SLOVENSKI STANDARD
SIST EN 60143-1:2002

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Series capacitors for power systems - Part 1: General - Performance, testing and rating - Safety requirements - Guide for installation

Series capacitors for power systems -- Part 1: General - Performance, testing and rating - Safety requirements - Guide for installation

Reihenkondensatoren für Starkstromanlagen -- Teil 1: Allgemeines - Betriebsverhalten, Prüfen und Bemessen - Sicherheitsanforderungen - Richtlinie zum Errichten

Condensateurs série destinés à être installés sur des réseaux -- 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 60143-1:1993**

ICS:

31.060.70 Moļ nostni kondenzatorji Power capacitors

SIST EN 60143-1:2002 **en**

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 60143

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Supersedes HD 339 S1 : 1977

Descriptors: Power capacitors, series capacitors, capacitors banks, classification, tests, insulated level, safety requirements, marking, characteristics

English version

Series capacitors for power systems

(IEC 143 : 1992)

Condensateurs série destinés à être installés sur les réseaux
(CEI 143 : 1992)

Reihenkondensatoren für Starkstromanlagen
(IEC 143 : 1992)

This European Standard was approved by CENELEC on 1993-07-06. 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, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

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

Central Secretariat: rue de Stassart 35, 8-1050 Brussels

Foreword

The IEC/CENELEC Parallel Voting procedure, performed for finding out whether or not the International Standard IEC 143 : 1992 could be accepted without textual changes, has shown that some common modifications were necessary for acceptance as a European Standard.

Following decision D71/016 taken by 71 Technical Board it was decided that the reference document, together with the common modifications prepared by the CENELEC Reporting Secretariat SR 33, would be submitted to the CENELEC members for formal vote.

The text of the draft was approved by CENELEC as EN 60143 on 6 July 1993.

This European Standard replaces HD 339 S1 : 1977.

The following dates were fixed:

- latest date of publication of an identical national standard (dop) 1994-08-01
- latest date of withdrawal of conflicting national standards (dow) 1994-08-01

Annexes designated 'normative' are part of the body of the standard. Annexes designated 'informative' are given only for information. In this standard, annexes A and ZA are normative and annexes B, C and D are informative.

Endorsement notice

The text of the International Standard IEC 143 : 1992 was approved by CENELEC as a European Standard with agreed common modifications as given below.

Common modifications

CLAUSE

5.3 Add a new paragraph at the end of the subclause:

Manufacture and installation of new capacitors containing PCB are forbidden.

Annex C Modify the first line of the second paragraph as follows:

'... of PCB which are used in the impregnation of capacitors ...'.

CONTENTS

Clause Page

SERIES CAPACITORS FOR POWER SYSTEMS

SECTION 1: GENERAL

1.1 Scope and object

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

NOTES

1 Additional requirements for capacitors to be protected by internal fuses as well as the requirements for internal fuses are found in IEC 595.

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

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

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

- capacitors for inductive heat-generating plants (IEC 110);
- capacitors for motor applications and the like (IEC 252);
- capacitors to be used in power electronics circuits (IEC 1071);
- capacitors for discharge lamps (IEC 566).

5 A separate standard for series capacitor accessories (spark-gaps, non-linear resistors, discharge reactors, damping resistors, breakers, etc.) is under consideration.

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

The object of this standard is

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

1.2 Normative references

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

IEC 50(436): 1990, *International Electrotechnical Vocabulary (IEV) – Chapter 436: Power capacitors.*

IEC 60, *High-voltage test techniques.*

IEC 60-1:1989, *High-voltage test techniques – Part 1: General definitions and test requirements.*

IEC 60-2: 1973, *High-voltage test techniques – Part 2: Test procedures.*

IEC 60-3: 1976, *High-voltage test techniques – Part 3: Measuring devices.*

IEC 60-4: 1977, *High-voltage test techniques – Part 4: Application guide for measuring devices.*

IEC 71, *Insulation co-ordination.*

IEC 71-1: 1976, *Insulation co-ordination – Part 1: Terms, definitions, principles and rules.*

IEC 71-2: 1976, *Insulation co-ordination – Part 2: Application guide.*

IEC 71-3: 1982, IEC 71-1: 1976, *Insulation co-ordination – Part 3: Phase-to-phase insulation co-ordination. Principles, rules and application guide.*

IEC 549: 1976, *High-voltage fuses for the external protection of shunt power capacitors.*

IEC 595: 1977, *Internal fuses for series capacitors.*

* IEC 816: 1986, *Guide for the selection of insulators in respect of polluted conditions.*

IEC 871-2: 1987, *Shunt capacitors for a.c. power systems having a rated voltage above 660 V. Part 2: Endurance testing.*

IEC 996: 1989, *Method for verifying accuracy of tan delta measurements applicable to capacitors.*

*See national foreword for details of textual error.

1.3 Definitions

For the purposes of this International Standard, the following definitions apply:

1.3.1 **capacitor element (or element)**: A device consisting essentially of two electrodes separated by a dielectric. [IEV 436-01-03 modified]

1.3.2 **capacitor unit (or unit)**: An assembly of one or more capacitor elements in the same container with terminals brought out. [IEV 436-01-04 modified]

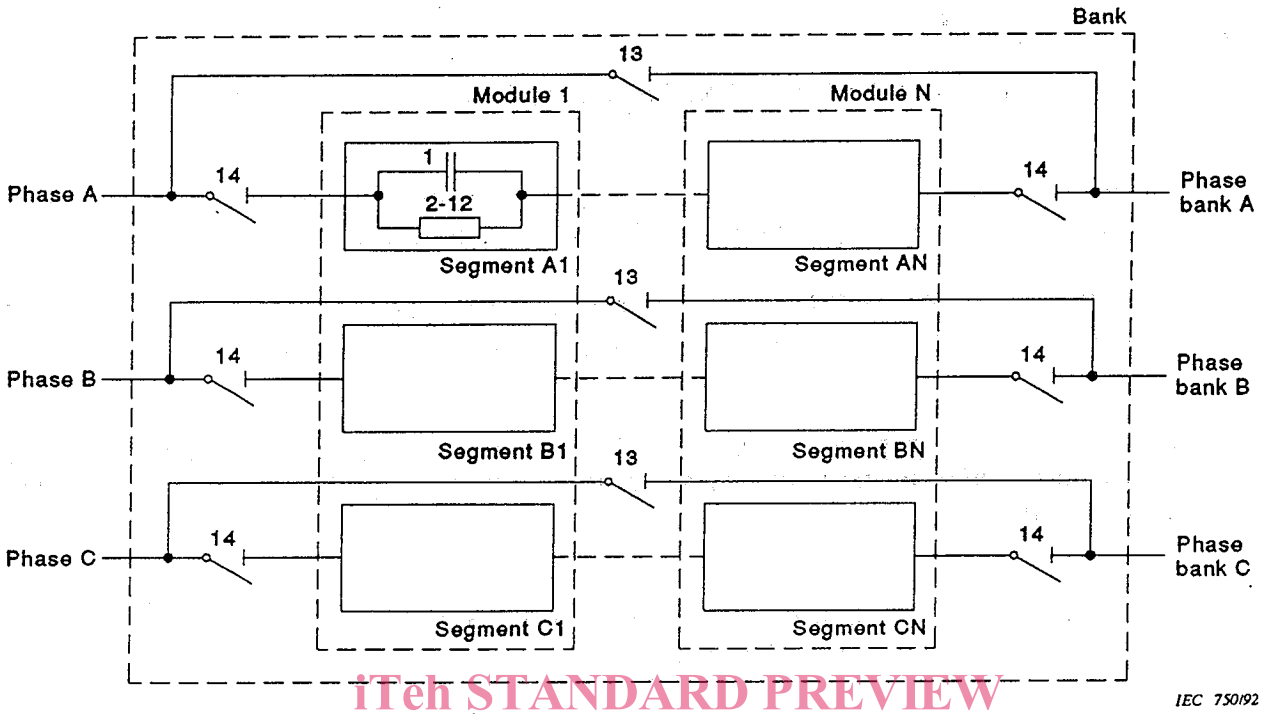
1.3.3 **series capacitor phase bank (or phase bank)**: An assembly of capacitor units connected in one phase so as to act together, the protection system(s) for these capacitors, etc. (see figure 1).

1.3.4 **segment (of a series capacitor)**: Where the phase bank is divided into several series-connected parts of which each part contains its own assembly of capacitor units and protection system(s) each such complete part is called segment (see figure 1).

1.3.5 **series capacitor bank (or bank)**: The three-phase banks operated in common (see figure 1). [IEV 436-01-06 modified]

1.3.6 **module (of a series capacitor)**: A switchable step of a series capacitor consisting of identical segments in each phase (see figure 1), which furthermore also are equipped with provisions for a common operation of the by-pass device at each of these segments.

NOTE - If maintenance is required on the segment(s) of a by-passed module when the remaining module(s) of the series capacitor remains in operation also series disconnecting devices (and other personal safety requirements) are needed for the segments.



1 = Assembly of capacitor units

2-12 = Main protective equipment

13 = By-pass disconnector

14 = Series disconnector

(See also figure B3 of annex B)

Figure 1 – Series capacitor bank definitions

1.3.7 **capacitor**: In this standard, the word "capacitor" is used when it is not necessary to lay particular stress upon the different meanings of the words capacitor unit, segment or phase bank.

1.3.8 **capacitor installation**: A series capacitor bank and its accessories. [IEV 436-01-07 modified]

1.3.9 **overvoltage protector (of a series capacitor)**: A quick-acting device which limits the instantaneous voltage across the capacitor to a permissible value when that value would otherwise be exceeded as a result of a circuit fault or other abnormal network conditions. [IEV 436-03-14 modified]

1.3.10 **discharge device (of a capacitor)**: A 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. Further requirements on the size of the discharge device are found in clause 5.1. [IEV 436-03-15 modified]

1.3.11 **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]

1.3.12 **external fuse (of a capacitor)**: A fuse connected in series with a capacitor unit or with a group of parallel units.

1.3.13 **line terminals:** The terminals to be connected to the lines. [IEV 436-03-01 modified]

1.3.14 **rated capacitance (of a capacitor)** (C_N): The capacitance value for which the capacitor has been designed. [IEV 436-01-12 modified]

1.3.15 **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]

NOTE - Due consideration should be given to the time profile of the line current (7.2.1).

1.3.16 **rated frequency (of a capacitor)** (f_N): The frequency of the system in which the capacitor is intended to be used. [IEV 436-01-14 modified]

1.3.17 **rated voltage (of a capacitor)** (U_N): The r.m.s. value of the voltage between the terminals, derived from rated capacitance, rated current and rated frequency. [IEV 436-01-15 modified]

1.3.18 **rated output (of a capacitor)** (Q_N): The reactive power derived from rated capacitance, rated current and rated frequency. [IEV 436-01-16 modified]

1.3.19 **capacitor losses**: The active power dissipated by a capacitor. [IEV 436-04-10 modified]

NOTES

1 All loss-producing components shall be included:

- for a unit, losses from the dielectric, internal fuses, discharge device(s), internal connections, etc.;
- for a bank, losses from the units, external fuses, busbars, discharge and damping reactors, etc.

Losses may also be generated by auxiliary power for heating of breakers, cubicles, etc.

2 The capacitor losses may be recalculated as an equivalent series resistance to the capacitor.

3 When evaluating the losses, it is recommended either to use the loss value at the average ambient air temperature or to use the losses at some different ambient air temperatures and calculate their mean value. Series capacitors usually have an average output well below rated, which should be taken into account.

1.3.20 **tangent of loss angle (of a capacitor)** (tan δ): The ratio between the equivalent series resistance and the capacitive reactance of a capacitor at specified sinusoidal alternating voltage and frequency.

NOTE - Tangent of loss angle can also be expressed as the capacitor losses divided by the reactive power of the capacitor.

1.3.21 **limiting voltage** (U_{lim}): The maximum instantaneous voltage occurring between capacitor terminals immediately before or during operation of the overvoltage protector, divided by $\sqrt{2}$.

1.3.22 **highest voltage of a three-phase system**: The highest r.m.s. phase-to-phase voltage which occurs under normal operating conditions at any time and at any point of the system. 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).

1.3.23 **highest voltage for equipment** (U_m): The highest r.m.s. phase-to-phase voltage for which the equipment is designed as regards its insulation as well as other characteristics which relate to this voltage in the relevant equipment standards. This voltage is the maximum value of the highest voltage of the system for which the equipment may be used.

1.3.24 **insulation level** (U_i): The non-simultaneous combination of test voltages (power-frequency 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 not at earth potential.

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

1.3.26 **cooling air temperature**: The temperature of cooling air measured at the hottest position in the phase 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.

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

1.3.28 **residual voltage**: The voltage remaining between terminals of a capacitor at a given time following disconnection of the supply.

1.4 Service conditions

1.4.1 *Normal service conditions*

This standard gives requirements for capacitors to be used in the following conditions.

1.4.1.1 *Altitude*

Not exceeding 1 000 m.

1.4.1.2 *Ambient air temperature categories*

Capacitors are classified in temperature categories, each category being specified by one number followed by one letter. The number represents the lowest ambient air temperature at which the capacitor may operate. The letter represents the upper limit of temperature variation range, having the maximum value specified in table 1.

Table 1 – Letter symbols for upper limit of temperature range

Symbol	Ambient air temperature °C		
	Max.	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

The temperature categories cover a total temperature range from –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.

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.

Table 1 is based on service conditions in which the capacitor does not influence the ambient air temperature (e.g. outdoor installations). If the capacitor influences the air temperature, the ventilation and/or choice of capacitor shall be such that the limits of table 1 are maintained. The cooling air temperatures in such installations shall not exceed the temperature limits of table 1 by more than 5 °C.

NOTE - The temperature values according to table 1 can be found in the meteorological temperature tables covering the installation site.

1.4.2 *Unusual service conditions*

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