
Zaporedni kondenzatorji za elektroenergetske sisteme – 1. del: Splošno

Series capacitors for power systems - Part 1: General

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SIST EN 60143-1:2004

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EUROPEAN STANDARD

EN 60143-1

NORME EUROPÉENNE

EUROPÄISCHE NORM

March 2004

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English version

Series capacitors for power systems
Part 1: General
(IEC 60143-1:2004)

Condensateurs série destinés
à être installés sur des réseaux
Partie 1: Généralités
(CEI 60143-1:2004)

Reihenkondensatoren
für Starkstromanlagen
Teil 1: Allgemeines
(IEC 60143-1:2004)

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This European Standard was approved by CENELEC on 2004-03-01. 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.

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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 33/400/FDIS, future edition 4 of IEC 60143-1, prepared by IEC TC 33, Power capacitors, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60143-1 on 2004-03-01.

This European Standard supersedes EN 60143-1:1993 + corrigendum October 1994.

The main changes with respect to the previous edition regard in particular the old section 3 "Insulation level" that has been deeply modified and the new subclause 6.3 "Air clearances" has been added. In addition, many technical changes have been introduced throughout the text regarding tests and operation.

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) 2004-12-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2007-03-01

Annex ZA has been added by CENELEC.

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[SIST EN 60143-1:2004](#)

The text of the International Standard IEC 60143-1:2004 was approved by CENELEC as a European Standard without any modification. [25196ef148f/sist-en-60143-1-2004](#)

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

IEC 60273	NOTE	Harmonized as HD 578 S1:1992 (not modified).
IEC 60060-2	NOTE	Harmonized as EN 60060-2:1994 (not modified).
IEC 60721-2-6	NOTE	Harmonized as HD 478.2.6 S1:1993 (not modified)
IEC 60110-1	NOTE	Harmonized as EN 60110-1:1998 (not modified).
IEC 60252-1	NOTE	Harmonized as EN 60252-1:2001 (not modified).
IEC 61048	NOTE	Harmonized as EN 61048:1993 (modified).
IEC 61049	NOTE	Harmonized as EN 61049:1993 (modified).
IEC 61071	NOTE	Harmonized in EN 61071 series (partly modified).

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE Where 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 60060-1 + corr. March	1989 1990	High-voltage test techniques Part 1: General definitions and test requirements	HD 588.1 S1	1991
IEC 60071-1	1993	Insulation co-ordination Part 1: Definitions, principles and rules	EN 60071-1	1995
IEC 60071-2	1996	Part 2: Application guide	EN 60071-2	1997
IEC 60143-2	1994	Series capacitors for power systems Part 2: Protective equipment for series capacitor banks	EN 60143-2	1994
IEC 60143-3	1998	Part 3: Internal fuses	EN 60143-3	1998
IEC 60549	1976	High-voltage fuses for the external protection of shunt power capacitors	-	-
IEC 60815	1986	Guide for the selection of insulators in respect of polluted conditions	-	-
IEC 60871-2	1999	Shunt capacitors for a.c. power systems having a rated voltage above 1kV Part 2: Endurance testing	-	-
IEEE Std 693	1997	IEEE Recommended Practice for Seismic Design of Substations	-	-

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**Condensateurs série destinés
à être installés sur des réseaux –**

**Partie 1:
Généralités**

iTeh STANDARD PREVIEW

Series capacitors for power systems –

Part 1: [SIST EN 60143-1:2004](https://standards.iteh.ai/catalog/standards/sist/0628a607-914a-44a5-a1d3-25196ef14f6f/sist-en-60143-1-2004)

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International Electrotechnical Commission
Международная Электротехническая Комиссия

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

SERIES CAPACITORS FOR POWER SYSTEMS –

Part 1: General

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of 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, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). 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. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 60143-1 has been prepared by IEC technical committee 33: Power capacitors.

This fourth edition cancels and replaces the third edition, published in 1992, and constitutes a technical revision.

The main changes with respect to the previous edition regard in particular the old section 3: “Insulation level” that has been deeply modified and the new subclause 6.3 “Air clearances” has been added. In addition, many technical changes have been introduced throughout the text regarding tests and operation.

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

FDIS	Report on voting
33/400/FDIS	33/401/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.

The committee has decided that the contents of this publication will remain unchanged until 2011. At this date, the publication will be

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

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SERIES CAPACITORS FOR POWER SYSTEMS –

Part 1: General

1 Scope and object

This part of IEC 60143 applies both to capacitor units and capacitor banks intended to be used connected in series with an a.c. transmission or distribution line or circuit forming part of an a.c. power system having a frequency of 15 Hz to 60 Hz.

The primary focus of this standard is on transmission application.

The series capacitor units and banks are usually intended for high-voltage power systems. This standard is applicable to the complete voltage range.

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

The following capacitors, even if connected in series with a circuit, are excluded from this standard:

- capacitors for inductive heat-generating plants (IEC 60110-1);
- capacitors for motor applications and the like (IEC 60252-1);
- capacitors to be used in power electronics circuits (IEC 61071);
- capacitors for discharge lamps (IEC 61048 and IEC 61049).

Standard types of accessories such as insulators, switches, instrument transformers, external fuses, etc. should comply with the pertinent IEC standard.

NOTE 1 Additional requirements for capacitors to be protected by internal fuses, as well as the requirements for internal fuses, are found in IEC 60143-3.

NOTE 2 Additional requirements for capacitors to be protected by external fuses, as well as the requirements for external fuses, are found in Annex A.

NOTE 3 A separate standard for series capacitor accessories (spark-gaps, non-linear resistors, discharge reactors, current-limiting damping reactors, damping resistors, circuit-breakers, etc.), IEC 60143-2, was completed in 1994. A separate standard for internal fuses for series capacitors, IEC 60143-3 (formerly IEC 60595), has been revised and was completed in 1998.

The object of this standard is:

- to formulate uniform rules regarding performance, testing and rating;
- to formulate specific safety rules;
- to serve as a guide for installation and operation.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE If there is a conflict between this standard and a standard listed below, the test of IEC 60143-1 prevails.

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 60071-2:1996, *Insulation co-ordination – Part 2: Application guide*

IEC 60143-2:1994, *Series capacitors for power systems – Part 2: Protective equipment for series capacitor banks*

IEC 60143-3:1998, *Series capacitors for power systems – Part 3: Internal fuses*

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

IEC 60815:1986, *Guide for the selection of insulators in respect of polluted conditions*

IEC 60871-2:1999, *Shunt capacitors for a.c. power systems having a rated voltage above 1 000 V – Part 2: Endurance testing*

IEEE Std. 693:1997, *IEEE Recommended Practice for Seismic Design of Substations*

3 Terms and definitions

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

NOTE Certain terms come from IEC 60050(436) or IEC 60050(604) and where this is the case, the concept from that publication is referenced in square brackets after the definition.

3.1

ambient air temperature (for capacitors)

temperature of air at the proposed location of the capacitor installation

3.2

bypass switch

device such as a switch or circuit-breaker used in parallel with a series capacitor and its overvoltage protector to shunt line current for some specified time or continuously

NOTE This device should also have the capability of inserting and bypassing the capacitor into a circuit carrying a specified level of current.

3.3

capacitor

word used when it is not necessary to distinguish between the different meanings of the words capacitor unit and the assembly of capacitors associated with a segment

3.4**capacitor unit**

unit

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

[IEC 60050, 436-01-04]

3.5**(capacitor) element**

device consisting essentially of two electrodes separated by a dielectric

[IEC 60050, 436-01-03]

3.6**capacitor losses**

active power dissipated in the capacitor

[IEC 60050, 436-04-10]

NOTE All loss-producing components should be included. For a unit, this includes losses from the dielectric, discharge device, internal fuses (if applicable) and internal connections. For the bank, this includes losses from the units, external fuses (if applicable) and busbars. See Annex B for additional discussion.

3.7**cooling air temperature**

temperature of cooling air measured at the hottest position in the capacitor assembly of a segment, under rated current and 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

3.8**degree of compensation***k*degree of series compensation, *k* (of a line section) is

$$k = 100 (X_c / X_L) \%$$

where

 X_c is the capacitive reactance of the series capacitor; X_L is the total positive sequence inductive reactance of the transmission line section on which the series capacitor is applied.**3.9****discharge device (of a capacitor)**

device connected across the terminals of the capacitor or built into the capacitor unit, capable of reducing the residual voltage across the capacitor effectively to zero after the capacitor has been disconnected from the supply

[IEC 60050, 436-03-15, modified]

NOTE Further requirements on the size of the discharge device are found in 8.1

3.10**external fuse (of a capacitor)**

fuse connected in series with a capacitor unit or with a group of parallel units

3.11**fuseless capacitor bank**

capacitor bank without any fuses, internal or external, constructed of parallel strings of capacitor units. Each string consists of capacitor units connected in series

NOTE See Annex C for an explanation of “string”.

3.12**highest voltage of a three-phase system**

highest r.m.s. phase-to-phase voltage which occurs under normal operating conditions at any time and at any point of the system

NOTE It excludes voltage transients (such as those due to system switching) and temporary voltage variations due to abnormal system conditions (such as due to faults or sudden disconnection of large loads).

3.13**highest voltage for equipment** U_m

highest r.m.s. value of phase-to-phase voltage for which the equipment is designed in respect of its insulation as well as other characteristics which relate to this voltage in the relevant equipment standards

[IEC 60050, 604-03-01]

NOTE This voltage is the maximum value of the highest voltage of the system for which the equipment may be used.

3.14**insulation level** U_i

non-simultaneous combination of test voltages (power-frequency (U_{ipf}) or switching impulse, and lightning impulse) which characterizes the insulation of the capacitor with regard to its capability of withstanding the electric stresses between terminals and earth, between phases and between terminals and metalwork (e.g. platform) not at earth potential

3.15**internal fuse of a capacitor**

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

[IEC 60050, 436-03-16]

3.16**limiting voltage** U_{lim}

maximum peak of the power frequency voltage occurring between capacitor unit terminals immediately before or during operation of the overvoltage protector, divided by $\sqrt{2}$ (see 5.1.4)

3.17**line terminal**

terminal to be connected to the power system

[IEC 60050, 436-03-01, modified]

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