

INTERNATIONAL STANDARD



**Railway Applications – Electric equipment for rolling stock –
Part 3: Electrotechnical components – Rules for DC circuit-breakers**

(<https://standards.iteh.ai>)
Document Preview

[IEC 60077-3:2019](https://standards.iteh.ai/catalog/standards/iec/7e07c31e-00ef-46e1-b453-94f572115b76/iec-60077-3-2019)

<https://standards.iteh.ai/catalog/standards/iec/7e07c31e-00ef-46e1-b453-94f572115b76/iec-60077-3-2019>



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2019 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

[IEC 60077-3:2019](https://standards.iteh.ai/catalog/standards/iec/7e07c31e-00ef-46e1-b453-94f572115b76/iec-60077-3-2019)

<https://standards.iteh.ai/catalog/standards/iec/7e07c31e-00ef-46e1-b453-94f572115b76/iec-60077-3-2019>



IEC 60077-3

Edition 2.0 2019-10
REDLINE VERSION

INTERNATIONAL STANDARD



**Railway Applications – Electric equipment for rolling stock –
Part 3: Electrotechnical components – Rules for DC circuit-breakers**

Document Preview

[IEC 60077-3:2019](https://standards.iteh.ai/catalog/standards/iec/7e07c31e-00ef-46e1-b453-94f572115b76/iec-60077-3-2019)

<https://standards.iteh.ai/catalog/standards/iec/7e07c31e-00ef-46e1-b453-94f572115b76/iec-60077-3-2019>

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 45.060.01

ISBN 978-2-8322-7565-8

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD	4
1 Scope and object	6
2 Normative references	7
3 Terms, definitions and abbreviated terms	7
3.1 Components	8
3.2 Component parts	8
3.3 Operational features	10
3.4 Breaking characteristics	10
3.5 Abbreviated terms	13
4 Classification	13
5 Characteristics	13
5.1 List of characteristics	13
5.2 Type of circuit-breaker	13
5.3 Rated values and limiting values for the main circuit	13
5.3.1 General	13
5.3.2 Rated voltages	14
5.3.3 Rated currents	14
5.3.4 Rated time constants	14
5.3.5 Short-circuit characteristics (see also annex B) Rated short-circuit making and breaking capacity	15
5.4 Operational frequencies	15
5.5 Electric and pneumatic control circuits	15
5.6 Electric and pneumatic auxiliary circuits	15
5.7 Overcurrent release	15
5.8 Peak arc voltages	16
6 Product information	16
6.1 Component documentation	16
6.2 Marking	16
7 Normal service conditions	16
8 Constructional and performance requirements	16
8.1 Constructional requirements	16
8.2 Performance requirements	16
8.2.1 Operating conditions	16
8.2.2 Temperature rise limits	16
8.2.3 Operation following inactivity	16
8.2.4 Electromagnetic compatibility (EMC)	16
8.2.5 Acoustic noise emission	16
8.2.6 Dielectric properties Clearances	17
8.2.7 Creepage distances	17
8.2.8 Switching overvoltages	17
8.2.9 Operational performance capability	17
8.2.10 Ability to withstand vibration and shock	18
8.2.11 Ability to make and break under short-circuit conditions	18
9 Tests	19
9.1 Kinds of tests	19

9.1.1	General	19
9.1.2	Type tests.....	19
9.1.3	Routine tests	19
9.1.4	Investigatory Investigation tests.....	19
9.2	Verification of constructional requirements.....	19
9.2.1	General	19
9.2.2	Type tests.....	19
9.2.3	Routine tests	20
9.3	Type tests for verification of performance requirements	20
9.3.1	Test sequences	20
9.3.2	General test conditions	21
9.3.3	Test sequence I: General performance characteristics.....	22
9.3.4	Test sequence II: Rated short-circuit making and breaking capacities.....	23
9.3.5	Test sequence III: capability Ability to withstand vibration and shock.....	25
9.3.6	Test sequence IV: Searching for critical currents	26
9.3.7	Test sequence V: Climatic conditions	26
9.3.8	Test sequence VI: Other tests.....	26
9.4	Routine tests for verification of performance requirements.....	27
9.4.1	General	27
9.4.2	Mechanical operation Functional test.....	27
9.4.3	Measurement of resistance.....	27
9.4.4	Calibration of releases.....	27
9.4.5	Air-tightness (for pneumatic circuit-breaker)	27
9.4.6	Dielectric withstand	27
Annex A (normative)	Test circuit to verify the making and breaking capacities	28
Annex B (informative)	Verification of short-circuit making and breaking capacities	29
Bibliography.....	IEC 60077-3:2019.....	31
Figure A.1	– Diagram of the test circuit	28
Figure B.1	– Calibration of the circuit to obtain the prospective peak making current	29
Figure B.2	– Oscillogram corresponding to a break after the current has passed its maximum value.....	30
Figure B.3	– Oscillogram corresponding to a break before the current has reached its maximum value (current-limiting circuit-breaker).....	30
Table 1	– Rated time constants.....	14
Table 2	– Operational performance capability	18
Table 3	– List of type test sequences for performance requirements	20
Table 4	– Tolerances on test values.....	21

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**RAILWAY APPLICATIONS –
ELECTRIC EQUIPMENT FOR ROLLING STOCK –****Part 3: Electrotechnical components –
Rules for DC circuit-breakers**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of 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, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). 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. 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 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 IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

International Standard IEC 60077-3 has been prepared by IEC technical committee 9: Electrical equipment and systems for railways.

This second edition cancels and replaces the first edition, issued in 2001. It constitutes a technical revision.

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

- a) procedure of verification of temperature rise is changed;
- b) air-tightness test as type test, insulation resistance measurement are added.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
9/2537/FDIS	9/2553/RVD

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

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

This document should be read in conjunction with IEC 60077-1 and IEC 60077-2.

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.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

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

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

RAILWAY APPLICATIONS – ELECTRIC EQUIPMENT FOR ROLLING STOCK –

Part 3: Electrotechnical components – Rules for DC circuit-breakers

1 ~~Scope and object~~

In addition to the general requirements of IEC 60077-2, this part of IEC 60077 gives the rules for circuit-breakers, the main contacts of which are ~~to be~~ connected to DC power and/or auxiliary circuits. The nominal voltage of these circuits does not exceed 3 000 V DC according to IEC 60850.

This part of IEC 60077, together with IEC 60077-2, states specifically:

- a) the characteristics of the circuit-breakers;
- b) the service conditions with which circuit-breakers ~~have to comply~~ complies with reference to:
 - operation and behaviour in normal service;
 - operation and behaviour in the case of short circuit;
 - dielectric properties;
- c) the tests for confirming the compliance of the components with the characteristics under the service conditions and the methods to be adopted for these tests;
- d) the information to be marked on, or given with, the circuit breaker.

NOTE 1 Circuit-breakers which are dealt with in this document ~~may~~ can be provided with devices for automatic opening under predetermined conditions other than those of overcurrent, for example, under-voltage and reversal of power ~~current~~ flow direction. This document does not deal with the verification of operation under such predetermined conditions.

NOTE 2 The incorporation of electronic components or electronic sub-assemblies into electrotechnical components is now common practice.

Although this document is not applicable to electronic equipment, the presence of electronic components does not provide a reason to exclude such electrotechnical components from the scope.

Electronic sub-assemblies included in circuit-breakers ~~should~~ comply with the relevant document for electronics (IEC 60571).

NOTE 3 Certain of these rules ~~may~~, after agreement between the user and the manufacturer, ~~be~~ are used for electrotechnical components installed on vehicles other than rail rolling stock such as mine locomotives, trolleybuses, etc. In this case, particular additional requirements ~~may~~ can be necessary.

This document does not cover:

- a) multi-connection of electro-technical components to achieve a particular duty;
- b) industrial circuit-breakers which ~~have to comply~~ complies with IEC 60947-2;
- c) DC circuit-breakers for fixed installations which ~~have to comply~~ complies with IEC 61992-2.

For b) and c), in order to ensure satisfactory operation, this document ~~should be~~ is used to specify only the particular requirements for rolling stock. In such cases, a specific document ~~should state~~ states the additional requirements with which the industrial or fixed installations circuits breakers ~~are to~~ comply, for example:

- either to be adapted (for example, for control voltage, environmental conditions, etc.);

- or to be installed and used in such a way that they do not have to endure specific rolling stock conditions;
- or to be additionally tested to prove that these components can withstand satisfactorily the rolling stock conditions.

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(441):1984, International Electrotechnical Vocabulary — Switchgear, controlgear and fuses~~

IEC 60077-1:1999/2017, *Railway applications – Electric equipment for rolling stock – Part 1: General service conditions and general rules*

IEC 60077-2:1999/2017; *Railway applications – Electric equipment for rolling stock – Part 2: Electrotechnical components – General rules*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*

~~IEC 60571:1998, Electronic equipment used on rail vehicles~~

~~IEC 60850:2000, Railway applications — Supply voltage of traction systems~~

~~IEC/TR3 60943:1998, Guidance concerning the permissible temperature rise for parts of electrical equipment, in particular for terminals~~

~~IEC 60947-2:1989, Low-voltage switchgear and controlgear — Part 2: Circuit-breakers~~

IEC 61373:1999, *Railway applications – Rolling stock equipment – Shock and vibration tests*

~~IEC 61992-2:2001, Railway applications — Fixed installations — DC switchgear — Part 2: Circuit-breakers~~

3 Terms, definitions and abbreviated terms

~~For the purpose of this part of IEC 60077, the definitions given in clauses 3 of IEC 60077-1 and IEC 60077-2 are applicable together with the following additional definitions.~~

For the purposes of this document, the terms and definitions given in Clause 3 of IEC 60077-1:2017 and Clause 3 of IEC 60077-2:2017, and 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

polarized circuit-breaker

circuit-breaker for which the breaking characteristics are defined for only one prescribed direction of current in the main circuit

3.1.2

bi-directional circuit-breaker

circuit-breaker for which the breaking characteristics are the same for both directions of current in the main circuit

3.1.3

air circuit-breaker

circuit-breaker in which the contacts open and close in air at atmospheric pressure

[SOURCE: IEC 60050-441:1984/AMD1:2000, 441-14-27]

3.1.4

vacuum circuit-breaker

circuit-breaker in which the contacts open and close within a highly evacuated envelope

[SOURCE: IEC 60050-441:1984/AMD1:2000, 441-14-29]

3.1.5

semiconductor circuit-breaker

circuit-breaker designed to make and break the current in an electric circuit by means of the controlled conductivity of a semiconductor

Note 1 to entry: There can be mechanical contacts associated with these semiconductor devices.

[SOURCE: IEC 60050-811:2017, 811-29-42]

3.1.6

hybrid circuit-breaker

circuit-breaker with mechanical contacts for isolation associated with a semiconductor for switching

Note 1 to entry: Semiconductor circuit-breakers without mechanical isolation are not used on rolling stock.

3.2 Component parts

3.2.1

release, <for a circuit-breaker>

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

[IEV 441-15-17, modified]

Note 1 to entry: A circuit-breaker ~~may have~~ can be activated by several releases each becoming operational according to specified conditions.

Note 2 to entry: ~~A release may include mechanical, electromechanical or electronic parts.~~ These releases can be mechanically or electrically connected to the switching device.

[SOURCE: IEC 60050-811:2017, 811-29-44]

3.2.2

overcurrent (~~instantaneous~~) release

~~device which causes a tripping operation without any intentional time delay when the current exceeds a specified value~~

~~[IEV 441-16-32, modified]~~

release which permits a mechanical switching device to open with or without time-delay when the current in the release exceeds a predetermined value

Note 1 to entry: This value can in some cases depend upon the rate-of-rise of current.

[SOURCE: IEC 60050-441:1984/AMD1:2000, 441-16-33]

3.2.3

direct overcurrent release

overcurrent release directly energized by the current in the main circuit of ~~the circuit-breaker~~ a mechanical switching device

[SOURCE: IEC 60050-441:1984/AMD1:2000, 441-16-36, ~~modified~~]

3.2.4

indirect overcurrent release, <for a circuit-breaker>

overcurrent release initiated by the current in the main circuit of a mechanical switching device through a current sensor ~~(shunt or current transducer)~~

[SOURCE: IEC 60050-441:1984/AMD1:2000, 441-16-37, modified – "energized" and "a current transformer or a shunt" have been replaced with "initiated" and "a current sensor".]

3.2.5

anti-pumping device

device which prevents reclosing after a close-open operation as long as the device initiating closing is maintained in the position for closing ~~7-3:2019~~

<https://standards.iteh.ai/catalog/standards/iec/7e07c31e-00ef-46e1-b453-94f572115b76/iec-60077-3-2019>

Note 1 to entry: The opening operation may be either an opening command or a tripping operation.

[SOURCE: IEC 60050-441:1984/AMD1:2000, 441-16-48, modified – Note 1 to entry has been added.]

3.2.6

enclosure, <of an assembly>

part of an assembly providing a specified degree of protection of ~~the circuit-breaker~~ equipment against external ~~pollution~~ influences and a specified degree of protection against ~~access~~ approach to or contact with live parts and against contact with moving parts

Note 1 to entry: The enclosure may also provide a protection of adjacent parts against the influence of the circuit-breaker (for example, arcing).

[SOURCE: IEC 60050-441:1984/AMD1:2000, 441-13-01, modified – Note 1 to entry has been added.]

3.2.7

integral enclosure

enclosure forming an integral part of the circuit-breaker

3.3 Operational features

3.3.1

current-limiting circuit-breaker

circuit-breaker with a break-time short enough to prevent the short-circuit current reaching its otherwise attainable peak value

[SOURCE: IEC 60050-441:1984/AMD1:2000, 441-14-21]

3.3.2

trip-free circuit-breaker

circuit-breaker in which the moving ~~main~~ contacts ~~of which~~ return to and remain in the open position when the ~~opening (i.e. tripping)~~ operation is initiated after the initiation of the closing operation, even if the closing command is maintained

~~[IEV 441-16-31, modified]~~

Note 1 to entry: To ensure proper breaking of the current which may have been established, it may be necessary that the contacts momentarily reach the closed position.

[SOURCE: IEC 61992-1:2006/AMD1:2014, 3.4.11]

3.3.3

current setting, <of an overcurrent release>

~~value of the current in the main circuit to which the operating characteristics of the overcurrent release are referred and for which the release is set~~

value of the operating current for which the release is adjusted and in accordance with which its operating conditions are defined

Note 1 to entry: A release may have more than one current setting.

[SOURCE: IEC 60050-441:1984/AMD1:2000, 441-16-46, modified – Note 1 to entry has been added.]

3.3.4

current setting range, <of an overcurrent release>

range between the minimum and maximum values over which the current setting of the ~~overcurrent~~ release can be adjusted

[SOURCE: IEC 60050-441:1984/AMD1:2000, 441-16-47, ~~modified~~]

3.3.5

tripping operation

opening operation of a circuit-breaker initiated by a release

3.4 Breaking characteristics

~~NOTE – Some of the terms defined in this clause are used in the examples of annex B.~~

3.4.1

opening time, <of a mechanical switching device>

interval of time between the specified instant of initiation of the opening operation and the instant when the arcing contacts have separated in all poles

Note 1 to entry: The instant of initiation of the opening operation is specified by the manufacturer for all the opening commands other than overcurrent.

Note 2 to entry: The opening time includes the operating time of any auxiliary equipment necessary to open the circuit-breaker and forming an integral part of the circuit-breaker.

[SOURCE: IEC 60050-441:1984/AMD1:2000, 441-17-36, modified – Note 1 to entry has been modified and Note 2 to entry has been added.]

3.4.2

overcurrent opening time

interval of time between the instant when the current in the main circuit reaches the current setting value of the overcurrent release and the instant when the arcing contacts have separated

3.4.3

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 ~~circuit-breaker~~ switching device or the fuse were replaced by a conductor of negligible impedance

Note 1 to entry: This term is commonly associated with fault conditions.

[SOURCE: IEC 60050-441:1984/AMD1:2000, 441-17-01, modified – Note has been replaced.]

3.4.4

prospective peak current

peak value of a prospective current during the transient period following initiation

[SOURCE: IEC 60050-441:1984/AMD1:2000, 441-17-02, modified – Note has been deleted.]

3.4.5

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: The instant of initiation of the breaking process is usually defined as the beginning of the arc.

[SOURCE: IEC 60050-441:1984/AMD1:2000, 441-17-06, modified – Note 1 to entry has been replaced.]

<https://standards.iteh.ai/catalog/standards/iec/7e07c31e-00ef-46e1-b453-94f572115b76/iec-60077-3-2019>

3.4.6

cut-off current

maximum instantaneous value of current attained during the breaking operation of a switching device or a fuse

Note 1 to entry: This concept is of particular importance when the switching device or the fuse operates in such a manner that the prospective peak current of the circuit is not reached.

[SOURCE: IEC 60050-441:1984/AMD1:2000, 441-17-12, modified – In note 1 to entry "is" has been added between "concept" and "of particular".]

3.4.7

recovery voltage

voltage which appears across the terminals of ~~each~~ a pole of a ~~circuit-breaker~~ switching device or a fuse after the breaking of the current

[SOURCE: IEC 60050-441:1984/AMD1:2000, 441-17-25, modified – Note has been deleted.]

3.4.8

arcing time, <of a pole or a fuse>

interval of time between the instant of the initiation of the arc ~~between the arcing contacts~~ in a pole or a fuse and the instant of final arc extinction in that pole or that fuse

[SOURCE: IEC 60050-441:1984/AMD1:2000, 441-17-37, ~~modified~~]

**3.4.9
break-time**

interval of time between the beginning of the opening time of a ~~circuit-breaker~~ mechanical switching device (or the pre-arcing time of a fuse) and the end of the arcing time

[SOURCE: IEC 60050-441:1984/AMD1:2000, 441-17-39, ~~modified~~]

**3.4.10
joule integral, <for a circuit-breaker>**

I^2t
integral of the square of the current in a circuit-breaker during a breaking process, over the break-time

$$I^2t = \int_{t_1}^{t_2} i^2 dt$$

~~t_1 = beginning of the opening time~~

~~t_2 = end of the arcing time~~

$$I^2t = \int_{t_0}^{t_1} i^2 dt$$

t_0 = beginning of the opening time

t_1 = end of the arcing time

[SOURCE: IEC 60050-441:1984/AMD1:2000, 441-18-23, modified – "in a circuit-breaker during a breaking process," has been added. "a given time interval" has been replaced with "the break-time". Notes have been deleted, keys for t_0 and t_1 have been added.]

**3.4.11
 I^2t characteristic, <for a circuit-breaker>**

information (generally a curve) giving the value of I^2t as a function of the prospective peak current for specified conditions such as the current setting of the release, the time constant of the test circuit, etc.

[SOURCE: IEC 60050-441:1984/AMD1:2000, 441-18-24, modified – "information (generally a curve) giving" has been added. "under prescribed conditions" has been deleted. "prospective current and/or voltage" has been replaced with "the prospective peak current ...". Note has been deleted.]

**3.4.12
break-time – current characteristic**

curve giving the break-time as a function of the prospective peak current for specified conditions such as the current setting of the release, the time constant of the test circuit, etc.

**3.4.13
cut-off current characteristic, <for a circuit-breaker>**

curve giving the cut-off current as a function of the prospective peak current for specified conditions such as the current setting of the release, the time constant of the test circuit, etc.

[SOURCE: IEC 60050-811:2017, 811-29-43, modified – "peak", "such" and ", etc." have been added.]

**3.4.14
initial current rate of rise**

di/dt
rate of rise at the beginning of the current flow