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Electrical safety in low voltage distribution systems up to 1000 V a.c. and 1500 V d.c. – Equipment for testing, measuring or monitoring of protective measures –

Part 6: Effectiveness of residual current devices (RCD) in TT, TN and IT systems

Sécurité électrique dans les réseaux de distribution basse tension de 1 000 V c.a. et 1 500 V c.c. – Dispositifs de contrôle, de mesure ou de surveillance de mesures de protection –

Partie 6: Efficacité des dispositifs à courant résiduel (DCR) dans les réseaux TT, TN et IT

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CONTENTS

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ELECTRICAL SAFETY IN LOW VOLTAGE DISTRIBUTION SYSTEMS UP TO 1000 V a.c. AND 1500 V d.c. – EQUIPMENT FOR TESTING, MEASURING OR MONITORING OF PROTECTIVE MEASURES –

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International Standard IEC 61557-6 has been prepared by IEC technical committee 85: Measuring equipment for electrical and electromagnetic quantities.

This second edition cancels and replaces the first edition published in 1997. This edition constitutes a technical revision.

The following changes were made with respect to the previous edition (1997):

a) title and scope complemented;
b) definitions complemented;
c) revision of requirements;
d) "tripping tests" and "non-tripping tests" subclauses complemented;

e) markings complemented;

f) addition of Annex A.

The text of this standard is based on the following documents:

Enquiry draft	Report on voting
85/279A/CDV	85/298/RVC

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

This part of IEC 61557 shall be used in conjunction with Part 1.

A list of all parts of the IEC 61557 series, published under the general title *Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures,* can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
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ELECTRICAL SAFETY IN LOW VOLTAGE DISTRIBUTION SYSTEMS UP TO 1000 V a.c. AND 1500 V d.c. – EQUIPMENT FOR TESTING, MEASURING OR MONITORING OF PROTECTIVE MEASURES –

Part 6: Effectiveness of residual current devices (RCD) in TT, TN and IT systems

1 Scope

This part of IEC 61557 specifies the requirements for measuring equipment applied to the testing of the effectiveness of protective measures by regular disconnections of residual current protective devices (RCD) in TT, TN and IT systems.

2 Normative references

The following referenced documents are indispensable for the application 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/TR 60755, *General requirements for residual current operated protective devices*

IEC 60947-2, *Low-voltage switchgear and controlgear – Part 2: Circuit-breakers*

IEC 61008 (all parts), *Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs)*

IEC 61009 (all parts), *Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs)*

IEC 61010-1:2001, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements*

IEC 61557-1:2007, *Electrical safety in low voltage distribution systems up to 1 000 V a.c and 1 500 V d.c – Equipment for testing, measuring or monitoring of protective measures – Part 1: General requirements*

3 Terms and definitions

For the purposes of this document, the definitions given in IEC 61557-1 and the following definitions apply.

3.1
fault current
***I*Δ**
current flowing to earth due to an insulation fault

3.2
rated residual operating current
$I_{\Delta N}$
fault current for which the residual current protective device is designed

3.3
residual operating current
I_a
fault current at which the residual current protective device is activated

3.4
test resistance
R_p
resistance by means of which a fault current for test purposes is produced

3.5
total earthing resistance
R_A
resistance between the main earthing terminal and the earth

[IEV 826-04-03[1)]]

4 Requirements

The following requirements as well as those given in IEC 61557-1 shall apply.

4.1 Tests

4.1.1 Tripping tests

The measuring equipment shall be capable of indicating that the residual operating current of the protective device is less than or equal to the rated residual operating current.

The tests shall be carried out with a sinusoidal, or mains-derived quasi sinusoidal test current.

The operating uncertainty of the calibrated test currents shall not exceed 0 % to +10 % of the rated residual current with the rated residual operating current as fiducial value determined in accordance with Table 1.

The operating uncertainty of measurement of the residual operating current shall not exceed ±10 % of the rated residual operating current as fiducial value determined in accordance with Table 1.

If the measuring equipment is provided for the purpose of testing residual current protective devices of 30 mA or below, installed for supplementary protection, the measuring equipment shall be capable of providing a test of five times the rated residual operating current. The test period shall be limited to 40 ms. When measuring the trip time, this limit of test period need not be applied so long as the fault voltage remains below the touch voltage limit.

If the measuring equipment is capable of producing half-wave test currents, testing of residual current protective devices (RCDs) Type A may alternatively be carried out using half-wave test currents according to the IEC 61008 and IEC 61009 series, IEC 60947-2 and IEC/TR 60755. In this case test equipment shall be able to test in both polarities.

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[1)] IEC 60050-826:1982, *International Electrotechnical Vocabulary – Part 826: Electrical installations of buildings* (withdrawn and superseded by IEC 60050-826:2004, *International Electrotechnical Vocabulary – Part 826: Electrical installations*, in which this definition no longer appears).

Table 1 – Calculation of operating uncertainty

Intrinsic uncertainty or influence quantity	Reference conditions or specified operating range	Designation code	Requirements or test in accordance with the relevant parts of IEC 61557	Type of test
Intrinsic uncertainty	Reference conditions	A	Part 6, 6.1	R
Position	Reference position ± 90°	E_1	Part 1, 4.2	R
Supply voltage	At the limits stated by the manufacturer	E_2	Part 1, 4.2, 4.3	R
Temperature	0 °C and 35 °C	E_3	Part 1, 4.2	T
Resistance of the probes	Within the limits stated by the manufacturer	E_5	Part 6, 4.5	T
System voltage	85 % to 110 % of the nominal voltage	E_8	Part 6, 4.5	T
Operating uncertainty	$B = \pm(\lvert A\rvert + 1{,}15\sqrt{E_1^2 + E_2^2 + E_3^2 + E_5^2 + E_8^2})$		Part 6, 4.1 Part 6, 4.2 Part 6, 4.3	R
A = intrinsic uncertainty E_n = variations R = routine test T = type test		$B[\%] = \pm\frac{B}{\text{fiducial value}} \times 100\,\%$		

4.1.2 Non-tripping tests

When a test at 50 % or less of the rated residual operating current to test the reliability of the RCD is included, the minimum test period for general type RCDs shall be 0,3 s and for type S RCDs it shall be 0,5 s. The protective device shall not open.

When a no trip test at 50 % or less of the rated residual operating current is included, the operating uncertainty of the calibrated test current shall not exceed 0 % to –10 % of the specified no tripping test current in accordance with Table 1.

NOTE If the purpose of the test is to evaluate other parameters (e.g. fault voltage) the minimum test period may be shorter but not less than one cycle of the rated frequency.

4.2 The measuring equipment shall be capable of indicating whether the fault voltage at the rated residual current of the protective device is less than or equal to the conventional touch voltage limit. The test may be carried out with or without a probe.

NOTE Indication can be by displaying the value of the fault voltage or by the use of other clear indicators.

4.2.1 If a fault voltage is displayed or indicated for the residual operating current and not for the rated residual current, this shall be indicated in the display or on the measuring equipment, or calculated according to the following formulae.

The following condition shall be fulfilled:

$$U_F \leq U_L * \frac{I_\Delta}{I_{\Delta N}}$$

where

U_L is the conventional touch voltage limit.

4.2.2 The operating uncertainty during the measurement of the fault voltage shall not exceed 0 % to +20 % with the conventional touch voltage limit as fiducial value, determined in accordance with Table 1.

NOTE The internal resistance of the voltage measuring equipment should be at least 0,7 kΩ/V of the full-scale value of the measurement range. The influence of the voltage measurement on the measurement of the fault current should be taken into consideration.

4.3 The measuring equipment shall be capable of measuring the trip time of residual current protective devices at the rated residual operating current or shall be capable of indicating the compliance with the maximum allowed trip time.

When measuring the trip time, the operating uncertainty shall not exceed ± 10 % with the maximum permissible trip time as fiducial value and the influence quantities according to Table 1.

4.4 On measuring equipment with indicators, the switching value of the indicators shall be the conventional true value for the calculation of uncertainties, provided nothing to the contrary is stated.

4.5 The operating uncertainty applies under the rated operating conditions stated in IEC 61557-1 and the following:

– the protective conductor is free from extraneous voltages;
– the system voltage remains constant during the measurement;
– the circuit following the residual current protective device carries no leakage current;
– the system voltage is within 85 % to 110 % of the nominal system voltage for which the equipment has been designed;
– the resistance of the probes is within the limits stated by the manufacturer;
– sinusoidal test current.

4.6 When testing with the rated residual operating current, the following conditions shall be met:

– the current shall be switched on at a zero crossing;
– the test period shall be limited to the maximum allowed trip time of the residual current protective device under test. When measuring the trip time, these limits of the test periods need not be applied.

4.7 Prevention of danger during measurements by fault voltages exceeding 50 V within the system under test shall be ensured. This can be achieved as follows:

– automatic disconnection in accordance with Figure 1 of IEC 61010-1 when fault voltages with a magnitude >50 V occur;
– use of test resistances R_p adjustable in steps, or continuously, in such a manner that the test is started with a resistance that permits current of a maximum of 3,5 mA to flow when all parallel-connected circuits are included. An unambiguous detection shall be ensured, for example by means of a voltmeter, as to whether this test resistance can be varied without producing a hazardous fault voltage.

4.8 The user shall not be exposed to danger and the equipment shall not be damaged when the measuring equipment is connected to 120 % of the nominal voltage of the distribution system for which the measuring equipment has been designed. Protective devices shall not be activated.