



SLOVENSKI STANDARD
SIST EN 60871-1:2001
01-september-2001

Shunt capacitors for a.c. power systems having a rated voltage above 1 kV - Part 1: General - Performance, testing and rating - Safety requirements - Guide for installation and operation

Shunt capacitors for a.c. power systems having a rated voltage above 1 kV -- Part 1: General - Performance, testing and rating - Safety requirements - Guide for installation and operation

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Parallelkondensatoren für Wechselspannungs-Starkstromanlagen mit einer Nennspannung über 1 kV -- Teil 1: Allgemeines - Ausführung, Prüfung und Bemessung - Sicherheitsanforderungen - Anleitung für Errichtung und Betrieb

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Condensateurs shunt pour réseaux à courant alternatif de tension assignée supérieure à 1 kV -- Partie 1: Généralités - Caractéristiques fonctionnelles, essais et valeurs assignées - Règles de sécurité - Guide d'installation et d'exploitation

Ta slovenski standard je istoveten z: EN 60871-1:1997

ICS:

31.060.70 T [] [• q ã [] å ^ } : æ [] ã Power capacitors

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EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 60871-1

November 1997

ICS 31.060.70

Supersedes HD 525.1 S1:1989 and its amendment

Descriptors: Shunt capacitor, performance, testing, installation, operation

English version

Shunt capacitors for a.c. power systems having a rated voltage above 1 kV
Part 1: General - Performance, testing and rating - Safety requirements
Guide for installation and operation
(IEC 60871-1:1997)

Condensateurs shunt pour réseaux à courant alternatif de tension assignée supérieure à 1 kV
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(CEI 60871-1:1997)

Parallelkondensatoren für Wechselspannungs-Starkstromanlagen mit einer Nennspannung über 1 kV
Teil 1: Allgemeines - Ausführung, Prüfung und Bemessung
Sicherheitsanforderungen
Anleitung für Errichtung und Betrieb
(IEC 60871-1:1997)

This European Standard was approved by CENELEC on 1997-10-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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CENELEC

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

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The text of document 33/260/FDIS, future edition 2 of IEC 60871-1, prepared by IEC TC 33 "Power capacitors", was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60871-1 on 1997-10-01.

This European Standard supersedes HD 525.1 S1:1989 and its amendment A1:1991.

The following dates were fixed:

- latest date by which the EN has to be implemented
at national level by publication of an identical
national standard or by endorsement (dop) 1998-07-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 1998-07-01

Annexes designated "normative" are part of the body of the standard.

Annexes designated "informative" are given for information only.

In this standard, annexes A, B, C and ZA are normative and annexes D and E are informative. Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60871-1:1997 was approved by CENELEC as a European Standard without any modification.

In the official version, for annex E, Bibliography, the following notes have to be added for the standards indicated:

- IEC 60143-2 NOTE: Harmonized as EN 60143-2:1994 (not modified).
- IEC 60831-2 NOTE: Harmonized as EN 60831-2:1996 (not modified).
- IEC 60871-2 NOTE: Harmonized as HD 525.2 S1:1989 (not modified).
- IEC 60931-2 NOTE: Harmonized as EN 60931-2:1996 (not modified).
- IEC 60931-3 NOTE: Harmonized as EN 60931-3:1996 (not modified).
- IEC 61071-2 NOTE: Harmonized as EN 61071-2:1996 (not modified).

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Annex ZA (normative)

Normative references to international publications
with their corresponding European publications

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

NOTE: When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
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	HD 588.1 S1 ¹⁾	1991
IEC 60071-1	1993	Insulation co-ordination Part 1: Definitions, principles and rules	EN 60071-1	1995
IEC 60071-2	1976	Part 2: Application guide	HD 540.2 S1 ²⁾	1991
IEC 60099	series	Surge arresters	EN 60099	series
IEC 60110	1973	Recommendation for capacitors for inductive heat generating plants operating at frequencies between 40 Hz and 24 kHz	HD 207 S1	1977
IEC 60143-1 (mod)	1992	Series capacitors for power systems Part 1: General - Performance, testing and rating - Safety requirements - Guide for installation	EN 60143-1 + corr. October	1993 1994
IEC 60252 (mod)	1993	A.C. motor capacitors	EN 60252 + corr. May	1994 1994
IEC 60358	1990	Coupling capacitors and capacitor dividers	HD 597 S1 + corr. March	1992 1992
IEC 60549	1976	High-voltage fuses for the external protection of shunt power capacitors	-	-

1) HD 588.1 S1 includes the corrigendum March 1990 to IEC 60060-1.

2) HD 540.2 S1 is superseded by EN 60071-2:1997, which is based on IEC 60071-2:1996.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
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 kV Part 1: General - Performance, testing and rating - Safety requirements - Guide for installation and operation	EN 60831-1	1996
IEC 60871-4	1996	Shunt capacitors for a.c. power systems having a rated voltage above 1 kV Part 4: Internal fuses	EN 60871-4	1996
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 kV Part 1: General - Performance, testing and rating - Safety requirements - Guide for installation and operation	EN 60931-1	1996
IEC 61048 (mod) 1991	1991	Auxiliaries for lamps - Capacitors for use in tubular fluorescent and other discharge lamp circuits - General and safety requirements	EN 61048 ³⁾	1993
IEC 61049 (mod) 1991	1991	Capacitors for use in tubular fluorescent and other discharge lamp circuits - Performance requirements	EN 61049 ⁴⁾	1993
IEC 61071-1 (mod)	1991	Power electronic capacitors Part 1: General	EN 61071-1	1996
IEC 61270-1	1996	Capacitors for microwave ovens Part 1: General	EN 61270-1	1996

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3) EN 61048 includes the corrigendum January 1992 to IEC 61048.

4) EN 61049 includes the corrigendum January 1992 to IEC 61049.

**NORME
INTERNATIONALE
INTERNATIONAL
STANDARD**

**CEI
IEC**

60871-1

Deuxième édition
Second edition
1997-10

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

Partie 1:

**Généralités – Caractéristiques fonctionnelles,
essais et valeurs assignées – Règles de sécurité –
Guide d'installation et d'exploitation**

**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**

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Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

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Pour prix, voir catalogue en vigueur
For price, see current catalogue

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**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**

FOREWORD

- 1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The 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 the 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 National Committees.
- 3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical reports or guides and they are accepted by the National Committees in that sense.
- 4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
- 5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.
- 6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

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

This second edition cancels and replaces the first edition published in 1987, its amendment 1 (1991), and constitutes a technical revision.

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

FDIS	Report on voting
33/260/FDIS	33/279/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.

Annexes A, B and C form an integral part of this standard.

Annexes D and E are for information only.

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

Section 1: General

1 Scope and object

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 part of IEC 60871 is not applicable to high-voltage capacitors composed of low-voltage capacitors of the self-healing type. Additional definitions, requirements and tests for self-healing capacitors can be found in IEC 60831.

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);
- series capacitors for power systems (IEC 60143);
- capacitors for motor applications and the like (IEC 60252);
- coupling capacitors and capacitor dividers (IEC 60358);
- shunt capacitors of the non-self-healing type for a.c. systems having a rated voltage up to and including 1 000 V (IEC 60931);
- 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);
- capacitors for suppression of radio interference (under consideration);
- capacitors intended for use with d.c. voltage superimposed on the a.c. voltage.

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

The object of this part of IEC 60871 is:

- 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 contain provisions which, through reference in this text, constitute provisions of this part of IEC 60871. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this section of IEC 60871 are encouraged to investigate the possibility of applying the most recent editions of the normative documents listed 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 60071-1:1993, *Insulation co-ordination – Part 1: Definitions, principles and rules*

IEC 60071-2:1976, *Insulation co-ordination – Part 2: Application guide*

IEC 60099: *Surge arresters*

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

IEC 60143-1:1992, *Series capacitors for power systems – Part 1: General – Performance, testing and rating – Safety requirements – Guide for installation*

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

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

IEC 60549:1976, *High-voltage fuses for the external protection of shunt power capacitors*

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

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 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 61071-1:1991, *Power electronic capacitors – Part 1: General*

IEC 61270-1:1996, *Capacitors for microwave ovens – Part 1: General*

3 Definitions

For the purpose of this part of IEC 60871, 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 capacitor bank (or bank): A number of capacitor units connected so as to act together. [IEV 436-01-06]

3.4 capacitor: In this part of IEC 60871, 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.

3.5 capacitor installation: One or more capacitor banks and their accessories. [IEV 436-01-07]

3.6 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]

3.7 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]

3.8 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.

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3.9 rated capacitance of a capacitor (C_N): The capacitance value derived from the values of rated output, voltage and frequency of the capacitor. [IEV 436-01-12]

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3.10 rated output of a capacitor (Q_N): The reactive power for which the capacitor has been designed. [IEV 436-01-16]

3.11 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 (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.

3.12 rated frequency of a capacitor (f_N): The frequency for which the capacitor has been designed. [IEV 436-01-14]

3.13 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]

3.14 capacitor losses: The active power dissipated in the capacitor. [IEV 436-04-10]

NOTES

1 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.

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

3.15 tangent of the loss angle (of a capacitor); $\tan \delta$ (abbreviation): 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]

3.16 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]

3.17 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]

3.18 ambient air temperature: The temperature of the air at the proposed location of the capacitor.

3.19 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.

3.20 steady-state condition: Thermal equilibrium attained by the capacitor at constant output and at constant ambient air temperature.

3.21 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 % of rated voltage (see clauses 21, 31, subclause 19.2 and annex D).

b) Altitude

Not exceeding 1 000 m.

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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 $+5\text{ }^{\circ}\text{C}$, $-5\text{ }^{\circ}\text{C}$, $-25\text{ }^{\circ}\text{C}$, $-40\text{ }^{\circ}\text{C}$, $-50\text{ }^{\circ}\text{C}$.

NOTE – With the agreement of the manufacturer, the capacitor may be used at a lower temperature than the limits above, provided that energization takes place at a temperature at or above these limits (see 29.1).

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 $^{\circ}\text{C}$			
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 $5\text{ }^{\circ}\text{C}$.

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

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.

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