

TECHNICAL SPECIFICATION

SPECIFICATION TECHNIQUE

Shunt capacitors for a.c. power systems having a rated voltage above 1 000 V –
Part 2: Endurance testing

(standards.iteh.ai)

Condensateurs shunt pour réseaux à courant alternatif de tension assignée
supérieure à 1 000 V –

Partie 2: Essais d'endurance



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2014 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 Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
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 corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub

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 also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 30 000 terms and definitions in English and French, with equivalent terms in 14 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

More than 55 000 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 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: csc@iec.ch.

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.

Catalogue IEC - webstore.iec.ch/catalogue

Application autonome pour consulter tous les renseignements bibliographiques sur les Normes internationales, Spécifications techniques, Rapports techniques et autres documents de l'IEC. Disponible pour PC, Mac OS, tablettes Android et iPad.

Recherche de publications IEC - www.iec.ch/searchpub

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

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

Electropedia - www.electropedia.org

Le premier dictionnaire en ligne de termes électroniques et électriques. Il contient plus de 30 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 14 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

Plus de 55 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: csc@iec.ch.

TECHNICAL SPECIFICATION

SPECIFICATION TECHNIQUE

**Shunt capacitors for a.c. power systems having a rated voltage above 1 000 V –
Part 2: Endurance testing** (standards.iteh.ai)

**Condensateurs shunt pour réseaux à courant alternatif de tension assignée
supérieure à 1 000 V –
Partie 2: Essais d'endurance**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX

K

ICS 29.249.99; 31.060.70

ISBN 978-2-8322-1937-9

**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.....	3
1 Scope.....	5
2 Normative references	5
3 Terms and definitions	5
4 Quality requirements and tests	6
4.1 Test requirements – General purpose	6
4.2 Test procedure.....	6
4.2.1 General	6
4.2.2 Routine test.....	6
4.2.3 Conditioning of the units before the test.....	6
4.3 Ageing test	6
4.3.1 Initial capacitance and dielectric loss measurements	6
4.3.2 Final capacitance and dielectric loss measurements	7
4.3.3 Acceptance criteria	7
4.4 Validity of test.....	7
Annex A (normative) Requirements regarding comparable element design and test unit design.....	8
A.1 Test element design criteria	8
A.2 Test unit design	8
Annex B (informative) Definition of element and capacitor container dimensions.....	10
B.1 Flattened pressed element.....	10
B.2 Capacitor container.....	10
Figure B.1 – Flattened pressed element.....	10
Figure B.2 – Capacitor container.....	10

iTech STANDARD PREVIEW
 (standards.iotech.ai)
<https://standards.iotech.ai/catalog/standards/sist/0673b301-2889-4cdc-a5c8-d19c9d535af1/iec-ts-60871-2-2014>

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**SHUNT CAPACITORS FOR AC POWER SYSTEMS
HAVING A RATED VOLTAGE ABOVE 1 000 V –****Part 2: Endurance testing**

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.

The main task of IEC technical committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a technical specification when

- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC/TS 60871-2, which is a technical specification, has been prepared by IEC technical committee 33: Power capacitors and their applications.

This third edition cancels and replaces the second edition published in 1999. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) The overvoltage cycling test has been moved to IEC 60871-1:2014.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
33/536/DTS	33/565/RVC

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

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

A list of all parts in the IEC 60871 series, published under the general title *Shunt capacitors for a.c. power systems having a rated voltage above 1 000 V*, can be found on the IEC website.

The committee has decided that the contents of this publication 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

- transformed into an International standard, [IEC TS 60871-2:2014](https://standards.iteh.ai/catalog/standards/sist/0673b301-2889-4edc-a5e8-d19c9d535af1/iec-ts-60871-2-2014)
- reconfirmed, [https://standards.iteh.ai/catalog/standards/sist/0673b301-2889-4edc-a5e8-](https://standards.iteh.ai/catalog/standards/sist/0673b301-2889-4edc-a5e8-d19c9d535af1/iec-ts-60871-2-2014)
- withdrawn, [d19c9d535af1/iec-ts-60871-2-2014](https://standards.iteh.ai/catalog/standards/sist/0673b301-2889-4edc-a5e8-d19c9d535af1/iec-ts-60871-2-2014)
- replaced by a revised edition, or
- amended.

SHUNT CAPACITORS FOR AC POWER SYSTEMS HAVING A RATED VOLTAGE ABOVE 1 000 V –

Part 2: Endurance testing

1 Scope

This part of IEC 60871, which is a technical specification, applies to capacitors according to IEC 60871-1 and gives the requirements for ageing tests of these capacitors.

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 60871-1:2014, *Shunt capacitors for a.c. power systems having a rated voltage above 1 000 V – Part 1: General*

IEC TR 60996, *Method for verifying accuracy of tan delta measurements applicable to capacitors*

3 Terms and definitions

[IEC TS 60871-2:2014](https://standards.iteh.ai/catalog/standards/sist/0673b301-2889-4edc-a5e8-d19c9d535af1/iec-ts-60871-2-2014)

<https://standards.iteh.ai/catalog/standards/sist/0673b301-2889-4edc-a5e8-d19c9d535af1/iec-ts-60871-2-2014>

For the purpose of this technical specification, the following terms and definitions apply in addition to those given in IEC 60871-1:

3.1

test unit

one of the units to be manufactured or a special unit which, with respect to the properties to be checked by the ageing test, is equivalent to the units to be manufactured

Note 1 to entry: The restrictions on test unit design are detailed in Annex A.

3.2

comparable element design

range of construction elements that will be comparable in performance, under the test procedure, with elements of the units to be manufactured

Note 1 to entry: See Annex A for detailed design limits.

3.3

inter-element insulation

insulation between two series-connected elements, consisting of:

- the outer turns of the insulation layers around the electrodes in an element, or
- a separate insulation layer placed between the two elements

Note 1 to entry: This separate insulation layer may protrude outside the width and (or) length dimension(s) of the flattened element (see Annex B).

4 Quality requirements and tests

4.1 Test requirements – General purpose

The ageing test is a special test carried out in order to ascertain that the progression of deterioration resulting from increased voltage stress at elevated temperature does not cause untimely failure of the dielectric. It is a mean to ensure that basic material selection is properly made and that any rapid deterioration does not take place. The test should not be seen as a tool for any exact assessment of life characteristics of a dielectric. For that purpose various research and development activities are to be taken care of by the manufacturers.

The ageing test shall be carried out as special tests by the manufacturer for a particular dielectric system, i.e. not for each particular capacitor rating. The test results are applicable to a wide range of capacitor ratings within the limits defined in Annex A. The purchaser shall, on request, be supplied with a certificate detailing the results of such tests.

4.2 Test procedure

4.2.1 General

The ageing test shall be carried out in the sequence given below. The applied test voltage shall have a frequency of 50 Hz or 60 Hz, except for the test according to 4.2.2 where a d.c. voltage can be used according to 9.3 of IEC 60871-1:2014.

4.2.2 Routine test

The test unit shall be subjected to the routine voltage test between the terminals (see IEC 60871-1) with an amplitude such that the correct test voltage is obtained across each element.

4.2.3 Conditioning of the units before the test

The test unit shall be subjected to a voltage of not less than $1,1 U_N$ at an ambient temperature of not less than $+10\text{ °C}$ for not less than 16 h.

NOTE The conditioning is carried out to stabilize the dielectric properties of the test units.

4.3 Ageing test

4.3.1 Initial capacitance and dielectric loss measurements

The capacitor unit shall be measured at 0,9 to 1,1 times the rated voltage. The choice of temperature is left to the manufacturer.

4.3.1.1 Test method

The ambient temperature during the ageing test shall be not less than 55 °C .

It is anticipated, given the limits for the test object specified in Annex A, that more than 60 °C average dielectric temperature is achieved. If requested by the purchaser further details about the relation between external and internal (dielectric) temperatures should be given by the manufacturer. The dielectric temperature may be measured with thermocouples on specially prepared test units or estimated from previously established relationships between internal and external temperatures such as by use of resistive dummy capacitors described in IEC 60996.

The ambient temperature shall be held constant with a tolerance of -2 °C to $+5\text{ °C}$. Prior to energization, the test units shall be stabilized in this ambient for 12 h. Due to the length of this test, voltage interruptions are allowed. During these interruptions, the units shall remain in the

controlled ambient. If power is lost to the chamber, the ambient temperature shall be reattained for 12 h prior to re-energization of the units.

The testing time shall depend on the test voltage. Either one of the following test conditions shall be used:

Test voltage	Duration h
1,25 U_N	3 000
1,40 U_N	1 000

4.3.2 Final capacitance and dielectric loss measurements

The measurement shall be repeated under the same conditions as for the initial measurement, within a temperature tolerance of $\pm 5^\circ\text{C}$. The measurements shall be made within two days after completing the tests in 4.1.3.2.

4.3.3 Acceptance criteria

No breakdown shall occur when two units have been tested, or alternatively one breakdown is accepted when three units have been tested.

To verify no breakdown the capacitance measurements performed in 4.3.1 and 4.3.2 shall differ by less than an amount corresponding to breakdown of an element.

4.4 Validity of test

The ageing test is a test on the elements (their dielectric design and composition), and on their processing (element winding, drying and impregnation) when assembled in a capacitor unit. Each ageing test will also cover other capacitor designs, which are allowed to differ from the tested design within the limits stated in Annex A.

A test performed at 50 Hz is also applicable for 60 Hz (and lower frequency) units and vice versa.

Annex A (normative)

Requirements regarding comparable element design and test unit design

A.1 Test element design criteria

A tested element design is considered to be comparable with respect to the elements in the units to be manufactured if the following requirements are fulfilled:

- a) the tested element shall have the same or an inferior number of layers of solid materials in the dielectric and be impregnated with the same liquid.
the dielectric shall be within 70°% to 130°% of the thickness and be rated at equal or higher electrical stress.
when a dielectric contains both film and paper, the stress value to be used in this comparison is the stress across each of the solid materials, calculated using the thickness of only the solid materials and their respective permittivity.
for the ageing test, using resistors and/or internal fuses is irrelevant for the test. It is up to the manufacturer to choose.
- b) the dielectric composition of the solid materials shall be the same, for example all-film or all-paper or film-paper-film, etc.;
- c) solid and liquid dielectric materials shall satisfy the same manufacturer's specifications;
- d) the aluminium-foil design shall be the same:
 - same manufacturer's specification;
 - thickness within $\pm 20\%$;
 - extended or non-extended foil edges;
 - folded foil at the edges and (or) cut ends if it is a feature of the design;
 - less or equal free margin;
- e) element connections shall be of the same type, for example tabs, soldering, etc.;
- f) the element width (active foil width) is allowed to vary within 50°% to 400°% and the element length (active foil length) is allowed to vary within 30°% to 300°% (see Annex B).

A.2 Test unit design

A test unit is considered to be comparable to the units to be manufactured if the following requirements are satisfied:

- a) elements meeting the requirements of Clause A.1 shall be similarly assembled, have equal or thinner inter-element insulation, be equally pressed within the manufacturing tolerance, etc., as compared with the units to be manufactured;
- b) a suitable number of elements shall be connected to give not less than 100 kvar output at rated voltage (50 Hz). All connected elements shall be placed adjacent to each other.

NOTE The connected elements may be series and parallel-connected in any way to match the test equipment.

- c) the connections outside the tested elements may be enlarged in order to handle the increased currents due, for example, to a number of elements in parallel;
- d) the insulation to the container shall be of the same thickness or thicker;

NOTE This requirement is intended to ensure that the drying and impregnation conditions are equal to those of the units to be produced. The electrical withstand requirements of the insulation to container are taken care of by the tests according to Clauses 10 and 15 of IEC 60871-1:2014.

- e) a container shall be used, the height of which is not less than 20% of the height of the unit to be manufactured. The depth and width of the container shall not be less than 50%.

NOTE These ranges in container dimensions are necessary to allow for the variation in element sizes.

The container material shall be of equal type (metal, polymer etc.), but the painting can be omitted or may be different.

The bushing design and number of bushings may be adjusted in order to match the test voltage and/or test currents;

- f) the drying and impregnation process shall be identical with the normal production process.

iTeh STANDARD PREVIEW **(standards.iteh.ai)**

[IEC TS 60871-2:2014](https://standards.iteh.ai/catalog/standards/sist/0673b301-2889-4edc-a5e8-d19c9d535af1/iec-ts-60871-2-2014)

<https://standards.iteh.ai/catalog/standards/sist/0673b301-2889-4edc-a5e8-d19c9d535af1/iec-ts-60871-2-2014>