

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Railway applications – Electric equipment for rolling stock –
Part 2: Electrotechnical components – General rules**

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**Applications ferroviaires – Equipements électriques du matériel roulant –
Partie 2: Composants électrotechniques – Règles générales**

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Part 2: Electrotechnical components – General rules**
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Partie 2: Composants électrotechniques – Règles générales**

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**RAILWAY APPLICATIONS –
ELECTRIC EQUIPMENT FOR ROLLING STOCK –****Part 2: Electrotechnical components – General rules**

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International Standard IEC 60077-2 has been prepared by IEC technical committee 9: Electrical equipment and systems for railways.

This second edition cancels and replaces the first edition of IEC 60077-2, issued in 1999. It constitutes a technical revision.

This edition includes the following main technical changes with regard to the previous edition:

- a) Short circuit breaking capacity;
- b) Rated short-time withstand current;
- c) Critical currents range;
- d) Climatic conditions are specified.

This standard is to be read in conjunction with IEC 60077-1.

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

| FDIS | Report on voting |
|-------------|------------------|
| 9/2267/FDIS | 9/2279/RVD |

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

A list of all parts in the IEC 60077 series, published under the general title *Railway applications – Electric equipment for rolling stock*, can be found on the IEC website.

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

The committee has decided that the contents of this 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,
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RAILWAY APPLICATIONS – ELECTRIC EQUIPMENT FOR ROLLING STOCK –

Part 2: Electrotechnical components – General rules

1 Scope

In addition to the rules given in IEC 60077-1, this part of IEC 60077 provides general rules for all electrotechnical components installed in power circuits, auxiliary circuits, control and indicating circuits, etc., on railway rolling stock.

The purpose of this document is to adapt the general rules given in IEC 60077-1 to all electrotechnical components for rolling stock, in order to obtain uniformity of requirements and tests for the corresponding range of components.

Electrotechnical components are mainly switchgear and controlgear, including also relays, valves, resistors, fuses, etc., irrespective of the nature of their control.

The incorporation of electronic components or electronic subassemblies into electrotechnical components is now common practice. Although this document is not applicable to electronic equipment, the presence of electronic components does not give grounds to exclude such electrotechnical components from the scope of this document.

Electronic subassemblies comply with the relevant standard.

Some of these rules, after agreement between the user and the manufacturer, are used for electrotechnical components installed on vehicles other than railway rolling stock, such as mine locomotives, trolleybuses, etc.

This document states:

- a) the characteristics of the components;
- b) the service conditions with which components have to comply;
- c) the tests intended to confirm compliance of the components with these characteristics under these service conditions, and the methods to be adopted for these tests;
- d) the information to be marked on, or given with, the apparatus.

This document does not cover industrial electrotechnical components which comply with their own product standard. In order to ensure satisfactory operation of these components for rolling stock, this document is used to specify only the particular requirements for railway application. In that case, a specific document would state the additional requirements with which the industrial components are to comply, e.g.:

- to be adapted (for example for control voltage, environmental conditions, etc.); or
- to be installed and used so as not to have to endure specific railway conditions; or
- to be additionally tested to prove that these components can satisfactorily withstand railway conditions.

In the event of there being a difference in requirements between this document and a railway rolling stock relevant product standard, then the product standard requirements take precedence.

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 60050-811:2017, *International Electrotechnical Vocabulary (IEV) – Chapter 811: Electric traction*

IEC 60068-2-1, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-2, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60068-2-30, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60068-2-52, *Environmental testing – Part 2-52: Test methods – Test Kb: Salt mist, cyclic (sodium, chloride solution)*

IEC 60068-2-78, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC 60077-1:2017, *Railway applications – Electric equipment for rolling stock – Part 1: General service conditions and general rules*

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 TR 60943, *Guidance concerning the permissible temperature rise for parts of electrical equipment, in particular for terminals*

3 Terms, definitions and abbreviated terms

For the purposes of this document, the terms and definitions given in IEC 60077-1 as well as the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1 Components

3.1.1

active electrical component

simple device or assembly of devices which, in response to a control signal, executes a function or various inseparable functions of logical or analogical nature by changing their state, for which the control or the function is electrical (e.g. contactor, relay, etc.)

Note 1 to entry: Passive electrical component is defined as the antonym of this term.

3.1.2**passive electrical component**

simple device or assembly of devices which are not included in the active electrical components group and have at least one electrical function (e.g. mounting insulator, permanent connection, resistor, capacitor, etc.)

3.1.3**switchgear and controlgear**

general term covering switching devices and their combination with associated control, measuring, protective and regulating equipment, also assemblies of such devices and equipment with associated interconnections, accessories, enclosures and supporting structures

[SOURCE: IEC 60050-441:1984 / AMD1:2007, 441-11-01]

3.1.4**switchgear**

general term covering switching devices and their combination with associated control, measuring, protective and regulating equipment, also assemblies of such devices and equipment with associated interconnections, accessories, enclosures and supporting structures, intended in principle for use in connection with generation, transmission, distribution and conversion of electric energy

[SOURCE: IEC 60050-441:1984 / AMD1:2007, 441-11-02]

3.1.5**controlgear**

general term covering switching devices and their combination with associated control, measuring, protective and regulating equipment, also assemblies of such devices and equipment with associated interconnections, accessories, enclosures and supporting structures, intended in principle for the control of electric energy consuming equipment

[SOURCE: IEC 60050-441:1984 / AMD1:2007, 441-11-03]

3.1.6**switching device**

device designed to make or break the current in one or more electric circuits

Note 1 to entry: A switching device may perform one or both of these operations.

[SOURCE: IEC 60050-441:1984 / AMD1:2007, 441-14-01, modified – Note 1 to entry has been added.]

3.1.7**fuse**

device that, by the fusing of one or more of its specially designed and proportioned components, opens the circuit in which it is inserted by breaking the current when this exceeds a given value for a sufficient time

Note 1 to entry: The fuse comprises all the parts that form the complete device.

[SOURCE: IEC 60050-441:1984 / AMD1:2007, 441-18-01, modified – The second sentence has been changed to Note 1 to entry.]

3.1.8**<mechanical> switch**

mechanical switching device capable of making, carrying and breaking currents under normal circuit conditions which may include specified operating overload conditions and also carrying

for a specified time currents under specified abnormal circuit conditions such as those of short-circuit

Note 1 to entry: A switch may be capable of making but not breaking short-circuit currents.

[SOURCE: IEC 60050-441:1984 / AMD1:2007, 441-14-10]

3.1.9 mechanical switching device

switching device designed to close and open one or more electric circuits by means of separable contacts

Note 1 to entry: Any mechanical switching device may be designated according to the medium in which its contacts open and close, e.g. air, SF₆, oil.

[SOURCE: IEC 60050-441:1984 / AMD1:2007, 441-14-02]

3.1.10 circuit breaker

mechanical switching device, capable of making, carrying and breaking currents under normal circuit conditions and also making, carrying for a specified time and breaking currents under specified abnormal circuit conditions such as those of short-circuit

[SOURCE: IEC 60050-441:1984 / AMD1:2007, 441-14-20]

3.1.11 contactor

mechanical switching device having only one position of rest, operated otherwise than by hand, capable of making, carrying and breaking currents under normal circuit conditions including operating overload conditions

Note 1 to entry: Contactors may be designated according to the method by which the force for closing the main contacts is provided.

Note 2 to entry: The definition is the same as "mechanical contactor": IEC 60050-441:1984 / AMD1:2007, 441-14-33.

3.1.12 disconnecter

mechanical switching device which provides, in the open position, an isolating distance in accordance with specified requirements

Note 1 to entry: A disconnecter is capable of opening and closing a circuit only when negligible current is broken or made, or when no significant change in the voltage across the terminals of each of the poles of the disconnecter occurs. It is also capable of carrying currents under normal circuit conditions and carrying for a specified time currents under abnormal conditions such as those of short circuit.

[SOURCE: IEC 60050-811:2017, 811-29-17]

3.2 Component parts

3.2.1 pole of a switching device

portion of a switching device associated exclusively with one electrically separated conducting path of its main circuit and excluding those portions which provide a means for mounting and operating all poles together

Note 1 to entry: A switching device is called single-pole if it has only one pole. If it has more than one pole, it may be called multipole (two-pole, three-pole, etc.) provided the poles are or can be coupled in such a manner as to operate together.

[SOURCE: IEC 60050-441:1984 / AMD1:2007, 441-15-01]

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3.2.2**main circuit**, <of a switching device>

all the conductive parts of a switching device included in the circuit which it is designed to close or open

Note 1 to entry: This does not include parts that are included in the auxiliary circuit of the switching device (see 3.2.4).

[SOURCE: IEC 60050-441:1984 / AMD1:2007, 441-15-02, modified – Note 1 to entry has been added.]

3.2.3**control circuit**, <of a switching device>

all the conductive parts (other than the main circuit) of a switching device which are included in a circuit used for the closing operation or opening operation, or both, of the device

[SOURCE: IEC 60050-441:1984 / AMD1:2007, 441-15-03]

3.2.4**auxiliary circuit**, <of a switching device>

all the conductive parts of a switching device which are intended to be included in a circuit other than the main circuit and the control circuits of the device

Note 1 to entry: Some auxiliary circuits fulfil supplementary functions such as signalling, interlocking, etc., and, as such, they may be part of the control circuit of another switching device.

[SOURCE: IEC 60050-441:1984 / AMD1:2007, 441-15-04]

3.2.5**contact**, <of a mechanical switching device>

conductive parts designed to establish circuit continuity when they touch and which, due to their relative motion during an operation, open or close a circuit or, in the case of hinged or sliding contacts, maintain circuit continuity

[SOURCE: IEC 60050-441:1984 / AMD1:2007, 441-15-05]

3.2.6**main contact**

contact included in the main circuit of a mechanical switching device, intended to carry, in the closed position, the current of the main circuit

[SOURCE: IEC 60050-441:1984 / AMD1:2007, 441-15-07]

3.2.7**auxiliary contact**

contact included in an auxiliary circuit and mechanically operated by the switching device

[SOURCE: IEC 60050-441:1984 / AMD1:2007, 441-15-10]

3.2.8**make contact**

contact which is closed when the main contacts of the mechanical switching device are in their operate condition and which is open when they are in their release condition

Note 1 to entry: See complementary information in Annex A of this document.

Note 2 to entry: “normally open contact” is a deprecated term.

[SOURCE: IEC 60050-811:2017, 811-31-03, modified – “relay” is replaced with “main contacts of the mechanical switching device”. Note 1 to entry and Note 2 to entry have been added.]

3.2.9 break contact

contact which is open when the main contacts of the mechanical switching device are in their operate condition and which is closed when they are in their release condition

Note 1 to entry: See complementary information in Annex A of this document.

Note 2 to entry: “normally closed contact” is a deprecated term.

[SOURCE: IEC 60050-811:2017, 811-31-04, modified – “relay” is replaced with “main contacts of the mechanical switching device”. Note 1 to entry and Note 2 to entry have been added.]

3.2.10 <electric> relay

device designed to produce sudden predetermined changes in one or more electric output circuits, when certain conditions are fulfilled in the electric input circuits controlling the device

Note 1 to entry: This definition may also be applied to relays for which the actuation is not electric.

[SOURCE: IEC 60050-151:2001, 151-13-31, modified – Note 1 to entry has been added.]

3.2.11

release, <of a mechanical switching device>

device, mechanically connected to a mechanical switching device, which releases the holding means and permits the opening or the closing of the switching device

[SOURCE: IEC 60050-441:1984 / AMD1:2007, 441-15-17]

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3.3 Operational features

3.3.1

operation, <of a mechanical switching device>

transfer of the moving contact(s) from one position to an adjacent position

Note 1 to entry: For a circuit-breaker, this may be a closing operation or an opening operation.

Note 2 to entry: If distinction is necessary, an operation in the electrical sense, e.g. make or break, is referred to as a switching operation, and an operation in the mechanical sense, e.g. close or open, is referred to as a mechanical operation.

[SOURCE: IEC 60050-441:1984 / AMD1:2007, 441-16-01]

3.3.2

operating cycle, <of a mechanical switching device>

succession of operations from one position to another and back to the first position through all other positions, if any

[SOURCE: IEC 60050-441:1984 / AMD1:2007, 441-16-02]

3.3.3

manual control

control of an operation by human intervention

[SOURCE: IEC 60050-441:1984 / AMD1:2007, 441-16-04]

3.3.4

closed position, <of a mechanical switching device>

position in which the predetermined continuity of the main circuit of the device is secured

[SOURCE: IEC 60050-441:1984 / AMD1:2007, 441-16-22]

3.3.5

open position, <of a mechanical switching device>

position in which the predetermined dielectric withstand voltage requirements are satisfied between open contacts in the main circuit of the device

Note 1 to entry: This definition differs from IECV 441-16-23 to meet the requirements of dielectric properties.

[SOURCE: IEC 60050-441:1984 / AMD1:2007, 441-16-23, modified – “clearance...is secured” is changed to “dielectric withstand voltage requirements are satisfied”. Note 1 to entry has been added.]

3.3.6

breaking current, <of a switching device or a fuse>

current in a pole of a switching device or in a fuse at the instant of initiation of the arc during a breaking process

Note 1 to entry: For AC the current is expressed as the symmetrical RMS value of the AC component.

[SOURCE: IEC 60050-441:1984 / AMD1:2007, 441-17-07, modified. Note 1 to entry has been added.]

3.3.7

prospective current, <of a circuit and with respect to a switching device or a fuse>

current that would flow in the circuit if each pole of the switching device or the fuse were replaced by a conductor of negligible impedance

Note 1 to entry: The method to be used to evaluate and to express the prospective current is to be specified in the relevant publications.

[SOURCE: IEC 60050-441:1984 / AMD1:2007, 441-17-01]

3.3.8

prospective making current, <for a pole of a switching device>

prospective current when initiated under specified conditions

Note 1 to entry: The specified conditions may relate to the method of initiation, e.g. by an ideal switching device, or to the instant of initiation, e.g. leading to the maximum prospective peak current in an AC circuit, or to the highest rate of rise. The specification of these conditions is given in the relevant publications.

[SOURCE: IEC 60050-441:1984 / AMD1:2007, 441-17-05]

3.3.9

prospective breaking current, <for a pole of a switching device or a fuse>

prospective current evaluated at a time corresponding to the instant of the initiation of the breaking process

Note 1 to entry: Specifications concerning the instant of the initiation of the breaking process are to be found in the relevant publications. For mechanical switching devices or fuses, it is usually defined as the moment of initiation of the arc during the breaking process.

[SOURCE: IEC 60050-441:1984 / AMD1:2007, 441-17-06]

3.3.10**breaking capacity**, <of a switching device or a fuse>

value of prospective breaking current that a switching device or a fuse is capable of breaking at a stated voltage under prescribed conditions of use and behaviour

Note 1 to entry: The voltage to be stated and the conditions to be prescribed are dealt with in the relevant publications.

Note 2 to entry: For AC, the current is expressed as the symmetrical RMS value of the AC component.

[SOURCE: IEC 60050-441:1984 / AMD1:2007, 441-17-08, modified – Note 2 to entry has been changed.]

3.3.11**short circuit breaking capacity**

breaking capacity for which the prescribed conditions include a short-circuit at the terminals of the switching device

[SOURCE: IEC 60050-441:1984 / AMD1:2007, 441-17-11]

3.3.12**critical current**

critical currents range

value (or range of values) of current at which the component is not capable of operating without risk of failure to break

Note 1 to entry: For AC current only AC contactor is applicable.

3.3.13**making capacity**, <of a switching device or a fuse>

value of prospective making current that a switching device is capable of making at a stated voltage under prescribed conditions of use and behaviour

Note 1 to entry: The voltage to be stated and the conditions to be prescribed are dealt with in the relevant publications.

[SOURCE: IEC 60050-441:1984 / AMD1:2007, 441-17-09, modified – In Note 1 to entry “specifications” is replaced with “publications”.]

3.3.14**short circuit making capacity**

making capacity for which the prescribed conditions include a short circuit at the terminals of the switching device

[SOURCE: IEC 60050-441:1984 / AMD1:2007, 441-17-10]

3.3.15**short-time withstand current**

current that a circuit or a switching device in the closed position can carry during a specified short time under prescribed conditions of use and behaviour

[SOURCE: IEC 60050-441:1984 / AMD1:2007, 441-17-17]

3.3.16**recovery voltage**

voltage which appears across the terminals of a pole of a switching device or a fuse after the breaking of the current