

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE

---

**Capacitors for high-voltage alternating current circuit-breakers –  
Part 2: TRV capacitors**

**Condensateurs pour disjoncteurs à courant alternatif haute tension –  
Partie 2: Condensateurs TTR**



**THIS PUBLICATION IS COPYRIGHT PROTECTED**  
**Copyright © 2023 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.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

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

Tel.: +41 22 919 02 11  
[info@iec.ch](mailto:info@iec.ch)  
[www.iec.ch](http://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](http://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 It also gives information on projects, replaced and withdrawn publications.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](http://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](http://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](mailto:sales@iec.ch).

#### **IEC Products & Services Portal - [products.iec.ch](http://products.iec.ch)**

Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

#### **Electropedia - [www.electropedia.org](http://www.electropedia.org)**

The world's leading online dictionary on electrotechnology, containing more than 22 300 terminological entries in English and French, with equivalent terms in 19 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

---

#### **A propos de l'IEC**

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

#### **A propos des publications IEC**

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

#### **Recherche de publications IEC -**

#### **[webstore.iec.ch/advsearchform](http://webstore.iec.ch/advsearchform)**

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études, ...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

#### **IEC Just Published - [webstore.iec.ch/justpublished](http://webstore.iec.ch/justpublished)**

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

#### **Service Clients - [webstore.iec.ch/csc](http://webstore.iec.ch/csc)**

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: [sales@iec.ch](mailto:sales@iec.ch).

#### **IEC Products & Services Portal - [products.iec.ch](http://products.iec.ch)**

Découvrez notre puissant moteur de recherche et consultez gratuitement tous les aperçus des publications. Avec un abonnement, vous aurez toujours accès à un contenu à jour adapté à vos besoins.

#### **Electropedia - [www.electropedia.org](http://www.electropedia.org)**

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 300 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 19 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.



IEC 62146-2

Edition 1.0 2023-01

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE

---

**Capacitors for high-voltage alternating current circuit-breakers –  
Part 2: TRV capacitors**

**Condensateurs pour disjoncteurs à courant alternatif haute tension –  
Partie 2: Condensateurs TTR**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

---

ICS 31.060; 31.060.70

ISBN 978-2-8322-6353-2

**Warning! Make sure that you obtained this publication from an authorized distributor.  
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

## CONTENTS

FOREWORD.....	4
1 Scope.....	6
2 Normative references .....	6
3 Terms and definitions .....	7
4 Abbreviated terms .....	8
5 Service conditions .....	8
6 Ratings.....	9
6.1 Rated voltage ( $U_{CR}$ ).....	9
6.2 Rated insulation level.....	9
6.3 Rated frequency ( $f_r$ ).....	11
7 Design and construction .....	11
7.1 Capacitance tolerances.....	11
7.2 Capacitor loss requirements.....	11
7.3 Partial discharge level.....	11
7.4 Angle of mounting.....	11
7.5 Minimum withstand value of mechanical bending load.....	11
7.5.1 Capacitors mounted on air insulated circuit-breaker.....	11
7.5.2 Immersed capacitors .....	12
7.5.3 Freestanding capacitors .....	12
7.6 Requirements for impregnation medium in capacitor .....	12
7.7 Protection against corrosion.....	12
7.8 Marking of the equipment.....	12
7.9 Creepage distances for outdoor insulators .....	13
7.10 Tightness .....	13
8 Type tests .....	13
8.1 Information for identification of specimens .....	13
8.2 Information to be included in type-test reports.....	13
8.3 Test conditions .....	13
8.4 Electrical type tests.....	13
8.4.1 General .....	13
8.4.2 Switching impulse voltage test.....	14
8.4.3 Lightning and chopped impulse voltage test.....	14
8.5 Voltage test at low and high temperature .....	15
8.5.1 Test procedure .....	15
8.5.2 Capacitor reduced-scale model design .....	15
8.6 Radio Interference Voltage (RIV) test.....	15
8.7 Short-circuit discharge test .....	16
8.8 Resonance frequency measurements.....	16
8.9 Mechanical bending test .....	16
8.10 Tightness test at different temperatures .....	16
8.11 Tightness test to check gas ingress from pressurized environment .....	16
8.12 Vibration test .....	16
9 Routine tests .....	17
9.1 General.....	17
9.2 Test conditions .....	17
9.3 Capacitance and loss angle measurements at power frequency.....	17

9.4	Power frequency voltage test .....	17
9.5	Partial discharge test .....	18
9.6	Tightness test .....	18
9.6.1	General .....	18
9.6.2	Oil impregnated capacitor .....	18
9.6.3	Tightness test for gas filled capacitors .....	18
9.7	Visual inspection and dimensional check .....	18
10	Recommendations for transport, storage, erection, operation, and maintenance .....	19
11	Safety .....	19
11.1	General .....	19
11.2	Precautions by manufacturers .....	19
11.3	Precautions by users .....	19
11.4	National regulations .....	19
12	Environmental aspects .....	20
Figure 1	– Electrical type tests sequence .....	14
Figure 2	– Reduced scale model capacitor element geometry .....	15
Figure 3	– Electrical routine test sequence .....	17
Table 1	– Standard insulation levels – Range I ( $U_r < 300$ kV) .....	9
Table 2	– Standard insulation levels – Range II ( $U_r \geq 300$ kV) .....	10
Table 3	– Partial discharge test voltages and permissible levels .....	11

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

---

**CAPACITORS FOR HIGH-VOLTAGE ALTERNATING  
CURRENT CIRCUIT-BREAKERS –**
**Part 2: TRV capacitors****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.

IEC 62146-2 has been prepared by IEC technical committee 33: Power capacitors and their applications. It is an International Standard.

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

Draft	Report on voting
33/685/FDIS	33/686/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at [www.iec.ch/members\\_experts/refdocs](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/publications](http://www.iec.ch/publications).

This International Standard is to be used in conjunction with IEC 62146-1:2013 and IEC 62146-1:2013/AMD1:2016.

A list of all parts in the IEC 62146 series, published under the general title *Capacitors for high-voltage alternating current circuit-breakers*, can be found on the IEC website. The title of the series was changed in 2022 by decision of TC 33, and the title of IEC 62146-1 will be modified accordingly in its next edition.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under [webstore.iec.ch](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.

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

## Part 2: TRV capacitors

### 1 Scope

This part of IEC 62146 is applicable to TRV capacitors used on high-voltage alternating current circuit-breakers with rated voltages above 100 kV with 50 Hz or 60 Hz.

TRV capacitors are installed phase to earth, either in parallel to the bushing on dead tank circuit-breakers, or immersed inside the circuit-breaker, or freestanding close to the circuit-breaker. Their function is to limit the transient recovery voltage (TRV) and the rate of rise of recovery voltage (RRRV) on the circuit-breaker. Capacitors in compliance with this document can be used as TRV capacitor.

This document applies to TRV capacitors falling into one or both of the following categories for:

- mounting on or close to air insulated switchgear (AIS) dead tank and live tank circuit-breakers, or
- mounting on gas insulated switchgear (GIS) circuit-breakers.

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

This document does not apply to grading capacitors installed in parallel to the chambers of the circuit-breaker, which are specified in IEC 62146-1.

This document does not apply to capacitors not directly associated with high-voltage alternating current circuit-breakers.

The object of this document is:

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

The TRV capacitor is a sub-component for the circuit-breaker and is specified in accordance with the circuit-breaker specifications according to IEC 62271-1, IEC 62271-100, and if applicable to IEC 62271-203.

TRV capacitors are commonly built with composite or ceramic housings (insulators). Those insulators follow IEC 61462 or IEC 62155. Other housings can be used if they can sustain applicable type tests according to IEC 61462 and IEC 62155.

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