BRITISH STANDARD

BS 6991:1990

Implementing Amendment No. 1, not published separately

Specification for

6/10 A, two-pole weather-resistant couplers for household, commercial and light industrial equipment

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Power Electrical Engineering Standards Policy Committee (PEL/-) to Technical Committee PEL/4, upon which the following bodies were represented:

Association of Consulting Engineers
Association of Control Manufacturers — TACMA (BEAMA Ltd.)
Association of Manufacturers of Domestic Electrical Appliances
ASTA Certification Services
British Electrical Systems Association (BEAMA Ltd.)
British Electrotechnical Approvals Board
British Plastics Federation
Consumer Standards Advisory Committee of BSI
Decorative Lighting Association
Department of Health and Social Security
Department of Trade and Industry (Consumer Safety Unit, C S Division)
ERA Technology Ltd.
Electrical Contractors' Association
Electrical Installation Equipment Manufacturers' Association (BEAMA Ltd.)
Electrical Power Engineers' Association
Electricity Supply Industry in England and Wales
Institution of Electrical Engineers
Lighting Industry Federation Ltd.
National Inspection Council for Electrical Installation Contracting

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

British Lawn Mower Manufacturers' Federation
British Radio and Electronic Equipment Manufacturers' Association
Electronic Components Industry Federation

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Contents

Foreword

This British Standard has been prepared under the direction of the Power Electrical Engineering Standards Policy Committee. It is based on a draft prepared by the Electrical Installation Equipment Manufacturers' Association (BEAMA Ltd.) and specifies the requirements for equipment couplers for use on outdoor equipment such as lawn-mowers and hedge cutters, as well as for general household equipment.

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 to iv, pages 1 to 34, 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.

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1 Scope

This British Standard specifies requirements for 6/10 A two-pole, polarized couplers for household, commercial and light industrial equipment with particular reference to safety and interchangeability in normal use. This standard applies to couplers which are suitable for the connection of the supply voltage to Class II portable appliances and are intended for indoor and outdoor use operating at voltages not exceeding 250 V. They are capable of safe operation in conditions of splashing water as defined by IPX4 in BS 5490 and are intended for use with circular type insulated and sheathed flexible cords and cables complying with Tables 6, 9 and 16 of BS 6500:1984, having conductor cross-sectional areas of 0.5 mm^2, 0.75 mm^2 or 1.0 mm^2. Couplers are suitable for use at an ambient temperature of – 5 °C to 40 °C, the average value over a 24 h period not exceeding 35 °C.

Requirements are specified for rewirable and non-rewirable connectors and also for rewirable and non-rewirable inlets.

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

2 Definitions

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

NOTE The terms "voltage" and "current" imply r.m.s. values unless otherwise stated.

2.1
accessory

connector or equipment inlet

2.2
coupler

a means consisting of a connector and equipment inlet, enabling the connection and disconnection of the supply to Class II equipment

2.3
connector

the part of a coupler which is integral with, or intended to be attached to, the flexible cord connected to the supply

2.4
equipment inlet

a part of a coupler which is connected to or intended to be connected to equipment

2.5
free equipment inlet

an equipment inlet intended to be attached by a flexible cord to equipment

2.6
fixed equipment inlet

an equipment inlet integrated in, or intended to be fixed to, equipment

2.7
non-rewirable accessory

an accessory so constructed that it forms a constructional unit with the flexible cord such that the flexible cord cannot be separated from the accessory without making it permanently useless, and the accessory cannot be opened by hand or by using a general purpose tool, e.g. a screwdriver and/or pliers, without making the accessory permanently useless

NOTE An accessory is considered to be permanently useless when, for reassembly of the accessory, parts or materials other than the original need to be used.

2.8
rewirable accessory

an accessory so constructed that a cable or flexible cord can be fitted or replaced using general purpose tools

2.9
termination

the part of the accessory to which a conductor is permanently attached

2.10
terminal

the part of the accessory to which a conductor is attached, providing a re-usable connection without special tools

2.11
screw-type terminal

a terminal for the connection and subsequent disconnection of a conductor, the connection being made, directly or indirectly, by means of screws or nuts of any kind

2.12
pillar terminal

a screw-type terminal in which the conductor is inserted into a hole or cavity where it is clamped under the shank of a screw

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

2.13
screw terminal

a screw-type terminal in which the conductor is clamped under a head of a screw

NOTE 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 antispread device.

2.14
stud terminal

a screw-type terminal in which the conductor is clamped under a nut

NOTE The clamping pressure may be applied directly by a suitably shaped nut or through an intermediate part, such as a washer, clamping plate or antispread device.

2.15
mantle terminal

a screw-type terminal in which the conductor is clamped against the base of the slot in a threaded stud by means of a nut

NOTE The conductor is clamped against the base of the slot by a suitably 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.

2.16
accessible surface of an accessory

any surface of an accessory that can be touched by means of test Finger III of BS 3042, when the accessory is assembled as in normal use and in the following conditions:

a) for connectors: without the complementary accessory in engagement but with the cover in the open position;

b) for equipment inlets: with the complementary accessory in the most unfavourable degree of engagement but such that electrical contact is made between the terminations.

2.17
type test

a test of one or more devices made to a certain design to show that the design meets certain specifications

2.18
type test sample

a sample consisting of one or more similar devices submitted for the purpose of a type test

2.19
cover

a part that covers the contacts of a connector when the mating part is not in place (see lower two views of Figure 1) and which is accessible when the accessory is in normal use, and is removable only with the use of a tool but does not require the use of a tool to open it

3 General requirements

Accessories shall be so designed and constructed that, in normal use, their performance is reliable and without danger to the user or surroundings.

Accessories shall be capable of meeting all the relevant requirements and tests specified herein.

NOTE Where tolerances are not specified in this standard the values are to be regarded as nominal.

4 General conditions for type testing

4.1 A manufacturer or responsible vendor, who claims compliance with this standard for any product, shall submit a representative sample of that product to the relevant tests of this standard in the order specified in **4.3**.

NOTE The tests may be made by the manufacturer, or the responsible vendor, or may be made on his behalf by any competent testing laboratory or certification authority.

The results of such tests shall be recorded.

4.2 Unless otherwise specified in this standard the accessories shall be tested as delivered by the manufacturer or responsible vendor and under normal conditions of use, at an ambient temperature of 20 ± 5 °C.

The accessories used for the tests shall be substantially identical to normal production items in respect of all details which may affect the test results.

Non-rewirable accessories shall be supplied for test with a flexible cord which shall be at least 1 m long. The flexible cord used for rewirable accessories shall be polyvinyl-chloride (PVC) sheathed circular flexible cord complying with Table 16 of BS 6500:1984.

4.3 A total sample comprising 18 accessories, of any one type, shall be submitted to inspection and tests in the following order of clauses:

a) three accessories: clauses **3** to **16** (visual inspection and manual examination);

b) three accessories: clauses **12** to **15** (excluding **15.2.2**) and clauses **17** to **23** (general tests);

c) three accessories: clauses **16** and **24**;

d) three accessories: **15.2.2**;

e) three accessories: clause **25** (material test);

f) three accessories: clause **26**.

NOTE 1 If any particular test is repeated, as part of the normal sequence, this requirement is specified in the appropriate clause.

NOTE 2 A test schedule of samples is given in appendix A.

4.4 If no accessory fails in the complete series of tests specified in **4.3** then accessories of that type shall be deemed to comply with this standard.

If one accessory fails in any group in the complete series of tests specified in **4.3**, then accessories of that type shall be deemed to have failed to comply with this standard, unless that accessory can be shown to be not representative of normal production or design, in which case a further set of accessories shall be submitted to the test or tests in that group. If there is no failure in this retest then accessories of that type shall be deemed to comply with this standard.

If more than one accessory fails in the complete series of tests specified in **4.3**, the accessories of that type shall be deemed to have failed to comply with this standard.

4.5 Where reference to BS 6500:1984 is made, equivalent flexible cords to the latest version of BS 6500 may be used.

5 Ratings

5.1 Couplers shall have a rated voltage of 250 V a.c.

5.2 The rated current shall be as follows:

a) for rewirable couplers, 10 A;

b) for non-rewirable couplers, appropriate to the attached cable.

6 Classification

6.1 Connectors shall be classified as follows: rewirable or non-rewirable.

6.2 Equipment inlets shall be classified as follows:

a) rewirable or non-rewirable;

b) free or fixed.

7 Marking

7.1 Couplers, except for fixed equipment inlets and non-rewirable free equipment inlets supplied with equipment, shall be marked with the following information:

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

b) the number and date of this British Standard, i.e. BS 6991:1990[1)];

c) rated current;

d) rated voltage;

e) symbol for nature of supply;

f) symbol for splashproof construction;

g) type reference which may be a catalogue number, code number, etc.

Fixed equipment inlets shall be marked with the information given in **7.1** a) and **7.1** g) which need not be visible when installed for use outdoors.

NOTE The marking on connectors and free equipment inlets need not be visible when connected together.

Compliance shall be checked by inspection.

7.2 Connectors and free equipment inlets shall be marked on their exterior, in a prominent position which is visible during normal use, with lettering at least 3.0 mm high with the following information:

a) for connectors: “Connect to mains”;

b) for free equipment inlets: “Connect to equipment”.

Compliance shall be checked by inspection and measurement.

7.3 Accessories shall not be marked with the symbol for Class II equipment.

Compliance shall be checked by inspection.

7.4 If symbols are used they shall be as follows:

amperes	A
volts	V
alternating current	∿
line	L
neutral	N
splashproof construction	IPX4 (in accordance with BS EN 60529)

NOTE BS 6217 gives information on symbols.

For the marking of rated current and rated voltage, figures may be used alone. The figure for rated current shall be placed before or above that for the rated voltage and separated from the latter by a line. The marking for nature of supply shall be placed next to the marking for rated current and rated voltage, e.g. 10 A 250 V ∿ or

$$10/250 \sim \text{ or } \frac{10}{250} \sim$$

Compliance shall be checked by inspection.

7.5 In rewirable connectors and inlets, terminals shall be identified by the symbols for line and neutral.

Compliance shall be checked by inspection.

7.6 Marking shall be easily legible and shall not be placed on screws, washers or other easily removable parts.

Compliance for legibility shall be checked by inspection using normal or corrected vision without additional magnification.

[1)] Marking BS 6991:1990 on or in relation to a product represents a manufacturer’s declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is therefore solely the responsibility of the person making the claim. Such a declaration is not to be confused with third party certification of conformity, which may also be desirable.

7.7 Marking shall be durable.

Compliance shall be checked by the test described in **7.7.1**. After this test the marking shall remain easily legible. Marking made by engraving, moulding or a similarly permanent process is deemed to comply with the requirement for durability without testing.

7.7.1 *Test.* Rub the marking by hand for approximately 15 s using a piece of cloth soaked in water and again for approximately 15 s with a piece of cloth soaked in petroleum spirit.

7.8 Cords of non-rewireable accessories shall not be coloured black, green, white or brown.

8 Instructions for use

8.1 Couplers intended for retail sale

The supplier shall include an instruction leaflet, on or inside the sales package, with each coupler or accessory, clearly describing the extent of its suitability for use outdoors. Information regarding weather resistance shall be clearly visible to the purchaser.

If the coupler or accessory is non-rewirable with flexible cord attached, each free end shall be marked for connection to the appliance or mains supply as appropriate, with guidance on the danger of incorrect connection or of connection to an appliance requiring the protection of an earth continuity conductor.

Except that where an equipment inlet fitted with a cord is supplied direct to a manufacturer for incorporation in other equipment, the free end of such an assembly shall have a label attached stating:

"The flexible cord of this accessory must be properly connected to a piece of equipment before the appliance is energized".

If the coupler or accessory is rewirable, instructions shall be provided on the following:

a) stripping lengths for sheath and insulation;

b) identity of accessories to be connected to appliance or mains flexible cord, as appropriate;

c) connection of brown wire to terminal marked "L" and blue wire to terminal marked "N";

e) suitable for use with circular type cable only;

f) a recommendation that the cord to be fitted to the accessory should not be coloured black, green, white or brown.

Compliance shall be checked by inspection.

9 Dimensions and compatibility

9.1 Couplers shall comply with the appropriate dimensions given in Figure 1 and Figure 2.

Compliance shall be checked by measurement and, where relevant, by the use of the gauge(s) shown in Figure 3 and Figure 4.

9.2 When the gauge shown in Figure 3 is used it shall be possible to insert the connector fully into the gauge with a force not exceeding 60 N.

Compliance shall be checked by insertion into the gauge. To verify correct and full insertion the gauge shall be provided with an aperture.

9.3 When the primary and supplementary gauges (Figure 4) are used it shall be possible to insert the primary gauge fully into the equipment inlet with a force not exceeding 60 N. The supplementary gauge shall be pushed over the bar.

Compliance shall be checked by operation of the gauges. Planes are provided with the primary gauge to check pin and shroud lengths and successful engagement of the supplementary gauge checks the equipment inlet outer recess.

9.4 Provision for retaining the connector in the equipment inlet shall comply with Figure 1 and Figure 2 and compliance shall be checked by the tests of clause **12**.

9.5 It shall not be possible to make single-pole connections between connectors and equipment inlets.Compliance is checked by manual test.

NOTE Conformity to Figure 1 and Figure 2 ensures compliance with this requirement.

9.6 Deviations from the dimensions specified may be made, but only if they provide a technical advantage and do not adversely affect the purpose and safety of equipment couplers complying with the dimensions, especially with regard to interchangeability and non-interchangeability.

Appliance couplers with such deviations shall, however, comply with all other requirements of this standard.

NOTE 1 A "technical advantage" may be claimed if, for example, a connector has to be enlarged to accommodate components such as switches or thermostats, or if, for some reason it is necessary to prevent the use of a standard connector with the normal length or type of cord.

NOTE 2 Changes which adversely affect the contact making ability are not allowed.

NOTE 3 It shall not be possible to engage such a non-standard accessory with a standardized complementary accessory of the same rating if by so doing live parts are rendered any more accessible than is the case with a standardized appliance coupler, or if the combination of non-standardized accessory and standard complementary accessory fails to comply with the requirements of this standard other than in respect of the dimensions in Figure 1and Figure 2.

10 Creepage distances, clearances and distances through insulation

10.1 Creepage distances, clearances and distances through insulation of connectors and equipment inlets other than those integrated in or incorporated in an appliance or equipment, shall be not less than the values shown in Table 1.

NOTE For indicator circuits having a resistance such that the fault current will never exceed 0.25 A under conditions of bridging any creepage distances or clearances in such circuits, the value specified may be reduced to 1.0 mm.
In addition, resistors in the indicator circuit shall operate at not greater than 75 % of the manufacturer's declared and published rated dissipation.

Accessories shall have either a minimum distance of 2 mm through insulation between live parts and the accessible external surface, or the minimum distance shall be made up of 2 mm through air and 1 mm insulation, provided the parts are located such that there is no likelihood of distance through air being reduced by distortion or the movement of the parts.

Compliance shall be checked by measurement as follows.

Table 1 — Minimum creepage distances and clearances

Parts under consideration	Creepage distance and clearance
	mm
Between live parts of different polarity	3
Between live parts and accessible metal parts	4
Between live parts and inaccessible external screws etc.	3
Between live parts and accessible external surface	2

NOTE 1 The term "accessible metal parts" includes metal foil in contact with the external surface of the insulating material.
NOTE 2 "Inaccessible screws" are those which cannot be touched with the standard test finger.

For rewirable connectors make measurements on accessories fitted with conductors having a cross-sectional area of 1.0 mm^2 and also without conductors. For non-rewirable connectors make the measurements on accessories with flexible cord as delivered.

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

11 Accessibility of live parts

11.1 Couplers shall be so designed that live parts of equipment inlets are not accessible when the connector is in partial or complete engagement.

Connectors shall be so designed that live parts are not accessible when the connector is properly assembled and wired as in normal use, but with the cover open.

Compliance is checked by inspection and, if necessary by a test with Test Probe B of BS 3042:1992. This probe is applied in every possible position, an electrical indicator being used to show contact with the relevant parts. For connectors with shrouds, enclosures or bodies of elastomeric or thermoplastic material, the probe is applied for 30 s ± 5 s with a force of 20 N ± 3 N at all points where yielding of the insulating material could impair the safety of the connector. This test is made at an ambient temperature of 35 °C ± 2 °C.

11.2 It shall not be possible to make connection between a pin of an equipment inlet and a contact of a connector as long as any of the pins is accessible.

Compliance shall be checked by manual test and by the test described in **11.1**.

The electrical indicator shall not show contact with relevant parts.

11.3 It shall not be possible to remove parts preventing access to live parts without the aid of a tool.

The means for fixing these parts shall be insulated from live parts.

Bushes, if any, in the entry holes for the pins shall be adequately fixed and it shall not be possible to remove them without dismantling the connector.

Compliance shall be checked by inspection and manual test.

11.4 External parts of connectors, with the exception of assembly screws and the like, shall be of insulating material. The shroud and base of equipment inlets shall be of insulating material.

Compliance is checked by inspection.

NOTE 1 The suitability of the insulating material is checked during the insulation tests of clause **18**.
NOTE 2 Lacquer or enamel is not considered to be of insulating material for the purpose of **11.1** to **11.4**.

12 Construction

12.1 External parts of connectors, with the exception of assembly screws etc., shall be of insulating material. The shroud and the base of equipment inlets shall be of insulating material. (See Figure 1 and Figure 2.)

Compliance shall be checked by inspection.

NOTE Lacquer, varnish and enamel are not considered to be insulating materials for the purpose of this subclause.

12.2 A coupler shall incorporate means for ensuring the required degree of protection against moisture when the inlet and connectors are in complete engagement with the complementary accessory.

Compliance shall be checked by inspection and by the test described in **17.1.1**.

12.3 A connector or free equipment inlet, when fitted with a flexible cord as in normal use and when not in engagement with the complementary accessory, shall be capable of complying with clause **11** and **17.1**.

Connectors shall be provided with a lid or cover to achieve the required degree of protection against moisture when the complementary accessory is not in position. The lid or cover shall be self-closing and shall be securely fixed to the connector.

Compliance shall be checked by the tests of clauses **11**, **20**, **22**, **26** and **17.1**.

12.4 Fixed equipment inlets shall incorporate means of ensuring the required degree of protection against moisture, from the open interface to the terminals or terminations.

Non-rewirable free equipment inlets for incorporation in equipment shall be fitted with a cord of 500 mm or less (measured from the point of entry of the cable into the free equipment inlet to the point of entry of the cable into the equipment).

Compliance shall be checked by inspection and the test described in **17.1.1**.

12.5 The lid or cover spring(s), if any, of a connector, when fitted with a flexible cord as in normal use, shall be sufficiently strong to rapidly close the lid when the complementary accessory is not engaged and to withstand opening and closing in normal operation to an angle of not less than 90° and not more than 100°. The lid or cover and associated spring(s), if any, shall withstand damage when opened to the fullest extent and shall be of corrosion-resistant materials.

Compliance shall be checked by inspection and by the test described in **12.5.1**. At the end of the test the lid shall close as required by this standard.

Compliance with the requirement for corrosion-resistant materials shall be checked by the test described in **26.2.1**.

12.5.1 Test. Open the cover to its fullest extent and allow it to close under the influence of the associated spring(s), in sequence, 4 000 times at a rate of 15 ± 2 times per minute.

12.6 A retaining catch shall be provided to prevent inadvertent disconnection of the accessories when engaged. The retaining catch shall operate correctly. It shall be possible to insert or withdraw the connector and operate the retaining catch with two hands without difficulty.

Compliance shall be checked by manual operation and by the test described in **12.6.1**. During this test the connection between the accessories shall be maintained during the application of the principal weight and shall disconnect when the supplementary weight is applied.

12.6.1 *Test.* Determine the maximum and minimum forces necessary to separate the coupler by means of an apparatus as shown in Figure 5. This apparatus comprises a mounting plate (A) and an equipment coupler wired as in normal use (B), mounted so that the coupler hangs vertically with the equipment inlet downwards.

For rewirable equipment couplers using cord anchorages with clamping screws, tighten these screws with a torque as given in Table 2.

The maximum and minimum separation forces provided by the retaining device are measured by inserting the connector into the equipment inlet to the full depth. A carrier (C), with a principal weight (D), and a supplementary weight (E), is attached to the cable (F). The forces exerted by these components are given in Table 3. The principal weight is hung on without jolting the connector and the supplementary weight is allowed to fall from a height of 50 mm ± 2.5 mm onto the principal weight.

12.6.2 The maximum and minimum forces necessary to withdraw a connector from the equipment inlet are determined by means of the apparatus as shown in Figure 5.

The maximum and minimum withdrawal forces are measured with the retaining device being rendered inoperative.

The equipment inlet is of a type corresponding with the connector to be tested and has hardened steel pins, having a surface roughness not exceeding 0.8 μm. The length of the pins and the distance between the pin centres have the values specified in Figure 1 and Figure 2, the tolerance on the distance between the pin centres being ± 0.02 mm, however.

For measuring the maximum withdrawal force, the pin dimensions have the maximum values specified in Figure 2, with a tolerance of – 0.01 mm and the inner dimensions of the shroud have the minimum values specified in Figure 2, with a tolerance of + 0.1 mm.

Table 2 — Test torque levels

Nominal outside diameter of screw thread	Torque	
	For screws described below[a]	For other screws end nuts
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		2.5

[a] This column applies to screws without heads if the screw, when tightened, does not protrude from the hole, or if the use of a screwdriver with a blade wider than the diameter of the screw is effectively prevented.

Table 3 — Forces exerted by components

Component	Force
	N
Carrier (C) and principal weight (D)	60 ± 1
Supplementary weight (E)	30 ± 1

For measuring the minimum withdrawal force, the pin dimensions have the minimum values specified in Figure 2, with a tolerance of + 0.01 mm, and the inner dimensions of the shroud have the maximum values specified in Figure 2, with a tolerance of – 0.1 mm.

NOTE It is recommended that the test apparatus has two equipment inlets mounted on it, one having the dimensions prescribed for measuring the maximum withdrawal force and the other having the dimensions prescribed for measuring the minimum withdrawal force.

The connector is inserted to the full depth into and withdrawn from the appropriate equipment inlet ten times. It is then again inserted, a carrier C for a principal weight D and a supplementary weight E being attached to it by means of a suitable clamp. The supplementary weight is such that it exerts a force equal to one-tenth of the maximum withdrawal force specified in Table 3a.

The principal weight, together with the supplementary weight, the clamp, the carrier and the connector, exert a force equal to the maximum withdrawal force specified. The principal weight is hung on without jolting the connector and the supplementary weight is allowed to fall from a height of 50 mm ± 2.5 mm onto the principal weight.

The connector shall not remain in the appliance inlet.

Following this, the test is repeated using the other equipment inlet, the principal weight and the supplementary weight being replaced by another weight such that the total weight of the connector, the clamp, the carrier and the new weight exert a force equal to the minimum withdrawal force specified in Table 3a.

Table 3a — Withdrawal forces

Withdrawal force	
Maximum	Minimum
N	N
50	10

The connector shall not come out.

12.7 The enclosure of rewirable accessories shall consist of more than one part and shall completely enclose the terminals and the end of the flexible cord.

NOTE Parts of the enclosure linked together by flexible means are considered to be separate parts.

The construction shall be such that from the point of separation of the cores the conductors can be properly connected and that when the accessory is assembled and wired as in normal use there is no risk of:

a) the cores being pressed against each other;

b) a core coming into contact with accessible metal parts;

c) a core coming into contact with other live parts.

Compliance shall be checked by inspection and by manual test.

12.8 Parts of the body of accessories shall be reliably fixed to one another.

For rewirable accessories, there shall be separate independent means for fixing and locating the parts of the body with respect to each other at least one of which, for example a screw, can only be operated with the aid of a tool. Thread-cutting screws shall not be used for this purpose.

It shall not be possible to dismantle them without the aid of a tool.

The resiliency of the contacts shall not depend upon the assembly of the parts of the body.

Partial loosening of assembly screws or the like shall not allow the detachment of parts providing protection against electric shock.

Compliance shall be checked by inspection.

NOTE 1 The requirement with regard to fixing and locating does not preclude the use of one fixing and one locating means.
NOTE 2 The requirement that it shall not be possible to dismantle the connectors without the aid of a tool does not necessarily mean that their component parts have to be fixed to the enclosure.

12.9 Contacts of connectors and pins of equipment inlets shall be locked against rotation.

Compliance shall be checked by inspection and by the test described in **12.10.1**.

12.10 Pins of equipment inlets shall be securely retained and shall have adequate mechanical strength. It shall not be possible to remove them without the aid of a tool and they shall be surrounded by a shroud as illustrated in Figure 2.

NOTE 1 This requirement does not exclude pins which are to some extent floating.
NOTE 2 The extent of permissible floating is checked by measurement.

Compliance shall be checked by inspection and by the test described in **12.10.1**.

12.10.1 *Test.* Heat the sample for a minimum of 1 h in a heating cabinet at 75 ± 2 °C and maintain this temperature for the duration of the test including the 5 min period after removal of the test load.

Hold the equipment inlet firmly in such a manner that there is no undue squeezing, or distortion of the body, and so that the means of holding does not assist in maintaining the pins in their original position.

Subject each pin to a force of 60 ± 0.6 N applied without jerks, in a direction along the axis of the pins and maintain it at this value for a minimum of 60 s.

For all pins apply the force twice, first in the direction away from the base of the equipment inlet and then in the direction towards the base of the appliance inlet.

The attachment of the pins shall be deemed to be satisfactory if there is no movement of the pin in either direction exceeding 2.5 mm during the test of any pin, and provided that within 5 min after removal of the pushing-in test force, or within 5 min after the removal of the pulling-out test force, all pins remain within the tolerances shown in Figure 2.

12.10.2 Compliance is checked for non-solid pins, by the following test which is made after all other tests have been completed.

The shroud is removed from the equipment inlet and the pin supported as shown in Figure 15.

A force of 100 N ± 2 N is exerted on the pin for 60 s ± 5 s in a direction perpendicular to the major axis of the pin, by means of a steel rod having a diameter of 4.8 mm ± 0.2 mm, the axis of which is also at right angles to the axis of the pin.

After the test, there shall be no significant alteration in the shape of the pin.

12.11 Contacts of connectors shall be self-adjusting so as to provide adequate contact pressure.

Self-adjustment of the contact shall not depend upon the resilience of insulating material.

Compliance shall be checked by inspection and by using the withdrawal pull gauge shown in Figure 6 to check each individual line and neutral contact, ensuring that the hinged cover of the enclosure does not have any effect on the results of the test. During the test the connector contact shall retain the gauge for not less than 30 s when the connector is held vertically and the gauge is hanging downwards.

12.12 Accessories shall be so designed that should a wire of a stranded conductor escape from a terminal or termination when the conductors are fitted, there is no risk of:

a) part of a conductor straying outside the enclosure or coming into contact with accessible screws or the like;

b) contact between live parts of different polarity.

Compliance shall be checked by inspection, by manual test and by the test described in **12.12.1**. The free wire of a conductor connected to a live terminal shall not stray outside the enclosure nor come into contact with live parts of different polarity or accessible screws etc.

12.12.1 *Test.* Remove an 8 ± 0.5 mm length (or as instructed by the manufacturer) of insulation from the end of a flexible conductor of 0.75 mm^2 cross-sectional area. Leave one wire of the stranded conductor free and insert the other wires fully into the terminal and clamp them in place. Bend the free wire, without tearing the insulation back, in every possible direction but without making sharp bends round barriers.

12.13 Screws which fix a part providing protection against electric shock, for example the part covering the contacts of a connector, shall be adequately locked against loosening.

Compliance is checked by inspection and by the tests of clauses **15** and **19**.

12.14 For rewireable connectors, it shall not be possible to assemble the connector in such a way that the terminals are enclosed and the contacts are accessible.

NOTE This requirement excludes the use of separate front pieces enclosing only the contacts.

12.15 Fuses, relays, thermostats and thermal cut-outs shall not be incorporated in connectors complying with Figure 1.

Fuses, relays, thermostats and thermal cut-outs incorporated in fixed equipment inlets shall comply with the relevant British Standards.

Switches or energy regulators incorporated in connectors or equipment inlets shall comply with the relevant British Standards.

Where a fixed equipment inlet is integrated in or incorporated in an appliance or equipment, then that part which can be identified as the equipment inlet, by reference to Figure 2, shall comply with the requirements of this standard.

Compliance is checked by inspection and by testing the switches, fuses, relays, thermostats, thermal cut-outs or energy regulators according to the relevant British Standard.

13 Terminals and terminations

13.1 Non-rewirable accessories shall be provided with soldered, welded, crimped or similar terminations. Screwed terminals shall not be used. Crimped connections shall not be made onto presoldered flexible cords unless the soldered area is entirely outside the crimp. The end of a stranded conductor shall not be consolidated by soft soldering at places where the conductor is subject to contact pressure unless the clamping means is designed so as to obviate the risk of a bad contact due to cold flow of the solder. For all these methods of termination, not more than two strands or 10 % of the total number of strands of the conductor, whichever is the larger, shall be fractured during connection. The method of connection shall also ensure that all the strands are held together.

Compliance shall be checked by inspection.

13.2 Rewirable accessories shall have terminals suitable for the connection of flexible cords complying with Table 16 of BS 6500:1994, having conductor cross-sectional areas of 0.5 mm^2 and 1.0 mm^2.

Compliance is checked by inspection, by measurement and by fitting conductors having cross-sectional areas of 0.5 mm^2 and 1.0 mm^2.

13.3 Screw-type terminals shall allow the conductor to be connected without special preparation.

Compliance shall be checked by inspection.

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

13.4 The clamping means of terminals shall not be used to fix any other component, although they may hold the terminals in place or prevent them from turning.

Compliance shall be checked by inspection.

13.5 Screw-type terminals shall be so designed that they clamp the conductor reliably and between metal surfaces.

Compliance shall be checked by inspection and by the test described in **13.5.1**. During the test the conductor shall not move noticeably in the terminal.

13.5.1 *Test.* Fit the terminals with flexible conductors of cross-sectional area 1.0 mm^2 and then 0.5 mm^2, tightening the terminal screws with a torque equal to two-thirds of the appropriate torque given in Table 2.

Subject each conductor to a pull of 30 ± 3 N, applied smoothly, for 1 min in the direction of the axis of the conductor space.

13.6 Screw-type terminals shall be so designed that they clamp the conductor without undue damage to the conductor.

Compliance shall be checked by inspection after the conductors of the flexible cords specified in **13.2** are clamped once, applying a torque equal to two-thirds of the appropriate torque given in Table 2 and then loosened.

NOTE Stranded flexible conductors are considered to be unduly damaged when more than 10 % of the strands are cut. (The value of 10 % is provisional.)

13.7 Screw-type terminals shall be so designed or placed that a strand of a 0.50 mm^2 flexible conductor cannot slip out while the clamping screws or nuts are tightened.

Compliance shall be checked by the test described in **13.7.1** After the test, no strand of the conductor shall have escaped from the terminal.

13.7.1 *Test.* Before insertion into the terminal, twist the flexible conductors in one direction, so that there is a uniform twist of one complete turn in a length of approximately 10 mm.

Insert the conductor into the clamping means over the minimum distance prescribed or, where no distance is prescribed, until the conductor just projects from the far side of the terminal and in the position most likely to assist the wire to escape. Then tighten the clamping screw with a torque equal to two-thirds of the appropriate torque given in Table 2.

Repeat the test with a new conductor which is twisted as before, but in the opposite direction.

13.8 Screw-type terminals shall be so designed or placed that, in normal use, the temperature occurring at the point where the conductor is clamped is not excessive; in addition, the terminals shall not attain temperatures such that the insulating properties of adjacent parts or the insulation of the conductors are impaired.

Compliance shall be checked by the temperature rise test described in **21.1.1**.

13.9 Screw-type terminals shall have adequate mechanical strength and shall be so fixed or located within the connector that when the clamping screws or nuts are tightened or loosened, the terminals shall not work loose and creepage distances and clearances shall not be reduced below the values specified in clause **10**. Screws and nuts for clamping the conductors shall have a thread complying with BS 3643. Screws shall not be of metal which is soft or liable to creep, such as zinc or aluminium.

NOTE 1 These requirements do not imply that the terminals should be so designed that their rotation or displacement is prevented, but any movement should be sufficiently limited so as to prevent non-compliance with this standard.

NOTE 2 The use of sealing compound or resin is considered to be sufficient for preventing a terminal from working loose, provided that:

a) the sealing compound or resin is not subject to stress during normal use; and

b) the effectiveness of the sealing compound or resin is not impaired by temperatures attained by the terminal under the most unfavourable conditions as specified in this standard.

Compliance shall be checked by inspection, by measurement and by the tests described in **13.7.1** and **13.9.1**. During the test described in **13.9.1** terminals shall not work loose and there shall be no damage, such as breakage of screws or damage to the head slots, threads, washers or stirrups, that will impair the further use of the terminals.

13.9.1 *Test.* Place a flexible copper conductor of 0.5 mm^2 cross-sectional area in the terminal.

Tighten and loosen screws and nuts five times by means of a suitable test screwdriver or spanner, the torque applied when tightening being equal to the appropriate torque given in Table 2.

The conductor is moved each time the screw or nut is loosened. For mantle terminals, the specific nominal diameter is that of the slotted stud. Select the shape of the blade of the test screwdriver to suit the head of the screw to be tested and do not tighten the screws and nuts in jerks.

13.10 For pillar terminals in which the conductor cannot pass right through, the distance from the clamping screw to the end of the conductor when fully inserted shall not be less than 1.5 mm.

Compliance is checked by measurement, see Figure 16.

14 Screws, current-carrying parts and connections

14.1 Screwed connections, electrical and otherwise, shall withstand the mechanical stresses occurring in normal use. Screws transmitting electrical contact pressure shall screw into metal.

Screws shall not be of insulating material if their replacement by a metal screw would affect compliance with clause **10**.

Compliance shall be checked by inspection and, for screws and nuts which are intended to be tightened during installation or in use, by the test described in **14.1.1**. During the test, no damage impairing the further use of the screwed connections shall occur.

NOTE Screws or nuts which are likely to be operated by the user include terminal screws or nuts, assembly screws, etc.

14.1.1 *Test.* Tighten and loosen the screws or nuts as follows:

a) 10 times for screws in engagement with a thread of insulating material completely removing and reinserting the screw each time;

b) five times in all other cases.

When testing terminal screws of connectors or free equipment inlets, place a flexible conductor having a cross-sectional area of 0.5 mm^2 in the terminal. Replace the conductor each time the screw is loosened.

Make the test by means of a suitable test screwdriver, applying the appropriate torque given in Table 2.

14.2 Screws in engagement with a thread of insulating material shall have a thread length in insulating material not less than 3 mm plus one-third of the nominal screw diameter, except that this length need not exceed 8 mm.

Correct introduction of the screw into its counterpart shall be ensured.

Compliance shall be checked by inspection, by measurement and by manual test.

NOTE The requirement with regard to correct introduction is met if introduction of the screw in a slanting manner is prevented, for example by guiding the screw by the part to be fixed, by a recess in the female thread or by the use of a screw with a leading thread removed.

14.3 Electrical connections shall be so designed that contact pressure is not transmitted through insulating material other than ceramic or mica.

Compliance shall be checked by inspection.

14.4 Screws and rivets which serve as electrical as well as mechanical connections shall be locked against loosening or turning.

Compliance shall be checked by inspection.

NOTE 1 Spring washers may provide satisfactory locking.
NOTE 2 For rivets, a non-circular shank or an appropriate notch may be sufficient.
NOTE 3 Sealing compound which softens on heating provides satisfactory locking only for screw connections not subject to torsion in normal use.

14.5 Connections between terminals and other parts shall be so designed that they will not work loose in normal use.

Compliance shall be checked by inspection and by manual test.

14.6 Current-carrying parts shall be of a metal having, under conditions occurring in the coupler, adequate mechanical strength and resistance to corrosion.

Compliance is checked by inspection and if necessary, by chemical analysis.

NOTE 1 Examples of suitable metals, when used within the permissible temperature range and under normal conditions of chemical pollution are:

— copper;
— an alloy containing at least 58 % copper for parts that are worked cold or at least 50 % copper for other parts;
— stainless steel containing at least 13 % chromium and not more than 0.09 % carbon;
— steel provided with an electroplated coating of zinc according to BS 1706, the coating having a thickness of at least 5 µm;
— steel provided with an electroplated coating of nickel and chromium according to BS 1224, the coating having a thickness of at least 20 µm;
— steel provided with an electroplated coating of tin, according to BS 1872, the coating having a thickness equal to at least 12 µm.

Parts which may be subjected to mechanical wear shall not be made of steel provided with electroplated coating.

Steel provided with an electroplated coating of zinc shall only be used for current-carrying parts if no fixed electrical connection is intended to be made. For connections, an electroplated coating of zinc shall be used only on parts which do not participate directly in current transmission, such as screws or washers used for certain types of terminals in which they transmit only the contact pressure.

NOTE 2 Screws, nuts, washers, clamping plates and similar parts of terminals are not regarded as current-carrying parts.

15 Provision for flexible cords

15.1 Non-rewirable free equipment inlets shall be provided with a flexible cord of 0.5 mm^2, 0.75 mm^2 or 1.0 mm^2 cross-sectional area complying with BS 6500:1984 appropriate to the rating of the appliance.

Compliance shall be checked by inspection.

15.2 Connectors and free equipment inlets shall be provided with a cord anchorage such that the conductors are relieved from strain, including twisting, where they are connected to the terminals or terminations, and that their outer covering is protected from abrasion.

Rewirable accessories shall comply with the following when checked by inspection.

a) It shall be clear how the relief from strain and the prevention of twisting is intended to be effected.

b) The cord anchorage, or at least part of it, shall be integral with or fixed to one of the other component parts of the accessory.

c) Cord anchorages shall be of insulating material or be provided with an insulating lining fixed to the metal parts.

d) Cord anchorage methods such as tying the flexible cord into a knot or tying the cords with string shall not be used.

e) Cord anchorages shall be suitable for the flexible cord which may be connected, and their effectiveness shall not depend upon the assembly of the parts of the body.

f) It shall not be possible for the cord to touch the clamping screws of the cord anchorage if these are accessible with test probe II of BS 3042:1992 or are electrically connected to accessible metal parts.

After the test described in **15.2.1** the flexible cord shall not have been displaced by more than 2 mm and shall not be damaged. In addition the following requirements shall be met:

a) for rewirable connectors, the ends of the conductors shall not have moved noticeably in the terminals;

b) for non-rewirable connectors, there shall be no break in the electrical connections.

During the test described in **15.2.2** there shall be no interruptions of the current passing through the conductors and no short circuit between them. After the test samples shall show no damage except that breakage of not more than 10 % of the total number of conductor strands in any core is ignored, provided they have not pierced the insulation. The guard, if any, shall not have separated from the body and the insulation of the flexible cord shall show no sign of abrasion or wear.

15.2.1 *Test.* Test non-rewirable connectors and free equipment inlets with the flexible cord as delivered and test rewirable connectors and free equipment inlets with 0.5 mm^2 and 1.0 mm^2 flexible cord complying with Table 16 of BS 6500:1984.

Introduce conductors of the flexible cord of rewirable connectors into the terminals, and tighten the terminal screws just sufficiently to prevent the conductors from easily changing their position.

Use the cord anchorage in the normal way. Tighten clamping screws, if any, with a torque equal to two-thirds of the appropriate torque given in Table 2. Reassemble the accessory so that the component parts fit snugly and it is not possible to push the flexible cord into the connector to any appreciable extent.

Fix the accessory in the test apparatus as shown in Figure 7 so that the axis of the flexible cord is vertical where it enters the connector.

Subject the flexible cord 25 times to a pull of 150 N. Apply the pulls without jerks, each time for 1 s.

Immediately afterwards, subject the flexible cord for 1 min to a torque of 0.15 N m applied adjacent to the entry of the flexible cord.

For the measurement of the longitudinal displacement, make a mark on the flexible cord before starting the tests while subjecting it to a preliminary pull of 150 N. Make the mark at a distance of approximately 20 mm from the end of the accessories or the cord guard. If, for non-rewirable accessories, there is no definite end to the connector or the cord guard, make an additional mark on the body from which the distance to the other mark is measured.

15.2.2 *Test.* Subject accessories to a flexing test in an apparatus having an oscillating member similar to that shown in Figure 8.

Fit rewirable connectors and free equipment inlets with a 0.5 mm^2 flexible cord complying with Table 16 of BS 6500:1984, having an appropriate length and with the cord guard, if any, in place.

Test non-rewirable connectors with the flexible cord as delivered.

Fix the accessory to the oscillating member of the apparatus so that when this is at the middle of its travel the axis of the flexible cord, where it enters the accessory, is vertical and passes through the axis of oscillation.

Position the oscillating member, by variation of distance *d* shown in Figure 8, so that the flexible cord makes the minimum lateral movement when the oscillating member of the test apparatus is moved over its full travel.

Load the flexible cord so that the force applied is $20 \, ^{+0}_{-2}$ N

Pass a current of 6 ± 0.1 A through the conductors, the voltage between them being equal to the rated voltage.

Move the oscillating member backwards and forwards through an angle of approximately 90° (45 ± 3° on either side of the vertical), the number of flexings being 20 000 for rewirable and non-rewirable accessories and the rate of flexing being 60 ± 1 per min.

NOTE A flexing is one movement, either backwards or forwards.

Rotate accessories about the axis of the cord through 90° in the oscillating member after half the required number of flexings.

Carry out the test on accessories not subjected to any other test. A short circuit between the conductors of the flexible cord is considered to occur if the current attains a value equal to twice the rated current of the accessory.

The test is repeated with a 1.0 mm^2 flexible cord connected.

16 Resistance to ageing

16.1 Accessories with enclosures, covers or bodies of rubber or thermoplastics, and parts of rubber such as sealing rings and gaskets shall be sufficiently resistant to ageing.

Compliance shall be checked by the test described in **16.1.1**. After the tests the accessory shall show no crack visible with normal or corrected vision without additional magnification, nor shall the material have become sticky or greasy. The accessories shall show no damage which could lead to non-compliance with this standard.

16.1.1 *Test.* Subject accessories to an accelerated ageing test made in an atmosphere having the composition and pressure of the ambient air, for rubber at 70 ± 2 °C for a period of at least 10 days (240 h) and for thermoplastics at 80 ± 2 °C for a period of at least 7 days (168 h).

Suspend the accessories freely in a heated cabinet, ventilated by natural circulation, at the temperatures and for the durations specified. After the treatment allow the accessories to attain approximately room temperature and then examine them for cracks.

With the forefinger wrapped in a dry piece of rough cloth press the accessory with a force of between 4.9 N and 5 N. Examine the cloth for traces of the accessory and the accessory for traces of the cloth, which if present would indicate that material has become sticky or greasy.

NOTE 1 The force of 5 N may be obtained by placing the accessory on one of the pans of a balance with the other pan loaded with a mass equal to the mass of the accessory plus 500 g. Equilibrium is then restored by pressing the accessory with the forefinger wrapped in a dry piece of rough cloth.

NOTE 2 The use of an electrically heated cabinet is recommended. Natural circulation may be provided by holes in the walls of the cabinet.

17 Resistance to moisture and humidity

17.1 Connectors and couplers shall be of splashproof construction complying with IPX4 of BS EN 60529.

Compliance shall be checked by the test described in **17.1.1** followed immediately by wiping the surplus surface water from the accessory and carrying out the electric strength test given in **18.1.2**.

Accessories shall withstand the electric strength test and inspection shall show that water has not entered the samples to any appreciable extent and has not reached enclosed current carrying parts.

17.1.1 *Test.* Test accessories designed for attachment by flexible cord as follows:

a) for non-rewirable accessories, with the flexible cord supplied;

b) for rewirable accessoires, with 0.5 mm^2 and 1.00 mm^2 cord.

Test fixed equipment inlets when mounted in or on a suitable watertight enclosure, in accordance with the manufacturer's instructions for mounting to the equipment.

Tighten fixing screws of enclosures and covers with a torque equal to two-thirds of the appropriate torque given in Table 2. Place accessories in the most unfavourable position.

Test connectors with and also without the complementary accessory in engagement, the means for ensuring the required degree of protection against moisture (as specified in **12.2**) being positioned as in normal use.

Use the appropriate test described in BS EN 60529.

NOTE It is intended that connectors be tested separately and couplers should be tested as an assembly.

17.2 Couplers shall be proof against humid conditions which may occur in normal use.

Compliance shall be checked by the test described in **17.2.1** followed immediately by the measurement of the insulation resistance and by the electric strength test described in clause **18**.

After the treatment described in **17.2.1** the accessories shall show no damage which would affect compliance with this standard.

17.2.1 *Test.* Test equipment connectors and inlets when not in engagement. Fit rewirable accessories with a flexible cord.

Carry out the humidity treatment in a humidity cabinet containing air with a relative humidity maintained between 91 % and 95 %. Maintain the temperature of the air, at all places where accessories can be located, within 1 °C of any convenient value t between 20 °C and 30 °C.

Before being placed in the humidity cabinet, bring the accessories to a temperature between t and $t + 4$ °C.

Keep the accessories in the cabinet for at least 7 days (168 h) for equipment connectors and inlets, which are submitted as individual accessories, not incorporated in other equipment.

NOTE 1 In most cases, the accessories may be brought to the specified temperature by keeping them at this temperature for at least 4 h before the humidity treatment.

NOTE 2 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.

NOTE 3 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.

18 Insulation resistance and electric strength

18.1 Immediately after the tests described in clause **17** accessories shall be subjected in quick succession to the tests described in **18.1.1** and **18.1.2**. When tested by the method of **18.1.1** accessories shall demonstrate an insulation resistance of not less than 5 MΩ. When tested by the method of **18.1.2** there shall be no flashover or breakdown.

18.1.1 *Test.* The insulation resistance is measured with a d.c. voltage of approximately 500 V applied, each measurement being made 60 s ± 5 s after the application of the voltage.

The insulation resistance is measured:

a) for fixed equipment inlets with a connector in engagement, between the current-carrying pins connected together and the body;

b) for fixed equipment inlets with a connector in engagement, between each current-carrying pin in turn and the other, the latter being connected to the body;

c) for connectors and free equipment inlets, between the current-carrying pins or contacts connected together and the body;

d) for connectors and free equipment inlets, between each current-carrying pin or contact in turn and the other, the latter being connected to the body;

e) for rewireable connectors and rewireable free equipment inlets, between any metal part of the cord anchorage, excluding clamping screws, and a metal rod of the maximum diameter of the cord inserted in its place.

NOTE 1 The maximum diameters of the cords are given in Table 3b.

Table 3b — Maximum diameters of cords

Type of cord	Number of cores and nominal cross-sectional area in mm^2	Maximum diameter
		mm
BS 6500:1994	2 × 0.5	7.8
Tables 6 and 9	2 × 0.75	8.2
	2 × 1.0	8.8
BS 6500:1994	2 × 0.5	7,0
Table 16	2 × 0.75	7,6
	2 × 1.0	8,0

The insulation resistance shall be not less than 5 MΩ.

NOTE 2 The term "body" used in items a, b, c and d includes all accessible metal parts, fixing screws, external assembly screws or the like and metal foil in contact with the outer surface of external parts of insulating material, including the engagement face of connectors (items c and d).
The metal foil should be wrapped round the outer surface of external parts of insulating material and the foil should be pressed into openings using Test Probe B of BS 3042:1992 (see **11.1.1**).

18.1.2 *Test.* Apply a voltage of substantially sinusoidal form at a frequency of approximately 50 Ωz between the parts as indicated in **18.1.1** as follows.

Initially, not more than half the prescribed voltage is applied, then it is raised rapidly to the full value for a period of 60 s ± 5 s.

The value of the test voltage is:

a) 4 000 V ± 60 V between current-carrying parts and the body;

b) 2 000 V ± 60 V between all other parts.

NOTE 1 The high voltage transformer used for the test needs to 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. It is essential that the overcurrent relay does not trip when the output current is less than 100 mA.
NOTE 2 Care should be taken that the r.m.s. value of the test voltage applied is measured within ± 3 %.
NOTE 3 Glow discharges without drop in voltage are neglected.

19 Electrical breaking capacity

19.1 The connectors shall have adequate breaking capacity.

Compliance shall be checked by the test described in **19.1.1** During that test there shall be no flashover between live parts of different polarity neither shall there be any sustained arcing. After the test the accessory shall show no damage impairing its further use.

19.1.1 *Test.* Mount the connector in an apparatus similar to that shown in Figure 9 which incorporates an equipment inlet having hardened steel pins of maximum dimensions as given in Figure 2 with a surface roughness of maximum R_a value of 0.4 μm, in accordance with BS 1134, over the active length.

Position the connector so that the plane through the axis of the socket contacts is horizontal and the lid is held open.

Connect and disconnect the plug connector and the equipment inlet on load 50 times (100 strokes), at a rate of 30 ± 2 strokes per minute.

The test voltage shall be 275^{+0}_{-25} V , the test current connected as shown in Figure 10 shall be a resistive load giving current of 1.25 times rated current $^{+0}_{-0.5}$ A which flows for a nominal 1.5 s per cycle (i.e. 2 strokes).

NOTE Inlets are not checked for breaking capacity.

20 Normal operation

20.1 The equipment connectors shall withstand, without excessive wear or other harmful effect with the lid open, the mechanical, electrical and thermal stresses occurring in normal use. Rewireable accessories are fitted with 1.0 mm^2 PVC flexible cable conforming to BS 6500. Non-rewireable accessories are tested with the cable supplied.

Compliance shall be checked by the test described in **20.1.1**. During the test there shall be no flashover between live parts of different polarity; neither shall there be any sustained arcing. After the test there shall be:

a) no wear impairing further use;

b) no deterioration of enclosures or barriers;

c) no damage to the entry holes for the pins that might impair proper working;

d) no loosening of electrical or mechanical connections;

e) no seepage of sealing compound.

After examination the accessories shall withstand an electric strength test as described in **18.1.2** but with the test voltage reduced to 1 500 V.

NOTE 1 The humidity treatment is not repeated before the electric strength test of this clause.
NOTE 2 Inlets are not tested for normal operation.

20.1.1 *Test.* Using the apparatus shown in Figure 9 insert and withdraw connectors from equipment inlets as follows:

a) 1 000 times (2 000 strokes) at rated voltage and rated current, followed by:

b) 3 000 times (6 000 strokes) without the current flowing.

Position connectors so that the plane through the axis of the socket contacts is horizontal and the lid is held open.

21 Temperature rise

21.1 Accessories shall be so designed and constructed that, when installed and carrying current as in normal use the temperature rise is not excessive.

Compliance shall be checked by the test procedure of **21.1.1**. During the test the temperature rise of terminals or terminations shall not exceed 45 K. After this test, the set of three accessories specified in **4.3** b) shall comply with **12.10**.

21.1.1 *Test*. Fit rewirable connectors and free equipment inlets with 1.0 mm^2 PVC flexible cord having a length of approximately 500 mm, the terminal screws being tightened with two-thirds of the appropriate torque given in Table 2. Test non-rewirable connectors with flexible cord as delivered having a length of 500 mm.

Insert the connector into a free equipment inlet as shown in Figure 2, except that pins shall have minimum dimensions[2)] with a + 0.02, – 0.00 mm tolerance.

Test free equipment inlets with a connector that complies with this standard.

Pass an alternating current of 1.25 times rated current $^{+0}_{-0.5}$ A through the current-carrying contacts for 1 h, or until steady conditions are attained, whichever is the longer.

Determine the temperature by means of thermocouples, which are so chosen and positioned that they have negligible effect on the temperature being determined.

22 Mechanical strength

22.1 Connectors and free equipment inlets shall have adequate mechanical strength.

Compliance shall be checked by the test described in **22.1.1**. After the test the accessories shall show no damage which would affect compliance with this standard. In particular, no part shall have become detached or loosened.

NOTE 1 Special attention should be paid to the connection of the flexible cord. Small pieces may be broken off the accessories without causing rejection, provided that compliance with clause **11** is not affected.
NOTE 2 Damage to finish and small dents which do not reduce the creepage distances or clearance below the values specified in clause **10** are ignored.

Compliance shall be checked further by the test described in **22.1.2**. After the test the samples shall show no damage within the meaning of this standard. In particular live parts shall not have become accessible and the enclosure shall show no cracks visible to the naked eye. Accessories shall still comply with **17.1**.

22.1.1 *Test.* Test connectors and free equipment inlets coupled together in a tumbling barrel as shown in Figure 11. Fit rewirable accessories with a 1.0 mm^2 PVC flexible cord having a length of approximately 100 mm, measured from the outer end of the guard or accessory.

Tighten terminal screws and assembly screws with a torque equal to two-thirds of the appropriate torque given in Table 2.

[2)] Minimum dimensions implies the dimensions as given in Figure 2 with the stated negative tolerance applied.

Test non-rewirable connectors with the flexible cord as delivered, the flexible cable or cord being cut so that a free length of approximately 100 mm projects from the outer end of the guard.

Let the accessories fall from a height of 500 ± 2.5 mm onto a steel plate with a nominal thickness of 3 mm, the number of falls being 500.

Turn the barrel at a rate not exceeding five revolutions per minute, 10 falls per minute thus taking place.

Test one accessory only at a time.

22.1.2 *Test.* Before commencing the test, place accessories with enclosures of resilient or thermoplastics material, with their bases or flexible cables, in a refrigerator at a temperature of – 5 ± 2 °C for at least 16 h. When removed from the refrigerator, immediately subject accessories to the following test.

Apply blows to the samples by means of the spring-operated impact test apparatus shown in Figure 12.

The apparatus consists of three main parts: the body, the striking element and the spring-loaded release cone.

The body comprises the housing, the striking element guide, the release mechanism and all parts rigidly fixed thereto. The mass of this assembly is 1 250 ± 10 g.

The striking element comprises the hammer head, the hammer shaft and the cocking knob. The mass of the assembly is 250 ± 1 g.

The hammer head has a hemispherical face of polyamide having a Rockwell hardness of R 100 in accordance with BS 2782:Method 365C, with a radius of $10\ ^{+0}_{-0.1}$ mm; it is fixed to the hammer shaft in such a way that the distance from its tip to the plane of the front of the cone, when the striking element is on the point of release, is approximately 28 mm.

The cone has a mass of approximately 60 g and the cone spring is such that it exerts a force of approximately 20 N when the release jaws are on the point of releasing the striking element.

The hammer spring is adjusted so that the product of the compression, in millimetres, and the force exerted, in newtons, equals 2 000, the compression being approximately 28 mm. With this adjustment, the impact energy is 1 ± 0.05 J.

Adjust the release mechanism springs so that they exert just sufficient pressure to keep the release jaws in the engaged position.

Cock the apparatus by pulling the cocking knob until the release jaws engage with the groove in the hammer shaft.

Apply the blows by pushing the release cone against the sample in a direction perpendicular to the surface at the point to be tested.

Slowly increase the pressure so that the cone moves back until it is in contact with the release bars, which then move to operate the release mechanism and allow the hammer to strike.

Carry out the test with the sample fixed as in normal use to a rigid support. Leave cable entries open and tighten fixing screws of covers and enclosures with a torque equal to two-thirds of the appropriate torque given in Table 2.

Apply three blows to every point that is likely to be weak.

23 Resistance to heat

23.1 Accessories shall be sufficiently resistant to heat.

Compliance shall be checked by the tests described in **23.1.1**, **23.1.2** and **23.1.3**.

During the test described in **23.1.1** the sample shall not undergo any change impairing its further use, and sealing compound shall not flow to such an extent that live parts are exposed.

NOTE A slight displacement of the sealing compound is ignored.

As a result of the ball pressure test described in **23.1.2** the diameter of the impression shall not exceed 2 mm.

After the test described in **23.1.3** the sample shall show no damage which would affect compliance with this standard.

23.1.1 *Test.* Keep connectors and equipment inlets, other than those incorporated in or fixed to equipment, for 60 min ± 5 min in a heating cabinet maintained at a temperature of 100 °C ± 2 °C.

If connectors and equipment inlets are submitted together, test them while in engagement.

23.1.2 *Test*. Subject parts of insulating material necessary to retain current-carrying parts, to a ball pressure test by means of the apparatus shown in Figure 13. When it is not possible to carry out the test on the sample itself carry out the test on a specimen of the same material not less than 2 mm thick. A test force of 20 ± 0.2 N is applied by means of a steel ball 5 mm in diameter.

Make the tests in a heating cabinet at a temperature of 125 ± 2 °C.

Place the surface of the part to be tested in a horizontal position and support the underside of the part so as to withstand the test force and to minimize the risk of distortion.

Place the apparatus and the supporting means within the heating cabinet for a sufficient time to ensure thay have attained the stabilized testing temperature before the test commences.

Place the part to be tested in the heating cabinet, for a period of 10 min, before the test load is applied.

Apply the test force by pressing the steel ball against the surface of the part to be tested.

After 1 h, remove the ball from the sample and let the sample cool down by immersion for at least 10 s in water at approximately room temperature. Measure the diameter of the impression caused by the ball.

23.1.3 *Test*. Subject connectors and free equipment inlets of PVC or similar flexible material to a pressure test in an apparatus similar to that shown in Figure 14, the test being made in a heating cabinet at a temperature of 100 °C ± 2 °C.

Clamp the sample between steel jaws, having dimensions as shown in Figure 14, in such a way that the jaws press against it in the area where it is gripped in normal use, the centreline of the jaws coinciding as nearly as possible with the centre of the area.

Apply a force of 20 N through the jaws.

After 1 h, remove the jaws and examine the sample for damage.

24 Resistance of insulating material to abnormal heat and fire

24.1 Parts of the insulating material which might be exposed to thermal stresses due to electric currents and the deterioration of which might impair the safety of the equipment coupler shall not be unduly affected by abnormal heat and by fire.

Compliance shall be checked by the glow-wire test described in **24.1.1**.

The glow-wire test is applied to ensure that an electrically heated test wire under defined test conditions does not cause ignition of insulating parts and to ensure that a part of insulating material, which might be ignited by the heated test wire under defined conditions, has a limited time to burn without spreading fire by flame or burning parts or droplets falling down from the tested part onto the pinewood board covered with a tissue paper.

The specimen is regarded as having passed the glow-wire test if:

a) there is no visible flame and no sustained glowing; or

b) flames and glowing at the specimen extinguish within 30 s after the removal of the glow-wire and the specimen is not totally consumed.

There shall be no ignition of the tissue paper or scorching of the board during the glow-wire test.

24.1.1 *Test.* Carry out the glow-wire test as described in clauses **4** to **10** of BS 6458-2.1:1984 at the following temperatures:

a) for parts of insulating material necessary to retain current-carrying parts in position, at a temperature of 750 ± 10 °C;

b) for parts of insulating material not necessary to retain current-carrying parts in position, although they are in contact with them, at a temperature of 650 ± 10 °C.

If the tests are to be made at more than one place on the same specimen, care should be taken to ensure that any deterioration caused by previous tests does not affect the result of the test to be made.

NOTE 1 Small parts, such as washers, are not subjected to the glow-wire test.

NOTE 2 The tests are not made on parts of ceramic material.

The specimen tested should be a complete accessory but if this is not possible a suitable part may be cut from the accessory for the purpose of the test.

Make the test on one specimen. In case of doubt, repeat the test on two further specimens.

Position the specimen during the test in the most unfavourable position of its intended use (with the surface tested in a vertical position).

Make the test applying the glow-wire once.

Apply the tip of the glow-wire to the surface of the specimen taking into account the conditions of the intended use under which a heated or glowing element may come into contact with the specimen.

25 Resistance to tracking

25.1 Insulating parts supporting or in contact with live parts of equipment couplers shall be of a material resistant to tracking.

Compliance shall be checked, for material other than ceramic, by the test described in BS 5901. The material under test shall pass at a proof tracking index of 175 V using the test solution A with an interval between drops of 30 ± 5 s.

Carry out the test on a sample with dimensions at least 15 mm × 15 mm and, if possible, at least 3 mm thick.

NOTE If it is not possible to carry out the test on a sample 3 mm thick, it is permitted to stack specimens to reach the 3 mm thickness value or else to use a plaque of the identical material 3 mm thick.

The test need not be made:

a) if the creepage distances have at least twice the values specified in clause **10**;

b) on ceramic materials.

26 Resistance to excessive residual stresses and to rusting

NOTE Attention is drawn to the fact that due precautions should be taken when using the liquids prescribed in the tests in this clause as they are toxic.

26.1 Contacts and other parts of rolled sheet copper or copper alloy the failure of which might cause accessories to become unsafe shall not be damaged due to excessive residual stresses.

Compliance is checked by the following test.

The surfaces of the specimens are carefully cleaned, varnish being removed by acetone, grease and finger prints by petroleum spirit or the like.

The specimens are placed for 24 h in a test cabinet, the bottom of which is covered by an ammonium chloride solution having a pH value of 10.
(For details of the test cabinet, the test solution and the test procedure see appendix B.)

After this treatment, the specimens are washed in running water; 24 h later they shall show no cracks when inspected at an optical magnification of × 8.

NOTE In order not to influence the results of the test, the specimens should be handled with care.

26.2 Ferrous parts shall be adequately protected against rusting.

Compliance shall be checked by the test described in **26.2.1**. After the test there shall be no signs of rust.

26.2.1 *Test.* Remove all grease from the parts to be tested by immersion in trichloroethane, or any other suitable degreasing agent, for 10 min. Then immerse the parts for a minimum of 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. Then dry the parts for 10 min in a heating cabinet at a temperature of 100 ± 5 °C. Remove any traces of rust on sharp edges and any yellowish film by rubbing, and then examine their surfaces for signs of rust.

Appendix A Test schedule

Table 4 — Test schedule

Test	Number of samples	Order of tests (clause references)
Visual inspection and manual examination	3	**3**, **4**, **5**, **6**, **7**, **8**, **9**, **10**, **11**, **12**, **13**, **14**, **15**, **16**
General tests	3	**12**, **13**, **14**, **15** (except **15.2.2**), **17**, **18**, **19**, **20**, **21**, **22**, **23**
General tests	3	**16**, **24**
Flexing test	3	**15.2.2**
Material test	3	**25**
Material test	3	**26**

Appendix B Test for resistance to excessive residual stresses and to rusting

B.1 Test cabinets

Closeable glass vessels shall be used as test cabinets. These may be, for example, desiccator vessels or simple glass troughs with ground rim and lid. The vessels' volume shall be at least 10 l. A ratio of test space to volume of test solution of 20 : 1 to 10 : 1 shall be maintained.

B.2 Test solution

Preparation of 1 l of solution:

Dissolve 107 g of ammonium chloride (reagent grade NH_4Cl) in about 0,75 l of distilled or fully demineralized water and add as much 30 % sodium hydroxide solution (prepared from reagent grade NaOH and distilled or fully demineralized water) as is necessary to reach a pH value of 10 at 22 °C. For other temperatures, adjust this solution to the corresponding pH value specified in Table 5.

Table 5 — Test solution pH values

Temperature	Test solution pH
°C	
22 ± 1	10.0 ± 0,1
25 ± 1	9.9 ± 0,1
27 ± 1	9.8 ± 0,1
30 ± 1	9.7 ± 0,1

After the pH adjustment, make up to 1 l with distilled or fully demineralized water.

NOTE This dilution does not change the pH value any further.

Keep the temperature constant to within ± 1 °C during the pH adjustment, carry out the pH measurement using an instrument which permits an adjustment to the pH value to within ± 0,02.

The test solution may be used over a prolonged period, but the pH value, which represents a measure of the ammonium concentration in the vapour atmosphere, shall be checked at least every 3 weeks and adjusted if necessary.

B.3 Test procedure

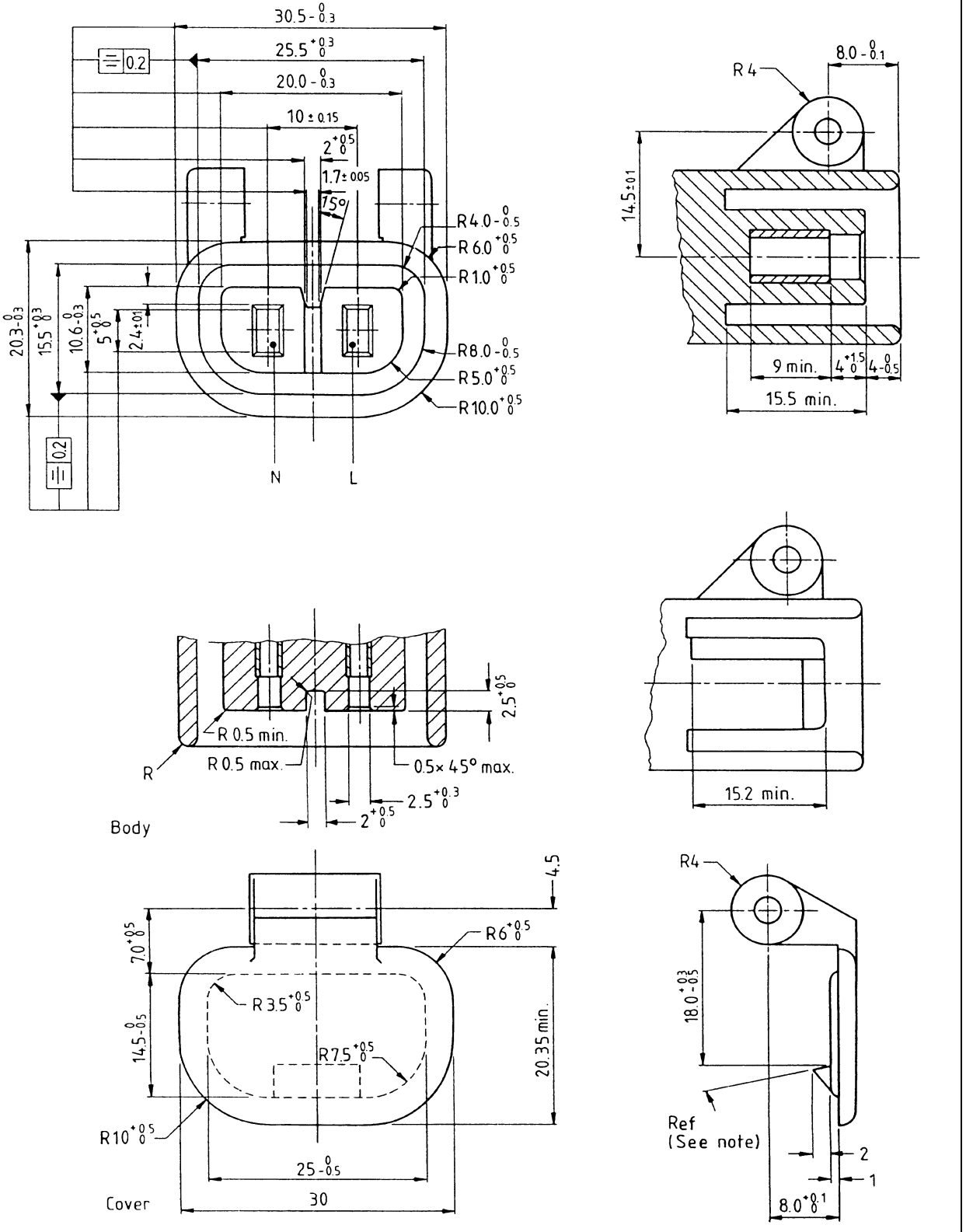
Prior to testing, the test cabinet containing the test solution shall be brought to a temperature of 30 °C ± 1 °C. The test cabinet shall subsequently be filled as quickly as possible with the specimens pre-heated to 30 °C and closed. This moment is to be considered the beginning of the test.

Introduce, preferably suspend, the specimens into the test cabinet in such a way that the ammonia vapour can take effect unhindered.

The specimens shall not dip into the test solution nor touch each other.

Supports or suspension devices shall be made of materials which are not susceptible to attack by ammonia vapour, e.g. glass or porcelain.

Testing shall be carried out at a constant temperature of 30 °C ± 1 °C to exclude visible condensed water formation caused by temperature fluctuations, which could severely falsify the test results.



All linear dimensions are in millimetres.

NOTE. Ref angle to be adjusted as necessary to suit pull off force requirements of **12.6.1**.

Figure 1 — Connector (see **9.1**)

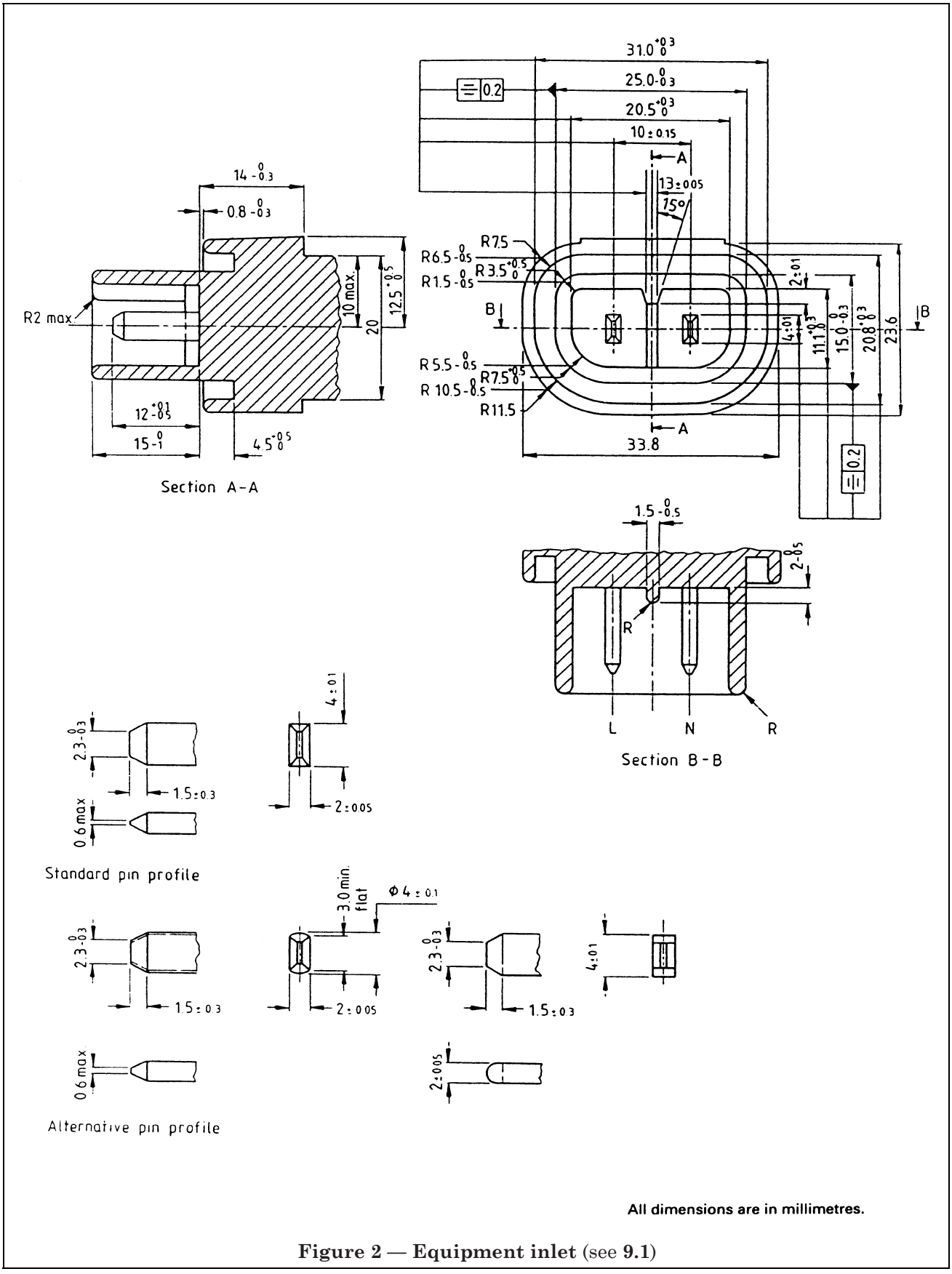
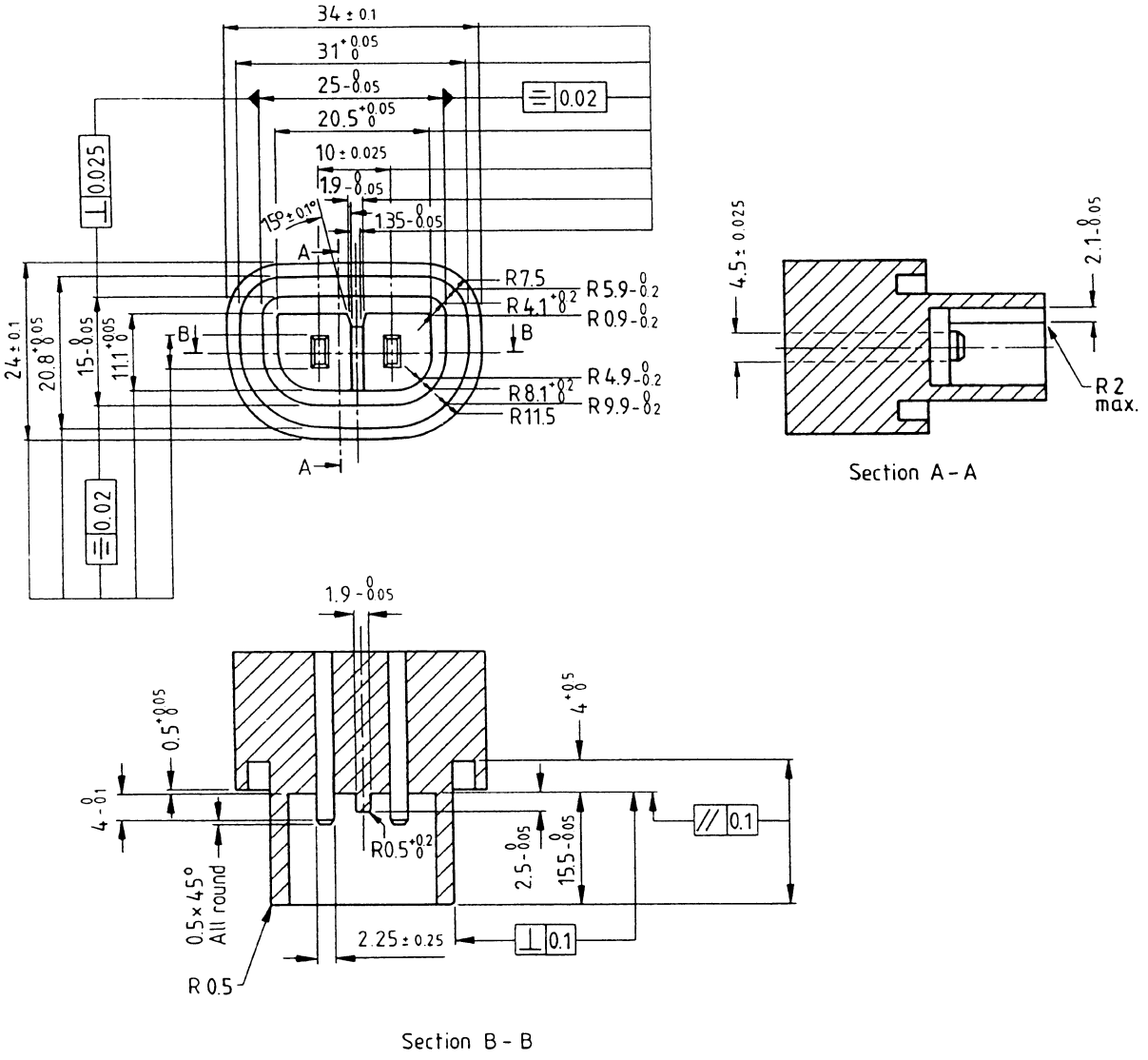


Figure 2 — Equipment inlet (see **9.1**)



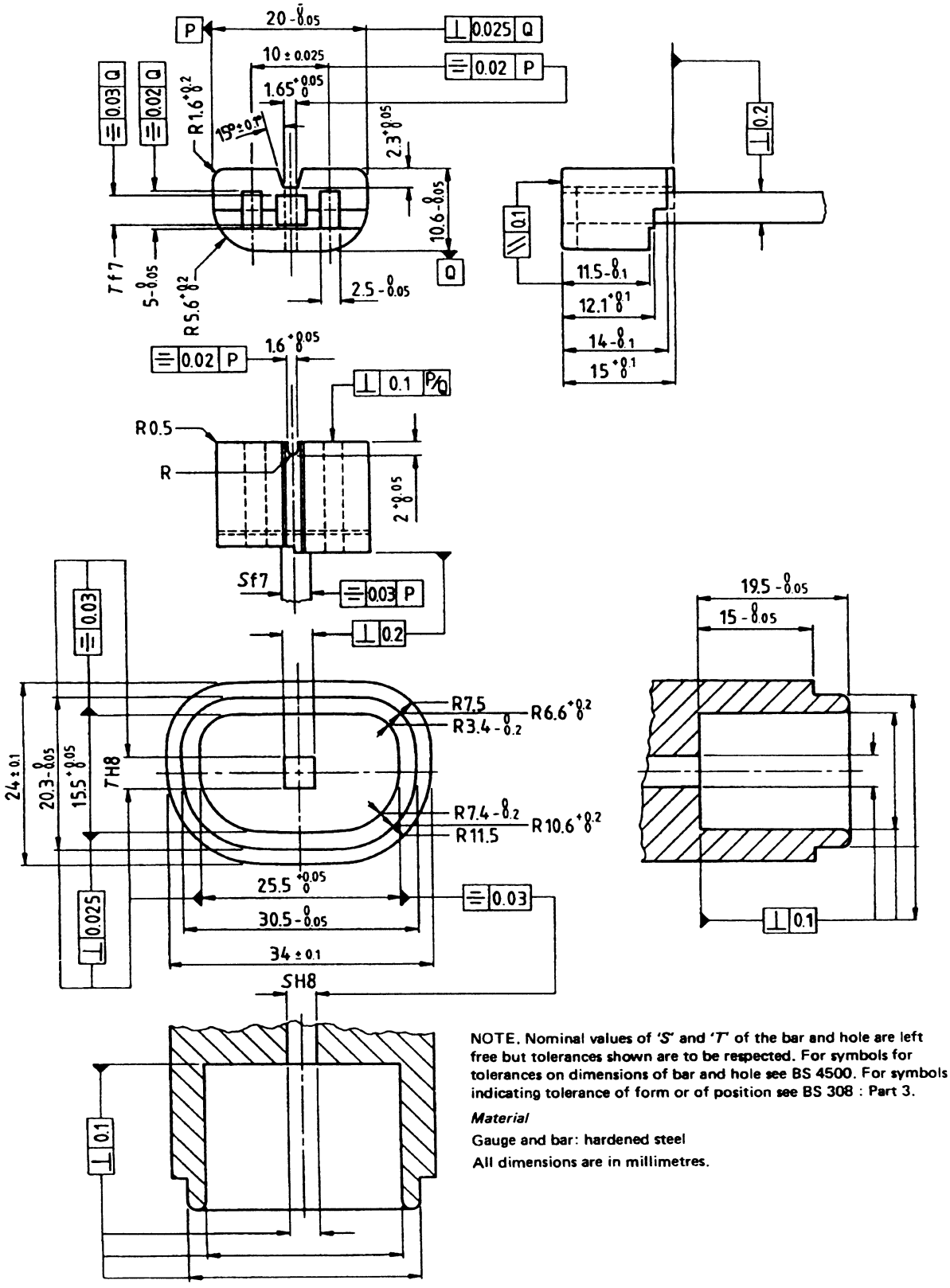
Material

Gauge and pins: hardened steel

NOTE. For symbols indicating the tolerance of form or of position see BS 308 : Part 3.

All dimensions are in millimetres.

Figure 3 — GO gauge for connector (see **9.2**)



NOTE. Nominal values of *'S'* and *'T'* of the bar and hole are left free but tolerances shown are to be respected. For symbols for tolerances on dimensions of bar and hole see BS 4500. For symbols indicating tolerance of form or of position see BS 308 : Part 3.

Material

Gauge and bar: hardened steel

All dimensions are in millimetres.

Figure 4 — Primary and supplementary GO gauges for equipment inlets (see **9.3**)

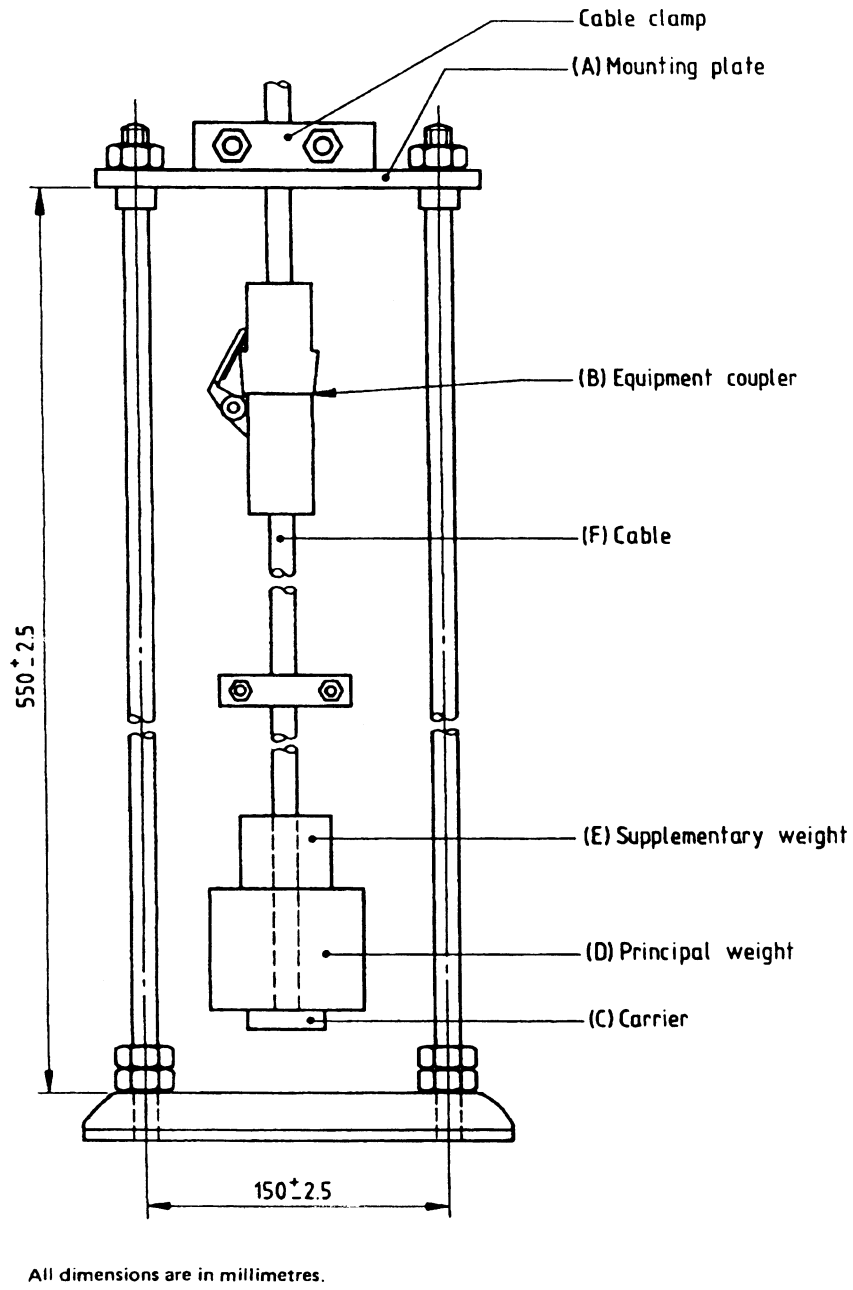
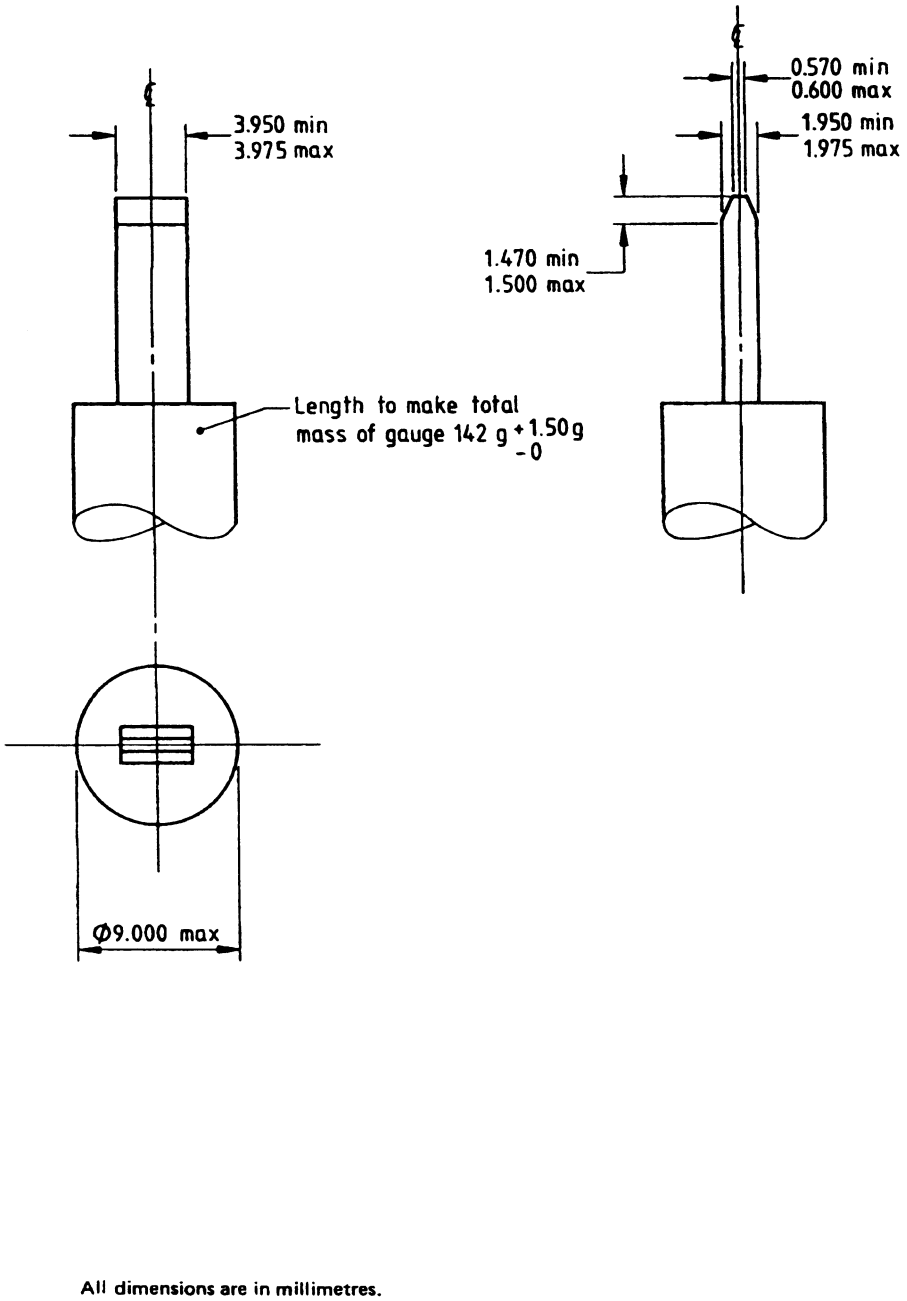
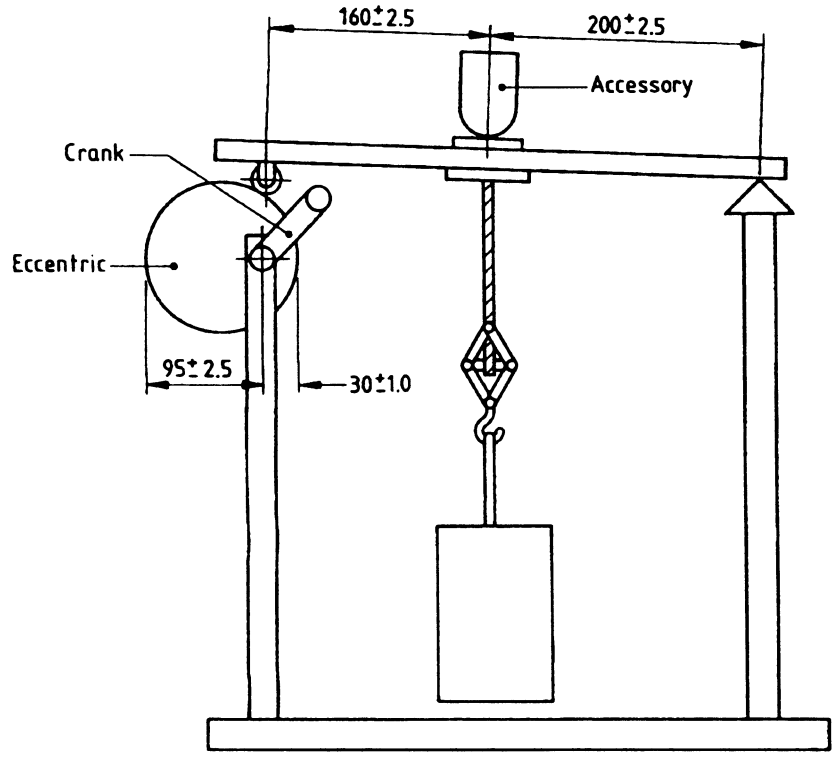


Figure 5 — Apparatus for testing inadvertent disconnection of accessories (see **12.6**)



All dimensions are in millimetres.

Figure 6 — Withdrawal pull gauge (see **12.11**)



All dimensions are in millimetres.

Figure 7 — Apparatus for testing the cord anchorage (see **15.2.1**)

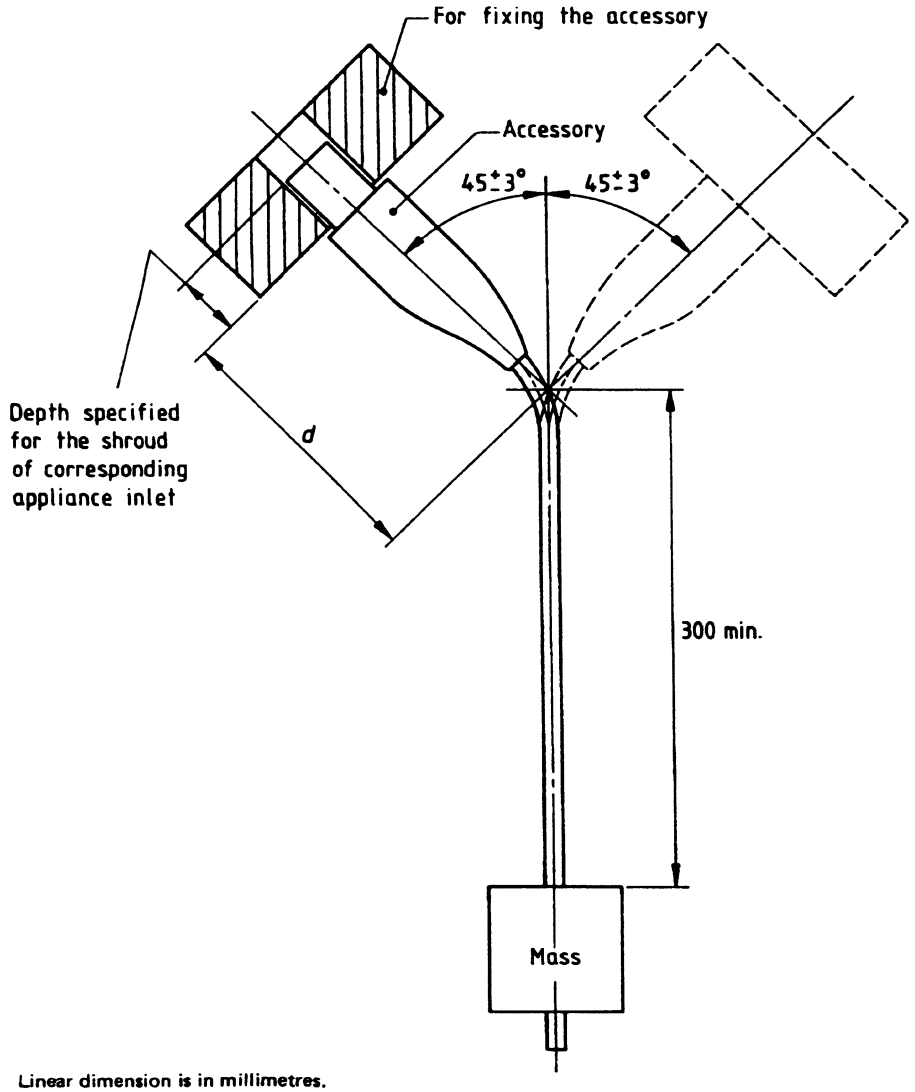
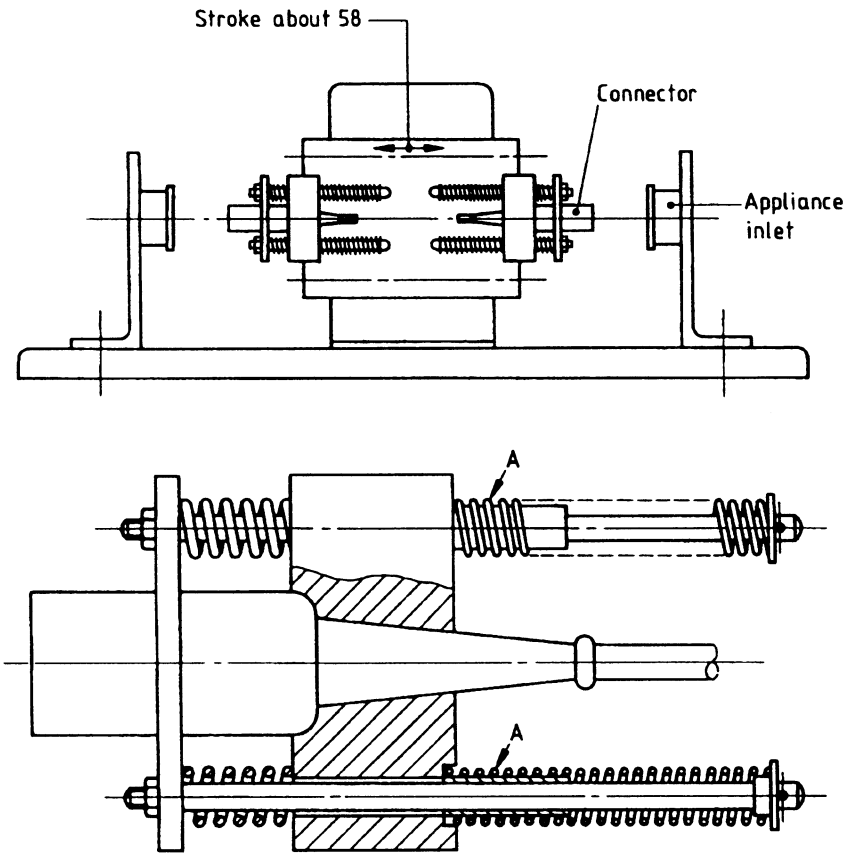


Figure 8 — Apparatus for the flexing test (see **15.2.2**)



NOTE 1. The springs A consist of steel piano wire, class II, hard quality, 0.7 mm in diameter. The number of turns is 34, the external diameter of the spring is 10.6 mm and its length in the disengaged position is 85 mm.

NOTE 2. The springs are so adjusted that they exert in the disengaged position a force on the connector carrier equal to 0.9 times the relevant minimum withdrawal force specified in **12.6**. For two springs the force at the moment of breaking is 9 ± 0.25 N, the springs being compressed to 26 ± 0.2 mm.

NOTE 3. The test apparatus is designed and adjusted so as to simulate as far as possible disconnection in normal use.

Figure 9 — Apparatus for breaking capacity and normal operation tests (see clauses **19** and **20**)

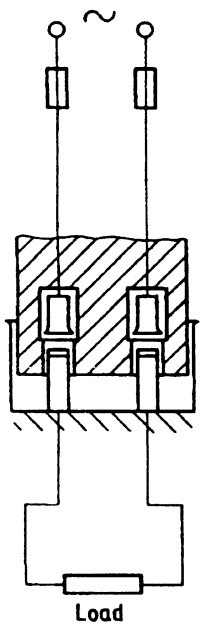


Figure 10 — Circuit diagram for breaking capacity and normal operation tests
(see clauses **19** and **20**)

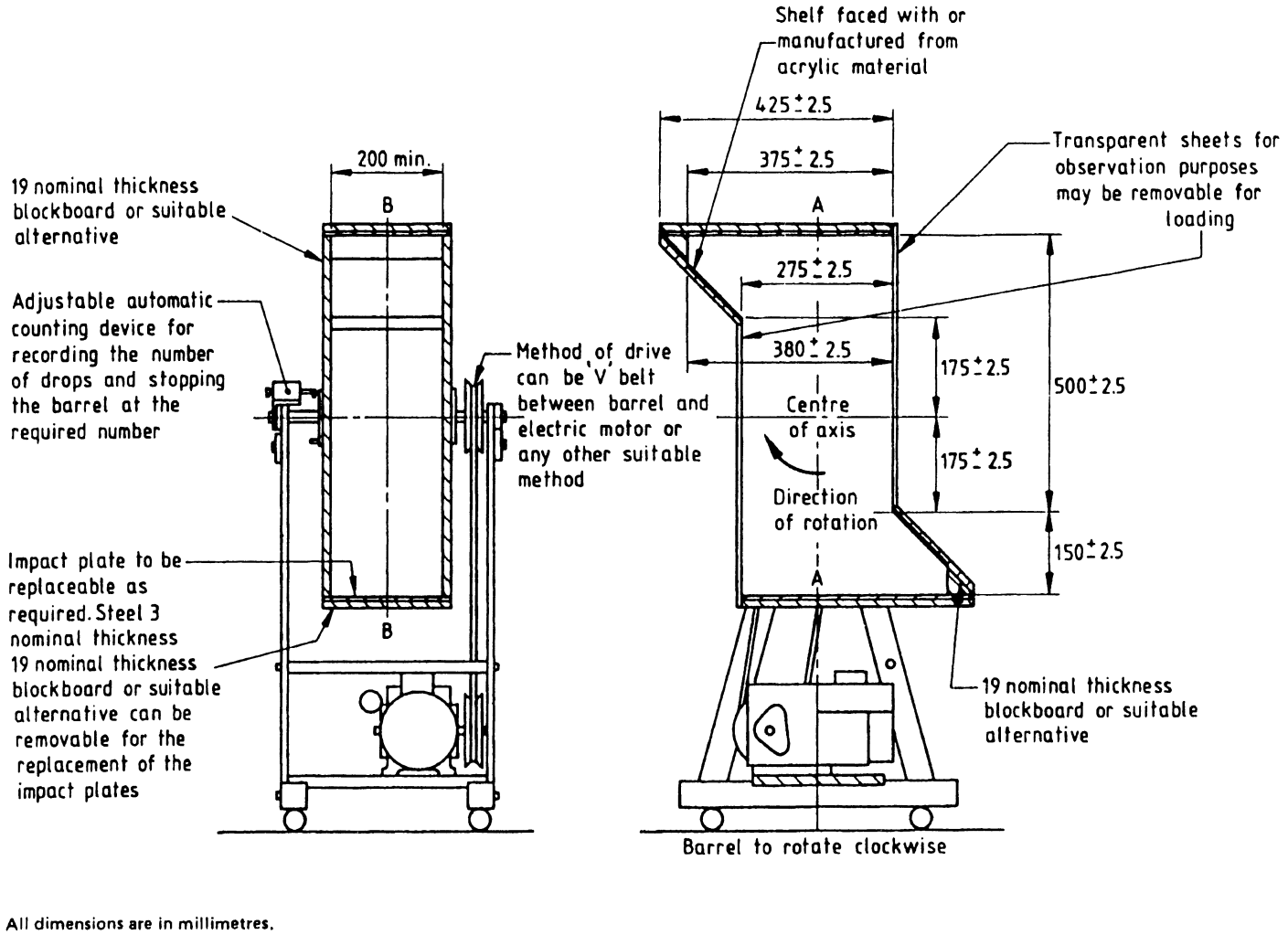


Figure 11 — Tumbling barrel (see **22.1.1**)

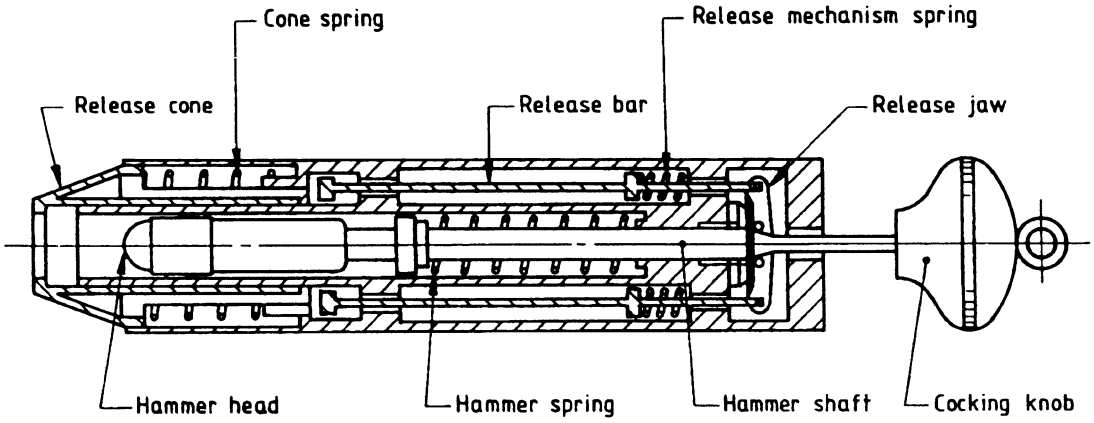
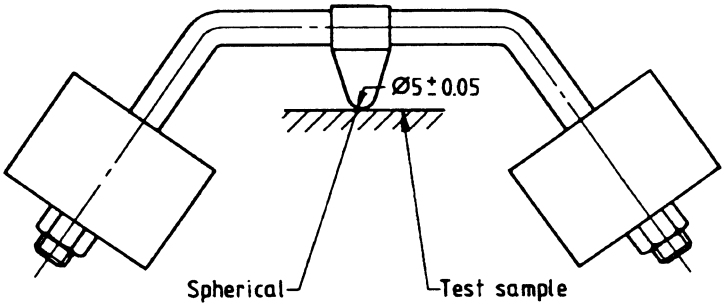
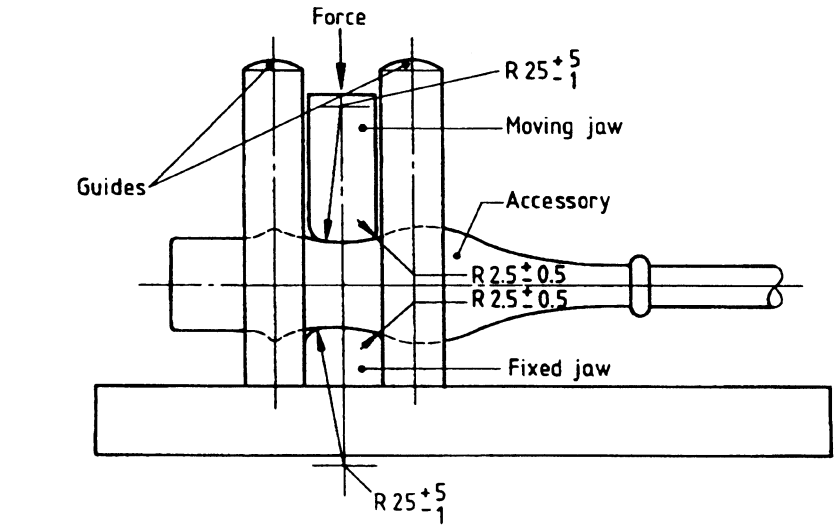


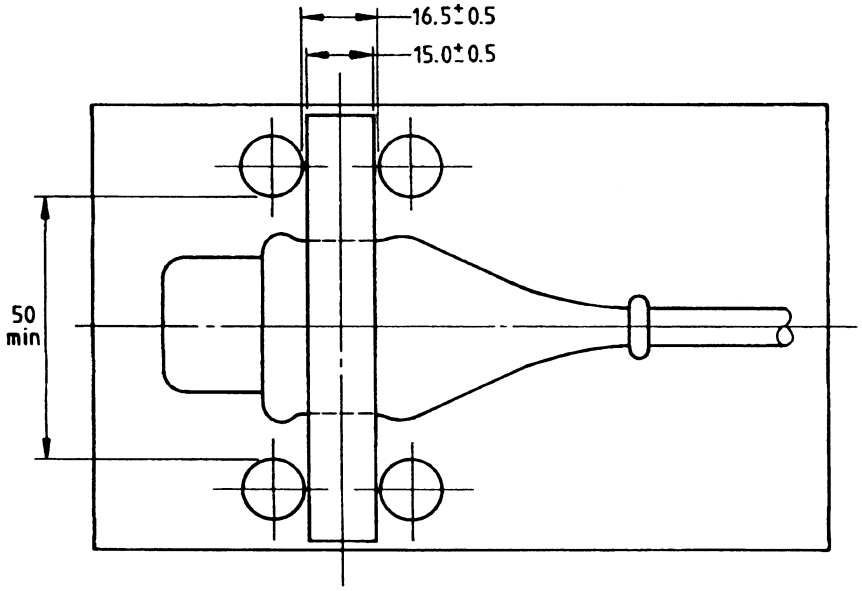
Figure 12 — Impact test apparatus (test hammer) (see **22.1.2**)



Dimension is in millimetres.

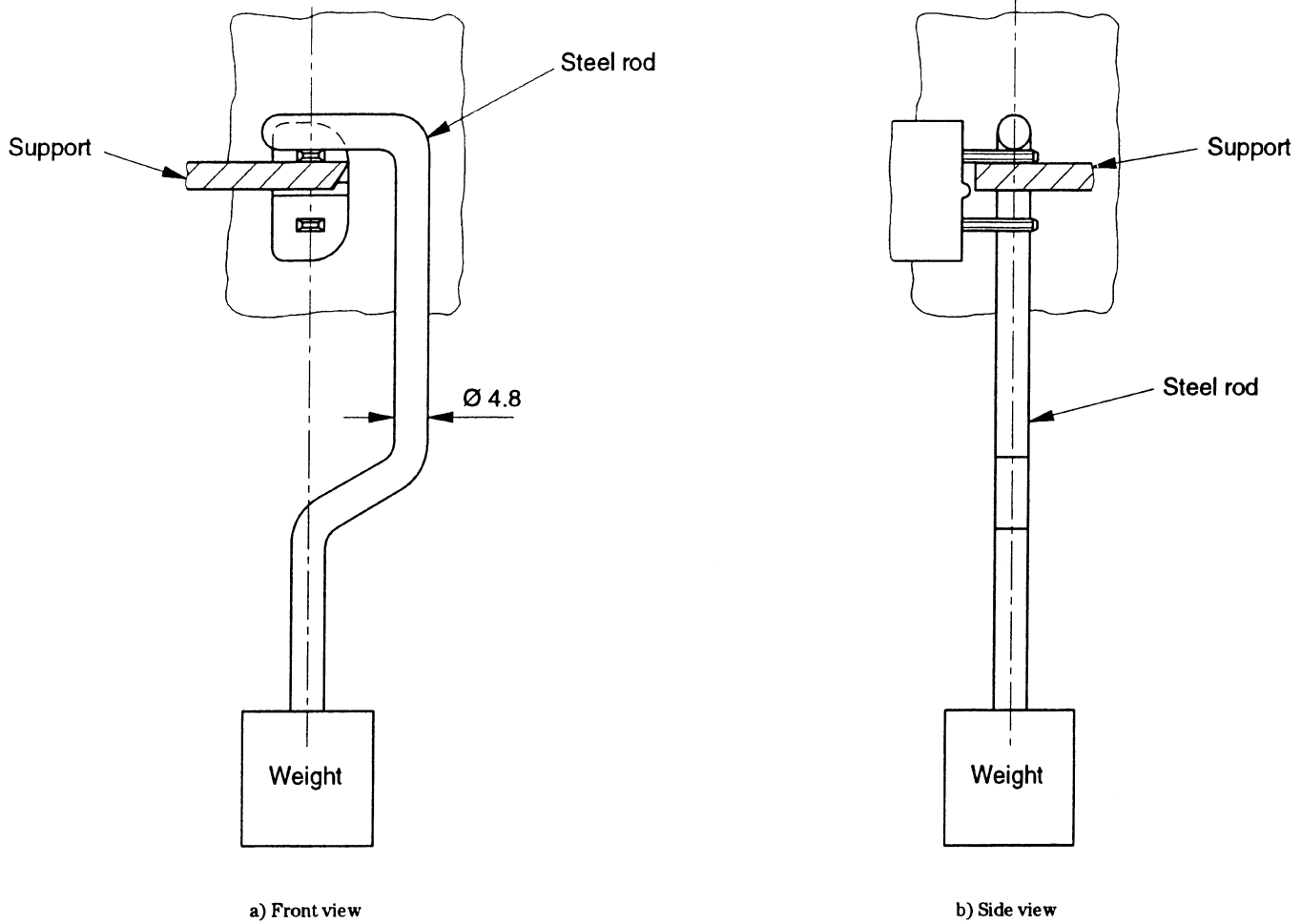
Figure 13 — Ball pressure test apparatus (see **23.1.2**)





All dimensions are in millimetres.

Figure 14 — Apparatus for pressure test on connectors (see **23.1.3**)

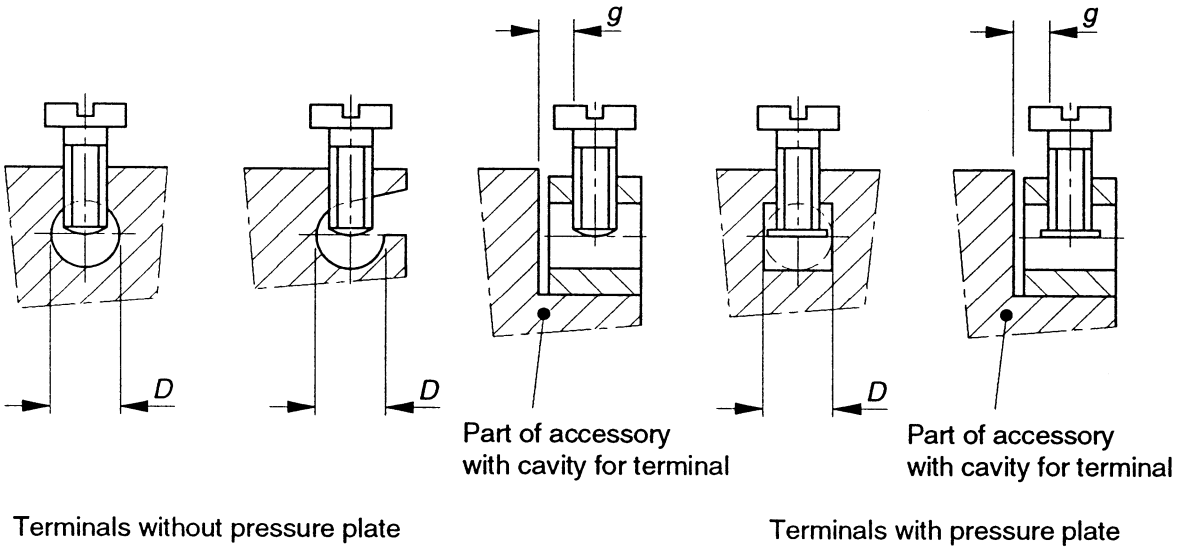


a) Front view

b) Side view

All dimensions are in millimetres.

Figure 15 — Device for testing non-solid pins



Terminal size	Minimum diameter, *D*, of conductor space	Minimum distance, *g*, between clamping screw and end of conductor when fully inserted
	mm	mm
1	2.5	1.5
2*	3.0	1.5
*Terminal size 2 is included for information.		

NOTE. The part of the terminal containing the threaded hole and the part of the terminal against which the conductor is clamped by the screw may be two separate parts, as in the case of terminals provided with a stirrup.

The shape of the conductor space may differ from those shown, provided a circle with a diameter equal to *D* can be inscribed.

Figure 16 — Pillar terminals

Publications referred to

BS 308, *Engineering drawing practice*

BS 308-3*, Geometrical tolerancing.*

BS 1134, *Assessment of surface texture.*

BS 1134-1*, Methods and instrumentation.*

BS 1134-2, *General information and guidance.*

BS 1224, *Specification for electroplated coatings of nickel and chromium.*

BS 1706, *Method for specifying electroplated coatings of zinc and cadmium on iron and steel.*

BS 1872, *Specification for electroplated coatings of tin.*

BS 2782, *Methods of testing plastics.*

BS 2782:Method 365C, *Determination of Rockwell hardness.*

BS 3042, *Specification for standard test fingers and probes for checking protection against electrical, mechanical and thermal hazards.*

BS 3643, *ISO metric screw threads.*

BS 3643-1, *Principles and basic data.*

BS 3643-2, *Specification for selected limits of size.*

BS 4500, *ISO limits and fits.*

BS 5901, *Method of test for determining the comparative and the proof tracking indices of solid insulating materials under moist conditions.*

BS 6217, *Guide to graphical symbols for use on electrical equipment.*

BS 6458, *Fire hazard testing for electrotechnical products.*

BS 6458-2.1, *Glow-wire test.*

BS 6500, *Specification for insulated flexible cords and cables.*

BS EN 60529, *Specification for degrees of protection provided by enclosures (IP code).*

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