

INTERNATIONAL STANDARD



**Shunt power capacitors of the self-healing type for a.c. systems having a rated voltage up to and including 1 000 V –
Part 1: General – Performance, testing and rating – Safety requirements – Guide for installation and operation**

IEC 60831-1:2014

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

SHUNT POWER CAPACITORS OF THE SELF-HEALING TYPE FOR A.C. SYSTEMS HAVING A RATED VOLTAGE UP TO AND INCLUDING 1 000 V –**Part 1: General – Performance, testing and rating –
Safety requirements – Guide for installation and operation**

FOREWORD

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International Standard IEC 60831-1 has been prepared by IEC technical committee 33: Power capacitors and their applications.

This third edition cancels and replaces the second edition published in 1996 and Amendment 1:2002. This edition constitutes a technical revision.

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

- a) Updating of the normative references;
- b) Test conditions have been clarified;
- c) Thermal stability test has been clarified;
- d) Maximum permissible voltage and current have been clarified;
- e) The protection of the environment has been amended with safety concerns and plastic quality requirements.

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

FDIS	Report on voting
33/543/FDIS	33/550/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 60831 series, published under the general title *Shunt power capacitors of the self-healing type for a.c. systems having a rated voltage up to and including, 1 000 V* can be found on the IEC website: <https://www.iec.ch/standards/614a-5851-496e-8b04-db3d6c91e47c/iec-60831-1-2014>

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- withdrawn,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

The contents of the corrigendum of May 2014 have been included in this copy.

SHUNT POWER CAPACITORS OF THE SELF-HEALING TYPE FOR A.C. SYSTEMS HAVING A RATED VOLTAGE UP TO AND INCLUDING 1 000 V –

Part 1: General – Performance, testing and rating – Safety requirements – Guide for installation and operation

Section 1: General

1 ~~Scope and object~~

This part of the IEC 60831 series 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 up to and including 1 000 V and frequencies of 15 Hz to 60 Hz.

This part of IEC 60831 also applies to capacitors intended for use in power filter circuits. Additional definitions, requirements, and tests for **power** filter capacitors are given in Annex A.

The following capacitors are excluded from this part of IEC 60831:

- Shunt power capacitors of the non-self-healing type for a.c. systems having a rated voltage up to and including 1 000 V (IEC 60931-1, -2 and -3).
- Shunt capacitors for a.c. power systems having a rated voltage above 1 000 V (IEC 60871-1, -2, -3 and -4).
- Capacitors for inductive heat-generating plants operating at frequencies between 40 Hz and 24 000 Hz (IEC 60110-1 and -2).
- Series capacitors (IEC 60143-1, -2, -3 and -4).
- ~~Capacitors for motor applications and the like~~ AC motor capacitors (IEC 60252-1 and -2).
- Coupling capacitors and capacitor dividers (IEC 60358-1).
- Capacitors ~~to be used in for~~ power electronic circuits (IEC 61071).
- Small a.c. capacitors to be used for fluorescent and discharge lamps (IEC 61048 and IEC 61049).
- Capacitors for suppression of radio interference (under consideration).
- Capacitors intended to be used in various types of electrical equipment, and thus considered as components.
- Capacitors intended for use with d.c. voltage superimposed on the a.c. voltage.

Accessories such as insulators, switches, instrument transformers, fuses, etc., should be in accordance with the relevant IEC standards **and are not covered by the scope of this part of IEC 60831.**

The object of this part of IEC 60831 is to:

- a) formulate uniform rules regarding performances, testing and rating;
- b) formulate specific safety rules;
- c) 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 60050(436):1990, International Electrotechnical Vocabulary (IEV) — Chapter 436: Power capacitors~~

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

~~IEC 60110:1973, Recommendation for capacitors for inductive heat generating plants operating at frequencies between 40 and 24 000 Hz~~

~~IEC 60143:1992, Series capacitors for power systems~~

~~IEC 60252:1993, A.C. motor capacitors~~

IEC 60269-1:2006, *Low-voltage fuses – Part 1: General requirements*

~~IEC 60358:1990, Coupling capacitors and capacitor dividers~~

IEC 60695-2-12:2010, *Fire hazard testing – Part 2-12: Glowing/hot-wire based test methods – Glow-wire flammability index (GWFI) test method for materials*

IEC 60831-2:2013, *Shunt power capacitors of the self-healing type for a.c. systems having a rated voltage up to and including 1 000 V – Part 2: Ageing test, self-healing test and destruction test*

~~IEC 60871-1:1987, Shunt capacitors for a.c. power systems having a rated voltage above 1 000 V* — Part 1: General — Performance, testing and rating — Safety requirements — Guide for installation and operation~~

~~IEC 60931-1:1996, Shunt power capacitors of the non-self-healing type for a.c. systems having a rated voltage up to and including 1 000 V — Part 1: General — Performance, testing and rating — Safety requirements — Guide for installation and operation~~

~~IEC 60931-3:1996, Shunt power capacitors of the non-self-healing type for a.c. systems having a rated voltage up to and including 1 000 V — Part 3: Internal fuses~~

IEC 61000-2-2:2002, *Electromagnetic compatibility (EMC) – Part 2-2: Environment – Compatibility levels for low-frequency conducted disturbances and signalling in public low-voltage power supply systems*

IEC 61000-4-1:2006, *Electromagnetic compatibility (EMC) – Part 4-1: Testing and measurement techniques — Overview of immunity tests. Basic EMC publication Overview of IEC 61000-4 series*

~~IEC 61048:1991, Capacitors for use in tubular fluorescent and other discharge lamp circuits — General and safety requirements~~

~~IEC 61049:1991, Capacitors for use in tubular fluorescent and other discharge lamp circuits — Performance requirements~~

~~IEC 61071-1:1993, Power electronic capacitors — Part 1: General~~

* According to Amendment 1 (1991).

3 Terms and definitions

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

3.1

capacitor element element

device consisting essentially of two electrodes separated by a dielectric

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

3.2

capacitor unit 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

self-healing capacitor

capacitor of which the electrical properties, after local breakdown of the dielectric, are rapidly and essentially restored

[SOURCE: IEC 60050-436:1990, 436-03-12]

3.4

capacitor bank bank

number of capacitor units connected so as to act together

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

3.5

capacitor

generic term, encompassing the notions of capacitor unit and capacitor bank

Note 1 to entry: In this part of IEC 60831, the word capacitor is used when it is not necessary to lay particular stress upon the different meanings of the words capacitor unit or capacitor bank.

3.6

capacitor installation

one or more capacitor banks and their accessories

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

3.7

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 ("intended to reduce ... value" has been replaced by "capable of reducing ... zero")]

3.8

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]

3.9

overpressure disconnecter for a capacitor

disconnecting device designed to switch off the capacitor in the case of abnormal increase of the internal pressure

[SOURCE: IEC 60050-436:1990, 436-03-17, modified ("to interrupt ... in the event" has been replaced by "to switch off ... in the case")]

3.10

overtemperature disconnecter for a capacitor

disconnecting device designed to switch off the capacitor in the case of abnormal increase of the internal temperature

3.11

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]

3.12

rated capacitance of a capacitor

C_N

capacitance value for which the capacitor has been designed

[SOURCE: IEC 60050-436:1990, 436-01-12, modified (symbol C_N added and "the r.m.s. value of the alternating current" has been replaced by "capacitance value")]

3.13

rated output of a capacitor

Q_N

reactive power derived from the rated values of capacitance, frequency and voltage

[SOURCE: IEC 60050-436:1990, 436-01-16, modified (symbol Q_N added and "for which the capacitor has been designed" has been replaced by "derived ... voltage")]

3.14

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 (such as 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]

3.15

rated frequency of a capacitor

f_N

frequency for which the capacitor has been designed

[SOURCE: IEC 60050-436:1990, 436-01-14]

3.16 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]

3.17 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.

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

3.18 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]

3.19 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

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

3.20 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]

3.21 ambient air temperature

temperature of the air at the proposed location of the capacitor

3.22 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.

3.23 steady-state condition

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

3.24

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 under the following conditions:

- a) Residual voltage at energization
Not to exceed 10 % rated voltage (Clause 22, Clause 32, and Annex B).
- b) Altitude
Not exceeding 2 000 m.
- 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.

For indoor use, a lower limit of –5 °C is normally applicable.

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

Symbol	Ambient temperature °C		
	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 1 The temperature values according to Table 1 can be found in the meteorological temperature table covering the installation site.

NOTE 2 Higher temperature values than those indicated in Table 1 can be considered in special applications by mutual agreement between manufacturer and purchaser. In that case, the temperature category should be indicated by the combination of minimum and maximum temperature values, for example, –40/60.

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.