

# 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**



IEC 61540

Edition 2.0 2023-07

Corrected version  
2026-08

# 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**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

ICS 29.120.01

ISBN 978-2-8322-7185-8

**Warning! Make sure that you obtained this publication from an authorized distributor.  
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

## CONTENTS

|                                                                                                                                                                     |    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| FOREWORD.....                                                                                                                                                       | 10 |
| INTRODUCTION.....                                                                                                                                                   | 12 |
| 1 Scope.....                                                                                                                                                        | 13 |
| 2 Normative references .....                                                                                                                                        | 14 |
| 3 Terms and definitions, symbols and abbreviated terms .....                                                                                                        | 15 |
| 3.1 Definitions relating to plugs and socket-outlets .....                                                                                                          | 15 |
| 3.2 Definitions relating to residual current devices (RCDs).....                                                                                                    | 16 |
| 3.2.1 Definitions relating to currents flowing from live parts to earth .....                                                                                       | 16 |
| 3.2.2 Definitions relating to the energization of a residual current device (RCD) .....                                                                             | 17 |
| 3.2.3 Definitions relating to the operation and to the functions of a residual current device.....                                                                  | 17 |
| 3.2.4 Definitions relating to values and ranges of energizing quantities .....                                                                                      | 18 |
| 4 Classification .....                                                                                                                                              | 18 |
| 4.1 According to the type of connection .....                                                                                                                       | 18 |
| 4.1.1 PRCD intermediate adaptor .....                                                                                                                               | 18 |
| 4.1.2 Non-rewireable residual current-protected cord extension sets .....                                                                                           | 19 |
| 4.1.3 Residual current-protected plugs .....                                                                                                                        | 19 |
| 4.1.4 In-line PRCDs.....                                                                                                                                            | 19 |
| 4.2 According to the type of terminals.....                                                                                                                         | 19 |
| 4.3 According to behaviour after opening automatically in case of failure of the line voltage .....                                                                 | 19 |
| 4.4 According to their operating characteristics and behaviour in presence of DC components .....                                                                   | 19 |
| 4.5 According to the ambient air temperature.....                                                                                                                   | 20 |
| 4.5.1 For use between –5 °C and +40 °C.....                                                                                                                         | 20 |
| 4.5.2 For use between –25 °C and +40 °C.....                                                                                                                        | 20 |
| 4.6 Classification according to the protective conductor path .....                                                                                                 | 20 |
| 4.6.1 PRCDs with switched protective conductor .....                                                                                                                | 20 |
| 4.6.2 PRCDs with non-switched protective conductor .....                                                                                                            | 20 |
| 4.7 According to the supply.....                                                                                                                                    | 20 |
| 4.7.1 PRCDs supplied from one phase and neutral (LNSE or LNE).....                                                                                                  | 20 |
| 4.7.2 PRCDs supplied from two phases (LLSE or LLE).....                                                                                                             | 20 |
| 4.8 According an additional function of detecting faults on the supply side.....                                                                                    | 20 |
| 4.8.1 PRCDs not providing an additional function of detecting faults on the supply side .....                                                                       | 20 |
| 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) ..... | 20 |
| 5 Characteristics of PRCDs .....                                                                                                                                    | 20 |
| 5.1 Summary of characteristics .....                                                                                                                                | 20 |
| 5.2 Rated quantities and other characteristics.....                                                                                                                 | 21 |
| 5.2.1 Rated voltage .....                                                                                                                                           | 21 |
| 5.2.2 Rated current ( $I_n$ ) .....                                                                                                                                 | 21 |
| 5.2.3 Rated residual operating current ( $I_{\Delta n}$ ).....                                                                                                      | 21 |
| 5.2.4 Rated residual non-operating current ( $I_{\Delta no}$ ) .....                                                                                                | 21 |
| 5.2.5 Rated frequency .....                                                                                                                                         | 21 |

|        |                                                                                                       |    |
|--------|-------------------------------------------------------------------------------------------------------|----|
| 5.2.6  | Rated making and breaking capacity ( $I_m$ ) .....                                                    | 22 |
| 5.2.7  | Rated residual making and breaking capacity ( $I_{\Delta m}$ ) .....                                  | 22 |
| 5.2.8  | Operating characteristics in case of residual currents comprising a DC component.....                 | 22 |
| 5.3    | Standard and preferred values .....                                                                   | 22 |
| 5.3.1  | Preferred values of rated operational voltage ( $U_e$ ).....                                          | 22 |
| 5.3.2  | Standard values of rated current ( $I_n$ ) .....                                                      | 22 |
| 5.3.3  | Standard values of rated residual operating current ( $I_{\Delta n}$ ) .....                          | 23 |
| 5.3.4  | Standard value of residual non-operating current ( $I_{\Delta no}$ ) .....                            | 23 |
| 5.3.5  | Standard minimum value of the non-operating overcurrent through the PRCD .....                        | 23 |
| 5.3.6  | Preferred values of rated frequency .....                                                             | 23 |
| 5.3.7  | Minimum value of the rated making and breaking capacity ( $I_m$ ) .....                               | 23 |
| 5.3.8  | Minimum value of the rated residual making and breaking capacity ( $I_{\Delta m}$ ) .....             | 23 |
| 5.3.9  | Standard value of the rated conditional short-circuit current ( $I_{nc}$ ) .....                      | 24 |
| 5.3.10 | Standard value of the rated conditional residual short-circuit current ( $I_{\Delta c}$ ) .....       | 24 |
| 5.3.11 | Standard values of maximum break time.....                                                            | 24 |
| 5.4    | Coordination with short-circuit protective devices (SCPDs) .....                                      | 24 |
| 5.4.1  | General .....                                                                                         | 24 |
| 5.4.2  | Rated conditional short-circuit current ( $I_{nc}$ ) .....                                            | 24 |
| 5.4.3  | Rated conditional residual short-circuit current ( $I_{\Delta c}$ ).....                              | 24 |
| 6      | Marking and other product information.....                                                            | 24 |
| 6.1    | Information and marking for PRCDs .....                                                               | 24 |
| 6.2    | Information to be provided in an instruction sheet .....                                              | 27 |
| 7      | Standard conditions for operation in service and for installation.....                                | 27 |
| 7.1    | Standard conditions .....                                                                             | 27 |
| 7.2    | Conditions for installations .....                                                                    | 28 |
| 7.3    | Pollution degree.....                                                                                 | 28 |
| 8      | Requirements for construction and operation.....                                                      | 28 |
| 8.1    | Mechanical design .....                                                                               | 28 |
| 8.1.1  | General .....                                                                                         | 28 |
| 8.1.2  | Plug part, socket-outlet parts and RCD part(s).....                                                   | 29 |
| 8.1.3  | Mechanism .....                                                                                       | 34 |
| 8.1.4  | Clearances and creepage distances (see Annex C) .....                                                 | 35 |
| 8.1.5  | Screws, current-carrying parts and connections .....                                                  | 37 |
| 8.1.6  | Terminals for external conductors for rewirable PRCDs .....                                           | 37 |
| 8.1.7  | Terminations for non-rewirable PRCDs .....                                                            | 39 |
| 8.1.8  | Current-carrying parts.....                                                                           | 39 |
| 8.2    | Protection against electric shock.....                                                                | 40 |
| 8.2.1  | General .....                                                                                         | 40 |
| 8.2.2  | Requirements relating to plugs and socket-outlets, whether incorporated or not in integral items..... | 40 |
| 8.3    | Dielectric properties .....                                                                           | 42 |
| 8.4    | Temperature rise .....                                                                                | 42 |
| 8.4.1  | Temperature rise limits .....                                                                         | 42 |

|        |                                                                                                                    |    |
|--------|--------------------------------------------------------------------------------------------------------------------|----|
| 8.4.2  | Ambient air temperature .....                                                                                      | 42 |
| 8.5    | Operating characteristic .....                                                                                     | 42 |
| 8.6    | Mechanical and electrical endurance .....                                                                          | 42 |
| 8.7    | Performance at short-circuit currents .....                                                                        | 43 |
| 8.8    | Resistance to mechanical shock and impact .....                                                                    | 43 |
| 8.9    | Resistance to heat .....                                                                                           | 43 |
| 8.10   | Resistance to abnormal heat and to fire .....                                                                      | 43 |
| 8.11   | Test device .....                                                                                                  | 43 |
| 8.11.1 | General .....                                                                                                      | 43 |
| 8.11.2 | Test function.....                                                                                                 | 43 |
| 8.12   | Behaviour of PRCDs in case of failure of line voltage.....                                                         | 44 |
| 8.13   | Behaviour of PRCDs in case of overcurrent in the main circuit .....                                                | 44 |
| 8.14   | Resistance of PRCDs against unwanted tripping due to surge currents to earth resulting from impulse voltages ..... | 44 |
| 8.15   | Behaviour of PRCDs in case of an earth fault current comprising a DC component.....                                | 44 |
| 8.16   | Reliability .....                                                                                                  | 44 |
| 8.17   | Resistance to tracking.....                                                                                        | 44 |
| 8.18   | Electromagnetic compatibility (EMC).....                                                                           | 44 |
| 8.19   | Standing current in the protective conductor .....                                                                 | 45 |
| 8.20   | Electrical performance .....                                                                                       | 45 |
| 8.20.1 | Protective conductor path .....                                                                                    | 45 |
| 8.20.2 | Contact mechanism .....                                                                                            | 45 |
| 8.20.3 | Operation with supply failure and hazardous live protective conductor conditions.....                              | 46 |
| 8.20.4 | Behaviour of PRCDs in case of external fault current in the protective conductor .....                             | 46 |
| 9      | Test.....                                                                                                          | 46 |
| 9.1    | General.....                                                                                                       | 46 |
| 9.1.1  | Characteristics of PRCDs checked by means of type tests .....                                                      | 46 |
| 9.1.2  | For certification purposes, type tests to be carried out in test sequences.....                                    | 47 |
| 9.1.3  | Routine tests .....                                                                                                | 48 |
| 9.2    | Test conditions .....                                                                                              | 48 |
| 9.3    | Test of indelibility of marking .....                                                                              | 48 |
| 9.4    | Test of reliability of screws, current-carrying parts and connections .....                                        | 49 |
| 9.5    | Test of reliability of terminals for external conductors.....                                                      | 50 |
| 9.6    | Verification of protection against electric shock.....                                                             | 51 |
| 9.6.1  | Test with conductors of the smallest and largest cross-sections .....                                              | 51 |
| 9.6.2  | Test with plug completely withdrawn.....                                                                           | 52 |
| 9.6.3  | Test with engagement surface in horizontal position .....                                                          | 52 |
| 9.6.4  | Verification of the resistance between the earthing terminal and the accessible metal part.....                    | 52 |
| 9.6.5  | Verification of the isolation between the earthing terminal and the accessible metal part.....                     | 52 |
| 9.6.6  | Stray wire test for rewirable PRCDs .....                                                                          | 52 |
| 9.6.7  | Stray wire verification for non-rewirable PRCDs.....                                                               | 53 |
| 9.6.8  | Verification of high electrical resistance of the conductive operating means .....                                 | 53 |
| 9.7    | Test of dielectric properties.....                                                                                 | 53 |
| 9.7.1  | Resistance to humidity.....                                                                                        | 53 |

|        |                                                                                                                                                                             |    |
|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| 9.7.2  | Insulation resistance of the main circuit .....                                                                                                                             | 54 |
| 9.7.3  | Dielectric strength of the main circuit .....                                                                                                                               | 54 |
| 9.7.4  | Secondary circuit of detection transformers .....                                                                                                                           | 55 |
| 9.7.5  | Verification of impulse withstand voltages.....                                                                                                                             | 55 |
| 9.8    | Temperature-rise test.....                                                                                                                                                  | 58 |
| 9.8.1  | Test conditions .....                                                                                                                                                       | 58 |
| 9.8.2  | Ambient air temperature .....                                                                                                                                               | 58 |
| 9.8.3  | Test procedure .....                                                                                                                                                        | 59 |
| 9.8.4  | Measurement of the temperature-rise of different parts.....                                                                                                                 | 59 |
| 9.8.5  | Temperature-rise of a part .....                                                                                                                                            | 59 |
| 9.9    | Verification of the operating characteristic .....                                                                                                                          | 59 |
| 9.9.1  | Test circuit.....                                                                                                                                                           | 59 |
| 9.9.2  | Off-load tests with residual sinusoidal alternating currents at the<br>reference temperature of $(20 \pm 2) ^\circ\text{C}$ .....                                           | 59 |
| 9.9.3  | Verification of the correct operation with load at the reference<br>temperature .....                                                                                       | 60 |
| 9.9.4  | Tests at the temperature limits.....                                                                                                                                        | 61 |
| 9.9.5  | Additional tests for PRCDs classified according to 4.8.2 .....                                                                                                              | 61 |
| 9.9.6  | Verification of protective conductor contact behaviour .....                                                                                                                | 64 |
| 9.9.7  | Verification of behaviour in case of external fault current in the<br>protective conductor .....                                                                            | 64 |
| 9.9.8  | Verification of standing current in the protective conductor .....                                                                                                          | 65 |
| 9.10   | Verification of mechanical and electrical endurance .....                                                                                                                   | 65 |
| 9.10.1 | Normal operation of socket-outlets and plugs of the PRCD .....                                                                                                              | 65 |
| 9.10.2 | Test of the RCD part of the PRCD .....                                                                                                                                      | 66 |
| 9.11   | Verification of the behaviour of the PRCD under overcurrent conditions.....                                                                                                 | 67 |
| 9.11.1 | List of the overcurrent tests .....                                                                                                                                         | 67 |
| 9.11.2 | Short-circuit tests .....                                                                                                                                                   | 67 |
| 9.11.3 | Verification of the making and breaking capacity of the plug and socket-<br>outlet(s) of the PRCD, separate or incorporated in integral items.....                          | 72 |
| 9.12   | Verification of resistance to mechanical shock and impact .....                                                                                                             | 72 |
| 9.12.1 | General .....                                                                                                                                                               | 72 |
| 9.13   | Test of resistance to heat.....                                                                                                                                             | 75 |
| 9.14   | Resistance of insulating material to abnormal heat and to fire.....                                                                                                         | 76 |
| 9.14.1 | General .....                                                                                                                                                               | 76 |
| 9.14.2 | Glow-wire test.....                                                                                                                                                         | 76 |
| 9.15   | Verification of the trip-free mechanism .....                                                                                                                               | 77 |
| 9.15.1 | General test conditions .....                                                                                                                                               | 77 |
| 9.15.2 | Test procedure .....                                                                                                                                                        | 77 |
| 9.16   | Verification of the test device .....                                                                                                                                       | 77 |
| 9.16.1 | Verification of the operation of the test device to disconnect the load .....                                                                                               | 77 |
| 9.16.2 | Verification of the ampere-turns.....                                                                                                                                       | 77 |
| 9.17   | Verification of the behaviour of PRCDs in case of failure of the line voltage .....                                                                                         | 77 |
| 9.17.1 | Determination of the limiting value of the line voltage ( $U_X$ ).....                                                                                                      | 77 |
| 9.17.2 | Verification of the behaviour in case of failure of the line voltage .....                                                                                                  | 78 |
| 9.17.3 | Verification of the re-closing of PRCDs classified according to 4.3.2 at<br>restoration of the line voltage after automatic opening on failure of the<br>line voltage ..... | 79 |
| 9.18   | Verification of limiting values of the non-operating current under overcurrent<br>conditions .....                                                                          | 79 |

|                                                                                                                                |                                                                                                                                                                                                                                                             |     |
|--------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| 9.19                                                                                                                           | Verification of resistance against unwanted tripping due to surge currents to earth resulting from impulse voltages for PRCDs of $I_{\Delta n} \geq 0,010$ A .....                                                                                          | 79  |
| 9.20                                                                                                                           | Verification of the correct operation with residual currents having a DC component for PRCDs according to 4.4.2.....                                                                                                                                        | 79  |
| 9.20.1                                                                                                                         | General .....                                                                                                                                                                                                                                               | 79  |
| 9.20.2                                                                                                                         | Verification of the correct operation in case of a continuous rise of a residual pulsating direct current.....                                                                                                                                              | 79  |
| 9.20.3                                                                                                                         | Verification of the correct operation in case of suddenly appearing residual pulsating direct currents .....                                                                                                                                                | 80  |
| 9.20.4                                                                                                                         | Verification at the reference temperature of the correct operation with load .....                                                                                                                                                                          | 80  |
| 9.20.5                                                                                                                         | Verification of the correct operation in case of residual pulsating direct currents superimposed by a smooth direct current of 0,006 A .....                                                                                                                | 80  |
| 9.21                                                                                                                           | Verification of reliability.....                                                                                                                                                                                                                            | 81  |
| 9.21.1                                                                                                                         | Climatic test.....                                                                                                                                                                                                                                          | 81  |
| 9.21.2                                                                                                                         | Test with temperature of 40 °C .....                                                                                                                                                                                                                        | 82  |
| 9.22                                                                                                                           | Verification of ageing .....                                                                                                                                                                                                                                | 83  |
| 9.23                                                                                                                           | Resistance to tracking.....                                                                                                                                                                                                                                 | 84  |
| 9.24                                                                                                                           | Test on pins provided with insulating sleeves.....                                                                                                                                                                                                          | 84  |
| 9.25                                                                                                                           | Test of mechanical strength of non-solid pins of plugs and portable socket-outlets.....                                                                                                                                                                     | 84  |
| 9.26                                                                                                                           | Verification of the effects of strain on the conductors .....                                                                                                                                                                                               | 84  |
| 9.27                                                                                                                           | Checking of the torque exerted by plug-in PRCDs on fixed socket-outlets .....                                                                                                                                                                               | 85  |
| 9.28                                                                                                                           | Tests of the cord anchorage.....                                                                                                                                                                                                                            | 85  |
| 9.29                                                                                                                           | Flexing test of non-rewireable PRCDs.....                                                                                                                                                                                                                   | 86  |
| 9.30                                                                                                                           | Verification of the electromagnetic compatibility (EMC).....                                                                                                                                                                                                | 87  |
| 9.31                                                                                                                           | Tests replacing verifications of creepage distances and clearances for electronic circuits connected between live conductors (phases and neutral) and/or between live conductors and the earth circuit when the contacts are in the closed position .....   | 87  |
| 9.31.1                                                                                                                         | PRCDs shall not create fire and/or shock hazards under abnormal conditions likely to occur in service.....                                                                                                                                                  | 87  |
| 9.31.2                                                                                                                         | When PRCDs are exposed to abnormal conditions, no part shall reach temperatures likely to cause danger of fire to the surroundings of the PRCDs and no live parts shall become accessible.....                                                              | 87  |
| 9.31.3                                                                                                                         | Unless otherwise specified, the tests are made on PRCDs while they are mounted, connected and loaded as specified in 9.8.....                                                                                                                               | 88  |
| 9.32                                                                                                                           | Requirements for capacitors and specific resistors and inductors used in electronic circuits connected between live conductors (phases and neutral) and/or between live conductors and the earth circuit when the contacts are in the closed position ..... | 90  |
| 9.32.1                                                                                                                         | Capacitors .....                                                                                                                                                                                                                                            | 90  |
| 9.32.2                                                                                                                         | Resistors and inductors .....                                                                                                                                                                                                                               | 90  |
| 9.33                                                                                                                           | Verification of the behaviour of the PRCD under temporary over voltage (TOV) conditions.....                                                                                                                                                                | 90  |
| 9.33.1                                                                                                                         | General .....                                                                                                                                                                                                                                               | 90  |
| 9.33.2                                                                                                                         | Test for all PRCDs.....                                                                                                                                                                                                                                     | 90  |
| 9.33.3                                                                                                                         | Verification after the tests .....                                                                                                                                                                                                                          | 91  |
| Annex A (normative) Test sequences and number of samples to be submitted for verification of conformity to this document ..... |                                                                                                                                                                                                                                                             | 119 |
| A.1                                                                                                                            | Verification of conformity .....                                                                                                                                                                                                                            | 119 |
| A.2                                                                                                                            | Test sequences .....                                                                                                                                                                                                                                        | 119 |
| A.3                                                                                                                            | Number of samples to be submitted for full test procedure .....                                                                                                                                                                                             | 121 |

|              |                                                                                                                                                                                       |     |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| A.4          | Number of samples to be submitted for simplified test procedures in case of submitting simultaneously a range of PRCDs of the same fundamental design.....                            | 121 |
| Annex B      | (normative) Routine tests.....                                                                                                                                                        | 126 |
| B.1          | General.....                                                                                                                                                                          | 126 |
| B.2          | Tripping test.....                                                                                                                                                                    | 126 |
| B.3          | Dielectric strength test.....                                                                                                                                                         | 126 |
| B.4          | Performance of the test device.....                                                                                                                                                   | 126 |
| B.5          | Stray wire test.....                                                                                                                                                                  | 126 |
| B.6          | Correct continuity test.....                                                                                                                                                          | 127 |
| Annex C      | (normative) Determination of clearances and creepage distances.....                                                                                                                   | 128 |
| C.1          | General.....                                                                                                                                                                          | 128 |
| C.2          | Orientation and location of a creepage distance.....                                                                                                                                  | 128 |
| C.3          | Creepage distances where more than one material is used.....                                                                                                                          | 128 |
| C.4          | Creepage distances split by floating conductive part.....                                                                                                                             | 128 |
| C.5          | Measurement of creepage distances and clearances.....                                                                                                                                 | 128 |
| Annex D      | (normative) List of tests, additional test sequences and numbers of samples for verification of compliance of PRCDs with the requirements of electromagnetic compatibility (EMC)..... | 132 |
| D.1          | General.....                                                                                                                                                                          | 132 |
| D.2          | EMC tests already included in the product standard.....                                                                                                                               | 132 |
| D.3          | Additional tests of IEC 61543 to be applied.....                                                                                                                                      | 132 |
| Annex E      | (informative) Application of PRCD according to 4.8.2 (PRCD-S).....                                                                                                                    | 134 |
| E.1          | Explanation of switched protective conductor function and application.....                                                                                                            | 134 |
| E.2          | Examples of incorrect supply wiring.....                                                                                                                                              | 135 |
| Annex F      | (informative) Examples of terminal designs.....                                                                                                                                       | 138 |
| Annex G      | (informative) Correspondence between ISO and AWG copper conductors.....                                                                                                               | 141 |
| Annex H      | (informative) Methods for determination of short-circuit power-factor.....                                                                                                            | 142 |
| Bibliography | .....                                                                                                                                                                                 | 143 |
| Figure 1     | – Examples of types of connection classified according to 4.1.....                                                                                                                    | 92  |
| Figure 2     | – Standard test wire 1,0 mm.....                                                                                                                                                      | 93  |
| Figure 3     | – Gauge for checking non-accessibility of live parts through shutters and of live parts of socket-outlets with increased protection.....                                              | 94  |
| Figure 4     | – Test circuit for the verification of the correct operation of PRCDs, in the case of residual pulsating direct currents.....                                                         | 95  |
| Figure 5     | – Test circuit for the verification of the correct operation of PRCDs, in the case of residual pulsating direct currents superimposed by a smooth direct current.....                 | 96  |
| Figure 6     | – Verification of behaviour in case of external fault current in the protective conductor.....                                                                                        | 97  |
| Figure 7     | – Test circuit for the verification of the rated making and breaking capacity and of the coordination.....                                                                            | 98  |
| Figure 8     | – Tumbling barrel.....                                                                                                                                                                | 99  |
| Figure 9     | – Arrangement for compression test.....                                                                                                                                               | 99  |
| Figure 10    | – Ball-pressure test apparatus.....                                                                                                                                                   | 100 |
| Figure 11    | – Arrangement and dimensions of the electrodes for the tracking test.....                                                                                                             | 100 |
| Figure 12    | – Apparatus for testing the cord retention.....                                                                                                                                       | 101 |
| Figure 13    | – Apparatus for flexing test.....                                                                                                                                                     | 102 |

|                                                                                                                                                                                                 |     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Figure 14 – Arrangement for mechanical strength test on PRCDs provided with cords (9.12.6).....                                                                                                 | 103 |
| Figure 15 – Test apparatus for the verification of the minimum $I^2t$ and $I_p$ values to be withstood by the PRCD (9.11.2.1 a)).....                                                           | 104 |
| Figure 16 – Stabilizing period for reliability test (9.21.1.4).....                                                                                                                             | 105 |
| Figure 17 – Reliability test cycle (9.21.1.4) .....                                                                                                                                             | 106 |
| Figure 18 – Example for test circuit for verification of ageing of electronic components (9.22).....                                                                                            | 107 |
| Figure 19 – Current ring wave 0,5 $\mu$ s/100 kHz .....                                                                                                                                         | 107 |
| Figure 20 – Example of test circuit for the verification of resistance to unwanted tripping .....                                                                                               | 108 |
| Figure 21 – Minimum creepage distances and clearances as a function of peak value of voltage.....                                                                                               | 109 |
| Figure 22 – Minimum creepage distances and clearances as a function of peak value of operating voltage .....                                                                                    | 110 |
| Figure 23 – Test cycle for low temperature test (9.9.4).....                                                                                                                                    | 111 |
| Figure 24 – Test circuit for the verification of operating characteristic (9.9), endurance test (9.10), trip-free mechanism (9.15) and behaviour in case of failure of line voltage (9.17)..... | 112 |
| Figure 25 – Test circuit for the verification of PRCD when plugged into incompatible supply systems (9.9.5.4) .....                                                                             | 113 |
| Figure 26 – Verification of correct operation for hazardous live PE (see Table 15) .....                                                                                                        | 114 |
| Figure 27 – Verification of open neutral for LNSE types, and open line for LLSE types .....                                                                                                     | 115 |
| Figure 28 – Verification of a standing current in the protective conductor in normal service (9.9.8).....                                                                                       | 116 |
| Figure 29 – Verification of open protective conductor (see 9.9.5.5) .....                                                                                                                       | 117 |
| Figure 30 – Standard test finger.....                                                                                                                                                           | 118 |
| Figure C.1 – Examples of methods of measuring creepage distances and clearances.....                                                                                                            | 131 |
| Figure E.1 – Examples of incorrect supply wirings for LLSE types.....                                                                                                                           | 136 |
| Figure E.2 – Examples of incorrect supply wirings for LNSE types .....                                                                                                                          | 137 |
| Figure F.1 – Examples of pillar terminals .....                                                                                                                                                 | 138 |
| Figure F.2 – Examples of screw terminals and stud terminals .....                                                                                                                               | 139 |
| Figure F.3 – Examples of saddle terminals.....                                                                                                                                                  | 140 |
| Figure F.4 – Examples of lug terminals .....                                                                                                                                                    | 140 |
| Table 1 – Standard values of rated current and corresponding preferred values of rated operational voltages.....                                                                                | 23  |
| Table 2 – Standard values of maximum break time for AC residual currents .....                                                                                                                  | 24  |
| Table 3 – Marking or information item .....                                                                                                                                                     | 25  |
| Table 4 – Standard conditions for operation in service .....                                                                                                                                    | 27  |
| Table 5 – Minimum cross-sectional area of flexible cable or cord suitable for non-rewireable plugs and non-rewireable socket-outlets of PRCDs.....                                              | 33  |
| Table 6 – Clearances and creepage distances .....                                                                                                                                               | 36  |
| Table 7 – Connectable cross-sections of copper conductors for screw-type terminals.....                                                                                                         | 38  |
| Table 8 – Degree of protection of PRCD parts .....                                                                                                                                              | 41  |
| Table 9 – Temperature-rise values.....                                                                                                                                                          | 42  |

|                                                                                                                                                                           |     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Table 10 – List of type tests .....                                                                                                                                       | 47  |
| Table 11 – Cross-sectional area for test conductors.....                                                                                                                  | 48  |
| Table 12 – Screw thread diameters and applied torques .....                                                                                                               | 49  |
| Table 13 – Conductor composition .....                                                                                                                                    | 51  |
| Table 14 – Test voltage for verification of impulse withstand voltage .....                                                                                               | 57  |
| Table 15 – Supply failure and hazardous live protective conductor (PE) connections for<br>test with reference to correct supply connections for LNSE and LLSE types ..... | 62  |
| Table 16 – Tests to verify the behaviour of PRCDs under overcurrent conditions .....                                                                                      | 67  |
| Table 17 – List of tests of resistance to mechanical shock and impact .....                                                                                               | 73  |
| Table 18 – Torque applied to the spanner for the test of 9.12.3.....                                                                                                      | 74  |
| Table 19 – Tripping current ranges for PRCDs in case of pulsating DC current .....                                                                                        | 80  |
| Table 20 – Make-up of cables suitable for the retention test of rewirable PRCDs .....                                                                                     | 85  |
| Table 21 – Maximum permissible temperatures under abnormal conditions.....                                                                                                | 89  |
| Table A.1 – Test sequences.....                                                                                                                                           | 120 |
| Table A.2 – Number of samples to be submitted for full test procedure .....                                                                                               | 121 |
| Table A.3 – Reduction of number of samples .....                                                                                                                          | 123 |
| Table A.4 – Reduction of additional test sequences .....                                                                                                                  | 124 |
| Table A.5 – Reduction of additional test sequences .....                                                                                                                  | 125 |
| Table D.1 – EMC test.....                                                                                                                                                 | 132 |
| Table D.2 – Additional tests .....                                                                                                                                        | 133 |

# INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

### FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

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.

The text of this International Standard is based on the following documents:

| Draft         | Report on voting |
|---------------|------------------|
| 23E/1320/FDIS | 23E/1323/RVD     |

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](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/publications](http://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](http://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.

The content of the corrigendum 1 (2026-08) has been included in this copy.

## 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*

## Bibliography

IEC 61140:2016, *Protection against electric shock – Common aspects for installation and equipment*

---