IEC 60364-5-53

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

AMENDMENT 1
AMENDEMENT 1

Low-voltage electrical installations – Part 5-53: Selection and erection of electrical equipment – Devices for protection for safety, isolation, switching, control and monitoring

Installations électriques à basse tension – Partie 5-53: Choix et mise en oeuvre des matériels électriques – Dispositifs de protection pour assurer la sécurité, le sectionnement, la coupure, la commande et la surveillance

IEC 60364-5-53:2019-02/AMD1:2020-12(en-fr)

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FOREWORD

This amendment has been prepared by IEC technical committee 64: Electrical installations and protection against electric shock.

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

FDIS	Report on voting
64/2457/FDIS	64/2465/RVD

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

The committee has decided that the contents of this amendment and the base publication will remain unchanged until the stability date indicated on the IEC website 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- withdrawn,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
- amended.

531 Devices for protection against indirect contact by automatic disconnection of supply

Replace the existing Clause 531, including its title, with the following new Clause 531:

531 Equipment for protection against electric shock

531.1 General

Clause 531 deals with requirements for the selection and erection of equipment for the following protective measures in accordance with IEC 60364-4-41:

- automatic disconnection of supply,
- double or reinforced insulation,
- electrical separation,
- extra-low-voltage provided by SELV and PELV systems.

It also deals with requirements for the selection and erection of equipment for additional protection.

531.2 Devices for automatic disconnection of supply

531.2.1 General

Devices used for automatic disconnection of supply shall be placed at the origin or upstream of the circuit which is intended to be protected.

These devices shall be suitable for isolation in accordance with 536.

NOTE 1 Protective devices which require manual operation in order to achieve isolation are not excluded.

The following protective devices may be used:

– overcurrent protective devices in accordance with 531.2.2;
– residual current protective devices (RCDs) in accordance with 531.2.3.

Devices according to IEC 60947-2 identified with voltage value(s) followed by the symbol  (IEC 60417-6363:2016-07-16) or by the symbol  shall not be used in IT systems for such voltage(s) or above.

Devices according to IEC 60947-2 identified with the symbol  (IEC 60417-6363:2016-07-16) or by the symbol  with no associated voltage value, shall not be used in IT systems.

NOTE 2 The symbol  previously required will be progressively superseded by the preferred new symbol above.

531.2.2 Overcurrent protective devices

531.2.2.1 TN system

An overcurrent protective device shall be so selected that its operating characteristics meet the following requirement:

$$I_a \leq \frac{U_o}{Z_s}$$

where

I_a is the current in amperes (A) causing the automatic operation of the disconnecting device within the time specified in IEC 60364-4-41:2005 and IEC 60364-4-41:2005/AMD1:2017, 411.3.2.2 or 411.3.2.3.

Z_s is the impedance in ohms (Ω) of the fault loop comprising

– the source,
– the line conductor up to the point of the fault, and
– the protective conductor between the point of the fault and the source;

U_o is the nominal AC or DC line-to-earth voltage in volts (V).

531.2.2.2 TT system

According to IEC 60364-4-41:2005 and IEC 60364-4-41:2005/AMD 1:2017, 411.5.2, RCDs shall generally be used for protection against electric shock in TT systems.

Overcurrent protective devices may alternatively be used for this purpose, provided a suitably low value of earth fault loop impedance is permanently and reliably ensured.

Where, exceptionally, an overcurrent protective device is used for this purpose, it shall be so selected that its operating characteristics meet the following requirement.

$$I_a \leq \frac{U_o}{Z_s}$$

where

I_a is the current in amperes (A) causing the automatic operation of the disconnecting device within the time specified in IEC 60364-4-41:2005 and IEC 60364-4-41:2005/AMD1:2017, 411.3.2.2 or 411.3.2.4;

Z_s is the impedance in ohms (Ω) of the fault loop comprising

- the source,
- the line conductor up to the point of the fault,
- the protective conductor of the exposed-conductive-parts,
- the earthing conductor,
- the earth electrode of the installation, and
- the earth electrode of the source;

U_o is the nominal AC or DC line-to-earth voltage in volts (V).

531.2.2.3 IT system

Devices shall be suitable for IT systems in accordance with the manufacturer instructions.

The overcurrent protective devices shall be so selected that their operating characteristics comply with the following requirement:

a) Where exposed-conductive-parts are interconnected by a protective conductor collectively earthed to the same earthing arrangement, the following conditions shall be fulfilled:

- where the neutral or mid-point conductor is not distributed:

$$I_a \leq \frac{U}{2Z_s}$$

- or where the neutral or mid-point conductor is distributed:

$$I_a \leq \frac{U_o}{2Z'_s}$$

where

U is the nominal AC or DC voltage in volts (V) between line conductors;

U_o is the nominal AC or DC voltage in volts (V) between line conductor and neutral or mid-point conductor, as appropriate;

Z_s is the impedance in ohms (Ω) of the fault loop comprising the line conductor and the protective conductor of the circuit;

Z'_s is the impedance in ohms (Ω) of the fault loop comprising the neutral or mid-point conductor and the protective conductor of the circuit;

I_a is the current in amperes (A) causing operation of the protective device within the time required for TN systems in IEC 60364-4-41:2005 and IEC 60364-4-41:2005/AMD1:2017, 411.3.2.2 or 411.3.2.3.

NOTE The factor 2 in both formulas takes into account that in the event of the simultaneous occurrence of two faults, the faults may exist in different circuits.

b) Where the exposed-conductive-parts are earthed in groups or individually, the following condition applies:

- In alternating current

$$I_a \leq \frac{50}{R_A}$$

where

R_A is the sum of the resistances in ohms (Ω) of the earth electrode and the protective conductor to the exposed-conductive-parts;

I_a is the current in amperes (A) causing automatic disconnection of the protective device in a time complying to that for TT systems in IEC 60364-4-41:2005 and IEC 60364-4-41: 2005/AMD1:2017, 411.3.2.2 or 411.3.2.4.

In direct current, in accordance with IEC 60364-4-41:2005 and IEC 60364-4-41:2005/AMD1:2017, 411.6.2, no requirement is needed.

531.2.3 Residual current protective devices

531.2.3.1 General conditions of installation

An RCD shall disconnect all live conductors in the circuit protected, except as permitted in 531.2.3.5.1.

For a multiphase supplied installation, where there is subdivision into single phase final circuits, protection by individual RCDs is recommended. Where time delayed RCDs (CBRs (circuit breaker incorporating residual current protection), and MRCD (modular residual current device) in conjunction with circuit-breakers, according to IEC 60947-2) are used, the setting of the time delay shall be in accordance with IEC 60364-4-41:2005 and IEC 60364-4-41:2005/AMD1:2017, 411.3.2.

Where a modular RCD is used, an MRCD according to IEC 60947-2:2016, Annex M shall be selected and used in conjunction with a circuit breaker in accordance with IEC 60947-2.

A protective conductor shall not pass through the sensor of an MRCD. However, where such passing is unavoidable, for example in case of armoured cables, the protective conductor alone shall be passed again through the sensor but in the reverse direction. The protective conductor shall be insulated and shall not be earthed between the first and the second passing.

531.2.3.2 Unwanted tripping

To reduce the risk of unwanted tripping, the following shall be considered:

- subdivision of electrical circuits with individual associated RCDs so that the accumulated protective conductor currents and/or leakage currents likely to occur during normal operation downstream of an RCD is less than 0,3 times the value of the rated residual operating current ($I_{\Delta n}$) of the RCD. See also IEC 60364-1:2005, Clause 314 and IEC 60364-5-51:2005, Clause 516,
- coordination of general type RCDs, selective type RCDs (i.e. type S according to IEC 61008-1, IEC 61009-1 or IEC 62423) and time delayed RCDs (i.e. CBRs, MRCDs according to IEC 60947-2), and
- coordination of RCDs with surge protective devices (SPDs).

531.2.3.3 Types of RCDs

531.2.3.3.1 Selection of type of RCD

The type of RCD shall be selected according to the waveform of the expected AC and DC components of the residual current to be interrupted.

531.2.3.3.2 Selection of the types of RCDs connected in series

Wherever an RCD type A, F or B is installed downstream of another RCD, the upstream RCD

- shall comply at least with the requirements of the type of the downstream RCD, or
- shall be coordinated with the downstream RCD, in accordance with the manufacturer's instructions.

NOTE See Annex G for the different types of RCDs and their behaviour with fault currents.

531.2.3.4 Selection according to the accessibility to the installation

531.2.3.4.1

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

- IEC 61008-2-1 for RCCBs, or
- IEC 61009-2-1 for RCBOs, or
- IEC 62423 for RCCBs and RCBOs.

531.2.3.4.2

In AC installations where RCDs are accessible only to instructed persons (BA4) or skilled persons (BA5), residual current protective devices shall comply with

- IEC 61008 (all parts) for RCCBs, or
- IEC 61009 (all parts) for RCBOs, or
- IEC 62423 for RCCBs and RCBOs, or
- IEC 60947-2 for CBRs and MRCDs.

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.

CBR is a circuit breaker incorporating residual current protection.

MRCD is a modular residual current device, in conjunction with a circuit-breaker.

531.2.3.4.3

In DC installations, IEC TS 63053 may be used as a reference for DC-RCDs.

531.2.3.5 Selection of RCD according to the type of system earthing

531.2.3.5.1 TN systems

A PEN conductor shall not be used on the load side of an RCD.

In a TN-S system and in the part of a TN-C-S system, where the neutral and protective functions are provided by separate conductors, the neutral conductor need not be disconnected if the neutral conductor is considered to be reliably at earth potential.

In TN-C systems RCDs shall not be used.

The characteristics of the RCD, except those selected according to IEC 60364-4-41:2005 and IEC 60364-4-41:2005/AMD1:2017, 411.3.3, shall be such that:

$$I_a \leq \frac{U_o}{Z_s}$$

where

I_a is the current in amperes (A) causing the automatic operation of the disconnecting device within the time specified in IEC 60364-4-41:2005 and IEC 60364-4-41:2005/AMD1:2017, 411.3.2.2 or 411.3.2.3;

Z_s is the impedance in ohms (Ω) of the fault loop comprising

- the source,
- the line conductor up to the point of the fault, and
- the protective conductor between the point of the fault and the source;

U_o is the nominal AC or DC line-to-earth voltage in volts (V).

531.2.3.5.2 TT systems

In AC installations the characteristics of the RCD, except those selected according to IEC 60364-4-41:2005 and IEC 60364-4-41:2005/AMD1:2017, 411.3.3, shall be such that:

$$I_a \leq \frac{50}{R_A}$$

where

R_A is the sum of the resistance in ohms (Ω) of the earth electrode and the protective conductor to the exposed conductive-parts;

I_a is the current in amperes (A) causing the automatic operation of the disconnecting device within the time specified in IEC 60364-4-41:2005 and IEC 60364-4-41:2005/AMD1:2017, 411.3.2.2 or 411.3.2.4.

NOTE The disconnecting times according to IEC 60364-4-41:2005 and IEC 60364-4-41:2005/AMD1:2017, Table 41.1 relate to prospective residual currents significantly higher than the rated residual operating current of the RCD (typically 5 $I_{\Delta n}$).

Where the value of R_A is not known, it shall be replaced by Z_s (see 531.2.2.2).

531.2.3.5.3 IT systems

531.2.3.5.3.1 Disconnection at first fault condition for IT public distribution systems

Where the disconnection at the first fault is to be achieved by an RCD, the rated residual operating current of the RCD shall be selected to be less or equal to the current which circulates on the first fault to earth.

NOTE Where the current circulating during the first fault is not known or cannot be calculated, the current in mA can, for IT installations connected to a network, be estimated to 0,5 times the value of the rated power of the transformer given in kVA.

531.2.3.5.3.2 Disconnection at second fault condition

Where the automatic disconnection of supply at a second fault is to be achieved by an RCD, that RCD shall be installed in the final circuit to be protected. The rated residual current of the

RCD shall be greater than 2 times the current which circulates on the first fault to earth of negligible impedance affecting a line conductor.

After the occurrence of a first fault, conditions for automatic disconnection of supply in the event of a second fault occurring on a different live conductor shall be as follows:

a) Where exposed-conductive-parts are interconnected by a protective conductor collectively earthed to the same earthing arrangement, the following condition shall be fulfilled:

- where the neutral or mid-point conductor is not distributed:

$$I_a \leq \frac{U}{2Z_s}$$

- or where the neutral or mid-point conductor is distributed:

$$I_a \leq \frac{U_o}{2Z'_s}$$

where

U_o is the nominal AC or DC voltage, in volts (V) between line conductor and neutral conductor or mid-point conductor, as appropriate;

U is the nominal AC or DC voltage in volts (V) between line conductors;

Z_s is the impedance in ohms (Ω) of the fault loop comprising the line conductor and the protective conductor of the circuit;

Z'_s is the impedance in ohms (Ω) of the fault loop comprising the neutral conductor and the protective conductor of the circuit;

I_a is the current in amperes (A) causing the automatic operation of the disconnecting device within the time specified in IEC 60364-4-41:2005 and IEC 60364-4-41:2005/AMD1:2017, 411.3.2.2 or 411.3.2.4.

The times stated in IEC 60364-4-41:2005 and IEC 60364-4-41:2005/AMD1:2017, Table 41.1 for the TN system apply to IT systems with a distributed or non-distributed neutral conductor or mid-point conductor.

NOTE 1 The factor 2 in both formulas takes into account that in the event of the simultaneous occurrence of two faults, the faults can exist in different circuits.

b) In AC installations where the exposed-conductive-parts are earthed in groups or individually, the following condition applies:

$$I_a \leq \frac{50}{R_A}$$

where

R_A is the sum of the resistances in ohms (Ω) of the earth electrode and the protective conductor to the exposed-conductive-parts;

I_a is the current in amperes (A) causing the automatic operation of the disconnecting device within the time specified in IEC 60364-4-41:2005 and IEC 60364-4-41:2005/AMD1:2017, 411.3.2.2 or 411.3.2.4.

NOTE 2 The disconnecting times according to IEC 60364-4-41:2005 and IEC 60364-4-41:2005/AMD1:2017, Table 41.1 relate to prospective residual fault currents significantly higher than the rated residual operating current of the RCD (typically 5 $I_{\Delta n}$)

531.3 Equipment for protection by double or reinforced insulation

531.3.1 General

For compliance with IEC 60364-4-41:2005 and IEC 60364-4-41:2005/AMD 1:2017, Clause 412, electrical equipment shall be selected as follows:

a) electrical equipment marked with the symbol  (IEC 60417-5172:2003-02-18); or

b) electrical equipment declared in the relevant product standard or by the manufacturer as equivalent to Class II; or

c) electrical equipment with basic insulation only: supplementary insulation shall be provided by an enclosure of at least IPXXB or IP2X, or by a process of installation providing the equivalent level of safety; or

d) electrical equipment having uninsulated live parts shall have reinforced insulation provided by an enclosure of at least IPXXB or IP2X, or by a process of installation providing the equivalent level of safety.

In the case of equipment covered by c) or d) above, 531.3.2 to 531.3.6 apply.

531.3.2

The following requirements apply as specified:

– the insulating enclosure shall not be traversed by conductive parts likely to transmit a potential; and

– the insulating enclosure shall not contain any screws or other fixing means of insulating material which might need to be removed, or are likely to be removed, during installation and maintenance and whose replacement by metallic screws or other fixing means could impair the enclosure's insulation.

Where the insulating enclosure has to be traversed by mechanical joints or connections (e.g. for operating handles of built-in apparatus), these should be arranged in such a way that protection against shock in case of a fault is not impaired.

531.3.3

Where lids or doors in the insulating enclosure can be opened without the use of a tool or key, all conductive parts which are accessible if the lid or door is open shall be behind an insulating barrier (providing a degree of protection not less than IPXXB or IP2X) preventing persons from coming unintentionally into contact with those conductive parts. This insulating barrier shall be removable only by use of a tool or key.

531.3.4

Conductive parts enclosed in the insulating enclosure shall not be connected to a protective conductor. However, provision may be made for connecting protective conductors which necessarily run through the enclosure in order to serve other items of electrical equipment whose supply circuit also runs through the enclosure. Inside the enclosure, any such conductors and their terminals shall be insulated as though they were live parts, and their terminals shall be marked as PE terminals.

531.3.5

Accessible-conductive-parts and intermediate parts shall not be connected to a protective conductor unless specific provision for this is made in the specifications for the equipment concerned.

531.3.6

The enclosure shall not adversely affect the operation of the equipment protected in this way.

531.3.7

The installation of equipment mentioned in IEC 60364-4-41:2005 and IEC 60364-4-41:2005/AMD1:2017, 412.2.1 (fixing, connection of conductors, etc.) shall be effected in such a way as not to impair the protection afforded in compliance with the equipment specification.

531.4 Equipment for protection by electrical separation

The equipment selected for electrical separation, for example safety isolating transformer in accordance with IEC 61558-2-6, shall provide at least simple separation between incoming and outgoing terminals and the separated side shall be installed so that it is isolated from other circuits and earth.

531.5 Equipment for protection by extra-low-voltage provided by SELV and PELV systems

531.5.1 Sources for SELV or PELV systems

The following sources may be used for SELV or PELV systems:

- A safety isolating transformer in accordance with IEC 61558-2-6.
- A source of current providing a degree of safety equivalent to that of the safety isolating transformer specified above (e.g. motor generator with windings providing equivalent isolation).
- An electrochemical source (e.g. a battery) or another source independent of a higher voltage circuit (e.g. a diesel-driven generator).

- Certain electronic devices complying with appropriate standards where provisions have been taken in order to ensure that, even in the case of an internal fault, the voltage at the outgoing terminals cannot exceed the values specified in IEC 60364-4-41:2005 and IEC 60364-4-41:2005/AMD1:2017, 414.1.1. Higher voltages at the outgoing terminals are, however, permitted if it is ensured that, in case of contact with a live part or in the event of a fault between a live part and an exposed-conductive-part, the voltage at the output terminals is immediately reduced to those values or less.

  NOTE 1 Examples of such devices include insulation testing equipment and monitoring devices.

  NOTE 2 Where higher voltages exist at the outgoing terminals, compliance with 531.5 can be assumed if the voltage at the outgoing terminals is within the limits specified in IEC 60364-4-41:2005 and IEC 60364-4-41:2005/AMD1:2017, 414.1.1 when measured with a voltmeter having an internal resistance of at least 3 000 Ω.

- Mobile sources supplied at low voltage, for example safety isolating transformers or motor generators, shall be selected or erected in accordance with the requirements for protection by the use of double or reinforced insulation (see IEC 60364-4-41:2005 and IEC 60364-4-41:2005/AMD1:2017, Clause 412).

531.5.2 Selection of plugs and socket-outlets

Plugs and socket-outlets in SELV or PELV systems shall comply with the following requirements:

– plugs shall not be able to enter socket-outlets of other voltage systems;

– socket-outlets shall not admit plugs of other voltage systems;

– plugs and socket-outlets in SELV systems shall not have a protective contact.

NOTE For socket-outlets according to IEC 60884-1 the protective contact is referred to as earthing contact.

531.6 Devices for additional protection

A PEN conductor shall not be used on the load side of an RCD.

In AC installations, an RCD used for additional protection shall have a rated residual operating current not exceeding 30 mA and shall be selected according to the requirements of 531.2.3.1 to 531.2.3.4.

In AC installations, when installed at the origin of a final circuit, an 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).

In AC installations, an RCD 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 all the socket-outlets of the circuit or associated with all fixed socket-outlets within the same mounting box or in the immediate vicinity, see for example IEC 62640.

RCDs for protection of luminaires shall be installed at the origin of the final circuit.

In DC installations, an RCD used for additional protection shall have a rated residual operating current not exceeding 80 mA, and shall be selected according to the requirements of 531.2.3.1 to 531.2.3.4.

531.7 Monitoring devices

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

– Insulation monitoring devices (IMDs) selected and erected in accordance with 537.1.2;
– residual current monitors (RCMs) selected and erected in accordance with 537.1.3;
– equipment for insulation fault location selected and erected in accordance with 537.2.1.

Annex F

Insert, between the headers and first row of the table of notes concerning certain countries, the following new rows:

IT	531.2.2.	In Italy only RCDs shall be used for protection against electric shock in TT systems
IT	531.2.2.3	531.2.2.3 In Italy point b) of 531.2.2.3 is not applicable.
AT	531.2.2.3	531.2.2.3 In Austria point b) of 531.2.2.3 is not applicable.
AT	531.2.3.1	NOTE In Austria the recommendation for multiphase supplied installations does not apply.
DE	531.2.3.2	In Germany, the use of short time-delayed residual current devices (RCDs) is acceptable, provided the applicable requirements of IEC 60364-4-41 are met.
DE	531.2.3.3	In Germany, Type AC RCDs are not permitted.
FI	531.2.3.3	In Finland, Type AC RCDs are not permitted.
BE	531.2.3.3.2	In Belgium, the use of an RCD type A upstream of a type B downstream is not allowed in residential installations.