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Protection against overcurrent

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTRICAL INSTALLATIONS OF BUILDINGS –

Part 4-43: Protection for safety – Protection against overcurrent

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The 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 the 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 National Committees.
3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.
4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.
6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60364-4-43 has been prepared by IEC technical committee 64: Electrical installations and protection against electric shock.

The IEC 60364 series (parts 1 to 6), is currently being restructured, without any technical changes, into a more simple form (see annex B).

According to a unanimous decision by the Committee of Action (CA/1720/RV (2000-03-21)), the restructured parts of IEC 60364 have not been submitted to National Committees for approval.

The text of this second edition of IEC 60364-4-43 is compiled from and replaces

– part 4-43, first edition (1977) and its amendment 1 (1997),
– part 4-473, first edition (1977) and its amendment 1 (1998).

This publication has been drafted, as close as possible, in accordance with the ISO/IEC Directives, Part 3.

Annexes A and B are for information only.

The committee has decided that the contents of this publication will remain unchanged until 2006. At this date, the publication will be

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

The contents of the corrigendum of August 2002 have been included in this copy.

ELECTRICAL INSTALLATIONS OF BUILDINGS –

Part 4-43: Protection for safety – Protection against overcurrent

430 Introduction

430.1 (431)[1] Scope

Part 4-43 of IEC 60364 describes how live conductors are protected by one or more devices for automatic interruption of the supply in the event of overload (see clause 433) and short-circuits (see clause 434) except in cases where the overcurrent is limited in accordance with clause 436 or by the conditions described in 433.3, 433.5 or 434.3 are met. Further, protection against overload and against short-circuits shall be co-ordinated in accordance with clause 435.

NOTE 1 Live conductors protected against overload in accordance with clause 433 are considered to be protected also against faults likely to cause overcurrents of a magnitude similar to overload currents.

NOTE 2 The requirements of this standard do not take account of external influences. For the application of protective measures in relation to conditions of external influences, see 410.3.4 of IEC 60364-4-41 and clause 422 of IEC 60364-4-42.

NOTE 3 Protection of conductors according to this standard does not necessarily protect the equipment connected to the conductors.

(433.1 and 434.1)[1]

Protective devices shall be provided to break any overcurrent flowing in the circuit conductors before such a current could cause a danger due to thermal and mechanical effects or a temperature rise detrimental to insulation, joints, terminations, or surroundings of the conductors.

430.2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 60364. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of IEC 60364 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60269-1:1998, *Low-voltage fuses – Part 1: General requirements*

IEC 60269-2:1986, *Low-voltage fuses – Part 2: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application)*

IEC 60269-3:1987, *Low-voltage fuses – Part 3: Supplementary requirements for fuses used by unskilled persons (fuses mainly for household and similar applications)*

IEC 60364-4-41: *Electrical installations of buildings – Part 4-41: Protection for safety – Protection against electric shock*

IEC 60364-5-52: *Electrical installations of buildings – Part 5-52: Selection and erection of electrical equipment – Wiring systems*

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[1] In this standard, references in brackets refer to the previous numbering system.

IEC 60724:1984, *Guide to the short-circuit temperature limits of electric cables with a rated voltage not exceeding 0,6/1,0 kV*

IEC 60898:1995, *Electrical accessories – Circuit-breakers for overcurrent protection for household and similar installations*

IEC 60947-1:1999, *Low-voltage switchgear and controlgear – Part 1: General rules*

IEC 60947-2:1995, *Low-voltage switchgear and controlgear – Part 2: Circuit-breakers*

IEC 60947-4-1:1990, *Low-voltage switchgear and controlgear – Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters*

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

431 (473.3) Requirements according to the nature of the circuits

431.1 (473.3.1) Protection of phase conductors

431.1.1 (473.3.1.1) Detection of overcurrent shall be provided for all phase conductors; it shall cause the disconnection of the conductor in which the overcurrent is detected, but not necessarily the disconnection of other live conductors, except where 431.1.2 applies.

431.1.2 (473.3.1.2) In TT systems, for circuits supplied between phases and in which the neutral conductor is not distributed, overcurrent detection need not be provided for one of the phase conductors, provided that the following conditions are simultaneously fulfilled:

a) there exists, in the same circuit or on the supply side, differential protection intended to cause disconnection of all the phase conductors;

b) the neutral conductor is not distributed from an artificial neutral point of the circuits situated on the load side of the differential protective device mentioned in a).

NOTE If disconnection of a single phase may cause danger, for example in the case of three-phase motors, appropriate precautions should be taken.

431.2 (473.3.2) Protection of the neutral conductor

431.2.1 (473.3.2.1) TT or TN systems

Where the cross-sectional area of the neutral conductor is at least equal or equivalent to that of the phase conductors, it is not necessary to provide overcurrent detection for the neutral conductor or a disconnecting device for that conductor.

Where the cross-sectional area of the neutral conductor is less than that of the phase conductors, it is necessary to provide overcurrent detection for the neutral conductor, appropriate to the cross-sectional area of that conductor; this detection shall cause the disconnection of the phase conductors, but not necessarily of the neutral conductor.

However, overcurrent detection need not be provided for the neutral conductor if the two following conditions are simultaneously fulfilled:

- the neutral conductor is protected against short-circuit by the protective device for the phase conductors of the circuit, and
- the maximum current likely to be carried by the neutral conductor is, in normal service, clearly less than the value of the current-carrying capacity of that conductor.

NOTE This second condition is satisfied if the power carried is shared as evenly as possible between the different phases, for example if the sum of the powers absorbed by current-using equipment supplied from each phase and neutral (such as lighting and socket-outlets) is much less than the total power carried by the circuit concerned. The cross-sectional area of the neutral conductor should be not less than the appropriate value prescribed in IEC 60364-5-52.

431.2.2 (473.3.2.2) IT systems

In IT systems it is strongly recommended that the neutral conductor should not be distributed.

However, where the neutral conductor is distributed, it is generally necessary to provide overcurrent detection for the neutral conductor of every circuit, which will cause the disconnection of all the live conductors of the corresponding circuit, including the neutral conductor. This measure is not necessary if

- the particular neutral conductor is effectively protected against short-circuit by a protective device placed on the supply side, for example at the origin of the installation, in accordance with the rules stated in 434.5; or if
- the particular circuit is protected by a residual current-operated protective device with a rated residual current not exceeding 0,15 times the current-carrying capacity of the corresponding neutral conductor. This device shall disconnect all the live conductors of the corresponding circuit, including the neutral conductor.

431.3 (473.3.3) Disconnection and reconnection of the neutral conductor

Where disconnection of the neutral conductor is required, disconnection and reconnection shall be such that the neutral conductor shall not be disconnected before the phase conductors and shall be reconnected at the same time as or before the phase conductors.

432 Nature of protective devices

The protective devices shall be of the appropriate types indicated by 432.1 to 432.3.

432.1 Devices ensuring protection against both overload current and short-circuit current

These protective devices shall be capable of breaking any overcurrent up to and including the prospective short-circuit current at the point where the device is installed. They shall satisfy the requirements of clause 433 and 434.5.1. Such protective devices may be:

- circuit-breakers incorporating overload release complying with IEC 60898, IEC 60947-1, IEC 60947-2 or IEC 61009;
- circuit-breakers in conjunction with fuses;
- fuses having fuse-links with gG characteristics complying with IEC 60269-1 and IEC 60269-2 or IEC 60269-3.

NOTE 1 The fuse comprises all the parts that form the complete protective device.

NOTE 2 The use of a protective device having a breaking capacity below the value of the prospective short-circuit current at its place of installation is subject to the requirements of 434.5.1.

432.2 Devices ensuring protection against overload current only

These are generally inverse-time-lag protective devices whose interrupting capacity may be below the value of the prospective short-circuit current at the point where the devices are installed. They shall satisfy the requirements of clause 433.

432.3 Devices ensuring protection against short-circuit current only

These devices shall be installed where overload protection is achieved by other means or where clause 433 allows overload protection to be dispensed with. The devices shall be capable of breaking the short-circuit current up to and including the prospective short-circuit current. They shall satisfy the requirements of clause 434.

Such devices may be

- circuit-breakers with short-circuit release complying with IEC 60898, IEC 60947-1, IEC 60947-2 or IEC 61009,
- fuses complying with IEC 60269-1 and IEC 60269-2 or IEC 60269-3.

433 Protection against overload current

433.1 (433.2) Co-ordination between conductors and overload protective devices

The operating characteristics of a device protecting a cable against overload shall satisfy the two following conditions:

$$I_B \leq I_n \leq I_z \quad (1)$$

$$I_2 \leq 1{,}45 \times I_z \quad (2)$$

where

I_B is the current for which the circuit is designed;

I_z is the continuous current-carrying capacity of the cable (see clause 523);

I_n is the nominal current of the protective device;

NOTE For adjustable protective devices, the nominal current I_n is the current setting selected.

I_2 is the current ensuring effective operation in the conventional time of the protective device.

The current I_2 ensuring effective operation of the protective device is given in the product standard or may be provided by the manufacturer.

NOTE Protection in accordance with this clause does not ensure complete protection in certain cases, for example against sustained overcurrent less than I_2, nor will it necessarily result in an economical solution. Therefore it is assumed that the circuit is so designed that small overloads of long duration will not frequently occur.

433.2 (473.1.1) Position of devices for overload protection

433.2.1 (473.1.1.1) A device ensuring protection against overload shall be placed at the point where a change, such as a change in cross-sectional area, nature, method of installation or in constitution, causes a reduction in the value of current-carrying capacity of the conductors, except where 433.2.2 and 433.3 apply.

433.2.2 (473.1.1.2) The device protecting the conductor against overload may be placed along the run of that conductor if the part of the run between the point where a change occurs (in cross-sectional area, nature, method of installation or constitution) and the position of the protective device has neither branch circuits nor socket-outlets and fulfils one of the following two conditions:

a) it is protected against short-circuit current in accordance with the requirements stated in clause 434;

b) its length does not exceed 3 m, it is carried out in such a manner as to reduce the risk of short-circuit to a minimum, and it is not placed near combustible material (see 434.2.1).

433.3 (473.1.2) Omission of devices for protection against overload

The various cases stated in this subclause shall not be applied to installations situated in locations presenting a fire risk or risk of explosion and where the requirements for special installations and locations specify different conditions.

Devices for protection against overload need not be provided for

a) a conductor situated on the load side of a change in cross-sectional area, nature, method of installation or in constitution, which is effectively protected against overload by a protective device placed on the supply side,

b) a conductor which is not likely to carry overload current, provided that this conductor is protected against short-circuit in accordance with the requirements of clause 434 and that it has neither branch circuits nor socket-outlets,

c) installations for telecommunications, control, signalling and the like,

d) distribution circuits comprising cables laid in the ground or overhead lines where overloading of the circuits will not cause danger.

NOTE Conditions for overload protection for the installations mentioned in item c) are under consideration.

433.4 (473.1.3) Position or omission of devices for protection against overload in IT systems

433.4.1 (473.1.3) The provisions in 433.2.2 and 433.3 for an alternative position or omission of devices for protection against overload are not applicable to IT systems unless each circuit not protected against overload is protected by one of the following means:

a) use of the protective measures described in 413.2 of IEC 60364-4-41,

b) protection of each circuit by a residual current protective device which will operate immediately on the second fault,

c) use of an insulation monitoring device which either

- causes the disconnection of the circuit when the first fault occurs, or
- gives a signal indicating the presence of a fault. The fault shall be rectified according to the operational requirements and recognizing the risk from a second fault.

433.4.2 (473.3.1.3) In IT systems without a neutral conductor the overload protective device may be omitted in one of the phase conductors if a residual current protective device is installed in each circuit.

433.5 (473.1.4) Cases where omission of devices for overload protection is recommended for safety reasons

The omission of devices for protection against overload is recommended for circuits supplying current-using equipment where unexpected opening of the circuit could cause danger.

Examples of such cases are

- exciter circuits of rotating machines,
- supply circuits of lifting magnets,
- secondary circuits of current transformers.

NOTE In such cases consideration should be given to the provision of an overload alarm.

433.6 (473.1.5) Overload protection of conductors in parallel

Where a single protective device protects several conductors in parallel there shall be no branch circuits or devices for isolation or switching in the parallel conductors.

This subclause does not preclude the use of ring circuits.

433.6.1 (473.1.5.1) Equal current sharing between parallel conductors

Where a single device protects conductors in parallel sharing currents equally, the value of I_z to be used in 433.1 is the sum of the current-carrying capacities of the various conductors.

It is deemed that current sharing is equal if the requirements of the first indent of 523.7 a) of IEC 60364-5-52 are satisfied.

433.6.2 (473.1.5.2) Unequal current sharing between parallel conductors

Where the use of a single conductor, per phase, is impractical and the currents in the parallel conductors are unequal, the design current and requirements for overload protection for each conductor shall be considered individually.

NOTE Currents in parallel conductors are considered to be unequal if the difference between any currents is more than 10 % of the design current for each conductor. Guidance is given in annex A (see clause A.2).

434 Protection against short-circuit currents

434.1 (434.2) Determination of prospective short-circuit currents

The prospective short-circuit current at every relevant point of the installation shall be determined. This may be done either by calculation or by measurement.

434.2 (473.2.1) Position of devices for short-circuit protection

A device ensuring protection against short-circuit shall be placed at the point where a reduction in the cross-sectional area of the conductors or another change causes a change to the current-carrying capacity of the conductors, except where 434.2.1, 434.2.2 or 434.3 apply.

434.2.1 (473.2.2 and 473.2.2.1) The device for protection against short-circuit may be placed other than as specified in 434.2, under the following conditions.

The part of the conductor between the point of reduction of cross-sectional area or other change and the position of the protective device shall

a) not exceed 3 m in length,

b) be installed in such a manner as to reduce the risk of a short-circuit to a minimum,

NOTE This condition may be obtained for example by reinforcing the protection of the wiring against external influences.

c) not be placed close to combustible material.

434.2.2 (473.2.2.2) A protective device may be placed on the supply side of the reduced cross-sectional area or another change made, provided that it possesses an operating characteristic such that it protects the wiring situated on the load side against short-circuit, in accordance with the rule of 434.5.2.