

INTERNATIONAL STANDARD

NORME INTERNATIONALE



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

(standards.iteh.ai)

**Condensateurs shunt pour réseaux à courant alternatif de tension assignée
supérieure à 1 000 V –
Partie 1: Généralités**

<https://standards.iteh.ai/catalog/standards/sist/98b53caf-687b-4b1d-8c3f-88f903094ec7/iec-60871-1-2014>



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Part 1: General**

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**Condensateurs shunt pour réseaux à courant alternatif de tension assignée
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Partie 1: Généralités

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HAVING A RATED VOLTAGE ABOVE 1 000 V –****Part 1: General****FOREWORD**

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International Standard IEC 60871-1 has been prepared by IEC technical committee 33: Power capacitors and their applications.

This fourth edition cancels and replaces the third edition published in 2005. 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 this standard from the IEC 60871-2;
- b) the ranges of the standardized values of the highest voltage for equipment have been modified;
- c) for installations installed on altitudes above 1 000 m a correction factor to all insulation requirements has been introduced;
- d) new standard insulation tables have been defined;

The text of this standard is based on the following documents:

FDIS	Report on voting
33/559/FDIS	33/564/RVD

Full information on the voting for the approval of this standard 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

- reconfirmed,
- withdrawn,
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SHUNT CAPACITORS FOR AC POWER SYSTEMS HAVING A RATED VOLTAGE ABOVE 1 000 V –

Part 1: General

1 Scope

This part of IEC 60871 is applicable to both capacitor units and capacitor banks intended to be used, particularly, for power-factor correction of a.c. power systems having a rated voltage above 1 000 V and frequencies of 15 Hz to 60 Hz.

This part of IEC 60871 also applies to capacitors intended for use in power filter circuits. Additional definitions, requirements and tests for filter capacitors are given in Annex B.

Additional requirements for capacitors protected by internal fuses as well as requirements for the internal fuses are given in IEC 60871-4.

Requirements for capacitors to be protected by external fuses, as well as requirements for the same, are given in Annex C.

This standard does not apply to capacitors of the self-healing metallized dielectric type.

The following capacitors are excluded from this part of IEC 60871:

- capacitors for inductive heat-generating plants operating at frequencies between 40 Hz and 24 000 Hz (IEC 60110-1);
- series capacitors for power systems (see the IEC 60143 series);
- capacitors for motor applications and the like (see the IEC 60252 series);
- coupling capacitors and capacitor dividers (IEC 60358);
- shunt capacitors for a.c. power systems having rated voltage up to and including 1 000 V (see the IEC 60831 and IEC 60931 series);
- small a.c. capacitors to be used for fluorescent and discharge lamps (IEC 61048 and IEC 61049);
- capacitors to be used in power electronic circuits (IEC 61071);
- capacitors for microwave ovens (IEC 61270-1);
- capacitors for suppression of radio interference;
- capacitors intended for use with a.c. voltage superimposed on d.c. voltage.

Accessories such as insulators, switches, instrument transformers, external fuses, etc. are in accordance with the relevant IEC standards.

The object of this part of IEC 60871 is as follows:

- a) to formulate uniform rules regarding the performance and rating of units and banks, and the testing of units;
- b) to formulate specific safety rules;
- c) to provide a guide for installation and operation.

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

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

IEC 60549, *High-voltage fuses for the external protection of shunt capacitors*

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

IEC 60871-4:1996, *Shunt capacitors for AC power systems having a rated voltage above 1 000 V – Part 4: Internal fuses*

3 Terms and definitions

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

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3.1 capacitor element

element

device consisting essentially of two electrodes separated by a dielectric

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

3.2

capacitor unit

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

[SOURCE: IEC 60050-436:1990, 436-01-04]

3.3

capacitor bank

bank

number of capacitor units connected so as to act together

[SOURCE: IEC 60050-436:1990, 436-01-06]

3.4

capacitor

two-terminal device characterized essentially by its capacitance

Note 1 to entry: The term "capacitor" is used when it is not necessary to specify whether a capacitor unit or capacitor bank is meant.

[SOURCE: IEC 60050-151:2001, 151-13-28]

3.5

capacitor installation

one or more capacitor banks and their accessories

[SOURCE: IEC 60050-436:1990, 436-01-07]

3.6

discharge device of a capacitor

device which may be incorporated in a capacitor, capable of reducing the voltage between the terminals practically to zero, within a given time, after the capacitor has been disconnected from a network

[SOURCE: IEC 60050-436:1990, 436-03-15, modified by replacement of “intended to” by “capable of” and of “to a given value” by “practically to zero”]

3.7

internal fuse of a capacitor

fuse connected inside a capacitor unit, in series with an element or a group of elements

[SOURCE: IEC 60050-436:1990, 436-03-16]

3.8

line terminal

terminal intended for connection to a line conductor of a network

Note 1 to entry: In polyphase capacitors, a terminal intended to be connected to the neutral conductor is not considered to be a line terminal.

[SOURCE: IEC 60050-436:1990, 436-03-01, modified by addition of Note 1]

3.9

rated capacitance of a capacitor

C_N

capacitance value derived from the values of rated output, voltage and frequency of the capacitor

[SOURCE: IEC 60050-436:1990, 436-01-12, modified by addition of “ C_N ”]

3.10

rated output of a capacitor

Q_N

reactive power for which the capacitor has been designed

[SOURCE: IEC 60050-436:1990, 436-01-16, modified by addition of “ Q_N ”]

3.11

rated voltage of a capacitor

U_N

r.m.s. value of the alternating voltage for which the capacitor has been designed

Note 1 to entry: In the case of capacitors consisting of one or more separate circuits (for example single-phase units intended for use in polyphase connection, or polyphase units with separate circuits), U_N refers to the rated voltage of each circuit.

For polyphase capacitors with internal electrical connections between the phases, and for polyphase capacitor banks, U_N refers to the phase-to-phase voltage.

[SOURCE: IEC 60050-436:1990, 436-01-15, modified by addition of “ U_N ” and Note 1]

3.12

rated frequency of a capacitor

f_N

frequency for which the capacitor has been designed

[SOURCE: IEC 60050-436:1990, 436-01-14, modified by addition of " f_N "]

3.13 rated current of a capacitor

I_N

r.m.s. value of the alternating current for which the capacitor has been designed

[SOURCE: IEC 60050-436:1990, 436-01-13, modified by addition of " I_N "]

3.14 capacitor losses

active power dissipated in the capacitor

Note 1 to entry: All loss-producing components should be included, for example:

- for a unit, losses from dielectric, internal fuses, internal discharge resistor, connections, etc;
- for a bank, losses from units, external fuses, busbars, discharge and damping reactors, etc.

Note 2 to entry: The capacitor losses may be recalculated as an equivalent series resistor to the unit and/or bank.

[SOURCE: IEC 60050-436:1990, 436-04-10, modified by addition of Note 1]

3.15 tangent of the loss angle (of a capacitor)

$\tan \delta$

ratio between the equivalent series resistance and the capacitive reactance of the capacitor at specified sinusoidal alternating voltage and frequency

[SOURCE: IEC 60050-436:1990, 436-04-11]

3.16 maximum permissible a.c. voltage of a capacitor

maximum r.m.s. alternating voltage which the capacitor can sustain for a given time in specified conditions

[SOURCE: IEC 60050-436:1990, 436-04-07]

3.17 maximum permissible a.c. current of a capacitor

maximum r.m.s. alternating current which the capacitor can sustain for a given time in specified conditions

[SOURCE: IEC 60050-436:1990, 436-04-09]

3.18 ambient air temperature

temperature of the air at the proposed location of the capacitor

3.19 cooling air temperature

temperature of the cooling air measured at the hottest position in the bank, under steady-state conditions, midway between two units

Note 1 to entry: If only one unit is involved, it is the temperature measured at a point approximately 0,1 m away from the capacitor container and at two-thirds of the height from its base.

3.20

steady-state condition

thermal equilibrium attained by the capacitor at constant output and at constant ambient air temperature

3.21

residual voltage

voltage remaining on the terminals of a capacitor at a certain time following disconnection

4 Service conditions

4.1 Normal service conditions

This standard gives requirements for capacitors intended for use in the following conditions:

a) Residual voltage at energization

This shall not exceed 10 % of the rated voltage (see Clause 21, Subclause 19.2 and Annex D).

b) Altitude

If the altitude exceeds 1 000 m above sea level a correction factor shall be applied to all external insulation requirements as stipulated in Clause 18.

c) Ambient air temperature categories

Capacitors are classified in temperature categories, each category being specified by a number followed by a letter. The number represents the lowest ambient air temperature at which the capacitor may operate. The letters represent upper limits of temperature variation ranges, having maximum values specified in Table 1. The temperature categories cover the temperature range of -50 °C to +55 °C.

The lowest ambient air temperature at which the capacitor may be operated should be chosen from the five preferred values +5 °C, -5 °C, -25 °C, -40 °C, -50 °C.

NOTE With the agreement of the manufacturer, the capacitor can be used at a lower temperature than the limits above, provided that energization takes place at a temperature at or above these limits (see 27.3.1).

Table 1 is based on service conditions in which the capacitor does not influence the ambient air temperature (for example outdoor installations).

Table 1 – Letter symbols for upper limit of temperature range

Ambient temperature °C			
Symbol	Maximum	Highest mean over any period of	
		24 h	1 year
A	40	30	20
B	45	35	25
C	50	40	30
D	55	45	35

NOTE These temperature values can be found in the meteorological temperature tables covering the installation site.

If the capacitor influences the air temperature, the ventilation and/or choice of capacitor shall be such that the Table 1 limits are maintained. The cooling air temperature in such an installation shall not exceed the temperature limits of Table 1 by more than 5 °C.

Any combination of minimum and maximum values can be chosen for the standard temperature category of a capacitor, for example –40/A or –5/C. Preferred standard temperature categories are: –40/A, –25/A, –5/A and –5/C.

4.2 Unusual service conditions

Unless otherwise agreed between manufacturer and purchaser, this standard does not apply to capacitors, the service conditions of which, in general, are incompatible with the requirements of the present standard.

5 Quality requirements and tests

5.1 General

Clauses 5 to 17 give the test requirements for capacitor units.

Supporting insulators, switches, instrument transformers, external fuses, etc. shall be in accordance with relevant IEC standards.

NOTE The year of issue (version number) of referred standards is given in test reports.

5.2 Test conditions

Unless otherwise specified for a particular test or measurement, the temperature of the capacitor dielectric shall be in the range +5 °C to +35 °C.

When a correction has to be applied, the reference temperature to be used is +20 °C, unless otherwise agreed between the manufacturer and the purchaser.

It may be assumed that the dielectric temperature of the capacitor unit is the same as the ambient temperature, provided that the capacitor has been left in an unenergized state at a constant ambient temperature for an adequate period.

The a.c. tests and measurements shall be carried out at a frequency of 50 Hz or 60 Hz independent of the rated frequency of the capacitor, if not otherwise specified.

6 Classification of tests

6.1 General

The tests are classified as routine tests, type tests and acceptance tests.

6.2 Routine tests

- a) Capacitance measurement (see Clause 7).
- b) Measurement of the tangent of the loss angle ($\tan \delta$) of the capacitor (see Clause 8).
- c) Voltage test between terminals (see Clause 9).
- d) AC voltage test between terminals and container (see Clause 10).
- e) Test of internal discharge device (see Clause 11).
- f) Sealing test (see Clause 12).
- g) Discharge test on internal fuses (see 5.1.1 of IEC 60871-4:1996).

Routine tests shall have been carried out by the manufacturer on every capacitor before delivery. If the purchaser so requests, he shall be supplied with a certificate detailing the results of such tests. The test sequence above is not mandatory.