

# INTERNATIONAL STANDARD



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

(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>



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

**Part 2: Endurance testing**

**FOREWORD**

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

**IEC TS 60871-2 edition 3.1 contains the third edition (2014-11) [documents 33/536/DTS and 33/565/RVC] and its amendment 1 (2022-03) [documents 33/668/DTS and 33/671/RVDTS].**

**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.**



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 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.

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 the base publication and its amendment will remain unchanged until the stability date indicated on the IEC web site under [webstore.iec.ch](http://webstore.iec.ch) in the data related to the specific publication. At this date, the publication will be

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- withdrawn,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

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# 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

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  $55\text{ °C}$ .

It is anticipated, given the limits for the test object specified in Annex A, that more than  $60\text{ °C}$  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  $-2\text{ °C}$  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.

### 5 Element fail safe test for fuseless capacitors

#### 5.1 General

The proof of element fail safe is a design test applicable to fuseless power capacitors, as defined in IEC 60871-1:2014, Clause E.4.

This proof is obtained by means of two separate tests, the low energy test and the high energy test.

The low energy test is aimed to demonstrate that a failure of one capacitive element, caused by a low voltage element failure event at the rated voltage, will result in reliable and secure foil welding on the failed portion of the element without generation of hot spots and persistent release of gas.

The high energy test is aimed to demonstrate that a failure of one or more capacitive elements, caused by the occurrence of an overvoltage on the capacitor bank, will result in reliable and safe behaviour without container rupture or explosion.

The physical location of the fault on the capacitor element is intended to represent the worst possible location under the expected low or high energy level tested. A damage to the