

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



**Series capacitors for power systems –  
Part 1: General**

**Condensateurs série destinés à être installés sur des réseaux –  
Partie 1: Généralités**

[IEC 60143-1:2015](https://standards.iteh.ai)

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**IEC 60143-1 edition 5.1 contains the fifth edition (2015-06) [documents 33/578/FDIS and 33/580/RVD], its corrigendum (2017-04), and its amendment 1 (2023-11) [documents 33/690/CDV and 33/693/RVC].**

**In this Redline version, a vertical line in the margin shows where the technical content is modified by amendment 1. Additions are in green text, deletions are in strikethrough red text. A separate Final version with all changes accepted is available in this publication.**

International Standard IEC 60143-1 has been prepared by IEC technical committee 33: Power capacitors and their applications.

This fifth edition constitutes a technical revision.

The main change with respect to the previous edition is that the endurance test has been replaced by an ageing test because voltage cycling is already performed in the cold duty test. The guide section has been expanded regarding long line correction and altitude correction. In addition the insulation tables and references to other standards have been updated.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 60143 series, published under the general title *Series capacitors for power systems*, can be found on the IEC website.

The committee has decided that the contents of this document and its amendment will remain unchanged until the stability date indicated on the IEC website under [webstore.iec.ch](https://webstore.iec.ch) in the data related to the specific document. At this date, the document will be

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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 (all parts));
- capacitors to be used in power electronics circuits (IEC 61071);
- capacitors for discharge lamps (IEC 61048 and IEC 61049).

For standard types of accessories such as insulators, switches, instrument transformers, external fuses, etc. see 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. See also Annex C.

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 and Annex C.

NOTE 3 A separate standard for series capacitor accessories (spark-gaps, varistors, discharge reactors, current-limiting damping reactors, damping resistors, circuit-breakers, etc.), IEC 60143-2, has been revised and was completed in 2012. A separate standard for internal fuses for series capacitors, IEC 60143-3 has been revised and was completed in 2013.

NOTE 4 Some information regarding fuseless capacitor units and fuseless capacitor banks is found in Annex C.

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 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.

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

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

IEC 60071-1:2006, *Insulation co-ordination – Part 1: Definitions, principles and rules*

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

IEC 60143-2:2012, *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 60143-4: 2010 *Series capacitors for power systems – Part 4: Thyristor controlled series capacitors*

IEC 60549:2013, *High-voltage fuses for the external protection of shunt capacitors*

IEC 60871-1: 2014 *Shunt capacitors for a.c power systems having a rated voltage above 1000V – Part 1: General*

IEC 62271-1:2007, *High-voltage switchgear and controlgear – Part 1: Common specifications*

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.

#### 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 1 to entry: This device shall also have the capability of bypassing the capacitor during specified power system fault conditions. The operation of the device is initiated by the capacitor bank control, remote control or by an operator. The device may be mounted on the platform or on the ground near the platform. Besides bypassing the capacitor, this device shall also have the capability of inserting 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

[SOURCE: IEC 60050-436:1990, 436-01-04]

### 3.5

#### **(capacitor) element**

device consisting essentially of two electrodes separated by a dielectric

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

### 3.6

#### **capacitor losses**

active power dissipated in the capacitor

Note 1 to entry: 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.

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

### 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

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.

### 3.8

#### **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

Note 1 to entry: Further requirements on the size of the discharge device are found in 8.1.

[SOURCE: IEC 60050-436:1990, 436-03-15, modified (modified definition, addition of Note 1 to entry)]

### 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 1 to entry: See Annex C for an explanation of "string".