
Cinematography

Part 7. Production and presentation

Section 7.5 Film and television location lighting

Subsection 7.5.3 Specification for plugs and socket connectors

Cinématographie

Partie 7. Production et présentation

Section 7.5 Eclairage pour tournage de films et réalisation de programmes de télévision à l'extérieur

Sous-section 7.5.3 Spécification des fiches et connecteurs douilles

Kinematographie

Teil 7. Aufführung und Darstellung

Abschnitt 7.5 Beleuchtung für Film- und Fernsehaußenaufnahmen

Unterabschnitt 7.5.3 Spezifikation für Steckverbindungen

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Foreword

This Subsection of BS 5550 has been prepared under the direction of the Cinematograph Standards Committee, following a request from the television broadcast industry. It is an adaptation of BS 4343 'Industrial plugs, socket outlets and couplers for a.c. and d.c. supplies' to cover in-line flat-pin connectors to enable close stacking in distribution units and for stability when placed on the ground.

Television lighting equipment, evolving from well established film studio apparatus, has been based in general upon the use of original or modified 110 V d.c. plant and luminaires. Since television seldom requires the use of carbon arc light sources, a.c. has been adopted at 240 V for all tungsten lighting. However, because of the convenience and simplicity of the flat pin d.c. connectors, these were retained in modified form for location use on 240 V 50 Hz single-phase.

It has become apparent that such connectors can constitute a safety hazard under some circumstances. This hazard is overcome with connectors complying with the requirements of this British Standard which deals with two non-interchangeable flat pin connectors, one rated at 25 A and one at 45 A, designed specifically for use in the film and television industry.

The accessories of the same rating, making up these connectors, wherever manufactured, need to be completely

interchangeable. The constructional details specified are intended to ensure this interchangeability not only as regards the mating of the pins and contacts but also of the mechanical retaining device.

Other British Standards for plugs and socket outlets for electric power supply which are used for film, television and theatre lighting are:

- BS 546 Two-pole and earthing-pin plugs, socket outlets and socket outlet adaptors for circuits up to 250 V;
- BS 1363 13 A plugs, switched and unswitched socket outlets and boxes;
- BS 1778 15 A three-pin plugs, socket outlets and connectors (theatre type);
- BS 4343 Industrial plugs, socket outlets and couplers for a.c. and d.c. supplies.

Attention is drawn to the other Subsections of BS 5550 dealing specifically with location lighting:

- Subsection 7.5.1 Code of practice for distribution of a.c. electricity for location lighting
- Subsection 7.5.2 Specification for location lighting power distribution units
- Subsection 7.5.4 Specification for single pole high current plugs and socket connectors

British Standard

Cinematography

Part 7. Production and presentation

Section 7.5 Film and television location lighting

Subsection 7.5.3 Specification for plugs and socket connectors

1. Scope

This British Standard specifies requirements for plugs, socket outlets, cable couplers and appliance couplers of splashproof construction (these are referred to generally throughout the specification as accessories*). The accessories are for use with single-phase a.c. supplies with a voltage not exceeding 250 V and a frequency not exceeding 500 Hz, and for use with d.c. supplies not exceeding 250 V. Two rated current values are covered: 25 A and 45 A.

These accessories are intended for use in the film and television industry for lighting purposes 'on location' either indoors or outdoors.

The connectors are intended for continuous use in ambient temperatures between -20°C and $+35^{\circ}\text{C}$.

2. References

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

3. Definitions

For the purposes of this Subsection the following definitions, together with those given in BS 4727 apply.

3.1 on location. Electronic or motion-picture film cameras are said to be on location when they are used outdoors or indoors in any temporary or permanent building, either static, transportable or mobile, which is not specifically constructed for use as a film or television studio.

NOTE. A licensed theatre is not deemed to be a studio unless it has been specially adapted for regular film or television use.

3.2 plug and socket outlet*. Means enabling the connection, at will, of a flexible cable to fixed wiring. It consists of two parts:

- (a) a **socket outlet**, provided with female contacts which is the part intended to be installed with the fixed wiring;
- (b) a **plug**, provided with contact pins, which is the part integral with or attached to the flexible cable connected to the equipment or to a connector.

3.3 cable coupler†. Means enabling the connection, at will, of two flexible cables. It consists of two parts:

- (a) a **connector**, provided with female contacts which is the part integral with or intended to be attached to the flexible cable connected to the supply;
- (b) a **plug**, provided with contact pins which is the part integral with or intended to be attached to the flexible cable connected to equipment or to a connector.

3.4 appliance coupler†. Means enabling the connection, at will, of a flexible cable to the equipment. It consists of two parts:

- (a) a **connector**, provided with female contacts, which is the part integral with or intended to be attached to the flexible cable connected to the supply.
- (b) an **appliance inlet**, provided with contact pins, which is the part incorporated in or fixed to the equipment, or intended to be fixed to it.

NOTE. In general, the connector of an appliance coupler is identical to the connector of a cable coupler, and an appliance inlet has the same contact arrangement as a plug.

3.5 rewirable plug or connector. Accessory so constructed that the flexible cable can be replaced.

NOTE. All accessories covered by this standard are rewirable.

3.6 retaining device. Mechanical arrangement that holds a plug or connector in position when it is in proper engagement and prevents its unintentional withdrawal.

3.7 rated current. Current value assigned to the accessory by the maker.

3.8 maximum rated voltage. Maximum voltage at which any component part may be used.

NOTE. Where the terms 'voltage' and 'current' are used they imply r.m.s. values.

3.9 functional insulation. Insulation necessary for the proper functioning of the accessory and for basic protection against electric shock.

3.10 supplementary insulation (protective insulation). Independent insulation provided in addition to the functional insulation in order to ensure protection against electric shock in the event of a failure of the functional insulation.

*Attention is called to the fact that it is claimed that these accessories are the subject of a registered design. BSI will supply, on request, the information available but takes no position as to the validity of the registered design. The registered design holder has assured BSI that he is willing to grant licences under this registered design to anyone wishing to obtain them on non-discriminating terms and conditions.

†The use of these accessories is shown in figure 1.

3.11 double insulation. Insulation comprising both functional insulation and supplementary insulation.

3.12 reinforced insulation. Improved functional insulation with such mechanical and electrical qualities that it provides the same degree of protection against electric shock as double insulation.

3.13 pillar terminal. Terminal in which the conductor is inserted into a hole or cavity, where it is clamped under the shank of a screw or screws.

NOTE. The clamping pressure may be applied directly by the shank of the screw or through an intermediate clamping member to which pressure is applied by the shank of the screw.

3.14 screw terminal. Terminal in which the conductor is clamped under the head of the screw. The clamping pressure may be applied directly by the head of the screw or through an intermediate part, such as a washer, clamping plate or anti-spread device.

3.15 stud terminal. Terminal in which the conductor is clamped under a nut. The clamping pressure may be applied directly by a suitable shaped nut or through an intermediate part, such as a washer, clamping plate or anti-spread device.

3.16 saddle terminal. Terminal in which the conductor is clamped under a saddle by means of two or more screws or nuts.

3.17 lug terminal. Screw terminal or a stud terminal, designed for clamping a cable lug or bar by means of a screw or nut.

3.18 mantle terminal. Terminal in which the conductor is clamped against the base of a slot in a threaded stud by means of a nut. The conductor is clamped against the base of the slot by a suitable shaped washer under the nut, by a central peg if the nut is a cap nut, or by equally effective means for transmitting the pressure from the nut to the conductor within the slot.

4. General requirements

The accessories shall be of two non-interchangeable sizes: 25 A rated load and 45 A rated load. All tests specified in this standard shall apply to both sizes unless otherwise stated.

The overall cross section shall be rectangular to permit close stacking of socket outlets in such devices as portable distribution units, and also to minimize tripping hazards from single connectors when lying on the floor or ground. They shall be so designed that connectors may be stored or carried in the rain with the minimum of protection or cover either when coupled or uncoupled. Protection of personnel against leakage shocks whilst handling connectors is therefore fundamental. Accessories shall not have metal enclosures.

The retaining device shall be such as to permit the connection or disconnection of a cable coupler, when the socket outlet or connector is securely anchored, by the use only of the one hand which is being used for the operation. An illustration of typical mated accessories is shown in figure 2.

5. General notes on tests

5.1 Tests according to this standard are type tests.

5.2 Unless specified elsewhere in this standard, the samples are tested as delivered and under normal conditions of use, at an ambient temperature of $20 \pm 5^\circ\text{C}$, the tests being made at rated frequency.

5.3 Unless specified elsewhere in this standard, the tests are carried out in the order of the clauses.

5.4 Three samples are subjected to all the tests. If, however, the test given in clause 21 has to be carried out with both d.c. and a.c., the test with a.c. is carried out on three additional samples.

5.5 Accessories do not comply with the requirements of this British Standard if there are more failures than that of one sample in one of the tests. If one sample fails in a test, that test, and all preceding tests that may have influenced the results of that test, are repeated on another set of three samples. If any of these samples fails in any of the repeated tests, the accessory shall be deemed not to comply with the requirements of this British Standard.

NOTE. In general, it will only be necessary to repeat the test which caused the failure, unless the sample fails in one of the tests given in clauses 22 and 23, in which case the tests are repeated from that given in clause 21 onwards.

6. Standard rating

6.1 Maximum rated voltage is:

250 V a.c. or d.c.

6.2 Rated currents are:

25 A and 45 A.

7. Classification

Accessories shall be classified according to purpose:

- (a) plugs and socket outlets;
- (b) cable couplers, comprising a connector and a plug;
- (c) appliance couplers, comprising a connector and an appliance inlet.

8. Marking

8.1 Accessories shall be marked with:

- (a) rated current in amperes;
- (b) maximum rated voltage in volts;
- (c) symbol for splashproof construction;
- (d) the number of this British Standard, i.e. BS 5550 : Subsection 7.5.3*;
- (e) manufacturer's name or trade mark;
- (f) type reference, which may be a catalogue number.

8.2 When symbols are used, they shall be as follows:

A amperes

V volts

 splashproof construction

8.3 For plugs and connectors, the marking specified in 8.1 shall be easily discernible when the accessory is wired ready for use.

NOTE. The term 'ready for use' does not imply the plug or connector is in engagement with its complementary accessory.

*Marking BS 5550 : Subsection 7.5.3 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, 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.

8.4 The phase contact shall be indicated by the symbol L, the neutral contact by the letter N, and the earthing contact by the symbol $\oplus$.

These symbols shall also be on the insulators, close to the relevant terminals; they shall not be placed on screws, removable washers or other removable parts.

8.5 Marking shall be indelible and easily legible.

TEST. Compliance with the requirements of 8.1 to 8.5 shall be checked by inspection if necessary during the test given in 12.3. In addition, after the humidity treatment given in 19.2, the marking shall be rubbed vigorously by hand for 15 s with a piece of cloth soaked with petroleum spirit, and then checked by inspection. The marking shall again be checked by inspection after the test given in 28.2.

9. Dimensions

9.1 Accessories shall conform to the dimensions given in figures 3 to 5 and tables 12 to 15.

TEST. Compliance shall be checked by means of gauges and by measurement.

The appropriate gauges are shown in figures 6 to 8.

9.2 Accessories shall be in accordance with the figures and tables, especially with regard to safety, interchangeability and non-interchangeability.

9.3 It shall not be possible to engage plugs with socket outlets or connectors or appliance inlets with connectors or socket outlets having different current ratings.

The design shall be such that:

- (a) the earth pin cannot make contact with the neutral female contact or with the phase female contact;
- (b) the neutral pin or earth pin cannot make contact with the phase female contact.

TEST. Compliance shall be checked by the gauges shown in figures 6 and 7.

For accessories with enclosures of resilient material, the test shall be made at a temperature of $35 \pm 2^\circ\text{C}$, both the accessories and the gauges being at this temperature.

A force of 200 N is applied for 1 min.

NOTE. For accessories of rigid material, such as thermosetting resins, ceramic materials and the like, conformity to the dimensions given in the relevant figure or table ensures compliance with this requirement, so that, in general, the test by means of gauges will not be necessary.

9.4 It shall not be possible to make improper connections between plugs and socket outlets or connectors, or between appliance inlets and connectors or socket outlets.

TEST. Compliance shall be checked by manual test with the gauges shown in figures 6 and 7.

The gauges are applied with a force of 200 N for 1 min.

For accessories with enclosures of resilient material, the gauge is applied at a temperature of $35 \pm 2^\circ\text{C}$, both the accessory and the gauge being at this temperature.

NOTE. Improper connections include single pole connection and other connections which do not comply with the requirements for protection against electric shock.

For accessories of rigid materials, such as thermosetting resins, ceramic and other materials with similar properties, conformity to the dimensions given in the relevant figure or table ensures compliance with this requirement.

10. Protection against electric shock

10.1 Accessories shall be so designed that live parts of socket outlets and connectors, when they are wired as in

normal use, and live parts of plugs and appliance inlets, when they are in partial or complete engagement with the complementary accessories, are not accessible.

It shall not be possible to make contact between a pin of a plug or appliance inlet and contact of a socket outlet or connector, while any pin is accessible.

The earthing pins and female contacts of accessories with enclosures of insulating material shall not be accessible while the earth pin is mated with the earth contact.

TEST. Compliance shall be checked by inspection and, if necessary, for the sample wired as in normal use, by applying the standard test finger (see figure 9) in every possible position, an electrical indicator with a voltage not less than 40 V being used to show contact with the relevant parts.

The test figure shall not make contact with any live part.

NOTE 1. Neutral female contacts of socket outlets and connectors are deemed to be live parts.

NOTE 2. Conformity to the dimensions given in the relevant figure or table ensures compliance with the requirement so far as the inaccessibility of contacts during insertion of a plug or connector into the complementary accessories is concerned.

10.2 It shall not be possible to interchange the insulating inserts of plugs and appliance inlets with those of socket outlets or connectors.

TEST. Compliance shall be checked by manual test.

11. Provision for earthing

11.1 Accessible metal parts of accessories which may become live in the event of an insulation fault, shall be reliably connected to the internal earthing terminal.

NOTE. For the purpose of this requirement, screws for fixing bases, covers and the like, are not deemed to be accessible metal parts which may become live in the event of an insulation fault. If accessible metal parts are screened from live parts by metal parts which are connected to an earthing terminal or an earthing contact, or if they are separated from live parts by double insulation or reinforced insulation, they are not, for the purposes of this requirement, regarded as likely to become live in the event of an insulation fault.

TEST. Compliance shall be checked by inspection.

11.2 Earthing contacts shall be capable of carrying a current equal to that specified for the phase contacts.

TEST. Compliance shall be checked by the test given in clause 23.

11.3 The earthing contacts shall be so shrouded or guarded that they are protected against mechanical damage.

TEST. Compliance shall be checked by inspection.

12. Terminals

12.1 The accessories shall be provided with terminals in which connection is made by means of screws, nuts or equally effective devices.

TEST. Compliance shall be checked by inspection.

12.2 Parts of terminals other than screws, nuts, washers, stirrups, clamping plates and the like, shall be either of copper, or an alloy containing at least 58 % copper or other metal no less resistant to corrosion than copper and having mechanical properties no less suitable. Steel screws shall be adequately protected against corrosion.

TEST. Compliance shall be checked by inspection and by chemical analysis.

12.3 Terminals and any lugs supplied with lug terminals shall allow the connection of conductors having nominal cross-sectional areas as shown in table 1.

TEST. Compliance shall be checked by inspection, by measurement and by fitting conductors of the smallest and largest cross-sectional areas specified.

Table 1. Conductor cross-sectional areas

Rated current	Nominal cross-sectional area of conductor	Nominal size of pillar, screw, stud and saddle terminals*	Nominal size of lug terminal†
A	mm ²		
25	2.5 to 4.0	5	6
45	4.0 to 6.0	7	6

*See tables 12 to 14.

†See table 15.

12.4 Terminals shall have adequate mechanical strength.

Screws and nuts for clamping the conductors shall have ISO metric screw threads complying with the requirements of BS 3643.

12.5 Terminals shall be so designed that they can be properly fixed to the accessory. They shall not work loose when the clamping screws or nuts are tightened or loosened.

Screws and nuts for clamping the conductors shall not serve to fix any other component.

NOTE. The clamping means for the conductors may be used to stop rotation or displacement of the pins or female contacts.

TEST. Compliance with the requirements of **12.4** and **12.5** shall be checked by inspection, by measurement and by the test given in **26.1**.

NOTE. These requirements do not preclude terminals that are floating or terminals so designed that rotation or displacement of the terminals is prevented by the clamping screw or nut, provided that their movement is appropriately limited and does not impair the correct operation of the accessory.

Terminals may be prevented from working loose by fixing with two screws, by fixing with one screw in a recess such that there is no appreciable play, or by other suitable means.

Covering with sealing compound without other means of locking is not deemed to be sufficient. Self-hardening resins may, however, be used to lock terminals which are not subject to torsion in normal use.

12.6 Terminals shall be so designed that they clamp the conductor between metal surfaces with sufficient contact pressure and without damage to the conductor.

Terminals of size 5 shall allow the conductor to be connected without special preparation and shall be so designed or placed that the conductor cannot slip out when the clamping screws or nuts are tightened.

Special preparation is acceptable for terminals of size 6 and 7 (see tables 12 to 14).

TEST. For terminals other than lug terminals, compliance shall be checked by inspection of the terminals and of the conductors, after conductors of the smallest and largest cross-sectional areas specified in **12.3** have been clamped and loosened, the maximum torque applied to clamp the conductor being equal to two-thirds of the torque specified

in table 10. If the screw has a hexagonal head with a slot, the torque applied is equal to two-thirds of the torque shown in column C of table 10.

TEST. For lug terminals, compliance shall be checked by inspection of the terminals after clamping a rectangular gauge strip of 3 mm thickness and 11 mm width with a clearance hole for a screw of 6 mm nominal diameter situated at a distance of 6 mm from the end. The maximum torque applied to clamp the gauge strip is 1.4 N m (two-thirds of the torque specified in columns C and D of table 10).

NOTE. The term 'special preparation' covers soldering of the strands of the conductor, use of cable lugs, formation of eyelets, etc., but not the reshaping of the conductor before the introduction into the terminal or the twisting of a standard conductor to consolidate the end.

Conductors are considered to be damaged if they show deep or sharp indentations.

12.7 Terminals shall conform to the dimensions given in table 12 for pillar terminals, table 13 for screw and stud terminals, table 14 for saddle terminals and table 15 for lug terminals, except that for tables 12 to 14 the length of thread in the fixed part or nut and the length of thread on the screw or stud may be reduced if the mechanical strength of the terminal is adequate and at least two full threads of every clamping screw are in engagement when a conductor of the most unfavourable cross-sectional area is clamped.

Mantle terminals shall conform to the dimensions given in table 12 with regard to the dimensions *D* and *e*.

Terminals which are essentially of the pillar type, but having the part with the hole for the conductor slotted to enable the conductor to be moved laterally into position, shall conform to the dimensions given in table 12 except that the maximum gap between the conductor restraining parts on the side where the slot is located shall conform to the dimensions given in table 13.

If the required length of thread in a terminal screw hole is obtained by plunging, the edge of the extrusion shall be reasonably smooth and the length of thread shall exceed the specified minimum value by at least 0.5 mm.

TEST. Compliance shall be checked by inspection, by measurement and, for terminals with a reduced length of thread, by the tests given in **12.8**. The maximum gap between the conductor restraining parts is checked by means of a steel gauge pin with a diameter equal to $e \pm 0.05$ mm.

For terminals without a pressure plate or a similar device, conforming to the dimensions given in table 12, the clamping screw is screwed fully home without a conductor in position. It shall not then be possible to insert the gauge pin between the threaded part of the screw and the wall of the conductor space.

For terminals conforming to the dimensions given in table 13 and for terminals with pressure plates or a similar device, conforming to the dimensions given in table 12, where it is not appropriate to insert the gauge pin in all positions, a conductor is clamped in the terminal.

For terminals conforming to the dimensions given in table 12, the conductor is in the form of a rod with a diameter equal to that corresponding to the middle cross-sectional area of the range specified for the particular terminal, and having a flat end perpendicular to the axis.

For terminals conforming to the dimensions given in table 13, the conductor is solid and has a diameter D as specified in the figure or table for the particular terminal.

With this conductor in position, it shall not be possible to insert the gauge pin, applied in a direction parallel to the axis of the conductor, into any gap through which a wire of a stranded conductor might escape.

The minimum distance between the clamping screw and the end of the conductor when fully inserted, which is specified in table 12, is checked by means of the rod conductor specified above, which shall pass into the conductor space for a distance beyond the threaded hole at least equal to the minimum distance specified.

NOTE 1. The following negative deviations from the specified values are allowed for the minimum thread diameter of the screw:

- 0.15 mm for screws with a nominal diameter not exceeding 5 mm;
- 0.22 mm for screws with a nominal diameter over 5 mm but not exceeding 10 mm.

NOTE 2. This clause does not exclude terminals of types other than those shown in the figures and tables. Such terminals, however, have to comply with the other requirements of clause 2.

If the thread in the fixed part or nut is recessed, the total length of the shank of headed screws has to be increased accordingly.

If one or more of the dimensions are larger than the minimum values specified in the figures and tables, the other dimensions need not be correspondingly increased, but departures from the specified values have not to impair the function of the terminal.

NOTE 3. For terminals with a pressure plate, conforming to the dimensions given in table 12, the gauge pin is applied to the gap between the pressure plate and the wall of the conductor space.

12.8 Terminals conforming to the dimensions given in table 12 but with a reduced length of thread, are fitted with a conductor of the smallest cross-sectional area specified in table 1, tightly clamped, or a conductor of the largest cross-sectional area specified in that table, lightly clamped, whichever is the more unfavourable.

Terminals conforming to the dimensions given in tables 13 or 14, but with a reduced length of thread, are fitted with a conductor of the largest cross-sectional area specified in table 1, lightly clamped.

At least two threads shall be in full engagement.

The terminals are then fitted with conductors of the smallest and largest cross-sectional areas specified in table 1, fixed wiring (solid or stranded) for socket outlets and appliance inlets and flexible cable for plugs and connectors, and the terminal screws are tightened, the maximum torque applied being equal to two-thirds of the torque specified in table 10. Each conductor is subjected to a pull of the value, in newtons, given in table 2; the pull is applied without jerks, for 1 min, in the direction of the axis of the conductor space.

During the test, the conductor shall not move noticeably in the terminal.

Table 2. Conductor pull on terminals

Terminal size	Pull
	N
5	80
7	100

12.9 Clamping screws or nuts of earthing terminals shall be adequately locked against accidental loosening and it shall not be possible to loosen them without the aid of a tool.

TEST. Compliance shall be checked by inspection and by manual test.

NOTE. In general, the designs shown in the figures and tables, other than some that conform to the dimensions given in table 12, provide sufficient resiliency to comply with this requirement; for other designs special provisions, such as the use of an adequately resilient part which is not likely to be removed inadvertently, may be necessary.

12.10 Terminals shall be located or shielded such that:

- (a) screws becoming loose from the terminals cannot establish any connection between live parts and metal parts connected to the earthing terminals;
- (b) conductors becoming detached from live terminals cannot touch metal parts connected to the earthing terminal;
- (c) conductors becoming detached from the earthing terminal cannot touch live parts.

TEST. Compliance shall be checked by inspection and by manual test.

12.11 When the conductors have been correctly fitted there shall be no risk of accidental contact between live parts of different polarity or between such parts and accessible metal parts, and, should a wire of a stranded conductor escape from a terminal, there shall be no risk that wires emerge from the enclosure.

TEST. Compliance shall be checked by inspection and, where the risk of accidental contact between live parts and other metal parts is concerned, by the following test.

An 8 mm length of insulation is removed from the end of a flexible conductor having a cross-sectional area chosen in the middle of the range specified in table 1. One wire of the stranded conductor is left free and the other wires are fully inserted into and clamped in the terminal.

The free wire is bent, without tearing the insulation back, in every possible direction, but without making sharp bends around the barriers.

The free wire of a conductor connected to a live terminal shall neither touch any metal part which is not a live part nor emerge from the enclosure, and that of a conductor connected to the earthing terminal shall not touch any live part.

NOTE. The test may be repeated with the free wire in another position.

13. Retaining device

A mechanical retaining device shall be incorporated such that the catch engages automatically when accessories are mated. (See figures 2 to 4.)

The release mechanism for the catch shall form a part of the male assembly, and shall be operable with the one hand used for withdrawing the plug.

TEST. Compliance shall be checked by inspection and manual operation.

14. Resistance to ageing of rubber and thermoplastic (resilient) materials

Accessories with enclosures of rubber or thermoplastic material and parts of rubber, such as sealing rings and gaskets, shall be sufficiently resistant to ageing.

TEST. Compliance shall be checked by means of an accelerated ageing test by suspending the samples freely in a heating cabinet, ventilated by natural circulation. The temperature in the cabinet and the duration of the ageing test are:

$70 \pm 2^\circ\text{C}$ and 10 days (240 h) for rubber;

$80 \pm 2^\circ\text{C}$ and 7 days (168 h) for thermoplastic material.

After the samples have been allowed to attain approximate room temperature, they are examined and shall show no crack visible to the naked eye, nor shall the material have become sticky or greasy.

After the test the samples shall show no damage which would lead to non-compliance with this standard.

If there is a doubt as to whether the material has become sticky, the sample is placed on one of the pans of a balance and the other pan is loaded with a mass equal to the mass of the sample plus 500 g. Equilibrium is then restored by pressing the sample with the forefinger wrapped in a piece of dry flannelette*.

No traces of the flannelette shall remain on the sample of the material and the sample shall not stick to the flannelette.

NOTE. The use of an electrically heated cabinet is recommended. Natural circulation may be provided by holes in the walls of the cabinet.

15. General construction

15.1 When mated, a plug and socket combination shall be splashproof.

Unmated accessories shall be splashproof when a separate cap or cover is applied. The cap shall not necessarily form an integral part of, or be fixed to, either plug or socket, in which case it shall be an available component.

TEST. Compliance shall be checked by inspection of the marking and by the relevant tests given in 19.1.

15.2 Accessible surfaces of accessories shall be free from burrs, flash and similar sharp edges.

15.3 Screws or other means for fixing the part carrying the female contacts or the part carrying the pins to its mounting surface in a box or in an enclosure shall be easily accessible. These fixings and those which fix the enclosure shall not serve to fix any other part.

TEST. Compliance with 15.2 and 15.3 shall be by inspection.

15.4 It shall not be possible for the user to alter the position of the earthing contact, or the neutral contact, in relation to the body of the socket outlet or connector or to the body of the plug or appliance inlet.

TEST. Compliance shall be checked by a manual test to ensure that only one mounting position is possible.

16. Construction of socket outlets

16.1 Female contacts of socket outlets shall be designed so that adequate contact pressure with a mated pin is ensured.

TEST. Compliance shall be checked by inspection and by the following tests.

The sample is mounted so that the axes of the contacts are vertical with the contact openings downwards.

A single-pin gauge of hardened steel with a finely ground finish and free from grease, having the dimensions of one pin as shown in figure 8 is inserted into each female contact

in turn and the force necessary to withdraw the gauge is measured by the apparatus illustrated in figure 10.

The steadily applied force required to withdraw the gauge from each female contact shall lie between the limits given in table 3.

Table 3. Single-pin gauge withdrawal force

Rating	Minimum force	Maximum force
A	N	N
25	10	40
45	15	40

16.2 The pressure exerted by the female contacts of socket outlets on the contact pins of a plug shall be not so great as to prevent the easy insertion and withdrawal of the plug.

TEST. Compliance shall be checked by determining the force necessary to withdraw the test gauge from the sample with the sample mounted so that the axes of the female contacts are vertical and with the contact openings downwards as shown in figure 10.

A test gauge conforming to the dimensions given in figure 8, is inserted into the sample. A principal weight and a supplementary weight are used, the supplementary weight having a mass equal to one-tenth of the principal weight plus the mass of the plug.

The principal weight together with the supplementary weight and the test gauge, are such as to exert a force equal to the maximum withdrawal force given in table 4. The principal weight is hung on without jolting the test gauge and the supplementary weight is allowed to fall from a height of 50 mm on to the principal weight.

The gauge shall not remain in the sample.

Following this, the test gauge is again inserted into the sample. A weight, which together with the mass of the test gauge exerts a force equal to the minimum withdrawal force given in table 4, is hung on the test gauge.

The gauge shall not come out.

Table 4. Three-pin gauge withdrawal force

Rated current of the accessory	Withdrawal force	
	Maximum	Minimum
A	N	N
25	160	40
45	200	60

16.3 Socket outlets shall be so constructed as to permit:

- the conductors to be easily introduced into the terminals and secured therein;
- The correct positioning of the conductors without their insulation coming into contact with live parts of polarity different from that of the conductors;
- The covers of the enclosures to be fixed easily after connection of the conductors.

16.4 Parts providing protection against electric shock shall have adequate mechanical strength (see clause 25); they shall be securely fixed in such a way that they will not work loose in normal use. It shall not be possible to remove these parts without the aid of a tool.

*Flannelette as specified in appendix B of BS 1945 : 1971 is suitable.

Enclosures shall be secured in position by at least two independent means which require the use of a tool for their operation.

16.5 Cable entries shall allow the introduction of the protective covering of the cable so as to afford complete mechanical protection.

TEST. Compliance with the requirements of **16.3** to **16.5** shall be checked by inspection and by an installation test with conductors of the largest cross-sectional area specified in table 1.

16.6 Insulating linings, barriers and the like, shall have adequate mechanical strength and shall be secured in a reliable manner.

TEST. Compliance shall be checked by inspection and by the tests given in **19.2** and clause **25**.

NOTE. The fixing of insulated linings by means of a self-setting varnish is allowed.

17. Construction of plugs and connectors

17.1 The insulated body of plugs and connectors shall completely enclose the terminals, the end of the flexible cable and the cable anchorage. The construction shall be such that the conductors can be properly connected and the cores kept in place so that there is no risk of contact between them from the point of separation of the cores to the terminals.

The pin assembly of a plug shall be protected by a surrounding shroud.

Plugs and connectors shall be so constructed that the part protecting the pins or the female contacts cannot be removed without making the accessory unusable.

TEST. Compliance shall be checked by inspection and, if necessary, by a manual test.

17.2 The various parts of a plug or connector shall be reliably fixed to one another in such a way that they will not work loose in normal use. It shall not be possible to dismantle plugs or connectors without the aid of a tool.

TEST. Compliance shall be checked by manual test and by the test given in **25.4**.

17.3 If an insulating lining is provided, it shall be secured to the enclosure in a reliable manner.

TEST. Compliance shall be checked by inspection and by the tests given in **19.2** and **25.4**.

NOTE. Self-setting varnish is allowed for fixing insulating linings.

17.4 Contact pins of plugs shall be solid, and shall not be removable without dismantling the plug. The pins shall be floating or sufficiently resilient to ensure adequate alignment with a mated female contact.

17.5 Female contacts shall be designed so that adequate contact pressure with a mated pin is ensured.

TEST. Compliance shall be checked by inspection and by the test given in **16.1**.

17.6 The pressure exerted by the female contacts of connectors on the contact pins of a plug shall be not so great as to prevent the easy insertion and withdrawal of the plug, but sufficient to prevent it from working out of the connector in normal use.

TEST. Compliance shall be checked by the test given in **16.2**.

18. Construction of appliance inlets

18.1 Contact pins of appliance inlets shall be solid and shall not be removable without the aid of a tool. The pins shall

be floating or sufficiently resilient to ensure adequate alignment with a mated female contact.

The contact assembly of appliance inlets shall be protected by a surrounding shroud.

TEST. Compliance shall be checked by inspection and by manual test.

18.2 Appliance inlets shall incorporate means (which can only be dismantled by the use of a tool) for ensuring the required degree of protection against moisture when an appropriate connector is completely engaged.

TEST. Compliance shall be checked by inspection and by the tests given in clauses **19** and **20**.

19. Moisture resistance

19.1 The enclosures of the accessories shall provide an adequate degree of protection against moisture.

TEST. Compliance shall be checked by the appropriate treatment specified below which is made on accessories fitted with cables for which they are designed. Glands, fixing screws of enclosures and covers are tightened with a torque equal to two-thirds of the torque applied in the tables 9 and 10 as appropriate. Screwed caps are tightened as in normal use.

Socket outlets are mounted on a vertical surface so that the drain hole, if any, is in the lowest position. Connectors are placed in the most unfavourable position.

Socket outlets and connectors are tested with, and also without, the complementary accessory in engagement; the means for ensuring the required degree of protection against moisture being positioned as in normal use.

Plugs and appliance inlets are only tested when in engagement with the complementary accessory.

The accessories are sprayed with water for 10 min by means of the spray apparatus shown in figure 11, which comprises a tube formed into a semicircle. The radius of the circle is 200 mm or a multiple of 200 mm and is as small as is compatible with the size and position of the sample. The tube is perforated so that jets of water are directed towards the centre of the circle, and the water pressure at the inlet to the apparatus is equivalent to a head of approximately 10 m.

The tube is caused to oscillate through the angle of 120° , 60° on either side of the vertical. The time for one complete oscillation ($2 \times 120^\circ$) being approximately 4 s.

The sample is mounted at the centre of the semicircle formed by the tube, so that its lowest part is level with the axis of oscillation. The sample is turned about its vertical axis during the test.

Immediately afterwards, the sample is subjected for 5 min to splashing in all directions by means of the splash apparatus shown in figure 12.

During this test, the water pressure is so regulated that the water splashes up 150 mm above the bottom of the bowl. The apparatus is placed on a horizontal support 50 mm to 100 mm below the lowest edge of the sample; the apparatus is moved around so as to splash the sample from all directions. Care is taken that the sample is not hit by the direct jet.

Immediately after this treatment, the samples shall withstand an electric strength test as specified in **20.3**.

19.2 Accessories shall be proof against humid conditions which may occur in normal use.

TEST. Compliance shall be checked by the humidity treatment described here, followed immediately by the

measurement of the insulation resistance and by the electric strength test specified in 20.2 and 20.3.

Cable entries, if any, are left open.

Covers which can be removed without the aid of a tool are removed and subjected to the humidity treatment with the main part.

The humidity treatment is carried out in a humidity cabinet containing air with a relative humidity maintained between 91 % and 95 %. The temperature of the air, at all places where samples can be located, is maintained within 1°C (1 K) of any convenient value T between 20°C and 30°C .

The samples are kept in the cabinet for 7 days (168 h).

NOTE. In most cases, the samples may be brought to the specified temperature of $T \pm 2^{\circ}\text{C}$, by keeping them at this temperature for at least 4 h before the humidity treatment.

A relative humidity between 91 % and 95 % can be obtained by placing in the humidity cabinet a saturated solution of sodium sulphate (Na_2SO_4) or potassium nitrate (KNO_3) in water, having a sufficiently large contact surface with the 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 which is thermally insulated.

The samples shall show no damage resulting from this treatment.

20. Insulation resistance, electric strength and resilient enclosures

20.1 General. The insulation resistance and the electric strength of accessories shall be adequate.

TEST. Compliance shall be checked by the tests given in 20.2 and 20.3, which are made immediately after the test given in 19.2, in the humidity cabinet or in the room in which the samples were brought to the prescribed temperature, after reassembly of covers which may have been removed.

Accessories with enclosures of resilient material are subjected to the additional test given in 20.4.

NOTE. For the purpose of these tests, the neutral contact is considered as a pole.

20.2 Insulation resistance test. The insulation resistance is measured by applying a d.c. voltage of approximately 500 V, the measurement being made 1 min after application of the voltage.

For socket outlets and connectors, the insulation resistance is measured consecutively:

- (a) between all poles connected together and the body, the measurement being made with and without a plug in engagement;
- (b) between each pole in turn and all others connected to the body, with a plug in engagement;
- (c) between any metal part of the cable anchorage of connectors including clamping screws and the earthing terminal, if any;
- (d) between any metal part of the cable anchorage of connectors and metal foil wrapped around the body and the flexible cable or cord, or a metal rod of the same diameter as the flexible cable, inserted in its place.

For plugs and appliance inlets, the insulation resistance is measured consecutively:

- (e) between all poles connected together and the body;
- (f) between each pole in turn and all others connected to the body;

(g) between any metal part of the cable anchorage of plugs, including clamping screws and the earthing terminal, if any;

(h) between any metal part of the cable anchorage of plugs and metal foil wrapped around the body and the flexible cable or a metal rod of the same diameter as the flexible cable inserted in its place.

The term body, as used in this subclause, includes all accessible metal parts, metal foil in contact with the outer surface of external parts of insulating material, other than the engagement face of connectors and plugs, fixing screws of bases, enclosures and covers, external assembly screws and earthing terminals, if any.

The insulation resistance shall be not less than 5 M Ω .

20.3 Electric strength test. A voltage of substantially sine-wave form, having a frequency of 50 Hz and a value of 2000 V is applied for 1 min between the parts indicated in 20.2.

Initially, not more than half the prescribed voltage is applied; then it is raised rapidly to the full value.

No flashover or breakdown, other than glow discharges without drop in voltage, shall occur during the test.

20.4 Resilient enclosures test. Immediately after the test given in 20.3 it shall not be possible to engage an accessory having an enclosure of resilient material with a gauge other than that appropriate to the accessory under test and then only in the correct orientation. The gauges are those shown in figures 6 and 7.

The gauges are applied with a force of 200 N for 1 min.

21. Breaking capacity

The accessories shall have adequate breaking capacity.

TEST. Compliance shall be checked by testing socket outlets and connectors by means of an appropriate test plug in an apparatus similar to that shown in figure 13.

The test plug is inserted into and withdrawn from the socket outlet or connector 50 times at a rate of 7.5 strokes per minute; the rate of travel of the plug at the moment of separation being approximately 0.8 m/s.

NOTE. A stroke is an insertion or a withdrawal of the plug.

The samples are tested at 1.1 times the maximum rated voltage and 1.25 times the rated current.

The test is made with direct current in a non-inductive circuit and with alternating current in a circuit such that $\cos \phi$ is 0.6 ± 0.05 .

The test is made using the connections shown in figure 14. The selector switch C connecting the metal support and the accessible metal parts to one of the poles of the supply is operated after half the number of strokes.

Resistors and inductors are not connected in parallel, except that, if an air-core inductor is used, a resistor taking approximately 1 % of the current through the inductor is connected in parallel with it. Iron-core inductors may be used, provided the current has substantially sine-wave form.

During the test, no sustained arcing shall occur.

After the test, the samples shall show no damage impairing their further use.