mm chip of silver foil (99.8 %) having a thickness of 0.06 mm which is placed on the upper surface of the tip of the heated glow-wire. The temperature of 960 °C is reached when the foil lying flat on the surface just melts.



Key

1. Support for sample
2. Carriage
3. Pulling string
4. Base plate
5. Weight
6. Adjustable stop
7. Scale for flame height
8. Scale for depth of penetration
9. Glow-wire with thermocouple
10. Opening in base plate to pass molten or glowing particles

Figure 7 — Glow-wire test apparatus

Check the calibration of the thermocouple as often as is necessary to ensure its continuing accuracy.

Make allowance for the fact that the thermocouple is able to compensate by an axial movement for thermal elongation of the glow-wire.

Place the test apparatus in a draught-free room in subdued light so that any flame is visible.

Position the specimen during the test in the most unfavourable position of its normal use (normally with the surface to be tested in a vertical position). Apply the tip of the glow-wire to the specified surface of the test sample according to the intended use under which a heated or glowing element may come in contact with the test sample.

Position a piece of white pine-board, approximately 10 mm thick and covered with a single layer of wrapping tissue, nominally 200 mm directly beneath the glow-wire where it is applied to the specimen.

NOTE Wrapping tissue paper as defined in **6.86** of BS 3203:1979 may be used, i.e. a soft and strong light-weight wrapping paper of grammage (basic weight) generally between 12 g/m^2 and 30 g/m^2. It is primarily intended for protective packaging of delicate articles and for gift wrapping.

Heat the glow-wire electrically to the test temperature, which is measured with the calibrated thermocouple. Take care that this temperature and the heating current are constant for 60 s before starting the test and that no heat radiation influences the specimen during this period.

Bring the tip of the glow-wire in contact with the specimen and apply it for 30 ± 1 s; maintain the heating current during this period.

Limit the movement of the tip of the glow-wire through the test sample to which it is pressed to 7 mm.

If possible, apply the tip of the glow-wire to flat surfaces and not to grooves, knock-outs, narrow recesses or sharp edges. Apply the tip of the glow-wire where the section is the thinnest, but not less than 15 mm from the upper edge of the specimen.

After 30 ± 1 s remove the glow-wire from the specimen, avoiding any movement of air that may affect the results of the test and any further heating of the specimen.

NOTE It is necessary to clean the tip of residue of insulating material after each test, e.g. by means of a brush.

Apply the glow-wire to parts made of plastics insulating materials as follows:

a) parts necessary to retain live parts in position, at a test temperature of 850 ± 15 °C;

b) parts not necessary to retain live parts in position, although they may be in contact with them, at a test temperature of 650 ± 10 °C.

During the application time of the glow-wire and during a period of 30 s from the end of the application time, observe the specimen and the surrounding parts, including the layer under the specimen. Measure and record the time when any ignition of the specimen occurs and/or the time when flames extinguish during or after the application time.

17 Resistance to rusting

17.1 Requirement. Ferrous parts shall be adequately protected against rusting.

Compliance shall be checked by the test specified in **17.2**. After the test there shall be no signs of rust on the surfaces of the parts, traces of rust on sharp edges and any yellowish film removable by rubbing being disregarded for this purpose.

17.2 Test. Remove all grease from the parts to be tested, by immersion in trichloroethane or an equivalent degreasing agent for 10 min. Then immerse the parts for 10 min in a 10 % solution of ammonium chloride in water at a temperature of 20 ± 5 °C.

Without drying, but after shaking off any drops, place the parts for 10 min in a box containing air saturated with moisture at a temperature of 20 ± 5 °C. After drying the parts for 10 min in a heating cabinet at a temperature of 100 ± 5 °C, examine their surfaces for signs of rust.

Publications referred to

BS 31, *Steel conduit and fittings for electrical wiring.*

BS 89, *Specification for direct acting indicating electrical measuring instruments and their accessories.*

BS 3042, *Standard test fingers and probes for checking protection against electrical, mechanical and thermal hazard.*

BS 3203, *Glossary of paper, board, pulp and related terms.*

BS 4568, *Steel conduit and fittings with metric threads of ISO form for electrical installations.*

BS 4607, *Non-metallic conduits and fittings for electrical installations.*

BS 4662, *Boxes for the enclosure of electrical accessories.*

BS 4937, *International thermocouple reference tables.*

BS 5733, *Specification for general requirements for electrical accessories*[2)].

BS 6004, *PVC-insulated cables (non-armoured) for electric power and lighting.*

BS 6099, *Conduits for electrical installations.*

[2)] Referred to in the foreword only.

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