

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Grading capacitors for high-voltage alternating current circuit-breakers –
Part 1: General**

**Condensateurs de répartition pour disjoncteurs à courant alternatif haute
tension –
Partie 1: Généralités**

[IEC 62146-1:2013](https://standards.iteh.ai/)

<https://standards.iteh.ai/catalog/standards/iec/e7325502-7a0e-4c4c-9cd4-3f806d62be5a/iec-62146-1-2013>



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IEC 62146-1

Edition 1.1 2016-06
CONSOLIDATED VERSION

INTERNATIONAL STANDARD

NORME INTERNATIONALE



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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 31.060.01; 31.060.70

ISBN 978-2-8322-3485-3

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**GRADING CAPACITORS FOR HIGH-VOLTAGE
ALTERNATING CURRENT CIRCUIT-BREAKERS –**

Part 1: General

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This consolidated version of the official IEC Standard and its amendment has been prepared for user convenience.

IEC 62146-1 edition 1.1 contains the first edition (2013-09) [documents 33/535/FDIS and 33/541/RVD] and its amendment 1 (2016-06) [documents 33/583/FDIS and 33/586/RVD].

In this Redline version, a vertical line in the margin shows where the technical content is modified by amendment 1. Additions are in green text, deletions are in strikethrough red text. A separate Final version with all changes accepted is available in this publication.

International Standard IEC 62146-1 has been prepared by IEC technical committee 33: Power capacitors and their applications.

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

A list of all parts in the IEC 62146 series, published under the general title *Grading capacitors for high-voltage alternating current circuit-breakers*, can be found on the IEC website.

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

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GRADING CAPACITORS FOR HIGH-VOLTAGE ALTERNATING CURRENT CIRCUIT-BREAKERS –

Part 1: General

1 Scope

This part of the IEC 62146 series is applicable to grading capacitors used on circuit-breakers. Their function is to control the voltage distribution across the individual interrupter units of a multi-break circuit-breaker.

Grading capacitors can also be used in parallel to the interrupter unit on single break circuit-breakers to modify the Transient Recovery Voltage (TRV).

The grading capacitor is a sub-component for the circuit-breaker and shall be specified in accordance with the circuit-breaker specifications.

This standard applies to grading capacitors falling into one or both of the following categories for:

- mounting on air-insulated circuit-breakers;
- mounting on enclosed circuit-breakers (for example immersed in SF₆, in oil, etc.).

The testing for each of the above applications is in some cases different.

The object of this standard is:

- to define uniform rules regarding performances, testing and rating;
- to define specific safety rules;
- to provide a guidance for installation and operation.

NOTE CIGRE Technical Brochure 368 [2] presents a study about the operating environment of voltage grading capacitors applied to high-voltage circuit-breakers.

This standard does not apply to phase-to-earth capacitors installed on the circuit-breaker to modify the Transient Recovery Voltage.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050 (all parts), *International electrotechnical vocabulary* (available at <http://www.electropedia.org>)

IEC 60060-1:2010, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60068-2-17:1994, *Official version in Russian – Basic environmental testing procedures – Part 2-17: Tests – Test Q: Sealing*

IEC 60071-1:2006, *Insulation co-ordination – Part 1: Definitions, principles and rules*

IEC 60270:2000, *High-voltage test techniques – Partial discharge measurements*

IEC 60376:2005, *Specification of technical grade sulfur hexafluoride (SF₆) for use in electrical equipment*

IEC 60507-1:1991, *Artificial pollution tests on high-voltage insulators to be used on a.c. systems*

IEC 60567:2011, *Oil-filled electrical equipment – Sampling of gases and analysis of free and dissolved gases – Guidance*

IEC 60721-1:2002, *Classification of environmental conditions – Part 1: Environmental parameters and their severities*

IEC 60815 (all parts), *Selection and dimensioning of high-voltage insulators intended for use in polluted conditions*

IEC 61462:2007, *Composite hollow insulators – Pressurized and unpressurized insulators for use in electrical equipment with rated voltage greater than 1 000 V – Definitions, test methods, acceptance criteria and design recommendations*

IEC 62155:2003, *Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1 000 V*

IEC 62271-1:2007, *High-voltage switchgear and controlgear – Part 1: Common specifications*

IEC 62271-100:2008, *High-voltage switchgear and controlgear – Part 100: Alternating current circuit-breakers*

[IEC 62146-1:2013](https://standards.iteh.ai/IEC/62146-1:2013)

<https://standards.iteh.ai/IEC/62271-203:2003>, *High-voltage switchgear and controlgear – Part 203: Gas-insulated metal-enclosed switchgear for rated voltages above 52 kV*

IEC 62271-300:2006, *High-voltage switchgear and controlgear – Part 300: Seismic qualification of alternating current circuit-breakers*

IEC Guide 109, *Environmental aspects – Inclusion in electrotechnical product standards*

CISPR 18-2:1986, *Radio interference characteristics of overhead power lines and high-voltage equipment – Part 2: Methods of measurement and procedure for determining limits*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

arcing distance

shortest distance in the air external to the insulator between the metallic parts which normally have the operating voltage between them

[SOURCE: IEC 60050-471:2007, 471-01-01]

3.2

capacitor element

device consisting essentially of two electrodes separated by a dielectric

[SOURCE: IEC 60050-436:1990, 436-01-03]

3.3

capacitor losses

active power dissipated in the capacitor

[SOURCE: IEC 60050-436:1990, 436-04-10]

3.4

capacitor terminals

terminals intended for electrical and mechanical connection to the terminals of the interrupter units of circuit-breakers

3.5

capacitance tolerance

permissible difference between the actual capacitance and the rated capacitance under specified conditions

Note 1 to entry: The actual capacitance should be measured at, or referred to, the temperature at which the rated capacitance is defined.

[SOURCE: IEC 60050-436:1990, 436-04-01, modified by addition of Note to entry]

3.6

capacitor unit

assembly of one or more capacitor elements in the same container with terminals brought out

Note 1 to entry: A common type of unit for grading capacitors has a cylindrical housing of insulating material and metal end flanges which serve as terminals.

[SOURCE: IEC 60050-436:1990, 436-01-04, modified by addition of Note to entry]

3.7

completely immersed capacitor

capacitor, both ends of which are intended to be immersed in insulating media other than ambient air (e.g. oil or gas)

[SOURCE: IEC 60050-471:2007, 471-02-04, modified (definition originally referred to "bushing" instead of "capacitor")]

3.8

creepage distance

shortest distance along the surface of a solid insulating material between two conductive parts

Note 1 to entry: The surface of cement or any other non-insulating jointing material is not considered as forming part of the creepage distance.

Note 2 to entry: If high-resistance coating is applied to parts of the insulating part of an insulator, such parts are considered to be effective insulating surface and the distance over them is included in the creepage distance.

[SOURCE: IEC 60050-604:1987, 604-03-61, modified by addition of Notes to entry]

3.9

dielectric of a capacitor

insulating material between the electrodes of the capacitor element

Note 1 to entry: The major insulation generally consists of paper, plastic film, or a mixed of paper and plastic film subsequently treated and impregnated with oil or gas at atmospheric pressure or higher.

3.10

external insulation

distance in air and the surfaces in contact with open air of insulation of the grading capacitor which are subject to dielectric stresses

Note 1 to entry: They are also subject to the effects of the atmospheric and other external conditions such as pollution, humidity, ice, vermin, etc.

3.11

failure

termination of the ability of an item to perform a required function

Note 1 to entry: After failure the item has a fault.

Note 2 to entry: "Failure" is an event, as distinguished from "fault", which is a state.

Note 3 to entry: This concept as defined does not apply to items consisting of software only.

[SOURCE: IEC 60050-191:1990, 191-04-01]

3.12

flashover

electric breakdown between conductors in a gas or in a liquid or in a vacuum, at least partly along the surface of solid insulation

[SOURCE: IEC 60050-212:2012, 212-11-47]

3.13

grading capacitor

capacitor for installation on high-voltage circuit-breakers to control the voltage distribution across the individual interrupter unit

Note 1 to entry: The grading capacitors alone are accessories of the circuit-breaker

3.14

indoor capacitor

capacitor, both ends of which are intended to be in ambient air at atmospheric pressure but not exposed to outdoor atmospheric conditions

[SOURCE: IEC 60050-471:2007, 471-02-05, modified (definition originally referred to "bushing" instead of "capacitor")]

3.15

insulating envelope

insulator which is open from end to end, with or without sheds, including end fittings

Note 1 to entry: An insulating envelope can be made from one or more permanently assembled insulating elements.

Note 2 to entry: The insulating envelope may be in ceramic, glass or analogous inorganic material, cast or moulded resin, composite insulating material, in one piece or more pieces permanently assembled.