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Low-voltage electrical installations - Part 5-53: Selection and erection of electrical equipment - Switchgear and control gear

Errichten von Niederspannungsanlagen - Teil 5-53: Auswahl und Errichtung elektrischer Betriebsmittel - Schalt- und Steuergeräte

Installations électriques basse tension - Partie 5-53: Choix et mise en œuvre des matériels électriques - Appareillage

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29.130.01	Stikalne in krmilne naprave na splošno	Switchgear and controlgear in general
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HARMONIZATION DOCUMENT

HD 60364-5-53

DOCUMENT D'HARMONISATION

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July 2015

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English Version

Low-voltage electrical installations - Part 5-53: Selection and erection of electrical equipment - Switchgear and controlgear

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

This document (HD 60364-5-53:2015) has been prepared by CLC/TC 64 "Electrical installations and protection against electric shock".

The following dates are fixed:

- latest date by which this document has (dop) 2016-01-17
to be implemented at national level by
publication of an identical national
standard or by endorsement
- latest date by which the national (dow) 2017-10-06
standards conflicting with this
document have to be withdrawn

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

During the CLC/TC 64 plenary meetings held on 2013 in Stockholm and later on 2014 in Vienna it was agreed that the present draft of HD 60364-5-53 would not include the relevant text of clauses 534 "Devices for protection against overvoltages", 536 "Coordination of protective devices" and 537 "Isolation and switching".

The requirements for these three clauses are currently covered in separate HD documents:

- Clause 534 is covered HD 60364-5-534;
- Clause 536 is covered by HD 50573-5-57;
- Clause 537 is covered by HD 384.5.537 S2 which is currently being revised with the new numbering HD 60364-5-537.

CLC/TC 64 also agreed that all these projects will be integrated into HD 60364-5-53 once all they are voted positively and published.

Taking into account the mentioned agreements, in the present draft clauses 534, 536 and 537 include a reference to the appropriate HD covering the relevant requirements.

530 Introduction

530.1 Scope

This part of HD 60364 deals with general requirements for isolation, switching, control and monitoring and with the requirements for selection and erection of the devices provided to fulfil such functions.

530.2 Normative references

HD 384.4.46 S2, *Electrical installations of buildings - Part 4: Protection for safety - Chapter 46: Isolation and switching*

HD 384.5.537 S2, *Electrical installations of buildings - Part 5: Selection and erection of electrical equipment - Chapter 53: Switchgear and controlgear - Section 537: Devices for isolation and switching*

EN 50085 (all parts), *Cable trunking systems and cable ducting systems for electrical installations*

HD 50573-5-57, *Co-ordination of electrical equipment for protection, isolation, switching and control*

HD 60269-2, *Low-voltage fuses - Part 2: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) - Examples of standardized systems of fuses A to J (IEC 60269-2)*

HD 60269-3, *Low-voltage fuses - Part 3: Supplementary requirements for fuses for use by unskilled persons (fuses mainly for household and similar applications) - Examples of standardized systems of fuses A to F (IEC 60269-3)*

EN 60269-4, *Low-voltage fuses - Part 4: Supplementary requirements for fuse-links for the protection of semiconductor devices (IEC 60269-4)*

HD 60364-1, *Low-voltage electrical installations - Part 1: Fundamental principles, assessment of general characteristics, definitions (IEC 60364-1)*

HD 60364-4-41, *Low-voltage electrical installations - Part 4-41: Protection for safety - Protection against electric shock (IEC 60364-4-41)*

HD 60364-4-42, *Low voltage electrical installations - Part 4-42: Protection for safety - Protection against thermal effects (IEC 60364-4-42)*

HD 60364-5-52, *Low-voltage electrical installations - Part 5-52: Selection and erection of electrical equipment - Wiring systems (IEC 60364-5-52)*

HD 60364-5-534, *Low-voltage electrical installations - Part 5-53: Selection and erection of electrical equipment - Isolation, switching and control - Clause 534: Devices for protection against overvoltages (IEC 60364-5-534)*

EN 60670 (all parts), *Boxes and enclosures for electrical accessories for household and similar fixed electrical installations (IEC 60670)*

EN 60898-1, *Electrical accessories - Circuit breakers for overcurrent protection for household and similar installations - Part 1: Circuit-breakers for a.c. operation (IEC 60898-1)*

EN 60898-2, *Electrical accessories - Circuit-breakers for overcurrent protection for household and similar installations - Part 2: Circuit-breakers for a.c. and d.c. operation (IEC 60898-2)*

EN 60947-2:2006, *Low-voltage switchgear and controlgear - Part 2: Circuit-breakers (IEC 60947-2:2006)*

EN 60947-3, *Low-voltage switchgear and controlgear - Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units (IEC 60947-3)*

EN 60947-6-2, *Low-voltage switchgear and controlgear - Part 6-2: Multiple function equipment - Control and protective switching devices (or equipment) (CPS) (IEC 60947-6-2)*

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

EN 61008-2-1, *Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCB's) - Part 2-1: Applicability of the general rules to RCCB's functionally independent of line voltage (IEC 61008-2-1)*

EN 61009-1, *Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs) - Part 1: General rules (IEC 61009-1)*

EN 61009-2-1, *Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBO's) - Part 2-1: Applicability of the general rules to RCBO's functionally independent of line voltage (IEC 61009-2-1)*

EN 61439 (all parts), *Low-voltage switchgear and controlgear assemblies*

EN 61557-8, *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 8: Insulation monitoring devices for IT systems (IEC 61557-8)*

EN 61557-9, *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 9: Equipment for insulation fault location in IT systems (IEC 61557-9)*

EN 62020, *Electrical accessories - Residual current monitors for household and similar uses (RCMs) (IEC 62020)*

EN 62208, *Empty enclosures for low-voltage switchgear and controlgear assemblies - General requirements (IEC 62208)*

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EN 62423, *Type F and type B residual current operated circuit-breakers with and without integral overcurrent protection for household and similar uses (IEC 62423)*

EN 62606, *General requirements for arc fault detection devices (IEC 62606)*

530.3 Terms and definitions

530.3.1 control

1) deliberate action resulting in the operation of an apparatus;

2) a device which initiates the operation of an apparatus

[SOURCE: IEC 821-01-28]

530.3.2 isolation

function intended to make dead for reasons of safety all or a discrete section of the electrical installation by separating the electrical installation, or section, from every source of electric energy

[SOURCE: IEC 826-17-01]

530.3.3 monitor, verb

acquire a quantity value continuously or sequentially in order to check whether it is within normal operating limits and, where appropriate, to signal if it passes its tolerance boundaries

[SOURCE: IEC 351-43-03]

530.3.4 switching

function intended to make or break the current in one or more electric circuits

530.4 General and common requirements

530.4.1 Every item of equipment shall be selected and erected so as to allow compliance with the requirements stated in the following clauses of this part as well as the fundamental principles of HD 60364-1 and the relevant rules in other parts of the HD 60364 series.

530.4.2 The moving contacts of all poles of multipole devices for isolation and switching shall be so coupled mechanically that they make and break substantially together.

The moving contacts of multipole switching devices marked for the connection of the neutral or mid-point may close before and open after the other contacts.

530.4.3 A switching device shall not be inserted in the neutral conductor alone.

530.4.4 Devices embodying more than one function, as defined in the following clauses, shall comply with the relevant requirements of this part appropriate to each separate function.

530.4.5 Equipment intended for protection only shall not be provided for functional switching of circuits.

NOTE Functional switching does not include disconnection and isolation of circuits for the purposes of testing servicing and maintenance.

530.5 Fixing of equipment

530.5.1 Equipment shall be erected according to the manufacturer's instructions in such a way that connections between wiring and equipment shall not be subject to undue stress or strain resulting from the foreseen use of the equipment.

530.5.2 Unenclosed type equipment shall be mounted in a suitable mounting box or enclosure in compliance with EN 60670, EN 62208 or other relevant standard like EN 61439.

530.5.3 Equipment such as circuit breakers, switches, socket outlets, control equipment, etc. may be installed in or on a cable trunking system in accordance with EN 50085 series.

531 Devices for protection against electric shock by automatic disconnection of supply

531.1 General

Devices for protection against electric shock by automatic disconnection of supply shall be suitable for isolation in accordance with HD 384.4.46 S2 and Clause 537.

Automatic re-closing of devices for protection against electric shock by automatic disconnection of supply is permitted in installations where access is restricted to electrically instructed persons (BA4) or skilled persons (BA5) only.

NOTE Automatic re-closing of devices used for continuity of supply may also be used according to local or National wiring rules for installations where access is permitted to ordinary persons (BA1) or children (BA2) or handicapped persons (BA3) provided assessment means according to 4.3.2 of EN 50557:2011 are complied with.

Requirements for the selection of devices for protection against electric shock by automatic disconnection of supply are given in the following sections:

In TN, TT and IT systems the following protective devices may be used:

- overcurrent protective devices in accordance with 531.2;
- residual current devices (RCDs) in accordance with 531.3.

Devices according to EN 60947-2 marked with the voltage value followed by the symbol  shall not be used in IT systems for such voltage.

In IT-systems the following monitoring devices may be used to detect insulation fault conditions:

- Insulation monitoring devices (IMDs) in accordance with 538.3;
- equipment for insulation fault location in accordance with 538.2;
- residual current monitors (RCMs) in accordance with 538.4.

531.2 Overcurrent protective devices

531.2.1 General

Where overcurrent protective devices are used for the protection against electric shock by automatic disconnection of supply they shall be selected in accordance with 533.

531.2.2 TN systems

In TN systems overcurrent protective devices when used as devices for fault protection shall be selected and erected in order to comply with the requirements specified in Part 4-41 (see in particular sub-clause 411.4.4).

If for certain equipment or for certain parts of the installation, the maximum tripping time of the Table 41A cannot be fulfilled by the overcurrent protective devices, those parts shall be protected by a residual current device (RCD) in compliance with 531.3.5.2.

In TN-S systems, the neutral need not be disconnected if the supply conditions are such that the neutral conductor can be considered to be reliably at earth potential.

In TN-C systems, the PEN conductor shall not be disconnected.

531.2.3 TT systems

In TT systems, overcurrent protective devices may be used for fault protection provided that a suitably low value of Z_s is permanently and reliably assured (see also 411.5.4 of Part 4-41) so that in case of a fault, tripping of the overcurrent protective device in compliance with the required disconnection times is ensured.

531.2.4 IT systems

Overcurrent protective devices when used as devices for fault protection, in the event of a second fault, shall comply with:

- 531.2.2, taking into account the requirements of 411.6.4.a) of Part 4-41, where exposed-conductive-parts are interconnected; or
- 531.2.3, taking into account the requirements of 411.6.4.b) of Part 4-41, where exposed-conductive-parts are earthed in groups or individually.

In IT systems, if disconnection required by part 4-41 in the event of the second fault to earth cannot be achieved by an overcurrent protective device, one or more residual current devices (RCDs) shall be used to provide the required fault protection within the installation.

NOTE Reference is also made to 411.3.2.6 where supplementary protective equipotential bonding is required in those cases where automatic disconnection according to 411.3.2.1 cannot be achieved.

Overcurrent protective devices used in IT systems shall have line poles suitable for line-to-line voltage applications and a neutral pole, if applicable, suitable for the line to neutral voltage for operation in case of a second insulation fault.

In IT systems, in the event of a second fault, the operation of the overcurrent protective device shall result in the disconnection of all corresponding live conductors, including the neutral conductor, if any (see also 431.2.2 of Part 4-43).

531.3 Residual current devices (RCDs)

531.3.1 General

A residual current device shall ensure the disconnection of all live conductors of the circuit protected.

The protective conductor shall not pass through the sensor of the residual current device (RCD) beside exceptional cases, where passing through the sensor is unavoidable, e.g. in case of armoured cables. In such exceptional cases the protective conductor alone has to be passed again through the sensor but in the reverse direction. The protective conductor shall be insulated and shall not be earthed neither at the first nor at the second passing through the sensor.

A protective conductor current shall not contribute to the measurement of the residual current.

531.3.2 Unwanted tripping

Residual current protective devices shall be so selected and erected to limit the risk of unwanted tripping. The following shall be considered:

- subdivision of circuits with individual associated residual current devices (RCDs). RCDs shall be selected and the electrical circuits shall be subdivided in such a way that any earth-leakage current likely to occur during normal operation of the connected load, will not cause unwanted tripping of the device. See also Clause 314.

In order to avoid unwanted tripping by protective conductor currents and/or earth leakage currents the accumulation of such currents downstream the residual current device (RCD) shall be not more than 0,3 times the rated residual operating current.

NOTE 1 This will also allow a better selection of the type of residual current devices (RCDs) according to the nature of the circuit or the load.

NOTE 2 Residual current devices (RCDs) may operate at any value of residual current in excess of 50 % of the rated residual current.

- use of short time-delayed residual current devices (RCDs) provided the applicable requirements of HD 60364-4-41 are met.

NOTE 3 In the case of transient effects tripping of the residual current protective device may occur by charging of bypass capacitors or by other electromagnetic disturbances.

- coordination of general type residual current devices (RCDs), selective type RCDs and time delayed RCDs (CBRs according to EN 60947-2) as covered in subclause 536 (currently covered in HD 50573-5-57).
- coordination of residual current devices (RCDs) with surge protective devices (SPD) according subclause 534.2.6.

531.3.3 Types of RCDs

Different types of residual current devices (RCDs) exist depending on their behaviour in the presence of d.c. components and frequencies other than the rated frequency:

- RCD Type AC: RCD tripping on alternating sinusoidal residual current, suddenly applied or smoothly increasing.
- RCD Type A: RCD tripping on alternating sinusoidal residual current and on residual pulsating direct current, suddenly applied or smoothly increasing.

NOTE 1 For RCD Type A tripping is ensured for residual pulsating direct currents superimposed on a smooth direct current up to 0,006 A.

- RCD Type F: RCD for which tripping is ensured as for Type A and in addition:
 - for composite residual currents, whether suddenly applied or slowly rising intended for circuit supplied between phase and neutral or phase and earthed middle conductor;
 - for residual pulsating direct currents superimposed on smooth direct current.

NOTE 2 For RCD Type F tripping is ensured for residual pulsating direct currents superimposed on a smooth direct current up to 0,010 A.

- RCD Type B: RCD for which tripping is ensured as for Type F and in addition:
 - for residual sinusoidal alternating currents up to 1 000 Hz;
 - for residual alternating currents superimposed on a smooth direct current;
 - for residual pulsating direct currents superimposed on a smooth direct current;
 - for residual pulsating rectified direct current which results from two or more phases;

- for residual smooth direct currents whether suddenly applied or slowly increased independent of polarity.

NOTE 3 For RCD Type B tripping is ensured for residual pulsating direct currents superimposed on a smooth direct current up to 0,006 A.

For general purpose, type AC RCD may be used.

NOTE 4 For a guidance for the correct use of residual current operated protective devices for household and similar use, see IEC/TR 62350.

NOTE 5 Some typical fault currents in circuits comprising semiconductors are given in the Informative Annex A.

531.3.4 Selection according to the accessibility to the installation

531.3.4.1 In a.c. installations where residual current devices (RCDs) are accessible to ordinary persons (BA1), children (BA2) or handicapped persons (BA3) residual current protective devices shall comply with:

- EN 61008-1 and EN 61008-2-1 for RCCBs; or
- EN 61009-1 and EN 61009-2-1 for RCBOs; or
- EN 62423 for RCCBs and RCBOs.

NOTE RCCB is a Residual Current operated Circuit Breaker without integral overcurrent protection. RCBO is a Residual Current operated Circuit Breaker with integral overcurrent protection.

531.3.4.2 In a.c. installations where residual current devices (RCDs) are accessible only to instructed persons (BA4) or skilled persons (BA5) residual current protective devices shall comply with:

- EN 61008-1 and EN 61008-2-1 for RCCBs; or
- EN 61009-1 and EN 61009-2-1 for RCBOs; or
- EN 62423 for RCCBs and RCBOs; or
- EN 60947-2 for CBRs and MRCDs.

NOTE CBR is a circuit-breaker incorporating residual current protection. MRCD is a modular residual current device.

531.3.5 Residual current devices (RCDs) for fault protection

531.3.5.1 General

The use of residual current devices (RCDs) shall ensure the protection against fault in compliance with 411.3 of Part 4-41.

The selection of residual current devices (RCDs) depends on the type of system earthing (see 531.3.5.2, 531.3.5.3 and 531.3.5.4).

531.3.5.2 TN system

Residual current devices (RCDs) shall be erected at the origin of that part of the installation to be protected. The requirements for unwanted tripping in accordance with 531.3.2 shall also be taken into account.

NOTE Except particular restriction for selectivity, several circuits may be protected by the same device.

The division of the PEN conductor in neutral conductor and protective conductor shall take place at the supply side of the residual current devices (RCDs);

On the load side of the residual current device (RCD), connection between the protective and neutral conductors is not permitted.

In TN-C systems residual current devices (RCDs) shall not be used.

531.3.5.3 TT system

531.3.5.3.1 Location of residual current devices (RCDs)

Residual current devices (RCDs) shall be erected at the origin of that part of the installation to be protected. The requirements for unwanted tripping in accordance with 531.3.2 shall also be taken into account.

NOTE Where there is more than one origin, this requirement applies to each origin.

531.3.5.3.2 Selection of the rated residual operating current of the residual current device (RCD)

The rated residual operating current value $I_{\Delta n}$ of a residual current device (RCD) shall not exceed to the one corresponding to the maximum value of the earth resistance R_A of the exposed-conductive parts, taking into account the possible seasonal variations, including soil freezing and drying, of the part of the installation protected by this device as shown in Table 1.

R_A is the sum of the resistance in Ω of the earth electrode and the protective conductor for the exposed conductive-parts,

Table 1 - Correlation between the maximum value of earth resistance R_A and the maximum rated residual operating current $I_{\Delta n}$ of the RCD

Maximum value of R_A (Ω)	Maximum $I_{\Delta n}$ of the RCD
2,5	20 A
5	10 A
10	5 A
17	3 A
50	1 A
100	500 mA
167	300 mA
500	100 mA
1666	30 mA

531.3.5.4 IT system

531.3.5.4.1 General

In IT systems, protection of neutral conductor by residual current device (RCD) is permitted provided that the requirements of 431.2.2 of Part 4-41 are fulfilled.

531.3.5.4.2 Case of second fault on another live conductor when exposed-conductive-parts are interconnected

Where residual current devices (RCDs) are used according to 411.6.4 a), one RCD per circuit shall be used.

Operating characteristics of this residual current device (RCD) shall be selected according to Table 41A.

531.3.5.4.3 Case of second fault on another live conductor when exposed-conductive-parts are not interconnected

When, in an installation, all exposed-conductive-parts are not interconnected, one residual current device (RCD) shall protect each group of interconnected exposed-conductive-parts.

The conditions for determining the characteristics of the residual current device (RCD) shall be those for TT systems defined in 411.5 of Part 4-41:

- The rated residual current $I_{\Delta n}$ has to be selected according to Table 1.
- The disconnection time has to comply with the values given in 411.3 of Part 4-41.

In addition, fault protection for every circuit located downstream of this residual current device (RCD), shall be provided in accordance with requirements of 411.6.4 b) of Part 4-41. In this case every final circuit shall be protected by a residual current device (RCD) of its own.

531.3.6 RCDs for additional protection

The use of residual current devices (RCDs) with a rated residual operating current not exceeding 30 mA is recognized as additional protection in compliance to 415.1) of Part 4-41.

These residual current devices (RCDs) shall be provided to comply with the requirement of 411.3.3) of Part 4-41.

Residual current devices (RCDs) for additional protection in a.c. installations shall comply with:

- EN 61008-1 and EN 61008-2-1 for RCCBs; or
- EN 61009-1 and EN 61009-2-1 for RCBOs; or
- EN 62423 for RCCBs and RCBOs.

When installed at the origin of a final circuit or a group of final circuits, a residual current device (RCD) with a rated residual current not exceeding 30 mA may ensure simultaneously fault protection and additional protection. In this case, not all final circuits supplied by a common distribution circuit shall be disconnected by this RCD.

NOTE Correct assignment of the final circuits to the common RCD will contribute to continuity of the supply (see 531.3.2).

Residual current devices (RCDs) for protection of socket-outlets shall be installed at the origin of the final circuit except where this additional protection is provided by RCDs integral with socket-outlets or associated with fixed socket-outlets within the same mounting box or in the immediate vicinity.

532 Devices for protection against the risk of fire

532.1 General

In locations where, in accordance with HD 60364-4-42, a particular risk of fires exists, preventive protection measures against the risk of fires are required. This may also apply to other locations of the electrical installation depending on a risk analysis.

A suitable evaluation of the risk should be carried out by the operator, the supervisory authority or the fire insurer.

For the selection of protective and monitoring devices possible impact on the intended function shall be taken into account, e.g. fault currents of higher frequencies, d.c. fault currents or increased leakage currents.

NOTE In addition to the measures included in 532.2 to 532.6, other methods that may be used are:

- devices intended to provide protection in case of overheating;
- optically operated devices that provide signalling to another device intended to break the circuit;
- smoke detection devices that provide signalling to another device intended to break the circuit.

Devices according to EN 60947-2 marked with the voltage value followed by the symbol  shall not be used in IT systems for such voltage.

532.2 Residual current devices (RCDs) for protection against the risk of fire

Residual current devices (RCDs) shall comply with 531.3.1 to 531.3.4 and with the applicable requirements of 531.3.5.

Residual current device (RCDs) with a rated residual operating current not exceeding 300 mA shall be used.

Residual current device (RCDs) shall be installed at the origin of the circuit to be protected.

532.3 Residual current monitoring devices (RCMs) for preventing the risk of fire in IT systems

In IT systems, RCMs may be used as an alternative to RCDs in accordance with 532.2 provided the location is supervised by instructed (BA4) or skilled (BA5) persons.

RCMs shall be in accordance with EN 62020 and operate in conjunction with switchgear suitable for isolation.

RCMs shall be installed at the origin of final circuits.