

Shunt power capacitors of the non-self-healing type for a.c. systems having a rated voltage up to and including 1 kV —

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

The European Standard EN 60931-1:1996, with the incorporation of amendment A1:2003, has the status of a British Standard

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National foreword

This British Standard is the official English language version of EN 60931-1:1996, including amendment A1:2003. It is identical with IEC 60931-1:1996, including amendment 1:2002. It supersedes BS EN 60931-1:1994 which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags **A1** **A1**. Tags indicating changes to IEC text carry the number of the IEC amendment. For example, text altered by IEC amendment 1 is indicated by **A1** **A1**.

The UK participation in its preparation was entrusted to Technical Committee PEL/33, Power capacitors, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

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

(includes amendment A1:2003)
(IEC 60931-1:1996 + A1:2002)

Condensateurs shunt de puissance non autorégénérateurs pour réseaux à courant alternatif de tension assignée inférieure ou égale à 1 kV —
Partie 1: Généralités — Caractéristiques fonctionnelles, essais et valeurs assignées — Règles de sécurité — Guide d'installation et d'exploitation
(inclut l'amendement A1:2003)
(CEI 60931-1:1996 + A1:2002)

Nichtselbstheilende Leistungs-Parallelkondensatoren für Wechselstromanlagen mit einer Nennspannung bis 1 kV —
Teil 1: Allgemeines — Leistungsanforderungen, Prüfung- und Bemessung — Sicherheitsanforderungen Anleitung für Errichtung und Betrieb
(enthält Änderung A1:2003)
(IEC 60931-1:1996 + A1:2002)

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

The text of document 33/235/FDIS and 33/235A/FDIS, future edition 2 of IEC 60931-1, prepared by IEC TC 33, Power capacitors, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60931-1 on 1996-10-01.

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The following dates were fixed:

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Annexes designated “normative” are part of the body of the standard.

Annexes designated “informative” are given for information only.

In this standard, Annex A and Annex ZA are normative and Annex B is informative.

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60931-1:1996 was approved by CENELEC as a European Standard without any modification.

Foreword to amendment A1

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Endorsement notice

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Section 1. General

1 Scope and object

This part of IEC 60931 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 15 Hz to 60 Hz.

This part of IEC 60931 also applies to capacitors intended for use in power filter circuits. Additional definitions, requirements, and tests for filter capacitors are given in Annex A.

Additional requirements for capacitors protected by internal element fuses, as well as requirements for the same, are given in IEC 60931-3.

The following capacitors are excluded from this part of IEC 60931.

- Shunt power capacitors of the self-healing type for a.c. systems having a rated voltage up to and including 1 000 V (IEC 60831).
- Shunt capacitors for a.c. power systems having a rated voltage above 1 000 V (IEC 60871).
- Capacitors for inductive heat-generating plants operating at frequencies between 40 Hz and 24 000 Hz (IEC 60110).
- Series capacitors (IEC 60143).
- Capacitors for motor applications and the like (IEC 60252).
- Coupling capacitors and capacitor dividers (IEC 60358).
- Capacitors to be used in 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., are to be in accordance with the relevant IEC standards.

- a) to formulate uniform rules regarding performances, testing and rating;
- b) to formulate specific safety rules;
- c) to provide a guide for installation and operation.

2 Normative references

The following normative documents contains provisions which, through reference in this text, constitute provisions of this part of IEC 60931. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this part of IEC 60931 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60050(436):1990, *International Electrotechnical Vocabulary (IEV) — Chapter 436: Power capacitors*.

IEC 60060-1:1989, *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 60269-1:1986, *Low-voltage fuses — Part 1: General requirements*.

IEC 60358:1990, *Coupling capacitors and capacitor dividers*.

IEC 60831-1:1996, *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 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.*¹⁾

IEC 60931-2:1995, *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 2: Ageing test and destruction test.*

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 61000-2-2:1990, *Electromagnetic compatibility (EMC) — Part 2: Environment — Section 2: Compatibility levels for low-frequency conducted disturbances and signalling in public low-voltage power supply systems.*

IEC 61000-4-1:1992, *Electromagnetic compatibility (EMC) — Part 4: Testing and measurement techniques — Section 1: Overview of immunity tests — Basic EMC publication.*

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.*

3 Definitions

For the purpose of this part of IEC 60931, the following definitions apply.

3.1

capacitor element (or element)

a device consisting essentially of two electrodes separated by a dielectric
[IEV 436-01-03]

3.2

capacitor unit (or unit)

an assembly of one or more capacitor elements in the same container with terminals brought out
[IEV 436-01-04]

3.3

non-self-healing capacitor

a capacitor in which the dielectric, after local breakdown, is not restored

3.4

capacitor bank (or bank)

a number of capacitor units connected so as to act together
[IEV 436-01-06]

3.5

capacitor

in this part of IEC 60931, 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
[IEV 436-01-07]

3.7

discharge device of a capacitor

a 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
[IEV 436-03-15 modified]

¹⁾ According to Amendment No. 1 (1991).

3.8**internal fuse of a capacitor**

a fuse connected inside a capacitor unit, in series with an element or a group of elements
[IEV 436-03-16]

3.9**overpressure disconnecter for a capacitor**

a disconnecting device designed to switch off the capacitor in the case of abnormal increase of the internal pressure
[IEV 436-03-17 modified]

3.10**overtemperature disconnecter for a capacitor**

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

3.11**line terminal**

a terminal intended for connection to a line conductor of a network
[IEV 436-03-01]

NOTE In polyphase capacitors, a terminal intended to be connected to the neutral conductor is not considered to be a line terminal.

3.12**rated capacitance of a capacitor (C_N)**

the capacitance value for which the capacitor has been designed
[IEV 436-01-12 modified]

3.13**rated output of a capacitor (Q_N)**

the reactive power derived from the rated values of capacitance, frequency and voltage
[IEV 436-01-16 modified]

3.14**rated voltage of a capacitor (U_N)**

the r.m.s. value of the alternating voltage for which the capacitor has been designed
[IEV 436-01-15]

NOTE 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.

3.15**rated frequency of a capacitor (f_N)**

the frequency for which the capacitor has been designed
[IEV 436-01-14]

3.16**rated current of a capacitor (I_N)**

the r.m.s. value of the alternating current for which the capacitor has been designed
[IEV 436-01-13]

3.17**capacitor losses**

the active power dissipated in the capacitor
[IEV 436-04-10]

NOTE 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.

3.18**tangent of the loss angle ($\tan \delta$) of a capacitor**

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

[IEV 436-04-11]

3.19**maximum permissible a.c. voltage of a capacitor**

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

[IEV 436-04-07]

3.20**maximum permissible a.c. current of a capacitor**

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

[IEV 436-04-09]

3.21**ambient air temperature**

the temperature of the air at the proposed location of the capacitor

3.22**cooling air temperature**

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

the 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*

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 $-50\text{ }^{\circ}\text{C}$ to $+55\text{ }^{\circ}\text{C}$.

The lowest ambient air temperature at which the capacitor may be operated should be chosen from the five preferred values $+5\text{ }^{\circ}\text{C}$, $-5\text{ }^{\circ}\text{C}$, $-25\text{ }^{\circ}\text{C}$, $-40\text{ }^{\circ}\text{C}$, $-50\text{ }^{\circ}\text{C}$.

For indoor use, a lower limit of $-5\text{ }^{\circ}\text{C}$ 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.

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 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.