Specification for

Portable residual current devices

Dispositifs (de protection) portatifs à courant différentiel-résiduel — Spécifications

Tragbare Nullstromgeräte

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Contents

Foreword

This British Standard has been prepared under the direction of the Power Electrical Engineering Standards Policy Committee. It supersedes BS 7071 : 1989, which is withdrawn.

This edition introduces technical changes but it does not reflect a full review or revision of the standard, which will be undertaken in due course.

Compliance with a British Standard does not itself confer immunity from legal obligations.

Specification

1 Scope

This British Standard specifies requirements for portable residual current devices (portable rcds) (including devices using auxiliary sources and devices with electronic circuitry) for operation on an a.c. supply and having a rated voltage not exceeding 250 V a.c. single phase, a rated current not exceeding 16 A, a rated frequency not exceeding 400 Hz and a rated residual operating current not exceeding 30 mA. Portable rcds incorporate a plug-pin portion and/or socket-outlet portion(s) and may include terminals for external flexible cords where appropriate. Portable rcds with an intentional time delay are not covered by this standard.

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

2 Definitions and symbols

2.1 Definitions

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

2.1.1 residual current (I_Δ). The root mean square (r.m.s.) value of the vector resultant of the instantaneous values of the currents flowing in the main circuit of the residual current device.

2.1.2 portable residual current device (portable rcd). A device which incorporates an auxiliary sensing circuit that will automatically disconnect the main circuit at a predetermined value of residual current.

2.1.3 interlocked portable rcd. A portable rcd incorporating an interlock (either mechanical or electrical) which prevents the contacts of the portable rcd from being closed on-load.

2.1.4 rewireable portable rcd. A portable rcd so constructed that a cable or flexible cord can be fitted or replaced using general purpose tools.

2.1.5 non-rewireable portable rcd. A portable rcd so constructed that it forms a construction unit with the flexible cord such that the flexible cord cannot be separated from the portable rcd without making it permanently useless, and the portable rcd cannot be opened by hand or by using a general purpose tool, e.g. a screwdriver and/or pliers, without making the portable rcd permanently useless.

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

2.1.6 tripping current ($I_{o,\Delta}$). The minimum value of residual current that causes the device to open.

2.1.7 rated tripping current ($I_{o,\Delta,N}$) (rated residual operating current). The value of residual current, assigned by the manufacturer, at which the device opens under specific conditions.

2.1.8 rated non-tripping current ($I_{\phi,\Delta,N}$). The value of residual current, assigned by the manufacturer, at which the device does not open under specified conditions.

2.1.9 rated current of a device (I_N). The r.m.s. value of current, assigned by the manufacturer, which the main circuit of the device is capable of carrying continuously under specified conditions of use and behaviour.

2.1.10 prospective current. The current (r.m.s. value of the a.c. component) that would flow in the circuit due to the applied voltage if each main current path of the device were replaced by a link of negligible impedance but without any other circuit change.

NOTE. For the purpose of this definition the term 'device' includes the short length of cable or cord used to connect the device to the test circuit.

2.1.11 rated voltage (U_N). The r.m.s. value of voltage, assigned by the manufacturer, to which the performance of the device is referred.

2.1.12 pole. The portion of a switching device associated exclusively with one electrically separated conducting path of its main circuit and excluding those portions which provide a means for mounting and operating all poles together.

NOTE. All the conducting parts of a switching device included in the circuit which it is designed to close or open are considered to be the main circuit.

2.1.13 switched pole. A pole containing contacts for opening and closing the current path.

2.1.14 switched neutral. A switched pole, in the neutral current path, with contacts not intended to make or break current but arranged to open after and to close before the contacts in any other switched pole of the main current path.

2.1.15 main contacts. The fixed and moving contacts in the main current carrying paths.

2.1.16 test circuit. An integral circuit to enable the protective function of the device to be checked.

2.1.17 integral auxiliary source. An auxiliary source intended to supply the auxiliary circuit(s), which is derived from the same mains supply within the device as the load being protected.

2.1.18 portable rcd with integral overcurrent protection. A portable rcd designed to perform the additional function of overload and/or short circuit protection.

NOTE. This includes a portable rcd with a socket-outlet and/or plug-pin portions as an integral part of its construction, which can supply a local load only through either a fused plug or its integral overcurrent protection.

2.1.19 termination. A means by which an electrical connection can be made between the appropriate cable or flexible cord and the conducting part of the portable rcd using special purpose tools, e.g. soldering, welding and crimping.

2.1.20 terminal. A means by which the user can make an electrical connection between the appropriate cable or flexible cord and the conducting parts of the portable rcd without the use of special tools.

2.1.21 pillar terminal. A terminal in which the conductor is inserted into a hole or cavity where it is clamped under the end of the screw or screws or through an intermediate clamping member to which pressure is applied by the end of the screw.

2.1.22 screw terminal. A terminal in which the conductor is clamped under the head of the screw, the clamping pressure being applied either directly by the head of the screw or through an intermediate metallic part in direct contact with the screw, such as a washer, clamping plate or antispread device.

2.1.23 stud terminal. A terminal in which the conductor is clamped under a nut, the clamping pressure being applied either directly by a suitably shaped nut or through an intermediate part, such as a washer, clamping plate or antispread device.

2.1.24 rcd adaptor. A portable rcd comprising a plug-pin portion and socket-outlet(s) as integral parts of the portable rcd's construction, the plug-pins being of the same rating and to the same standard as the socket-outlet portion.

2.1.25 rcd plug. A portable rcd comprising a plug-pin portion and terminals for connection of a flexible cord as integral parts of the rcd plug's construction or with a flexible cord connected.

2.1.26 portable rcd socket-outlet. A portable rcd comprising socket-outlet(s) portions as integral parts of the device with terminals for connection of a flexible cord or with a flexible cord connected.

2.1.27 in-line portable rcd. A portable rcd comprising integral input and output flexible cords permanently connected to the rcd to which appropriate plugs, socket connections or appliances can subsequently be connected.

2.1.28 functional earth circuit. For the purposes of this standard a functional earth circuit is one connected to earth for protection against supply faults, suppression and similar functions.

2.1.29 accessible external surface of a portable rcd. All surfaces which can be touched by test finger I of BS 3042 : 1971 when the portable rcd is in normal use or, in the case of a portable rcd with plug pins, when it is in full engagement with a corresponding socket-outlet.

2.2 Symbols

For the purposes of this British Standard the following symbols apply:

I = current
U = voltage

qualified by the following subscripts:

N = rated
o = open
ϕ = non-opening
Δ = residual (out-of-balance)
a = auxiliary

3 Classification

A portable rcd shall be classified according to the following:

(a) the type of portable rcd, as follows:
  (1) portable rcd adaptor; or
  (2) portable rcd plug; or
  (3) portable rcd socket-outlet; or
  (4) in-line portable rcd;
(b) whether it is rewireable or non-rewireable;
(c) the number of poles, as follows:
  (1) single-pole with switched neutral; or
  (2) double pole;
(d) the type of switching, as follows:
  (1) on-load closing; or
  (2) on-load closing prevented (interlocked portable rcd).

4 Rating

A portable rcd shall be rated in terms of the following:

(a) voltage;
(b) current;
(c) frequency;
(d) tripping current.

5 Marking and labelling

5.1 The portable rcd shall be marked legibly and in a durable manner with the following details:

(a) the rated voltage (U_N);
(b) the rated current (I_N);
(c) the rated tripping current ($I_{o,\Delta,N}$);
(d) the symbol for nature of supply;
(e) the frequency of supply if other than 50 Hz;
(f) the manufacturer's or responsible vendor's name or distinguishing mark;
(g) the type reference (which may be a catalogue number);
(h) the number and date of this British Standard, i.e. BS 7071 : 1992;

(i) the details concerning the operation of the test circuit including such words as 'Test each time before use';

(j) the closed and open positions of the portable rcd;

NOTE. The symbols given in 5.4 may be used.

(k) a diagram of connections, if a diagram of connections is not separately supplied with the device;

(l) the words 'Supply Fault' adjacent to the reverse polarity indicator, if fitted.

The test details in items (i), (j) and (l) shall be visible when the portable rcd is in normal use. All other marking shall be on the external surface.

5.2 The terminals for the connection of the neutral and line conductors shall be identified by the symbols N and L respectively. Where it is necessary to distinguish between supply and load terminals, they shall be clearly identified by suitable marking.

5.3 Terminals for the connection of protective conductors shall be marked with the symbol for earth.

5.4 If symbols are used they shall be as follows:

amperes	A
volts	V
frequency	Hz
alternating current	∿ *
line	L
neutral	N
earth	⏚ * preferred or ⏚ *
fuse	 *
ON	I *
OFF	0 *

NOTE. For the marking of the rated current and rated voltage of the portable rcd figures may be used alone, the figures for the current rating being placed before or above those for the rated voltage and separated by a line. If a symbol for nature of supply is used, it is placed next to the marking for rated current and rated voltage. Examples are as follows:

13 A 250 V ∿

13/250 ∿

$\frac{13}{250}$ ∿

5.5 Compliance with **5.1** to **5.4** shall be checked by inspection and by the tests described in **8.7**.

5.6 When a rewireable portable rcd is fitted with a fuse link, the rating of the fuse link shall be indicated, e.g. 'Fitted with *X* ampere fuse' (where *X* denotes the rating of the fuse link).

NOTE. This information may be provided on a removable tag or label or it may be given in accompanying literature or on a card such as a retail blister card, to which the portable rcd is fixed.

Compliance shall be checked by inspection.

5.7 Unless supplied direct to a manufacturer for incorporation in other equipment, flexible cords shall be supplied with a label or instruction indicating the colour coding of the cores of the flexible cords.

5.7.1 A label or instruction provided for the flexible output cord of an rcd plug or an in-line portable rcd shall include the following:

'IMPORTANT
Output

This cable shall be fixed to the device to be protected.

The wires in this mains lead are coloured in accordance with the following code:

Green/Yellow	Earth (if any)
Blue	Neutral
Brown	Live'.

5.7.2. The label or instruction for the flexible input cord of a portable rcd socket-outlet or an in-line portable rcd shall include the following:

'IMPORTANT
Input

This cable shall be affixed to the power input plug.

The wires in this mains lead are coloured in accordance with the following code:

Green/Yellow	Earth (if any)
Blue	Neutral
Brown	Live'.

5.7.3 Compliance with **5.7.1** and **5.7.2** shall be checked by inspection.

5.8 A portable rcd shall be provided with an instruction sheet for its use. The following text shall be included:

(a) a detailed procedure for testing before use arranged as a logical sequence of actions;

(b) a statement that the device shall not be used if it fails to operate correctly in accordance with the instructions;

(c) adequate instructions on the safe connection of any appropriate flexible cords including reference to BS 6500, the number and colour of cores, the correct cross-sectional area of the conductors and, in the case of portable rcd socket-outlets and in-line portable rcd's, an instruction that a maximum length of 2 m of flexible cord should be connected between the device and the corresponding plug;

(d) a statement detailing the appropriate British Standards and ratings of any integral or associated overcurrent protective devices necessary for the safe operation of the portable rcd and any associated cables;

(e) a statement warning against storage or use outside the service conditions (see clause 6) and misuse such as dropping, immersion, etc.

*BS 6217 gives guidance on these symbols.

(f) a statement that electricity can be dangerous and that the use of a portable rcd should not be regarded as a substitute for basic electrical safety precautions, and specific mention of the need to unplug equipment to achieve isolation before any inspection or repair of that equipment is attempted;

(g) a statement warning the user to seek advice from the manufacturer, responsible vendor or a competent electrician if the portable rcd repeatedly trips with an appliance connected or if it fails to trip when tested in accordance with the instructions.

Compliance shall be checked by inspection.

6 Service conditions

A portable rcd complying with this standard shall be suitable for use under the following conditions of service:

(a) an ambient temperature range of −5 °C to +40 °C, with an average value not exceeding +35 °C measured over any 24 h period;

(b) an altitude not exceeding 2000 m above sea level;

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

NOTE 1. Portable rcds complying with this standard may not be suitable for exposure to direct radiation from the sun or to other sources of heat likely to raise the temperature above the designated ambient temperature, nor for subjection to excessive vibration.

NOTE 2. Where service conditions differ from those prescribed above the advice of the manufacturer or responsible vendor should be sought.

7 Design and construction

7.1 General

7.1.1 The portable rcd shall be so designed and constructed that in normal use it performs reliably and without danger to the user or to the surroundings.

7.1.2 The portable rcd shall be capable of meeting all the relevant requirements of this standard and the tests specified in clauses **8** and **9**.

7.1.3 Where tolerances are not specified the values given shall be regarded as nominal.

7.1.4 For a portable rcd incorporating overcurrent protection as an integral part of its construction, such overcurrent protection shall comply with the appropriate British Standard, as declared by the manufacturer (e.g. fuse links shall comply with BS 1362 and circuit-breakers shall comply with BS 3871 : Part 1).

Compliance shall be checked by inspection of the marking or by testing to the appropriate standard.

7.1.5 A portable rcd incorporating plug pins and/or socket contacts, intended to engage with socket-outlets or plugs complying with other British Standards, shall be so designed and constructed that such plug pins and/or socket contacts comply with the appropriate requirements specified in those British Standards.

NOTE. For BS 1363 configurations the relevant tests are referred to in appendix A.

Compliance shall be checked by the tests referred to in **8.28**.

7.2 Temperature rise

A portable rcd and its surroundings shall not attain temperatures in excess of those specified in the appropriate British Standard for the appropriate plugs and socket-outlets.

Compliance shall be checked by the test described in **8.4**.

7.3 Provision for testing residual current operation

Provision shall be made for testing the automatic opening of the portable rcd main contacts by an integral test circuit.

Operation of the test circuit shall excite the current-balance transformer(s) and the exciting ampere-turns produced by the test circuit shall not exceed 2.5 times the exciting ampere-turns produced by the rated tripping current flowing in one pole of the portable rcd.

The test circuit shall be arranged for external operation in such a way that the protection afforded by the cover or enclosure is not impaired. To safeguard against loss, the push button or the operating handle of the test circuit shall not be removable without the use of tools nor until the cover has been removed from the portable rcd.

NOTE. Appendix B gives information on the function of the test circuit.

Compliance shall be checked by the tests described in **8.29**.

7.4 Voltage limits for auxiliary source supplies

A portable rcd that depends on an integral auxiliary source for operation shall perform its protective function at any value of the source voltage between 0.70 and 1.1 times its rated voltage.

Compliance shall be checked by the tests described in **8.10.2**.

7.5 Construction

7.5.1 A portable rcd shall have adequate mechanical strength and be so constructed as to withstand such handling as may be expected in normal use.

Compliance shall be checked by the tests described in **8.11**.

7.5.2 The enclosure of the portable rcd shall be sealed by the manufacturer to prevent any access other than to replaceable fuses and rewireable terminals.

NOTE. This means that the enclosure cannot be opened by hand or by using general purpose tools, e.g. a screwdriver and/or pliers, without rendering the portable rcd permanently useless. A portable rcd is considered to be permanently useless when, for reassembly, parts or materials other than the original need to be used. This does not apply to the replacement of a fuse link.

Compliance shall be checked by inspection, the appropriate mechanical strength tests of this standard and manipulation by hand and/or the use of general purpose tools.

7.5.3 Current-carrying parts and earthing contacts shall be of brass, copper, phosphor-bronze or other metal at least equivalent with regard to its conductivity, resistance to abrasion and resistance to corrosion.

NOTE. This requirement does not apply to screws, nuts, washers, clamping plates and similar parts of terminals, nor to parts of portable rcd socket-outlets used for earth continuity purposes other than the earthing contacts.

Compliance shall be checked by the tests of **8.13.2** and the relevant tests referred to in **8.2.8**.

7.5.4 Ferrous parts shall be adequately protected against rusting.

Compliance shall be checked by the test described in **8.13.1**.

7.6 Operating mechanism

7.6.1 The portable rcd shall be arranged for automatic opening under earth fault conditions.

Compliance shall be checked by the tests described in **8.9** and **8.10**.

7.6.2 It shall be impossible to hold the portable rcd contacts closed by the operating mechanism under fault conditions in which tripping should occur.

Compliance shall be checked by the tests described in **8.10.2**.

7.6.3 The position of the contacts shall be reliably indicated. Neon or other electroluminescent parts shall not be used for this purpose.

It shall be impossible for the indicating device to assume the open position unless all moving contacts are also in the open position.

Compliance shall be checked by inspection and the test described in **8.31**.

7.6.4 The portable rcd contacts shall be incapable of unintentional reclosure as a result of mechanical shock or vibration.

Compliance shall be checked by the test described in **8.11.2**.

7.6.5 The portable rcd shall be capable of withstanding without excessive wear or other harmful effects, the electrical and mechanical stresses occurring in use.

Compliance shall be checked by the tests described in **8.12**.

7.6.6 A portable rcd shall either function as normal or trip automatically on connection to supply terminals with reversed polarity (L and N).

7.6.7 The portable rcd shall not be fitted with an intentional time delay.

Compliance shall be checked by the test described in **8.10.3**.

7.7 Connection arrangements

7.7.1 Terminals in a rewireable portable rcd shall permit the connection, without special preparation, of flexible cords having nominal conductor cross-sectional areas of 0.5 mm^2 to 1.5 mm^2.

Compliance shall be checked by inspection, by a manual test and by the tests described in **8.18**.

7.7.2 Where pillar terminals are used they shall have clamping screws of sufficient length to extend to the far side of the conductor hole. The end of the screw shall be slightly rounded so as to minimize damage to the conductors.

The sizes of the conductor hole and the clamping screw shall be such that the clearance between the sides of the major diameter of the clamping screw and the conductor hole does not exceed 0.4 mm.

Compliance shall be checked by inspection and measurement.

7.7.3 Terminal screws shall have a nominal (outside) diameter as given in table 3.

Compliance shall be checked by inspection and measurement.

7.7.4 Terminals of a portable rcd shall be so located or shielded that should a wire of a stranded conductor escape when the conductors are fitted, there is no risk of accidental connection between live parts and accessible external surfaces.

Compliance shall be checked by the test described in **8.17**.

7.7.5 A non-rewireable portable rcd fitted with a flexible cord shall be provided with soldered, welded, crimped or similar terminations; screw-type and 'snap-on' terminals shall not be used.

Crimped connections shall not be made on to presoldered ends of flexible cords.

For all these methods of termination, not more than one strand, or 5 % of the total number of strands of the conductor, whichever is the greater, shall be fractured during connection.

Compliance shall be checked by inspection and measurement.

7.8 Screws, current carrying parts and connections

7.8.1 Screwed connections, electrical and otherwise, shall withstand the mechanical stresses occurring in normal use. Screws transmitting electrical contact pressure shall screw into metal and shall be of metal which is not soft nor liable to creep.

Compliance shall be checked by inspection and by the tests described in **8.18**.

7.8.2 Screws accessible to the user shall not be of insulating material if their replacement by a metal screw would affect the safety or performance requirements of the portable rcd.

Compliance shall be checked by inspection.

7.8.3 Contact pressure in electrical connections shall not depend on the dimensional stability of insulating materials other than ceramic or mica.

Compliance shall be checked by inspection.

7.8.4 Thread-forming or thread-cutting screws for the connection of current-carrying parts and parts of the earthing circuit shall be used only when screwed into metal parts. Such screws shall not be accessible during installation or in normal use.

Compliance shall be checked by inspection.

7.8.5 Screws which make a mechanical connection between different parts of the device shall be locked against loosening, if the connection carries current, including earth fault currents.

Compliance shall be checked by inspection and manual test.

7.9 Cord anchorage and the connection of flexible cords

7.9.1 Cord anchorages in the portable rcd shall anchor the cord securely.

Compliance shall be checked by the tests referred to in **8.5**.

7.9.2 The cord entry to the portable rcd shall be so shaped as to prevent damage to the cord which could be caused by excessive bending.

Compliance shall be checked by inspection.

7.9.3 Flexible cords supplied with a portable rcd shall be coloured as indicated on the instructions described in **5.7**.

Compliance shall be checked by inspection.

7.9.4 A portable rcd supplied fitted with a flexible cord shall be so designed that the flexible cord is not subjected to excessive bending where it enters the portable rcd.

Compliance shall be checked by the test described in **8.19**.

7.9.5 Flexible cords fitted to a portable rcd socket-outlet or in-line portable rcd shall comply with BS 6500. The maximum length of the flexible input cord fitted shall not exceed 2 m.

Compliance shall be checked by inspection and measurement.

7.10 Accessibility of live parts

7.10.1 The portable rcd shall be so designed that when installed in normal use, live parts are not accessible.

Compliance shall be checked by the tests referred to in **8.20**.

7.10.2 Where a portable rcd has a resilient enclosure it shall be so designed and constructed that when assembled and wired as in normal use there is no risk that, as a result of undue pressure, live parts could penetrate the cover or become so disposed as to reduce creepage distances and clearances to values below those specified in **7.12**.

Compliance shall be checked by the tests described in **8.21**.

7.11 Provision for earthing

All accessible metal parts of a portable rcd shall be in effective electrical contact with the earth socket contacts and/or earthing plug pin, except for metal parts on, or screws in or through, non-conducting material, and separated by such material from current-carrying parts in such a way that in normal use they can not become live, which need not be in effective electrical contact with the earthing socket contact or earthing plug pin.

NOTE. Metal parts having an accessible surface coating of lacquer or enamel are taken to be accessible metal parts for the purposes of this requirement.

Compliance shall be checked by the following tests:

(a) for metal parts insulated from live parts, by the test described in **8.3**;

(b) for metal parts connected to an earthing terminal or earthing plug pin, by the test described in **8.22**.

7.12 Creepage distances, clearances and distances through insulation

7.12.1 The minimum clearance through air and the minimum creepage distances on main current carrying circuits shall be 2.5 mm for the following cases:

(a) between live parts and any other metal parts;

(b) between live parts and the accessible external surface of the portable rcd;

(c) between component parts in any fused line circuit that is separated by the removal of the fuse link.

Where printed circuit boards are used the guidance given in BS 6221 : Part 3 shall be followed.

NOTE. These requirements do not apply to :
(a) any flexible cord connected to a portable rcd.
(b) electronic components forming a functional earth circuit.

Compliance shall be checked by the tests described in **8.25**.

7.12.2 The isolation distance between contacts in the same conductive path shall be at least 3 mm.

Compliance shall be checked by inspection and measurement.

7.12.3 The portable rcd 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 so located that there is no likelihood of the distance through air being reduced by distortion or movement of the parts.

NOTE. These requirements do not apply to :
(a) any flexible cord connected to a portable rcd.
(b) electronic components forming a functional earth circuit.

Compliance shall be checked by the tests described in **8.21**.

7.13 Resistance to humidity

The portable rcd shall be proof against humid conditions which may occur in normal use.

Compliance shall be checked by the test described in **8.14**.

7.14 Ability to withstand through fault current

The portable rcd shall be capable of withstanding the thermal and electromagnetic stresses which may occur under through fault conditions before the back-up protection clears.

Compliance shall be checked by the tests described in **8.16**.

7.15 Resistance to heat

The portable rcd shall be resistant to heat.

Compliance shall be checked by the tests described in **8.26**.

7.16 Resistance to abnormal heat, fire and tracking

The portable rcd shall be proof against abnormal heat, fire and tracking.

Compliance shall be checked by the tests described in **8.27**. The tests shall not be made on parts of ceramic material or metal.

7.17 Insulation resistance and electric strength

The insulation resistance and electric strength of a portable rcd shall be adequate.

Compliance shall be checked by the tests described in **8.3** and **8.8**.

7.18 Core balance requirement

The portable rcd shall not be subject to nuisance tripping due to an inherent unbalance in the transformer when subject to moderate current surges.

Compliance shall be checked by the test described in **8.6**.

7.19 Loss of supply neutral

The portable rcd shall automatically trip or shall continue to give protection in the event of a loss of the supply neutral.

Compliance shall be checked by the test described in **8.23**.

8 Type tests

8.1 General

Type tests as specified in **8.2** to **8.31** shall be made on samples representing each type of portable rcd.

NOTE 1. A test for electronic component reliability is under consideration.

NOTE 2. Routine tests are given in clause **9**.

8.2 Conditions

8.2.1 Tests shall be made at rated voltage ± 5 %, at rated frequency ± 10 % and at an ambient temperature of 20 ± 5 °C unless otherwise stated in this standard.

8.2.2 The specified sequences shall be completed without any adjustment being made to the samples.

8.2.3 The portable rcd shall be positioned and wired as in normal use unless otherwise stated and in compliance with any requirements specified by the manufacturer.

8.2.4 Flexible cords used for the tests shall comply with BS 6500 and be of the appropriate size according to the rating of the portable rcd unless otherwise specified in the appropriate clause.

8.2.5 A separate sample shall be used for each of the test sequences given in **8.2.8** except for test sequence 8, which may require more than one sample (see appendix A). Each sample shall be in a clean, new condition.

8.2.6 The tests shall be performed in the order given for each test sequence.

8.2.7 When routine tests as described in clause **9** are carried out as part of the type test sequences of **8.2.8** all of **8.2** shall be complied with.

8.2.8 The portable rcd shall be deemed to comply with this standard provided that there are no failures during the following test sequences.

NOTE. The type testing sequences may be modified by the requirements referred to in appendix A.

Test sequence 1	
(a) Routine tests	clause **9**
(b) Verification of construction	**8.24**
Test sequence 2	
(a) Routine tests	clause **9**
(b) High impulse voltage	*
(c) Temperature rise	**8.4**
(d) Transformer balance	**8.6**
(e) Tests for reverse polarity	**8.30**
(f) Portable rcd performance	**8.10**
(g) Insulation resistance	**8.8**
(h) Resistance to excessive residual stresses and to rusting	**8.13**
Test sequence 3	
(a) Routine tests	clause **9**
(b) Loss of supply neutral	**8.23**
(c) Endurance	**8.12**
(d) Condition of tested sample	**8.15**
(e) Portable rcd performance	**8.10**
(f) Reliability of contact position indicator	**8.31**

* This test is under consideration and will be added by amendment.

Test sequence 4

(a) Routine tests	clause 9
(b) Circuit fault current	8.16
(c) Condition of tested sample	8.15
(d) Portable rcd performance	8.10

Test sequence 5

(a) Routine tests	clause 9
(b) Resistance to humidity	8.14
(c) Insulation resistance	8.8
(d) High voltage	8.3
(e) Durability of marking	8.7

Test sequence 6

(a) Routine tests	clause 9
(b) Earth fault breaking current	8.9
(c) Portable rcd performance	8.10
(d) Condition of tested sample	8.15
(e) Electronic component reliability	*

Test sequence 7

(a) Routine tests	clause 9
(b) Stray conductor strand	8.17
(c) Screwed connections	8.18
(d) Accessibility of live parts	8.20
(e) Durability of marking	8.7
(f) Cord anchorage	8.5
(g) Mechanical strength	8.11
(h) Tripping current	8.10.4
(i) Effective earthing	8.22
(j) Resistance to heat	8.26
(k) Accessibility of live parts	8.20
(l) Routine high voltage	9.2
(m) Flexing test for flexible cords	8.19
(n) Test circuit operation	8.29
(o) Verification of creepage and clearances	8.25
(p) Distance through insulation	8.21
(q) Resistance to abnormal heat, fire and tracking	8.27

Test sequence 8

(a) Routine tests	clause 9
(b) Verification of plug and/or socket-outlet(s) portion	8.28

8.3 High voltage

(a) Between all incoming terminals of poles in turn with the portable rcd contacts closed. If an auxiliary source or electronic control circuit is required to close the contacts, this may be disconnected and the test shall be carried out with the contacts open followed by a second test between all outgoing terminals of poles in turn, excluding the functional earth connection.

(b) Between all incoming terminals of switched poles and the corresponding outgoing terminals of switched poles in turn with the contacts open.

(c) Between the terminals of of all main poles connected together, excluding the functional earth connection, and any earthed metal.

(d) Between the terminals of all main poles connected together, excluding the functional earth connection, and a metal foil in contact with the entire accessible external surface.

Where terminals are not directly accessible, these tests shall be made using accessible parts, e.g. pins or socket-outlet contacts, known to be connected to the terminals.

Table 1. High voltage test values

Rated voltage, U_N	a.c. test voltage (r.m.s.)
V	V
$U_N \leqslant 60$	$1000\ ^{-0}_{+30}$
$60 < U_N \leqslant 300$	$2000\ ^{-0}_{+60}$

A voltage of substantially sinusoidal waveform at the rated frequency of the device is applied. Initially, not more than half the test voltage is applied, the voltage then being increased to full value. The high voltage source used shall be such that when the output is adjusted to 2000 ± 60 V for 1 min and is then short-circuited, the output current is $200\ ^{+20}_{-0}$ mA.

Any overcurrent protection shall not operate at a current less than 100 mA.

During the test, no flashover or breakdown shall occur. Glow discharges without drop in voltage are neglected.

NOTE 1. Attention is drawn to the need for special precautions to be taken in the use of test sets with outputs greater than 10 mA.

NOTE 2. Connections to under-voltage releases or electronic devices may be removed or disconnected for this test.

8.4 Temperature rise

The temperature rise test shall be carried out in accordance with the tests for the requirements specified in the standard appropriate to the associated plug/socket-outlet. In-line portable rcd's shall be tested in accordance with **8.4.1.**

After the test there shall be no damage to adjacent parts and the operation of the portable rcd shall not be impaired.

NOTE. The term 'no damage' implies that the essential characteristics remain such that the mechanical, dielectric and operating functions comply with the appropriate requirements of this standard. These are checked when carrying out the remaining tests in the sequence.

*This test is under consideration and will be added by amendment.

8.4.1 Temperature rise test in-line portable rcd

The temperature rises of the parts of the in-line portable rcd shall not exceed the limits specified in table 1(a).

Table 1(a) Limits of temperature rises

Parts	Temperature rise K
External parts	40
External metallic parts of operating means	25

The ambient air temperature shall be measured during the last quarter of the test period by means of at least two thermometers or thermocouples symmetrically distributed around the in-line portable rcd at about half its height and at a distance of 1 m ± 100 mm.

The thermometers or thermocouples and portable rcd shall be protected against draughts, radiant heat, sudden temperature changes, and the ambient temperature shall be maintained in accordance with **8.2.1.**

The in-line portable rcd shall be tested with 1 m of flexible cord or such length as supplied by the manufacturer and shall be connected by means of suitable plugs and sockets.

It shall be mounted according to the manufacturer's instructions either horizontally or vertically, whichever is considered to be the most onerous, on a plywood board having a nominal thickness of 10 mm and having two coats of matt paint complying with BS 4800 No. 08 C35.

A current equal to I_n shall be passed simultaneously through both poles of the portable rcd, it being closed in the same manner as in service.

The test current I_n shall be maintained until the variation of the temperature rise does not exceed 1 K/h.

The temperature rise shall be measured by means of fine wire thermocouples or by equivalent means at the nearest accessible position to the hottest spot. Good heat conductivity between the thermocouple and the surface of the part under test shall be ensured.

The temperature rise is the difference between the temperature of the part measured and the ambient air temperature.

8.5 Cord anchorage

The tests for the requirements specified in the standard appropriate to the associated plug/socket-outlet shall be carried out.

8.6 Transformer balance

The portable rcd shall be closed three times on to a circuit such that each pole carries twice the rated current (I_N) at the rated voltage of the device. The portable rcd shall not trip. The test current shall be maintained for 5 s.

NOTE. Appendix C of BS 4293 : 1983 gives information on the purpose of the transformer balance test.

8.7 Durability of marking

The durability of marking shall be checked by rubbing the marking by hand for 15 s with a piece of cloth soaked in water and again for 15 s with a piece of cloth soaked in petroleum spirit.

Petroleum spirit used for this test shall consist of a solvent hexane having a maximum aromatics content of 0.1 % by volume, a kauri-butanol value of 29, an initial boiling point of approximately 65 °C, a dry point of approximately 69 °C and a relative density at 15/15 °C of approximately 0.68.

NOTE. Relative density may be determined by the method described in BS 4714.

After testing the marking shall remain legible; it shall not be possible to remove easily any marking plates and they shall show no curling. Marking produced by an engraving or moulding process shall be deemed to comply without test.

8.8 Insulation resistance

The insulation resistance is measured using a d.c. voltage of not less than 500 V applied for a sufficient time for the reading of the measuring instrument to become steady. The insulation resistance is measured between the following points.

(a) Between all incoming terminals of poles in turn with the portable rcd contacts closed.

NOTE 1. If an auxiliary source or electronic control circuit is required to close the contacts, this may be disconnected and the test is carried out with the contacts open followed by a second test between all outgoing terminals of poles in turn, excluding the functional earth connection.

The insulation resistance shall be not less than 0.5 M Ω.

(b) Between all incoming terminals of switched poles and the corresponding outgoing terminals of switched poles in turn with the contacts open. The insulation resistance shall be not less than 0.25 M Ω.

(c) Between the terminals of all main poles connected together, excluding the functional earth connection, and any earthed metal. The insulation resistance shall not be less than 0.5 M Ω.

(d) Between the terminals of all main poles connected together, excluding the functional earth connection, and a metal foil in contact with the entire accessible external surface.

The insulation resistance shall not be less than 0.5 M Ω.

NOTE 2. Connections to under-voltage releases or electronic devices may be removed or disconnected for these tests.

Where terminals are not directly accessible, these tests shall be made using accessible parts, e.g. pins or socket-outlet contacts, known to be connected to the terminals.

For the purposes of this test it is sufficient for any marked points on the instrument scale to be within ± 10 % of the marked value when checked against a standard resistor of that value. If the stressing voltage is generated within the instrument, the terminal voltage shall be not less than the specified value under open circuit conditions and not less than 80 % of this value when loaded with a 1 M Ω resistor.

The effect of the voltage measuring device input impedance shall be taken into account in the load.

8.9 Earth fault breaking current

The portable rcd shall be connected as shown in figure 1.

Any part of the portable rcd intended to be earthed shall be connected to earth via a fine wire fuse. This fuse (for indicating earth faults) shall be copper wire of 0.1 mm diameter and not less than 50 mm long. If necessary, a resistor (see figure 1) shall be connected between the fuse and the neutral point of the supply to limit the value of the earth fault current to about 100 A.

The method of earthing the test circuit in figure 1 shall be stated in the test report.

A test at a prospective current of $250\ ^{+12.5}_{-0}$ A at rated voltage to earth ± 5 % and power factor 0.95 ± 0.05 shall be applied to each switched pole, excluding a switched neutral, three times at 1 min intervals. The portable rcd shall open each time.

At the conclusion of the test the fine wire fuse shall be intact.

8.10 Portable rcd performance

8.10.1 *General.* In test sequence 3 only, the portable rcd shall comply with the performance requirements of **8.10.2** and **8.10.3** in an ambient temperature of $-5\ ^{+0}_{-2}$ °C and $40\ ^{+2}_{-0}$ °C.

Prior to testing, the portable rcd shall be installed as in normal service but shall not be connected to its supply and shall be left for at least 4 h to normalize to the ambient temperature at which the tests are to be carried out.

8.10.2 *Sensitivity.* With the switch contacts held closed by the mechanism, the rated tripping current shall be switched on to each pole in turn. In each case the portable rcd shall open within 0.2 s. The test shall be carried out with the source voltage equal to $0.70\ ^{+0}_{-2}$ % times its rated value and with the source voltage equal to $1.1\ ^{+2}_{-0}$ % times its rated value.

For a portable rcd not fitted with a quick make mechanism, the test shall be repeated with the contacts of the circuit-breaker just touching.

8.10.3 *Speed of operation.* Five times the rated tripping current shall be applied to each pole in turn. In each case the portable rcd shall open within 0.04 s.

8.10.4 *Tripping current.* With the device fully closed, a test current shall be increased gradually through each pole in turn. The device shall operate at a value above 50 % but not exceeding 100 % of the rated tripping current, but shall not operate at any value up to and including 50 % of the rated tripping current.

8.11 Mechanical strength

8.11.1 *General.* The portable rcd shall be tested in a tumbling barrel as shown in figure 2, falling 500 mm on to a plywood base 10 mm thick. The barrel is turned at a rate of 5 r/min, 10 falls per minute thus taking place.

A cord 100 mm in length shall be attached to the portable rcd, except in the case of an adaptor. For an in-line device each of the cords shall be 100 mm long.

The smallest width of the test barrel (see figure 2) shall be at least 10% greater than the longest dimension of the device under test including both input and output cords.

The portable rcd shall be tested individually, with the number of falls being 200.

After the test the portable rcd shall show no external damage which might affect the safety and no components shall have become detached. The earthing pin terminal screw, if any, shall remain tight to a torque not less than 80 % of the original tightening torque and internal current-carrying joints shall not have become loose and shall make satisfactory contact.

The device shall be capable of fitting into a socket-outlet complying with the appropriate standard or accepting a plug of the appropriate standard. The device shall be capable of carrying rated current, at rated voltage, when mounted as in normal use for at least 1 h, after which the device shall trip on actuation of the test button. The device shall then be left for 15 ± 2 min, after which it shall be capable of being switched on and carrying rated current at rated voltage.

Damage to the finish, small dents that do not reduce creepage clearances and distances to below the values specified in **7.12** and small chips that do not adversely affect the protection against electric shock or moisture shall be ignored. Cracks not visible with normal or corrected vision without additional magnification and surface cracks in fibre-reinforced mouldings and the like shall be ignored.

NOTE. A vibration test is under consideration and this may be appropriate for checking compliance with **7.6.4** in the future.

8.11.2 *Inadvertent closure (bump test).* The portable rcd shall be subjected to 10 drops from a height of 75 mm in its most unfavourable plane on to a 19 mm block board complying with BS 3444* resting on a concrete surface. The test shall be applied with the contacts open.

NOTE. The contacts may just touch during the test, provided that they do not remain closed.

Care shall be taken to ensure that connecting leads have sufficient flexibility so as not to interfere with the test.

8.11.3 *Torque and force test on control devices.* The control devices, e.g. knobs, handles, etc., shall be subjected for 1 min to a torque corresponding to a force of 25 N applied at the periphery, but not more than 1 N·m, and to an axial pull of 25 N for 1 min.

The control device shall not be damaged.

*Obsolescent.

8.12 Endurance

The portable rcd shall be tested for endurance as follows in accordance with the test sequence of table 2 when connected as shown in figure 3:

(a) by being switched on and off by the manual operating mechanism, 1000 times where a means of switching off manually is provided;

(b) by being switched on manually and switched off by means of the test circuit, 500 times (where no means of switching off manually is provided, the number of operations shall be increased to 1500);

(c) by being switched on manually and switched off by establishing an out-of-balance current equal to twice the rated tripping current, 500 times.

For these tests the portable rcd shall be operated at 240 ± 30 cycles per hour. One cycle of operation shall consist of 2 ± 0.2 s on and 13 ± 1.3 s off.

For an interlocked portable rcd the closing operations in items (a), (b) and (c) shall be performed externally and off-load and the opening operation shall be performed by the application of an out-of-balance current (as in item (c)).

Table 2. Endurance test sequence

Type of operation	Number of cycles of operation
Manual	1000
Test circuit	500*
Out-of-balance	500

*1500 where no means of switching off manually is provided.

During the test each pole of the portable rcd shall carry rated current ± 5 % at rated voltage ± 5 % (power factor 0.75 ± 0.05 lagging).

8.13 Resistance to excessive residual stresses and to rusting

8.13.1 *General.* Compliance with **7.5.4** shall be verified as follows.

All grease is removed from the parts to be tested by immersion in trichloroethane or an equivalent degreasing agent for $10\ ^{+1}_{-0}$ min. The parts are then immersed for $10\ ^{+1}_{-0}$ 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, the parts are placed for $10\ ^{+1}_{-0}$ min in a box containing air with a relative humidity of 91 % to 95 % at a temperature of 20 ± 5 °C. After the parts have been dried for $10\ ^{+1}_{-0}$ min in a heating cabinet at a temperature of 100 ± 5 °C their surfaces shall show no signs of rust.

NOTE. Traces of rust on sharp edges and any yellowish film removable by rubbing should be ignored.

NOTE 2. For small helical springs and the like, and for the parts exposed to abrasion, a layer of grease may provide sufficient protection against rusting. Such parts are only subjected to the test if there is doubt about the effectiveness of the grease film and the test should then be made without previous removal of grease.

NOTE 3. Precautions should be taken when using trichloroethane.

8.13.2 *Excessive residual stress.* Compliance with **7.5.3** shall be verified as follows.

The sample is degreased in a suitable alkaline degreasing solution or organic solvent and then immersed in an aqueous solution of mercurous nitrate containing 10 g of $Hg_2(NO_3)_2$ and 10 mL of HNO_3 (relative density 1.42) per litre of solution for $30\ ^{+1}_{-0}$ min at a temperature of 20 ± 5 °C.

After the treatment the sample is washed in running water, any excess mercury is wiped off and the sample is immediately visually examined.

There shall be no cracks visible with normal or corrected vision without additional magnification.

NOTE. Precautions should be taken when using mercurous nitrate.

8.14 Resistance to humidity

A portable rcd adaptor is tested as supplied. A rewireable portable rcd is fitted with 1 m of appropriate size 3-core flexible cord to table 16 of BS 6500 : 1984. A non-rewireable portable rcd or an in-line portable rcd is tested with not less than 100 mm of the flexible cord(s) with which it is supplied.

To suit the ambient conditions at the time of test, a convenient temperature (T in °C) between 20 °C and 30 °C is chosen as a reference temperature. The sample is brought to a temperature of between T °C and $T + 4$ °C and is then placed in a humidity cabinet containing air with a relative humidity maintained between 91 % and 95 %. The temperature of the air at all positions within the cabinet where samples can be placed shall be kept within 1 °C of T.

The sample shall be kept in the cabinet for 48 h.

After the conditioning period of 48 h the sample shall be removed from the cabinet and allowed to stabilize to between 20 °C and 25 °C for 30 min, then the tests described in **8.3** and **8.8** shall be carried out at a relative humidity of between 45 % and 75 %.

NOTE 1. The sample should be kept at the test temperature for at least 4 h before the humidity treatment.

NOTE 2. A relative humidity of between 91 % and 95 % can be obtained by placing in the humidity cabinet a saturated solution of potassium nitrate (KNO_3) or sodium sulphate (Na_2SO_4) 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 that is thermally insulated.

8.15 Condition of the portable rcd after test

8.15.1 The portable rcd shall be capable, without maintenance, of withstanding a voltage equal to twice its rated voltage applied for 1 s as follows. The test voltage shall not be applied between terminals of poles where electronic circuits are connected.

(a) Between all incoming terminals of poles in turn with the device open followed by a second test between all outgoing terminals of poles in turn excluding the earth terminal.

NOTE. It is permissible for the portable rcd to close during this latter test.

(b) Between all incoming terminals of switched poles and the corresponding outgoing terminals of switched poles in turn with the contacts open.

(c) Between the terminals of all main poles connected together, excluding the earth terminal, and any earthed metal.

8.15.2 It shall be demonstrated immediately after the test that the portable rcd will close and open satisfactorily during a no-load close/open operation.

8.15.3 The contacts shall be in a suitable condition to carry the rated current. A temperature rise test in accordance with **8.4** shall be carried out at rated current on the same portable rcd. The measured temperature rises shall not exceed the temperature rises permitted in the relevant standard appropriate to the plug and socket portion nor result in visible distortion or discoloration.

8.16 Circuit fault current

The portable rcd shall be connected as shown in figure 4. The line pole(s) of the portable rcd shall be connected in series with a silver wire fuse 85 mm in length having a silver content of not less than 99.9 % and a diameter of 0.33 mm. Where a portable rcd is fitted with integral overcurrent protection (see **2.1.18**), it shall be tested as supplied without the external silver wire fuse being fitted.

Any part of the portable rcd intended to be earthed and any accessible metal parts which may become live in the event of failure of the insulation shall be connected to earth via a fine wire fuse. This fuse (for indicating earth faults) shall be copper wire of 0.1 mm diameter and not less than 50 mm long. If necessary, a resistor (see figure 4) shall be connected between the fuse and the neutral point of the supply to limit the value of the earth fault current to about 100 A. The positioning of the sample for test shall be stated in the test report.

The method of earthing the test circuit shall be stated in the test report.

A test at a prospective current of 1500 A r.m.s. +5,-0 % at rated voltage ± 5 % on open circuit (power factor 0.95 ± 0.05) shall be applied to, the combination of silver wire fuse and portable rcd.

The following test sequence shall be performed:

0 - t - CO

with the 0 test being performed with the initiation of short-circuit current at a voltage of zero ± 10 °

where

0 represents a breaking of the circuit following the short-circuit initiation by the making switch (figure 4);

t represents a time interval of 3 min or the inherent resetting time of any integral overcurrent protection;

CO represents a making operation of the portable rcd followed by the breaking of the circuit.

For an interlocked portable rcd, only two 0 tests shall be carried out.

For tests on portable rcd's not fitted with integral overcurrent protection the silver wire fuse in series with each switched pole shall be renewed in the 3 min interval between the breaking and/or making operations. In any event the time interval shall be recorded.

The break may be effected by the operation of the fuse and/or by the automatic opening of the portable rcd. After arc extinction the recovery voltage shall be maintained for not less than 0.1 s.

During all circuit fault current tests cheesecloth shall be applied to the exterior of the portable rcd at all openings, handles, etc., care being taken not to block the vents.

The cheesecloth shall be clean and dry, bleached, plain cotton, approximately 30 g/m^2 to 40 g/m^2. When placed in position, the cheesecloth shall be folded loosely in such a manner that cut or torn edges will not be exposed directly to the arc or flash.

There shall be no ignition of the cheesecloth, which is considered to have occurred when a flame is visible. Smouldering shall not be considered to be evidence of ignition.

NOTE. The cheesecloth may be changed during the series of tests.

At the conclusion of the test sequence the fine wire fuse shall be intact.

8.17 Stray conductor strand test of stranded conductor

A length of insulation, as stated in the manufacturer's wiring instructions, is removed from the end of an appropriate flexible conductor. 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 barriers unless a bend is produced by the replacement of the cover.

The free wire of a conductor connected to a live terminal shall not touch any metal part so as to bypass the fuse link, or any metal part which is accessible or is connected to an accessible metal part, or reduce creepage distances and clearances to accessible surfaces to less than 1.3 mm. The free wire of a conductor connected to an earthing terminal shall not touch any live parts.

8.18 Screwed connections

The screw is tightened and loosened as follows:

(a) 10 times for screws in engagement with a thread of insulating material, the screw being completely removed and replaced each time;

(b) 5 times for nuts and screws not in engagement with a thread of insulating material.

When testing terminal screws and nuts, a 1.5 mm^2 flexible conductor is placed in the terminal in the case of portable socket-outlets and plugs. The conductor is moved each time the screw is loosened.

The test is made by means of a suitable test screwdriver, applying a torque as given in table 3.

During the test no damage impairing the further use of the screwed connection shall occur.

NOTE. It is essential that the shape of the blade of the test screwdriver suits the head of the screw being tested and that the screw is not tightened in jerks.

8.19 Flexing test for flexible cords

The portable rcd shall be checked using an apparatus as shown in figure 5. The rcd plug, portable rcd socket-outlet or each cord in turn of an in-line portable rcd, is fixed to the oscillating members of the apparatus so that when this is vertical the axis of the flexible cord at the point of entry is vertical and passes through the axis of oscillation.

Samples with flat flexible cords are mounted so that the major axis of the section is parallel to the axis of oscillation.

The flexible cord is loaded with a weight such that the force applied is 10 N for cords of 0.5 mm^2 and 0.75 mm^2 and 20 N for cords of 1.0 mm^2 up to and including 1.5 mm^2.

The distance between the point of entry to the rcd plug or portable rcd socket-outlet and the axis of oscillation is adjusted so that the weight makes the minimum lateral movement as the oscillating member moves. The maximum rated current stated by the manufacturer is passed through the line and neutral conductors, the voltage between them being approximately 250 V a.c. If an earthing conductor is incorporated in the flexible cord it shall be connected to the supply earth.

The oscillating member is moved backwards and forwards through an angle of 90 °, 45 ° on either side of the vertical, the number of flexings being 10 000 at a rate of 60/min. After 5000 flexings, accessories with cords of circular section are turned through 90 ° about the cord entry centreline.

NOTE. A flexing is one movement through 90 °, either backwards or forwards.

During the test there shall be no interruptions of the current passing through the conductors and no short circuit between them. Also the portable rcd shall not trip.

After the test the sample shall show no damage except that breakage of no more than 10 % of the total number of conductor strands in any core is ignored, provided they have not pierced the insulation.

8.20 Accessibility of live parts

The portable rcd shall be checked for compliance by the tests in the appropriate standard for the plug and socket configuration.

8.21 Distance through insulation

The distance shall be checked by measurement and inspection and for portable rcds that have a minimum distance through insulation less than 2 mm by the following test.

Table 3. Torque values for screws and nuts

Nominal (outside) diameter of thread	Torque		
	For metal screws as described below*	For other metal screws	For screws of insulating material
mm	N·m	N·m	N·m
Up to and including 2.8	0.2	0.4	0.4
Over 2.8 up to and including 3.0	0.25	0.5	0.5
Over 3.0 up to and including 3.2	0.3	0.6	0.6
Over 3.2 up to and including 3.6	0.4	0.8	0.6
Over 3.6 up to and including 4.1	0.7	1.2	0.6
Over 4.1 up to and including 4.7	0.8	1.8	0.9
Over 4.7 up to and including 5.3	0.8	2.0	1.0
Over 5.3 up to and including 6	—	2.5	1.25

*This column applies to metal screws without heads if the screw when tightened does not protrude from the hole, and to other metal screws which cannot be tightened by means of a screwdriver with a blade wider than the diameter of the screw.

The portable rcd is wired, mounted as for the test of **8.4** and subjected to the current for 2 h. Immediately at the conclusion of this test and while the portable rcd is still hot, test finger III of BS 3042 : 1971 is applied to the external surface of the device with a force of 30 N. This shall not cause any distance through air to reduce below 2 mm as defined in **7.12.3**.

8.22 Effective earthing

A current of 25 A, derived from an a.c. source having a no-load voltage not exceeding 12 V, shall be passed between the earthing point and all other earthed metal parts in turn for 1 min.

The voltage drop between the earthing point and the accessible metal part shall be measured and the resistance calculated from the current and the voltage drop.

In no case shall the resistance exceed 0.05 Ω, the resistance of any cable or cord being neglected.

NOTE. Care should be taken to ensure that the contact resistance between the tip of the measuring probe and the metal part under test does not influence the test results.

8.23 Loss of supply neutral

A portable rcd shall be mounted as in normal use via a socket-outlet with a switch inserted in the neutral supply to the socket-outlet. With the supply 'ON' and the portable rcd contacts closed, the neutral supply shall be switched 'OFF'.

The portable rcd shall either trip immediately or trip when a current equal to rated residual current flows in the line conductor.

8.24 Verification of construction

Compliance with **5.1** to **5.8**, **7.1.4**, **7.5.2**, **7.6.3**, **7.6.6**, **7.7.1**, **7.7.2**, **7.7.3**, **7.7.5**, **7.8**, **7.9.2**, **7.9.3**, **7.9.5** and **7.12.2** shall be checked by inspection and if applicable by measurement.

8.25 Verification of creepage and clearance distances

Compliance with **7.12.1** shall be checked by inspection and measurement with any movable parts being placed in the most unfavourable position. The method of measurement shall be as given in appendix C.

Nuts and screws with non-circular heads shall have been tightened in the most unfavourable position.

Clearances shall be measured with the maximum size of conductor fitted.

8.26 Resistance to heat

8.26.1 The portable rcd is kept for 1 h in a heating cabinet maintained at 70 ± 2 °C.

During the test the portable rcd shall not undergo any change impairing its further use, and sealing compound shall not flow to such an extent that live parts are exposed. A slight displacement of the sealing compound shall be disregarded.

8.26.2 External parts of resilient material (e.g. thermoplastics, rubber, etc.) are subjected to a pressure test by means of the apparatus similar to that shown in figure 6, the test being made in a heating cabinet at 70 ± 2 °C.

The apparatus comprises two steel jaws, having a cylindrical face of 25 mm radius, a width of 15 mm and a length of 50 mm.

The corners of the jaws are rounded with a radius of 2.5 mm.

The portable rcd is clamped between the jaws in such a way that they press against it in the area where it is gripped in normal use, the centreline of the jaws coinciding as much as possible with the centre of this area.

The force applied through the jaws is 20 N.

After 1 h, the jaws are removed and the portable rcd shall satisfy any gauging or dimensional requirements affecting safety or interchangeability as given in the appropriate standard for the plug/socket configuration.

8.26.3 Test details for parts of the portable rcd are as follows:

(a) parts of ceramic material shall be deemed to comply without testing;

(b) external parts of the portable rcd that are tested in accordance with **8.26.2** shall be deemed to comply without further testing;

(c) all other parts of insulating material shall be subjected to the ball pressure test using the apparatus shown in figure 7.

The test is made in a heating cabinet maintained at 75 ± 2 °C.

The surface of the part to be tested is placed in the horizontal position and a steel ball of 5 mm diameter is pressed against this surface by a force of 20 N.

The underside of the part being tested is supported to withstand the test force and to minimize the risk of distortion. The test load and the supporting means are placed in the heating cabinet for a sufficient time to ensure that they have attained the stabilized testing temperature before the test commences.

The part to be tested is placed in the heating cabinet for 10 min before the test load is applied. After 1 h, the ball is removed from the sample, which is then cooled down by immersion for at least 10 s in water at approximately room temperature. The diameter of the impression caused by the ball is measured and shall not exceed 2 mm.

8.27 Resistance to abnormal heat, fire and tracking

8.27.1 *Glow-wire test*

8.27.1.1 *General.* The glow-wire test is applied to ensure that an electrically heated test wire under defined test conditions does not cause ignition of external insulating parts and/or to ensure that a part of any external 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.

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

NOTE. These tests should not be carried out on small parts unlikely to be subjected to abnormal heat and whose failure to pass these tests would not materially affect the safety of the portable rcd.

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

The test specimen is conditioned for 24 h at a temperature in the range 15 °C to 35 °C and 45 % r.h. to 75 % r.h.

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

8.27.1.3 *Test apparatus*

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

NOTE. An example of the test apparatus is shown in figure 9.

8.27.1.3.2 *Glow wire,* consisting of a specified loop of 80/20 Ni/Cr wire (see figure 8). When forming the loop it is essential that care is taken to avoid fine cracking of the tip.

The glow wire is electrically heated; the current necessary for heating the tip to a temperature of 960 °C shall be between 120 A and 150 A.

8.27.1.3.3 *Sheathed fine wire thermocouple,* for temperature measurement, having an outside diameter of 0.5 mm. The wires consist of nickel-chromium and nickel-aluminium, the welding being located inside the sheath.

The sheath consists of a refractory metal, resistant to a temperature of at least 960 °C. The thermocouple is arranged in a 0.6 mm diameter pocket hole drilled in the tip of the glow wire as shown in section A-A of figure 8.

The thermo-voltages shall be as given in BS 4937 : Part 4, the characteristics being substantially linear. The cold connection is kept in melting ice or in a compensation box.

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

8.27.1.4 *Procedure.* The test apparatus is placed in a draught-free room in subdued light so that any flame is visible.

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

Allowance is made for the fact that the thermocouple is able to compensate by an axial movement for thermal elongation of the glow wire.

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

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

NOTE 1. Wrapping tissue as defined in 6.86 of BS 3203 : 1979 may be used, i.e. a soft and strong light-weight wrapping paper of grammage (basic weight) generally between 12 g/m^2 and 30 g/m^2. It is primarily intended for protective packaging of delicate articles and for gift wrapping.

The glow wire is electrically heated to the appropriate test temperature (as given in table 4) which is measured with the calibrated thermocouple. It is essential that care is taken to ensure that this temperature and the heating current are constant for 60 s before starting the test and that no heat radiation influences the specimen during this period.

The tip of the glow wire is brought in contact with the specimen and applied for 30 ± 1 s, the heating current being maintained during this period.

The movement of the tip of the glow wire through the test sample to which it is pressed shall be limited to 7 mm. If possible, the tip of the glow wire is applied to flat surfaces and not to grooves, knock-outs, narrow recesses or sharp edges. The tip of the glow wire is applied where the section is thinnest but not less than 15 mm from the upper edge of the specimen.

After 30 ± 1 s the glow wire is removed from the specimen, any movement of air whigh might affect the results of the test and any further heating of the specimen being avoided.

NOTE 2. It is necessary to clean the tip of residue of insulating material after each test, e.g. by means of a brush.

8.27.1.5 *Measurement and observations.* During the application time of the glow wire and during a period of 30 s from the end of the application time the specimen and the surrounding parts, including the layer under the specimen, are observed.

The time when ignition of the specimen and/or the time when flames extinguish during or after the application time are measured and recorded.

8.27.1.6 *Evaluation of the test results.* The specimen is regarded as having passed the glow-wire test if there is no visible flame and no sustained glowing, or if flames and glowing at the specimen extinguish within 30 s after the removal of the glow wire. There shall be no burning of the wrapping tissue or scorching of the board.

8.27.1.7 *Application of glow-wire test.* The glow-wire test shall be applied to parts made of insulating material at the test temperatures given in table 4.

Table 4. Application of glow-wire test

Part	Temperature of glow wire
	°C
Parts necessary to retain live parts in position	750 ± 10
Parts not necessary to retain live parts in position (although they may be in contact with live parts)	650 ± 10

8.27.2 *Tracking test.* A flat surface of the part to be tested, if possible at least 15 mm x 15 mm in size, is placed in a horizontal position. Two electrodes of platinum with dimensions shown in figure 10 are placed on the surface of the sample as shown in the figure, so that the rounded edges are in contact with the specimen over the whole length. The force exerted on the surface of each electrode is 1 ± 0.05 N.

The electrodes are connected to a 50 Hz supply of substantially sinusoidal waveform with a no-load voltage of 175 V. The short-circuit current is adjusted by means of a variable resistor to 1 ± 0.1 A with $\cos \phi = 0.95 \pm 0.05$.

An overcurrent relay which will trip when 0.5 A or more has persisted for 2 s is included in the circuit.

The surface of the sample is wetted by allowing drops of a solution of ammonium chloride in distilled water to fall centrally between the electrodes. The solution shall have a resistivity of 395 ± 5 Ω·cm at 23 ± 1 °C corresponding to a concentration of 0.1 %. The drops shall have a volume of $20 \, ^{+3}_{-0}$ mm^3 and shall fall a distance of 35 ± 5 mm.

The time interval between one drop and the next shall be 30 ± 5 s.

No flashover or breakdown between the electrodes shall occur before 50 drops have fallen.

The test shall be made at three places on the sample.

In case of doubt the test is repeated on a new sample.

NOTE. It is essential that care is taken to ensure that the electrodes are clean, correctly shaped and correctly positioned before each test is started.

8.28 Compliance with other standards

The portable rcd shall be tested for compliance with the appropriate requirements of the appropriate British Standard for the plugs/socket-outlets with which the socket-outlet portions and plug pins of the rcd are intended to engage (see appendix A).

8.29 Test circuit operation

8.29.1 To check compliance with **7.3** the portable rcd shall be tested as follows.

The portable rcd shall be tested in the following dispositions to verify correct operation under possible conditions of use (see figure 11). During these tests no failures shall be permitted.

For convenience the portable rcd under test shall be mounted centrally on a board of 10 mm plywood, 500 mm square, or shall be plugged into a socket mounted centrally on such a board.

With the board held in a vertical plane, the portable rcd shall be switched on to a supply at 0.85 rated voltage ± 5 % and the test circuit shall be operated. The portable rcd shall open.

The board shall then be rotated clockwise through an angle of 90 ° about an axis perpendicular to the plane of the board and the test shall be repeated.

The board shall then be similarly rotated through angles of 90 ° and the portable rcd shall be tested two more times.

On completion of this series of four tests, the board shall be held in the horizontal plane and the tests shall be repeated.

Finally, the board shall be rotated 180 ° clockwise about an axis in the plane of the board and the tests shall be repeated.

8.29.2 The test device ampere-turns shall be determined by either measurement or calculation and shall not exceed the value specified in **7.3**. During the measurement the tripping mechanism may be rendered inoperative.

8.30 Reverse polarity

8.30.1 The tests shall be carried out when connection is made via a socket-outlet with the L and N connections interchanged and the earth connection made to the supply earth.

With a supply connected to the socket-outlet the portable rcd shall be connected to the socket-outlet either by being plugged in or for a portable rcd socket-outlet connected via a plug which shall be correctly wired. A portable rcd shall comply with the requirements of either **8.10.2** or **8.30.2**.

8.30.2 The test shall be carried out at rated voltage and rated frequency and repeated at 0.7 and 1.1 times rated voltage. If the portable rcd has a range of rated voltage and a range of rated frequency then the test shall be carried out at 0.7 and 1.1 times the lower and upper limits of the voltage range and at the limits of the frequency range.

It shall not be possible for the main contact(s) of the portable rcd to be held closed for more than 0.2 s. If a reverse polarity indicator is fitted it shall continuously indicate a 'supply fault'.

8.31 Reliability of contact position indicator

With the portable rcd contacts in the closed position, each contact is held closed in turn by special means. Under this condition it shall not be possible to operate the portable rcd by means of the test circuit, or by applying an out-of-balance current, or by applying a force not exceeding 5 N to any manual operating means so as to indicate an 'OFF' position.

9 Routine tests

9.1 General

Each portable rcd in a clean new condition shall withstand the following tests, which can be carried out in any order.

9.2 High voltage

The portable rcd shall withstand the test voltage given in table 1, this being applied for between 1 s and 2 s as follows:

(a) between the incoming line and neutral terminals of poles with the portable rcd open;

(b) between the incoming line and outgoing line terminals of poles with the portable rcd open;

(c) between the incoming neutral and outgoing neutral terminals of poles with the portable rcd open.

The test voltage shall not be applied between terminals of poles where electronic circuits are connected.

Where terminals are not directly accessible, these tests shall be made using accessible parts that are known to be connected to the terminals, e.g. pins or socket-outlet contacts.

A voltage of substantially sinusoidal waveform at the rated frequency of the device is applied. The high voltage source used shall be such that when the output is adjusted to 2000 ± 60 V for 1 min and is then short-circuited, the output current is less than 10 mA.

During the test, no flashover or breakdown shall occur. Glow discharges without drop in voltage shall be disregarded.

9.3 Tripping current test no. 1

Five times the rated tripping current shall be applied to each pole of the portable rcd in turn. In each case the portable rcd contacts shall open within 0.04 s.

9.4 Tripping current test no. 2

With the device fully closed, a test current shall be increased gradually through each pole in turn. The device shall operate at a value above 50 % but not exceeding 100 % of the rated tripping current but shall not operate at any value up to and including 50 % of the rated tripping current.

9.5 Test circuit check test

The portable rcd shall be mounted as in normal use and shall be switched on to a supply at 0.85 times rated voltage ± 5 % and the test device shall be operated. The portable rcd shall open.

9.6 Reverse polarity test

9.6.1 Portable rcd's shall be tested in accordance with **9.6.2** or **9.6.3** as nominated by the manufacturer.

The tests shall be carried out at 0.7 times rated voltage ± 5 % and at rated frequency. If the portable rcd has a range of rated voltages and a range of rated frequencies, the test shall be carried out at 0.7 times the lower limit of the voltage range and at the lower limit of the frequency range.

9.6.2 When a portable rcd is connected to a supply with the line and neutral reversed it shall not be possible for the device to remain closed for more than 0.2 s. If a reverse polarity indicator is fitted it shall continuously indicate a 'supply fault'.

9.6.3 With the switch contacts closed the rated tripping current shall be switched on to each pole in turn. In each case the portable rcd shall open within 0.2 s.

9.7 Continuity test

Each non-rewireable rcd plug and portable rcd socket-outlet shall be checked for continuity and polarity. The earth circuit of non-rewireable rcd plugs and portable rcd socket-outlets fitted with 3-core flexible cords shall be checked for continuity at a current of 25 A. The upper limit of resistance shall not exceed the calculated resistance of the test fixture and the earth conductor, plug 0.05 Ω.

9.8 Stray wire test

Each non-rewireable rcd plug shall withstand a high voltage test, at the rated frequency of the device, applied between all current-carrying parts connected together and a conducting electrode in contact with the entire outer accessible surface, omitting the engagement face. This test shall be carried out at 6 kV for a period of between 3 s and 5 s.

During the test, no flashover or breakdown shall occur. Glow discharges without drop in voltage shall be disregarded.

Appendices

Appendix A. Relevant requirements and tests of standards for compatible plugs, adaptors and socket-outlets

A.1 General

The tests for compliance with the requirements are carried out in the order in which the requirements are given, unless stated otherwise.

A.2 Requirements and tests for an rcd plug compatible with a BS 1363 socket-outlet

A.2.1 The reference in **8.4** of this standard relates to clause **16** of BS 1363 : 1984.

A.2.2 The reference in **8.5** of this standard relates to **19.1**, **19.2** and **19.3** of BS 1363 : 1984.

A.2.3 The reference in **8.20** of this standard relates to **9.2** to **9.5** of BS 1363 : 1984. In **9.4** of BS 1363 : 1984 the reference to clause **8** of BS 1363 : 1984 is replaced by a reference to **7.12** of this standard.

A.2.4 The reference in **8.26.2** of this standard relates to **12.1** and **12.3** of BS 1363 : 1984.

A.2.5 The reference in **8.28** of this standard relates to **7.1**(e) and (g), **12.1**, **12.2**, **12.3**, **12.4**, **12.5**, which apply to both rewireable and non-rewireable rcd plugs, **12.8**, **12.12**, **12.13**, **12.15**, **12.16** and **12.17** of BS 1363 : 1984, and to **12.9** of BS 1363 : 1984 with tests carried out on a new set of samples.

Tests to **12.6** and **12.11** of BS 1363 : 1984 are required after tests to **8.11** in the sequence given in **8.2.8**. In **12.6** and **12.11** of BS 1363 : 1984, the reference to clause **20** of BS 1363 : 1984 is replaced by a reference to **8.11** of this standard, and the phrase 'the gauges shown in figure 5' is replaced by the phrase 'a socket-outlet complying with this standard'.

A.3 Requirements and tests for an rcd adaptor compatible with a BS 1363 socket-outlet

A.3.1 Adaptors complying with this standard can only have socket-outlet portions of the same system to that of the plug pin portion, i.e. BS 1363 (see **2.1.24** of this standard).

A.3.2 The reference in **8.4** of this standard relates to clause **16** of BS 1363 : Part 3 : 1989 after inserting in table 4 the entry 'Accessible surface of adaptor 50 K'.

A.3.3 The reference in **8.21** of this standard relates to clause **9** of BS 1363 : Part 3 : 1989.

A.3.4 The reference in **8.26.2** of this standard relates to **12.1**, **12.4**, **13.1**, **13.2**, **13.3**, **13.7** (except that the test described in clause **18** is not carried out) and **13.9** of BS 1363 : Part 3 : 1989.

A.3.5 The reference in **8.28** of this standard relates to **7.1**(d), **12.1**, **12.2**, **12.4**, **12.5**, **12.11**, **12.12**, **12.13**, **13.1**, **13.2**, **13.3**, **13.5**, **13.6**, **13.8**, **13.9**, **13.10**, **13.11** and clause **17** of BS 1363 : Part 3 : 1989.

In **13.10** of BS 1363 : Part 3 : 1989 rcd adaptors with a single BS 1363 socket-outlet portion shall be fitted with a device simulating a plug and 1 m of 1.5 mm^2 3-core flexible cord. (See figure 18, Load 2.)

Also tests to clause **18** of BS 1363 : Part 3 : 1989 using the same new set of samples, and to **12.9** and **12.14** of BS 1363 : Part 3 : 1989, each on a separate set of samples, are required.

Tests to **12.10** of BS 1363 : Part 3 : 1989 are required after tests to **8.11** of this standard in the sequence given in **8.2.8** of this standard. In **12.10** of BS 1363 : Part 3 : 1989, the reference to **20.2.5** is replaced by a reference to **8.11** of this standard and the phrase 'the gauge shown in figure 3' is replaced by the phrase 'a socket-outlet complying with this standard'.

A.4 Requirements and tests for a portable rcd socket-outlet compatible with a BS 1363 plug

A.4.1 The reference in **8.4** of this standard relates to **13.13** of BS 1363 : 1984, except that the test to **13.4.2** is not carried out.

A.4.2 The reference in **8.5** of this standard relates to **19.1**, **19.2** and **19.3** of BS 1363 : 1984 in that order.

A.4.3 The reference in **8.20** of this standard relates to **9.1**, **9.3**, **9.6** and **9.4** of BS 1363 : 1984. In **9.4** of BS 1363 : 1984 the reference to clause **8** of BS 1363 : 1984 is replaced by a reference to **7.12** of this standard.

A.4.4 The reference in **8.26.2** of this standard relates to **13.1**, **13.2**, **13.3** and **13.7** of BS 1363 : 1984, except that in **13.7** of BS 1363 : 1984 the tests of **18.1.2** of BS 1363 : 1984 are not carried out.

A.4.5 The reference in **8.28** of this standard relates to **7.1**(e), **13.1**, **13.2**, **13.3**, **13.4** (except that the test of **13.4.2** is only carried out between the socket contact and a corresponding plug pin), **13.5**, **13.6**, **13.8**, **13.9** (with the reference to clause **8** of BS 1363 : 1984 being replaced by a reference to **7.12** of this standard), **13.10**, **13.12**, **13.14**, **13.18**, **13.20** and **17.1.2** of BS 1363 : 1984.

Also tests to clause **18** of BS 1363 : 1984 followed by **13.7** of BS 1363 : 1984, using the same new set of samples, are required.

Appendix B. Function of the test circuit

A test circuit is provided to enable the operation of the portable rcd to be checked. Operation of this device creates an out-of-balance condition simulating an earth fault.

Tripping the portable rcd by means of the test circuit establishes the following:

(a) the integrity of the electrical and mechanical elements of the tripping device;

(b) whether or not the portable rcd is operating at approximately the correct order of sensitivity.

It should be noted that the test circuit does not provide means of checking the following:

(1) the continuity of the earthing conductor and the circuit protective conductors;

(2) the earth electrode or other means of earthing;

(3) any other part of the earthing circuit.

Appendix C. Measurement of creepage distances and clearances

The methods of measuring creepage distances and clearances to be used in interpreting the requirements of 7.12.1 are indicated in cases 1 to 10 of this appendix.

These cases do not differentiate between gaps and grooves or between types of insulation.

The following assumptions are made.

(a) A groove may have parallel, converging or diverging sides.

(b) Any groove having diverging sides, a minimum width exceeding 0.25 mm, a depth exceeding 1.5 mm and a width at the bottom equal to, or greater than, 1 mm is regarded as an air gap (see case 8).

(c) Any corner including an angle less than 80 ° is assumed to be bridged with an insulating link of 1 mm width (0.25 mm for dirt-free situations) moved into the most unfavourable position (see case 3).

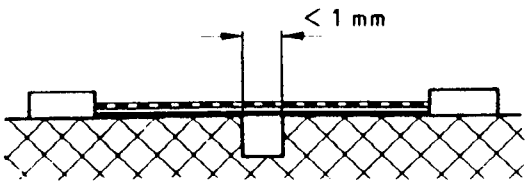
(d) Where the distance across the top of a groove is 1 mm (0.25 mm for dirt-free situations) or more, no creepage distance exists across the air space (see case 2).

(e) A creepage path is assumed not to exist if there is an air gap, as defined in item (b) above, exceeding 0.25 mm.

(f) Creepage distances and clearances measured between parts moving relative to each other are measured when these parts are in their most unfavourable stationary positions.

(g) A computed creepage distance is never less than a measured clearance.

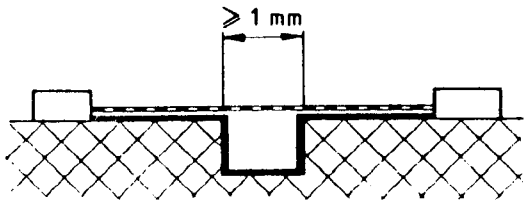
(h) Any air gap less than 1 mm wide (0.25 mm for dirt-free situations) is ignored in computing the total clearance.



Condition: Path under consideration includes a parallel or converging-sided groove of any depth with a width less than 1 mm.

Rule: Creepage distance and clearance are measured directly across the groove as shown.

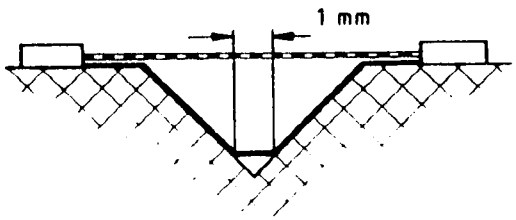
Case 1



Condition: Path under consideration includes a parallel-sided groove of any depth and equal to, or more than, 1 mm wide.

Rule: Clearance is the 'line of sight' distance. Creepage path follows the contour of the groove.

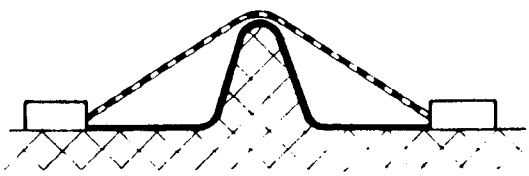
Case 2



Condition: Path under consideration includes a V-shaped groove with internal angle of less than 80 ° and with a width greater than 1 mm.

Rule: Clearance is the 'line of sight' distance. Creepage path follows the contour of the groove but 'short-circuits' the bottom of the groove by 1 mm (0.25 mm for dirt-free situations) link.

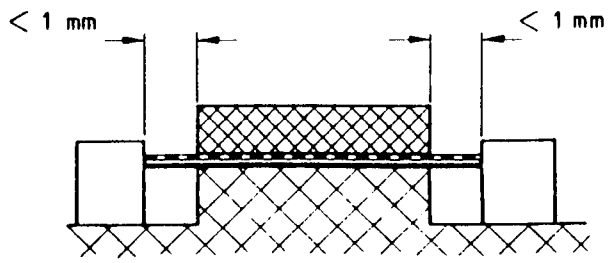
Case 3



Condition: Path under consideration includes a rib.

Rule: Clearance is the shortest direct air path over the top of the rib. Creepage path follows the contour of the rib.

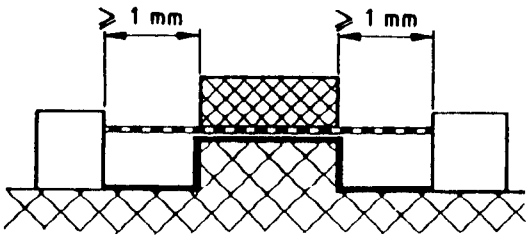
Case 4



Condition: Path under consideration includes an uncemented joint with grooves less than 1 mm (0.25 mm for dirt-free situations) wide on each side.

Rule: Creepage and clearance path is the 'line of sight' distance shown.

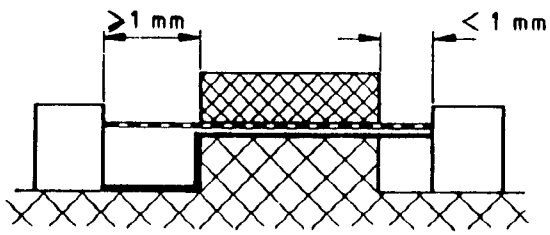
Case 5



Condition: Path under consideration includes an uncemented joint with grooves equal to, or more than, 1 mm wide on each side.

Rule: Clearance is the 'line of sight' distance. Creepage path follows the contour of the grooves.

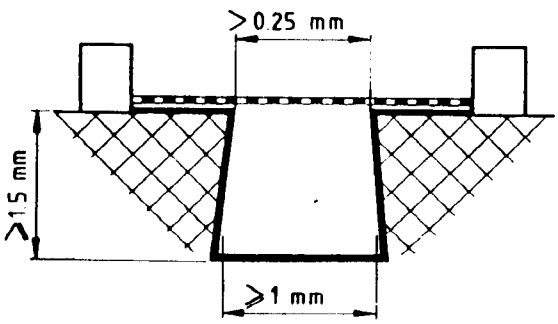
Case 6



Condition: Path under consideration includes an uncemented joint with a groove on one side less than 1 mm wide and the groove on the other side equal to, or more than, 1 mm wide.

Rule: Clearance and creepage paths are as shown.

Case 7

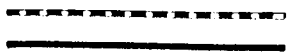


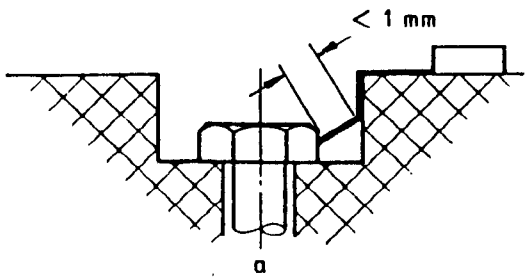
Condition: Path under consideration includes a diverging-sided groove equal to, or more than, 1.5 mm deep and more than 0.25 mm wide at the narrowest part and equal to, or more than, 1 mm at the bottom.

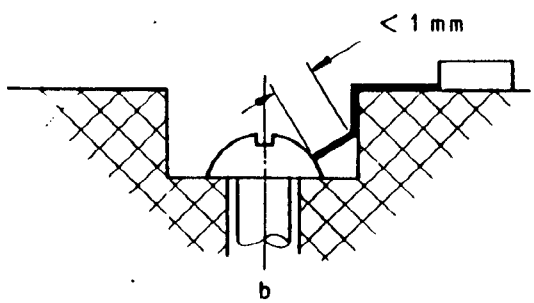
Rule: Clearance is the 'line of sight' distance. Creepage path follows the contour of the groove.

Case 3 applies as well to an internal corner if the angle is less than 80 °.

Case 8

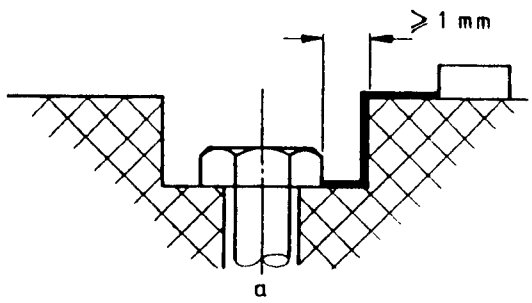


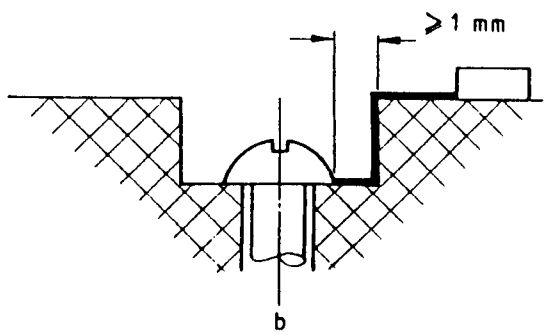




Gap between head of screw and wall of recess too narrow to be taken into account.

Case 9





Gap between head of screw and wall of recess wide enough to be taken into account.

Case 10

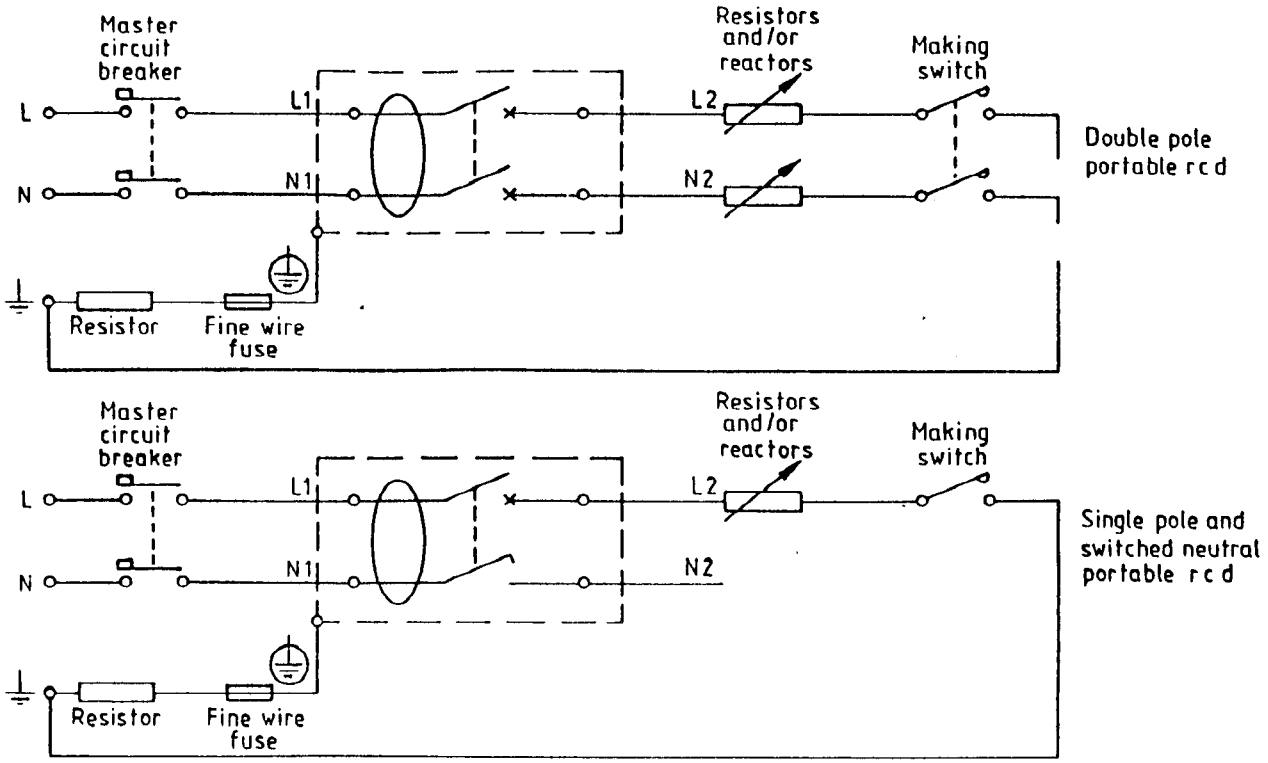
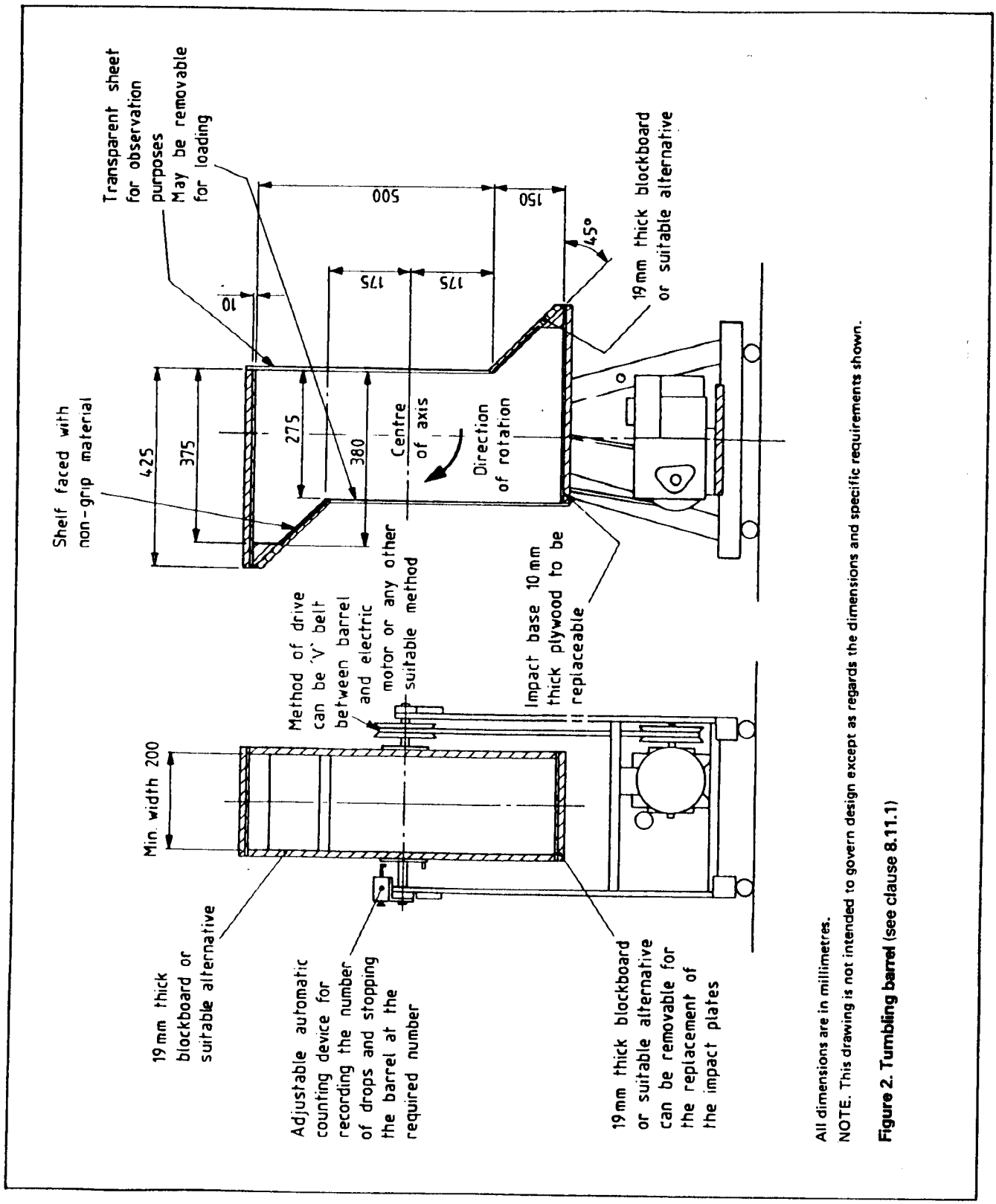


Figure 1. Test circuit for earth fault breaking current test (see 8.9)



All dimensions are in millimetres.

NOTE. This drawing is not intended to govern design except as regards the dimensions and specific requirements shown.

Figure 2. Tumbling barrel (see clause 8.11.1)

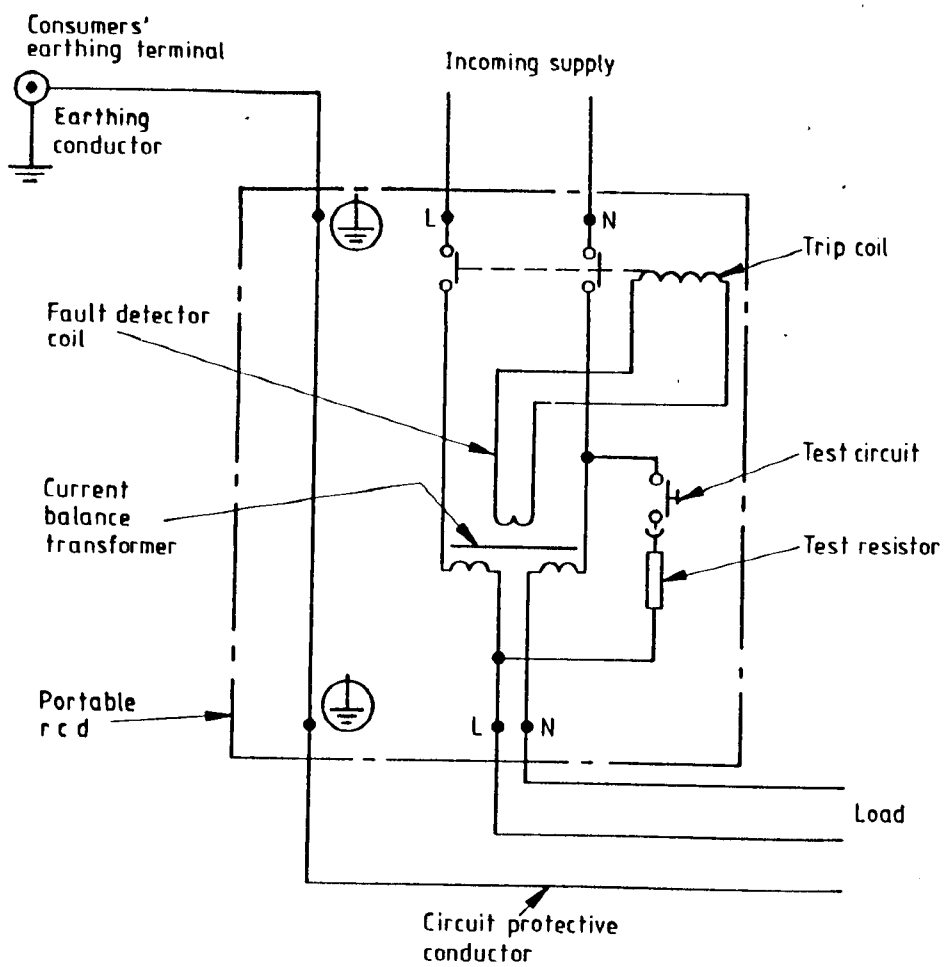


Figure 3. Typical circuit diagram for a portable rcd

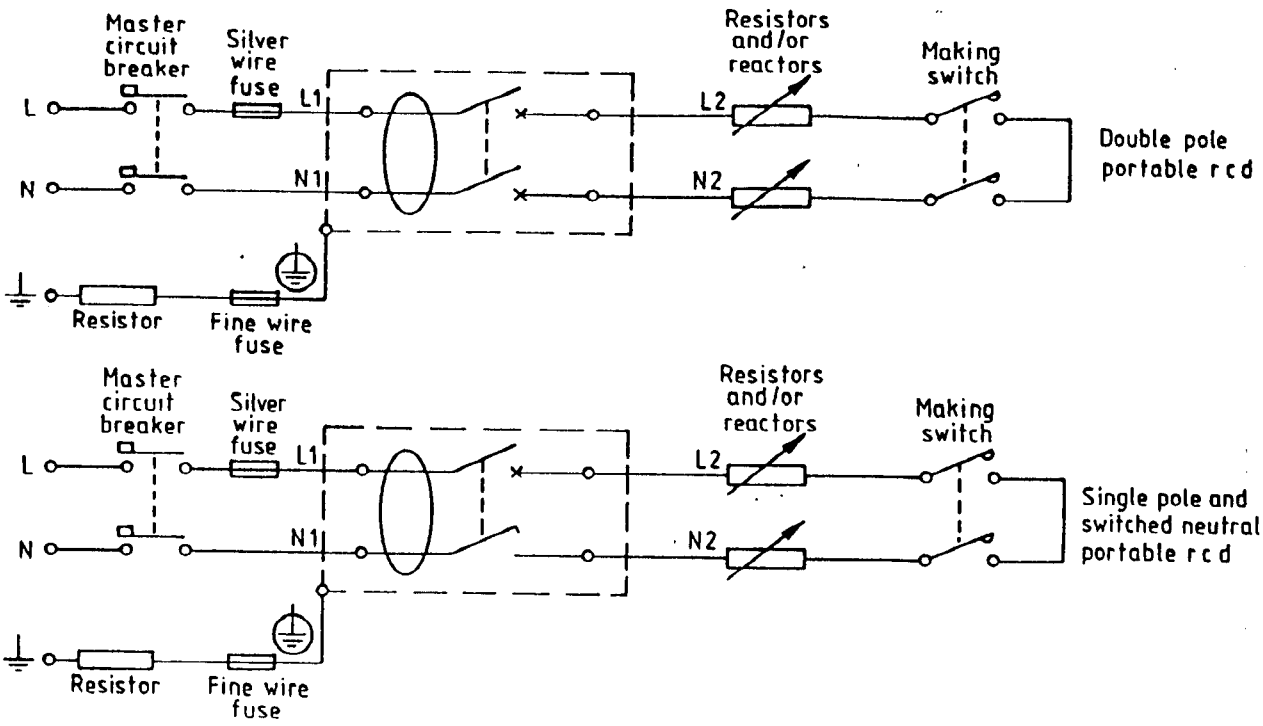
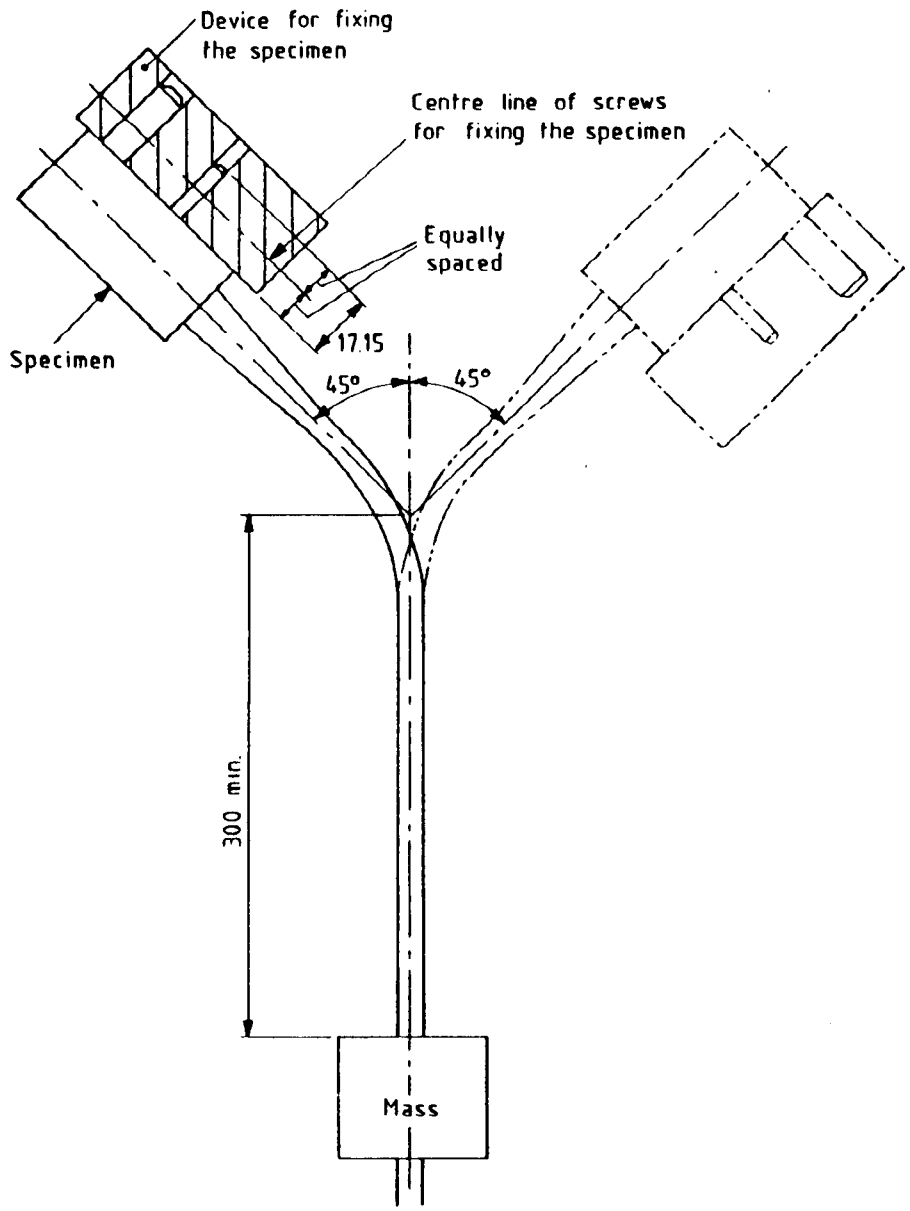


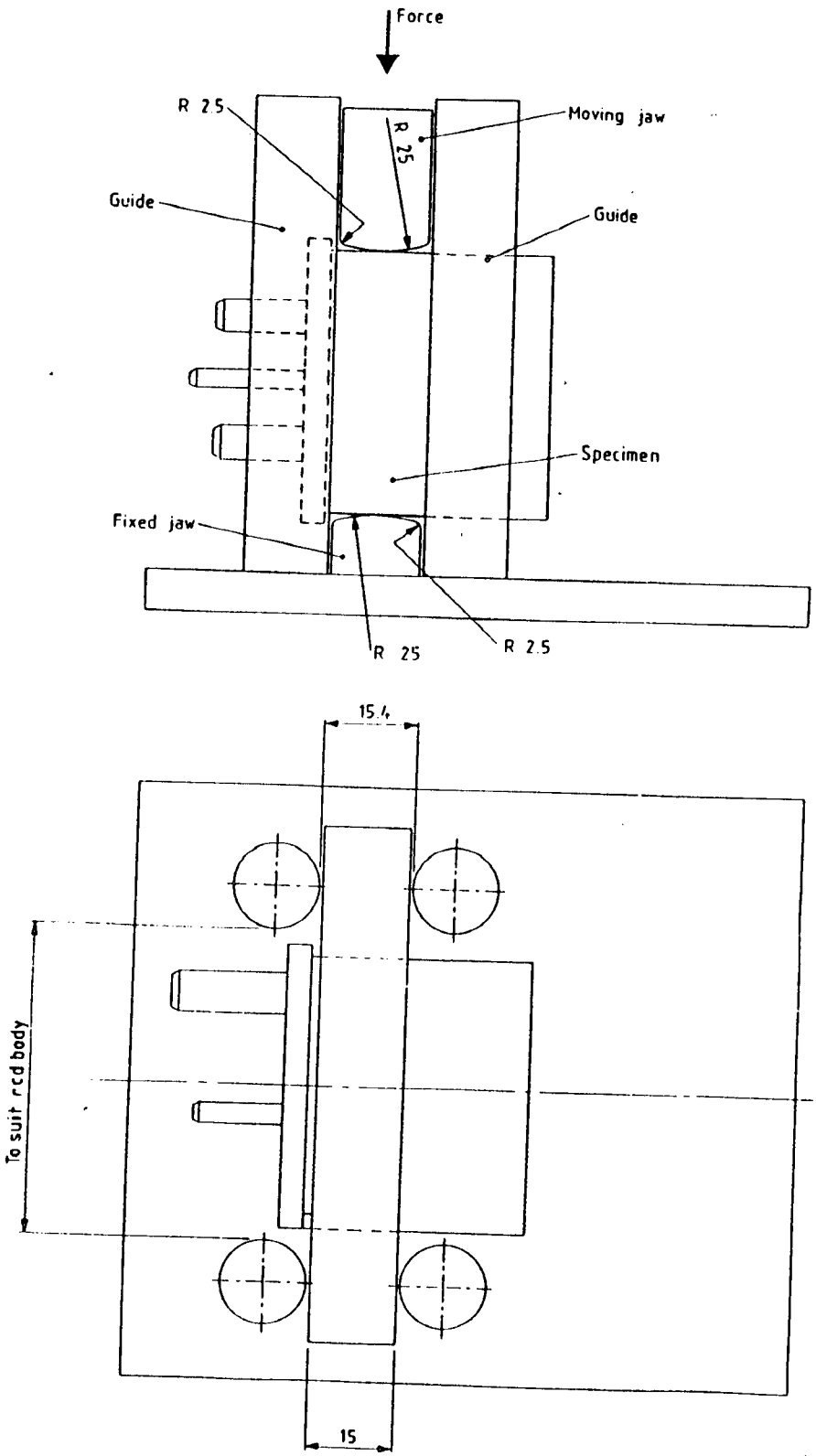
Figure 4. Test circuit for circuit fault current test (see 8.16)



Dimensions are in millimetres.

NOTE. This drawing is not intended to govern design except as regards the dimensions and specific requirements shown.

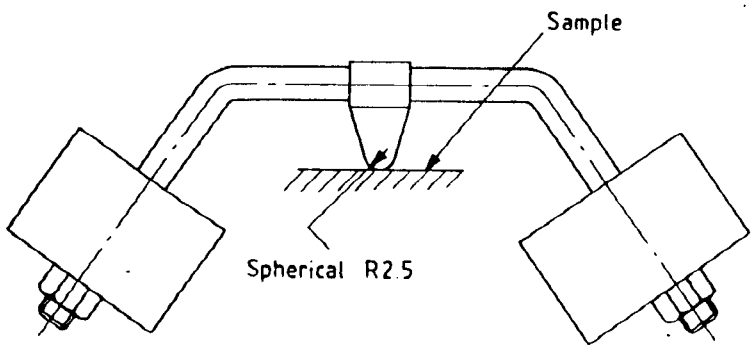
Figure 5. Apparatus for flexing test



All dimensions are in millimetres.

NOTE. This drawing is not intended to govern design except as regards the dimensions and specific requirements shown.

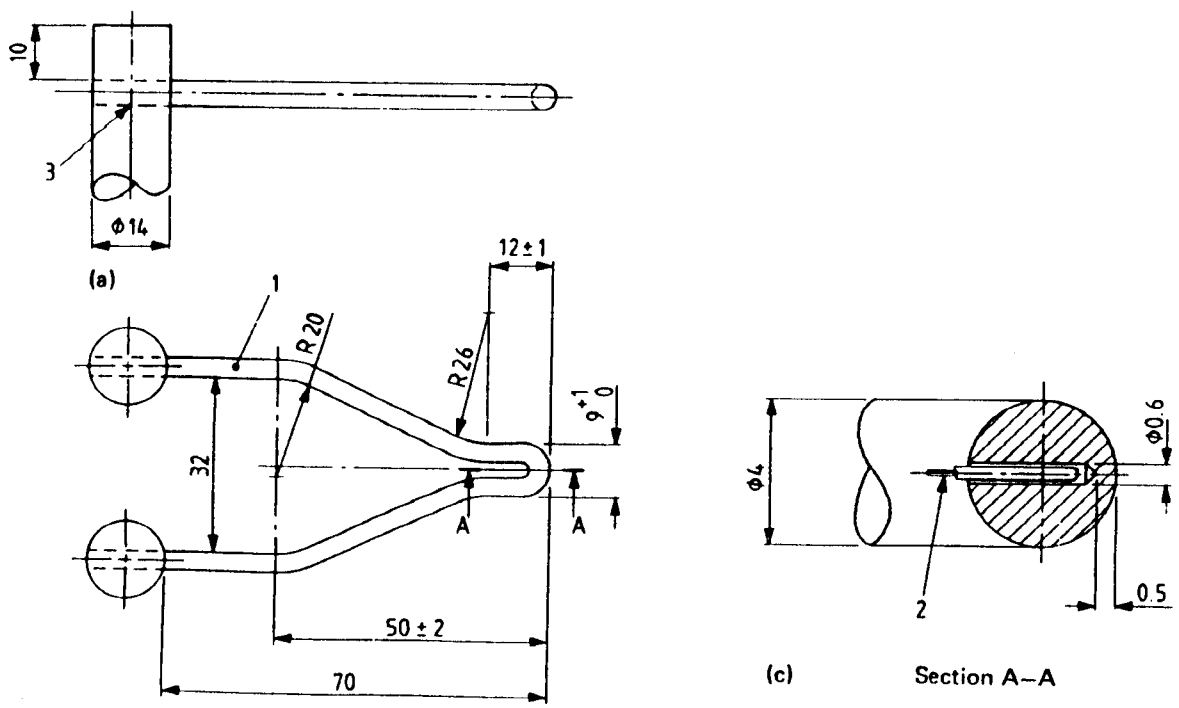
Figure 6. Apparatus for pressure test



The dimension is in millimetres.

NOTE. This drawing is not intended to govern design except as regards the dimension and specific requirements shown.

Figure 7. Ball pressure test apparatus

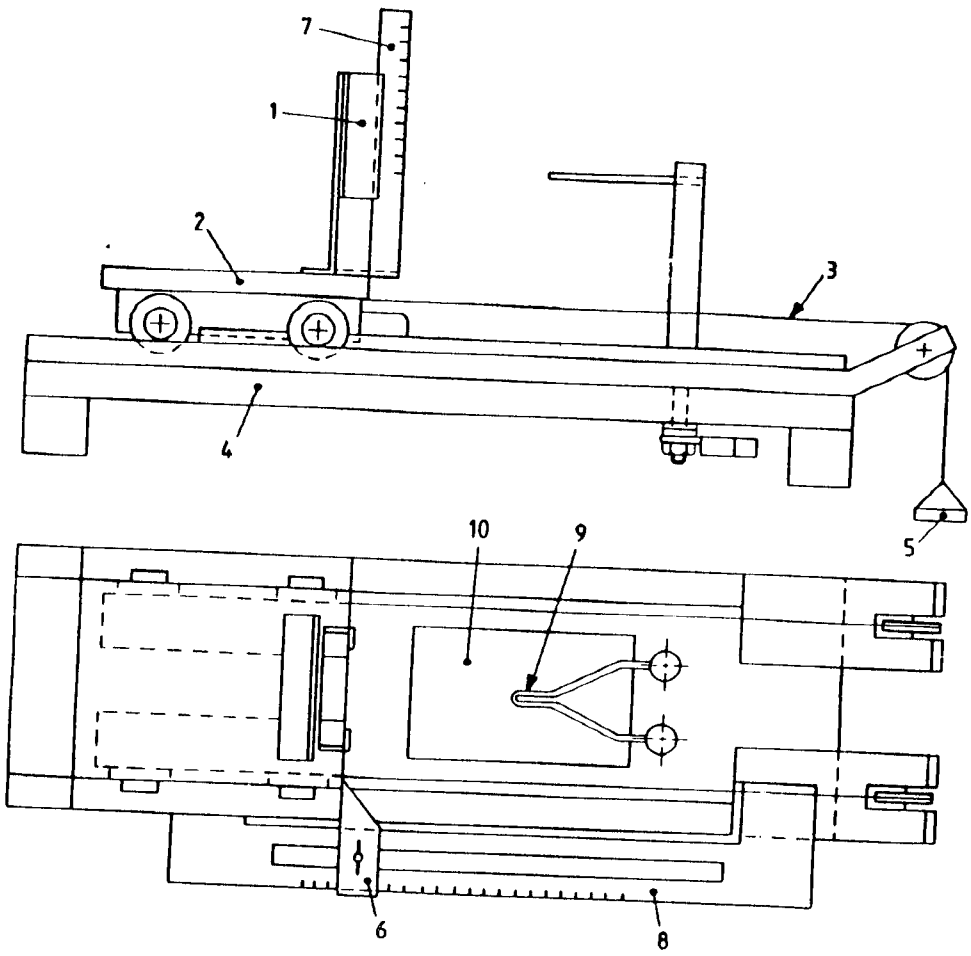


All dimensions are in millimetres.

Key

1. Glow wire, brazed to 3
2. Thermocouple
3. Brass studs (37 % Cu)

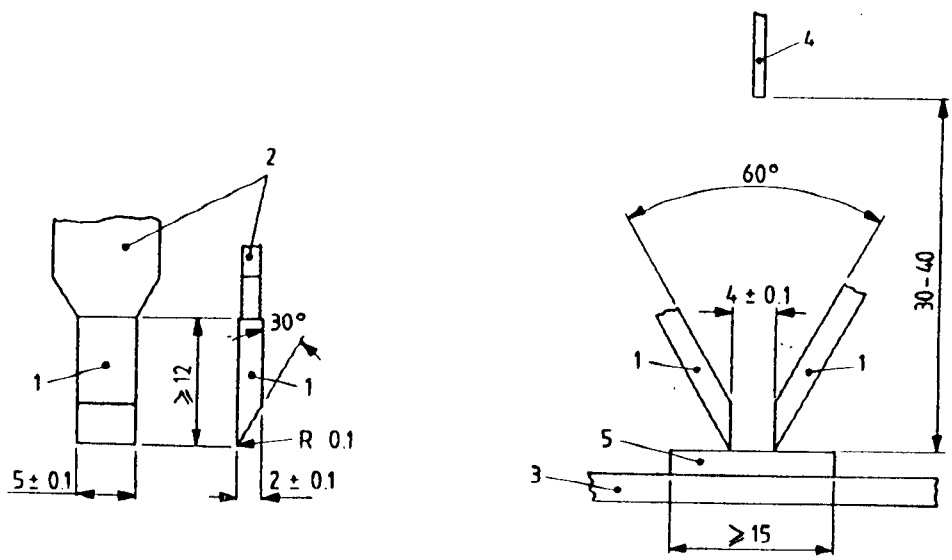
Figure 8. Glow wire with thermocouple



Key

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

Figure 9. Glow-wire test apparatus



(a) Electrode

(b) Electrode arrangement

Key

1. Platinum electrode
2. Brass extension
3. Support
4. Tip of dropping device
5. Specimen

All dimensions are in millimetres.

Figure 10. Arrangements and dimensions of the electrodes for the tracking test

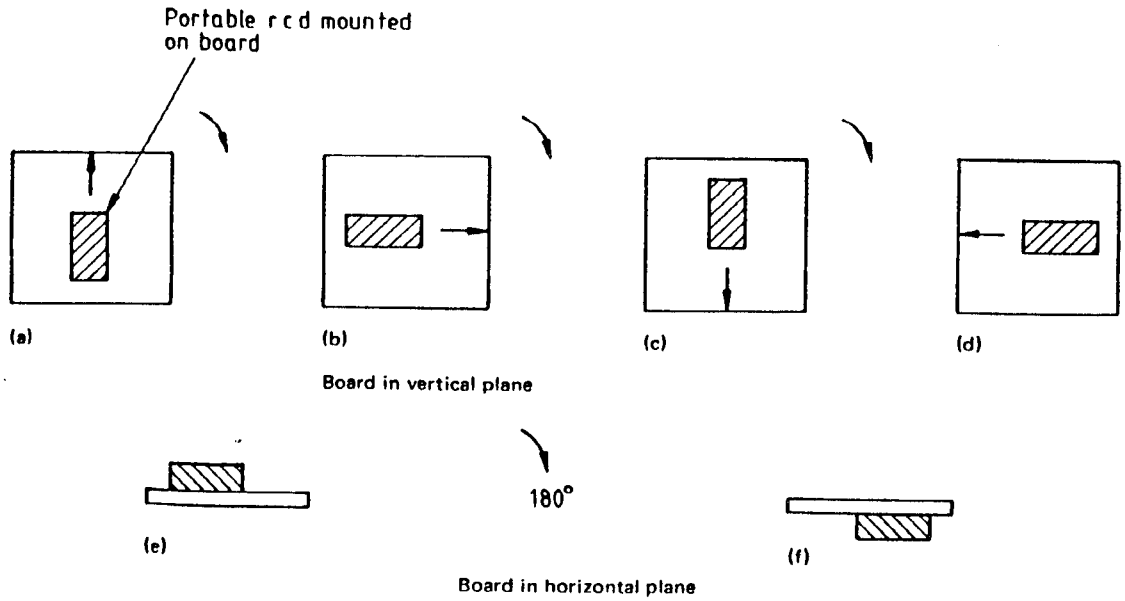


Figure 11. Dispositions of portable rcd for testing test circuit operation (see **8.29.1**)

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List of references

BS 89	Direct acting indicating electrical measuring instruments and their accessories
BS 1362	Specification for general purpose fuse links for domestic and similar purposes (primarily for use in plugs)
BS 1363	Specification for 13 A fused plugs and switched and unswitched socket-outlets
BS 1363	13 A plugs, socket-outlets and adaptors Part 3 Specification for adaptors
BS 3042	Specification for standard test fingers and probes for checking protection against electrical, mechanical and thermal hazard
BS 3203	Glossary of paper, board, pulp and related terms
BS 3444*	Specification for blockboard and laminboard
BS 3871	Specification for miniature and moulded case circuit-breakers Part 1 Miniature air-breakers for a.c. circuits
BS 4293	Specification for residual current-operated circuit-breakers
BS 4714	Method for laboratory determination of density or relative density of crude petroleum and liquid petroleum products (hydrometer method)
BS 4937	International thermocouple reference tables Part 4 Nickel-chromium/nickel-aluminium thermocouples. Type K
BS 6217	Guide to graphical symbols for use on electrical equipment
BS 6221	Printed wiring boards Part 3 Guide for the design and use of printed wiring boards
BS 6500	Specification for insulated flexible cords and cables

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