

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Portable residual current devices (PRCDs) without integral overcurrent protection for household and similar use

Dispositifs différentiels portables à courant résiduel (PCDM) sans protection incorporée contre les surintensités pour usages domestiques et analogues



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**PORTABLE RESIDUAL CURRENT DEVICES (PRCDS) WITHOUT
INTEGRAL OVERCURRENT PROTECTION FOR HOUSEHOLD
AND SIMILAR USE**

FOREWORD

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IEC 61540 has been prepared by subcommittee 23E: Circuit-breakers and similar equipment for household use, of IEC technical committee 23: Electrical accessories. It is an International Standard.

This second edition cancels and replaces the first edition published in 1997 and its Amendment 1:1998. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) The content of the document was revised and aligned with IEC 60755 (group safety publication for residual current devices) and standard library "blocks and modules".
- b) Introduction of classification "4.3 According to behaviour after opening automatically in case of failure of the line voltage".

- c) New requirements and tests were added to cover the introduced protection function against shock hazard:
 - Verification of correct performance in the case of missing protective conductor.
 - Verification of correct performance in the case of hazardous live protective conductor.
 - Verification of correct performance in the case of loss of protective conductor.
 - Verification of behaviour in the case of external fault current in the protective conductor.
- d) Clearances/creepage distances revised and modified in alignment with IEC 62752 (IC-CPD).
- e) Revision of values for minimum operating voltages.
- f) Introduction of requirements and test for ambient air temperature between –25 °C and +40 °C.
- g) Test of dielectric properties revised and aligned with standard library "blocks and modules".
- h) Relevant clauses aligned with IEC 62752 (IC-CPD); IC-CPD is a product standard describing similar product/features.
- i) All annexes revised and adapted to content of main document.

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Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

In this document, the following print types are used:

- requirements: in roman type;
- *conformity statements: in italic type;*
- notes: in small roman type.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

A portable residual current device (hereafter referred to as PRCD), consists of a plug, a residual current device (RCD) and one or more socket-outlets or a provision for connection.

This document is harmonized as far as practicable with the rules and requirements of IEC 60755 (group safety publication for RCD) and the standard library "blocks and modules", as defined in IEC 62873-1.

PORTABLE RESIDUAL CURRENT DEVICES (PRCDs) WITHOUT INTEGRAL OVERCURRENT PROTECTION FOR HOUSEHOLD AND SIMILAR USE

1 Scope

This document applies to portable residual current devices (PRCDs) for household and similar uses, consisting of a plug, a residual current device (RCD) and one or more socket-outlets or a provision for connection. They do not incorporate overcurrent protection. They are intended for single- and two-phase systems for rated currents not exceeding 16 A for rated voltages not exceeding 250 V AC, or for rated current not exceeding 32 A for rated voltages not exceeding 130 V AC to earth. They are intended to provide protection against shock hazard in case of direct contact, in addition to the protection provided by the fixed installations for the circuit downstream.

PRCDs have a rated residual operating current not exceeding 0,03 A.

The plug and socket-outlet parts of a PRCD are covered by the national standard of the country where the PRCD is placed on the market. If no national requirements exist, IEC 60884-1 is used.

This document applies to portable devices performing simultaneously the functions of detection of the residual current, of comparison of the value of this current with the residual operating value and of opening of the protected circuit when the residual current exceeds this value.

PRCDs providing an additional function of detecting faults on the supply side with a defined behaviour in case of supply failures or miswiring (PRCD-S) are also covered by this document.

PRCDs are not intended to be used as parts of fixed installations. Their connecting means can be plugs, socket-outlets, terminals or cords.

NOTE 1 The requirements for PRCDs are in compliance with the general requirements of IEC 60755. PRCDs are essentially intended to be operated by ordinary persons and designed not to require maintenance.

NOTE 2 An integral fuse is used, if necessary, for the relevant plug and socket-outlet system.

The switching contacts of the PRCDs are not intended to provide isolation, as isolation can be ensured by disconnecting the plug.

The requirements of this document apply for environmental conditions as defined in 7.1. Additional requirements can be necessary for PRCDs used in locations having more severe environmental conditions.

PRCDs including batteries are not covered by this document.

This document does not contain additional requirements for PRCDs without earthing contacts for which specific requirements can apply. This document can, however, be used as a guide for such devices which are intended to be used with Class II appliances only.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

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

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

IEC 60112, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

IEC 60227 (all parts), *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V*

IEC 60245 (all parts), *Rubber insulated cables – Rated voltages up to and including 450/750 V*

IEC 60364 (all parts), *Low-voltage electrical installations*

IEC 60364-4-44:2007, *Low-voltage electrical installations – Part 4-44: Protection for safety – Protection against voltage disturbances and electromagnetic disturbances*

IEC 60384-14, *Fixed capacitors for use in electronic equipment – Part 14: Sectional specification – Fixed capacitors for electromagnetic interference suppression and connection to the supply mains*

IEC 60417, *Graphical symbols for use on equipment*, available at <http://www.graphical-symbols.info/equipment>

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60664-1:2020, *Insulation coordination for equipment within low-voltage supply systems – Part 1: Principles, requirements and tests*

IEC 60664-3, *Insulation coordination for equipment within low-voltage systems – Part 3: Use of coating, potting or moulding for protection against pollution*

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

IEC 60695-2-11, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end products (GWEPT)*

IEC 60755, *General safety requirements for residual current operated protective devices*

IEC 60884-1:2022, *Plugs and socket-outlets for household and similar purposes – Part 1: General requirements*

IEC 61008-1:2010, *Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs) – Part 1: General rules*

IEC 61008-1:2010/AMD1:2012

IEC 61008-1:2010/AMD2:2013

IEC 61249-2 (all parts), *Materials for printed boards and other interconnecting structures*

IEC 61543:2022, *Residual current-operated protective devices (RCDs) for household and similar use – Electromagnetic compatibility*

IEC 62752, *In-cable control and protection device for mode 2 charging of electric road vehicles (IC-CPD)*

IEC 62873-2, *Residual current operated circuit-breakers for household and similar use – Part 2 – Residual current devices (RCDs) – Vocabulary*

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

3 Terms and definitions, symbols and abbreviated terms

For the purposes of this document, the terms and definitions given in IEC 62873-2 and the following apply.

NOTE 1 Where the terms "voltage" and "current" are used, they imply RMS values, unless otherwise specified.

NOTE 2 Throughout this document, the word "PRCD" is used for "RCD".

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1 Definitions relating to plugs and socket-outlets

3.1.1

plug

accessory having pins designed to engage with the contacts of a socket-outlet, also incorporating means for the electrical connection and mechanical retention of flexible cables or cords

3.1.2

socket-outlet

accessory having socket-contacts designed to engage with the pins of a plug and having terminals for the connection of conductors

3.1.3

portable socket-outlet

socket-outlet intended to be connected to, or integral with, flexible cables or cords, and which can easily be moved from one place to another while connected to the supply

3.1.4

multiple socket-outlets, pl

combination of two or more socket-outlets

3.1.5**rewireable plug**

accessory so constructed that the flexible cable or cord can be replaced

3.1.6**non-rewireable plug****non-rewireable portable socket-outlet**

accessory so constructed that it forms a complete unit with the flexible cable or cord after connection and assembly by the manufacturer of the accessory

Note 1 to entry: See also 14.1 of IEC 60884-1:2022.

3.1.7**moulded-on accessory**

non-rewireable accessory, the manufacture of which is completed by insulating material moulded around pre-assembled component parts and the terminations of the flexible cable or cord

3.1.8**cord extension set**

assembly consisting of a flexible cable or cord fitted with a non-rewireable plug and a non-rewireable portable socket-outlet

3.1.9**terminal**

insulated or non-insulated connecting device serving for reusable connection of the supply conductors

3.1.10**termination**

insulated or non-insulated connecting device serving for non-reusable connection of the supply conductors

3.1.11**adaptor**

accessory constructed as an integral unit incorporating both plug pins and socket contacts

3.1.12**intermediate adaptor**

adaptor which allows the connection of one or more plugs to a socket-outlet via a control device such as a dimmer, clock switch, photoelectric switch, residual current device, etc., which is connected to it by a flexible cord

3.2 Definitions relating to residual current devices (RCDs)**3.2.1 Definitions relating to currents flowing from live parts to earth****3.2.1.1****hazardous situation**

shock hazard situation occurring when an earth fault current higher than $I_{\Delta n}$ (see 5.2.3) flows through the RCD for a time longer than that specified in Table 2

3.2.1.2**supply failure**

situation occurring in the event of

- broken neutral;
- broken phase in the case of systems supplied between phases;
- broken protective earth (PE)

3.2.2 Definitions relating to the energization of a residual current device (RCD)

3.2.2.1

limiting impedance value

R_x

maximum impedance value between the PE-connection of the PRCD and the supply source for which protection is ensured when the PRCD is supplied from any one phase only and PE

3.2.2.2

PRCD type LNSE

type LNSE

device with a switched protective conductor that is used on a line (phase) to neutral supply (L, N, PE)

Note 1 to entry: See Annex E for example.

3.2.2.3

PRCD type LLSE

type LLSE

device with a switched protective conductor that is used on a line (phase) to line (phase) supply (L1, L2, PE)

Note 1 to entry: See Annex E for example.

3.2.2.4

PRCD type LNE

type LNE

device with a non-switched protective conductor that is used on a line (phase) to neutral supply (L, N, PE)

3.2.2.5

PRCD type LLE

type LLE

device with a non-switched protective conductor that is used on a line (phase) to line (phase) supply (L1, L2, PE)

3.2.2.6

protective conductor

PE

<identification> conductor provided for purposes of safety, for example protection against electric shock

3.2.2.7

hazardous live protective conductor

miswiring or fault condition where the protective contact of the socket outlet becomes live and, under certain conditions, can give a harmful electric shock

3.2.3 Definitions relating to the operation and to the functions of a residual current device

3.2.3.1

t_u

value of time of interruption of the line voltage supply below which a PRCD does not open automatically in the absence of a residual current (see 9.17.2)

3.2.3.2 **trip-free PRCD**

PRCD, the moving contacts of which return to and remain in the open position when the automatic opening operation is initiated after the initiation of the closing operation, even if the closing command is maintained

Note 1 to entry: To ensure proper breaking of the current which may have been established, it may be necessary that the contacts momentarily reach the closed position.

3.2.3.3 **break-time**

<of a PRCD> time which elapses between the instant when the residual operating current is suddenly attained and the instant of arc extinction in all poles

3.2.3.4 **PRCD-S**

PRCDs providing an additional function of detecting faults on the supply side with a defined behaviour in case of supply failures or miswiring

3.2.4 Definitions relating to values and ranges of energizing quantities

3.2.4.1 **rated value**

quantity value assigned by the manufacturer for a specific operating condition of a PRCD

[SOURCE: IEC 62873-2:2016, 3.4.1, modified – In the definition, "generally" deleted, "specified" replaced with "specific" and "RCD" replaced with "PRCD".]

3.2.4.2 **non-operating overcurrent**

<in the main circuit> maximum value of overcurrent of a single-phase load which, in the absence of any fault to frame or to earth, and in the absence of an earth leakage current, can flow through a two-pole PRCD without causing it to operate

Note 1 to entry: In the case of overcurrent in the main circuit, in the absence of residual current, operation of the detecting device may occur as a consequence of asymmetry existing in the detecting device itself.

3.2.4.3 Definitions relating to limiting values (U_x and U_y) of the line voltage for PRCDs functionally dependent on line voltage

3.2.4.3.1 U_x

minimum value of the line voltage at which a PRCD still operates under specified conditions in case of decreasing line voltage (see 9.17.1)

3.2.4.3.2 U_y

minimum value of the line voltage below which a PRCD opens automatically in the absence of any residual current (see 9.17.2)

4 Classification

4.1 According to the type of connection

NOTE See Figure 1.

4.1.1 PRCD intermediate adaptor

PRCD incorporating one plug and one or two socket-outlets.

4.1.2 Non-rewireable residual current-protected cord extension sets

4.1.2.1 PRCD the RCD portion of which incorporates the plug at one end and a cord with one or more socket-outlets at the other end.

4.1.2.2 PRCD the RCD portion of which is equipped, on one side, with a cord and plug, and, on the other side, with a cord and one or more socket-outlets.

4.1.2.3 PRCD the RCD portion of which incorporates one or more socket-outlets at one end and a cord with one non-rewireable plug at the other end.

4.1.3 Residual current-protected plugs

4.1.3.1 PRCD incorporating one plug and a set of terminals.

4.1.3.2 Residual current-protected plug for appliances: PRCD incorporating the plug and equipped with a non-rewireable cord.

4.1.4 In-line PRCDs

4.1.4.1 PRCD equipped, on the supply side, with one non-rewireable cord and one non-rewireable plug and, on the output side, with a set of terminals.

4.1.4.2 PRCD equipped, on the supply side, with one non-rewireable cord and one non-rewireable plug, and, on the output side, with one non-rewireable cord.

4.1.4.3 PRCD, the RCD portion of which is equipped on both sides with terminals or integral non-rewireable cords and intended for being incorporated in equipment by the manufacturers of such equipment with specific measures for the safety of the user.

4.2 According to the type of terminals

PRCDs with screw-type terminals for external copper conductors.

4.3 According to behaviour after opening automatically in case of failure of the line voltage

4.3.1 PRCDs not re-closing automatically when the line voltage is restored.

4.3.2 PRCDs re-closing automatically when the line voltage is restored.

4.4 According to their operating characteristics and behaviour in presence of DC components

4.4.1 PRCDs of type AC.

NOTE In the following countries type AC PRCDs are not permitted: DE, UK, IE.

4.4.2 PRCDs of type A.

4.5 According to the ambient air temperature

4.5.1 For use between –5 °C and +40 °C

4.5.2 For use between –25 °C and +40 °C

4.6 Classification according to the protective conductor path

4.6.1 PRCDs with switched protective conductor

This classification covers PRCDs which have a switched protective conductor.

4.6.2 PRCDs with non-switched protective conductor

This classification covers PRCDs which do not have a switched protective conductor.

4.7 According to the supply

4.7.1 PRCDs supplied from one phase and neutral (LNSE or LNE)

PRCDs according to this classification are supplied from one phase and neutral.

4.7.2 PRCDs supplied from two phases (LLSE or LLE)

PRCDs according to this classification are supplied from two phases.

4.8 According an additional function of detecting faults on the supply side

4.8.1 PRCDs not providing an additional function of detecting faults on the supply side

PRCDs according to this classification are not providing an additional function of detecting faults on the supply side.

4.8.2 PRCDs providing an additional function of detecting faults on the supply side with a defined behaviour in case of supply failures or miswiring (PRCD-S)

PRCDs according to this classification are providing an additional function of detecting faults on the supply side with a defined behaviour in case of supply failures or miswiring.

A PRCD classified according to 4.8.2 shall have a switched protective conductor.

5 Characteristics of PRCDs

5.1 Summary of characteristics

PRCDs are intended for single- and two-phase systems and they shall be provided with an earthing path.

The characteristics of a PRCD shall be stated in the following terms:

- type of connection and applications;
- type of plug and socket-outlet system to which it belongs;
- degree of protection according to IEC 60529;
- rated operational voltage U_e (see 5.2.1.1);
- rated current I_n (see 5.2.2);
- rated residual operating current $I_{\Delta n}$ (see 5.2.3);

- rated residual non-operating current $I_{\Delta no}$ (see 5.2.4);
- rated frequency (see 5.2.5);
- rated making and breaking capacity I_m (see 5.2.6);
- rated residual making and breaking capacity $I_{\Delta m}$ (see 5.2.7);
- operating characteristics in case of residual currents comprising a DC component (see 5.2.8);
- rated conditional short-circuit current I_{nc} (see 5.4.2);
- rated conditional residual short-circuit current $I_{\Delta c}$ (see 5.4.3).

5.2 Rated quantities and other characteristics

5.2.1 Rated voltage

5.2.1.1 Rated operational voltage (U_e)

The rated operational voltage of a PRCD is the value of voltage, assigned by the manufacturer, to which its performance is referred.

NOTE The same PRCD can be assigned more than one rated operational voltage.

5.2.1.2 Rated insulation voltage (U_i)

The rated insulation voltage of a PRCD is the value of voltage, assigned by the manufacturer, to which dielectric test voltages and creepage distances are referred.

Unless otherwise stated, the rated insulation voltage is the value of the maximum voltage of the PRCD. In no case shall the maximum voltage exceed the rated insulation voltage.

5.2.2 Rated current (I_n)

A current assigned by the manufacturer as the current which the PRCD can carry in uninterrupted duty (see IEC 62873-2), at a specified reference ambient air temperature.

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

The value of residual operating current (see IEC 62873-2), assigned to the PRCD by the manufacturer, at which the PRCD shall operate under specified conditions.

For a PRCD having multiple settings of residual operating current, the highest setting is used to designate it.

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

The value of residual non-operating current (see IEC 62873-2), assigned to the PRCD by the manufacturer, at which the PRCD does not operate under specified conditions.

5.2.5 Rated frequency

The rated frequency of a PRCD is the power frequency for which the RCD is designed and to which the values of the other characteristics correspond.

NOTE The same PRCD can be assigned more than one rated frequency.

5.2.6 Rated making and breaking capacity (I_m)

The RMS value of the AC component of prospective current, assigned by the manufacturer, which a PRCD can make, carry and break under specified conditions.

The conditions are those specified in 9.11.2.2.

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

The RMS value of the AC component of residual prospective current, assigned by the manufacturer, which a PRCD can make, carry and break under specified conditions.

The conditions are those specified in 9.11.2.3.

5.2.8 Operating characteristics in case of residual currents comprising a DC component

5.2.8.1 PRCD type AC

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

5.2.8.2 PRCD type A

A PRCD for which tripping is ensured:

- as for type AC,
- for residual pulsating direct currents, and
- for 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.

NOTE 1 According to IEC 61140, pluggable electrical equipment with a rated input ≤ 4 kVA is designed to have protective conductor current with a smooth superimposed DC current component limited to 6 mA.

NOTE 2 Operation in case of alternating current superimposed with smooth DC residual current is assumed to be covered by the test of pulsating DC superimposed with smooth DC residual current.

5.3 Standard and preferred values

5.3.1 Preferred values of rated operational voltage (U_e)

Preferred values of rated operational voltage are 230 V and 120 V.

NOTE 240 V is provisionally also a preferred value, in addition to 230 V.

5.3.2 Standard values of rated current (I_n)

The standard values of the rated current are indicated in Table 1.

Table 1 – Standard values of rated current and corresponding preferred values of rated operational voltages

Type	Rated operational voltage V	Rated current A
PRCDs supplied from one phase and neutral (LNSE or LNE) PRCDs supplied from two phases (LLSE or LLE)	230	6,10,13,16
PRCDs supplied from one phase and neutral (LNSE or LNE) PRCDs supplied from two phases (LLSE or LLE)	120	10, 13, 15, 20, 30, 32

The rated operational voltage of the PRCD shall not be lower than that of the plug. The rated current of the socket-outlet(s) shall not be higher than that of the PRCD.

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

Standard values of rated residual operating current are:

$$0,006 \text{ A} - 0,01 \text{ A} - 0,03 \text{ A}.$$

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

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

If for PRCD according to 4.6.1 the protective conductor is passed with more turns than the live conductors through the current transformer on a $I_{\Delta n} = 30 \text{ mA}$ device this value may be reduced to $0,25 I_{\Delta n}$.

NOTE For residual pulsating direct currents, residual non-operating currents depend on the current delay angle α (see Table 19).

5.3.5 Standard minimum value of the non-operating overcurrent through the PRCD

The standard minimum value of the non-operating overcurrent through the PRCD is $4 I_n$.

5.3.6 Preferred values of rated frequency

Preferred values of rated frequency are 50 Hz, 60 Hz and 50/60 Hz.

If another value is used, the rated frequency shall be marked on the device and the tests carried out at that frequency.

5.3.7 Minimum value of the rated making and breaking capacity (I_m)

The minimum value of the rated making and breaking capacity I_m is $10 I_n$ or 250 A whichever is the higher.

5.3.8 Minimum value of the rated residual making and breaking capacity ($I_{\Delta m}$)

The minimum value of the rated residual making and breaking capacity is $10 I_n$ or 250 A whichever is the higher.

5.3.9 Standard value of the rated conditional short-circuit current (I_{nc})

The standard value of the rated conditional short-circuit current is 1 500 A.

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

The standard value of the rated conditional residual short-circuit current is 1 500 A.

5.3.11 Standard values of maximum break time

The standard values of break time are given in Table 2.

Table 2 – Standard values of maximum break time for AC residual currents

$I_{\Delta n}$ (A)	Standard values of maximum break time at s			
	$I_{\Delta n}$	$2 I_{\Delta n}$	$5 I_{\Delta n}$	$> 5 I_{\Delta n}$
Any value	0,3	0,15	0,04	0,04
NOTE For operation with residual currents having a DC component, see 9.20.				

5.4 Coordination with short-circuit protective devices (SCPDs)

5.4.1 General

PRCDs shall be protected against short-circuits by means of circuit-breakers or fuses complying with their relevant standards according to the installation rules of the IEC 60364 series.

Coordination between PRCDs and SCPDs shall be verified under the general conditions of 9.11.2.1, by means of the tests described in 9.11.2.4 which verify that there is adequate protection against currents up to the rated conditional short-circuit current I_{nc} and up to the rated conditional residual short-circuit current $I_{\Delta c}$.

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

The RMS value of prospective current, assigned by the manufacturer, which a PRCD protected by an SCPD can withstand under specified conditions without undergoing alterations impairing its functions.

The conditions are those specified in 9.11.2.4 a).

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

The value of residual prospective current, assigned by the manufacturer, which a PRCD, protected by an SCPD, can withstand under specified conditions without undergoing alterations impairing its functions.

The conditions are those specified in 9.11.2.4 c).

6 Marking and other product information

6.1 Information and marking for PRCDs

The information given in Table 3 shall be provided.

Table 3 – Marking or information item

	Marking or information item	Position of the marking or information		
		Visible on product when in normal use	On the product	In a leaflet or manufacturer's catalogue
A	the manufacturer's name or trade mark		x	x
B	type designation, catalogue number or serial number		x	x
C	rated operational voltage(s)		x	x
D	rated frequency; PRCDs with more than one rated frequency (e.g. 50/60 Hz) shall be marked accordingly			x
E	rated current;		x	x
F	rated residual operating current;	x		x
G	the degree of protection	x		x
H	operating means of the test device, designated by the letter T;	x		x
I ¹	operating characteristic in presence of residual currents with DC components	x		x
J	"TEST BEFORE USE"	x		x
K	PRCDs according to 4.5.2 shall be marked  , according to IEC 60417-6292:2015-11.	x		x
L	rated residual making and breaking capacity			x
M	number of the product standard		x	x
N	PRCDs classified according to 4.6.1 with marking IEC 60417-6289:2015-03 	x		x
O	range of operating temperature			x
P	means shall be provided to distinguish between the open and closed states of the device	x		
Q	if it is necessary to distinguish between the supply and the load terminals, they shall be clearly marked (e.g. by "line" and "load" placed near the corresponding terminals)		x	x
R	terminals specifically intended for the connection of the neutral shall be indicated by the symbol N		x	x
S	terminals specifically intended for the connection of the protective earth shall be indicated by the symbol (IEC 60417-5019:2006-08) 		x	x
T	PRCDs according to 4.8.2 shall be marked "PRCD-S"		x	
¹ One of the following markings applies: – PRCDs of type AC with the symbol (IEC 60417-6148:2012-01)  – PRCDs of type A with the symbol (IEC 60417-6149:2012-1) 				

For the marking of rated current and rated operational voltage, numbers alone may be used. These numbers shall be placed on one line, separated or not by an oblique line, or the number for rated current shall be placed above the number for rated operational voltage, separated by a horizontal line.

The marking for nature of supply shall be placed next to the marking for rated current and rated operational voltage.

Examples of marking for current, voltage and nature of supply:

16 A 230 V~, or $\frac{16}{230}$ ~, or 16 A 230 V AC, or 16/230 AC., etc.

When symbols are used, they shall be as follows:

- | | |
|---|---|
| – amperes | A |
| – volts | V |
| – alternating current | ~ |
| – neutral | N |
| – protective earth (IEC 60417-5019:2006-08) |  |

The marking shall be on the PRCD itself or on a nameplate or nameplates attached to the PRCD.

If the PRCD is composed of more than one individual item incorporating the RCD part, the relevant markings C, D and E of Table 3 shall be repeated on each of these items.

For PRCDs 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 PRCD is in normal use.

For PRCDs 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".

If the test button is the only means for the opening operation it remains marked T, in which case the colour red may be used.

RED shall not be used for any other push-button of the PRCD. 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.

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

Compliance is checked by inspection and by the test of 9.3.

6.2 Information to be provided in an instruction sheet

- a) a statement instructing the user to test the PRCD each time before use by following a detailed procedure arranged as a logical sequence of actions;
- b) a statement that the device shall not be used if it fails to operate correctly in accordance with the instructions;
- c) adequate instructions for the safe connection of any appropriate flexible cords, including reference to the IEC 60227 series and the IEC 60245 series, the number and colour of cores, the minimum and maximum cross-sectional area of the conductors and the length, if necessary;
- d) a statement concerning the plug and portable socket-outlet system to which the PRCD belongs;
- e) a statement warning against storage or use beyond the service conditions given in Table 4 and against misuse such as dropping, immersion, etc.;
- f) a statement that misuse of electricity can be dangerous and that the use of a PRCD should not be regarded as a substitute for basic electrical safety precautions, and specific instruction to unplug the PRCD to achieve isolation;
- g) a statement instructing the user to seek advice from the manufacturer, responsible vendor or a competent electrician if the PRCD repeatedly trips with an appliance connected or if it fails to trip when tested in accordance with the instructions;
- h) a statement instructing the user that the PRCD shall be connected directly to a fixed socket-outlet.

Compliance is checked by inspection.

7 Standard conditions for operation in service and for installation

7.1 Standard conditions

PRCDs complying with this document shall be capable of operating under the standard conditions shown in Table 4.

Table 4 – Standard conditions for operation in service

Influencing quantity	Standard range of application	Reference value	Test tolerances ⁵⁾
Ambient temperature ¹⁾	–5 °C to +40 °C ^{2) 6)} –25 °C to +40 °C ⁷⁾	20 °C	±5 °C
Altitude	Not exceeding 2 000 m		
Relative humidity (maximum value at 40 °C)	50 % ³⁾		
External magnetic field	Not exceeding five times the earth's magnetic field in any direction	Earth's magnetic field	⁴⁾
Frequency	Reference value ±5 %	Rated value	±2 %
Sinusoidal wave distortion	Not exceeding 5 %	Zero	5 %
Alternating component in DC (for external auxiliary source)		Zero	3%

- 1) The maximum value of the mean daily temperature is +35 °C.
- 2) Values outside this range are admissible where more severe climatic conditions prevail, subject to agreement between manufacturer and user.
- 3) Higher relative humidities are admitted at lower temperature (for example 90 % at 20 °C).
- 4) PRCDs should not be used in the proximity of a strong magnetic field. In this case, supplementary requirements may be necessary.
- 5) The tolerances given apply unless otherwise specified in the relevant test.
- 6) For the range –5 °C to +40 °C extreme limits of –20 °C and +60 °C are admissible during storage and transportation and should be taken into account in the design of the device.
- 7) See 4.5.2.

7.2 Conditions for installations

PRCDs shall be used in accordance with the manufacturer's instructions.

7.3 Pollution degree

PRCDs are intended for an environment with pollution degree 2 as a minimum, i.e. normally, only non-conductive pollution occurs; occasionally, however, a temporary conductivity caused by condensation may be expected.

8 Requirements for construction and operation

8.1 Mechanical design

8.1.1 General

PRCDs shall be designed and constructed so that, in normal use, their use is safe and without danger to the user or to the environment.

The RCD part shall be in one unit and its correct operation shall not depend on the location of the flexible cables and cords connected to it and shall have a minimum degree of protection IPXXD after assembly as for normal use (see 8.2.2.5).

A maximum length of cord of 2 m is allowed between the plug of the PRCD and its RCD part.

For PRCDs with flexible conductors, the green-yellow conductor shall be used as the PE conductor.

There shall be no provision to alter the operating characteristics of PRCDs.

Plugs and socket-outlets of PRCDs shall be mechanically and electrically compatible with the plug and socket-outlet system in which they are intended to be used.

In all the following cases where IEC 60884-1 is referenced, requirements and tests for the plug part and for the socket-outlet part, the relevant national standards of the country where the PRCD is placed on the market apply. In the absence of a national standard, IEC 60884-1 applies.

Compliance is checked by inspection and the relevant clauses.

8.1.2 Plug part, socket-outlet parts and RCD part(s)

8.1.2.1 Dimensions of plug and socket-outlet part(s)

Compliance is checked by Clause 9 of IEC 60884-1:2022.

8.1.2.2 Provisions for earthing

8.1.2.2.1 The earthing contact shall be so constructed that, when inserting the plug, the earth connection is made before the current-carrying contacts of the plug become live.

When withdrawing the plug, the current-carrying pins shall separate before the earth connection is broken.

Compliance is checked by inspection of the manufacturing drawings, taking into account the effect of tolerances, and by checking the samples against these drawings.

NOTE Conformity with the relevant standard sheets ensures compliance with this requirement.

8.1.2.2.2 Earthing terminals of rewirable PRCDs shall comply with the appropriate requirements of 8.1.6.

They shall be of the same size as the corresponding terminals for the supply conductors.

The connection of the earth conductor shall be ensured under all conditions which may occur in normal use, including loosening of cover fixing screws, careless mounting of the cover, etc.

For PRCDs according to classification 4.6.2 parts of the earthing circuit shall be in one piece or shall be permanently connected together, e.g. by riveting or welding.

NOTE For the purpose of the requirements of this Subclause 8.1.2.2.2, screws are not considered as parts of contact pieces.

Compliance is checked by inspection and by the tests of 9.5.

8.1.2.2.3 For PRCDs according to 4.8.1, the connection between the earthing terminal and accessible metal parts to be connected thereto shall be of low resistance.

Compliance is checked by the test of 9.6.4.

8.1.2.2.4 For PRCDs according to 4.8.2, accessible metal parts shall be isolated from the earthing terminal.

Compliance is checked by the test of 9.6.4.

8.1.2.3 Operation of earthing contacts

Earthing contacts shall provide adequate contact pressure and shall not deteriorate in normal use.

Compliance is checked by the test of 9.8 but with the rated current flowing through the protective earthing path only.

8.1.2.4 Force necessary to withdraw the plug

Clause 22 of IEC 60884-1:2022 applies.

8.1.2.5 Construction

8.1.2.5.1 A non-rewireable part of a PRCD shall be such that:

- the flexible cable or cord cannot be separated from that part without making the PRCD permanently useless;
- the part cannot be opened by hand or by using a general-purpose tool, for example a screwdriver used as such.

A PRCD is considered to be permanently useless when, for its re-assembling, parts or materials other than the original ones have to be used.

8.1.2.5.2 Pins of plugs and portable socket-outlets shall have adequate mechanical strength.

Compliance is checked by the tests of 9.12 and, for pins which are not solid, by the test of 9.25 which is made after the test of 9.10 is for mechanical endurance.

8.1.2.5.3 Pins of plugs shall be:

- locked against rotation;
- not removable without dismantling the plug;
- adequately fixed in the body of the plug when the plug is wired and assembled as for normal use.

It shall not be possible to replace the earthing or neutral pins or contacts of plugs in an incorrect position.

Compliance is checked by inspection, by manual test and by the test of 9.12.

8.1.2.5.4 Earthing contacts and neutral contacts of portable socket-outlets shall be locked against rotation and shall not be removable.

Compliance is checked by inspection and by manual test after the test of 9.12.

8.1.2.5.5 Socket-contact assemblies shall have sufficient resilience to ensure adequate contact pressure.

This requirement may also cover socket-outlets where the contact pressure relies on insulating parts having such characteristics as to ensure a safe and permanent contact in any condition of normal use, with regard in particular to shrinkage, ageing and yielding.

Compliance is checked by inspection and by the tests of 9.10 and Clause 22 of IEC 60884-1:2022.

8.1.2.5.6 Pins and socket-contacts shall be resistant to corrosion and abrasion.

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

8.1.2.5.7 The enclosure of rewireable accessories shall completely enclose the terminals and the ends of flexible cables and cords.

The construction shall be such that the conductors can be properly connected and that, when the accessory is wired and assembled as for normal use, there is no risk that:

- the conductors are pressed against each other;
- a core, the conductor of which is connected to a live terminal, comes into contact with accessible metal parts;

- a core, the conductor of which is connected to the earthing terminal, comes into contact with live parts.

Compliance is checked by inspection and by manual test.

8.1.2.5.8 PRCDs according to 4.1.3.1 and 4.1.4.1 shall be so designed that terminal screws or nuts cannot become loose and fall out of position in such a way that they establish an electrical connection between live parts and the earthing terminal or metal parts connected to the earthing terminal.

Compliance is checked by inspection and by manual test.

8.1.2.5.9 PRCDs according to 4.1.3.1 and 4.1.4.1 shall be designed with ample space for slack of the earthing conductor in such a way that, if the strain relief should fail, the connection of the earthing conductor is subjected to strain after the connections of the current-carrying conductors and that, in case of excessive stresses, the earthing conductor will break after the current-carrying conductors.

Compliance is checked by the test of 9.26.

8.1.2.5.10 Terminals of PRCDs according to 4.1.3.1 and 4.1.4.1 shall be so located or shielded that they do not create a dangerous situation.

Compliance is checked by the test of 9.6.6.

8.1.2.5.11 For rewirable PRCDs according to 4.1.3.1 and 4.1.4.1:

- it shall be clear how the relief from strain and the prevention of twisting is intended to be effected;
- the cord anchorage, or at least part of it, shall be integral with or permanently fixed to one of the component parts of the plug or portable socket-outlet;
- makeshift methods, such as tying the cable or cord in a knot or tying the ends with string, shall not be used;
- cord anchorages shall be suitable for the different types of flexible cable or cord which may be connected, and their effectiveness shall not depend upon the assembly of the parts of the body;
- cord anchorages shall be of insulating material or be provided with an insulating lining fixed to the metal parts;
- metal parts of the cord anchorage, including clamping screws, shall be insulated from the earthing circuit.

Compliance is checked by inspection.

8.1.2.5.12 Insulating parts which keep the live parts in position shall be reliably fixed together, and it shall not be possible to dismantle the accessory without the aid of a tool.

Compliance is checked by inspection and by manual test.

8.1.2.5.13 If covers of PRCDs are provided with bushes for the entry holes for the pins, these bushes shall not be allowed to be removed from the outside or to become detached inadvertently from the inside, when the cover is removed.

Compliance is checked by inspection.

8.1.2.5.14 Screws intended to allow access to the interior of the accessory shall be captive.

NOTE The use of tight-fitting washers of cardboard or the like is deemed to be an adequate method for securing screws which are to be captive.

Compliance is checked by inspection.

8.1.2.5.15 The engagement face of plugs shall have no projections other than the pins when the plug is wired and assembled as for normal use.

Compliance is checked by inspection, after fitting conductors of the cross-sectional area specified in Table 5.

NOTE The earthing contacts are not considered as projections from the engagement face.

8.1.2.5.16 Socket-outlet parts of PRCDs shall be so designed that full engagement of associated plugs is not prevented by any projection from their engagement face.

Compliance is checked by determining that the gap between the engagement faces of the socket-outlet and a plug does not exceed 1 mm when the plug is inserted into the socket-outlet as far as it will go.

8.1.2.5.17 PRCDs of degree of protection higher than IPX4 shall be provided with a gland or the like for sealing the cable entries.

PRCDs of degree of protection higher than IPX4 shall be totally enclosed when fitted with a flexible cable or cord as for normal use.

For socket-outlets having a degree of protection higher than IPX0, the degree of protection shall be maintained without the plug inserted.

Compliance is checked by inspection and by the tests of 16.2 of IEC 60884-1:2022.

NOTE Total enclosure when the plug is not in position can be achieved by means of a captive lid.

8.1.2.5.18 Means for suspension from a wall or other mounting surfaces shall be so designed that they do not allow access to live parts and do not expose live parts.

8.1.2.5.19 If a plug is an integral part of plug-in equipment, that equipment shall not cause overheating of the pins or impose undue strain on fixed socket-outlets.

For plugs having rated currents and voltages up to and including 16 A and 250 V compliance is checked by the tests of 9.8 and 9.27.

NOTE For plugs of higher ratings tests are under consideration.

8.1.2.5.20 Plugs shall be shaped in such a way and made of such a material that they can easily be withdrawn by hand from the relevant socket-outlet.

In addition, the gripping surfaces shall be so designed that the plug can be withdrawn without having to pull on the flexible cable or cord.

NOTE 1 An appropriate test is under consideration.

NOTE 2 Additional requirements for portable multiple socket-outlets are under consideration.

8.1.2.6 Flexible cables and cords and their connection

8.1.2.6.1 Any rewirable PRCD part shall be provided with a cord anchorage such that the conductors are relieved from strain, including twisting, when they are connected to the terminals or terminations, and that their covering is protected from abrasion.

The sheath, if any, of the cord shall be clamped within the cord anchorage.

Compliance is checked by inspection and by the test of 9.28.

8.1.2.6.2 Non-rewireable parts of PRCDs shall be provided with a flexible cable or cord complying with the IEC 60227 series or the IEC 60245 series. The minimum cross-sectional areas of the conductors in relation to the rating of the plug part and the socket-outlet part are given in the relevant columns of Table 5.

Table 5 – Minimum cross-sectional area of flexible cable or cord suitable for non-rewireable plugs and non-rewireable socket-outlets of PRCDs

Rating of the plug part and of the socket-outlet parts	Minimum cross-section for non-rewireable accessories mm ²
6 A 130/250 V	0,75
10 A 130/250 V	1
13 A 16 A 130/250 V	1,5
20 A 130 V	2,5
32 A 130 V	6

The conductor connected to the earthing contact shall be identified by the colour combination green/yellow.

Compliance is checked by inspection, by measurement and by checking that the flexible cables or cords are in accordance with the IEC 60227 series or the IEC 60245 series, as applicable.

8.1.2.6.3 Non-rewireable parts shall be so designed that the flexible cable or cord is protected against excessive bending where it enters the accessory.

Guards provided for this purpose shall be of insulating material and shall be fixed in a reliable manner.

Helical metal springs, whether bare or covered with insulating material, shall not be used as cord guards.

Compliance is checked by inspection and by the test of 9.29.

8.1.2.6.4 Moulded-on PRCD parts shall have means to prevent loose wires of a conductor from reducing the minimum isolation distance requirements between such wires and all accessible external surfaces of the accessory, with the exception of the engagement face of a plug.

Compliance is checked by inspection according to 9.6.7.

8.1.3 Mechanism

PRCDs shall be constructed in such a way that the moving contacts can come to rest only in the closed position or in the open position, even when the operating means is released in an intermediate position.

Where the operating means is used to indicate the position of the contacts, the operating means, when released, shall automatically take up or keep 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 in the case of automatic opening, a third distinct position of the operating means may be provided, in which case the PRCD shall be manually reset before re-closing of the contacts is possible.

If a push-button is used for closing the contacts and is evidently identified as such, its depressed position is sufficient to indicate the closed position.

If a single push-button is used for closing and opening the contacts and is identified as such, the button remaining in its depressed position is sufficient to indicate the closed position. On the other hand, if the button does not remain depressed, an additional means indicating the position of the contacts shall be provided.

The indicating means may be either the operating means, provided this has two distinct rest positions, or a specific indicating means, or a combination of both.

PRCDs opening automatically in case of failure of the line voltage and re-closing automatically when the line voltage is restored (see 4.3.2), shall be provided with means for indicating the following:

- "ON" in which case the contacts may be either closed if the PRCD is energized, or open after failure of the line voltage, in which case they will re-close automatically after restoration of the line voltage;
- "OFF" if the contacts have been opened either by manual operation or by tripping due to an earth fault.

When an indicator light is used to indicate the closed and open positions, this shall be lit when the PRCD is in the closed position and be of bright colour.

For PRCDs according to 4.6.1, it shall not be possible for the live contacts to remain closed if the PE contact is not closed.

Compliance is checked by 9.9.6.3.

The action of the mechanism shall not be influenced by the position of enclosures or covers and shall be independent of any removable part.

A cover sealed in position by the manufacturer is considered to be a non-removable part.

If the cover is used as a guiding means for push-buttons, it shall not be possible to remove the buttons from the outside of the PRCD.

Operating means shall be securely fixed on their shafts and it shall not be possible to remove them without the aid of a tool.

Operating means fixed to covers are allowed.

Compliance with the above requirements is checked by inspection, by manual test and, for the trip-free mechanism, by the test of 9.15.

8.1.4 Clearances and creepage distances (see Annex C)

Clearances and creepage distances shall not be less than the values shown in Table 6, when the PRCD operated as in normal use. The values in Table 6 are based on the PRCD being designed for operating in an environment with pollution degree 2 and overvoltage category II.

For plug and socket-outlet portions, IEC 60884-1 applies.

NOTE If higher altitudes, pollution degrees or overvoltage category are considered, the appropriate clearances and creepage distances are defined in IEC 60664-1.

Compliance for item 1 in Table 6 is checked by measurement or by the test of 9.7.5.3.1 and 9.7.5.3.2. The test is carried out with samples not submitted to the humidity treatment described in 9.7.1.

The clearances of items 2 and 4 may be reduced provided that the measured clearances are not shorter than the minimum allowed in IEC 60664-1 for homogenous field conditions. In this case, after the humidity treatment described in 9.7.1, compliance for item 2 and 4 and arrangements of 9.7.2 items b), c) and d) is checked in the following order:

- *tests according to 9.7.2,*
- *test according to 9.7.5.2 is applied with test voltages given in Table 14 with test arrangements of 9.7.2 items b), c), d).*

If measurement does not show any reduced clearance, test 9.7.5.2 is not applied.

For clearance of item 5 in Table 6, double insulation or reinforced insulation shall be provided upstream of the interrupting contacts of the PRCD between hazardous-live parts and

- *accessible surfaces of operating means,*
- *screws or other means for fixing covers which may be removed when connecting the connector,*
- *accessible metal parts.*

Compliance is checked by the test of 9.7.5.2.

All measurements required in 8.1.4 shall be carried out in Test sequence A on 1 sample and the tests 9.7.5.2 shall be carried out before 9.7.1 on 3 samples of Test sequence B.

The insulating materials are classified into material groups on the basis of their comparative tracking index (CTI) according to 4.6.3 of IEC 60664-1:2020.

For domestic plugs and when a national standard exists the relevant national standard applies. If no relevant national standard is available IEC 60884-1 applies.

The verification of clearances and creepage distances on printed circuit boards is made by the tests of 9.31.

Table 6 – Clearances and creepage distances

	Minimum clearances ^g mm		Minimum creepage distances ^{c, g} mm					
			Group IIIa ^d (175 V ≤ CTI < 400 V) ^b		Group II (400 V ≤ CTI < 600 V) ^b		Group I (600 V ≤ CTI) ^b	
	Rated voltage V ^e		Working voltage V					
	120	250	120	250	120	250	120	250
Item / Description	U_{imp} 1,5 kV	U_{imp} 2,5 kV						
1. between live parts which are separated when the main contacts are in the open position ^a	0,5	1,5	1,5	2,5	1,05	1,8	0,75	1,5
2. between live parts of different polarity	0,5	1,5	1,5	2,5	1,05	1,8	0,75	1,5
3. downstream interrupting contacts of the PRCD between live parts and – accessible surfaces of operating means – screws or other means for fixing covers which may be removed when connecting the connector – accessible metal parts ^f – PE	0,5	1,5	1,5	2,5	1,05	1,8	0,75	1,5
4. upstream interrupting contacts of the PRCD between live parts and – accessible surfaces of operating means – screws or other means for fixing covers which may be removed when connecting the connector – accessible metal parts ^f	1,5	3	2,5	5	2,1	3,6	1,5	3
NOTE 1 The parts of the neutral path, if any, are considered to be live parts.								
NOTE 2 Clearances and creepage distances of the secondary circuit and between the primary windings of the PRCD transformer are not considered.								
^a For auxiliary and control contacts the values are given in the relevant standard.								
^b See IEC 60112.								
^c Interpolation is allowed in determining creepage distances corresponding to voltage values intermediate to those listed as working voltage. When interpolating, linear interpolation shall be used and values shall be rounded to the same number of digits as the values picked up from the tables. For determination of creepage distances, see Annex C.								
^d For material group IIIb (100 V ≤ CTI < 175 V) the values for material group IIIa multiplied by 1,6 apply.								
^e The rated voltage is the maximum operational voltage to earth.								
^f Including a metal foil in contact with the surfaces of insulating material which are accessible after installation for normal use. The foil is pushed into corners, grooves, etc., by means of a test wire according to 9.6 (see Figure 2).								
^g For altitudes of 3 000 m the values shall be multiplied by 1,14, for 4 000 m they shall be multiplied by 1,29.								

8.1.5 Screws, current-carrying parts and connections

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

Thread-forming screws are allowed for mechanical connections and fixing.

Screws or nuts which transmit contact pressure shall be of metal and shall be in engagement with a metal thread.

Compliance is checked by inspection.

NOTE Screwed connections are considered as checked by the tests of 9.8, 9.11, 9.12, 9.13 and 9.22.

Compliance is checked by inspection and by the test of 9.4.

8.1.5.2 For screws in engagement with a thread of insulating material and which are operated when assembling the PRCD 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 manual test.

8.1.5.3 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.

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

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

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

- copper;
- an alloy containing at least 58 % copper for parts from rolled sheet (in cold condition) or at least 50 % copper for other parts;
- stainless steel containing at least 13 % chromium and not more than 0,09 % carbon;
- other metal or suitably coated metal, not less suitable for their intended use.

The requirements of this Subclause 8.1.5.4 do not apply to contacts, magnetic circuits, heater elements, bimetals, shunts, parts of electronic devices, screws, nuts, washers, clamping plates, similar parts of terminals and parts of the test circuit.

8.1.6 Terminals for external conductors for rewirable PRCDs

8.1.6.1 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.

In this document, screw-type terminals for external copper conductors only are considered.

The terminals shall be readily accessible under the intended conditions of use.

Compliance is checked by inspection and by the tests of 9.5.

8.1.6.2 PRCDs shall be provided with terminals which shall allow the connection of copper conductors having nominal cross-sectional areas as shown in Table 7.

NOTE Examples of designs of terminals are given in Annex F.

Compliance is checked by inspection, by measurement and by the test of 9.5.4.

Table 7 – Connectable cross-sections of copper conductors for screw-type terminals

Rated current A	Range of nominal cross-sections to be clamped mm ²	Test pull N
	Flexible stranded conductors	
6, 10, 13, 16	0,75 to 1,5	40
20	1,5 to 4	60
32	2,5 to 6	80
NOTE For AWG cross-sections see Annex G.		

8.1.6.3 The means for clamping the conductors in the terminals shall not serve to fix any other component, although they may hold the terminals in place or prevent them from turning.

Compliance is checked by inspection and by the tests of 9.5.

8.1.6.4 Terminals shall allow the conductors to be connected without special preparation.

Compliance is checked by inspection.

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

8.1.6.5 Terminals 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.

Compliance is checked by inspection and by the tests of 9.4 and 9.5.2.

NOTE Provisionally, SI, BA and UN threads are considered to be comparable in pitch and mechanical strength to metric ISO thread.

8.1.6.6 Terminals shall be so designed that they clamp the conductor without undue damage to the conductor.

Compliance is checked by inspection and by the test of 9.5.3.

8.1.6.7 Terminals shall be so designed that they clamp the conductor reliably and between metal surfaces.

Compliance is checked by inspection and by the tests of 9.4 and 9.5.2.

8.1.6.8 Terminals shall be so designed or positioned that a wire of a conductor cannot slip out while the clamping screws or nuts are tightened.

Compliance is checked by the test of 9.5.4.

8.1.6.9 Terminals shall be so fixed or located that, when the clamping screws or nuts are tightened or loosened, their fixing shall not work loose.

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

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 subjected to stress during normal use;
- 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 document.

Compliance is checked by inspection, by measurement and by the test of 9.4.

8.1.6.10 Clamping screws or nuts of terminals intended for the connection of protective conductors shall be adequately secured against accidental loosening and it shall not be possible to unclamp them without a tool.

Compliance is checked by manual test.

In general, the design of terminals of which examples are shown in Annex IC of IEC 61008-1:2010 provides sufficient resilience to comply with this requirement.

For other designs, special provisions, such as the use of an adequately resilient part which is not likely to be removed inadvertently, may be necessary.

8.1.6.11 Screws and nuts of terminals intended for the connection of external conductors shall be in engagement with a metal thread and the screws shall not be of the tapping screw type.

Compliance is checked by inspection.

8.1.7 Terminations for non-rewireable PRCDs

Non-rewireable PRCDs shall be provided with soldered, welded, crimped or equally effective permanent connections.

Screwed or snap-on connections shall not be used.

Connections made by crimping a pre-soldered flexible conductor are not permitted, unless the soldered area is outside the crimping area.

Compliance is checked by inspection.

8.1.8 Current-carrying parts

Current-carrying parts incorporated in plugs or socket-outlets shall also comply with 26.5 of IEC 60884-1:2022.

Current-carrying parts which may be subjected to mechanical wear shall not be made of steel provided with an electroplated coating.

8.2 Protection against electric shock

8.2.1 General

PRCDs shall be so designed that, when they are used according to the manufacturers' 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 30).

External parts, other than screws or other means for fixing covers and labels, which are accessible when the PRCD is used under normal conditions, shall either be of insulating material, or be lined throughout with insulating material, unless the live parts are within an internal enclosure of insulating material.

Such lining shall be fixed so that it is not likely to be lost. It shall have adequate thickness and mechanical strength and shall provide adequate protection even at places where sharp edges occur.

Inlet openings for cables shall either be of insulating material or be provided with bushing or similar devices of insulating material. Such devices shall be reliably fixed and shall have adequate mechanical strength.

Accessible parts of operating means shall be made of insulating material. This does not apply to the conductive operating means to detect faults on the supply side for PRCDs classified according to 4.8.2.

Metal parts of the mechanism shall not be accessible. In addition, they shall be insulated from all accessible metal parts, including metal frames, plates, screws or other means used as supporting or fixing means.

Lacquer and enamel are not considered to provide adequate insulation for the purpose of this Subclause 8.2.1.

Compliance is checked by inspection and by the tests of 9.6.

8.2.2 Requirements relating to plugs and socket-outlets, whether incorporated or not in integral items

8.2.2.1 General

NOTE These requirements are in accordance with IEC 60884-1:2022, 10.1, 10.2, 10.3, 10.4 and 10.6 for the purposes of 8.2.2.2 and IEC 60884-1:2022, 10.5 for the purposes of 8.2.2.3.

8.2.2.2 Requirements relating to the engagement of plugs into socket-outlets

Live parts of plugs shall not be accessible when the plug is in partial or complete engagement with a socket-outlet.

NOTE In the USA, South Africa, Canada, Japan and Switzerland, this requirement is not required to be met during insertion of the plug.

Compliance is checked by inspection and, if necessary, by the test of 9.6.1.

It shall not be possible to make connection between a pin of a plug and a live socket contact of a socket-outlet while any other pin is accessible.

Compliance is checked by manual test and by means of the gauges whose dimensions are the least favourable for this kind of test. The tolerances of the gauges shall be as specified in 9.1 of IEC 60884-1:2022.

For accessories with enclosures or bodies of thermoplastic material, the test is made at an ambient temperature of $(35 \pm 2) ^\circ\text{C}$, both the accessory and the gauge being at this temperature.

For socket-outlets with enclosures or bodies of rubber or polyvinyl chloride, the gauge is applied with a force of 75 N for 1 min.

8.2.2.3 Socket-outlets belonging to PRCDs shall be provided with shutters and be constructed in such a way that live parts are not accessible without a plug in engagement when applying the gauge shown in Figure 3.

They shall be so constructed that the live contacts are automatically screened when the plug is withdrawn.

The means for achieving this shall be such that the socket-outlet cannot be easily operated by anything other than a plug and it shall not depend upon parts which are liable to be lost.

This prevention from access to the contacts without deliberate intention is verified by means of a gauge.

The gauge of Figure 3 shall be applied to the entry holes corresponding to the live contacts only and shall not touch live parts.

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.

NOTE In the following countries, socket-outlets without shutters are allowed: AT, DE.

Compliance is checked by inspection and by the test of 9.6.2.

8.2.2.4 Earthing contacts of a socket-outlet shall be so designed that they cannot be deformed by the insertion of a plug to such an extent that safety is impaired.

Compliance is checked by the test of 9.6.2.

8.2.2.5 Degree of protection of PRCDs

The degree of protection of the parts of a PRCDs shall be not lower than indicated in Table 8 (see also note of 8.2.2.2).

Table 8 – Degree of protection of PRCD parts

Part	Minimum degree of protection	Test reference
RCD	IP4X	IEC 60529
Socket-outlet (body)	IP4X	IEC 60529
Socket-outlet (live contacts)		9.6.2
Plug during engagement	IP2X	9.6.1
Plug engaged	IP2X	9.6.1

Compliance is checked by the relevant test indicated in the last column.

The cable entry of the rewirable types 4.1.3.1 and 4.1.4.1 shall be at least IP2X.

Compliance is checked by the relevant test of IEC 60529.

8.3 Dielectric properties

PRCDs shall have adequate dielectric properties.

Compliance is checked by the tests of 9.7.

8.4 Temperature rise

8.4.1 Temperature rise limits

The temperature-rises of the parts of a PRCD specified in Table 9, measured under the conditions specified in 9.8, shall not exceed the limiting values stated in Table 9.

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

Table 9 – Temperature-rise values

Parts ^{1, 2}	Temperature rise K
Pins of plugs, contacts of socket-outlets or terminals for external connections	50
External parts liable to be touched in normal service	40
¹ No value is specified for the contacts, since the design of most PRCDs 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 9.21.2 is considered to be sufficient for checking indirectly the behaviour of the contacts with respect to undue temperature rises in service. ² No value is specified for parts other than those listed, but no damage shall be caused to adjacent parts of insulating materials, and the operation of the PRCD shall not be impaired.	

8.4.2 Ambient air temperature

The temperature-rise limits given in Table 9 are applicable only if the ambient air temperature remains between the limits given in Table 4.

8.5 Operating characteristic

The operating characteristic of PRCDs shall be such that the verifications of 9.9 are satisfactorily met.

8.6 Mechanical and electrical endurance

PRCDs shall be capable of performing an adequate number of mechanical and electrical operations.

Compliance is checked by the tests of 9.10.1 and 9.10.2.

8.7 Performance at short-circuit currents

PRCDs shall be capable of performing a specified number of short-circuit operations.

Compliance is checked by the tests of 9.11.

8.8 Resistance to mechanical shock and impact

PRCDs shall have adequate mechanical behaviour so as to withstand the stresses imposed during connection and use.

Compliance is checked by the test of 9.12.

8.9 Resistance to heat

PRCDs shall be sufficiently resistant to heat.

Compliance is checked by the test of 9.13.

8.10 Resistance to abnormal heat and to fire

External parts of PRCDs 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 other tests of this document.

Compliance is checked by the test of 9.14.

8.11 Test device

8.11.1 General

PRCDs shall be provided with a test device to simulate a residual current passing through the detecting device in order to allow the periodic testing of the ability of the RCD to operate.

NOTE The test device is intended to check the tripping function, not the value at which this function is effective with respect to the rated residual operating current and the break times.

The ampere-turns produced when operating the test device of a PRCD shall not exceed 3,5 times the ampere-turns produced when a residual current equal to $I_{\Delta n}$ is passed through one of the poles of the PRCD.

The test device shall comply with the test of 9.16. The protective conductor of the installation shall not become live when the test device is operated.

8.11.2 Test function

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

The test device may be the sole means of performing the opening operation, in which case it shall also comply with 8.6.

The operating means of the test device shall be accessible when the PRCD is plugged in as in normal use.

8.12 Behaviour of PRCDs in case of failure of line voltage

PRCDs shall operate correctly at any value of the line voltage between 0,85 and 1,1 times their rated operational voltage. In the event of a loss of the supply, PRCDs shall open automatically.

PRCDs classified according to 4.3.1 shall not re-close automatically when the supply is restored.

PRCDs classified according to 4.3.2 shall re-close at the restoration of the line voltage, unless they have tripped due to a residual current, the momentary re-closing of the contacts for a time not exceeding that stated in Table 2, when the line voltage is restored under fault conditions is allowed.

Compliance is checked by the tests of 9.9 and 9.17 under the supplementary test conditions specified in 9.9.2.

8.13 Behaviour of PRCDs in case of overcurrent in the main circuit

PRCDs shall not operate under specified conditions of overcurrent.

Compliance is checked by the test of 9.18.

8.14 Resistance of PRCDs against unwanted tripping due to surge currents to earth resulting from impulse voltages

PRCDs shall adequately withstand impulse voltages.

Compliance is checked by the test of 9.19.

8.15 Behaviour of PRCDs in case of an earth fault current comprising a DC component

PRCDs according to classification 4.4.2 shall ensure tripping both in the case of a residual alternating current and in the case of residual pulsating direct current whether suddenly applied or slowly rising.

Compliance is checked by the tests of 9.20.

8.16 Reliability

PRCDs shall operate reliably even after long service, taking into account the ageing of their components.

Compliance is checked by the tests of 9.21 and 9.22.

8.17 Resistance to tracking

Parts of insulating materials in contact with live parts shall be resistant to tracking.

Compliance is checked by the test of 9.23.

8.18 Electromagnetic compatibility (EMC)

PRCDs shall operate reliably, even in presence of electromagnetic disturbances, and shall comply with relevant EMC requirements.

Compliance is checked by the tests of 9.30.

8.19 Standing current in the protective conductor

The value of the standing current in PE shall not exceed 1 mA.

In case the protective conductor is connected to live parts, this connection shall be done via a protective impedance, which shall consist of at least two independent impedances connected in series.

Capacitors used as protective impedance shall be of type Y2 according to IEC 60384-14.

Removing the protective impedance shall only be possible if the PRCD will be destroyed and becomes unusable.

The verification is made by inspection and by the tests according to 9.9.8.

8.20 Electrical performance

8.20.1 Protective conductor path

The switched contact within the protective conductor path, if any, shall provide adequate contact pressure and shall not deteriorate in normal use. The protective conductor may pass through the sensing toroid as long as the unit complies with the appropriate operating test. It shall be verified by inspection that the protective conductor path does not have any semiconductor device connected in series.

Compliance is checked by the temperature rise test of 9.8, the rated residual making and breaking capacity test of 9.11.2.3 and the rated conditional residual short-circuit current test of 9.11.2.4 c).

8.20.2 Contact mechanism

Each line conductor and the neutral conductor, if any, of the PRCD shall be provided with switching contacts. For PRCDs according to 4.6.1 the protective conductor shall be provided with a switching contact. The line contacts and the neutral contact, if any, shall be mechanically or electrically coupled such that they make and break substantially together.

The protective conductor contact, if any, may be mechanically or electrically coupled to the line and neutral contacts.

The switching contact of the protective conductor path, if any, shall close before and open after the switching contacts of the live conductors or close and open substantially together with the live conductors.

It shall be possible to switch off the PRCD when plugged in and energized as in normal use. This requirement is not considered met by the fact that the plug can be disconnected from its supply source. The test device may be used for that purpose.

Compliance with the above requirements is checked by inspection and by the relevant tests of 9.10.2.2.

The PRCD shall have means for manual reset after a residual current operation. This may be done by a dedicated means or by disconnecting from the socket-outlet.

The PRCD shall have an indicator showing the state of the contacts and give a clear indication or response in case of unintentionally closed contacts.

The action of the mechanism shall not be influenced by the position of enclosures or covers and shall be independent of any removable part.

PRCDs shall have a trip-free function where the moving contacts of which return to and remain in the open position when the automatic opening operation is initiated after the initiation of the closing operation, even if the closing command is maintained.

A cover sealed in position by the manufacturer is considered to be a non-removable part.

Compliance with the above requirements is checked by inspection and by the relevant tests of 9.15.

8.20.3 Operation with supply failure and hazardous live protective conductor conditions

The PRCD shall have a defined behaviour in case of shock hazard due to supply failures (see 3.2.1.2) or shock hazard due to miswiring.

PRCDs classified according to 4.8.2 may have a conductive operating means to detect faults on the supply side. This conductive operating means shall have high electrical resistance to avoid electric shock.

This only applies to PRCD classified according to 4.8.2.

Compliance with this requirement is checked by the test of 9.9.5 and 9.6.8.

8.20.4 Behaviour of PRCDs in case of external fault current in the protective conductor

During normal operation, PRCDs according to classification 4.6.1 shall ensure that in case of a fault current issued from an external electrical circuit, PRCDs shall not switch off the protective conductor.

NOTE For example a fault current issued from an external electrical circuit can occur by a drilling machine damaging a phase from a different protected circuit.

Compliance is checked by the test of 9.9.7.

9 Test

9.1 General

9.1.1 Characteristics of PRCDs checked by means of type tests

The type tests required by this document are listed in Table 10.

Plugs and socket-outlets that have already been type-tested to national standard or, if not available, according to IEC 60884-1 need not be tested again.

Table 10 – List of type tests

Tests	Subclause
– Indelibility of marking	9.3
– Reliability of screws, current-carrying parts and connections	9.4
– Reliability of terminals for external conductors	9.5
– Protection against electric shock	9.6
– Dielectric properties	9.7
– Temperature rise	9.8
– Operating characteristic	9.9
– Mechanical and electrical endurance	9.10
– Behaviour of PRCDs under overcurrent conditions	9.11
– Resistance to mechanical shock and impact	9.12
– Resistance to heat	9.13
– Resistance of insulating material to abnormal heat and to fire	9.14
– Trip-free mechanism	9.15
– Verification of the test device	9.16
– Behaviour of PRCDs in case of failure of the line voltage	9.17
– Limiting values of the non-operating current under overcurrent conditions	9.18
– Resistance against unwanted tripping due to surge currents to earth resulting from impulse voltages for PRCDs of $I_{\Delta n} \geq 0,010$ A	9.19
– Correct operation with residual currents having a DC component	9.20
– Reliability	9.21
– Ageing	9.22
– Resistance to tracking	9.23
– Pins provided with insulating sleeves	9.24
– Mechanical strength of non-solid pins of plugs and portable socket-outlets	9.25
– Effects of strain on the conductors	9.26
– Torque exerted by plug-in PRCDs on fixed socket-outlets	9.27
– Retention of cord anchorage	9.28
– Flexing test of non-rewireable PRCDs	9.29
– Electromagnetic compatibility (EMC)	9.30
– Tests replacing verifications of creepage distances and clearances for PRCDs containing electronic components permanently connected between the two poles	9.31
– Requirements for single electronic components used in PRCDs	9.32
– Verification of the behaviour of the PRCD under temporary over voltage (TOV) conditions	9.33

9.1.2 For certification purposes, type tests to be carried out in test sequences

NOTE The term "certification" denotes:

- either manufacturer's declaration of conformity;
- or third-party certification, for example by an independent certification body.

The test sequences and the number of samples to be submitted are stated in Annex A.

Unless otherwise specified, each type test (or sequence of type tests) is made on PRCDs in a clean and new condition, the influencing quantities having their normal reference values (see Table 4).

9.1.3 Routine tests

Routine tests are intended to detect faults in materials and workmanship and to ascertain safety and proper functioning of the PRCD. They shall be made on each individual device of the PRCD.

Routine tests to be carried out by the manufacturer are given in Annex B.

9.2 Test conditions

The tests are made on new samples representative of the production.

Unless otherwise specified, the PRCD is connected as in normal use, using plugs, and/or socket-outlets of the same system, at an ambient temperature between 20 °C and 25 °C and according to the manufacturer's instructions.

PRCDs are tested using a fixed socket-outlet fitted with 1 m of rigid conductors (solid or stranded) conductors. Devices with terminals on the supply side are tested using a flexible conductor of 1 m according to Table 11 fitted with a plug.

In the case of 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 11 – Cross-sectional area for test conductors

Rated current of the PRCD A	Nominal cross-sectional area mm ²	
	Flexible conductors for test plug and terminals of PRCDs	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
Above 16 up to and including 20	2,5	4
Above 20 up to and including 32	4	6
NOTE For American wire gauge (AWG) conductors, see Annex ID of IEC 61008-1:2010.		

Where tolerances are not specified, type tests are carried out at values not less than those specified in this document. Unless otherwise specified, tests are carried out at the rated frequency $\pm 5\%$.

The tightening torques to be applied to the terminal screws are two-thirds of those specified in Table 12. During the tests, no maintenance or dismantling of the sample is allowed.

An operating speed of 0,1 m/s $\pm 25\%$ shall be used during actuation for the tests of 9.10.2 and 9.11. The speed is measured at the extremity when and where the operating means of the test apparatus touches the actuating means of the PRCD 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 PRCD under test.

9.3 Test of indelibility of marking

The test 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, initial boiling point approximately 65 °C, dry point approximately 69 °C and specific gravity of 0,68 g/cm³).