



SLOVENSKI STANDARD
SIST EN 60143-2:2000
01-september-2000

Series capacitors for power systems - Part 2: Protective equipment for series capacitor banks

Series capacitors for power systems -- Part 2: Protective equipment for series capacitor banks

Reihen Kondensatoren für Starkstromanlagen -- Teil 2: Schutzeinrichtungen für Reihen Kondensatorbatterien

Condensateurs série destinés à être installés sur des réseaux -- Partie 2: Matériel de protection pour les batteries de condensateurs série

[https://standards.iteh.ai/catalog/standards/sist/dd057964-d036-41bd-9fce-](https://standards.iteh.ai/catalog/standards/sist/dd057964-d036-41bd-9fce-e993938923d4/sist-en-60143-2-2000)

Ta slovenski standard je istoveten z: EN 60143-2:1994

ICS:

31.060.70 Močnostni kondenzatorji Power capacitors

SIST EN 60143-2:2000

en

iTeh STANDARD PREVIEW
(standards.iteh.ai)

SIST EN 60143-2:2000

<https://standards.iteh.ai/catalog/standards/sist/dd057964-d036-41bd-9fce-e993938923d4/sist-en-60143-2-2000>

EUROPEAN STANDARD

EN 60143-2

NORME EUROPEENNE

EUROPÄISCHE NORM

September 1994

ICS 31.060.00

Descriptors: Electronic-components, capacitors, power capacitors, capacitor banks, safety devices, overload protection, isolating switches, spark gaps, damping, current transformers, potential transformers, classifications, quality, tests

ENGLISH VERSION

Series capacitors for power systems
Part 2: Protective equipment for series
capacitor banks
(IEC 143-2:1994)

Condensateurs série destinés à
être installés sur des réseaux
Partie 2: Matériel de protection
pour les batteries de
condensateurs série
(CEI 143-2:1994)

Reihenkondensatoren für
Starkstromanlagen
Teil 2: Schutzeinrichtungen
für Reihenkondensatorbatterien

(IEC 143-2:1994)

iTeh STANDARD PREVIEW
(standards.iteh.ai)

This European Standard was approved by CENELEC on 1994-07-05. 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, B-1050 Brussels

FOREWORD

The text of document 33(CO)115, as prepared by IEC Technical Committee 33: Power capacitors, was submitted to the IEC-CENELEC parallel vote in December 1993.

The reference document was approved by CENELEC as EN 60143-2 on 5 July 1994.

The following dates were fixed:

- latest date of publication of
an identical national standard (dop) 1995-07-01
- latest date of withdrawal of
conflicting national standards (dow) 1995-07-01

For products which have complied with the relevant national standard before 1995-07-01, as shown by the manufacturer or by a certification body, this previous standard may continue to apply for production until 2000-07-01.

Annexes designated "normative" are part of the body of the standard. Annexes designated "informative" are given only for information. In this standard, annex A is informative and annex ZA is normative.

SIST EN 60143-2:2000
ENDORSEMENT NOTICE
<https://standards.iteh.ai/catalog/standards/sist/en-60143-2-1994-d036-41bd-9fce-e993938923d4/sist-en-60143-2-2000>

The text of the International Standard IEC 143-2:1994 was approved by CENELEC as a European Standard without any modification.

ANNEX ZA (normative)

OTHER INTERNATIONAL PUBLICATIONS QUOTED IN THIS STANDARD
WITH THE REFERENCES OF THE RELEVANT 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.

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

IEC Publication -----	Date -----	Title -----	EN/HD -----	Date -----
44-4	1980	Instrument transformers - Part 4: Measurement of partial discharges	-	-
50(436)	1990	International Electrotechnical Vocabulary (IEV) Chapter 436: Power capacitors	-	-
56 (mod)	1987	High-voltage alternating current circuit-breakers	HD 348 S4	1991
60-1	1989	High-voltage test techniques - Part 1: General definitions and test requirements (corrigendum March 1990 and March 1992)	HD 588.1 S1	1991
68-2-30	1980	Basic environmental testing procedures Part 2: Tests - Test Db and guidance: Damp heat, cyclic (12 + 12-hour cycle)	HD 323.2.30 S3*	1988
76-1	1993*	Power transformers - Part 1: General	-	-
99-1	1991	Surge arresters - Part 1: Non-linear resistor type gapped surge arresters for a.c. systems	EN 60099-1	1994
99-4	1991	Part 4: Metal-oxide surge arresters without gaps for a.c. systems	EN 60099-4	1993
129	1984	Alternating current disconnectors and earthing switches	EN 60129	1994
143 (mod)	1992	Series capacitors for power systems (corrigendum January 1994)	EN 60143	1993

* HD 323.2.30 S3 includes A1:1985 to IEC 68-2-30
IEC 76-1:1976 (mod) is harmonized as HD 398.1 S1:1980

IEC Publication -----	Date -----	Title -----	EN/HD -----	Date -----
185 (mod)	1987	Current transformers	HD 553 S2*	1993
186 (mod)	1987	Voltage transformers	HD 554 S1*	1992
255-6 (mod)	1988	Electrical relays - Part 6: Measuring relays and protection equipment	EN 60255-6	1994
289	1988	Reactors	EN 60289	1994
383-1	1993	Insulators for overhead lines with a nominal voltage above 1000 V - Part 1: Ceramic or glass insulator units for a.c. systems - Definitions, test methods and acceptance criteria	-	-
383-2	1993	Part 2: Insulator strings and insulator sets for a.c. systems - Definitions, test methods and acceptance criteria	-	-
595 A2	1977 1987	Internal fuses for series capacitors	-	-
654-1	1979	Operating conditions for industrial-process measurement and control equipment - Part 1: Climatic conditions	HD 413.1 S1*	1981
654-2	1979	Part 2: Power	HD 413.2 S2*	1994
654-3	1983	Part 3: Mechanical influences	HD 413.3 S1	1987
654-4	1987	Part 4: Corrosive and erosive influence	-	-
694	1980	Common clauses for high-voltage switchgear and controlgear standards	HD 448 S2*	1984
794-1	1993	Optical fibre cables - Part 1: Generic specification	-	-
794-2	1989	Part 2: Product specifications	-	-

-
- * HD 553 S2 includes A1:1990 to IEC 185
 HD 554 S1 includes A1:1988 to IEC 186
 HD 413.1 S1 is superseded by EN 60654-1:1993, which is based on IEC 654-1:1993
 HD 413.2 S2 includes A1:1992 to IEC 654-2
 HD 448 S2 includes A1:1985 to IEC 694

**NORME
INTERNATIONALE
INTERNATIONAL
STANDARD**

**CEI
IEC
143-2**

Première édition
First edition
1994-07

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

Partie 2:

**Matériel de protection pour les batteries
de condensateurs série**

(standards.iteh.ai)

Series capacitors for power systems –

[https://standards.iteh.ai/catalog/standards/sist/dd057964-d036-41bd-9fce-](https://standards.iteh.ai/catalog/standards/sist/dd057964-d036-41bd-9fce-23d4/sist-en-60143-2-2000)

Part 2:

Protective equipment for series capacitor banks

© CEI 1994 Droits de reproduction réservés — Copyright — all rights reserved

Aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'éditeur.

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

Bureau Central de la Commission Electrotechnique Internationale 3, rue de Varembe Genève, Suisse



Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

CODE PRIX XA
PRICE CODE

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

CONTENTS

	Page
FOREWORD.....	7
Clause	
SECTION 1: GENERAL	
1.1 Scope and object	9
1.2 Normative references	11
1.3 Definitions	15
SECTION 2: QUALITY REQUIREMENTS AND TESTS	
2.1 Overtoltage protector	25
2.1.1 Protective spark gap	27
2.1.1.1 Purpose	27
2.1.1.2 Classification	27
2.1.1.3 Tests	27
2.1.2 Non-linear resistor (varistor)	31
2.1.2.1 Purpose	31
2.1.2.2 Classification	31
2.1.2.3 Tests	33
2.2 By-pass circuit-breaker	43
2.2.1 Purpose	43
2.2.2 Classification	43
2.2.3 Tests	45
2.3 Disconnectors	49
2.3.1 Purpose	49
2.3.1.1 By-pass disconnector	49
2.3.1.2 Series disconnector	49
2.3.2 Classification	49
2.3.3 Tests	49
2.4 Current-limiting damping equipment	51
2.4.1 Purpose	51
2.4.2 Classification	51
2.4.3 Tests	53
2.5 Discharge reactor	59
2.5.1 Purpose	59
2.5.2 Classification	59
2.5.3 Tests	59

Clause	Page
2.6 Voltage transformer	61
2.6.1 Purpose	61
2.6.2 Classification	61
2.6.3 Tests	63
2.7 Current transformer	63
2.7.1 Purpose	63
2.7.2 Classification	63
2.7.3 Tests	63
2.8 Signal column	63
2.8.1 Purpose	63
2.8.2 Classification	65
2.8.3 Tests	65
2.9 Relay protection, control equipment and platform to ground communication equipment	65
2.9.1 Purpose	65
2.9.2 Classification	67
2.9.3 Tests	71
SECTION 3: GUIDE	
3.1 General	71
3.2 Specification data for series capacitors	71
3.3 Protective spark gap	73
3.4 Non-linear resistor (varistor)	75
3.5 By-pass circuit-breaker	89
3.6 Disconnectors	91
3.7 Current-limiting damping equipment	91
3.8 Discharge reactor	95
3.9 Voltage transformer	97
3.10 Current transformer	97
3.11 Relay protection, control equipment and platform to ground communication equipment	97
3.12 Precommissioning tests	97
3.13 Commissioning tests	99
Annex A – Bibliography	101

iTeh STANDARD PREVIEW

(standard.itih.ai)

SIST EN 60143-2:2000

<http://order.elsevier.com/standards/sist/dd057964-d036-41hd-9fce-e993938923d4/sist-en-60143-2-2000>

INTERNATIONAL ELECTROTECHNICAL COMMISSION

—————

**SERIES CAPACITORS
FOR POWER SYSTEMS –**
**Part 2: Protective equipment for series
capacitor banks**

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 cooperation 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, prepared by technical committees on which all the National Committees having a special interest therein are represented, express, as nearly as possible, an international consensus of opinion on the subjects dealt with.
- 3) They have the form of recommendations for international use 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.

International Standard IEC 143-2 has been prepared by IEC technical committee 33: Power capacitors.

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

DIS	Report on Voting
33(CO)115	33(CO)124

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

IEC 143 consists of the following parts, under the general title: Power capacitors:

- 143: 1992, Series capacitors for power systems (when revised, this standard will become IEC 143-1);
- 143-2: 1994, Series capacitors for power systems – Part 2: Protective equipment for series capacitor banks.

Other parts are under consideration.

SERIES CAPACITORS FOR POWER SYSTEMS –

Part 2: Protective equipment for series capacitor banks

Section 1: General

1.1 Scope and object

This part of IEC 143 covers protective equipment for series capacitor banks, with a size larger than 10 Mvar per phase. Protective equipment is defined as the main circuit apparatus and ancillary equipment, which are part of a series capacitor installation, but which are external to the capacitor part itself. The recommendations for the capacitor part are given in IEC 143. The protective equipment is mentioned in clauses 1.3 and 7.6 of IEC 143.

The protective equipment, treated in this standard, comprises the following items listed below.

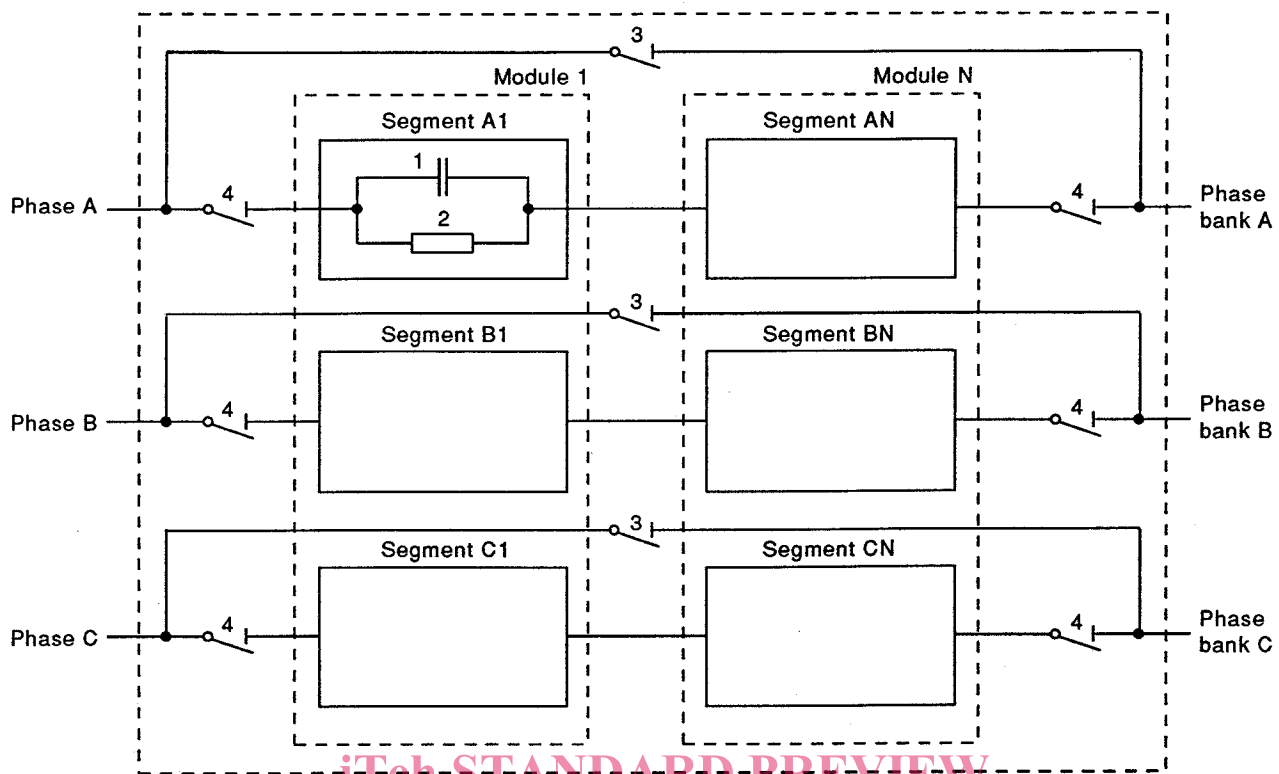
- overvoltage protector,
- protective spark gap,
- non-linear resistor (varistor),
- by-pass circuit-breaker,
- disconnectors,
- current-limiting damping equipment,
- discharge reactor,
- voltage transformer,
- current transformer,
- signal column,
- relay protection, control equipment and platform to ground communication equipment.

See figure 1.

Principles involved in the application and operation of series capacitors are given in section 3.

Examples of fault scenarios are given in section 3.

Examples of protective schemes utilizing different overvoltage protectors are given in clause 2.1.



iTeh STANDARD PREVIEW
(standards.iteh.ai)

IEC 673194

- 1 Assembly of capacitor units,
- 2 Main protective equipment for a segment.
- 3 By-pass disconnector.
- 4 Series disconnector.

Figure 1 – Series capacitor bank nomenclature

NOTE – Capacitor fuses are not treated in this standard, since they are treated in IEC 143 and IEC 595.

The object of this standard is:

- to formulate uniform rules regarding performance, testing and rating,
- to illustrate different kinds of overvoltage protectors,
- to provide a guide for installation and operation.

1.2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 143. 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 143 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.

The following IEC publications and reports are quoted in this standard:

- IEC 44-4: 1980, *Instrument transformers – Part 4: Measurement of partial discharges*
- IEC 50(436): 1990, *International Electrotechnical Vocabulary (IEV)– Chapter 436: Power Capacitors*
- IEC 56: 1987, *High-voltage alternating-current circuit-breakers*
- IEC 60-1: 1989, *High-voltage test techniques – Part 1: General definitions and test requirements*
- IEC 68-2-30: 1980, *Basic environmental testing procedures – Part 2: Tests – Test Db and guidance: Damp heat, cyclic (12 + 12 hour cycle)*
- IEC 76-1, 1993, *Power transformers – Part 1: General*
- IEC 99-1: 1991, *Surge arresters – Part 1 : Non-linear resistor type gapped arresters for a.c. systems*
- IEC 99-4: 1991, *Surge arresters – Part 4: Metal-oxide surge arresters without gaps for a.c. systems*
- IEC 129: 1984, *Alternating current disconnectors and earthing switches*
- IEC 143: 1992, *Series capacitors for power systems*
- IEC 185: 1987, *Current transformers* [SIST EN 60143-2:2000](https://standards.iteh.ai/catalog/standards/sist/dd057964-d036-41bd-9fce-993938923d4/sist-en-60143-2-2000)
- IEC 186: 1987, *Voltage transformers* <https://standards.iteh.ai/catalog/standards/sist/dd057964-d036-41bd-9fce-993938923d4/sist-en-60143-2-2000>
- IEC 255-6: 1988, *Electrical relays – Part 6: Measuring relays and protection equipment*
- IEC 289: 1988, *Reactors*
- IEC 383 (Parts 1-2): 1993, *Tests on insulators of ceramic material or glass for overhead lines with a nominal voltage greater than 1 000 V*
- IEC 595: 1977, *Internal fuses for series capacitors*
Amendment 2, 1987
- IEC 654 (Parts 1-4): 1979-1987, *Operating conditions for industrial-process measurement and control equipment*
- IEC 694: 1980, *Common clauses for high-voltage switchgear and controlgear standards*
- IEC 794-1: 1993, *Optical fibre cables – Part 1: Generic specification*
- IEC 794-2: 1989, *Optical fibre cables – Part 2: Product specifications*

NOTE – No standard exists for varistors for series capacitors (S.C.). The relevant tests for series capacitors varistors are therefore dealt with in this standard.

1.3 Definitions

For the purpose of this part of IEC 143, the following definitions apply:

1.3.0 definitions of capacitor parts and accessories: They are in accordance with IEC 143.

1.3.1 back-up gap: Supplementary gap which may be set to spark over at a voltage level higher than the protective level of the primary protective device, and which is normally placed in parallel with the primary protective device.

1.3.2 bank protection: General term for all protective equipment for a capacitor bank, or part thereof.

1.3.3 by-pass current: Current flowing through the by-pass device or devices in parallel with the series capacitor. This current can either be a fault current or a normal current.

1.3.4 by-pass device: Device such as a switch or a circuit-breaker used in parallel with a series capacitor and its overvoltage protector to shunt line current for a specified time, or continuously. Besides by-passing the capacitor, this device may also have the capability of inserting the capacitor into a circuit and carrying a specified current.

iTeh STANDARD PREVIEW

1.3.5 by-pass disconnect: Device to short-circuit the series capacitor after it is by-passed by the by-pass device.

1.3.6 by-pass fault current: Current flowing through the by-passed series capacitor bank caused by a fault on the line.

1.3.7 by-pass gap (protective gap): Gap, or system of gaps, to protect either the capacitor (Type K) against overvoltage or the non-linear resistor (Type M) against overload by carrying load or fault current around the protected parts for a specified time.

1.3.8 by-pass interlocking device: Device that requires all three poles of the by-pass device to be in the same open or closed position.

1.3.9 capacitance unbalance protection: Device to detect unbalance in capacitance between capacitor groups within a phase, such as that caused by blown capacitor fuses or faulted capacitors, and to initiate an alarm or the closing of the by-pass device, or both.

1.3.10 capacitor platform: Structure that supports the capacitor/rack assemblies and all associated equipment and protective devices, and is supported on insulators compatible with phase-to-earth insulation requirements.

1.3.11 capacitor switching step: See module.

1.3.12 continuous operating voltage (COV = MCOV) (U_c) (of a varistor): The (Maximum) Continuous Operating Voltage, COV, is the designated permissible r.m.s. value of power

r.m.s. frequency voltage that may be applied continuously between the varistor terminals.

NOTES

1 COV of the series capacitor varistor is usually equal to the rated voltage of the series capacitor. This definition is different from the definition of COV for a ZnO arrester according to IEC 99-4.

2 Consideration to short-time overvoltages of the series capacitor, such as voltages produced by swing currents and overload currents, should be taken into account when the protective level of the varistor is determined.

1.3.13 current-limiting damping equipment: Reactor or a reactor with a parallel connected resistor to limit the current magnitude and frequency and to provide a sufficient damping of the oscillation of the discharge of the capacitors upon operation of the by-pass gap or the by-pass device (see figure 1).

1.3.14 discharge device: Device permanently connected across the terminals of the capacitor or built into the capacitor unit, capable of reducing the residual voltage across the capacitor after the capacitor has been disconnected from the supply.

1.3.15 discharge voltage (of a varistor): See residual voltage.

1.3.16 external fault: Line fault occurring outside the protected line section containing the series capacitor bank.

1.3.17 fault within the capacitor bank: Fault appearing within the capacitor bank (for example changes of the capacitance within a segment, platform fault, etc.). Such faults should be handled by the protection of the series capacitor bank and cleared without the interruption of the transmission line.

[SIST EN 60143-2:2000](https://standards.iteh.ai/catalog/standards/sist/dd057964-d036-41bd-9fce-e993938923d4/sist-en-60143-2-2000)

[https://standards.iteh.ai/catalog/standards/sist/dd057964-d036-41bd-9fce-](https://standards.iteh.ai/catalog/standards/sist/dd057964-d036-41bd-9fce-e993938923d4/sist-en-60143-2-2000)

[e993938923d4/sist-en-60143-2-2000](https://standards.iteh.ai/catalog/standards/sist/dd057964-d036-41bd-9fce-e993938923d4/sist-en-60143-2-2000)

1.3.18 fault-to-platform protection: Device to detect insulation failure on the platform that results in current flowing from normal current-carrying circuit elements to the platform and to initiate the closing of the by-pass device.

1.3.19 insertion: Opening of the by-pass device to place the series capacitor in service with or without load current flowing.

1.3.20 insertion current: Steady-state root-mean-square current that flows through the series capacitor after the by-pass device has opened.

1.3.21 insertion voltage: Steady-state root-mean-square voltage appearing across the series capacitor upon interruption of the by-pass current with the opening of the by-pass device.

1.3.22 internal fault: Line fault occurring within the protected line section containing the series capacitor bank.

1.3.23 insulation level: Combination of test voltage values (both power-frequency and impulse) which characterizes the insulation of the capacitor bank with regard to its capability of withstanding the electric stresses between platform and earth, between phases, between terminals of all equipment and between platform-mounted equipment and the platform.