

Specification for

Socket-outlets incorporating residual current devices (s.r.c.d's)

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Committees responsible for this British Standard

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- ASTA Certification Services
- Association of Control Manufacturers, TACMA (BEAMA Ltd.)
- British Lawn Mower Manufacturers Federation
- Consumer Policy Committee of BSI
- Department of Trade and Industry, Consumer Safety Unit, CA Division
- Electrical Installation Equipment Manufacturers' Association (BEAMA Ltd.)
- Electricity Supply Industry in England and Wales
- Electronic Components Industry Federation
- Health and Safety Executive
- Institution of Electrical Engineers
- National Inspection Council for Electrical Installation Contracting
- Portable Electric Tool Manufacturers' Association

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Foreword

This standard has been prepared under the direction of the Power Electrical Engineering Standards Policy Committee.

This standard specifies requirements for socket-outlets incorporating residual current devices (s.r.c.d's).

This edition covers the use of the following types of s.r.c.d.:

- a) single pole with switched neutral;
- b) double pole;
- c) single pole with solid neutral.

It should be noted that it is intended to withdraw the requirements for single pole devices with solid neutral at some future date.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 26, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This British Standard specifies the requirements for socket-outlets incorporating residual current devices (s.r.c.d.'s) (including devices utilizing integral auxiliary sources and devices with electronic circuitry) for use in fixed installations. This standard deals with protected socket-outlets having a rated voltage not exceeding 250 V a.c. single phase, a rated current not exceeding 16 A, a rated frequency not exceeding 400 Hz and a rated residual operating current not exceeding 100 mA. This standard covers socket-outlets incorporating single pole devices with switched neutral, double pole devices and single pole devices with solid neutral.

Socket-outlets incorporating residual current devices (s.r.c.d.'s) with intentional time delays are not covered by this standard.

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

2 Definitions and symbols

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

2.1

residual current (I_{Δ})

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

2.2

socket-outlet incorporating residual current devices (s.r.c.d.)

a socket-outlet for fixed installations which incorporates an integral sensing circuit that will automatically cause the switching contacts in the main circuit to open at a predetermined value of residual current

2.3

interlocked s.r.c.d.

an s.r.c.d. incorporating an interlock (either mechanical or electrical) which prevents contacts of the automatic tripping function from being closed on-load

2.4

tripping current (I_{Δ})

the minimum value of residual current that causes the device to open

2.5

rated tripping current ($I_{\Delta N}$) (rated residual operating current)

the value of residual current, assigned by the manufacturer, at which the device opens automatically under specific conditions

2.6

rated non-tripping current ($I_{\Delta N}$)

the value of residual current, assigned by the manufacturer, at which the device does not open under specified conditions

2.7

rated current of a device (I_N)

the r.m.s. value of current, assigned by the manufacturer, which the main circuit of the device is capable of carrying continuously under specified conditions of use and behaviour

2.8

prospective current

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

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

2.9

rated voltage (U_N)

the r.m.s. value of voltage, assigned by the manufacturer, to which the performance of the device is referred

2.10

rated earth fault breaking capacity

the value of earth fault current which the s.r.c.d., without the aid of any back-up protection, can satisfactorily break at rated voltage

2.11

rated frequency

the frequency of the supply for which an s.r.c.d. is designed

2.12

pole

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

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

2.13**switched pole**

a pole containing contacts for opening and closing the current path

2.14**switched neutral**

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

2.15**main contacts**

the fixed and moving contacts in the main current carrying paths

2.16**test circuit**

an integral circuit to enable the protective function of the device to be checked

2.17**integral auxiliary source**

an auxiliary source of power intended to supply the auxiliary circuit(s) which is derived from the same mains supply within the device as the load being protected

2.18**socket-outlet**

a device having a set of socket contacts designed to engage with the pins of corresponding plug and having terminals for the connection of appropriate conductors

2.19**accessible external surfaces of s.r.c.d.**

all surfaces which can be touched by test finger I of BS 3042:1971 when the s.r.c.d. is in normal use

2.20**s.r.c.d. with integral overcurrent protection**

an s.r.c.d. designed to perform the additional function of overload and/or short circuit protection

NOTE For the purpose of this standard, the s.r.c.d. is considered to have integral overcurrent protection if it can supply a local load only through a fused plug.

2.21**flush mounted s.r.c.d.**

an s.r.c.d. intended to be mounted in a box which is recessed into a wall or other flat surface

2.22**surface mounted s.r.c.d.**

an s.r.c.d. intended to be mounted on a wall or other flat surface within an associated enclosure but without the need for recessing

2.23**panel mounted s.r.c.d.**

an s.r.c.d. intended for incorporation into equipment panels or electrical cable trunking and which is dependent upon such incorporation for its enclosure

2.24**switched s.r.c.d.**

an s.r.c.d. which is provided with a manual switch (which may or may not be associated with the mechanism which is sensitive to residual current) to connect or disconnect the supply to the line socket contact or to both line and neutral socket contacts and which may be independent of the automatic tripping function

2.25**twin s.r.c.d.**

a combination of two socket-outlets incorporating residual current protection

2.26**shutter**

a moveable part arranged to shield the current carrying socket outlet contacts automatically when a corresponding plug is removed

2.27**actuating member**

that part which is moved, pulled, pushed or turned to operate the mechanism

2.28**indicator lamp (pilot lamp)**

a lamp which illuminates to indicate that the socket outlet contacts are energized

2.29**terminal**

a means by which the installer can make an electrical connection between the appropriate conductor and the conducting parts of the device without the use of special tools

NOTE 2.30, 2.31 and 2.32 are examples of screw type terminals.

2.30**pillar terminal**

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

2.31**screw terminal**

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

2.32**stud terminal**

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

2.33**base**

that part of the device retaining current carrying parts and, in general, the mechanism in position

2.34**intentional time delay**

the additional value of non-actuating time in excess of the specified operating time given in 8.9.3, for a corresponding value of residual current

2.35**type test**

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

2.36**routine test**

a test to which each individual s.r.c.d. is subjected during and/or after manufacture to ascertain whether it complies with certain criteria

2.37**earth fault current**

a current which flows to earth resulting from an insulation failure or the bridging of insulation

2.38**earth leakage current**

a current which flows to earth, in a circuit which is electrically sound

NOTE This current may have a capacitive component resulting from the deliberate use of capacitors.

2.39**symbols**

in the text of this British Standard the following symbols are used:

I	current
U	voltage

qualified by the following subscripts:

N	rated
o	opened
ϕ	non-opened
Δ	residual (out-of-balance)
a	auxiliary

2.40**functional earth circuit**

for the purposes of this British Standard a functional earth circuit is one connected to earth for protection against supply faults, suppression and similar functions

3 Classification

Devices specified in this standard are classified as follows.

- a) Type of s.r.c.d.:
 - 1) single s.r.c.d.;
 - 2) twin s.r.c.d.;
 - 3) unswitched s.r.c.d.
 - 4) switched s.r.c.d. (see 2.24);
 - 5) s.r.c.d. with integral overload protection;
 - 6) s.r.c.d. without integral overload protection.
- b) The number of poles as follows:
 - 1) single pole with switched neutral;
 - 2) double pole;
 - 3) single pole with solid neutral (see foreword).
- c) The type of switching as follows:
 - 1) capable of being switched on-load;
 - 2) not capable of being switched on-load (interlocked device).

4 Rated values

An s.r.c.d. shall be rated in terms of the following:

- a) rated tripping current ($I_{o\Delta N}$) (see 2.5);
- b) rated non-tripping current ($I_{1\Delta N}$) (see 2.6);
- c) rated current of the s.r.c.d. (I_N) (see 2.7);
- d) rated voltage (U_N) (see 2.9);
- e) rated earth fault breaking capacity (see 2.10);
- f) rated frequency (see 2.11).

5 Marking and labelling

5.1 An s.r.c.d. shall be marked legibly and in a durable manner with the following particulars:

- a) rated voltage;
- b) rated current;
- c) rated tripping current;

- d) nature of supply and frequency, if other than 50 Hz;
- e) manufacturer's or responsible vendor's name or distinguishing mark;
- f) type reference where more than one type is manufactured;
- g) the number and date of this British Standard, i.e. BS 7288:1990¹⁾
- h) the details concerning the operation of the test circuit on the s.r.c.d., including such words as "Test each time before use";
- i) the closed and open positions (e.g. OFF/ON or O/I or both);
- j) the words "Supply Fault" adjacent to the reverse polarity indicator, if fitted.

5.2 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	^a
Off	0 ^a

^a BS 6217 gives guidance on the use of these symbols.

For the marking of the rated current and rated voltage of the s.r.c.d. 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
 $\frac{13}{250}$ ~

5.3 The test details in 5.1 c), h) and j) shall be visible when the s.r.c.d. is in normal use. All other markings shall be on any external surface unless otherwise stated.

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

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

5.6 Compliance with 5.1 to 5.5 shall be checked by inspection and by the tests of 8.6.

5.7 An s.r.c.d. 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, (see clause 6);
- d) a statement that electricity can be dangerous and that the use of an s.r.c.d. 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 s.r.c.d. 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 (see foreword), 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 Service conditions

An s.r.c.d. complying with this standard shall be suitable for use under the following conditions of service:

- a) an ambient temperature range of – 5 °C to + 40 °C, with an average value not exceeding + 35 °C measured over any 24 h period;
- b) an altitude not exceeding 2 000 m above sea level;
- c) an atmosphere not subject to excessive pollution by smoke, chemical or flammable fumes; salt-laden spray; prolonged periods of high humidity or other abnormal conditions.

NOTE 1 An s.r.c.d. complying with this standard may not be suitable for exposure to direct radiation from the sun or other source of heat likely to raise the temperature above the designated ambient, nor may it be suitable for subjection to excessive vibration.

¹⁾ Marking BS 7288:1990 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is therefore solely the responsibility of the person making the claim. Such a declaration is not to be confused with third party certification of conformity.

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

7 Design and construction

7.1 General

7.1.1 An s.r.c.d. shall be so designed and constructed that in normal use it performs reliably and without danger to the user or to its surroundings and shall be capable of meeting all the relevant requirements of this standard and the tests specified in clauses 8 and 9.

7.1.2 Where tolerances are not specified the values given are to be regarded as nominal.

7.1.3 For an s.r.c.d. 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.

7.1.4 An s.r.c.d. 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.

NOTE For BS 1363 and BS 4343 configurations the relevant tests are shown in Appendix A.

Compliance shall be checked by the tests of 8.26.

7.2 Switches

The actuating member of a switch shall not remain at rest in the off position whilst the switch contacts remain closed.

The actuating mechanism shall be so constructed that when operated, the switch can remain only either in a position giving adequate contact or in a position giving adequate separation of the contacts. Switches shall be so constructed that undue arcing cannot occur when the switch is operated slowly.

The switch in any switched device shall disconnect the supply to the phase socket contact.

Double pole switches shall make or break both poles with one movement of the actuator.

Compliance shall be checked by inspection and by the tests of 8.11.3.

7.3 Mounting arrangement

7.3.1 For flush mounted s.r.c.d's intended to be used in enclosures complying with BS 4662, the size of the base(s) shall be such that when the box or enclosure and the s.r.c.d. 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 may 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 s.r.c.d. 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 7.13).

For s.r.c.d's for use in enclosures other than those specified in BS 4662, 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.

7.3.2 Flush mounted s.r.c.d's intended for mounting in boxes complying with BS 4662 shall have provision for two M3.5 fixing screws at centres of either 60.3 ± 0.2 mm or 120.6 ± 0.3 mm on the horizontal or vertical centre lines. The size and disposition of fixing holes shall be such as to allow attachment to boxes having centres manufactured to a ± 0.8 mm tolerance.

Surface and panel mounted s.r.c.d's shall be provided with the means to ensure proper seating on a flat surface.

Compliance shall be checked by inspection.

7.4 Temperature rise

The supply terminals of an s.r.c.d. and its surroundings shall not attain temperatures in excess of those specified in the appropriate socket-outlet standard.

Compliance shall be checked by the tests of 8.4.

7.5 Provision for testing residual current operation

Provision shall be made for testing the automatic opening of the s.r.c.d. main contacts by an integral test circuit.

Operation of the test circuit shall excite each current-balance transformer and the exciting ampere-turns produced by the test circuit shall not exceed 2.5 times the exciting ampere-turns produced by the rated tripping current flowing in one pole of the s.r.c.d.

The test circuit shall be arranged for external operation in such a way that the protection afforded by the cover or enclosure is not impaired. To safeguard against their loss, the push button or the operating handle of the test circuit shall not be removable from the s.r.c.d.

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

Compliance shall be checked by the tests of **8.27**.

7.6 Voltage limits for auxiliary source supplies

An s.r.c.d. which depends on an integral auxiliary source for operation shall perform its protective function at any value of the source voltage between 0.70 and 1.1 times its rated voltage.

Compliance shall be checked by the tests of **8.9.2**.

7.7 Construction

7.7.1 An s.r.c.d. shall have adequate mechanical strength and be so constructed as to withstand such handling as may be expected in normal use.

Compliance shall be checked by the tests of **8.10**.

7.7.2 An s.r.c.d. shall be designed and constructed to show evidence of tampering should any access be gained to internal parts.

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

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

NOTE This requirement does not apply to screws, nuts, washers, clamping plates and similar parts of terminals, nor to parts of an s.r.c.d. used for earth continuity purposes other than the earthing contacts.

Compliance shall be checked by the tests of sequence 2) of Table 1.

7.7.4 Ferrous parts shall be adequately protected against rusting.

Compliance shall be checked by the test of **8.12**.

7.8 Operating mechanism

7.8.1 An s.r.c.d. shall be arranged for automatic opening under earth fault current conditions.

Compliance shall be checked by the tests of **8.8** and **8.9**.

7.8.2 It shall be impossible for the operating mechanism to hold the s.r.c.d. contacts closed under the fault conditions in which tripping should occur.

Compliance shall be checked by the tests of **8.9.2**.

7.8.3 The position of the contact(s) shall be reliably indicated.

If a mechanical flag is used for this purpose, it must not be possible for it to indicate the open position unless the moving contact(s) is also in the open position.

If the actuating member of the s.r.c.d. is so used as the only means of contact(s) position indication, then it shall not remain at rest in the open position unless the contact(s) is also in the open position.

Compliance shall be checked by inspection and the tests of **8.29**.

7.8.4 An s.r.c.d. shall be capable of withstanding without excessive wear or other harmful effects, the electrical and mechanical stresses occurring in use.

Compliance shall be checked by the endurance test of **8.11**.

7.8.5 Except for devices with a solid neutral, when the s.r.c.d. 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.

S.r.c.d.'s with a solid neutral shall trip automatically when connected to a supply of reversed polarity.

Compliance shall be checked by the test of **8.28**.

7.9 Connection arrangements

7.9.1 Terminals and terminations shall provide for effective clamping and securing of conductors connected to them, so that efficient electrical connection is made and the terminal connecting capacity shall be the same as that for the corresponding socket-outlet.

Compliance shall be checked by the test of **8.4**.

7.9.2 An s.r.c.d. shall be provided with screw type terminals as defined in **2.30**, **2.31** or **2.32**.

Compliance shall be checked by inspection.

7.9.3 Where pillar terminals are used they shall have clamping screws of sufficient length to extend to the far side of the conductor hole. The end of the screw shall be slightly rounded so as to minimize damage to the conductors. The sizes of the conductor hole and the clamping screw shall be such that the clearance between the major diameter of the clamping screw and the sides of the conductor hole does not exceed 0.6 mm.