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Specification for residual current devices with or without overcurrent protection for socket-outlets for household and similar uses

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Summary of pages

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Foreword

Publishing information

This British Standard is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 30 November 2016. It was prepared by Subcommittee PEL/23/1, *Circuit breakers and similar equipment for household use*, under the authority of Technical Committee PEL/23, *Electrical accessories*. A list of organizations represented on these committees can be obtained on request to their secretary.

Supersession

This British Standard supersedes BS 7288:1990, which remains current until 30 November 2019.

Relationship with other publications

This revision implements IEC 62640 with the common modification applied by HD 62640.

Information about this document

This standard reproduces the text of IEC 62640 with the common modifications set out in HD 62640 applied (this is why parts are labelled “void”) and certain necessary requirements retained from BS 7288:1990. The key differences between this edition of BS 7288 and IEC 62640 (with the common modifications) are set out in Annex F.

Where IEC 62640 text has been deleted as part of this revision, the words “*Text deleted*” have been inserted to indicate this.

This standard specifies requirements for socket-outlets incorporating residual current devices (SRCDs).

This edition covers the use of the following types of SRCDs:

a) single pole with switched neutral;

b) double pole;

c) single pole with solid neutral.

Use of this document

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is “shall”.

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

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0 Introduction

The BS EN 61008 and BS EN 61009 series are applicable to residual current devices having one to four poles used in any part of an electrical installation. These devices may be installed either at the origin of a whole installation or upstream of one or several circuits of a fixed installation or upstream of a circuit powering one or more socket-outlets, or be integrated in the same enclosure as a socket-outlet.

Such residual current devices are able to provide fault protection (protection against indirect contact), additional protection (protection against direct contact) if the rated residual current is equal to or less than 30 mA and protection against fire hazard due to a persistent earth leakage current without the operation of the overcurrent protection. Equipment meeting the requirements of the BS EN 61008 or BS EN 61009 series ensures isolation, withstands high levels of electromagnetic disturbances for household and similar applications, and allows safe use of an electrical installation.

Although the BS EN 61008 and BS EN 61009 series may be applicable to "residual current devices integrated in socket-outlets" it is acknowledged that due to the specific use and location of a socket-outlet, at the boundary of the fixed installation and immediately upstream of electrical equipment powered through a plug inserted into the socket-outlet, these devices require different features.

The residual current device at socket-outlet level is normally intended to be installed by skilled or instructed persons. It can be operated several times per day. The isolation function is not necessary since pulling out the plug from the socket-outlet is recognized as providing effective isolation. The absence of permanently connected long conductors downstream of the RCD, together with a limited number of powered appliances, justifies reduced EMC levels. Residual current devices covered by this standard are intended for additional protection in case of direct contact only. These particular features having been considered, it was recognized that a dedicated standard for socket-outlet residual current devices (SRCDs) was necessary.

1 Scope

This British Standard applies to residual current-operated devices (RCD) incorporated in, or specifically intended for use with, single pole and neutral and single pole and switched neutral and double pole socket-outlets, with provision of earthing of the socket-outlet for household and similar uses (SRCD: socket-outlet residual current devices). SRCDs, according to this standard, are intended to be used in single phase systems such as phase to neutral. SRCDs are only intended to provide supplementary protection downstream of the SRCD. SRCDs are intended for use in circuits where the fault protection and additional protection are already assured upstream of the SRCD.

NOTE 1 Void

NOTE 2 Void

NOTE 3 Void

SRCDs are neither intended to provide an isolation function nor intended to be used in IT systems.

NOTE 4 For SRCDs intended to provide isolation or fault protection, or to be used in IT systems, BS EN 61008-1 or BS EN 61009-1 should be used, as applicable, in conjunction with the requirements of BS 1363-2 for socket-outlets.

NOTE 5 Requirements and testing for SRCDs intended to be used in IT systems are under consideration.

SRCDs are not used in distribution boards. They are not intended for the protection of a complete distribution circuit or a complete final circuit. These products are intended to be installed:

- in boxes in compliance with BS EN 60670-1; or
- in cable trunking systems in compliance with the BS EN 61084 series; or
- in power track systems in compliance with the BS EN 61534 series; or
- in boxes according to one of the above standards adjacent to socket-outlet boxes.

They are not intended to be used in enclosures or distribution boards in conformity with BS EN 60670-24, BS EN 61439-1 or BS EN 61439-3.

RCDs for household and similar use not covered by the scope of this standard are covered by BS EN 61008-1 or BS EN 61009-1. SRCDs energized from batteries, or a circuit other than the one powering the loads, are not covered by this standard.

The residual current device incorporates the functions of detection of the residual current, of comparison of the value of this current with the residual operating value and of opening the protected circuit when the residual current exceeds this value.

The maximum rated residual operating current is 30 mA.

The maximum rated current is 16 A for devices with a rated voltage not exceeding 250 V a.c.

NOTE 6 Void

NOTE 7 Void

This British Standard applies to SRCDs incorporating overload or overcurrent protection.

This standard also applies to a connection unit incorporating a residual current device intended to protect fixed electrical equipment.

NOTE 8 SRCDs are designed to be operated by uninstructed persons and not to require maintenance.

The requirements of this standard apply for normal conditions of temperature and environment. Additional requirements may be necessary for devices used in locations having more severe environmental conditions.

The socket-outlet part of an SRCD is covered by BS 1363-2. The connection unit part of an SRCD is covered by BS 1363-4.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 1362, *Specification for general purpose fuse links for domestic and similar purposes (primarily for use in plugs)*

BS 1363, *13 A plugs, socket outlets, adaptors and connection units*

BS 1363-2:2016, *13 A plugs, socket-outlets, adaptors and connection units – Part 2: Specification for 13 A switched and unswitched socket-outlets*

BS 1363-4:2016, *13 A plugs, socket-outlets, adaptors and connection units – Part 4: Specification for 13 A fused connection units switched and unswitched*

BS 4662:2006+A1:2009, *Boxes for flush mounting of electrical accessories – Requirements, test methods and dimensions*

BS 6004:2012, *Electric cables – PVC insulated and PVC sheathed cables for voltages up to and including 300/500 V, for electric power and lighting*

BS EN 50525-2-11, *Electric cables. Low voltage energy cables of rated voltages up to and including 450/750V (U_0/U) – Cables for general applications – Flexible cables with thermoplastic PVC insulation*

BS EN 60065, *Audio, video and similar electronic apparatus – Safety requirements*

BS EN 60529, *Degrees of protection provided by enclosures (IP code)*

BS EN 60695-2-10:2013, *Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure*

BS EN 60068-2-30:2005, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

BS EN 60068-3-4, *Environmental testing – Part 3-4: Supporting documentation and guidance – Damp heat tests*

BS EN 61032:1998, *Protection of persons and equipment by enclosures – Probes for verification*

BS EN 61543:1996, *Residual current-operated protective devices (RCDs) for household and similar use – Electromagnetic compatibility*

BS EN ISO 306, *Plastics – Thermoplastic materials – Determination of Vicat softening temperature (VST)*

CISPR 14-1, *Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus – Part 1: Emission*

3 Terms, definitions and symbols

For the purposes of this British Standard, the following terms and definitions apply.

3.1 Definitions relating to currents flowing from live parts to earth

3.1.1 earth fault current
current flowing to earth due to an insulation fault

3.1.2 earth leakage current
current flowing from the live parts of the installation to earth in the absence of an insulation fault

3.1.3 pulsating direct current
current of pulsating wave form which assumes, in each period of the rated power frequency, the value 0 or a value not exceeding 0,006 A d.c. during one single interval of time, expressed in angular measure, of at least 150°

3.1.4 current delay angle
α
time, expressed in angular measure, by which the starting instant of the current conduction is delayed by phase control

3.1.5 smooth direct current
direct current which is ripple free

NOTE A current is considered to be ripple free when the coefficient of ripple is below 10%.

3.2 Definitions relating to the energization of a residual current device

3.2.1 residual current
I_{Δ}
vector sum of the instantaneous values of the current flowing in the main circuit of the RCD expressed as r.m.s. value

3.2.2 residual operating current
$I_{\Delta n}$
value of residual current which causes the residual current device to operate under specified conditions

3.2.3 residual non-operating current
$I_{\Delta no}$
value of residual current at which and below which the residual current device does not operate under specified conditions

3.3 Definitions relating to the operation and functions of the residual current device

3.3.1 residual current device
RCD
mechanical switching device or association of devices designed to make, carry and break currents under normal service conditions and to cause the opening of the contacts when the residual current attains a given value under specified conditions

3.3.2 detection
function consisting in sensing the presence of a residual current

3.3.3 evaluation
function consisting in giving to the RCD the possibility to operate when the detected residual current exceeds a specified reference value

3.3.4 interruption
function consisting in automatically bringing the main contacts of the RCD from the closed position into the open position, thereby interrupting the current(s) flowing through them

3.3.5 switching device
device designed to make or to break the current in one or more electric circuits

[SOURCE: BS IEC 60050-442:1998, **442-01-46**]

3.3.6 trip-free mechanism of an RCD
moving contacts which return to and remain in the open position when the opening operation is initiated after the initiation of the closing operation, even if the closing command is maintained

NOTE To ensure proper breaking of the current which may have been established, it may be necessary that the contacts momentarily reach the closed position.

[SOURCE: IEC 60050-441:2000, **441-16-31**, modified]

3.3.7 SRCD without integral overcurrent protection
SRCD not designed to perform the functions of protection against overloads and/or short-circuits

3.3.8 SRCD with integral overcurrent protection
SRCD designed to perform the functions of protection against overloads and/or short-circuits

3.3.9 residual current unit
device performing simultaneously the functions of detection of the residual current and of comparison of the value of this current with the residual operating value, and incorporating the means of operating the tripping mechanism of a circuit-breaker with which it is designed to be assembled

3.3.10 break time of a RCD
time which elapses between the instant the residual operating current is attained and the instant of arc extinction in all poles

3.3.11 limiting non-actuating time
maximum time during which the residual operating current can be applied to the RCD without causing it to operate

3.3.12 *Text deleted*

3.3.13 test device
device incorporated in the RCD simulating the residual current conditions for the operation of the SRCD under specified conditions

3.3.14 Void

3.3.15 Void

3.3.16 loss of supply
loss of one or more active conductors

3.3.17 fuse
switching device that, by the melting of one or more of its specially designed and proportioned components, opens the circuit in which it is inserted by breaking the current when it exceeds a given value for a sufficient time

NOTE The fuse comprises all the parts that form the complete device.

[SOURCE: IEC 60050-441:2000, **441-18-01**, modified]

3.3.18 pole
that part of an SRCD associated exclusively with one electrically separated conducting path of its main circuit, provided with contacts intended to connect and disconnect the main circuit itself, and excluding those portions which provide a means for mounting and operating the poles together

3.4 Definitions relating to values and ranges of energizing quantities

3.4.1 limiting value of the non-operating overcurrent in the case of a single-phase load
maximum value of a single-phase overcurrent which, in the absence of a residual current, can flow through an SRCD (whatever the number of poles) without causing it to operate

NOTE 1 In the case of overcurrent in the main circuit, unwanted tripping may occur in the absence of residual current, due to asymmetry existing in the detecting device itself.

NOTE 2 In the case of SRCD with integral overcurrent protection, the limiting value of the non-operating current may be determined by the overcurrent protection means.

3.4.2 residual short-circuit withstand current
maximum value of the residual current for which the operation of the RCD part is assured under specified conditions and above which that device may undergo irreversible alterations

3.4.3 limiting thermal value of the short-time current
highest value of current (r.m.s.) which the device is capable of carrying for a specified short period and under specified conditions without undergoing, by heating effect, permanent deterioration of its characteristics

3.4.4 prospective current
current that would flow in the circuit if each main current path of the SRCD and of the overcurrent protective device, if any, were replaced by a conductor of negligible impedance

NOTE The prospective current may be qualified in the same manner as an actual current, for example: prospective breaking current, prospective peak current, prospective residual current, etc.

[SOURCE: BS IEC 60050-442:1998, **442-01-47**, modified]

3.4.5 making capacity
value of the a.c. component of a prospective current that an SRCD is capable of making at a stated voltage under prescribed conditions of use and behaviour

[SOURCE: BS IEC 60050-442:1998, **442-01-48**, modified]

3.4.6 breaking capacity
value of the a.c. component of a prospective current that an SRCD is capable of breaking at a stated voltage under prescribed conditions of use and behaviour

[SOURCE: BS IEC 60050-442:1998, **442-01-49**, modified]

3.4.7 residual making and breaking capacity
$I_{\Delta m}$
value of the a.c. component of a residual prospective current which an SRCD can make, carry for its opening time and break under specified conditions of use and behaviour

[SOURCE: IEC 60050-442:1998, **442-05-27**, modified]

3.4.8 conditional short-circuit current
I_{nc}
value of the a.c. component of a prospective current, which an SRCD without integral short-circuit protection, but protected by a suitable short-circuit protective device (hereafter referred to as SCPD) in series, can withstand under specified conditions of use and behaviour

[SOURCE: BS IEC 60050-442:1998, **442-05-28**, modified]

3.4.9 conditional residual short-circuit current
$I_{\Delta c}$
value of the a.c. component of a residual prospective current which the RCD part without integral short-circuit protection, but protected by a suitable SCPD in series, can withstand under specified conditions of use and behaviour

[SOURCE: BS IEC 60050-442:1998, **442-05-22**, modified]

3.4.10 Joule integral
I^2t
integral of the square of the current, over a given time interval (t_0, t_1):

$$I^2t = \int_{t_0}^{t_1} i^2 \mathrm{d}t$$

[SOURCE: IEC 60050-441:2000, **441-18-23**, modified]

3.4.11 recovery voltage
voltage which appears across the supply terminals of the SRCD after the breaking of the current

NOTE This voltage may be considered as comprising two successive intervals of time, one during which a transient voltage exists, followed by a second one during which power-frequency voltage alone exists.

[SOURCE: BS IEC 60050-442:1998, **442-01-05**, modified]

3.4.12 transient recovery voltage
recovery voltage during the time in which it has a significant transient character

NOTE 1 The transient voltage may be oscillatory or non-oscillatory or a combination of these depending on the characteristics of the circuit and of the SRCD. It includes the voltage shift of the neutral of a polyphase circuit.

NOTE 2 The transient recovery voltage in three-phase circuits is, unless otherwise stated, that across the first pole to clear, because this voltage is generally higher than that which appears across each of the other two poles.

[SOURCE: IEC 60050-441:2000, **441-17-26**, modified]

3.4.13 power-frequency recovery voltage
recovery voltage after the transient voltage phenomena have subsided

[SOURCE: IEC 60050-441:2000, **442-17-27**]

3.4.14 overcurrent
current exceeding the rated current

3.4.15 overload current
overcurrent occurring in an electrically undamaged circuit

NOTE An overload current may cause damage if sustained for a sufficient time.

3.4.16 temporary overvoltage
overvoltage at power frequency of relatively long duration

3.4.17 short-circuit current
overcurrent resulting from a fault of negligible impedance between points intended to be at different potentials in normal service

NOTE A short-circuit current may result from a fault or from an incorrect connection.

3.5 Definitions relating to values and ranges of influencing quantities

3.5.1 influencing quantity
quantity likely to modify the specified operation of an SRCD

3.5.2 reference value of an influencing quantity
value of an influencing quantity to which the manufacturer's stated characteristics are referred

3.5.3 reference conditions of influencing quantities
collectively, reference values of all influencing quantities

3.5.4 range of an influencing quantity
range of values of an influencing quantity which permits the SRCD to operate under specified conditions, the other influencing conditions having their reference values

3.5.5 extreme range of an influencing quantity
range of values of an influencing quantity within which the SRCD suffers only spontaneously reversible changes, although not necessarily complying with all the requirements of this standard

3.5.6 ambient air temperature
temperature, determined under prescribed conditions, of the air surrounding the SRCD

NOTE For an enclosed SRCD, it is the air outside the enclosure.

[SOURCE: IEC 60050-441:2000, **441-11-13**, modified]

3.6 Definitions relating to conditions of operation

3.6.1 operation
transfer of the moving contact(s) from the open position to the closed position or vice versa

NOTE If a distinction is necessary, an operation in the electrical sense (e.g. make or break) is referred to as a switching operation, and an operation in the mechanical sense (e.g. close or open) is referred to as a mechanical operation.

3.6.2 closing operation
operation by which the SRCD is brought from the open position to the closed position

3.6.3 opening operation
operation by which the SRCD is brought from the closed position to the open position

[SOURCE: IEC 60050-441:2000, **441-16-09**, modified]

3.6.4 operating cycle
succession of operations from one position to another and back to the first position

[SOURCE: IEC 60050-441:2000, **441-16-02**, modified]

3.6.5 operation sequence
succession of specified operations with specified time intervals

[SOURCE: IEC 60050-441:2000, **441-16-03**]

3.6.6 clearance
shortest distance in air between two conductive parts

NOTE For the purpose of determining a clearance to accessible parts, the accessible surface of an insulating enclosure is considered conductive as if it was covered by a metal foil wherever it can be touched by hand or by the standard test finger according to BS EN 60529.

[SOURCE: IEC 60050-441:2000, **441-17-31**, modified]

3.6.7 creepage distance
shortest distance along the surface of an insulating material between two conductive parts

NOTE For the purpose of determining a creepage distance to accessible parts, the accessible surface of the insulating enclosure is considered conductive as if it was covered by a metal foil wherever it can be touched by a hand or a standard test finger according to BS EN 60529.

[SOURCE: IEC 60050-471:2007, **471-01-04**, modified]

3.7 Definitions relating to tests

3.7.1 type test
test of one or more devices made to a certain design to show that the design meets certain requirements

[SOURCE: IEC 60050-426:2008, **426-05-01**, modified]

3.7.2 routine test
test to which each individual device is subjected during and/or after manufacture to ascertain whether it complies with certain criteria

[SOURCE: BS IEC 60050-411:1996, **411-53-02**, modified]

3.8 Definitions relating to residual current devices in general

3.8.1 short-circuit protective device
SCPD
device, specified by the manufacturer, to be installed in the circuit in series with the SRCD in order to protect it against short-circuit currents only

3.8.2 supply terminals
terminals upstream of the RCD part

3.8.3 load terminals
terminals downstream of the RCD part

3.8.4 feed through
means provided on the SRCD for the connection of one or more additional socket-outlets, protected by the RCD part

3.8.5 instructed person
person adequately advised or supervised by skilled persons to enable him or her to avoid dangers and prevent risks which electricity may create

3.8.6 connection unit
device associated with the fixed wiring of an installation by which equipment can be connected, and having provision for a replaceable cartridge fuse-link

4 Classification

The SRCDs are classified in the following ways:

NOTE 1 The correct use of SRCDs corresponding to the classifications of this clause is subject to installation rules (e.g. according to BS 7671).

NOTE 2 Void

NOTE 3 Void

4.1 Classification according to behaviour resulting from failure of the line voltage

4.1.1 SRCD not opening automatically in case of failure of the line voltage

Text deleted

4.1.2 SRCD opening automatically in case of failure of the line voltage

a) not re-closing automatically when the line voltage is restored;

b) re-closing automatically when the line voltage is restored.

4.2 Classification according to the design

4.2.1 SRCD consisting of an RCD incorporated in (a) fixed socket-outlet(s)

a) SRCDs without feed through;

b) Void

4.2.2 *Text deleted*

4.2.3 SRCD consisting of an RCD incorporated in a fused connection unit intended to protect fixed electrical equipment (e.g. hand dryers, water coolers, etc.) immediately adjacent to the SRCD or to supply socket-outlets downstream of the connection unit

4.3 Classification according to behaviour in presence of d.c. components

a) SRCDs of type AC;

b) SRCDs of type A.

4.4 Classification according to the provision for earthing

a) SRCD with provision for earthing (PE terminal);

b) Void

4.5 Classification according to the design of the cover plate

a) Design A – SRCDs where the cover or cover plate can be removed without displacement of the conductors;

b) Design B – fixed SRCDs where the cover or cover plate cannot be removed without displacement of the conductors.

NOTE If a fixed SRCD has a base (main part) which cannot be separated from the cover or cover plate, and requires a supplementary plate to meet this standard which can be removed for redecorating the wall without displacement of the conductors, it is considered to be of design A, provided the supplementary plate meets the requirements specified for covers and cover plates.

4.6 Classification according to the method of mounting

a) surface type SRCD;

b) flush-type SRCD;

c) semi-flush type SRCD;

d) panel-type SRCD (switch-board and distribution board excluded);

e) floor recessed-type SRCD.

4.7 Classification according to the environmental conditions

4.7.1 Classification according to the degree of protection against ingress of solid foreign objects

a) IP2X: SRCD protected against access to hazardous parts with a finger and against harmful effects due to ingress of solid foreign objects of 12,5 mm diameter and greater;

b) IP4X: SRCD protected against access to hazardous parts with a wire and against harmful effects due to ingress of solid foreign objects of 1,0 mm diameter and greater;

c) IP5X: SRCD protected against access to hazardous parts with a wire and dust protected;

d) IP6X: SRCD protected against access to hazardous parts with a wire and dust-tight.

4.7.2 Classification according to the degree of protection against harmful ingress of water

a) ordinary SRCDs, i.e. with degree of protection IPX0 or IPX1, when mounted on a vertical surface for normal use;

NOTE For the purpose of this standard, the term "ordinary" applies only to the degree of protection against harmful ingress of water.

b) IPX4: SRCDs protected against splashing water;

c) IPX5: SRCDs protected against water jets;

d) IPX6: SRCDs protected against powerful jets.

4.7.3 Classification according to the range of ambient air temperature

a) SRCDs intended for use between –5 °C and +40 °C;

b) SRCDs intended for use between –25 °C and +40 °C.

4.8 Classification according to the type of terminals

a) SRCDs with screw type terminals;

b) SRCDs with screwless terminals for rigid conductors only;

c) SRCDs with screwless terminals for rigid and flexible conductors.

4.9 Classification according to overcurrent protection

a) SRCD without integral overcurrent protection;

b) SRCD with overcurrent protection independent of the RCD opening means (e.g. a fused device or a fused plug and socket system).

4.10 Type of SRCD

a) single SRCD;

b) twin SRCD;

c) unswitched SRCD;

d) switched SRCD.

4.11 Number of poles

a) single pole with switched neutral;

b) double pole;

c) single pole with solid neutral.

4.12 Type of switching

a) capable of being switched on-load;

b) not capable of being switched on-load (interlocked device).

5 Characteristics of SRCDs

5.1 Summary of characteristics

The characteristics of an SRCD shall be stated in the following terms, as applicable:

a) type of design and method of mounting (**4.5** and **4.6**);

b) rated current I_n (**5.2.1**);

c) operating characteristics in case of residual currents with d.c. components (**5.2.7**);

d) rated residual operating current $I_{\Delta n}$ (**5.2.2**);

e) rated residual non-operating current $I_{\Delta no}$ if different from the preferred value (**5.2.3**);

f) rated voltage U_n (**5.2.4**);

g) rated frequency (**5.2.5**);

h) rated making and breaking capacity I_m (**5.3.1.4**);

i) rated residual making and breaking capacity $I_{\Delta m}$ (**5.2.6**);

j) overcurrent protection:

   1) classified according to **4.9**a) and **4.9**b):

      i) rated conditional short-circuit current I_{nc} (**5.3.1.2**);

      ii) rated conditional residual short-circuit current $I_{\Delta c}$ (**5.3.1.3**).

Text deleted

5.2 Characteristics common to all socket-outlet residual current devices

5.2.1 Rated current (I_n)

The value of current assigned to the SRCD by the manufacturer, which the device can carry in uninterrupted duty.

5.2.2 Rated residual operating current ($I_{\Delta n}$)

The value of residual operating current (**3.2.2**), assigned to the SRCD by the manufacturer, at which the device shall operate under specified conditions.

NOTE $I_{\Delta n}$ is expressed by the r.m.s. value of the alternating current at rated frequency.

5.2.3 Rated residual non-operating current ($I_{\Delta no}$)

Maximum value of residual non-operating current (**3.2.3**), assigned to the SRCD by the manufacturer, at which the device does not operate under specified conditions.

5.2.4 Rated voltage (U_n)

The r.m.s. value of voltage, assigned to the SRCD by the manufacturer, to which the performance of the device is referred (particularly the short-circuit performance).

5.2.5 Rated frequency

Value of frequency assigned to the SRCD by the manufacturer at which the device operates correctly under specified conditions.

5.2.6 Rated residual making and breaking capacity ($I_{\Delta m}$)

The r.m.s. value of residual prospective current (**3.4.7** and **3.4.9**) which an SRCD can make, carry for its opening time and break under specified conditions without undergoing alterations impairing its functions.

5.2.7 Operating characteristics in case of residual current

5.2.7.1 SRCD type AC

SRCD for which tripping is ensured for residual sinusoidal alternating currents, whether suddenly applied or slowly rising.

5.2.7.2 SRCD type A

SRCD for which tripping is ensured for:

- residual sinusoidal alternating currents;
- residual pulsating direct currents;
- residual pulsating direct currents superimposed on a smooth direct current of 0,006 A,

with or without phase-angle control, independent of polarity, whether suddenly applied or slowly rising.

5.3 Characteristics specific to SRCDs with overcurrent protection (see 4.9)

5.3.1 SRCDs classified according to 4.9a) and 4.9b)

5.3.1.1 Coordination with BS 1362 fuse

The association of a BS 1362 fuse with an SRCD is intended to ensure adequate protection to the device from the effects of short-circuit currents.

Text deleted

5.3.1.2 Rated conditional short-circuit current (I_{nc})

The r.m.s. value of the prospective current assigned by the manufacturer, which an SRCD, protected by a short-circuit protective device, can withstand under specified conditions without undergoing alterations impairing its functions.

NOTE For the rated conditional short-circuit current assigned to an SRCD coordinated with a given short-circuit protective device, it is intended that such an association is able to withstand any short-circuit current up to the assigned value.

5.3.1.3 Rated conditional residual short-circuit current ($I_{\Delta c}$)

Value of residual prospective current assigned by the manufacturer, which an SRCD, protected by a short-circuit protective device, can withstand under specified conditions without undergoing alterations impairing its functions.

NOTE For the rated conditional residual short-circuit current assigned to an SRCD in coordination with a given short-circuit protective device, it is assumed that such an association is able to withstand any residual short-circuit current up to the assigned value.

5.3.1.4 Rated making and breaking capacity (I_m)

The r.m.s. value of prospective current (**3.4.4**) which an SRCD can make, carry for its opening time and break under specified conditions without undergoing alterations impairing its functions.

5.3.2 *Text deleted*

5.4 Preferred or standard values

5.4.1 Preferred values of rated voltage (U_n)

The preferred value of rated voltage is 230 V.

5.4.2 Standard values of rated current (I_n)

The standard values of rated current for rated voltages up to 250 V are:

6 A – 10 A – 13 A – 16 A.

5.4.3 Standard values of rated residual operating current ($I_{\Delta n}$)

The standard values of rated residual operating current are as follows:

0,01 A – 0,03 A.

5.4.4 Standard value of rated residual non-operating current ($I_{\Delta no}$)

The standard value of rated residual non-operating current is 0,5 $I_{\Delta n}$.

NOTE The value of 0,5 $I_{\Delta n}$ refers to alternating residual currents of power frequency only.

5.4.5 Preferred value of rated frequency

The preferred value of rated frequency is as follows:

50/60 Hz.

5.4.6 Standard values of the rated making and breaking capacity (I_m)

The standard value of the rated making and breaking capacity is as follows:

250 A.

The power factor associated with this value is given in Table 30.

The value of I_m shall be equal to or greater than the value of $I_{\Delta m}$.

5.4.7 Standard values of the rated residual making and breaking capacity ($I_{\Delta m}$)

The standard value of the rated residual making and breaking capacity is as follows:

250 A.

The power factor associated with this value is given in Table 30.

5.4.8 Standard values of the rated conditional short-circuit current (I_{nc})

The standard values of the rated conditional short-circuit current I_{nc} are as follows:

1 500 A – 3 000 A.

The power factors associated with these values are given in Table 30.

5.4.9 Standard values of the rated conditional residual short-circuit current ($I_{\Delta c}$)

The standard values of the rated conditional residual short-circuit current $I_{\Delta c}$ are as follows:

1 500 A – 3 000 A.

The power factors associated with these values are given in Table 30.

5.4.10 Standard values of the rated short-circuit capacity (I_{cn})

The standard values of the rated short-circuit capacity I_{cn} are as follows:

1 500 A – 3 000 A.

The power factors associated with these values are given in Table 30.

5.4.11 Standard values of break time

5.4.11.1 Standard values of maximum break time for a.c. residual current

Table 1 **Standard values of maximum break time of SRCDs for a.c. residual current**

$I_{\Delta n}$ A	Standard values of maximum break time at s			
	$I_{\Delta n}$	2 $I_{\Delta n}$	5 $I_{\Delta n}$ A)	250 A
Any value	0,3	0,15	0,04	0,04

A) 0,25 A may be used as an alternative to 5 $I_{\Delta n}$. (The revision of this value is under consideration.)

5.4.11.2 Standard values of maximum break time for pulsating d.c.

Table 2 **Standard values of maximum break time of SRCDs for pulsating d.c. residual current**

$I_{\Delta n}$ A	Standard values of maximum break time at s						
	1,4 $I_{\Delta n}$	2 $I_{\Delta n}$	2,8 $I_{\Delta n}$	4 $I_{\Delta n}$	7 $I_{\Delta n}$ A)	10 $I_{\Delta n}$ B)	175 A
≤0,010		0,3		0,15		0,04	0,04
>0,010	0,3		0,15		0,04		0,04

A) For SRCD with $I_{\Delta n}$ = 0,030 A, the value 0,35 A may be used instead of 7 $I_{\Delta n}$.

B) For SRCD with $I_{\Delta n}$ ≤ 0,010 A, the value 0,5 A may be used instead of 10 $I_{\Delta n}$.

5.5 *Text deleted*

6 Marking and other product information

6.1 General

6.1.1 The following information, as shown in Table 4, shall be provided.

Table 4 **Position of marking** *(1 of 2)*

	Marking or information item	**Position of the marking or information**		
		Visible on product when installed	**On the product**	**In a leaflet**
A	Manufacturer's name or trade mark		×	
B	Type designation		×	
C	Rated voltage(s)		×	
D	Rated frequency(s) (if different from 50 Hz)		×	
E1	Rated current for SRCDs according to **4.9**a) and b)		× A)	
	Text deleted			
F1	Symbol  for type A		×	
F2	Symbol  for type AC		×	
G	Rated residual operating current (in A or mA)	×		
H	Rated residual non-operating current if different from the preferred value			×
I	Rated short-circuit breaking and making capacity (as applicable)			×
J	Rated conditional short-circuit current, if applicable, and in this case, characteristics for the associated short-circuit protective device, according to **5.3.1**			×
K	Degree of protection (if different from IP20)	×		
L	Position for use, if applicable			×
M	Range of operating temperature, if classified according to **4.7.3**b) 		×	
N	Identification of the test device by the letter "T" or the word "Test"	×		
O	Means shall be provided to distinguish between the open and closed states of the device. For SRCDs other than those operated by means of push-buttons, the open position shall be indicated by the symbol "O" and the closed position by the symbol "I" (a short straight line). Additional national symbols are allowed for this indication. Provisionally, the use of national symbols as the only indication of the positions is allowed. These indications shall be readily visible when the SRCD is in normal use. For SRCDs operated by means of two push-buttons, the push-button intended for the opening operation only shall be RED and/or be marked with the symbol "O". In this case, the separate test button shall not be red but shall be marked with the letter "T" or the word "Test". If the test button is the only means for the opening operation, it remains marked "T" or "Test", in which case the colour red may be used. RED shall not be used for any other push-button of the SRCD. If a push-button is used for closing the contact and is clearly identified as such, its depressed position is sufficient to indicate the closed position.	×		
P	Void			
Q	For connection units, the supply and the load terminals shall be clearly marked (e.g. by "supply" and "load" placed near the corresponding terminals or by arrows indicating the direction of power flow).		×	
R	Terminals specifically intended for the connection of the neutral shall be indicated by the symbol "N"		×	
S	Information on the integral overcurrent protective device, if applicable			×

Table 4 **Position of marking** *(2 of 2)*

	Marking or information item	Position of the marking or information		
		Visible on product when installed	On the product	In a leaflet
T	Information on coordination with upstream protective device, if applicable			×
U	All relevant information for the correct assembly, if any, installation and use of the product shall be provided			×
V	Rated short-circuit capacity in amperes (I_{cn}) (as applicable)		×	
W	The number and date of this British Standard, i.e. BS 7288:2016		×	
X	The details concerning the operation of the test circuit of the SRCD, including such words as "Test each time before use"	×		
Y	"Supply Fault" adjacent to the reverse polarity indicator, if fitted.	×		

A) Shall not be visible on the product when installed as in normal use.

Text deleted

6.1.2 The terminals for the connection of the neutral and phase conductors shall be identified by the symbols, "N" and "L" respectively.

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

6.1.4 An SRCD shall be provided with an instruction sheet for its use and the following information 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) a statement warning against use outside the service conditions;

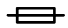
d) a statement that electricity can be dangerous and that the use of an SRCD should not be regarded as a substitute for basic electrical safety precautions;

e) a statement warning the user to seek advice from the manufacturer, responsible vendor or a competent electrician if the SRCD repeatedly trips with an appliance connected or if it should fail to trip when tested in accordance with the instructions;

f) for devices having a solid neutral, a statement instructing the installer to ensure the correct polarity of the incoming supply connections should the device trip automatically upon connection to the supply.

Compliance shall be checked by inspection.

6.1.5 When symbols are used they shall be as follows:

Amperes	A		
Volts	V		
Frequency	Hz		
Alternating current	~ A)		
Phase conductor	L		
Neutral	N		
Earth		preferred or	 A)
Fuse	 A)		
On	I A)		
Off	O A)		

A) IEC 60417-DB gives guidance on the use of these symbols.

6.1.6 For the marking of the rated current and rated voltage of the SRCD figures may be used alone, the figures for the current rating being placed before or above that of the rated voltage and separated by a line. The symbol for nature of supply shall be placed next to the marking for rated current and rated voltage. Examples are as follows:

13 A 250 V ~ or

13/250 ~ or

$\frac{13}{250}\sim$

6.2 Additional marking for screwless terminals

SRCDs with screwless terminals shall be marked with the following:

- an appropriate marking indicating the length of insulation to be removed before the insertion of the conductor into the screwless terminal;
- an indication of the suitability to accept rigid conductors only, for those SRCDs having this restriction.

The additional markings shall be put on the SRCD or on the packaging or given in an instruction sheet which accompanies the SRCD.

6.3 Void

7 Standard conditions for operation in service and for installation

The preferred ranges of application and the reference values of influencing quantities/factors and their associated test tolerances, are given in Table 5.

Table 5 **Values of influencing quantities**

Influencing quantity	Preferred ranges of application	Reference value	Test tolerance
Ambient air temperature	–5 °C to +40 °C –25 °C to +40 °C[A), B), E)]	–	As permitted by the test
Altitude	Not exceeding 2 000 m	–	–
Relative humidity: maximum value at 40 °C	50%[C)]	–	–
External magnetic field	Not exceeding five times the earth's magnetic field in any direction	Earth's magnetic field	[D)]
Position	As stated by the manufacturer, with a tolerance of 5° in any direction[D)]	As stated by the manufacturer	2° in any direction
Frequency	Reference value ±5%	Rated frequency as stated by the manufacturer	±2%
Sinusoidal wave distortion	Not exceeding 5%	Zero	5%
Pollution degree	2	–	–

A) The maximum value of the mean daily temperature is +35 °C or in accordance to the national standards for the socket-outlet part where the product is placed on the market.

B) Values outside the ranges may be required where more severe climatic conditions prevail.

C) Higher relative humidities are admitted at lower temperature (e.g. 90% at 20 °C).

D) The device shall be fixed without causing deformation liable to impair its functions.

E) For SRCDs with an operating range –5 °C to +40 °C, the extreme limits of –20 °C and +60 °C are admissible during storage and transportation; for SRCDs with an operating range –25 °C to +40 °C, the extreme limits are –35 °C and +60 °C. These limits shall be taken into account in the design of the SRCDs.

8 Requirements for construction and operation

8.1 General

SRCDs intended for compliance with this standard shall be in accordance with the scope and the relevant classifications.

8.1.1 For an SRCD incorporating integral overcurrent protection such protection shall comply with the requirements of the appropriate standard, as declared by the manufacturer (e.g. fuselinks shall comply with BS 1362).

Compliance shall be checked by inspection of the marking or by carrying out the tests of the appropriate standard.

8.1.2 An SRCD incorporating contacts intended to engage with plugs complying with British Standards shall be so designed and constructed that the contacts comply with the relevant tests and requirements specified in those standards.

Compliance is checked by visual inspection and tests as relevant.

8.2 Information and marking

Marking on the SRCD shall be indelible and easily legible.

Labels intended to provide permanent information shall not be easily removed from the device.

*Compliance is checked by visual inspection and by the test of **9.2**.*

8.3 Mechanical and electrical design

8.3.1 Mechanism

The RCD part of the SRCD shall have 2 poles.

The moving contacts of all poles of RCDs shall be mechanically coupled in such a way that all poles make and break substantially together, whether operated manually or automatically.

Means shall be provided to distinguish between the open and closed states of the contacts.

The mechanism shall be trip-free and constructed so that the moving contacts can come to rest only in the closed position or in the open position, even when the operating means is manually released in an intermediate position.

When the operating means is used to indicate the position of the contacts, the operating means, when released, shall automatically take up the position corresponding to that of the moving contacts; in this case, the operating means shall have two distinct rest positions corresponding to the position of the contacts but, for automatic opening, a third distinct position of the operating means may be provided.

If symbols are used, they shall be "I" and "O" to indicate the closed and open positions, respectively.

If colours are used, red shall indicate the closed position and green the open position.

Alternative national symbols may be used with or without the above symbols.

The earthing circuit PE within the SRCD, shall be continuous and shall not be affected by the operation of the SRCD.

*Compliance is checked by visual inspection and the tests of **9.3**.*

Except for devices with a solid neutral, when the SRCD is connected to a supply of reversed polarity it shall function in one of the following ways:

a) as normal providing residual current protection;

b) trip automatically on connection to the supply.

SRCDs with a solid neutral shall trip automatically when connected to a supply of reversed polarity.

*Compliance is checked by the test of **9.26**.*

8.3.2 Clearance and creepage distances

The minimum required clearances and creepage distances are given in Table 6 which is based on the SRCD being designed for operating in an environment with pollution degree 2.

However, the clearances 1, 2, 3 and 4 may be reduced provided that the tests in **9.13.2** are complied with.

*NOTE The insulating materials are classified into material groups on the basis of their comparative tracking index (CTI) according to **4.8.1** of BS EN 60664-1:2007 and measured according to BS EN 60112.*

Parts of printed boards with type 2 coating according to BS EN 60664-3 are exempt from this verification.

Electronic circuits showing clearances or creepage distances, between active conductors (phase and neutral) and/or between active conductors and the earth circuit, shorter than what is required in Table 6 when the contacts are in the closed position, have to comply with test of **9.4**.

*Compliance is checked by inspection and/or measurement and by the tests of **9.4** and **9.5** for electronic circuits, as applicable.*

Table 6 **Minimum clearances and creepage distances** *(1 of 2)*

	Minimum clearances mm	**Minimum creepage distances**[F)] mm								
	Rated voltage V	**Group IIIa** [H)] **(1 75 V ≤ CTI < 400 V)** [D)]			**Group II (400 V ≤ CTI < 600 V)** [D)]			**Group I (600 V ≤ CTI)** [D)]		
		Working voltage V [E)]								
Description:	230/400 230	>25 ≤50 [I)]	120	250	>25 ≤50 [I)]	120	250	>25 ≤50 [I)]	120	250
1 Between live parts which are separated when the main contacts are in the open position	3,0 [A)]	1,2	1,5	3,0	0,9	1,5	3,0	0,6	1,5	3,0
2 Between internal live parts of different polarity[Z1)]										
3 Void										
		Supply system rated voltage V								
		120/240	230/400		120/240	230/400		120/240	230/400	
4 Between live parts and: – accessible surfaces of operating means – screws or other means for fixing covers which have to be removed when mounting the SRCD – surface on which the SRCD is mounted [B)] – screws or other means for fixing the SRCD [B)] – metal covers or boxes [B)] – other accessible metal parts [C)] – metal frames supporting flush-type SRCD	3,0	1,5	4,0		1,5	3,0		1,5	3,0	

Table 6 **Minimum clearances and creepage distances** *(2 of 2)*

5 Between metal parts of the mechanism and: – accessible metal parts [C)] – screws or other means for fixing the SRCD – metal frames supporting flush-type SRCD							

A) This value may be reduced to 1,2 mm minimum provided the tests of **9.13.2** are complied with.

B) The values are doubled if clearances and creepage distances between live parts of the device and the metallic screen or the surface on which the SRCD is mounted are not dependent on the design of the SRCD only, so that they can be reduced when the SRCD is mounted in the most unfavourable condition.

C) Including a metal foil in contact with the surfaces of insulating material which are accessible after installation as for normal use. The foil is pushed into corners, grooves, etc., by means of a straight un-jointed test finger.

D) See BS EN 60112.

E) Interpolation is allowed in determining creepage distances corresponding to voltage values intermediate to those listed as working voltage. For determination of creepage distances, see Annex B.

F) Creepage distances cannot be less than the associated clearances.

H) For material group IIIb (CTI < 175 V) the values for material group IIIa multiplied by 1,6 apply.

I) For working voltages up to and including 25 V, reference may be made to BS EN 60664-1:2007.

J) Void

Z1) This applies also to clearance and creepage distances between live parts of different polarity of the SRCD and equipment mounted close to it.

8.3.3 Void

8.3.4 Screws, current-carrying parts and connections

Electrical connections shall not be subject to undue ageing.

8.3.4.1 Connections, whether electrical or mechanical, shall withstand the mechanical stresses occurring in normal use.

Screws operated when connecting the SRCD shall not be of the thread-cutting type.

NOTE Screws (or nuts) which are operated when connecting the SRCD include screws for fixing covers or cover plates, but not connecting means for screwed conduits and for fixing the base of an SRCD.

*Compliance is checked by inspection and by the test of **9.6**.*

8.3.4.2 For screws in engagement with a thread of insulating material and which are operated when assembling the SRCD during installation, correct introduction of the screw into the screw hole or nut shall be ensured.

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

*Compliance is checked by inspection and by the manual test of **9.6**.*

8.3.4.3 Electrical connections shall be so designed that contact pressure is not transmitted through insulating material other than ceramic, pure mica or other material with characteristics not less suitable, unless there is sufficient resilience in the metallic parts to compensate for any possible shrinkage or yielding of the insulating material.

Compliance is checked by inspection.

NOTE The suitability of the material is considered in respect of the stability of the dimensions.

8.3.4.4 Current-carrying parts, including those of terminals (also earthing terminals), shall be of brass, copper, phosphor-bronze or other metal having, under the conditions occurring in the equipment, mechanical strength, electrical conductivity and resistance to corrosion adequate for their intended use.

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

- *copper;*
- *an alloy containing at least 58% copper for parts from rolled sheet (in cold condition) or at least 50% copper for other parts;*
- *Text deleted;*
- *other metal or suitably coated metal, not less suitable for their intended use.*

The requirements of this subclause do not apply to contacts, magnetic circuits, heater elements, bimetals, shunts, parts of electronic devices, screws, nuts, washers, clamping plates nor to similar parts of terminals and parts of the test circuit, or to parts of an SRCD used for earth continuity purposes other than the earthing contacts.

*Compliance is checked by inspection and by the test of **9.27**.*

8.3.5 Terminals

8.3.5.1 Terminals for external conductors

Terminals for external conductors shall be such that the conductors may be connected so as to ensure that the necessary contact pressure is maintained permanently.

*Compliance is checked by the test of **9.7**.*

8.3.5.2 Void

8.3.6 Mounting arrangement

For flush-mounted SRCDs intended to be used in enclosures complying with the dimensional requirements of BS 4662:2006+A1:2009, the size of the base(s) shall be such that when the box or enclosure and the SRCD are in the relative positions they will occupy in use, the clearance for the purpose of wiring between the sides of the base(s) and the inside walls of the box or enclosure is not less than 6 mm and such that the clearance between the overall depth of the base(s) and the bottom of the specified deep box or enclosure is not less than 14 mm with the following exceptions.

a) Encroachments on these clearances are permissible provided that access to at least one conduit or cable entry on each face of the box or enclosure can still be gained.

b) If the terminals are arranged for front wiring after fixing the base then the 14 mm clearance need not apply.

There shall be no live metal protruding from or flush with the SRCD base. Any exposed live metal part shall be recessed to give the necessary clearance distance from any earthed metal which may come into contact with the base (see **8.3.2**).

For SRCDs for use in enclosures other than those specified in BS 4662:2006+A1:2009, the clearances within the associated box or enclosure shall provide adequate wiring space according to the method of entry of all the necessary cables.

Compliance shall be checked by inspection and measurement.

8.3.7 Construction of socket-outlets

Socket-outlets shall meet the requirements of Clause **13** of BS 1363-2:2016.

Compliance shall be checked by the relevant tests of Clause **13** of BS 1363-2:2016.

8.4 Operating characteristics

The operating characteristic of SRCDs shall take into account the classifications and the requirements of the following subclauses, as applicable.

Compliance of the following subclauses is checked by the tests of **9.8**.

8.4.1 Operation in response to the type of residual current

8.4.1.1 Alternating residual current

All SRCDs shall operate in response to a steady increase of alternating residual current of rated frequency within the limits of the non-operating current $I_{\Delta no}$ and the rated residual operating current $I_{\Delta n}$ in accordance with Table 7.

8.4.1.2 Pulsating d.c. residual current for type A

Type A SRCDs shall operate in response to a steady increase of pulsating direct residual current of rated frequency within specified limits of the non-operating current and the operating current in accordance with Table 7.

Table 7 **Tripping current limits**

Type	Current shape	Tripping current		
		Non-operating current (lower limit)	Operating current (upper limit)	
			$I_{\Delta n}$ < 30 mA	$I_{\Delta n}$ = 30 mA
AC and A	Sinusoidal alternative current	0,5 $I_{\Delta n}$	$I_{\Delta n}$	
A	Pulsating direct current			
	0°	0,35 $I_{\Delta n}$	2 $I_{\Delta n}$	1,4 $I_{\Delta n}$
	90°	0,25 $I_{\Delta n}$	2 $I_{\Delta n}$	1,4 $I_{\Delta n}$
	135°	0,11 $I_{\Delta n}$	2 $I_{\Delta n}$	1,4 $I_{\Delta n}$

The tripping limits apply independently of the polarity of the pulsating direct residual current.

8.4.1.3 Pulsating d.c. residual current in the presence of a standing smooth direct current of 0,006 A

Type A SRCDs shall operate in response to a steady increase of pulsating direct residual current of rated frequency within specified limits of the non-operating current and the operating current in accordance with Table 7, also in the case of simultaneous presence of a smooth direct current of 0,006 A through any pole of the SRCD.

The tripping limits of the pulsating direct current shall be kept even if the polarity of the pulsating direct residual current and the smooth direct current are the same.

8.4.2 Operation in response to the presence of a residual current equal to or greater than $I_{\Delta n}$

The operation of SRCDs to a suddenly applied residual current shall be in accordance with Tables 1 and 2, as applicable.

8.5 Void

8.6 Test device

The SRCD shall be provided with a test device, to simulate the passing through the detecting device of a residual current not exceeding 2,5 $I_{\Delta n}$ at rated voltage, in order to allow a periodic testing of the ability of the SRCD to operate.

Compliance is checked by the tests of ***9.10****.*

It shall not be possible to energize the circuit on the load side by operating the test device when the SRCD is in the open position and connected as in normal use.

Compliance is checked by inspection.

The protective conductor of the installation shall not become live when the test device is operated.

Compliance is checked by inspection.

8.7 Temperature rise

The temperature rises of the parts of an SRCD specified in Table 8, measured under the conditions specified in **9.11**, shall not exceed the limiting values stated in that table.

The SRCD shall not suffer damage impairing its functions and its safe use.

Table 8 **Temperature-rise values**

Parts[A),B)]	**Temperature rise** K
SRCD terminals for external connections	60
External parts liable to be touched in normal service	40
Other external parts, including that face of the SRCD in direct contact with the mounting surface	60

A) No value is specified for the contacts, since the design of most SRCDs is such that a direct measurement of the temperature of those parts cannot be made without the risk of causing alterations or displacement of parts likely to affect the reproducibility of the tests.
The test of **9.11** is considered to be sufficient for checking indirectly the behaviour of the contacts with respect to undue temperature rises in service.

B) No value is specified for parts other than those listed, but no damage shall be caused to adjacent parts of insulating materials.

Compliance is checked by the tests of ***9.11****.*

8.8 Resistance to humidity

SRCDs shall have adequate mechanical properties to withstand humid conditions.

Compliance is checked by the tests of ***9.12****.*

8.9 Dielectric properties

SRCDs shall have adequate dielectric properties.

Compliance is checked by the tests of ***9.13****.*

8.10 EMC compliance and unwanted tripping

8.10.1 EMC

SRCDs shall comply with relevant EMC requirements.

Compliance is checked by the tests of ***9.14.1****.*

8.10.2 Resistance against unwanted tripping due to current surges caused by impulse voltages for SRCDs of $I_{\Delta n}$ ≥ 0,010 A

SRCDs shall adequately withstand the current surges to earth due to the loading of capacitances in the load.

NOTE Such current surges may be attributable to load capacitance, surge protective devices (SPD) or flashover.

Compliance is checked by the tests of ***9.14.2****.*

8.11 Behaviour of SRCDs in case of overcurrent conditions

8.11.1 *Title deleted*

SRCDs shall have adequate capability in cases of overload or short-circuit conditions.

*Compliance is checked by the tests of **9.15** as applicable.*

8.11.2 *Text deleted*

8.11.3 *Text deleted*

8.12 Resistance of the insulation against impulse voltages

The insulation of an SRCD shall have adequate resistance to impulse voltages.

*Compliance is checked by the tests of **9.16**.*

8.13 Mechanical and electrical endurance

SRCDs shall be capable of carrying out a specified number of closing and opening operations and making and breaking operations.

*Compliance is checked by the tests of **9.17**.*

8.14 Resistance to mechanical shock

SRCDs shall be able to withstand the normal stresses imposed during installation and use.

*Compliance is checked by the tests of **9.18**.*

8.15 Reliability

SRCDs shall provide protection throughout their intended service life, taking into account the ageing in likely working conditions.

*Compliance is checked by the tests of **9.19** and **9.24**.*

8.16 Protection against electric shock and degree of protection IP of the SRCD

Lacquer and enamel are not considered to provide adequate insulation for the purpose of this subclause.

8.16.1 Inaccessibility of live parts

SRCDs shall be designed and constructed in such a way that when they are mounted and wired according to the manufacturer's instructions, live parts are not accessible, even after removal of parts which can be removed without the use of a tool.

A part is considered to be accessible if it can be touched by the standard test finger (see Figure 1).

*Compliance is checked by inspection and by the tests of **9.20.1**.*

8.16.2 Accessible knobs, operating means, etc.

Accessible parts, knobs, operating means, push-buttons, rockers and the like, shall be of insulating material, unless their accessible metal parts are separated from the metal parts of the mechanism by double insulation or reinforced insulation, or as an alternative, they are reliably connected to earth.

Compliance is checked by inspection.

8.16.3 Accessible parts of SRCDs

Accessible parts shall be made of insulating material with the exception of the following:

a) small screws and the like which are isolated from live parts and which are used for fixing bases and covers or cover plates;

b) actuating members complying with **8.16.2**;

c) the covers or cover plates of metal which comply with the requirements of **8.16.3.1** or **8.16.3.2**;

d) socket contact intended to be connected to the PE and parts of the earthing circuit.

8.16.3.1 Covers or cover plates of metal not intended to be earthed shall be protected by additional insulation made by insulating linings or insulating barriers.

The insulating linings or insulating barriers shall either:

a) be fixed to covers or cover plates or the body of the switches in such a way that they cannot be removed without being permanently damaged; or

b) be so designed that:

   i) they cannot be replaced in an incorrect position;

   ii) if they are omitted, the accessories are rendered inoperable or manifestly incomplete;

   iii) there is no risk of accidental contact between live parts and metal covers or cover plates, for example through their fixing screws, even if a conductor should come away from its terminal;

   iv) precautions are taken in order to prevent creepage distances or clearances to become less than the values specified in **8.3.2**.

Compliance is checked by inspection.

*The above linings or barrier shall comply with the requirements of **8.3.2** and **8.9**.*

8.16.3.2 The earthing of metal covers or cover plates

The earthing of metal covers or cover plates is made while fixing the covers or cover plates and may be made without requiring the use of means other than the fixing means; the resulting connection shall be of low resistance.

NOTE Fixing screws or other means are allowed.

*Compliance is checked by inspection and by the tests of **9.20.1**.*

8.16.4 Degree of protection IP of the SRCD

The minimum degree of protection of the SRCD shall be IP20.

*Compliance of the SRCD with degree of protection greater than IP 20 is checked by the tests of **9.20.2**.*

8.17 Resistance to heat

SRCDs shall be sufficiently resistant to heat.

*Compliance is checked by the tests of **9.21**.*

8.18 Resistance to abnormal heat and to fire

External parts of SRCDs made of insulating material shall not be liable to ignite and to spread fire if current-carrying parts in their vicinity, under fault or overload conditions, attain a high temperature. The resistance to abnormal heat and to fire of the other parts made of insulating material is considered as checked by the other tests of this standard.

*Compliance is checked by the tests of **9.22**.*

8.19 Behaviour of SRCDs within ambient temperature range

SRCDs shall operate correctly between –5 °C and +40 °C.

SRCDs according to **4.7.3**b) shall operate correctly between –25 °C and +40 °C.

*Compliance is checked by the tests of **9.8.5**.*

8.20 Resistance to temporary overvoltages

SRCDs shall adequately withstand temporary overvoltages due to various phenomena (such as a fault in the high-voltage network; break of neutral; short-circuit between line conductor and neutral conductor, etc.).

Values of alternating withstanding overvoltage levels and duration are given in Table 11.

Table 11 **Withstand values and duration of temporary overvoltages**

Occurrence	Voltage level	Duration
Between earth and all poles, including neutral, if any [A)]	1 200 V + U_n	5 s
Between earth and all poles, including neutral, if any [A)]	250 V + U_n	1 h
Between the two poles	$\sqrt{3} \times U_n$	1 h

[A)] Only for SRCD with PE terminal.

*Compliance of the above requirement is checked by the test of **9.25**.*

9 Tests

9.1 General

9.1.1 Test conditions

The SRCD is mounted individually according to the manufacturer's instructions as for normal use, in free air, at an ambient temperature between 20 °C and 25 °C, unless otherwise specified, and is protected against undue external heating or cooling.

Unless otherwise specified, tests are carried at the rated frequency ±5%. Test results at 50 Hz are valid at 60 Hz.

SRCDs designed for installation in individual enclosures are tested in the smallest of such enclosures specified by the manufacturer.

Text deleted

Unless otherwise specified, the tests are carried out at 1,1 U_n as applicable.

During the tests, no maintenance or dismantling of the samples is allowed.

For the tests of **9.4**, **9.8**, **9.11**, **9.17** and **9.24**, the SRCD is connected as follows:

- the connections are made by means of single-core, PVC-insulated copper cables in accordance with Table 12;
- the minimum length of each temporary connection from terminal to terminal is 1 m.

Table 12 **Test copper conductors corresponding to the rated currents**

Rated current I_n A	$I_n \leq 6$	$6 < I_n \leq 13$	$13 < I_n \leq 16$
S mm^2	1	2,5	2,5

The tightening torques to be applied to the terminal screws are two-thirds of those specified in Table 20.

An operating speed of 0,1 m/s ± 25% shall be used during actuation for the tests of **9.17** and **9.15.2**. The speed is measured at the extremity when and where the operating means of the test apparatus touches the actuating means of the SRCD under test. For rotary knobs, the angular velocity shall correspond substantially to the above conditions, referred to the speed of the operating means (at its extremities) of the SRCD under test.

9.1.2 Characteristics of SRCDs

Characteristics of SRCDs are checked by means of type tests.

The type tests required by this standard are listed in Table 13.

Table 13 **Type testing schedule**

Reference subclause	**Requirement**	**Test subclause**
8.1	General	
8.2	Information and marking	**9.2**
8.3	Mechanical and electrical design	**9.3, 9.4, 9.5, 9.6, 9.7, 9.26, 9.27**
8.4	Operating characteristics	**9.8**
8.5	Void	
8.6	Test device	**9.10**
8.7	Temperature rise	**9.11**
8.8	Resistance to humidity	**9.12**
8.9	Dielectric properties	**9.13**
8.10	EMC compliance and unwanted tripping	**9.14**
8.11	Behaviour of SRCDs in case of overcurrent conditions	**9.15**
8.12	Resistance of the insulation against impulse voltages	**9.16**
8.13	Mechanical and electrical endurance	**9.17**
8.14	Resistance to mechanical shock	**9.18**
8.15	Reliability	**9.19, 9.24**
8.16	Protection against electric shock	**9.20**
8.17	Resistance to heat	**9.21**
8.18	Resistance to abnormal heat and to fire	**9.22**
8.19	Behaviour of SRCD within ambient temperature range	**9.8.5**
8.20	Resistance to temporary overvoltage (TOV)	**9.25**

9.2 Marking and test of indelibility of marking

*The marking shall comply with the requirement of Clause **6**.*

The test of indelibility of marking is made by rubbing the marking by hand for 15 s with a piece of cotton cloth soaked with water and again for 15 s with a piece of cotton cloth soaked with aliphatic solvent hexane (with a content of aromatics of maximum 0,1% volume, a kauributanol value of 29, an initial boiling point of approximately 65 °C, a dry point of approximately 69 °C and a specific gravity of 0,68 g/cm^3).

Marking made by impressing, moulding or engraving is not subjected to this test.

After this test, the marking shall be easily legible. The marking shall also remain easily legible after all the tests of this standard.

It shall not be easily possible to remove labels and they shall show no curling.

9.3 Verification of the trip-free mechanism

9.3.1 General test conditions

The SRCD is connected and wired as in normal use.

It is tested in a substantially resistive circuit, the diagram of which is shown in Figure 2.

9.3.2 Test procedure

S_1 and the SRCD being previously closed, a residual current equal to 1,5 $I_{\Delta n}$ is passed by closing the switch S_2, whilst the operating means being held in the closed position. The SRCD shall trip.

This test is then repeated by resetting and/or relatching the SRCD slowly over a period of approximately 1 s to a position where the residual current starts to flow. Tripping shall occur without further movement of the operating means.

Both tests are carried out three times, at least once on each pole intended to be connected to a phase.

NOTE If the SRCD is fitted with more than one operating means, the trip-free operation is verified for each operating means.

9.4 Test for the verification of electronic circuits

SRCDs shall not create fire and/or shock hazards under abnormal conditions likely to occur in service.

The conditions under which a component is used within an SRCD shall be in accordance with the operating characteristics marked on the component and/or given in the data provided by the manufacturer.

When SRCDs are exposed to abnormal conditions, no part shall reach temperatures likely to cause danger of fire to the surroundings of the SRCDs and no live parts shall become accessible.

Compliance is checked by subjecting the SRCDs to the heating test under fault conditions as follows:

Unless otherwise specified, the tests are made on SRCDs while they are mounted, connected as specified in **9.11**.

Examination of the SRCD and its circuit diagram will show the fault conditions which shall be applied.

Generally, one separate sample is submitted for each fault condition to be tested.

Each of the following fault conditions a) to e) shall be applied in turn. Only one test is carried out for each of the following fault conditions.

a) Short-circuit across clearances and creepage distances, if smaller than those given by curve A of Figure 3 with the following exception.

   In the requirements for clearances and creepage distances between conductors (one of which may be connected to one pole of the supply mains), which are on a printed board, the values given by Figure 3 are replaced by the values calculated from the following formula:

$$\lg d = 0{,}78 \lg \frac{V}{300} \text{ with a minimum of 0,2 mm}$$

where:

d is the distance in millimetres;

V is the peak value of the voltage in volts.

NOTE 1 These distances can be determined by reference to Figure 4.

NOTE 2 The above reduced values apply to the conductors themselves, but not to mounted components or associated soldered connections. A lacquer coating or the like on printed boards is ignored when calculating the distances.

Clearances and creepage distances, complying with the requirements of Table 6 and printed boards with type 2 coating complying with BS EN 60664-3, are excluded from this test.

b) Short-circuit across insulation consisting of lacquer or enamel coatings.

c) Short-circuit or interruption of semiconductors.

   NOTE 3 For integrated circuits and other semiconductor devices with more than two terminals, the number of tests implied make it impracticable to apply the open-circuiting and/or shorting of all combinations of terminals. In this case, it is permissible first to analyse in detail, by a desk study, all the possible mechanical, thermal and electrical faults which may develop in the SRCD due to the malfunction of the electronic device or other circuit components. Only the combinations corresponding to faults that, on the basis of this analysis, are considered to be likely to cause the non-compliance of the SRCD with the requirements of the last two paragraphs of this subclause are investigated by this method.

d) Short-circuit of electrolytic capacitors.

e) Short-circuit or disconnection of resistors, inductors or capacitors.

   *NOTE 4 Condition e) need not be applied if these components comply with the requirements of **9.5**.*

The temperatures resulting from the fault conditions are measured for the parts mentioned in Table 14 after steady state has been reached or after 4 h (whichever is the shorter time) under each of the fault conditions a) to e).

These temperatures shall not exceed the values given in Table 14 during tests b) and c). They may exceed the values given in Table 14 during test a).

After the tests a) to e), the SRCDs may no longer be capable of meeting all their performance requirements, but they shall comply with the requirements of protection against electric shock according to **9.20**.

Table 14 **Maximum permissible temperatures under abnormal conditions** *(1 of 2)*

Parts of the SRCD	**Maximum permissible temperature under specific abnormal conditions** **°C**
Accessible parts	
Knobs, handles, accessible surfaces, enclosures, if:	
– metallic	100
– non-metallic [A)]	100
Internal surfaces of insulating enclosures [B)]	135
Supply cords and wiring insulation with:[C),F)]	
– polyvinyl chloride or synthetic rubber	135
– natural rubber	
Other insulations: [C)]	
– thermoplastic materials [D)]	[E)]
– non-impregnated paper	105
– non-impregnated cardboard	115
– impregnated cotton, silk, paper and textile	125
– laminates based on cellulose or textile, bonded with:	
• phenol-formaldehyde, melamine-formaldehyde, phenol-furfural or polyester	145
• epoxy	185
– mouldings of:	
• phenol-formaldehyde, or phenol-furfural, melamine and melamine phenolic compounds with:	
– cellulose fillers	165
– mineral fillers	185
• thermosetting polyester with mineral fillers	185
• alkyd with mineral fillers	185
– composite materials of:	
• polyester with fibre glass reinforcement	185
• epoxy with fibre glass reinforcement	185
– silicone rubber	225
Parts of thermoplastic materials [D)] **acting as support or as a mechanical barrier**	[E)]
Winding wires insulated with:[C),F)]	
– non-impregnated silk cotton, etc.	110
– impregnated silk cotton, etc.	135
– oleoresinous materials	170
– polyvinyl-formaldehyde or polyurethane resins	185
– polyester resins	190
– polyesterimid resins	215
Core laminations	As for the relevant windings
Terminals and parts which may come into contact with cable insulation when installed	135

Text deleted

[A)] If this temperature is higher than that allowed by the class of the relevant insulating material, the nature of the material is the governing factor.

[B)] The admissible temperatures for the internal part of insulating enclosures are those indicated for the relevant insulating materials.

[C)] In this standard, the permissible temperatures are based on service experience in relation to the thermal stability of the materials. The materials quoted are examples. For materials for which higher temperature limits are claimed and for materials other than those listed, the maximum temperatures should not exceed those which have been proved to be satisfactory.

[D)] Natural rubber and synthetic rubbers are not considered as being thermoplastic materials.

Table 14 **Maximum permissible temperatures under abnormal conditions** *(2 of 2)*

E) Due to their variety, it is not possible to specify permissible temperatures for thermoplastic materials.

While the matter is under consideration, the following method shall be used:

a) a softening temperature of the material is determined on a separate specimen, under the conditions specified in BS EN ISO 306, modified as follows:
   – the depth of penetration is 0,1 mm;
   – the total thrust of 10 N is applied before the dial gauge is set to zero or its initial reading noted;

b) the temperature limit to be considered is the softening temperature itself.

F) The possibility of raising the values for wires and cables insulated with heat-resistant polyvinyl chloride is under consideration.

9.5 Requirements for capacitors and specific resistors and inductors

These requirements concern capacitors and specific resistors and inductors used in electronic circuits connected between active conductors (phases and neutral) and/or between active conductors and the earth circuit when the contacts are in the closed position.

9.5.1 Capacitors

Capacitors shall comply with the requirements of BS EN 60384-14.

The relevant type of capacitors are as follows.

- X_1 or X_2 when relating to interference;
- Y_1 or Y_2 when relating to shock hazard.

These capacitors shall be marked with their rated voltage in volts, their rated capacitance in microfarads and their reference temperature in degrees Celsius, or the manufacturer may provide data sheets.

9.5.2 Resistors and inductors

Resistors and inductors, whose short-circuiting or disconnection resulted in non-compliance with the requirements of **9.4**, shall comply with the relevant safety requirements of BS EN 60065.

Tests already carried out on resistors and inductors complying with BS EN 60065 are not required to be repeated.

9.6 Test of reliability of screws, current-carrying parts and connections

*Compliance with the requirements of **8.3.4** is checked by inspection and, for screws and nuts which are operated when connecting the SRCD, by the following test.*

The screws or nuts are tightened and loosened:

- 10 times for screws in engagement with a thread of insulating material;
- 5 times in all other cases.

Screws or nuts in engagement with a thread of insulating material are completely removed and re-inserted each time.

The test is made by means of a suitable test screwdriver or spanner applying a torque as shown in Table 15.

Screws and nuts shall not be tightened in jerks.

The test is made with rigid conductors, having the largest cross-sectional areas specified in Table 16. The conductor is moved each time the screw or nut is loosened.

Table 15 **Screw thread diameters and applied torques**

Nominal diameter of thread mm		Torque Nm	
Greater than	Up to and including	I A)	II B)
–	2,8	0,2	0,4
2,8	3,0	0,25	0,5
3,0	3,2	0,3	0,6
3,2	3,6	0,4	0,8
3,6	4,1	0,7	1,2
4,1	4,7	0,8	1,8
4,7	5,3	0,8	2,0

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

B) Column II applies to other screws which are tightened by means of a screwdriver.

During the test, the screwed connections shall not work loose and there shall be no damage, such as breakage of screws or deterioration of the head slots, threads, washers or stirrups that will impair the further use of the SRCD.

Moreover, enclosures and covers shall not be damaged.

9.7 Screwed and screwless terminals

9.7.1 Screwed terminals for external copper conductors

9.7.1.1 SRCDs shall be provided with terminals which shall allow the proper connection of copper conductors having nominal cross-sectional areas as shown in Table 16.

Table 16 **Relationship between rated current and connectable nominal cross-sectional areas of copper conductors**

Current and type of SRCD	**Rigid (solid or stranded) copper conductors C)**		**Flexible copper conductors**	
	Nominal cross-sectional area mm²	**Diameter of the largest conductor** mm	**Nominal cross-sectional area** mm²	**Diameter of the largest conductor** **mm**
6 A	–	–	From 0,75 up to 1,5 inclusive	1,73
10 A 2P and ⏚ 2P+	From 1 up to 2,5 inclusive A)	2,13	–	–
13 A and16 A 2P and ⏚ 2P+	3 × 1,5 3 × 2,5 2 × 4	2,13	–	–

A) The terminal shall allow the connection of two 1,5 mm² conductors having a diameter of 1,45 mm.

Text deleted

C) The use of flexible conductors is permitted.

The conductor space shall be at least that specified in Figures 5, 6, 7 or 8.

Compliance is checked by inspection, by measurement and by fitting conductors of the smallest and largest nominal cross-sectional areas specified.

9.7.1.2 Terminals with screw clamping shall allow the conductor to be connected without special preparation.

Compliance is checked by inspection.

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

9.7.1.3 Terminals with screw clamping shall have adequate mechanical strength.

Screws and nuts for clamping the conductors shall have a metric ISO thread or a thread comparable in pitch and mechanical strength.

Screws shall not be of metal which is soft or liable to creep, such as zinc or aluminium or their alloys.

*Compliance is checked by inspection and by the tests of **9.7.1.6** and **9.7.1.8**.*

9.7.1.4 Terminals with screw clamping shall be resistant to corrosion.

Terminals, whose body is made of copper or copper alloy as specified in **8.3.4**, are considered as complying with this requirement.

9.7.1.5 Terminals with screw clamping shall be so designed and constructed that they clamp the conductor(s) without undue damage to the conductor(s).

Compliance is checked by the following test.

The terminal is placed in the test apparatus according to Figure 9 and fitted with rigid, solid, stranded and/or flexible conductor(s), according to Table 16 first with the smallest and then with the largest nominal cross-sectional area, the clamping screw(s) or nut(s) being tightened with the torque according to Table 15.

Where rigid stranded conductors do not exist, the test may be made with rigid solid conductors only. In this case, there is no need for further tests.

The length of the test conductor shall be 75 mm longer than the height (*H*) specified in Table 17.

The end of the conductor is passed through an appropriate bushing in a plate positioned at a height (*H*) below the equipment, as given in Table 17. The bushing is positioned in a horizontal plane in such a way that its centre line describes a circle of 75 mm diameter, concentric with the centre of the clamping unit in the horizontal plane; the platen is then rotated at a rate of (10 ±2) r/min.

The distance between the mouth of the clamping unit and the upper surface of the bushing shall be within ±15 mm of the height specified in Table 17. The bushing may be lubricated to prevent binding, twisting or rotation of the insulated conductor.

A mass as specified in Table 17 is suspended from the end of the conductor. The duration of the test is approximately 15 min.

During the test, the conductor shall neither slip out of the clamping unit nor break near the clamping unit, nor shall the conductor be damaged in such a way as to render it unfit for further use.

The test shall be repeated with rigid solid conductors where they exist, if the first test has been made with rigid stranded conductors.

Table 17 **Values for flexing under mechanical load test for copper conductors**

Nominal cross-sectional area of conductor mm^2	**Diameter of bushing hole** [A)] mm	**Height, *H*** mm	**Mass for conductor** kg
0,75	6,5	260	0,4
1,0	6,5	260	0,4
1,5	6,5	260	0,4
2,5	9,5	280	0,7
4,0	9,5	280	0,9

[A)] If the bushing-hole diameter is not large enough to accommodate the conductor without binding, a bushing having the next larger hole size may be used.

9.7.1.6 Terminals with screw clamping shall be so designed that they clamp the conductor reliably between metal surfaces.

Compliance is checked by inspection and by the following test.

The terminals are fitted with rigid solid or stranded conductors for fixed socket-outlets using conductors of the smallest and largest nominal cross-sectional area specified in Table 16, the terminal screws being tightened with a torque equal to two-thirds of the torque shown in the appropriate column of Table 15.

If the screw has a hexagonal head with a slot, the torque applied is equal to two-thirds of the torque shown in column 3 of Table 15.

Each conductor is then subjected to a pull as specified in Table 18, applied without jerks, for 1 min, in the direction of the axis of the conductor space.

Table 18 **Values for pull test for screw-type terminals**

Nominal cross-sectional area of conductors accepted by the terminal mm^2	**Pull** N
Above 0,75 up to 1,5 inclusive	40
Above 1,5 up to 2,5 inclusive	50
Above 2,5 up to 4 inclusive	50

If the clamp is provided for two or three conductors, the appropriate pull is applied consecutively to each conductor.

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

9.7.1.7 Terminals with screw clamping shall be so designed or placed that neither a rigid solid conductor nor a wire of a stranded conductor can slip out while the clamping screws or nuts are tightened.

Compliance is checked by the following test.

The terminals are fitted with conductors having the largest nominal cross-sectional area specified in Table 19.

The terminals of fixed socket-outlets are checked both with rigid solid conductors and with rigid stranded conductors.

Text deleted

Terminals intended for the looping-in of two or three conductors are checked, being fitted with the permissible number of conductors.

The terminals are fitted with conductors having the composition shown in Table 19.

Table 19 **Composition of conductors**

Nominal cross-sectional area mm²	**Number of wires (*n*) and nominal diameter of conductors** *n* × mm		
	Flexible conductor	**Rigid solid conductor**	**Rigid stranded conductor**
0,75	24 × 0,20	–	–
1,0	32 × 0,20	1 × 1,13	7 × 0,42
1,5	30 × 0,25	1 × 1,38	7 × 0,52
2,5	50 × 0,25	1 × 1,78	7 × 0,67
4,0	56 × 0,30	1 × 2,25	7 × 0,86

Before insertion into the clamping means of the terminal, wires of rigid (solid or stranded) conductors are straightened; rigid stranded conductors may, in addition, be twisted to restore them approximately to their original shape and flexible conductors are twisted in one direction so that there is a uniform twist of one complete turn in a length of approximately 20 mm.

The conductor is inserted into the clamping means of the terminal for the minimum distance prescribed, or where no distance is prescribed, until it just projects from the far side of the terminal and in the position most likely to allow the wire to escape.

The clamping screw is then tightened with a torque equal to two-thirds of the torque shown in the appropriate column of Table 20.

For flexible conductors, the test is repeated with a new conductor which is twisted as before, but in the opposite direction.

After the test, no wire of the conductors shall have escaped from the clamping unit thus reducing creepage distances and clearances to values lower than those indicated in Table 6.

9.7.1.8 Terminals with screw clamping shall be so fixed or located within the SRCD that, when the clamping screws or nuts are tightened or loosened, the terminals shall not work loose from their fixing to accessories.

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

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

- *the sealing compound or resin is not subject to stress during normal use; and*
- *the effectiveness of the sealing compound or resin is not impaired by temperatures attained by the terminal under the most unfavourable conditions specified in this standard.*

Compliance is checked by inspection, by measurement and by the following test.

A rigid solid copper conductor of the largest nominal cross-sectional area specified in Table 16 is placed in the terminal.

Where rigid solid conductors do not exist, the test may be made with rigid stranded conductors.

Before insertion into the clamping means of the terminal, wires of rigid (solid or stranded) are straightened; rigid stranded conductors may, in addition, be twisted to restore them approximately to their original shape.

The conductor is inserted into the clamping means of the terminal for the minimum distance prescribed, or where no distance is prescribed, until it just projects from the far side of the terminal and in the position most likely to allow the wire to escape.

Screws and nuts are tightened and loosened five times by means of a suitable test screwdriver or spanner, the torque applied when tightening being equal to the torque shown in the appropriate column of Table 20 or in the table of the appropriate Figures 5, 6 or 7, whichever is the greater.

The conductor is moved each time the screw or nut is loosened.

Where a screw has a hexagonal head with a slot, only the test with the screwdriver is made with the torque values given in column 3 of Table 20.

Table 20 **Tightening torques for the verification of the mechanical strength of screw-type terminals**

Nominal diameter of thread mm	**Torque** Nm		
	1 A)	**2** B)	**3** C)
Up to and including 2,8	0,2	0,4	–
Over 2,8 up to and including 3,0	0,25	0,5	–
Over 3,0 up to and including 3,2	0,3	0,6	–
Over 3,2 up to and including 3,6	0,4	0,8	–
Over 3,6 up to and including 4,1	0,7	1,2	1,2
Over 4,1 up to and including 4,7	0,8	1,8	1,2
Over 4,7 up to and including 5,3	0,8	2,0	1,4

A) Column 1 applies to screws without a head if the screw, when tightened, does not protrude from the hole and to other screws which cannot be tightened by means of a screwdriver with a blade wider than the diameter of the screw.

B) Column 2 applies to other screws which are tightened by means of a screwdriver and to screws and nuts which are tightened by means other than a screwdriver.

C) Column 3 applies to nuts of mantle terminals which are tightened by means of a screwdriver.

During the test, terminals shall not work loose and there shall be no damage, such as breakage of screws or damage to heads, slots (rendering the use of the appropriate screwdriver impossible), threads, washers or stirrups that will impair the further use of the terminal.

NOTE 3 For mantle terminals the specified nominal diameter is that of the slotted stud.

NOTE 4 The shape of the blade of the test screwdriver should suit the head of the screw to be tested.

NOTE 5 The screws and nuts should not be tightened in jerks.

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

Compliance is checked by manual test.

NOTE In general, the design of terminals shown in Figures 5, 6, 7 and 8 provide sufficient resiliency to comply with this requirement; for other designs, special provisions, such as the use of an adequate resilient part which is not likely to be removed inadvertently, may be necessary.

9.7.1.10 Earthing terminals with screw clamping shall be such that there is no risk of corrosion resulting from contact between these parts and the copper of the earthing conductor, or any other metal that is in contact with these parts.

The body of the earthing terminal shall be of brass or other metal no less resistant to corrosion, unless it is a part of the metal frame or enclosure, when the screw or nut shall be of brass or other metal no less resistant to corrosion.

If the body of the earthing terminal is a part of a frame or enclosure of aluminium alloy, precautions shall be taken to avoid the risk of corrosion resulting from contact between copper and aluminium or its alloys.

Compliance is checked by inspection.

NOTE Screws or nuts of plated steel withstanding the corrosion test are considered to be of a metal no less resistant to corrosion than brass.

9.7.1.11 For pillar terminals, the distance between the clamping screw and the end of the conductor, when fully inserted, shall be at least that specified in Figure 5.

NOTE The minimum distance between the clamping screw and the end of the conductor applies only to pillar terminals in which the conductor cannot pass right through.

For mantle terminals, the distance between the fixed part and the end of the conductor, when fully inserted, shall be at least that specified in Figure 8.

Compliance is checked by measurement, after a solid conductor of the largest nominal cross-sectional area, as specified in Table 16, has been fully inserted and fully clamped.

9.7.2 Screwless terminals for external copper conductors

9.7.2.1 Screwless terminals may be of the type suitable for rigid copper conductors only or of the type suitable for both rigid and flexible copper conductors.

For the latter type the tests are carried out with rigid conductors first and then repeated with flexible conductors.

NOTE This subclause is not applicable to SRCDs provided with:

- *screwless terminals requiring the fixing of special devices to the conductors before clamping them in the screwless terminal, for example flat push-on connectors;*
- *screwless terminals requiring twisting of the conductors, for example, those with twisted joints;*
- *screwless terminals providing direct contact to the conductors by means of edges or points penetrating the insulation.*

9.7.2.2 Screwless terminals shall be provided with two clamping units each allowing the proper connection of rigid or of rigid and flexible copper conductors having nominal cross-sectional areas as shown in Table 21.

Table 21 **Relationship between rated current and connectable cross-sectional areas of copper conductors for screwless terminals**

Rated current A	**Conductors**		
	Nominal cross-sectional areas mm^2	**Diameter of largest rigid conductor** mm	**Diameter of largest flexible conductor** mm
From 10 up to 16 inclusive	From 1,5 up to 2,5 inclusive	2,13	2,21

When two conductors have to be connected, each conductor shall be introduced in a separate independent clamping unit (not necessarily in separate holes).

Compliance is checked by inspection and by fitting conductors of the smallest and largest nominal cross-sectional areas specified.

9.7.2.3 Screwless terminals shall allow the conductor to be connected without special preparation.

Compliance is checked by inspection.

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

9.7.2.4 Parts of screwless terminals mainly intended to carry current shall be of materials as specified in **8.3.4**.

*Compliance is checked by inspection and by the test of **9.27**.*

NOTE Springs, resilient units, clamping plates and the like are not considered as parts mainly intended to carry current.

9.7.2.5 Screwless terminals shall be so designed that they clamp the specified conductors with sufficient contact pressure and without undue damage to the conductor.

The conductor shall be clamped between metal surfaces.

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

*Compliance is checked by inspection and by the tests of **9.7.2.10**.*

9.7.2.6 It shall be clear how the connection and disconnection of the conductors is to be made.

The intended disconnection of a conductor shall require an operation, other than a pull on the conductor, so that it can be made manually with or without the help of a general purpose tool.

It shall not be possible to confuse the opening intended for the use of a tool to assist the connection or disconnection with the opening intended for the conductor.

*Compliance is checked by inspection and by the tests of **9.7.2.10**.*

9.7.2.7 Screwless terminals which are intended to be used for the interconnection of two or more conductors shall be so designed that:

- during the insertion, the operation of the clamping means of one of the conductors is independent of the operation of that of the other conductor(s);

- during the disconnection, the conductors can be disconnected either at the same time or separately;
- each conductor shall be introduced in a separate clamping unit (not necessarily in separate holes);
- it shall be possible to clamp securely any number of conductors up to the maximum as designed.

Compliance is checked by inspection and by manual tests with the appropriate conductors (in number and size).

9.7.2.8 Screwless terminals of fixed SRCDs shall be designed so that adequate insertion of the conductor is obvious and over-insertion is prevented if further insertion is liable to reduce the creepage distances and/or clearances required in Table 6, or to influence the operation of the SRCD.

NOTE For the purpose of this requirement, an appropriate marking indicating the length of insulation to be removed before the insertion of the conductor into the screwless terminal may be put on the SRCD or given in an instruction sheet which accompanies the SRCD.

Compliance is checked by inspection and by the tests of ***9.7.2.10****.*

9.7.2.9 Screwless terminals shall be properly fixed to the SRCD.

They shall not work loose when the conductors are connected or disconnected during installation.

Compliance is checked by inspection and by the tests of ***9.7.2.10****.*

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

9.7.2.10 Screwless terminals shall withstand the mechanical stresses occurring in normal use.

Compliance is checked by the following tests which are carried out with uninsulated conductors on one screwless terminal of each specimen, using a new specimen for each test.

The test is carried out with solid rigid copper conductors, first with conductors having the largest nominal cross-sectional area, and then with conductors having the smallest nominal cross-sectional area specified in Table 21.

Conductors are connected and disconnected five times, new conductors being used each time, except for the fifth time, when the conductors used for the fourth connection are clamped at the same place. For each connection, the conductors are either pushed as far as possible into the terminal or are inserted so that adequate connection is obvious.

After each connection, the conductor is subjected to a pull of the value shown in Table 22. The pull is applied without jerks, for 1 min in the direction of the longitudinal axis of the conductor space.

Table 22 **Value for pull test for screwless-type terminals**

Rated current A	**Pull** N
10 up to and including 16	30

During the application of the pull the conductor shall not come out of the screwless terminal.

The test is then repeated with rigid stranded copper conductors having the largest and smallest nominal cross-sectional areas specified in **9.7.2.2**. These conductors are, however, connected and disconnected only once.

Screwless terminals intended for both rigid and flexible conductors shall also be tested with flexible conductors, making five connections and disconnections.

For fixed SRCDs with screwless terminals, each conductor is subjected for 15 min to a circular motion with (10 ±2) r/min using an apparatus, an example of which is shown in Figure 9. During this test, a mass as specified in Table 23 is suspended from the end of the conductor.

Table 23 **Values for flexing under mechanical load test for copper conductors**

Nominal cross-sectional area of conductor mm^2	**Diameter of bushing hole** [A)]	**Height, *H*** mm	**Mass for conductor** kg
0,5	6,5	260	0,3
0,75	6,5	260	0,4
1,0	6,5	260	0,4
1,5	6,5	260	0,4
2,5	9,5	280	0,7
4,0	9,5	280	0,9

Text deleted

[A)] If the bushing-hole diameter is not large enough to accommodate the conductor without binding, a bushing having the next larger hole size may be used.

During the test, the conductors shall not move noticeably in the clamping unit.

After these tests, neither the terminals nor the clamping means shall have worked loose and the conductors shall show no deterioration impairing their further use.

9.7.2.11 Screwless terminals shall withstand the electrical and thermal stresses occurring in normal use.

Compliance is checked by the following tests a) and b), which are carried out on five screwless terminals of SRCDs which have not been used for any other test.

Both tests are carried out with new copper conductors.

a) The test is carried out loading the screwless terminals for 1 h with an alternating current as specified in Table 24 and connecting rigid solid conductors 1 m long having the nominal cross-sectional area as specified in the same table.

   The test is carried out on each clamping unit.

Table 24 **Test current for the verification of electrical and thermal stresses in normal use for screwless terminals**

Rated current A	**Test current** A	**Nominal cross-sectional area of the conductor** mm^2
13	19	2,5
16	22	2,5

Text deleted

During the test, the current is not passed through the SRCD, but only through the terminals.

Immediately after this period, the voltage drop across each screwless terminal is measured with rated current flowing.

In no case shall the voltage drop exceed 15 mV.

The measurements are made across each screwless terminal and as near as possible to the place of contact.

If the back connection of the terminal is not accessible, the specimens may be adequately prepared by the manufacturer; care shall be taken not to affect the behaviour of the terminals.

Care shall be taken to ensure that, during the period of the test, including the measurements, the conductors and the measurement devices are not moved noticeably.

b) The screwless terminals already subjected to the determination of the voltage drop specified in the previous test a) are tested as follows.

During the test, a current equal to the test current value given in Table 24 is passed.

The whole test arrangement, including the conductors, shall not be moved until the measurements of the voltage drop have been completed.

The terminals are subjected to 192 temperature cycles, each cycle having a duration of approximately 1 h and carried out as follows:

- the current flows for approximately 30 min;
- for a further period of approximately 30 min no current flows.

The voltage drop in each screwless terminal is determined as prescribed for the test of a) after every 24 temperature cycles and after the 192 temperature cycles have been completed.

In no case shall the voltage drop exceed 22,5 mV or twice the value measured after the 24th cycle, whichever is the smaller.

After this test an inspection by normal or corrected vision without additional magnification shall show no changes evidently impairing further use such as cracks, deformations or the like.

In addition, the mechanical strength test according to **9.7.2.10** is repeated and all specimens shall withstand this test.

9.7.2.12 Screwless terminals shall be so designed that the connected rigid solid conductor remains clamped, even when it has been deflected during normal installation, for example, during mounting in a box, and the deflecting stress is transferred to the clamping unit.

Compliance is checked by the following test which is made on three specimens of SRCDs which have not been used for any other test.

The test apparatus, the principle of which is shown in Figure 10a) shall be so constructed that:

- a specified conductor properly inserted into a terminal is allowed to be deflected in any of the 12 directions differing from each other by 30°, with a tolerance referred to each direction of ±5°; and
- the starting point can be varied by 10° and 20° from the original point.

NOTE 1 A reference direction need not be specified.

The deflection of the conductor from its straight position to the testing positions shall be effected by means of a suitable device, applying a specified force to the conductor at a certain distance from the terminal.

The deflecting device shall be so designed that:

- the force is applied in a direction perpendicular to the undeflected conductor;
- the deflection is attained without rotation or displacement of the conductor within the clamping unit;
- the force remains applied while the prescribed voltage drop measurement is made.

Provisions shall be made so that the voltage drop across the clamping unit under test can be measured when the conductor is connected, as shown for example in Figure 10b).

The specimen is mounted on the fixed part of the test apparatus in such a way that the specified conductor inserted into the clamping unit under test can be freely deflected.

NOTE 2 If necessary, the inserted conductor may be permanently bent around obstacles so that these do not influence the results of the test.

NOTE 3 In some cases, with the exception of the case of guidance for the conductor, it may be advisable to remove those parts of the specimens which do not allow the deflection of the conductor corresponding to the force to be applied.

To avoid oxidation, the insulation shall be removed from the conductor immediately before starting the test.

A clamping unit is fitted as for normal use with a rigid solid copper conductor having the smallest nominal cross-sectional area specified in Table 25 and is submitted to a first test sequence; the same clamping unit is submitted to a second test sequence using the conductor having the largest nominal cross-sectional area, unless the first test sequence has failed.

The force for deflecting the conductor is specified in Table 26, the distance of 100 mm being measured from the extremity of the terminal, including the guidance, if any, for the conductor, to the point of application of the force to the conductor.

The test is made with continuous current (i.e. the current is not switched on and off during the test); a suitable power supply should be used and an appropriate resistance should be inserted in the circuit so that the current variations are kept within ±5% during the test.

Table 25 **Nominal cross-sectional areas of rigid copper conductors for deflection test of screwless terminals**

Rated current of the SRCD A	**Nominal cross-sectional area of the test conductor** mm^2	
	First test sequence	**Second test sequence**
13A, 16A	2,5	4
Text deleted		

Table 26 **Deflection test forces**

Nominal cross-sectional area of the test conductor mm²	**Force for deflecting the test conductor** [A)] N
1,0	0,25
1,5	0,5
2,5	1,0
4,0	1,5

[A)] The forces are chosen so that they stress the conductors close to the limit of elasticity.

A test current equal to the rated current of the SRCD is passed through the clamping unit under test. A force according to Table 26 is applied to the test conductor inserted in the clamping unit under test in one of the 12 directions shown in Figure 10a) and the voltage drop across this clamping unit is measured. The force is then removed.

The force is then applied successively on each one of the remaining 11 directions shown in Figure 10a), following the same test procedure.

If, for any of the 12 test directions, the voltage drop is greater than 25 mV, the force is maintained in this direction until the voltage drop is reduced to a value below 25 mV, but for not more than 1 min. After the voltage drop has reached a value below 25 mV, the force is maintained in the same direction for a further period of 30 s during which period the voltage drop shall not have increased.

The other two specimens of SRCDs of the set are tested following the same test procedure, but moving the 12 directions of the force so that they differ by approximately 10° for each specimen.

If one specimen has failed at one of the directions of application of the test force, the tests are repeated on another set of specimens, all of which shall comply with this new series of tests.

9.8 Verification of the operating characteristics of type AC and type A SRCDs

9.8.1 Test circuit

The SRCD is connected in accordance with Figure 2.

Unless otherwise specified, the tests shall be carried out at 0,85 U_n and 1,1 U_n.

The test circuit shall be of negligible inductance.

The instruments for the measurement of the residual current shall show (or permit to determine) the true r.m.s. value.

The instruments for the measurement of time shall have a maximum relative error not greater than 10% of the measured value.

9.8.2 Verification of behaviour in the case of supply voltage failure

With test switch S_2 in the open position, and S_1 and the SRCD in the closed position:

a) switch S_1 is then opened;

b) only SRCDs classified according to **4.1.2**a) and **4.1.2**b) shall open automatically;

c) switch S_1 is re-closed.

Only SRCDs classified according to **4.1.2**b) shall re-close automatically.

For SRCDs with manual opening means, the test is repeated with S_2 and the SRCD set in the open position and S_1 in the closed position.

Switch S_1 is then opened and re-closed.

The SRCD shall not re-close automatically.

For the purposes of this test, the test button is not considered to be a manual opening means.

9.8.3 Off-load tests with residual sinusoidal alternating currents at the reference temperature of (20 ±5) °C

The SRCD shall perform the tests of **9.8.3.1**, **9.8.3.2** and **9.8.3.3** (each one comprising five measurements, except at 175 A and above for which it is done only once), made on one pole only, taken at random, but not all samples being tested on the same pole.

9.8.3.1 Verification of the correct operation in case of a steady increase of the residual current

With the test switches S_1 and S_2 and the SRCD in the closed position, the residual current is steadily increased, starting from a value not higher than 0,2 $I_{\Delta n}$, to try to attain the value of $I_{\Delta n}$ within 30 s. The tripping current is measured each time.

All five measured values shall be between $I_{\Delta no}$ and $I_{\Delta n}$.

9.8.3.2 Verification of the correct operation at closing on residual current

Verification is carried out as follows.

a) With the test circuit calibrated at $I_{\Delta n}$ and the test switches S_1 and S_2 closed, the SRCD is closed on the circuit so as to simulate service conditions as closely as possible. The break time is measured five times. No measurement shall exceed the limiting value as specified in Table 1 or Table 2, as applicable.

b) For SRCDs classified according to **4.1.2**a), after the last tripping due to the residual current, switch S_1 is opened and then re-closed without manually resetting the SRCD.

   The SRCD shall remain in the open position.

   NOTE The momentary re-closing of the contacts for a time not exceeding that stated in Table 1, when the line voltage is restored under fault conditions, is allowed.

c) For SRCDs classified according to **4.1.2**b), the switch S_1 being closed, the SRCD is closed. The opening of switch S_1 shall open the SRCD. Switch S_2 is then closed and thereafter S_1. If the SRCD re-closes it shall trip within the relevant specified time. The test is made five times at $I_{\Delta n}$ with measurement of the break time. No measurement shall exceed the relevant specified limiting value in Table 1.

9.8.3.3 Verification of the correct operation in case of sudden appearance of residual current

For SRCDs classified to **4.1.1**, with the test circuit successively calibrated at each value of residual current specified in Table 1, the test switch S_2 and the SRCD in the closed position, the residual current is suddenly established by closing test switch S_1.

For SRCDs classified to **4.1.2**a) and **4.1.2**b), with the test circuit successively calibrated at each value of residual current specified in Table 1, the test switch S_1 and the SRCD in the closed position, the residual current is suddenly established by closing test switch S_2.

The SRCD shall trip during each test.

Five tests, with a delay of 60 s between each test, are carried out at each value of residual current with measurement of break time; test at 175 A and above is made only once.

No value shall exceed the relevant limiting value specified in Table 1.

9.8.4 Verification of the correct operation with load at the reference temperature

The tests of **9.8.3.2**a) and **9.8.3.3** are repeated, the SRCD being loaded with rated current for a sufficient time so as to reach steady-state conditions. In practice, these conditions are reached when the variation of temperature rise does not exceed 1 K/h.

9.8.5 Verification of the correct operation at the temperature limits with and without load

9.8.5.1 SRCDs classified according to 4.7.3a) and 4.7.3b)

The SRCD shall perform tests under the following conditions:

a) in **9.8.3.3** at 0,85 U_n and ambient temperature: –5 °C off-load;

b) in **9.8.3.2**a) and **9.8.3.3** at 1,1 U_n and ambient temperature: +40 °C, the SRCD being loaded with the rated current until it attains thermal steady-state conditions and mounted as in **9.11**.

In practice, these conditions are reached when the variation of temperature rise does not exceed 1 K/h.

NOTE 1 Preheating may be made at reduced voltage.

NOTE 2 The current and voltage may be derived from two separate sources. An example is given in Figure 11.

9.8.5.2 Verification of the correct operation at low ambient air temperatures for SRCDs classified according to 4.7.3b)

Enclosed-type SRCDs are tested in their enclosure, unenclosed-type SRCDs being mounted in an individual enclosure with a degree of protection IP55, and are connected as for normal use (see Figure 2).

NOTE 1 No drain hole in the enclosure should be opened for this test.

NOTE 2 SRCDs tested in enclosures IP55 may also be used in enclosures of a degree of protection other than IP55 within the temperature range of –25 °C to +40 °C.

The SRCD (including the enclosure) is brought into a suitable test chamber with an ambient air temperature of (23 ±2) °C and a relative humidity of (93 ±3)%. The volume ratio of the test chamber to the test samples (including enclosures) shall be greater than 50.

The SRCD is in the ON position without load and shall be subjected to the following cycle (see Figure 12).

For the first 6 h (stabilization period) the temperature is kept at (23 ±2) °C and the humidity at (93 ±3)%. Within the next 6 h, the ambient air temperature is decreased to (–25 ±2) °C without any supply of humidity. This temperature of (–25 ±2) °C is kept for 6 h. Within the next 6 h, the temperature is increased to (+23 ±2) °C and the relative humidity is increased to (93 ±3)% (end of the first cycle). This cycle is performed five times.

During these cycles the SRCD shall not trip.

During the fifth cycle, at the end of the period at (–25 ±2) °C, an a.c. residual current is passed through one pole of the SRCD (see Figure 2).

For SRCDs, the residual current is calibrated to 1,25 $I_{\Delta n}$ and established by closing test switch S_2. One test only is made on one pole taken at random. The break time measured shall not exceed the value specified in Table 1 for $I_{\Delta n}$.

In addition, the type A SRCD is tested with pulsating d.c. residual currents immediately after the above test with a.c. residual current, the test circuit corresponding to Figure 14.

The residual current is calibrated to 1,25 × 2 $I_{\Delta n}$ for SRCDs with I_{Δ} ≤ 0,01 A, and to 1,25 × 1,4 $I_{\Delta n}$ for SRCDs with $I_{\Delta n}$ > 0,01 A. The current delay angle shall be = 0°, the position of test switch S_3 is set at random, and the current is established by closing test switch S_2. One test only is made on one pole taken at random. The break time measured shall not exceed the value specified in Table 1 for $I_{\Delta n}$.

After these tests a visual inspection shall show that the materials have not undergone deterioration impairing the further use of the SRCD and it shall be possible to switch on the SRCD, without the presence of any residual current, at the temperature of –25 °C.

9.8.6 Void

9.8.7 Verification of correct operation of type A SRCDs with residual currents having a d.c. component

The test conditions of **9.8.1** apply, except that the test circuits shall be those shown in Figure 14 and Figure 15, as applicable.

9.8.7.1 Verification of correct operation in case of a continuous rise of a residual pulsating direct current

The test shall be performed according to Figure 14.

Test switches S_1 and S_2 and the SRCD under test are closed. The relevant thyristor shall be controlled in such a manner that current delay angles α of 0°, 90° and 135° are obtained. Each pole of the SRCD shall be tested twice at each of the current delay angles, twice in position I and twice in position II of test switch S_3.

At each test, the current, starting from zero, shall be steadily increased within 30 s to:

- 1,4 $I_{\Delta n}$ for SRCDs with $I_{\Delta n}$ > 0,01 A;
- 2 $I_{\Delta n}$ for SRCDs with $I_{\Delta n}$ ≤ 0,01 A.

The tripping current shall be in accordance with Table 27.

Table 27 **Tripping current ranges for SRCDs in case of pulsating d.c. current**

Angle	**Tripping current**	
	A	
α	**Lower limit for each value of** α	**Upper limit for all values of** α
0° 90° 135°	0,35 $I_{\Delta n}$ 0,25 $I_{\Delta n}$ 0,11 $I_{\Delta n}$	For $I_{\Delta n} \leq$ 10 mA: 2 $I_{\Delta n}$ For $I_{\Delta n}$ > 10 mA: 1,4 $I_{\Delta n}$

9.8.7.2 Verification of correct operation in case of residual pulsating direct currents in the presence of a standing smooth direct current of 0,006 A

The SRCD shall be tested according to Figure 15 with a half-wave rectified residual current (current delay angle α = 0°) and a standing smooth direct current of 0,006 A.

Each pole of the SRCD is tested in turn, twice in position I and twice in position II.

At each test, the half-wave current I_1, starting from zero, shall be steadily increased within 30 s to:

- 1,4 $I_{\Delta n}$ for SRCDs with $I_{\Delta n}$ > 0,01 A;
- 2 $I_{\Delta n}$ for SRCDs with $I_{\Delta n} \leq$ 0,01 A.

The half-wave current I_1, starting from zero, being steadily increased at an approximate rate of 1,4 $I_{\Delta n}$ /30 A/s for SRCDs with $I_{\Delta n}$ > 0,01 A and 2 $I_{\Delta n}$/30 A/s for SRCDs with $I_{\Delta n} \leq$ 0,01 A, the device shall trip before this half-wave current I_1 reaches a value not exceeding 1,4 $I_{\Delta n}$ or 2 $I_{\Delta n}$ as applicable.

9.8.7.3 Verification of correct operation in case of suddenly appearing residual pulsating direct currents

The SRCD shall be tested according to Figure 14.

The circuit is successively calibrated at the values of $I_{\Delta n}$ given in Table 2.

With the test circuit successively calibrated at each value of residual current specified in Table 2, the test switch S_1, and the SRCD in the closed position, the residual current is suddenly established by closing test switch S_2.

Two measurements of the break time are made at each of those values at a current delay angle α = 0°, with the test switch S_3 in position I for the first measurement and in position II for the second measurement.

No value shall exceed the specified limiting values given in Table 2.

9.8.7.4 Verification at reference temperature of the correct operation with load

The tests of **9.8.7.1** are repeated, only at current delay angle α = 0°, the SRCD being loaded with the rated current, this current being established shortly before the test.

NOTE The loading with rated current is not shown in Figure 14.

9.9 Void

9.10 Verification of the test device

9.10.1 Verification of the simulated residual current

In order to check that the ampere-turns due to the actuation of the test device are less than 2,5 times the ampere-turns produced by a residual current equal to $I_{\Delta n}$ at the rated voltage, the impedance of the circuit of the test device is measured and the test current is calculated, taking into account the configuration of the circuit of the test device.

If, for such verification, the dismantling of the SRCD is necessary, a separate sample shall be used.

*NOTE 1 The verification of the endurance of the test device is considered as covered by the tests of **9.17**.*

NOTE 2 If the test is performed with a pulsating d.c. residual current, the value 2,5 $I_{\Delta n}$ is multiplied by a factor 2 for SRCDs with $I_{\Delta n}$ ≤10 mA and 1,4 for SRCDs with $I_{\Delta n}$ >10 mA.

9.10.2 Verification of the operation of the test device

Verification is carried out as follows.

a) With the SRCD being supplied with a voltage equal to 1,1 times the rated voltage, the test device is momentarily actuated 25 times at intervals of 5 s, the SRCD being re-closed before each operation.

b) Test a) is then repeated, but only once, the operating means of the test device being held in the closed position for 30 s.

c) Test a) is then repeated at 0,85 times the rated voltage.

At each test a), b) and c), the SRCD shall operate. After the test, it shall show no change impairing its further use.

9.11 Verification of the limit of temperature rise

9.11.1 Test conditions

9.11.1.1 SRCD

Flush-mounted SRCDs having one or two sets of socket contacts and designed for use with flush-mounted socket-outlet boxes to either Figure 1b) or Figure 2b) of BS 4662:2006+A1:2009 are mounted on a steel box having an internal depth of 35 mm. The flush-mounted socket-outlet box is placed in a block of wood simulating the conditions of normal use, so that the front edges of the box are between 2.5 mm and 5 mm below the front surface of the block. The size of the block shall be such that there is a minimum of (25 ±1) mm of wood surrounding the box on all four sides and the back.

Surface type SRCDs shall be mounted centrally on the surface of a wooden block, which shall be at least 20 mm thick, 500 mm wide and 500 mm high.

Other types of SRCD shall be mounted according to the manufacturer's instruction or, in the absence of such an instruction, in the position of normal use considered to give the most onerous conditions.

The phase, neutral and earth terminals of a single or twin SRCD designed to accept plugs complying with BS 1363 are connected to an incoming and an outgoing 2.5 mm^2, 2-core and earth PVC insulated and sheathed cable complying with Table 8 of BS 6004:2012.

A single or twin SRCD designed for other plug configurations is connected with an incoming cable as specified above but with no outgoing cable.

The incoming cable shall enter on the horizontal axis on one side of the enclosure, and where an outgoing cable is fitted it shall leave on the horizontal axis on the opposite side of the enclosure.

Where possible, the cables shall enter and leave the enclosure through the standard knockouts provided and these, if appropriate, shall be fitted with suitable rubber grommets. The points of entry and exit shall be sealed to prevent circulation of air.

For surface-mounted SRCDs the length of each of the cables within the enclosure shall be (75 ±5) mm, and for flush and panel-mounted SRCDs the length of each cable within the box shall be (150 ±5) mm. In each case the outer sheath shall be removed from the cores to within 20 mm of the point of entry of the cable to the box or enclosure.

In the case of devices having more than one socket-outlet, the disposition of the plugs shall be so arranged as to give the most onerous test conditions with regard to the position of terminals and fuses.

The test conditions of **9.1** apply, except that the SRCD shall be supplied at 1,05 U_n.

SRCDs shall be so constructed that they comply with the following temperature-rise test.

The terminal screws or nuts, if any, are tightened with a torque equal to two-thirds of that specified in Table 15.

The test assembly shall be placed in a draught-free environment for the test.

9.11.1.2 Connection units

Surface-mounted connection units are mounted as in use, with their accompanying mounting block or backplate fixed to a vertical plywood board, having a nominal thickness of 24 mm and having a surface extending at least 150 mm in each direction beyond the extremity of the connection unit. For connection units that have an IP classification higher than IPX0 the test is carried out with any lids closed if the design permits this when in use.

Flush-mounted connection units designed for use with flush-mounted boxes as shown in Figure 1b) of BS 4662:2006+A1:2009 are mounted on a test fixture designed to simulate normal conditions of use, comprising a metal box having a nominal internal depth of 35 mm, which is fixed into a block of wood such that the front edges of the metal box are between 2.5 mm and 5 mm below the front surface of the block. The size of the block shall be such that there is a minimum of (25 ±1) mm of wood surrounding the box on all four sides and the back. The connection unit is then mounted by means of its fixing screws, so that the rear of the plate is flush with the surface of the block.

The incoming (supply) line, neutral and earth terminals of a connection unit are connected to an incoming and outgoing 2.5 mm^2, 2-core and earth PVC insulated and sheathed cable as given in Table 4 of BS 6004:2012.

The incoming (supply) cable shall enter on the horizontal axis on one side of the enclosure and the outgoing (supply) cable shall leave on the horizontal axis on the opposite side of the enclosure. Where possible, the cables shall enter and leave the enclosure through the standard knockouts provided and these, if required, shall be fitted with suitable grommets. The points of entry and exit shall be sealed to prevent circulation of air.

The connection unit shall be wired with the incoming and outgoing (supply) cables as described above, and with a 1.5 mm^2, 3-core flexible cord as given in Table 27 of BS EN 50525-2-11 for the load (outgoing) which shall leave the position dictated by the design or, where there is a choice, at the bottom of the enclosure. Connection units fitted with cord grips are wired as intended in normal use with the cord grip device operative.

For surface-mounted connection units the length of each of the cables within the enclosure shall be (75 ±5) mm and for flush connection units the length of each cable within the box shall be (150 ±5) mm. In each case the outer sheath shall be removed from the cores to within 20 mm of the point of entry of the cable to the box or enclosure.

Cables outside the box or enclosure shall each have a minimum length of 1 m.

The fuse-link incorporated in the connection units is replaced by a calibrated link which shall be constructed and calibrated in accordance with Annex A of BS 1363-4:2016.

The test conditions of **9.1** apply, except that the connection unit shall be supplied at 1,05 U_n.

Connection units shall be so constructed that they comply with the following temperature-rise test.

The terminal screws or nuts, if any, are tightened with a torque equal to two-thirds of that specified in Table 15.

The test assembly shall be placed in a draught-free environment for the test.

9.11.2 Ambient air temperature

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 SRCD/connection unit at about half its height and at a distance of about 1 m from the SRCD/connection unit.

The thermometers or thermocouples shall be protected against draughts and radiant heat.

NOTE Care should be taken to avoid errors due to sudden temperature changes.

9.11.3 Test procedure

9.11.3.1 Test for SRCD classified according to 4.2.1

The SRCD under test shall be subjected to electrical loading as described in Table 27A. Where a BS 1363 plug is specified it shall be a special test plug, as shown in BS 1363-2:2016, Figure 30, constructed and calibrated whilst carrying a 14 A load as described in Annex G of BS 1363-2:2016. During the test the resistor of the test plug shall be connected to a d.c. source of supply equivalent to the calibration voltage.

The SRCD is operated as described in Table 27A for a continuous period of 4 h or longer until temperature stability is reached with a maximum duration of 8 h, stability being taken as less than 1 K change within 1 h. Temperature rises shall not exceed the values specified in Table 8.

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

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

Table 27A **Loading of SRCDs for temperature rise test**

Type of socket	Plugs with connected loads	Balance of load	Total load on supply cable
Single complying with BS 1363-2	1 × 14 A	6 A	20 A
Other single	rated current	–	rated current
Twin complying with BS 1363-2	1 × 14 A + 1 × 6 A	–	20 A
Other twin	1 × rated current 1 × 50% rated current	–	1.5 × rated current

9.11.3.2 Test for connection unit classified according to 4.2.3

The connection unit under test shall be subjected to the following electrical loads:

a) total load on supply cables: 20 A nominal;

b) connected load on outgoing terminals: (14 ±0.4) A;

c) balance of load on supply terminals: (6 ±0.4) A.

The connection unit is operated with these loads for a continuous period of 4 h or longer until temperature stability is reached with a maximum duration of 8 h, stability being taken as less than 1 K change within 1 h. Temperature rises shall not exceed the values specified in Table 8.

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

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

9.11.4 Measurement of the temperature rise of different parts

The temperature of the different parts referred to in Table 8 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.

9.12 Resistance to humidity

9.12.1 Preparation of the SRCD for test

Parts of the SRCDs which can be removed without the aid of a tool are removed and subjected to the humidity treatment together with the main part. Spring lids, if any, are kept open during this treatment.

Inlet openings, if any, are left open; if knock-outs are provided, one of them is opened. The SRCD shall be in the open position, without supply voltage and in free air.

9.12.2 Test conditions

The humidity treatment is carried out in a humidity cabinet containing air with a relative humidity maintained between 91% and 95%.

The temperature of the air in which the sample is placed is maintained within ±1 K at any convenient value T between 20 °C and 30 °C.

Before being placed in the humidity cabinet the sample is brought to a temperature between T °C and (T + 4) °C.

9.12.3 Test procedure

The SRCD is kept in the cabinet for 48 h.

NOTE 1 A relative humidity between 91% and 95% may be obtained by placing in the humidity cabinet a saturated solution of sodium sulfate (Na_2SO_4) or potassium nitrate (KNO_3) in water having a sufficiently large surface in contact with the air.

NOTE 2 In order to achieve the specified conditions within the cabinet, it is recommended to ensure constant circulation of air and to use a cabinet which is thermally insulated.

9.12.4 Condition of the SRCD after the test

After this treatment, the sample shall show no damage within the meaning of this standard and when removed from the cabinet, shall comply with the tests of **9.13.1** and **9.13.2**.

9.13 Test of dielectric properties

9.13.1 Insulation resistance of the main circuit

After an interval between 30 min and 60 min following the test of **9.12**, the insulation resistance is measured 5 s after application of a d.c. voltage of approximately 500 V, successively as follows:

a) with the SRCD in the open position, in turn between each pair of the terminals or pins or contacts of socket-outlets which are electrically connected together when the SRCD is in the closed position;

b) with the SRCD in the closed position, between both poles, electronic components connected between current paths being disconnected for the test (where it is not possible to keep the SRCD in the closed position, each pole is bridged by an outside connection);

c) with the SRCD in the closed position, between poles connected together and the frame, including a metal foil in contact with the outer surface of the internal enclosure of insulating material, if any (components connected between live parts and the earthing path of an SRCD may be disconnected for this test);

d) between internal metal parts of the mechanism and the frame;

   NOTE Access to the internal metal part of the mechanism may be specifically provided for this measurement by the manufacturer.

e) for SRCDs with a metal enclosure having an internal lining of insulating material, between the frame and a metal foil in contact with the inner surface of the lining of insulating material, if any, including bushing and similar devices.

The term “frame” includes:

1) all accessible metal parts and a metal foil in contact with the surfaces of insulating material which are accessible in normal use;

2) screws for fixing covers which have to be removed when connecting the SRCD.

For the purpose of this test, the protective conductor is connected to the frame.

For measurements according to b), c), d) and e), the metal foil is applied in such a way that the sealing compound, if any, is effectively tested.

The insulation resistance shall not be less than:

i) 2 MΩ for the measurements according to a) and b);

ii) 5 MΩ for the other measurements.

9.13.2 Dielectric strength of the main circuit

Immediately after the SRCD has passed the tests of **9.13.1**, the test voltage specified below is applied for 1 min between the parts indicated in **9.13.1,** the electronic components, if any, being disconnected for the test.

The test voltage shall have a practically sinusoidal waveform and a frequency between 45 Hz and 65 Hz.

The source of the test voltage shall be capable of supplying a short-circuit current of at least 0,2 A.

No overcurrent tripping device of the transformer shall operate when the current in the output circuit is lower than 30 mA.

The values of the test voltage shall be as follows:

a) 2 000 V for a) to d) of **9.13.1**; an alternative voltage value of 1 500 V is allowed for SRCDs with rated residual current of 6 mA intended to be used in a bi-phase system with 120 V middle point;

b) 2 500 V for e) of **9.13.1**.

Initially, no more than half the prescribed voltage is applied, then it is raised to the full value within 5 s.

No flashover or breakdown shall occur during the test.

Glow discharges without drop in voltage are neglected.

9.13.3 Capability of withstanding high d.c. voltages due to insulation measurements

A d.c. voltage source is used with the following characteristics:

- open voltage: 600^{+25}_{0} V
- maximum ripple: 5%

where:

$$\text{ripple}(\%) = \frac{\text{max. value} - \text{mean value}}{\text{mean value}} \times 100$$

- short-circuit current: 12^{+2}_{0} mA.

The test is carried out on the SRCD in the closed position. Where it is not possible to keep the SRCD in the closed position, each pole is bridged by an outside connection.

The test voltage is applied for 1 min:

a) between the two poles connected together and the metal frame, if any, connected to the PE terminal;

b) between the two poles.

After this treatment, the SRCD shall be capable of performing satisfactorily the tests specified in **9.8.3.3**.

9.14 EMC compliance and unwanted tripping

9.14.1 Electromagnetic compatibility (EMC)

EMC tests shall be performed according to BS EN 61543:1996 as follows.

Tests listed in Table 28 are covered and shall not be repeated.

Table 28 **Tests to be applied for EMC**

Reference to Table 4 and Table 5 of BS EN 61543:1996	Electromagnetic phenomena	Tests of this standard
T 1.3	Voltage amplitude variations	**9.8.1**
T 1.4	Voltage unbalance	**9.8.1**
T 1.5	Power frequency variations	**9.1.1**
T 1.8	Magnetic fields	**9.15**
T 2.4	Current oscillatory transients	**9.14.2**

The remaining tests in Tables 4, 5 and 6 of BS EN 61543:1996 shall be carried out according to the test sequences EMC_1, EMC_2 and EMC_3 listed in Annex A of this standard.

For devices containing a continuously operating oscillator, the test of CISPR 14-1 shall be carried out on the samples prior to the tests of BS EN 61543:1996.

9.14.2 Verification of resistance against unwanted tripping due to surge currents to earth resulting from impulse voltages for SRCDs of $I_{\Delta n} \geq$ 0,010 A (ring wave test)

The SRCD is tested using a surge generator capable of delivering a damped oscillatory current as shown in Figure 16. An example of circuit diagram for the test of the SRCD is shown in Figure 17. One pole of the SRCD, chosen at random, is submitted to 10 applications of the surge current. The polarity of the surge current wave shall be inverted after every two applications. The interval between two consecutive applications shall be about 30 s.

The current impulse shall be measured by appropriate means and adjusted using an additional sample of an SRCD of the same type to meet the following requirements:

- peak value: $25\,\mathrm{A}^{+10\%}_{0}$
- virtual front time: 0,5 μs ±30%
- period of the following oscillatory wave: 10 μs ±20%
- each successive peak: about 60% of the preceding peak.

During the tests, the SRCD shall not trip.

9.15 Verification of the behaviour of the SRCD under overcurrent conditions

9.15.1 List of the overcurrent tests

The various tests to verify the behaviour of the SRCD under overcurrent conditions are shown in Table 29.

Table 29 **Tests to verify the behaviour of SRCDs under overcurrent conditions**

Verification	**SRCD classified according to 4.9a) and b)**
Rated making and breaking capacity I_m	**9.15.2.2**
Rated residual making and breaking capacity $I_{\triangle m}$	**9.15.2.3**
Coordination at 250 A and at the rated conditional short-circuit current I_{nc}	**9.15.2.4**a)
Coordination at the rated making and breaking capacity I_m	**9.15.2.4**b)
Coordination at 250 A and at the rated conditional residual short-circuit current $I_{\triangle c}$	**9.15.2.4**c)
Making and breaking capacity of the plug and socket-outlet(s) separate or incorporated in integral items of the SRCD	**9.15.3**

Text deleted

9.15.2 Short-circuit tests

9.15.2.1 General conditions for test

The conditions of **9.15.2** are applicable to any test intended to verify the behaviour of the SRCD under short-circuit conditions.

a) **Test circuit**

Figure 18 gives the diagram of the circuit to be used for the tests.

The supply S feeds a circuit including resistors R, reactors L, the SCPD, if any, the SRCD under test and the additional resistors R_2 and/or R_3, as applicable.

If the SRCD or the associated plug is fitted with a fuse no further SCPD is necessary.

The values of the resistors and reactors of the test circuit shall be adjusted to satisfy the specified test conditions.

The reactors L shall be air-cored. They shall always be connected in series with the resistors R and their value shall be obtained by series coupling of individual reactors. Parallel connecting of reactors is possible if these reactors have practically the same time constant.

Since the transient recovery voltage characteristics of test circuits including large air-cored reactors are not representative of normal service conditions, the air-cored reactor shall be shunted by a resistor taking approximately 0,6% of the current through the reactor, unless otherwise agreed between manufacturer and user.

In each test circuit, the resistors R and reactors L are inserted between the supply source S and the SRCD under test.

The SCPD, or the equivalent impedance [see **9.15.2.2**a) and **9.15.2.3**a)], is inserted between the resistors R and the SRCD under test.

The additional resistor R_3, if used, shall be inserted on the load side of the SRCD under test.

For the tests of **9.15.2.4**a) and **9.15.2.4**c), SRCDs shall be connected with cables having a length of 0,75 m per pole and a maximum cross section corresponding to the rated current according to Table 12.

NOTE 1 It is recommended that 0,5 m be connected on the supply side and 0,25 m on the load side of the SRCD.

The diagram of the test circuit shall be given in the test report. It shall be in accordance with the relevant figure of this standard.

There shall be one and only one point of the test circuit which is directly earthed. This may be the short-circuit link of the test circuit or the neutral point of the supply or any other convenient point. The method of earthing shall be stated in the test report.

R_2, suitably calibrated, is a resistance used to obtain one of the following currents:

- a residual current of 10 $I_{\Delta n}$ such as to cause the operation of the SRCD within the appropriate minimum operating time specified in Table 1 or Table 2;
- the rated residual making and breaking current $I_{\Delta m}$;
- the rated conditional residual short-circuit current $I_{\Delta c}$.

S_1 is a switch.

For the purpose of verifying the minimum let-through energy I^2t value and minimum peak current I_p to be withstood by the SRCD classified according to **4.9**a) in order to obtain reproducible test results, the SCPD, if any, shall be adjusted and shall be embodied either by a silver wire using the test apparatus shown in Figure 19 or by a fuse or by any other means. The manufacturer may specify the type of SCPD to be used in the tests.

The silver wire shall have a diameter of 0,35 mm and contain at least 99,9% pure silver.

The corresponding approximate values of I^2t and I_p are respectively 1 kA^2s and 1,02 kA when tested at the rated conditional short-circuit current or at the rated conditional residual short-circuit current (prospective current value: 1 500 A) up to a rated current of 16 A. For higher rated currents, a silver wire with a 0,5 mm diameter shall be used whose corresponding approximate values of let-through energy I^2t and peak current I_p are respectively 4,1 kA^2s and 1,5 kA.

The silver wire shall be inserted in the appropriate position of the test apparatus, i.e. horizontally, and stretched.

The silver wire shall be replaced after each test.

All the conductive parts of the SRCD under test normally earthed in service, including the metal support on which the SRCD is mounted or placed or any metal enclosure [see **9.15.2.1**f)], shall be connected to the neutral point of the supply or to a substantially non-inductive artificial neutral permitting a prospective fault current of at least 100 A.

This connection shall include a copper wire F of 0,1 mm diameter and not less than 50 mm in length for the detection of the fault current and, if necessary, a resistor R_1 limiting the value of the prospective fault current to about 100 A.

The current sensor O_1 is connected on the load side of the SRCD under test.

The voltage sensor O_2 is connected across the supply connections of the SRCD under test.

Unless otherwise stated in the test report, the resistance of the measuring circuits shall be at least 100 Ω per volt of the power-frequency recovery voltage.

SRCDs are supplied on the line side with the rated voltage.

In the case of SRCDs dependent on line voltage, in order to permit the breaking operations to be made, it is necessary either to insert the device T making the short-circuit or an additional short-circuit making device in that position on the load side of the SRCD.

b) **Tolerances on test quantities**

All the tests concerning the verification of rated making and breaking capacity and of the correct coordination between SRCD and SCPD shall be performed at values of influencing quantities and factors as stated by the manufacturer in accordance with Table 5 of this standard, unless otherwise specified.

The tests are considered as valid if the quantities as recorded in the test report are within the following tolerances for the specified values:

- current: $^{+5}_{0}\%$
- frequency: ±5%
- power factor: $0^{0}_{-0,05}$
- voltage: $^{0}_{-5}\%$ (including power-frequency recovery voltage).

c) Power factor of the test circuit

The power factor of the test circuit (see Table 30) shall be determined according to a recognized method which shall be stated in the test report.

Table 30 **Power factor ranges of the test circuit**

Test current I_{cc} A	**Corresponding power factor range**
I_{cc} ≤ 1 500	0,93 to 0,98
1 500 ≤ 3 000	0,85 to 0,90

d) **Power-frequency recovery voltage**

The value of the power-frequency recovery voltage shall be equal to a value corresponding to 110% of the rated voltage of the SRCD under test.

NOTE 2 The value of 110% of the rated voltage is deemed to cover the effects of the variations of the system voltage under normal service conditions. The upper limit value may be increased with the approval of the manufacturer.

After each arc extinction, the power-frequency recovery voltage shall be maintained for not less than 0,1 s.

e) **Calibration of the test circuit**

The SRCD under test and the SCPD, if any, are replaced by temporary connections G_1 having a negligible impedance compared with that of the test circuit.

For the test of **9.15.2.4**a), the load connections of the SRCD under test are short-circuited by means of connections C of negligible impedance, and the resistors R and the reactors L are adjusted so as to obtain, at the test voltage, a current equal to the rated conditional short-circuit current at the prescribed power factor. The test circuit is energized simultaneously in both poles and the current curve is recorded through the current sensor $O_{1.}$

Moreover, for the tests of **9.15.2.2**, **9.15.2.3**, **9.15.2.4**b) and **9.15.2.4**c), the additional resistors R_2 and/or R_3 are used, as necessary, so as to obtain the required test current values (I_m, $I_{\Delta m}$ and $I_{\Delta c}$ respectively).

f) **Condition of the SRCD for test**

The SRCD shall be assembled and connected according to the manufacturer's instructions.

SRCDs for flush mounting shall be tested in the appropriate box.

For the opening operation (O) only, a clear polyethylene sheet (0,05 ±0,01) mm thick of a size of at least 50 mm larger in each direction than the overall dimensions of the front face of the device, but not less than (200 × 200) mm, is fixed and reasonably stretched in a frame, placed at a distance of 20 mm from either:

- the maximum projection (tripped or un-tripped position) of the operating means of a device without recess for the operating means; or
- the rim of a recess for the operating means of a device with recess for the operating means.

The foil should have the following physical properties:

- density at 23 °C (0,92 ±0,05) g/cm^3;
- melting point 110 °C to 120 °C.

The control mechanism for the switching operations shall simulate, as closely as possible, the normal manual operation.

It shall be verified that the SRCD under test operates correctly on no-load when it is operated under the specified conditions.

g) **Sequence of operations**

The test procedure consists of a sequence of operations. The following symbols are used for defining the sequence of operations:

- O represents an opening operation, the short-circuit being established by the switch T, with the SRCD under test and the SCPD, if any, in the closed position;
- CO represents a closing operation of the SRCD under test, both the switch T and the SCPD, if any, being in the closed position, followed by an automatic opening (in the case of a SCPD see **9.15.2.4**);
- *t* represents the time interval between two successive short-circuit operations which shall be 3 min or such longer time as may be required for resetting or renewing the SCPD, if any.

h) **Behaviour of the SRCD during tests**

During tests, the SRCD under test shall not endanger the operator.

Furthermore, there shall be no permanent arcing, no flashover between poles or between poles and exposed conductive parts, nor operation of the device F.

Where an integral fuse is fitted, it may operate during the test.

i) **Condition of the SRCD after tests**

After each of the applicable tests, carried out in accordance with **9.15.2.2**, **9.15.2.3**, **9.15.2.4**a), **9.15.2.4**b) and **9.15.2.4**c), the SRCD under test shall show no damage impairing its further use and the polyethylene foil shall show no holes visible with normal or corrected vision without additional magnification.

The SRCD shall be capable, without maintenance, of:

- complying with the requirements of **9.13.2**, but at a voltage equal to twice its rated voltage, for 1 min without previous humidity treatment;
- making and breaking its rated current at its rated voltage.

Text deleted

Under the test conditions of **9.8.3.2**a), the SRCD shall trip at a test current of 1,25 $I_{\Delta n}$. One test only is made on one pole taken at random, with measurement of break time. This time shall not exceed the value specified in Table 1 for $I_{\Delta n}$.

9.15.2.2 Verification of the rated making and breaking capacity (I_m)

Text deleted

This test is intended to verify the ability of the SRCD to make, to carry for a specified time and to break short-circuit currents, while a residual current causes the SRCD to operate.

The test shall be carried out through either the socket-outlet or the load terminals as applicable.

a) **Test conditions**

The SRCD is tested in a circuit according to the general test conditions prescribed in **9.15.2.1**, no external SCPD being inserted in the circuit.

The connections G_1 of negligible impedance are replaced by the SRCD and by connections having approximately the impedance of the SCPD.

Switch S_1 remains closed.

b) **Test procedure**

With a residual operating current equal to 10 $I_{\Delta n}$ flowing through the switch S_1 and the resistance R_2, the following sequence of operation is performed:

CO – *t* – CO – *t* – CO

9.15.2.3 Verification of the rated residual making and breaking capacity ($I_{\Delta m}$)

This test is intended to verify the ability of the SRCD to make, to carry for a specified time and to break residual short-circuit currents.

The test shall be carried out through either the socket-outlet or the load terminals as applicable.

a) **Test conditions**

The SRCD shall be tested according to the general test conditions prescribed in **9.15.2.1**, no external SCPD being inserted in the circuit, but connected in such a manner that the short-circuit current is a residual current.

For this test the resistors R_3 are not used, the circuit being left open.

The current path which does not carry the residual short-circuit current is connected to the supply voltage at its line terminal. The connections G_1 of negligible impedance are replaced by the SRCD and by connections having approximately the impedance of the SCPD.

The switch S_1 remains closed.

The test is performed on each pole excluding the pole marked N, if any.

b) **Test procedure**

The following sequence of operations is performed:

O – *t* – CO – *t* – CO

For the breaking operation, the switch T is synchronized with respect to the voltage wave so that the point of initiation is (45 ±5)°.

9.15.2.4 Verification of the coordination between the SRCD and the SCPD

Text deleted

These tests are intended to verify that the SRCD protected by the SCPD is able to withstand, without damage, short-circuit currents up to its rated conditional short-circuit current (see **5.3.1.2** and **5.3.1.3**).

The tests shall be carried out through either the socket-outlet or the load terminals as applicable.

The short-circuit current is interrupted by the association of the SRCD and the SCPD.

During the test either the SRCD or the SCPD or both may open. However, if only the SRCD opens, the test is also considered as satisfactory.

The SCPD is renewed or reset, as applicable, after each operation.

The following tests are made under the general conditions of **9.15.2.1**:

- a test made without establishing any residual current to verify that up to the rated conditional short-circuit current I_{nc}, the SCPD protects the SRCD in accordance with a) below;
- a test made without establishing any residual current to verify that at a short-circuit current corresponding to the rated making and breaking capacity I_m, the SCPD operates and protects the SRCD, in accordance with b) below;
- a test to verify that in the case of phase-to-earth short-circuits with currents up to the value of the rated conditional residual short-circuit current $I_{\Delta c}$, the SRCD is able to withstand the corresponding stresses, due to the protection by the SCPD, in accordance with c) below.

For the breaking operations, the switch T is synchronized with respect to the voltage wave so that the point of initiation is (45 ±5)°.

a) Verification of the coordination at 250 A and at the rated conditional short-circuit current (I_{nc})

1) Test conditions

The connections G_1 of negligible impedance are replaced by the SRCD under test and by the SCPD.

Switch S_1 remains open. No residual current is established.

2) Test procedure

The following sequence of operations is performed:

O – *t* – CO

b) Verification of the coordination at the rated making and breaking capacity (I_m)

1) Test conditions

The connections G_1 of negligible impedance are replaced by the SRCD under test and by the SCPD.

Switch S_1 remains open. No residual current is established.

2) Test procedure

The following sequence of operations is performed:

O – *t* – CO – *t* – CO

c) Verification of the coordination at 250 A and at the rated conditional residual short-circuit current ($I_{\Delta c}$)

1) Test conditions

The SRCD shall be connected in such a manner that the short-circuit current is a residual current.

The test is performed on each pole excluding the pole marked N, if any.

The current path which does not carry the residual short-circuit current is connected to the supply at the line terminal.

Connections G_1 of negligible impedance are replaced by the SRCD under test and by the SCPD.

Switch S_1 remains closed.

2) Test procedure

The following sequence of operations is performed:

O – *t* – CO – *t* – CO

9.15.3 Verification of the making and breaking capacity of the socket-outlet of the SRCD, classified according to 4.2.1

Compliance is checked according to Clause **17** of BS 1363-2:2016, but at the rated voltage of the SRCD.

9.15.4 Verification of the making and breaking capacity of the connection unit of the SRCD, classified according to 4.2.1

Compliance is checked according to Clause **17** of BS 1363-4:2016, but at the rated voltage of the SRCD.

9.16 Verification of clearances of the SRCD with the impulse withstand voltage test

If the measurement of clearances of items 2 and 4, Table 6, shows a reduction of the required length this test applies. This test is carried out immediately after verification made in **9.13** (measurement of the insulation resistance and dielectric properties).

NOTE 1 The measurement of the clearances can be replaced by this test.

The test is carried out on an SRCD wired as in normal use and in the closed position.

The impulses are given by a generator producing impulses having a front time of 1,2 µs and a time to half value of 50 µs, the tolerances being:

- ±5% for the peak value;
- ±30% for the front time;
- ±20% for the time to half value.

For each test, five positive impulses and five negative impulses are applied; the interval between consecutive impulses being at least 1 s for impulses of the same polarity and being at least 10 s for impulses of the opposite polarity.

When performing the impulse voltage test on complete SRCD, the attenuation or amplification of the test voltage shall be taken into account. It needs to be assured that the required value of the test voltage is applied across the terminals of the equipment under test.

The surge impedance of the test apparatus shall have a nominal value not higher than 500 Ω.

NOTE 2 For the verification of clearances within the basic insulation, on complete SRCD, a very low impedance of the generator is needed for the test. For this purpose, a hybrid generator with a virtual impedance of 2 Ω is appropriate if internal components are not disconnected before testing. However, in any case, a measurement of the correct test voltage directly at the clearance is required.

The shape of the impulses is adjusted with the SRCD under test connected to the impulse generator. For this purpose appropriate voltage dividers and voltage sensors shall be used. It is recommended to disconnect surge protective components before testing.

NOTE 3 For SRCDs with incorporated surge arresters that cannot be disconnected, the shape of the impulses is adjusted without connection of the SRCD to the impulse generator.

Small oscillations in the impulses are allowed, provided that their amplitude near the peak of the impulse is less than 5% of the peak value.

A first series of tests is made, the impulses being applied between the two poles of the SRCD. The test impulse voltage values shall be chosen from Table 31. These values are corrected for barometric pressure and/or altitude at which the tests are carried out.

Table 31 **Test voltage for verification of impulse withstand voltage between poles**

Rated impulse withstand voltage U_{imp} kV	**Test voltages at corresponding altitude $U_{1,2/50}$ a.c. peak** kV				
	Sea level	**200 m**	**500 m**	**1 000 m**	**2 000 m**
2,5 A)	2,9	2,8	2,8	2,7	2,5
4	4,9	4,8	4,7	4,4	4

A) Values for product intended to be used with a 120 V rated voltage only.

A second series of tests is made, the impulses being applied between the metal support connected together with the terminals intended for the protective conductor and the poles connected together. The test impulse voltage values shall be chosen in Table 32. These values are corrected for barometric and/or altitude pressure at which the tests are carried out.

Table 32 **Test voltage for verification of impulse withstand voltage with the metal support**

Rated impulse withstand voltage U_{imp} kV	**Test voltages at corresponding altitude $U_{1,2/50}$ a.c. peak** kV				
	Sea level	**200 m**	**500 m**	**1 000 m**	**2 000 m**
3 A)	3,5	3,5	3,4	3,2	3
5	6,2	6	5,8	5,6	5

A) Values for product intended to be used with a 120 V rated voltage only.

If the SRCD trips during one test, it shall be re-closed before the next one.

No unintentional disruptive discharge shall occur.

If, however, only one such disruptive discharge occurs, 10 additional impulses having the same polarity as that which caused the disruptive discharge are applied, the connections being the same as those with which the failure occurred.

No further disruptive discharge shall occur, unless intentionally foreseen by design (see Note 2).

NOTE 4 The expression "unintentional disruptive discharge" is used to cover the phenomena associated with the failure of insulation under electric stress, which include a drop in the voltage and the flowing of current.

NOTE 5 Intentional disruptive discharges cover discharges of any incorporated surge suppressing device.

The shape of the impulses is adjusted with the SRCD under test connected to the impulse generator. For this purpose, appropriate voltage dividers and voltage sensors shall be used.

Small oscillations in the impulses are allowed, provided that their amplitude near the peak of the impulse is less than 5% of the peak value.

For oscillations on the first half of the front, amplitudes up to 10% of the peak value are allowed.

9.17 Mechanical and electrical endurance

9.17.1 Normal operation of socket-outlets and connection units of the SRCD

For socket-outlets of SRCDs classified in accordance with **4.2.1**, the tests of Clause **18** of BS 1363-2:2016 are applied but at the rated voltage of the SRCD.

For connection units of SRCDs classified in accordance with **4.2.1**, the tests of Clause **18** of BS 1363-4:2016 are applied but at the rated voltage of the SRCD.

9.17.2 Test of the RCD part of the SRCD

The tests are made on new samples.

The SRCD is connected as in normal use, at an ambient temperature between 20 °C and 25 °C and according to the manufacturer's instructions.

SRCDs classified according to **4.2.1** are tested using a plug fitted with 1 m of flexible conductors according to Table 33.

For multiple socket-outlets, the test is carried out on each socket-outlet in turn or on the most critical socket-outlet, when this is obvious.

Table 33 **Cross-sectional area for test conductors**

Rated current of the SRCD A	**Nominal cross-sectional area** mm²	
	Flexible conductors for test plug and terminals of SRCDs	**Rigid conductors (solid or stranded) for the fixed test socket-outlet**
Up to and including 10	1	1,5
Above 10 up to and including 16	1,5	2,5
Text deleted		

The tightening torques to be applied to the terminal screws are two-thirds of those specified in Table 15. During the tests, no maintenance or dismantling of the sample is allowed.

Endurance tests are made at the rate of four operating cycles per minute, the ON period having a duration of 1,5 s to 2 s.

9.17.2.1 Test procedure for on-load test

The test is made at rated operational voltage, at a current adjusted to the rated current by means of resistors and reactors in series, connected to the load terminals.

If air-core reactors are used, a resistor taking approximately 0,6% of the current through the reactors is connected in parallel with each reactor.

If iron-core reactors are used, the iron-power losses of these reactors shall not appreciably influence the recovery voltage.

The current shall have a substantially sine-wave form and the power factor shall be between 0,85 and 0,9.

SRCDs are subjected to 2 000 operating cycles, each operating cycle consisting of a closing operation followed by an opening operation.

The SRCD shall be operated as for normal use.

The opening operations shall be carried out as follows.

a) The first 500 operations are carried out by using the manual operating means, if any.
b) The following 750 operations are carried out by passing a residual operating current of $I_{\Delta n}$ through one pole.
c) For SRCDs opening automatically in the event of failure of the line voltage, classified according to **4.1.2**, 250 operations are made by interrupting the supply neutral.
d) The remaining operations up to a total of 2 000 are carried out by using the test device.

9.17.2.2 Test procedure for off-load test

Following the test of **9.17.2.1**, the SRCD is subjected without load, using the manual operating means, to 2 000 operating cycles.

NOTE For SRCDs without manual operating means, their test device is used for opening operations and the reset device for closing operations.

9.17.2.3 Condition of the SRCD after the tests

Following the tests of **9.17.2.1** and **9.17.2.2**, the SRCD shall not show during inspection:

- undue wear;
- damage of the enclosure permitting access to live parts by the standard gauge of Figure 20;
- loosening of electrical or mechanical connections;
- seepage of the sealing compound, if any.

Under the test condition of **9.8.3.3** the SRCD shall trip with a test current of 1,25 $I_{\Delta n}$. One test only is made without measurement of break time.

The SRCD shall then perform satisfactorily for the dielectric strength test specified in **9.13.2**, but at a voltage equal to 900 V for 1 min and without previous humidity treatment.

9.18 Resistance to mechanical shock

9.18.1 General

SRCDs, surface mounting boxes and screwed glands shall have adequate mechanical strength so as to withstand the stresses imposed during installation and use.

Compliance is checked by the appropriate tests of **9.18.2** to **9.18.5** as follows:

- for all kinds of fixed SRCD **9.18.2**;
- for fixed SRCD with a base intended to be mounted directly on a surface **9.18.3**;
- for screwed glands of accessories having an IP code higher than IP20 **9.18.4**;
- for socket-outlets shutters **9.18.5**;
- for surface-type mounting boxes **9.18.2**.

9.18.2 Impact test apparatus

The specimens are subjected to blows by means of an impact test apparatus as shown in Figures 21, 22, 23 and 24.

The striking element has a hemispherical face of 10 mm radius, made of polyamide having a Rockwell hardness of HR between 85 and 100, and a mass of (150 ±1) g.

It is rigidly fixed to the lower end of a steel tube with an external diameter of 9 mm and a wall thickness of 0,5 mm, which is pivoted at its upper end in such a way that it swings only in a vertical plane.

The axis of the pivot is (1 000 ±1) mm above the axis of the striking element.

The Rockwell hardness of the polyamide striking element is determined by using a ball having a diameter of (12,700 ±0,002 5) mm, the initial load being (100 ±2) N and the extra load (500 ±2,5) N.

NOTE 1 Additional information concerning the determination of the Rockwell hardness of plastics is given in BS EN ISO 2039-2.

The design of the apparatus is such that a force between 1,9 N and 2,0 N shall be applied to the face of the striking element to maintain the tube in a horizontal position.

The specimens are mounted on a sheet of plywood, 8 mm nominal thickness and approximately 175 mm^2, secured at its top and bottom edges to a rigid bracket which is part of the mounting support.

The mounting support shall have a mass of (10 ±1) kg and shall be mounted on a rigid frame by means of pivots. The frame is fixed to a solid wall.

The design of the mounting is such that:

- the specimen can be placed in such a way that the point of impact lies in the vertical plane through the axis of the pivot;
- the specimen can be moved horizontally and turned about an axis perpendicular to the surface of the plywood;
- the plywood can be turned 60° in both directions about a vertical axis.

Surface type SRCD and surface mounting boxes are mounted on the plywood as in normal use. Inlet openings which are not provided with knock-outs are left open; if they are provided with knock-outs, one of them is opened.

Flush-type SRCDs are mounted in a recess provided in a block of hornbeam or material having similar mechanical characteristics, which is fixed to a sheet of plywood, and not in its relevant mounting box.

If wood is used for the block, the direction of the wood fibres shall be perpendicular to the direction of impact.

Flush-type screw fixing SRCDs shall be fixed by means of screws to lugs recessed in the hornbeam block. Flush-type claw fixing SRCDs shall be fixed to the block by means of the claws.

Before applying the blows, fixing screws of bases and covers are tightened with a torque equal to two-thirds of that specified in Table 15.

The specimens are mounted so that the point of impact lies in a vertical plane through the axis of the pivot.

The striking element is allowed to fall from a height specified in Table 34.

Table 34 **Height of fall for impact tests**

Height of fall mm	**Parts of enclosures subjected to impact**	
	SRCD having IP code IPX0	**SRCD having an IP code higher than IPX0**
100	A and B	Operating means
150	C	A and B
200	D	C
250	–	D

A Parts on the front surface, including the parts which are recessed.

B Parts which do not project more than 15 mm from the mounting surface (distance from the wall) after mounting as in normal use, with the exception of parts specified in A.

C Parts other than those specified in A which project more than 15 mm and not more than 25 mm from the mounting surface (distance from the wall) after mounting as in normal use.

D Parts other than those specified in A which project more than 25 mm from the mounting surface (distance from the wall) after mounting as in normal use.

The mounting surface is applied on all parts of the specimen, with the exception of those specified in A.

The height of fall is the vertical distance between the position of a checking point, when the pendulum is released, and the position of that point at the moment of impact. The checking point is marked on the surface of the striking element where the line through the point of intersection of the axes of the steel tube of the pendulum and the striking element, perpendicular to the plane through both axes, meets the surface.

The specimens are subjected to blows, which are evenly distributed. The blows are not applied to knock-out areas or to any openings covered by a transparent material.

The following blows are applied:

a) two blows to the operating means of the RCD part;

b) for parts specified in A, five blows [see Figure 27a) and Figure 27b)]:

   1) one blow to the centre;

   2) one blow on each of the two most unfavourable points between the centre and the edges, after the specimen has been moved horizontally;

3) one blow on similar points, after the specimen has been turned 90° about its axis perpendicular to the plywood;

c) for parts specified in B (as far as applicable), C and D, four blows:

1) one blow is applied on one of the sides of the specimen where the blow can be applied, after the plywood sheet has been turned 60° about a vertical axis [see Figure 27c)];

2) one blow on the opposite side of the specimen where blows can be applied, after the plywood sheet has been turned 60° about a vertical axis, in the opposite direction [see Figure 27c)].

After the specimen has been turned 90° about its axis perpendicular to the plywood sheet:

- one blow is applied on one of the sides of the specimen where the blow can be applied, after the plywood sheet has been turned 60° about a vertical axis [see Figure 27d)];
- one blow on the opposite side of the specimen where blows can be applied, after the plywood sheet has been turned 60° about a vertical axis in the opposite direction [see Figure 27d)].

If inlet openings are provided, the specimen is mounted in such a way that the two lines of blows are, as closely as possible, equidistant from these openings.

Cover plates and other covers of multiple SRCD are treated as though they were the corresponding number of separate covers, but only one blow is applied to any one point.

For an SRCD having an IP code higher than IPX0, the test is made with the lids, if any, closed and, in addition, the appropriate number of blows is applied to those parts which are exposed when the lids are open.

After the test, the specimen shall show no damage within the meaning of this standard. In particular, live parts shall not become accessible.

After the test on a lens (window for pilot lights) the lens may be cracked and/or dislodged, but it shall not be possible to touch live parts with:

- the test probe B of BS EN 61032:1998, applied in every possible position, an electrical indicator with a voltage between 40 V and 50 V being used to show contact with the relevant parts;
- the test probe 11 of BS EN 61032:1998 under the conditions stated as above, but with a force of 10 N;
- the steel wire of Figure 20 applied with a force of 1 N, for accessories with increased protection.

In case of doubt, it is verified that it is possible to remove and replace external parts such as boxes, enclosures, covers and cover plates, without these parts or their insulating lining being broken.

If a cover plate backed by an inner cover is broken, the test is repeated on the inner cover, which shall remain unbroken.

NOTE 2 Damage to the finish, small dents which do not reduce creepage distances or clearances below the value specified in Table 6 and small chips which do not adversely affect the protection against electric shock or harmful ingress of water are neglected.

Cracks not visible with normal or corrected vision, without additional magnification, and surface cracks in fibre-reinforced mouldings and the like are ignored.

Cracks or holes in the outer surface of any part of the accessory are ignored if the accessory complies with this standard even if this part is omitted. If a decorative cover is backed by an inner cover, fracture of the decorative cover is ignored if the inner cover withstands the test after removal of the decorative cover.

9.18.3 Surface type SRCD

The bases of surface type SRCD are first fixed to a cylinder of rigid steel sheet, having a radius equal to 4,5 times the distance between fixing holes but, in any case, no less than 200 mm. The axes of the holes are in a plane perpendicular to the axis of the cylinder and parallel to the radius through the centre of the distance between the holes.

The fixing screws of the base are gradually tightened, the maximum torque applied being 0,5 Nm for screws having a thread diameter up to and including 3 mm and 1,2 Nm for screws having a larger thread diameter.

The bases of SRCD are then fixed in a similar manner to a flat steel sheet. During and after the tests, the bases of SRCD shall show no damage impairing their further use.

9.18.4 Screwed glands

Screwed glands are fitted with a cylindrical metal rod having a diameter, in millimetres, equal to the nearest whole number below the internal diameter, in millimetres, of the packing. The glands are then tightened by means of a suitable spanner, the torque shown in Table 35 being applied for 1 min.

Table 35 **Torque test values for glands**

Diameter of test rod mm	**Torque** Nm	
	Metal glands	**Glands of moulded material**
Up to and including 14	6,25	3,75
Above 14, up to and including 20	7,5	5,0
Above 20	10,0	7,5

After the test, the glands and the enclosures of the specimens shall show no damage within the meaning of this standard.

9.18.5 Socket-outlet shutters

Socket-outlets shall have shutters so designed that they withstand the mechanical force which may be expected in normal use, for example when a pin of a plug is inadvertently forced against the shutter of a socket-outlet entry hole.

*Compliance is checked by the tests of subclauses **9.1** and **13.7** of BS 1363-2:2016.*

9.19 Reliability

*Compliance is checked by the tests of **9.19.1** and **9.19.2**.*

9.19.1 Climatic test

9.19.1.1 Test chamber

The chamber shall be constructed as stated in Clause **4** of BS EN 60068-2-30:2005. Condensed water shall be continuously drained from the chamber and shall not be used again until it has been purified. Only distilled water shall be used for the maintenance of chamber humidity.

Before entering the chamber, the distilled water shall have a resistivity of not less than 500 Ωm and a pH value of 7,0 ±0,2. During and after the test the resistivity should be not less than 100 Ωm and the pH value should remain within 7,0 ±1,0.

9.19.1.2 Severity

The cycles are effected under the following conditions:

- upper temperature: (55 ±2) °C;
- number of cycles: 28.

9.19.1.3 Testing procedure

The test procedure shall be in accordance with BS EN 60068-2-30:2005 and BS EN 60068-3-4.

a) Initial verification

   An initial verification is made by submitting the SRCD to the test according to **9.8.3.3**, but only at $I_{\Delta n}$.

b) Conditioning

   1) The SRCD connected as for normal use is introduced into the chamber

      SRCDs shall be supplied at rated voltage or, in the case of more than one rated voltage, at any one rated voltage. They shall be in the closed position.

   2) Stabilizing period (see Figure 25)

      The temperature of the SRCD shall be stabilized at (25 ±3) °C:

      - either by placing the SRCD in a separate chamber before introducing it into the test chamber; or
      - by adjusting the temperature of the test chamber to (25 ±3) °C after the introduction of the SRCD and maintaining it at this level until temperature stability is attained.

      During the stabilization of temperature by either method, the relative humidity shall be within the limits prescribed for standard atmospheric conditions for testing (see Table 5).

      During the final hour, with the SRCD in the test chamber, the relative humidity shall be increased to not less than 95% at an ambient temperature of (25 ±3) °C.

   3) Description of the 24 h cycle (see Figure 25)

      i) The temperature of the chamber shall be progressively raised to the appropriate upper temperature prescribed in **9.19.1.2**. The upper temperature shall be achieved in a period of 3 h ±30 min and at a rate within the limits defined by the shaded area of Figure 25.

         During this period, the relative humidity shall be not less than 95%. Condensation shall occur on the SRCD during this period.

NOTE The fact that condensation occurs implies that the surface temperature of the SRCD is below the dew point of the atmosphere. This means that the relative humidity has to be higher than 95%, if the thermal time-constant is low. Care should be taken so that no drops of condensed water can fall on the sample.

ii) The temperature shall then be maintained at a substantially constant value, within the prescribed limits of ±2 °C for the upper temperature, for 12 h ±30 min from the beginning of the cycle.

During this period the relative humidity shall be (93 ±3)%, except for the first and the last 15 min when it shall be between 90% and 100%.

Condensation shall not occur on the SRCD during the last period of 15 min.

iii) The temperature shall then fall to (25 ±3) °C within 3 h to 6 h. The rate of fall for the first 1 h 30 min shall be such that, if maintained as indicated in Figure 25, it would result in a temperature of (25 ±3) °C being attained in 3 h ±15 min. During the temperature fall period, the relative humidity shall be not less than 95%, except for the first 15 min when it shall be not less than 90%.

iv) The temperature shall then be maintained at (25 ±3) °C with a relative humidity not less than 95%, until the 24 h cycle is completed.

9.19.1.4 Recovery

At the end of the cycles, the SRCD shall not be removed from the test chamber.

The door of the test chamber shall be opened and the temperature and humidity regulation is stopped.

A period of 4 h to 6 h shall then elapse to permit the ambient conditions (temperature and humidity) to be re-established before making the final measurement.

During the 28 cycles, the SRCD shall not trip.

9.19.1.5 Final verification

Under the conditions of tests specified in **9.8.3.3**, the SRCD shall trip with a test current of 1,25 $I_{\Delta n}$. One test only is made on one pole taken at random, with measurement of break time. This time shall not exceed the value specified in Table 1 for $I_{\Delta n}$.

9.19.2 Test with temperature of 40 °C

The SRCD is placed as for normal use on a dull black painted plywood support, about 20 mm thick.

For each pole, a single-core cable, 1 m long and having a nominal cross-sectional area as specified in Table 15 is connected on each side of the SRCD, the terminal screws or nuts being tightened by a torque equal to two-thirds of that specified in Table 15. The assembly is placed in a heating cabinet.

The SRCD is loaded with a current equal to the rated current at any convenient voltage and is subjected, at a temperature of (40 ±2) °C, to 28 cycles, each cycle comprising 21 h with current passing and thereafter 3 h without current. The current is interrupted by a switch, the SRCD being not operated.

SRCDs are supplied at the rated voltage or, in the case of more rated voltages, at the highest rated voltage (an example of a circuit is given in Figure 11).

At the end of the last period of 21 h with current passing, the temperature rise of the terminals is determined by means of fine wire thermocouples. This temperature rise shall not exceed 50 K.

After this test the SRCD is allowed to cool down in the cabinet to approximately room temperature without current passing.

Under the conditions of tests specified in **9.8.3.3**, the SRCD shall trip with a test current of 1,25 $I_{\Delta n}$. One test only is made on one pole taken at random with measurement of break time. This time shall not exceed the value specified in Table 1 for $I_{\Delta n}$.

NOTE An example of a test circuit for this verification is given in Figure 11.

9.20 Protection against electric shock and degree of protection IP of the SRCD

9.20.1 Protection against electric shock

9.20.1.1 General

The SRCD is installed, including any specified cover plate, and connected as for normal use and fitted with conductors of the smallest cross-sectional areas and the test is then repeated using conductors of the largest cross-sectional areas, as specified in Table 16.

For the SRCD, the standard test finger shown in Figure 1 is applied in every possible position.

For the plug portion, the test finger is applied in every possible position when the plug is in partial or complete engagement with a socket-outlet.

An electrical indicator with a voltage not less than 40 V and not more than 50 V is used to show contact with the relevant part.

For SRCDs where the use of elastomeric or thermoplastic material is likely to influence the requirement, the test is repeated but at an ambient temperature of (35 ±2) °C, the SRCD being at this temperature.

During this additional test, SRCDs are subjected for 1 min to a force of 75 N, applied through the tip of a straight enjoined test finger of the same dimensions as the standard test finger. This finger, with an electrical indicator as described above, is applied to all places where yielding of the insulating material could impair the safety of the SRCD.

During this test, the SRCDs shall not deform to such an extent that those dimensions shown in the relevant standard sheets which ensure safety are unduly altered and no live part shall be accessible by the standard test finger (see Figure 1).

15 min after removal of the test apparatus the sample shall not show such deformation as would result in undue alteration of those dimensions, shown in the relevant standard sheets, which ensure safety.

9.20.1.2 Additional tests for SRCDs incorporated in a fixed socket-outlet

9.20.1.2.1 SRCDs are tested with a plug completely withdrawn, by applying a steel gauge, as shown in Figure 20, with a force up to 1 N and with three independent straight movements applied in the most unfavourable conditions, withdrawing the gauge after each movement.

The socket-outlet part with a plug partially inserted is checked with the standard test finger (see Figure 1). For SRCDs with enclosures or bodies of thermoplastic material, the test is made at an ambient temperature of (35 ±2) °C, both the SRCD and the gauge being at this temperature.

9.20.1.2.2 The socket-outlet part is placed in such a position that its engagement surface is in the horizontal position. A test plug corresponding to the type of socket-outlet, is inserted into the socket-outlet with a force of 150 N which is applied for 1 min.

For verification of the resistance between the earthing terminal and the accessible metal part, a current of 1,5 times rated current or 25 A, whichever is the greater, derived from an a.c. source having a no-load voltage not exceeding 12 V, is passed between the earthing terminal and each of the accessible metal parts in turn.

The voltage drop between the earthing terminal and the accessible metal part is measured and the resistance is calculated from the current and this voltage drop.

In no case shall the resistance exceed 0,05 Ω.

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

9.20.2 Degree of protection IP of the SRCD

The degrees of protection shall be verified by the relevant tests in BS EN 60529. For IP6X category 1 of BS EN 60529 applies.

9.21 Resistance to heat

9.21.1 General

The tests are made according to **9.21.2**, **9.21.3** and **9.21.4**, as applicable.

The tests of **9.13.2** and **9.13.3** are not made on parts of ceramic material.

If two or more of the insulating parts referred to in **9.21.2** and **9.21.3** are made of the same material, the test is carried out only on any one of these parts, according to **9.21.2** or **9.21.3** as applicable.

9.21.2 Conditioning

The samples, without removable covers, if any, are kept for 1 h in a heating cabinet at a temperature of (100 ±2) °C.

Removable covers, if any, are kept for 1 h in the heating cabinet at a temperature of (70 ±2) °C.

During the test, they shall not undergo any change impairing their further use, and the sealing compound, if any, shall not flow to such an extent that live parts are exposed.

After the test and after the samples have been allowed to cool down to approximately room temperature, there shall be no access to live parts which are normally not accessible in normal use, even if the standard test finger is applied with a force not exceeding 5 N.

Under the test conditions of **9.8.3.3**, the SRCD shall trip with a test current of 1,25 $I_{\Delta n}$. Only one test is made, on one pole taken at random, without measurement of break time.

After the test, the marking shall still be legible.

NOTE Discoloration, blisters or a slight displacement of the sealing compound are disregarded, provided that safety is not impaired within the meaning of this standard.

9.21.3 External parts of SRCDs

External parts of SRCDs made of insulating material necessary to retain in position current-carrying parts or parts of the protective circuit and parts retaining the terminals or terminations in position are subjected to a ball pressure test by means of the apparatus shown in Figure 26.

Parts of the front surface zone of thermoplastic material of 2 mm width surrounding the phase and neutral pins entry holes of socket-outlets are also to be subjected to this test.

The part under test shall be placed on a steel plate at least 3 mm thick and in direct contact with it.

The part is placed on the steel support with the appropriate surface to be tested in the horizontal position. A steel ball of 5 mm diameter is pressed against this surface with a force of 20 N.

The test load and the supporting means shall be placed within the heating cabinet for a sufficient time to ensure that they have attained the stabilized test temperature before the test commences.

The test is made in a heating cabinet at a temperature of (125 ±2) °C.

After 1 h, the ball is removed from the sample which is then immersed 10 s in cold water to cool it to approximately room temperature.

The diameter of the impression caused by the ball is measured and shall not exceed 2 mm.

9.21.4 External insulating parts

External parts of SRCDs made of insulating material not necessary to retain in position current-carrying parts and parts of the protective circuit, even though they are in contact with them, are subjected to a ball pressure test in accordance with **9.21.3**, but the test is made at a temperature of (70 ±2) °C or (40 ±2) °C plus the highest temperature rise determined for the relevant part during the test of **9.11**, whichever is higher.

9.22 Resistance to abnormal heat and to fire – Glow-wire test

The test is performed according to Clauses **4** to **8** of BS EN 60695-2-10:2013 under the following conditions:

- for parts of insulating material necessary to retain current-carrying parts and parts of the earthing circuit in position, by the test made at a temperature of 850 °C;
- for parts of insulating material not necessary to retain current-carrying parts and parts of the earthing circuit in position, even though they are in contact with them, by the test made at a temperature of 650 °C.

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

Small parts according to BS EN 60695-2-11:2014, where each surface lies completely within a circle of 15 mm diameter, or where any part of the surface lies outside a 15 mm diameter circle and where it is not possible to fit a circle of 8 mm diameter on any of the surfaces, are not subjected to the test of this subclause (see Figure 28 for diagrammatic representation).

The tests are not made on parts of ceramic material.

The test is made on one sample.

In case of doubt, the test shall be repeated on two further samples.

The test is made by applying the glow-wire once.

The sample shall be positioned during the test in the most unfavourable position of its intended use (with the surface tested in a vertical position).

The tip of the glow-wire shall be applied to the specified surface of the sample taking into account the conditions of the intended use under which a heated or glowing element may come into contact with the sample.

The sample is considered as having passed the glow-wire test if one of the following conditions is met:

- there is no visible flame and no sustained glowing;
- flames and glowing at the sample extinguish within 30 s after the removal of the glow-wire.

There shall be no ignition of the tissue paper or scorching of the board.

9.23 *Text deleted*

9.24 Verification of ageing of electronic components

The SRCD is placed for a period of 168 h in an ambient temperature of (40 ±2) °C and loaded with the rated current. The voltage on the electronic parts shall be 1,1 times the rated voltage.

After this test, the SRCD in the cabinet is allowed to cool down to approximately room temperature without current passing. The electronic parts shall show no damage.

Under the conditions of tests specified in **9.8.3.3**, the SRCD shall trip with a test current of 1,25 $I_{\Delta n}$. One test only is made on one pole taken at random with measurement of break time. This time shall not exceed the value specified in Table 1 for $I_{\Delta n}$.

NOTE An example for the test circuit of this verification is given in Figure 11.

9.25 Verification of the behaviour of the SRCD under temporary overvoltage conditions

The source of the test voltage shall be capable of supplying a short-circuit current of at least 0,2 A.

No overcurrent tripping device of the transformer shall operate when the current in the output circuit is lower than 30 mA.

The test voltage shall have a practically sinusoidal waveform, and the same frequency as U_n.

The test voltage is applied on the supply side of the SRCD.

Verification is carried out according to the following series a), b) and c) of tests on different samples, each test being performed on one sample only.

a) The SRCD being in the closed position, a test voltage of 1 200 V is applied for 5 s according to Figure 29.

   The frame, if any, shall be connected to the PE.

   During the test, the SRCD may trip automatically and no flashover or breakdown shall occur. Glow discharges without drop in voltage are ignored.

   After the test, the SRCD shall pass the verification test in d).

b) The SRCD being in the closed position, a test voltage of 250 V is applied for 1 h according to Figure 29.

The frame, if any, shall be connected to the PE.

During the test, the SRCD may trip automatically and no flashover or breakdown shall occur. Glow discharges without drop in voltage are ignored.

After the test the SRCD shall pass the verification test in d).

c) The SRCD is supplied by a voltage of $\sqrt{3} \times U_n$ for 1 h.

During the test, the SRCD may trip automatically and no flashover or breakdown shall occur. Glow discharges without drop in voltage are ignored.

After the test, the SRCD shall pass the verification test in d).

d) After each test, the SRCD is then supplied at rated voltage and closed. The SRCD is then opened with the test device and the SRCD shall show no damage within the meaning of this standard.

Under the conditions of tests specified in **9.8.3.3**, the SRCD shall trip with a test current of 1,25 $_{n}I_{\Delta n}$. One test only is made on one pole taken at random, with measurement of break time. This time shall not exceed the value specified in Table 1 for $I_{\Delta n}$.

9.26 Tests for reverse polarity (see 8.3.1)

9.26.1 The tests shall be carried out with the L and N connections interchanged and the earth connection made to the supply earth. With a supply connected in such a manner an SRCD not having a solid neutral shall meet the requirements of either the test of **9.8** or **9.26.2**. Devices having a solid neutral shall meet the requirements of **9.26.2**.

9.26.2 The test shall be carried out at rated voltage and rated frequency and repeated at 0.85 and 1.1 times rated voltage. If the SRCD has a range of rated voltage and a range of rated frequency then the test shall be carried out at 0.85 and 1.1 times the lower and upper limits respectively of the voltage range and at the limits of the frequency range. It shall not be possible for the main contact(s) of the SRCD to be held closed for more than 0.2 s. If a reverse polarity indicator is fitted it shall continuously indicate a supply fault.

9.27 Resistance to excessive residual stress test

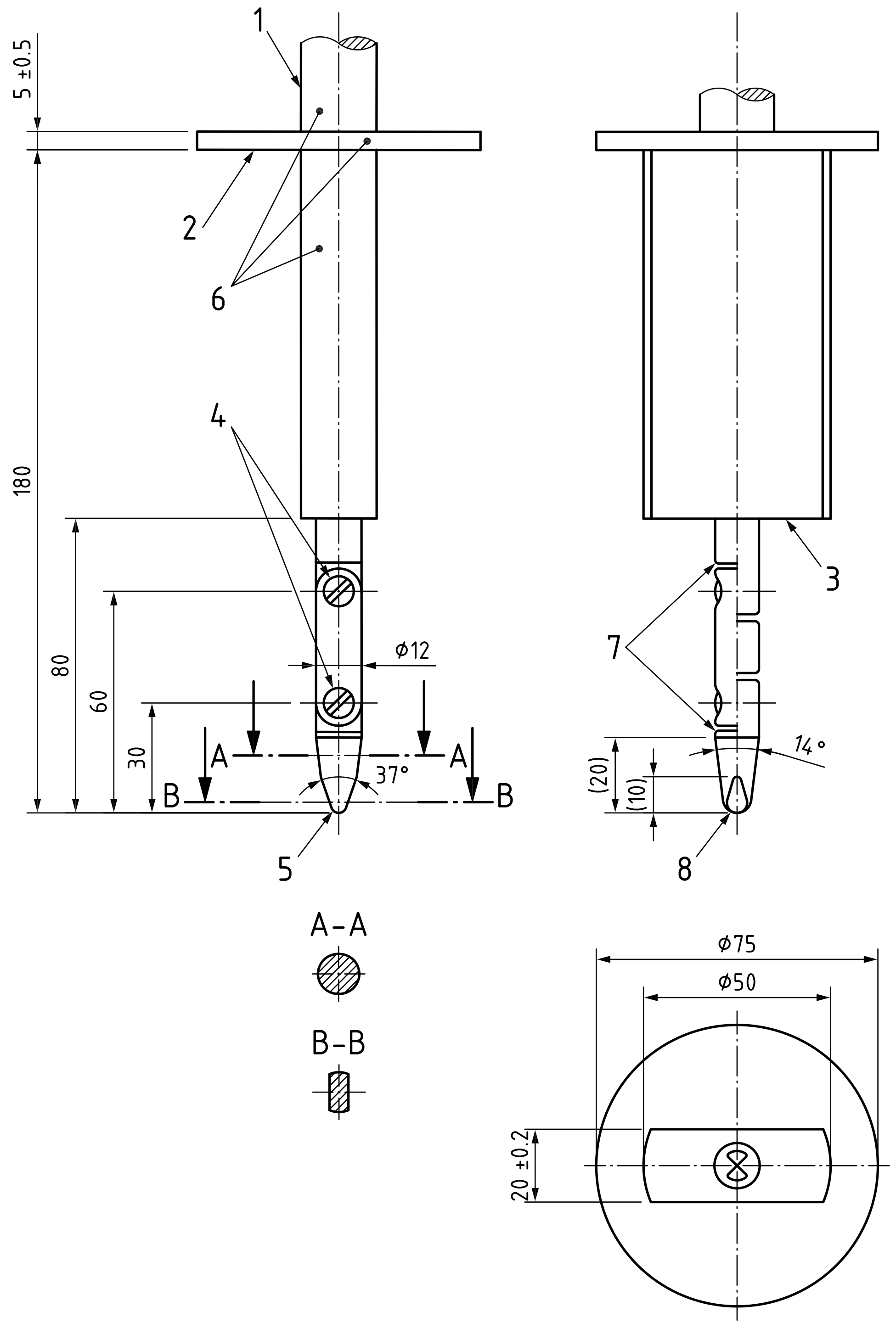
All grease is removed from the parts to be tested by immersion in trichloroethane or an equivalent degreasing agent for 10_{0}^{+1} min, then immersed in an aqueous solution of mercurous nitrate containing 10 g of $Hg_2(NO_3)_2$ and 10 mL of HNO_3 of relative density 1.42 per litre of solution, for 30_{0}^{+1} 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.

Figure 1 **Standard test finger** *(1 of 2)*

Dimensions in millimetres



Material: metal, except where otherwise specified

Tolerances on dimensions without specific tolerance:

– on angles: $^{0}_{-10}$

– on linear dimensions:

- up to 25 mm: $^{0}_{-0.05}$
- over 25 mm: $\pm 0,2$

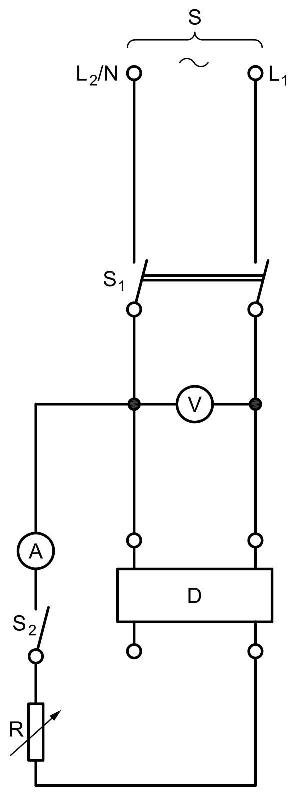
Figure 1 **Standard test finger** *(2 of 2)*

Both joints shall permit movement in the same plane and the same direction through an angle of 90° with a tolerance of $^{+10}_{0}$°

Key

1	Handle	5	R2 ±0,05 cylindrical
2	Guard	6	Insulating material
3	Stop face	7	Chamfer all edges
4	Joints	8	R4 ±0,05 spherical

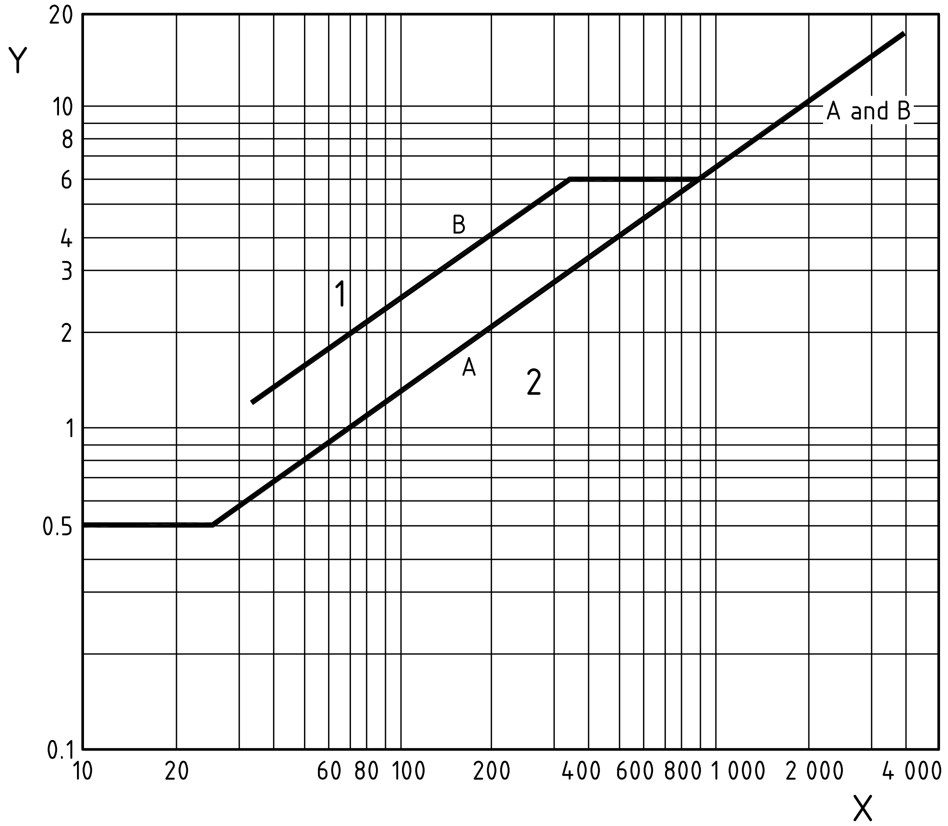
Figure 2 **General test circuit**



Key

S	Supply	S_1	Two-pole switch
V	Voltmeter	S_2	Single-pole switch
A	Ammeter	R	Variable resistor
D	SRCD under test		

Figure 3 **Minimum creepage distances and clearances as a function of peak value of voltage**



For parts conductively connected to the supply mains with voltages in the range of 220 V to 250 V (r.m.s.), the dimensions are equal to those relating 354 V, peak:

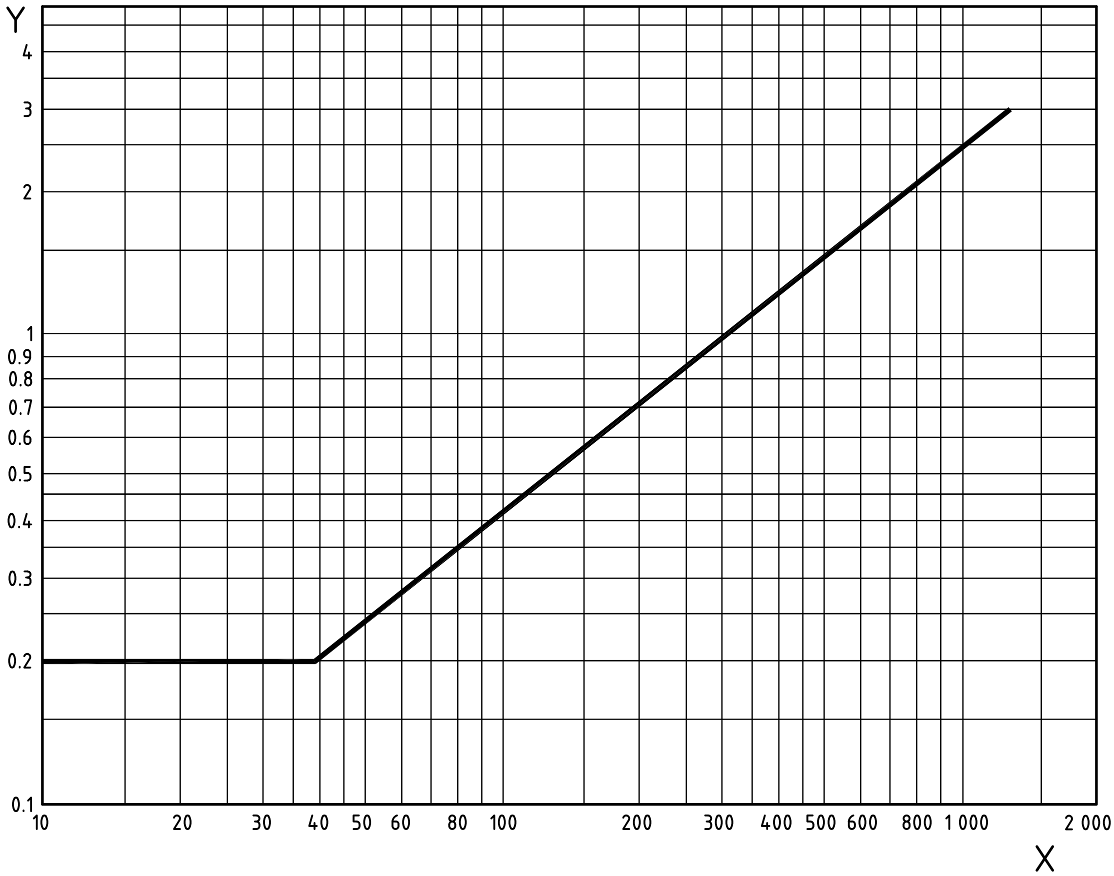
Curve A: 34 V corresponds to 0,6 mm
354 V corresponds to 3,0 mm

Curve B: 34 V corresponds to 1,2 mm
354 V corresponds to 6,0 mm

Key

X	Peak value of the voltage (V)	1	For reinforced insulation only
Y	Minimum creepage distances and clearances (mm)	2	For basic and supplementary insulation and fault condition testing

Figure 4 **Minimum creepage distances and clearances as a function of peak value of operating voltage**



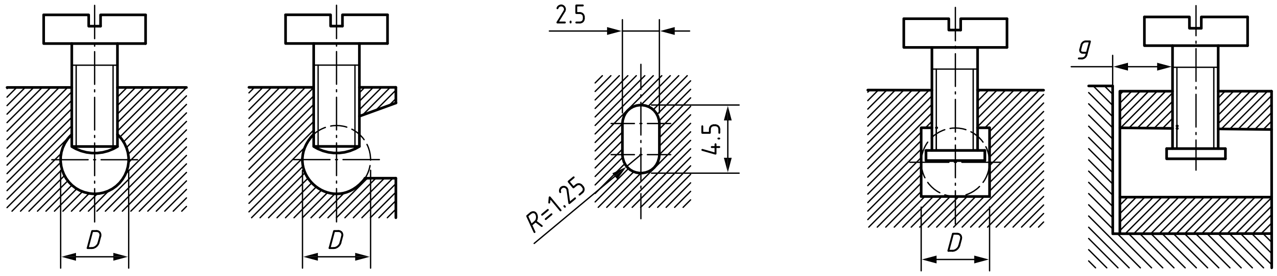
Key

X Peak value of the voltage (V)

Y Minimum creepage distances and clearances (mm)

Figure 5 **Pillar terminals**

Dimensions in millimetres



Terminals without pressure plate Elongated hole terminal Terminals with pressure plate

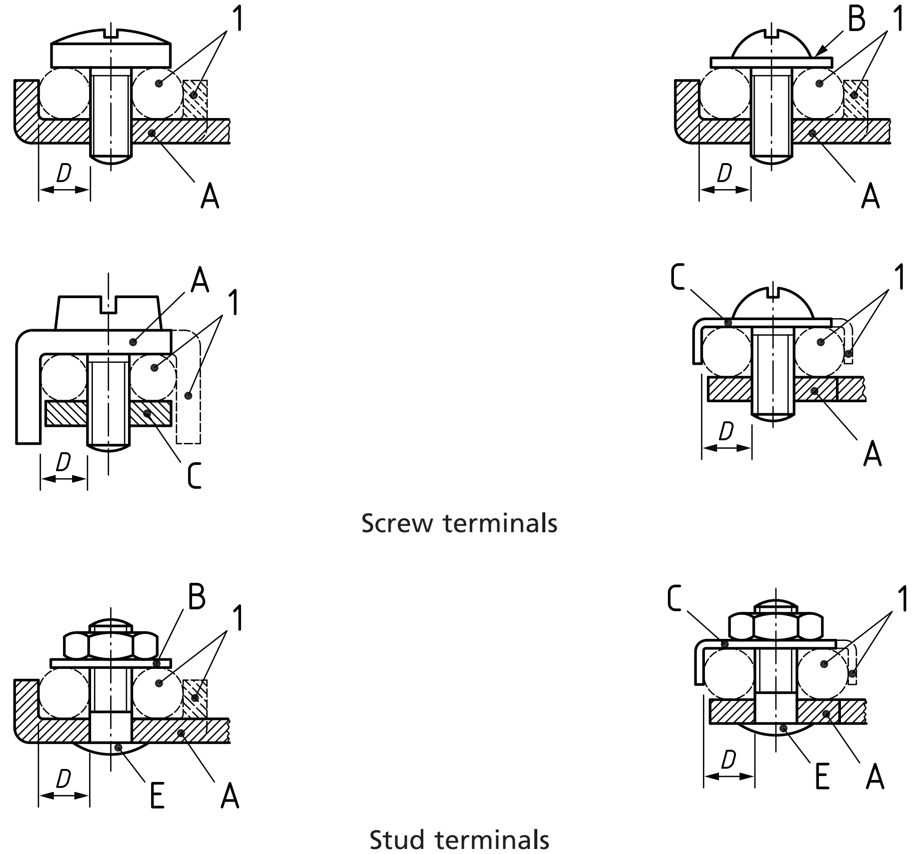
The part of the terminal containing the threaded hole and the part of the terminal against which the conductor is clamped by the screw may be two separate parts, as in the case of terminals provided with a stirrup.

The shape of the conductor space may differ from those shown, provided that a circle with a diameter equal to the minimum specified for *D* or the minimum outline specified for the elongated hole accepting cross sections of conductors up to 2,5 mm² can be inscribed.

Cross section of conductor accepted by the terminal mm²	**Minimum diameter *D* (or minimum dimensions) of conductor space** mm	**Minimum distance *g* between clamping screw and end of conductor when fully inserted** mm		**Torque** Nm					
				1 A)		**2** A)		**3** A)	
		One screw	**Two screws**	**One screw**	**Two screws**	**One screw**	**Two screws**	**One screw**	**Two screws**
Up to 1,5	2,5	1,5	1,5	0,2	0,2	0,4	0,4	0,4	0,4
2,5 (circular hole)	3,0	1,5	1,5	0,25	0,2	0,5	0,4	0,5	0,4
2,5 (elon-gated hole)	2,5 × 4,5	1,5	1,5	0,25	0,2	0,5	0,4	0,5	0,4
4	3,6	1,8	1,5	0,4	0,2	0,8	0,4	0,8	0,4
6	4,0	1,8	1,5	0,4	0,25	0,8	0,5	0,8	0,5
10	4,5	2,0	1,5	0,7	0,25	1,2	0,5	1,2	0,5

A) The values specified apply to screws covered by the corresponding columns in Table 6.

Figure 6 **Screw terminals and stud terminals**



a) Screw/stud not requiring washer or clamping plate

b) Screw/stud requiring washer, clamping plate or anti-spread device

The part which retains the conductor in position may be of insulating material provided the pressure necessary to clamp the conductor is not transmitted through the insulating material.

The second optional space for the terminal accepting cross section of conductors up to 2,5 mm² may be used for the connection of the second conductor when it is required to connect two 2,5 mm² conductors.

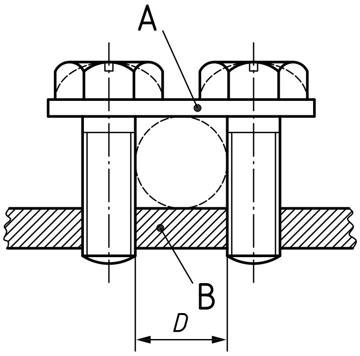
Key

A	Fixed part	D	Conductor space
B	Washer or clamping plate	E	Stud
C	Anti-spread device	1	Optional

Cross section of conductor accepted by the terminal mm²	**Minimum diameter *D* of conductor space** mm	**Torque** Nm	
		3 [A]	
		One screw or stud	**Two screws or studs**
Up to 1,5	1,7	0,5	–
Up to 2,5	2,0	0,8	–
Up to 4	2,7	1,2	0,5

[A] The values specified apply to screws covered by the corresponding columns in Table 6.

Figure 7 **Saddle terminals**



The shape of the conductor space may differ from that shown in this figure, provided that a circle with a diameter equal to the minimum value specified for *D* can be inscribed.

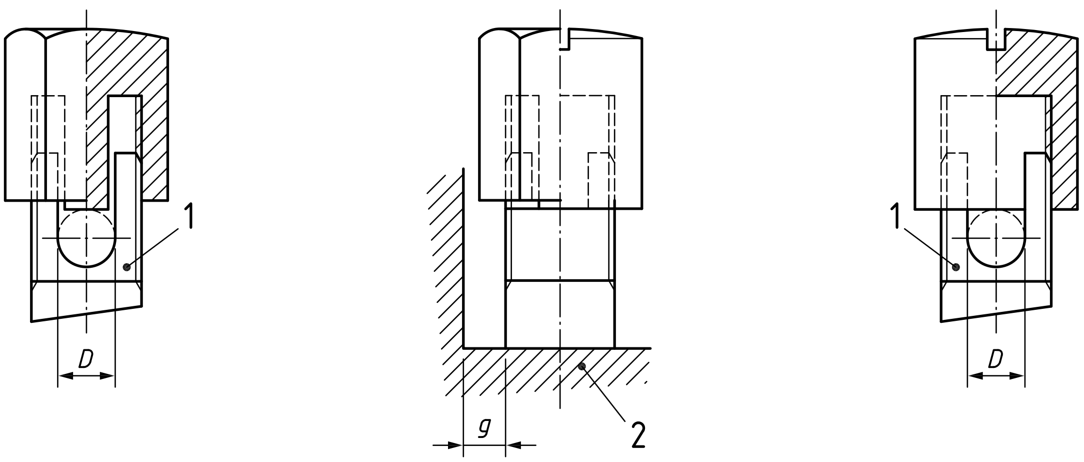
The shape of the upper and lower faces of the saddle may have a different shape to accommodate conductors of either small or large cross-sectional areas by inverting the saddle.

Key

A Saddle
B Fixed part
C Stud
D Conductor space

Cross section of conductor accepted by the terminal mm²	**Minimum diameter *D* of conductor space** mm	**Torque** Nm
Up to 4	3,0	0,5

Figure 8 **Saddle terminals**



Key

1 Fixed part
2 Part of accessory with cavity for terminal

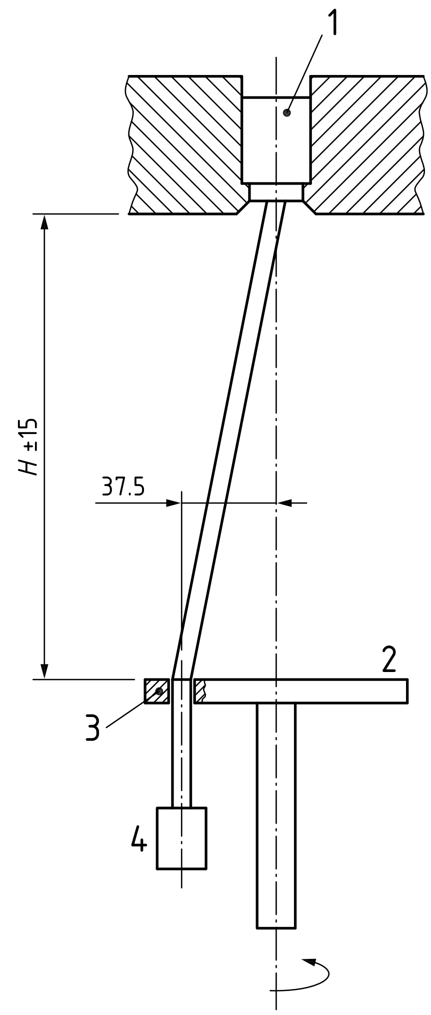
Cross section of conductor accepted by the terminal mm²	**Minimum diameter *D* of conductor space** A) mm	**Minimum distance *g* between fixed part and end of conductor when fully inserted** mm
Up to 1,5	1,7	1,5
Up to 2,5	2,0	1,5
Up to 4	2,7	1,8

A) The bottom of the conductor space shall be slightly rounded in order to obtain a reliable connection.

NOTE The value of the torque to be applied is that specified in column 2 or 3 of Table 20 as appropriate.

Figure 9 **Arrangement for checking damage to conductors**

Dimensions in millimetres



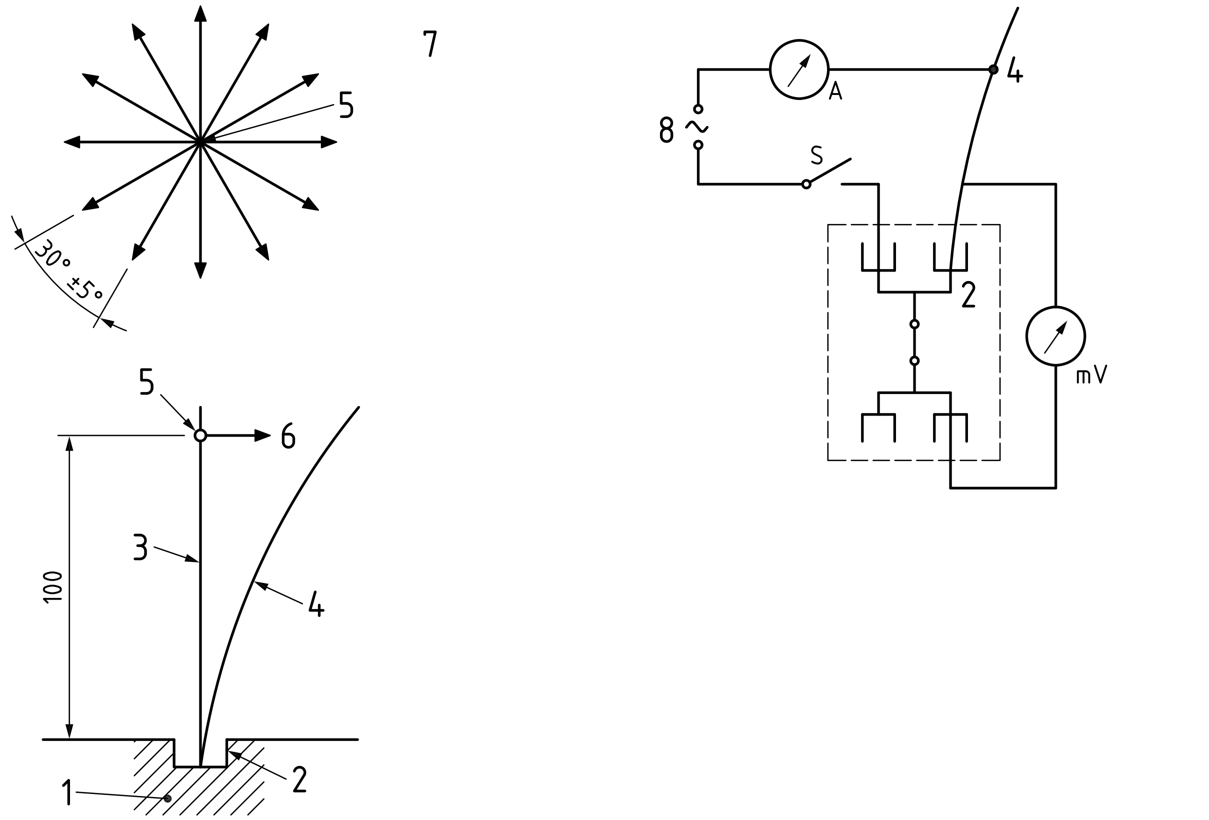
Key

1	Terminal	3	Bushing
2	Platen	4	Mass

NOTE Care should be taken that the bushing hole is made in a way which ensures that the force extended to the cable is pure pulling force and that the transmission of any torque to the connection in the clamping means is avoided.

Figure 10 **Information for deflection test**

Dimensions in millimetres



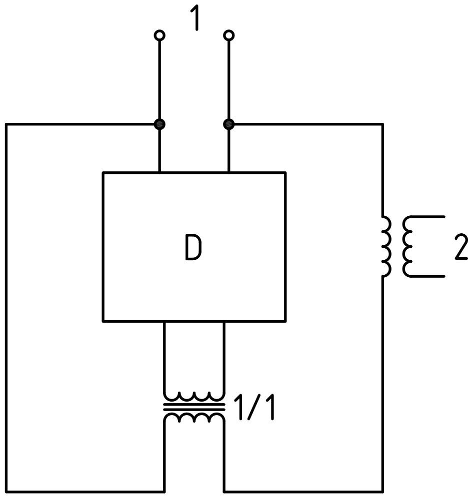
a) Principle of the test apparatus for deflection on screwless terminals

b) Example of test arrangement to measure the voltage drop during deflection test on screwless terminals

Key

A	Ammeter
mV	Millivoltmeter
S	Switch
1	Specimen
2	Clamping unit under test
3	Test conductor
4	Test conductor, deflected
5	Point of application of the force for deflecting the conductor
6	Deflection force (perpendicular to the straight conductor)
7	Directions of application of the forces
8	Supply

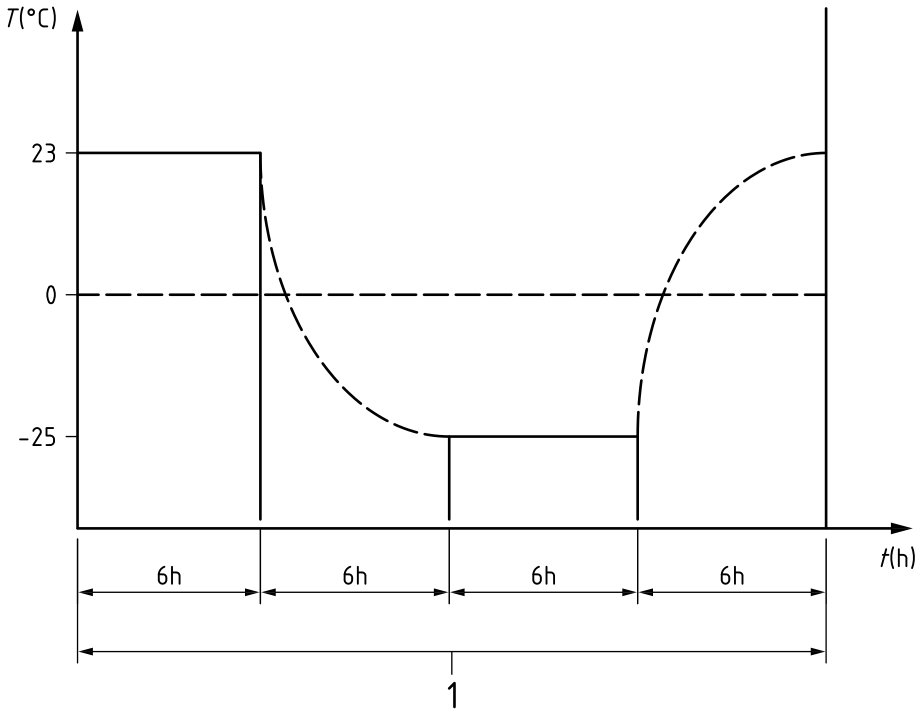
Figure 11 **Example of a test circuit with current and voltage derived from separate sources**



Key

1	Supply at 1,1 U_n	D	SRCD under test
2	Current supply		

Figure 12 **Test cycle for low temperature test**



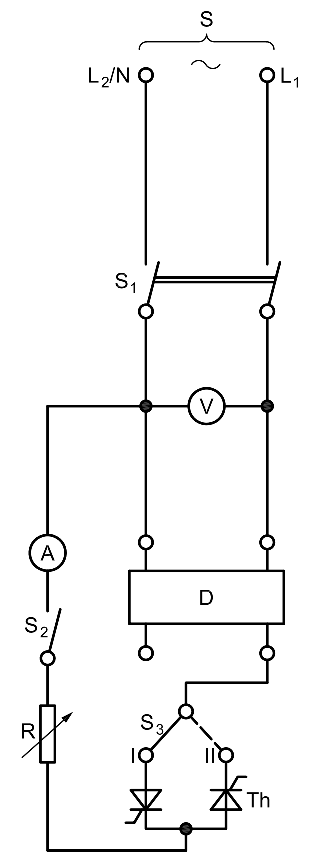
Key

1 1 cycle

Figure 13 **Void**

Void

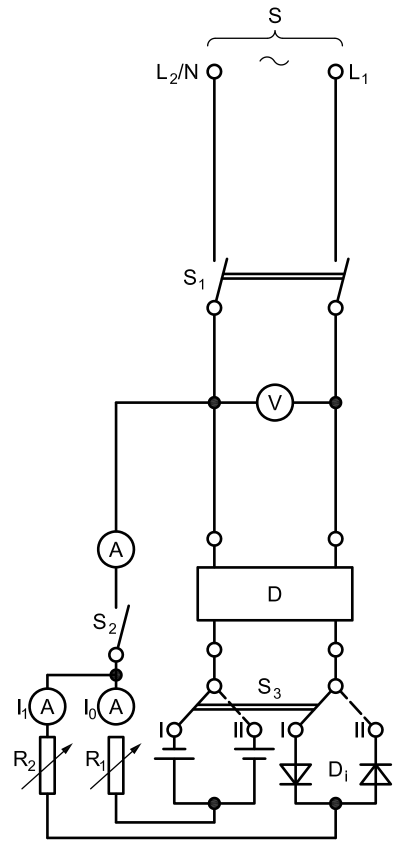
Figure 14 **Test circuit for the verification of the correct operation of SRCDs, in the case of residual pulsating direct currents**



Key

S	Supply	Th	Thyristor
V	Voltmeter	S_1	Two-pole switch
A	Ammeter (measuring r.m.s. values)	S_2	Single-pole switch
D	SRCD under test	S_3	One-pole two-way switch
R	Variable resistor		

Figure 15 **Test circuit for the verification of the correct operation of SRCDs, in the case of residual pulsating direct currents superimposed by a smooth direct current**



Key

S	Supply	D_i	Diode
V	Voltmeter	S_1	Two-pole switch
A	Ammeter (measuring r.m.s. values)	S_2	Single-pole switch
D	SRCD under test	S_3	Two-pole two-way switch
R_1	Variable resistor	R_2	Variable resistor

Figure 16 **Damped oscillator current wave 0,5 μs/100 kHz**

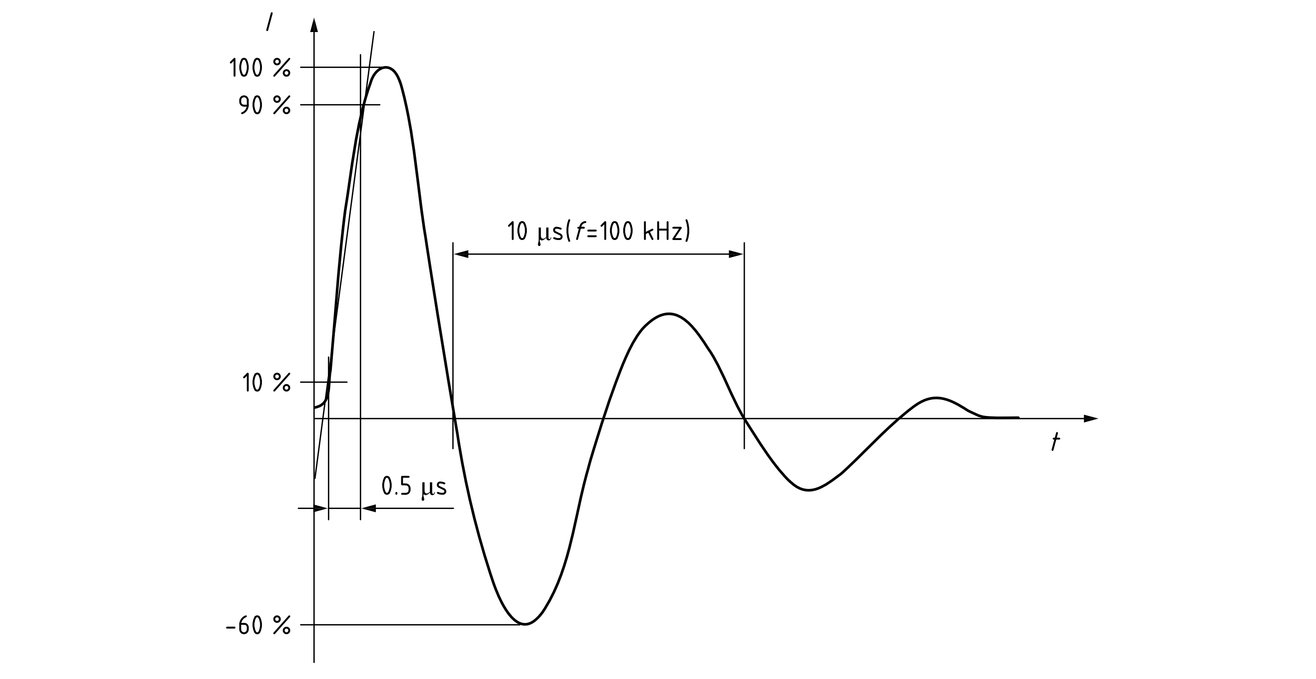
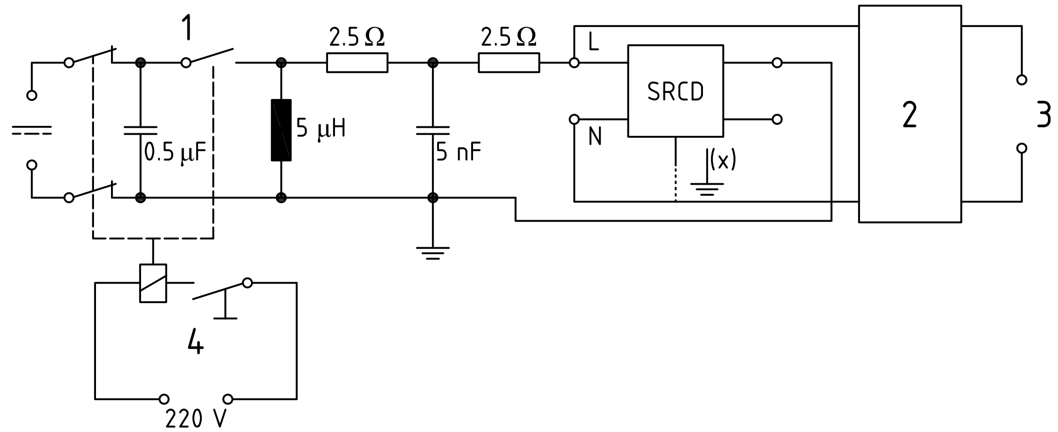


Figure 17 **Example of test circuit for the verification of resistance against unwanted tripping due to surge currents to earth resulting from impulse voltages for SRCDs**

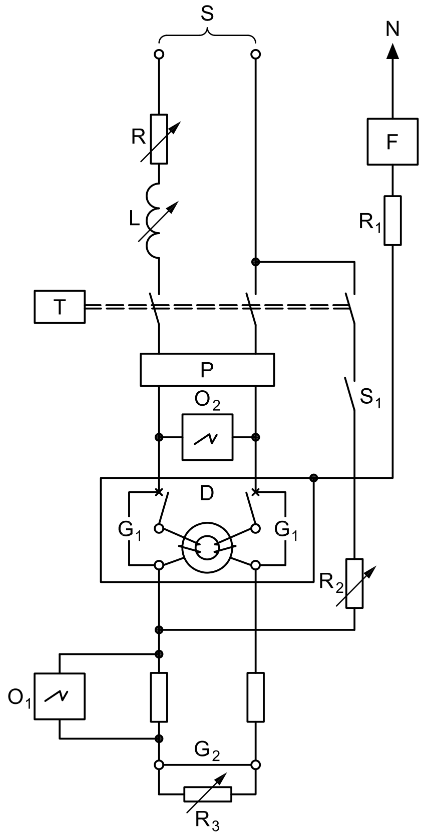


Key

1	Trigger	3	Supply
2	Filter	4	Start

(x) Earthing terminal connected to the neutral conductor if marked on the SRCD

Figure 18 **Test circuit for the verification of the rated making and breaking capacity and of the coordination**

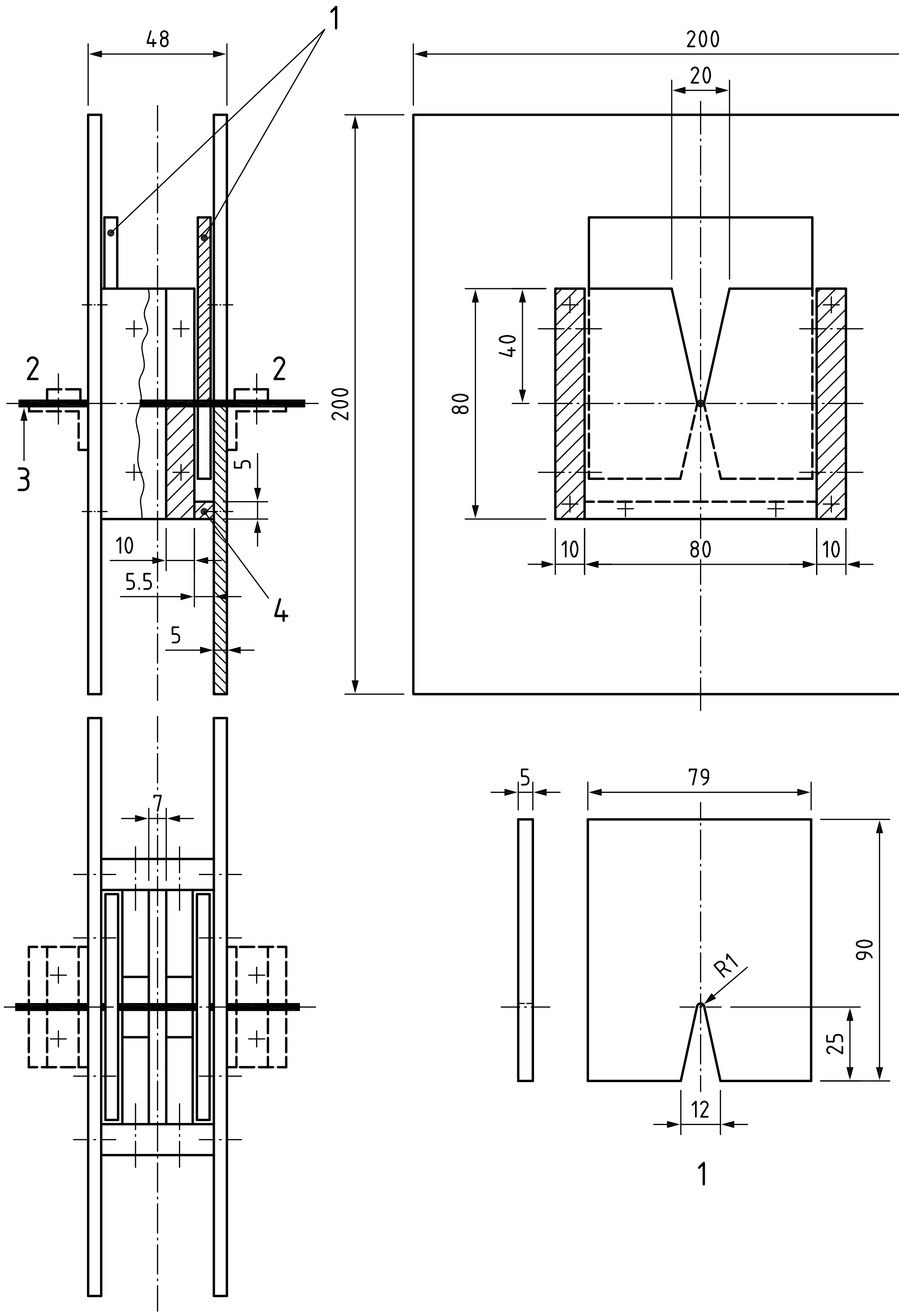


Key

N	Neutral conductor	O_1	Recording current sensor
S	Supply	O_2	Recording voltage sensor
R	Adjustable resistor	F	Device for the detection of a fault current in the device F
L	Adjustable reactor		
P	Short-circuit protective device (SCPD)	R_1	Resistor limiting the current in the device F
D	SRCD under test	R_2	Adjustable resistor for the calibration $I_{\triangle}$
G_1	Temporary connections for calibration	R_3	Additional adjustable resistor to obtain current below the rated conditional short-circuit current
G_2	Connection for the test with rated conditional short-circuit current		
T	Device making the short-circuit	S_1	Switch

Figure 19 **Test apparatus for the verification of the minimum I^2t and I_p values to be withstood by the SRCD [9.15.2.1a)]**

Dimensions in millimetres

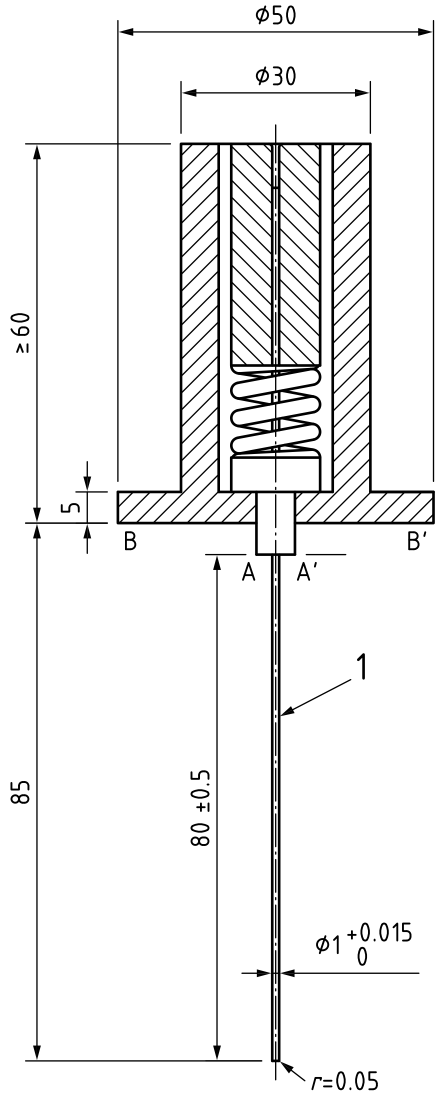


Key

1	Gliding plate	3	Silver wire
2	Terminal	4	Stop for gliding plate

Figure 20 **Gauge for checking non-accessibility of live parts**

Dimensions in millimetres

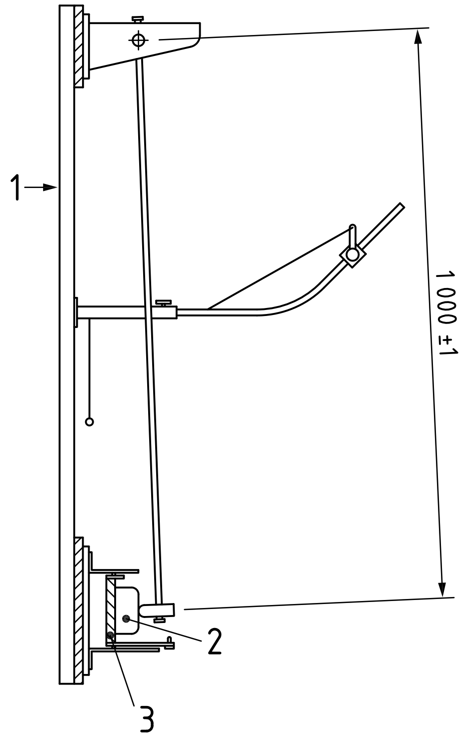


Key

1 Rigid steel wire

Figure 21 **Impact-test apparatus**

Dimensions in millimetres

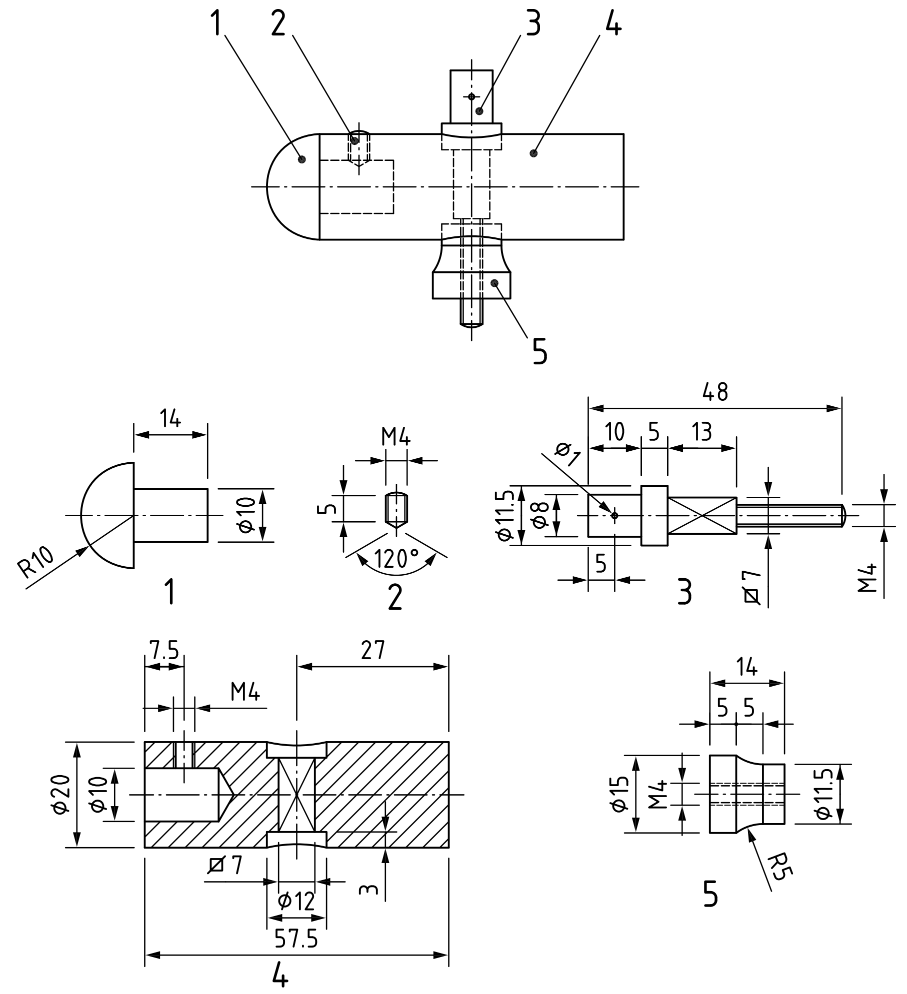


Key

1	Frame	3	Mounting support
2	Specimen		

Figure 22 **Details of the striking element**

Dimensions in millimetres

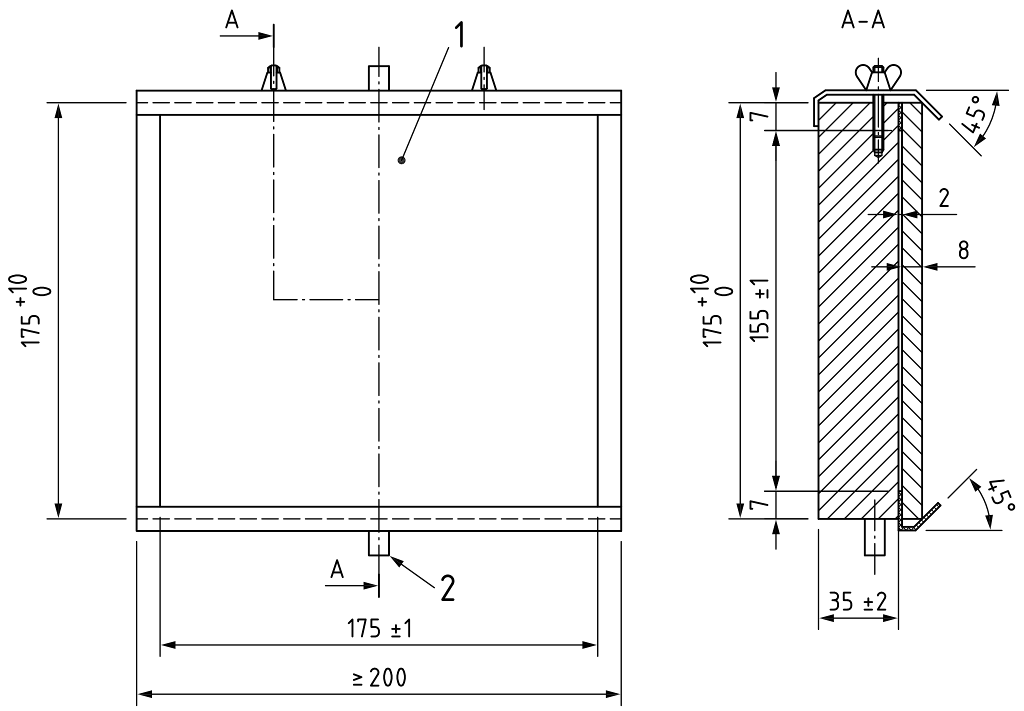


Key

1	Polyamide
2,3,4,5	Steel Fe 360

Figure 23 **Mounting support for specimens**

Dimensions in millimetres



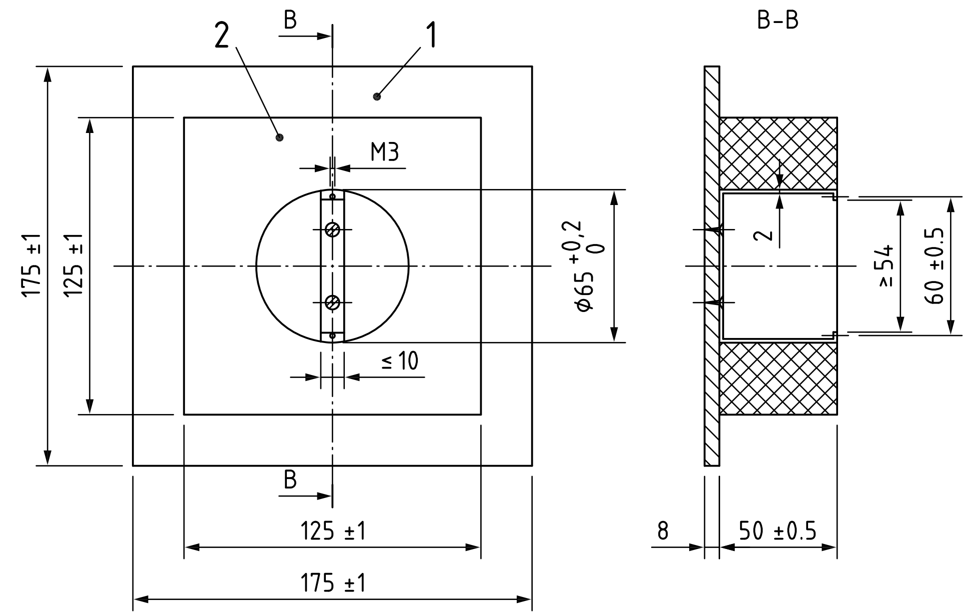
Key

1 Sheet of plywood

2 Pivot

Figure 24 **Mounting block for flush-type SRCDs**

Dimensions in millimetres



NOTE The dimensions of the recess in the hornbeam block are given as an example. More general dimensions are under consideration.

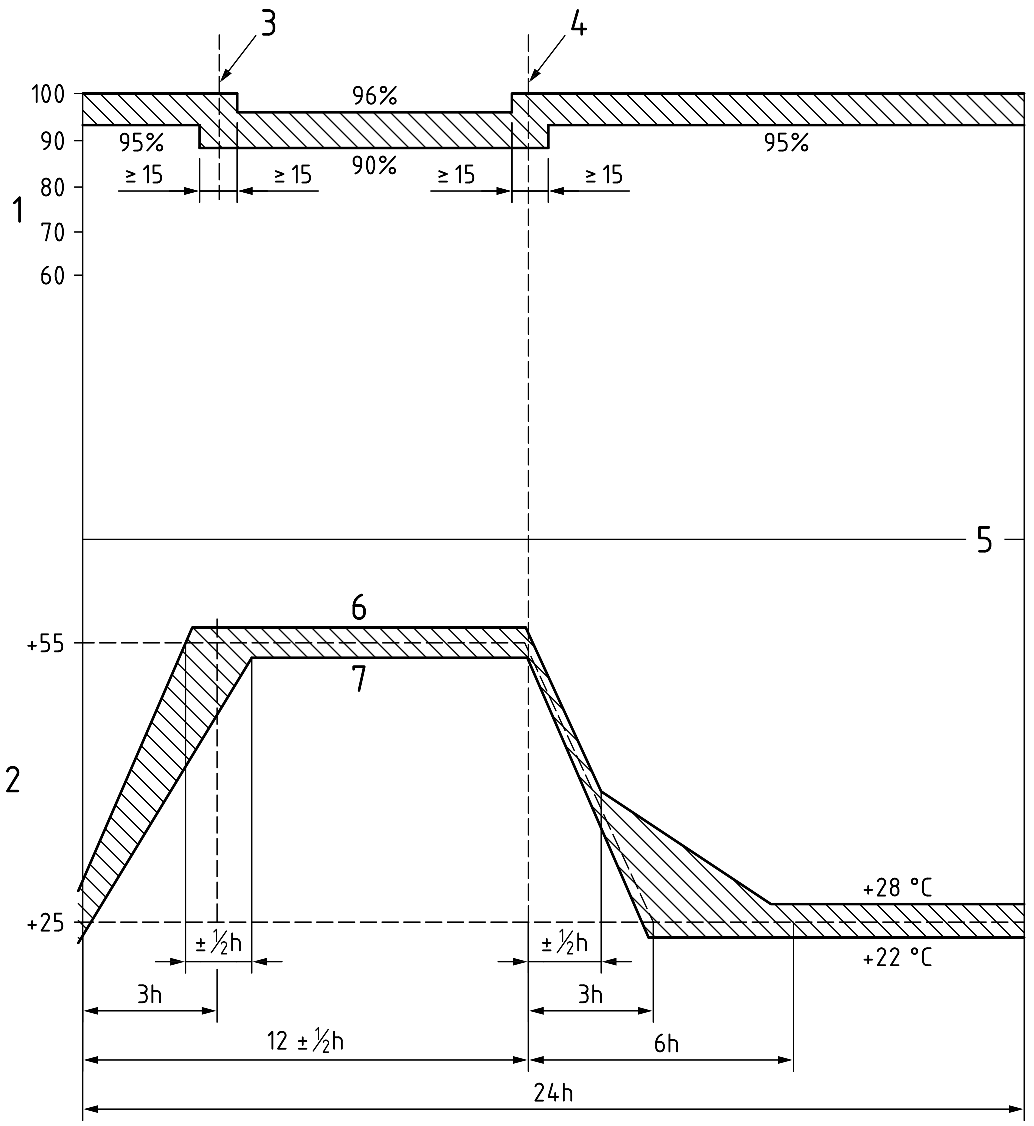
Key

1 Sheet of plywood

2 Block of hornbeam

Figure 25 **Reliability test cycle**

Dimensions in millimetres

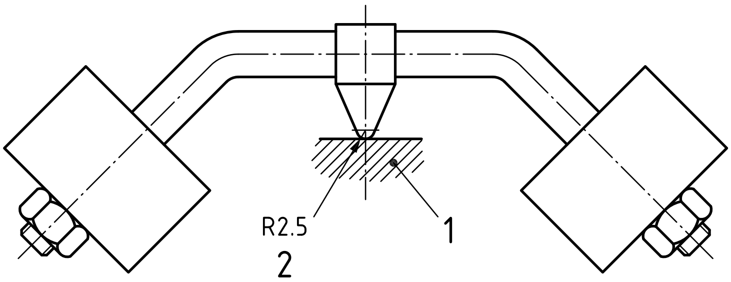


Key

1	Relative humidity (%)	5	Time
2	Ambient temperature (°C)	6	Upper temperature +57 °C
3	End of the temperature rise	7	Lower temperature +53 °C
4	Start of the temperature fall		

Figure 26 **Ball-pressure test apparatus**

Dimensions in millimetres

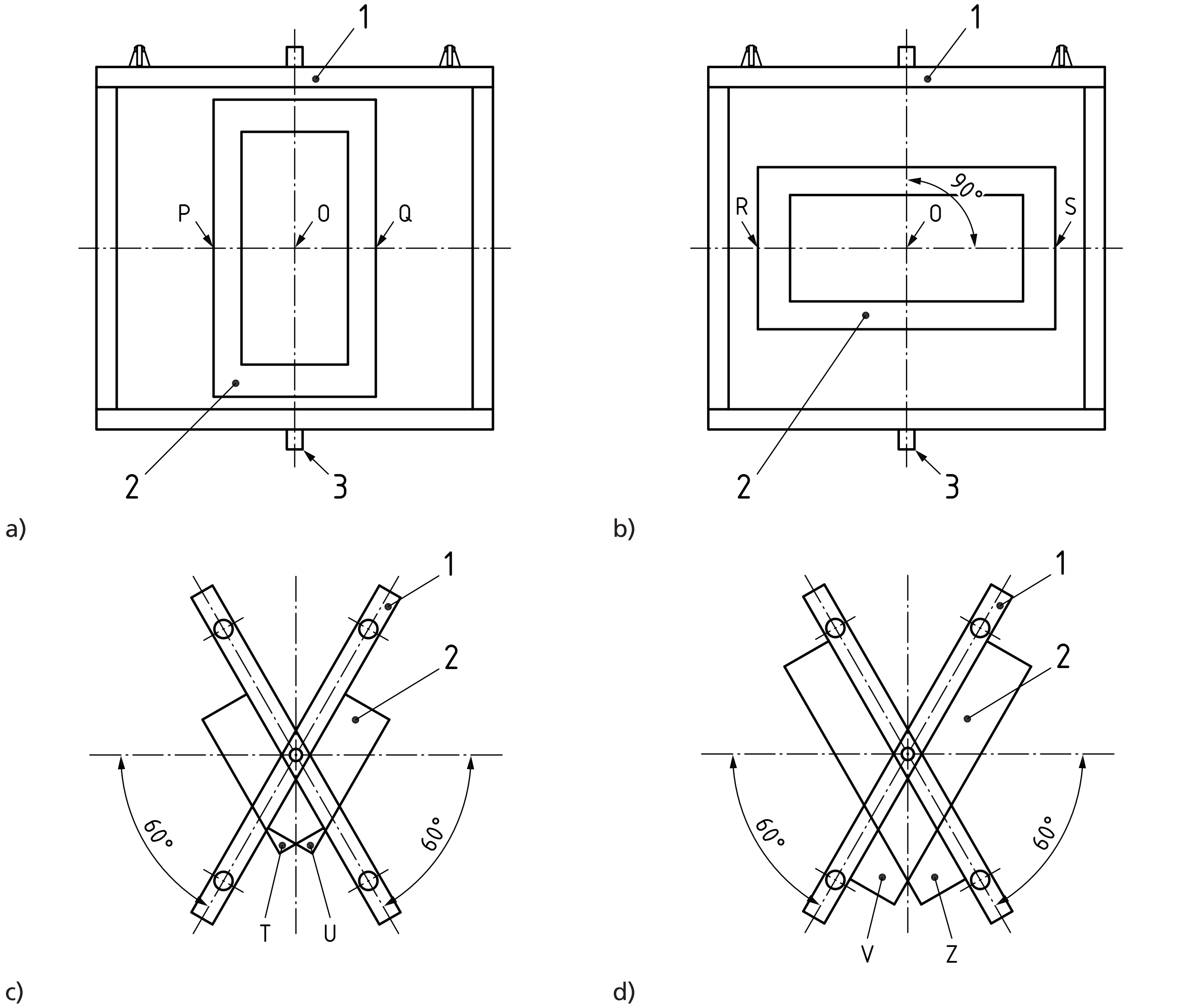


Key

1 Sample

2 Spherical

Figure 27 **Sketches and table showing the application of the blows**



Key

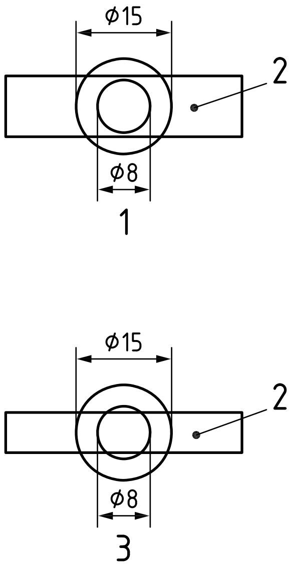
1 Sheet of plywood
2 Specimen
3 Pivot

Application of the blows			
Sketch	**Total number of blows**	**Points of application**	**Parts to be tested**
27a)	3	One at the centre One between O and P [A)] One between O and Q [A)]	A
27b)	2	One between O and R [A)] One between O and S [A)]	A
27c)	2	One on the surface T [A)] One on the surface U [A)]	B, C and D
27d)	2	One on the surface V [A)] One on the surface Z [A)]	B, C and D

[A)] The blow is applied to the most unfavourable point.

Figure 28 **Diagrammatic representation of 9.22**

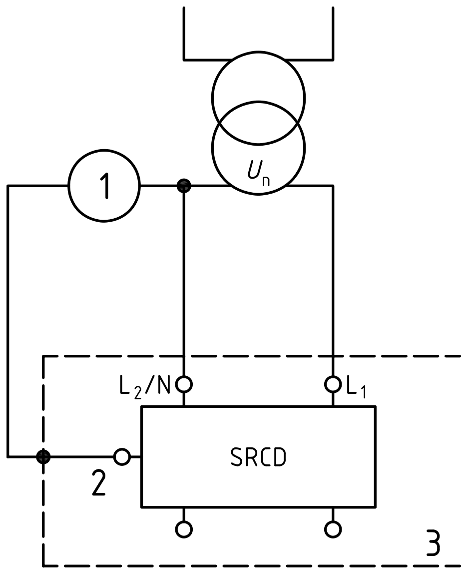
Dimensions in millimetres



Key

1	To be tested	3	No test is required
2	Specimen		

Figure 29 **Test circuit for the verification of TOV withstand (9.25)[A)]**



Key

1	Test voltage	3	Frame
2	PE if any		

[A)] The test voltage and U_n shall be in phase.

Annex A (normative) Test sequence and number of samples to be submitted for verification of conformity

NOTE Verification of conformity may be made:

- *by the manufacturer for the purpose of suppliers declaration; or*
- *by an independent body for certification.*

A.1 *Text deleted*

A.2 Test sequences

The tests are made according to Table A.1, the tests in each sequence being carried out in the order indicated.

Table A.1 **Type testing schedule** *(1 of 2)*

Test sequence	Clause or subclause	Text (or inspection)
A	**9.2**	Marking and test of indelibility of marking
	9.3	Verification of the trip-free mechanism
	9.6	Test of reliability of screws, current-carrying parts and connections
	9.7	Screwed and screwless terminals
	9.20	Protection against electric shock
	9.21	Resistance to heat
	8.3.2	Creepage and clearances
	9.22	Resistance to abnormal heat and to fire
B_0	**9.12**	Resistance to humidity
	9.13	Test of dielectric properties
	9.11.3.1	Temperature rise test for SRCDs classified according to **4.2.1**
	9.11.3.2	Temperature rise test for connection units classified according to **4.2.3**
	9.16	Verification of resistance of the SRCD against impulse voltages
	9.19.2	Test with temperature of 40 °C
	9.24	Verification of ageing of electronic components
B_1	**9.26**	Tests for reverse polarity
	9.25	Verification of the behaviour of the SRCD under temporary overvoltages (TOV) conditions
C_0	**9.17**	Mechanical and electrical endurance
C_1	**9.15.3**	Verification of the making and breaking capacity of the socket-outlet of the SRCD, classified according to **4.2.1**
D_0	**9.8**	Verification of the operating characteristics of type AC and type A SRCDs
	9.4	Tests replacing verifications of creepage distances and clearances for electronic circuits connected between active conductors (phases and neutral) and/or between active conductors and the earth circuit when the contacts are in the closed position
	9.5	Requirements for capacitors and specific resistors and inductors used in electronic circuits connected between active conductors (phases and neutral) and/or between active conductors and the earth circuit when the contacts are in the closed position

Table A.1 **Type testing schedule** *(2 of 2)*

Test sequence	Clause or subclause	Text (or inspection)
D_1		*Text deleted*
	9.14.2	Verification of resistance against unwanted tripping due to surge currents to earth resulting from impulse voltages for SRCDs of $I_{\Delta n} \geq 0{,}010$ A
	9.10	Verification of the test device
	9.15.2.3	Verification of the rated residual short-circuit making and breaking capacity ($I_{\Delta m}$)
	9.15.2.1i)	Condition of the SRCD after tests
	9.18	Resistance to mechanical shock
E_1 A)	**9.15.2.4**a)	Verification of the coordination at 250 A and at the rated conditional short-circuit current (I_{nc})
	9.15.2.2	Verification of the rated making and breaking capacity (I_m)
	9.15.2.1i)	Condition of the SRCD after test
E_2 A)	**9.15.2.4**b)	Verification of the coordination at the rated making and breaking capacity (I_m)
	9.15.2.4c)	Verification of the coordination at 250 A and at the rated conditional residual short-circuit current ($I_{\Delta c}$)
	9.15.2.1i)	Condition of the SRCD after tests
		Text deleted
G	**9.19.1**	Climatic test
H	**9.27**	Resistance to excessive residual stress test
EMC_1	**9.14.1**	BS EN 61543:1996, Table 4 – T 1.1 Harmonics, interharmonics
		BS EN 61543:1996, Table 4 – T 1.2 Signalling voltages
		BS EN 61543:1996, Table 5 – T 2.3 Conducted unidirectional transients of the ms and μs time scale
EMC_2	**9.14.1**	BS EN 61543:1996, Table 5 – T 2.1 Conducted oscillatory voltages or currents and T 2.5 Radiated high-frequency phenomena
		BS EN 61543:1996, Table 5 – T 2.2 Fast transients (bursts) Common mode
EMC_3	**9.14.1**	BS EN 61543:1996, Table 5 – T 2.6 Conducted common mode disturbances in the frequency range lower than 150 kHz
		BS EN 61543:1996, Table 6 – T 3.1 Electrostatic discharges

A) Test sequences E apply according to the relevant classification according to **4.9**.

A.3 Number of samples to be submitted for full test procedure

If one current rating and one residual operating current rating of one type of SRCD only is submitted for test, the number of samples to be submitted to the different test series is the number indicated in Table A.2 where the minimum performance criteria are also indicated.

If all samples submitted according to the second column of Table A.2 pass the tests, the compliance with the standard is met. If only the minimum number given in the third column passes the tests, additional samples as shown in the fourth column shall be tested and all shall then satisfactorily complete the test sequence.

For SRCDs having only one rated current but more than one residual operating current, two separate sets of samples shall be submitted to each test sequence: one at the highest residual operating current, the other at the lowest residual operating current.

Table A.2 **Number of samples for full test procedure**

Test sequence	No of samples	Minimum number of samples which shall pass the test[A),B)]	Maximum number of samples for repeated tests [C)]
A	1	1	
B_0	3	2	3
B_1	3	2	3
C_0	3	2	3
C_1	3	2	3
D_0	3	2 [D)]	3
D_1	3	2 [D)]	3
E_1	3	2 [D)]	3
E_2	3	2 [D)]	3
Text deleted			
G	3	2	3
H	1	1	
EMC_1 [F)]	3	2	3
EMC_2 [F)]	3	2	3
EMC_3 [F)]	3	2	3

A) In total, a maximum of three test sequences may be repeated.

B) It is assumed that a sample which has not passed a test has not met the requirements due to workmanship or assembly defects which are not representative of the design.

C) In the case of repeated tests, all test results shall be acceptable.

D) No failures are permitted during the tests of **9.8.3**, **9.8.4**, **9.15.2.2**, **9.15.2.3**, **9.15.2.4**a), **9.15.2.4**b) and **9.15.2.4**c) as appropriate.

Text deleted

F) On request of the manufacturer the same set of samples may be subjected to more than one of these test sequences.

A.4 Simplified test procedures in case of submitting simultaneously a range of SRCDs of the same fundamental design

A.4.1 General

SRCDs can be considered to be of the same fundamental design if all of the following conditions are met:

a) they have the same basic design according to the classification;

b) the residual current operating means have identical tripping mechanisms and identical relays or solenoids except for the variations permitted in 3) and 4) below;

c) the materials, finish and dimensions of the internal current-carrying parts are identical other than the variations detailed in 1) below;

d) the terminals are of similar design [see 2) below];

e) the contact size, material, configuration and method of attachment are identical;

f) the manual operating mechanism, materials and physical characteristics are identical;

g) the moulding and insulating materials are identical;

h) the method, materials and construction of the switching device are identical;

i) the basic design of the residual current sensing device is identical, for a given type of characteristic, other than the variations permitted in 3) below;

j) the basic design of the residual current tripping device is identical except for the variations permitted in 4) below;

k) the basic design of the test device is identical except for the variations permitted in 5) below.

The following variations are permitted provided that the SRCDs comply in all other respects with the requirements detailed above;

1) cross-sectional area of the internal current-carrying connections and lengths of the primary toroid connections;

2) size of terminals;

3) number of turns and cross-sectional area of the windings and the size and material of the core of the differential transformer;

4) the sensitivity of the relay and/or the associated electronic circuit, if any;

5) the ohmic value of the means to produce the maximum ampere-turns necessary to conform to the tests of **9.10**.

A.4.2 Simplified test procedure

For SRCDs of the same fundamental design and of the same classification having different current ratings and/or rated residual operating current, the number of samples to be tested may be reduced according to Table A.3.

Table A.3 **Number of samples for simplified test procedure**

Test sequence	Number of samples[A),B)]
A	1 max. rating I_n min. rating $I_{\triangle n}$
B_0	3 max. rating I_n min. rating $I_{\triangle n}$
B_1	3 max. rating I_n min. rating $I_{\triangle n}$
C	3 max. rating I_n min. rating $I_{\triangle n}$
$D_{0\ +}\ D_1$	3 max. rating I_n min. rating $I_{\triangle n}$
D_0	1 for all other ratings of $I_{\triangle n}$ with max. I_n
E_1	3 max. rating I_n min. rating $I_{\triangle n}$
D_1	1 for all other ratings I_n with min. $I_{\triangle n}$
E_2	3 max. rating I_n min. rating $I_{\triangle n}$ 3 min. rating I_n max. rating $I_{\triangle n}$
Text deleted	
G	3 max. rating I_n min. rating $I_{\triangle n}$
H	1 max. rating I_n min. rating $I_{\triangle n}$
EMC_1	3 any rating I_n min. rating $I_{\triangle n}$
EMC_2	3 any rating I_n min. rating $I_{\triangle n}$
EMC_3	3 any rating I_n min. rating $I_{\triangle n}$

A) If a test is to be repeated according to the minimum performance criteria of **A.2**, a new set of samples is used for the relevant test. In the repeated test all test results shall be acceptable.

B) If only one value of $I_{\triangle n}$ is submitted, min. rating $I_{\triangle n}$ and max. rating $I_{\triangle n}$ are replaced by $I_{\triangle n}$.

Text deleted

Annex B (normative) Determination of clearances and creepage distances

In determining clearances and creepage distances, the following points should be considered.

If a clearance or creepage distance is influenced by one or more metal parts, the sum of the sections should have at least the prescribed minimum value.

Individual sections less than 1 mm in length should not be taken into consideration in the calculation of the total length of clearances and creepage distances.

In determining creepage distance:

a) grooves at least 1 mm wide and 1 mm deep should be measured along their contour;

b) grooves having any dimension less than these dimensions should be neglected;

c) ridges at least 1 mm high:

   1) are measured along their contour, if they are integral parts of a component of insulating material (for instance by moulding, welding or cementing);

   2) are measured along the shorter of the two following paths: along the joint or along the profile of the ridge, if the ridges are not integral parts of a component of insulating material.

The application of the foregoing recommendations is illustrated by the following figures:

- Figures B.1, B.2 and B.3 indicate the inclusion or exclusion of a groove in a creepage distance;
- Figures B.4 and B.5 indicate the inclusion or exclusion of a ridge in a creepage distance;
- Figure B.6 illustrates how to take into account a joint when the ridge is formed by an inserted insulating barrier, the outside profile of which is longer than the length of the joint;
- Figures B.7, B.8, B.9 and B.10 illustrate how to determine the creepage distance in the case of fixing means situated in recesses in insulating parts of insulating material.

Figures B.1 to B.10 – Illustrations of the application of creepage distances

Dimensions in millimetres

Figure B.1

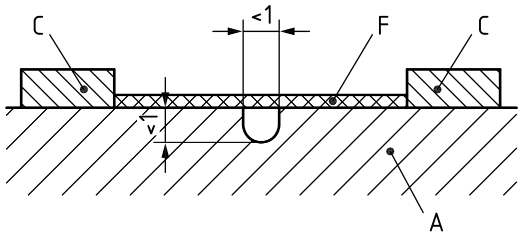


Figure B.2

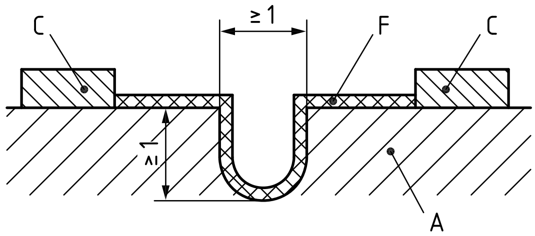


Figure B.3

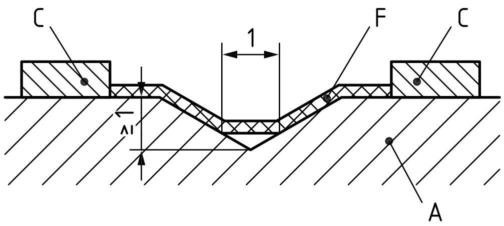


Figure B.4

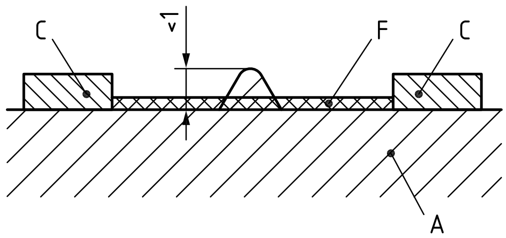


Figure B.5

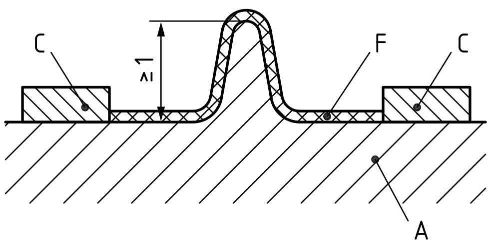


Figure B.6

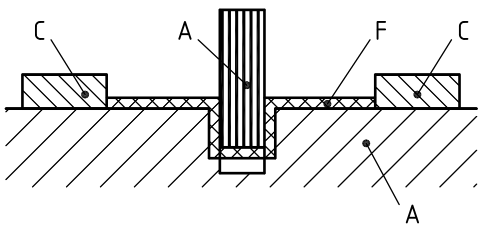


Figure B.7

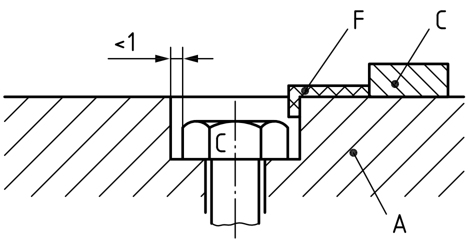


Figure B.8

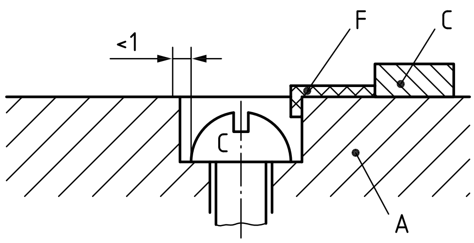


Figure B.9

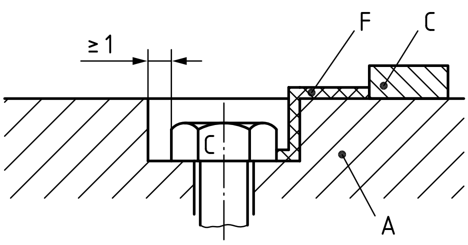
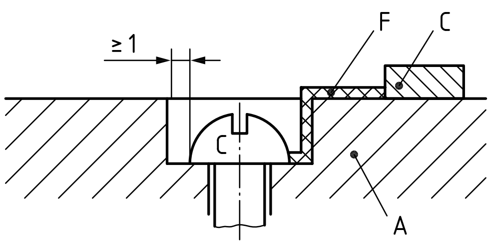


Figure B.10



Key

A Insulating material

C Conducting part

F Creepage distance

Annex C (informative) ***Text deleted***

Annex D (normative) Routine tests

D.1 General

The tests specified in this standard are intended to reveal, as far as safety is concerned, unacceptable variations in material or manufacture. In general, more tests have to be made to ensure that every SRCD conforms with the samples that withstood the tests of this standard, according to the experience gained by the manufacturer.

D.2 Tripping test

A residual current is passed through each pole of the SRCD in turn. The SRCD shall not trip at a current less than or equal to 0,5 $I_{\Delta n}$, but it shall trip at $I_{\Delta n}$ within a specified time (see Table 1). The test current shall be applied at least five times on each SRCD and shall be applied at least twice on each pole.

D.3 Dielectric strength test

A voltage of substantially sinusoidal wave form of value 1 500 V having a frequency of 50 Hz/60 Hz is applied for 1 s between the following parts:

a) with the SRCD in the open position, between each pair of terminals which are electrically connected together when the SRCD is in the closed position;

b) for SRCDs not incorporating electronic components, with the SRCD in the closed position, between each pole in turn and the others connected together;

c) for SRCDs incorporating electronic components, with the SRCD in the open position, either between all incoming terminals of poles in turn or between all outgoing terminals at poles in turn, depending on the position of the electronic components.

No flashover or breakdown shall occur.

D.4 Performance of the test device

With the SRCD in the closed position, and connected to a supply at the appropriate voltage, the test device, when operated, shall open the SRCD.

Where the test device is intended to operate at more than one value of voltage, the test shall be made at the lowest value of voltage.

Annex E (informative) Methods of determination of short-circuit power factor

E.1 General

There is no uniform method by which the short-circuit power factor can be determined with precision. Two examples of acceptable methods are given in this annex.

E.2 Method I – Determination from d.c. components

The angle φ may be determined from the curve of the d.c. component of the asymmetrical current wave between the instant of the short-circuit and the instant of contact separation as follows.

a) The formula for the d.c. component is:

$$i_d = i_{do} . e^{-Rt/L}$$

where:

i_d	is the value of d.c. components at the instant t;
i_{do}	is the value of the d.c. component at the instant taken as time origin;
L/R	is the time-constant of the circuit, in seconds;
t	is the time, in seconds, taken from the initial instant;
e	is the base of the Neperian logarithms.

The time-constant L/R can be ascertained from the above formula as follows:

1) measure the value of i_{do} at the instant of short-circuit and the value of i_d at another instant t before the contact separation;
2) determine the value of $e^{-Rt/L}$ by dividing i_d by i_{do};
3) from a table of values of e^{-x} determine the value of $-x$ corresponding to the ratio of i_d/i_{do};
4) the value x represents Rt/L from which L/R is obtained;
5) determine the angle from:

$$\varphi = \arc\tan \omega\ L/R$$

where ω is 2π times the actual frequency.

This method should not be used when the currents are measured by current transformers.

E.3 Method II – Determination with pilot generator

When a pilot generator is used on the same shaft as the test generator, the voltage of the pilot generator on the oscillogram may be compared in phase first with the voltage of the test generator and then with the current of the test generator.

The difference between the phase angles between pilot generator voltage and main generator voltage on the one hand and pilot generator voltage and test generator current on the other hand gives the phase-angle between the voltage and current of the test generator, from which the power factor can be determined.

Annex F (informative) Differences between BS 7822:2016 and IEC 62640:2011 (with the common modifications)

The key differences between BS 7288:2016 and IEC 62640:2011 (with the common modifications from HD 62640:2015) are set out in Table F.1.

Table F.1 **Differences between BS 7288:2016 and IEC 62640:2011/HD 62640:2015** *(1 of 3)*

(Sub)clause of IEC 62640	**Change from IEC 62640/HD 62640 in BS 7288:2016**
General	The cross references to some bibliographical/normative references throughout the text have been updated Notes relating to specific jurisdictions have been deleted
1	Scope modified to apply to single pole, neutral and single pole and switched neutral and two pole socket-outlets Maximum rated residual operating current has been changed from 100 mA to 30 mA (this change has been fed into the main body of text) Second sentence added to final paragraph indicating that BS 1363-4 covers the connection unit part of an SRCD
3.3.12	Definition deleted as term not used in text
3.8.6	Definition of “connection unit” modified
4.2.2	Deleted entirely, a change from HD 62640’s indication that only item a) is void
4.2.3	Text modified
4.4a)	Retained, a change from HD 62640’s indication that the whole of **4.4** is void
4.7.1, **4.7.2**	New item d) added for IP6X and IPX6
4.10, **4.11**, **4.12**	New subclauses added for type of SRCD (**4.10**), the number of poles (**4.11**) and the type of switching (**4.12**)
5.1 j1)iii and j)2)	Text deleted
5.3.1.1	Paragraphs 2 and 3 deleted Note deleted
5.3.2	Text deleted
5.4.3	“0.1” deleted as the SRCD is restricted to 0.03 A (30 mA)
5.4.5	Preferred value of rated frequency given as 50/60 Hz instead of the 50 Hz given by HD 62640
5.5	Text, including Table 3, deleted
6.1.1, Table 4	Row E2 and footnote B) deleted New rows W, X and Y added
–	New subclauses **6.1.2** to **6.1.6** added
–	New subclauses **8.1.1** and **8.1.2** added
8.3.1	Text on compliance and the functioning of an SRD connected to a supply of reversed polarity added to the end
8.3.4.4, paragraph 1	Modified to indicate the metals to be used for current-carrying parts Reference to stainless steel removed from the note
8.3.4.4, paragraph 2	Text added to the end
8.3.4.4, paragraph 3	The test in **9.27** is referenced in the sentence about compliance
–	New subclause **8.3.6** on mounting arrangements added
–	New subclause **8.3.7** on construction of socket-outlets added
8.11.1	Title deleted
8.11.2 and **8.11.3**	Text deleted
8.16.3d)	Instance of “tubes” replaced with “contact”
8.16.3.1b)iv)	References the values specified in **8.3.2**, rather than “the national requirements for socket-outlets of the country where the product is placed on the market” indicated by HD 62640

Table F.1 **Differences between BS 7288:2016 and IEC 62640:2011/HD 62640:2015** *(2 of 3)*

(Sub)clause of IEC 62640	Change from IEC 62640/HD 62640 in BS 7288:2016
8.16.3.1, Final paragraph	References the values specified in **8.3.2** and **8.9**, rather than "the national requirements for socket-outlets of the country where the product is placed on the market"
8.20, Table 11	Footnote retained rather than deleted as indicated by HD 62640, but "or FE" has been omitted
9.1.1, paragraph 2	Second sentence added
9.1.1	Paragraphs 4 and 5 deleted
9.1.1, Table 12	The value given for the rated current $6 < I_n \leq 13$ has been changed from 1,5 to 2,5 to align with UK wiring practice of using 2,5 cables for fixed installations
9.1.2, Table 13	Reference to **9.23** deleted from test column as this subclause has been deleted
9.7.1.1, Table 16	Nominal cross-sectional area for "13 A and 16 A, 2P and 2P" changed, and footnote [B)] removed
9.7.1.3, paragraph 2	"or their alloys" added to the end of the paragraph
9.1.7.6, paragraph 3	The words "and flexible connectors for plugs and portable socket-outlets" that followed "fixed socket-outlets" deleted
9.7.1.7, paragraph 5	Text deleted
9.7.2.4, paragraph 2	Reference to chemical analysis replaced with a reference to the test of **9.27**
9.7.2.10, Table 23	Note deleted because Annex C, which it referenced, has been removed
9.7.2.11a), Table 24	Values in first row modified Notes 1 and 2 deleted
9.7.2.12, Table 25	Now gives values only for "13A, 16A" Table note has been deleted
9.7.2.12, Table 26	Fourth row added for test conductors of nominal cross-sectional area 4,0 mm^2
9.8.3.2b)	"In the United Kingdom" removed from beginning of note
9.11.1	Substantially rewritten, including a new subclause **9.11.1.2** on correction units
9.11.3.1	Substantially rewritten, including a new table which is numbered Table 27A to preserve the numbering of the other IEC 62640 tables in later subclauses
9.11.3.2	Text changed to tests for connection units classified according to **4.2.3**
9.13.1a)	The term "contact tubes" replaced with "contacts"
9.13.3a)	"FE if any" deleted
9.15.1, Table 29	Final column and the bottom two rows removed
9.15.2.1a)	Paragraph 15 modified
9.15.2.2	Paragraph 1 deleted
9.15.2.4	Paragraph 1 deleted
9.15.3 and **9.17.1**	First sentences modified to reference applicable clauses of BS 1363-2:2016 and BS 1363-4:2016, rather than "the national requirements of the country where the product is placed on the market" indicated by HD 62640
–	New subclause **9.15.4** added for verification of the making and breaking capacity of the connection unit of the SCRD
9.17.1	Title and text modified to refer to connection units References to IEC 60884-1:2012 replaced by references to BS 1362-2:2016 and BS 1363-4:2016

Table F.1 **Differences between BS 7288:2016 and IEC 62640:2011/HD 62640:2015** *(3 of 3)*

(Sub)clause of IEC 62640	Change from IEC 62640/HD 62640 in BS 7288:2016
9.17.2, Table 33	Rows for “Above 16 and up to and including 20” and “Above 20 and up to and including 32” deleted
9.18.5	Now refers to “socket-outlets” or “socket-outlet shutters”, rather than “shuttered SRCDs” Tests referenced in paragraph 2 have been changed Paragraphs 3 to 8 and the note have been deleted
9.20.2	A second sentence has been added to the first paragraph to apply IP6X category 1 of BS EN 60529
9.23	Text deleted
9.26	Text replaced with tests for reverse polarity
–	New subclause **9.27** on tests resistance to residual stress added
Annex A, Title	“certification purposes” changed to “verification of conformity”
Annex A, A.1	Replaced by new note about verification of conformity
Table A.1	“Verification of the operating characteristic under overcurrent conditions as applicable” removed from test sequence D1 and test sequences F1 and F2 deleted because **9.23** deleted
Table A.1	Title of **9.26** updated and a new row H added for the tests in **9.27**
Table A.1	New rows added for test sequences EMC_1, EMC_2 and EMC_3
Table A.2	Test sequences F_1 and F_2 and footnote E) deleted because **9.23** deleted
Table A.2 and Table A.3	New rows for test sequence H added
Table A.3	Test sequences F_1 and F_2 and footnote C) deleted because **9.23** deleted
Annex C	Text deleted

Bibliography

Standards publications

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 7671, *Requirements for Electrical Installations – IET Wiring Regulations*

BS EN 60112, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

BS EN 60384-14, *Fixed capacitors for use in electronic equipment*

BS EN 60664-1:2007, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

BS EN 60664-3, *Insulation coordination for equipment within low-voltage systems – Part 3: Use of coating, potting or moulding for protection against pollution*

BS EN 60670-1, *Boxes and enclosures for electrical accessories for household and similar fixed electrical installations – Part 1: General requirements*

BS EN 60670-24, *Boxes and enclosures for electrical accessories for household and similar fixed electrical installations – Part 24: Particular requirements for enclosures for housing protective devices and other power dissipating electrical equipment*

BS EN 60695-2-11:2014, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products (GWEPT)*

BS EN 61008-1, *Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs) – Part 1: General rules*

BS EN 61009-1, *Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs) – Part 1: General rules*

BS EN 61084, *Cable trunking and ducting systems for electrical installations*

BS EN 61439-1, *Low-voltage switchgear and controlgear assemblies – Part 1: General rules*

BS EN 61439-3, *Low-voltage switchgear and controlgear assemblies – Part 3: Distribution boards intended to be operated by ordinary persons (DBO)*

BS EN 61534, *Powertrack systems*

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