

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**High-voltage switchgear and controlgear –
Part 109: Alternating-current series capacitor by-pass switches**

**Appareillage à haute tension –
Partie 109: Interrupteurs de contournement pour condensateurs série à courant
alternatif**



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

**Part 109: Alternating-current series capacitor
by-pass switches**

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This consolidated version of IEC 62271-109 consists of the second edition (2008) [documents 17A/837/FDIS and 17A/844/RVD] and its amendment 1 (2013) [documents 17A/1038/FDIS and 17A/1043/RVD]. It bears the edition number 2.1.

The technical content is therefore identical to the base edition and its amendment and has been prepared for user convenience. A vertical line in the margin shows where the base publication has been modified by amendment 1. Additions and deletions are displayed in red, with deletions being struck through.

International Standard IEC 62271-109 has been prepared by subcommittee 17A: High-voltage switchgear and controlgear, of IEC technical committee 17: Switchgear and controlgear.

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

The main changes with respect to the previous edition are listed below:

- By-passing test duty has been split with operations at rated by-pass making current I_{BP} and operations at capacitor bank discharge current $I_{DISCHARGE}$.
- Equivalence regarding applicability of test parameters (current peak and frequency) during by-pass making tests in relation with service conditions have been reviewed and changed accordingly.
- Recovery voltage waveshape during insertion test duty has been recalculated and optimized. An explanatory note on the calculation of the recovery voltage is given in Annex F.
- Withdrawal of the electrical endurance class BP2. Such devices are now covered in informative Annex E
- Addition of Annex D which gives examples of typical by-pass switch ratings.

A list of all parts of the IEC 62271 series can be found under the general title *High-voltage switchgear and controlgear*, on the IEC website.

This standard is to be read in conjunction with IEC 62271-100 and IEC 62271-1 (2007), to which it refers and which is applicable, unless otherwise specified in this standard. In order to simplify the indication of corresponding requirements, the same numbering of clauses and subclauses is used as in IEC 62271-1. Amendments to these clauses and subclauses are given under the same references whilst additional subclauses are numbered from 101.

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HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 109: Alternating-current series capacitor by-pass switches

1 General

1.1 Scope

This part of IEC 62271 is applicable to a.c. series capacitor by-pass switches designed for outdoor installation and for operation at frequencies of 50 Hz and 60 Hz on systems having voltages above 52 kV.

It is only applicable to by-pass switches for use in three-phase systems.

This standard is also applicable to the operating devices of by-pass switches and to their auxiliary equipment.

1.2 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.

IEC 60050-151:2001, *International Electrotechnical Vocabulary – Part 151: Electrical and magnetic devices*

IEC 60050-436:1990, *International Electrotechnical Vocabulary – Chapter 436: Power capacitors*

IEC 60050-441:1984, *International Electrotechnical Vocabulary – Chapter 441: Switchgear, controlgear and fuses*

IEC 60050-604:1987, *International Electrotechnical Vocabulary – Chapter 604: Generation, transmission and distribution of electricity – Operation*

IEC 60060 (all parts), *High-voltage test techniques*

IEC 60143-1:2004, *Series capacitors for power systems – Part 1: General*

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

IEC 60296, *Fluids for electrotechnical applications – Unused mineral insulating oils for transformers and switchgear*

IEC 60376, *Specification of technical grade sulphur hexafluoride (SF₆) for use in electrical equipment*

IEC 60480, *Guidelines for the checking and treatment of sulphur hexafluoride (SF₆) taken from electrical equipment and specification for its re-use*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

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

IEC 62271-100:2008, *High-voltage switchgear and controlgear – Part 100: Alternating-current circuit-breakers*

IEC 62271-101, *High-voltage switchgear and controlgear – Part 101: Synthetic testing*

IEC 62271-102:2001, *High-voltage switchgear and controlgear – Part 102: Alternating current disconnectors and earthing switches*

IEC 62271-303, *High-voltage switchgear and controlgear – Part 303: Use and handling of sulphur hexafluoride (SF₆)*

2 Normal and special service conditions

Clause 2 of IEC 62271-1 is applicable.

3 Terms and definitions

For the purposes of this document, the terms and definitions of IEC 60050-151, IEC 60050-436, IEC 60050-441, IEC 60050-604, IEC 60143-1, IEC 60143-2 and IEC 62271-1 apply. Some of them are recalled here for ease of reference.

Additional terms and definitions are classified so as to be aligned with the classification used in IEC 60050-441.

3.1 General terms

**3.1.101
switchgear and controlgear**
[IEV 441-11-01]

**3.1.102
outdoor switchgear and controlgear**
[IEV 441-11-05]

**3.1.103
short-circuit current**
[IEV 441-11-07]

**3.1.104
ambient air temperature**
[IEV 441-11-13]

**3.1.105
temperature rise (of a part of a by-pass switch)**
difference between the temperature of the part and the ambient air temperature

**3.1.106
overvoltage (in a system)**
any voltage between one phase and earth or between phases having a peak value or values exceeding the corresponding peak of the highest voltage for equipment

[IEV 604-03-09, modified]

3.1.107**unit test**

test made on a by-passing or insertion unit or group of units at the by-pass making current or the insertion current, specified for the test on the complete pole of a by-pass switch and at the appropriate fraction of the applied voltage, or the recovery voltage, specified for the test on the complete pole of the by-pass switch

3.1.108**external insulation**

distances in air and the surfaces in contact with open air of solid insulation of the equipment, which are subject to dielectric stresses and to the effects of atmospheric and other external conditions such as pollution, humidity, vermin, etc.

[IEV 604-03-02, modified]

3.1.109**internal insulation**

internal solid, liquid or gaseous parts of the insulation of equipment, which are protected from the effects of atmospheric and other external conditions

[IEV 604-03-03]

3.1.110**self-restoring insulation**

insulation which completely recovers its insulating properties after a disruptive discharge

[IEV 604-03-04]

3.1.111**non-self restoring insulation**

insulation which loses its insulating properties, or does not recover them completely, after a disruptive discharge

[IEV 604-03-05]

3.1.112**disruptive discharge**

phenomenon associated with the failure of insulation under electric stress, in which the discharge completely bridges the insulation under test, reducing the voltage between the electrodes to zero or nearly to zero

NOTE 1 This term applies to discharges in solid, liquid and gaseous dielectrics and to combinations of these.

NOTE 2 A disruptive discharge in a solid dielectric produces permanent loss of dielectric strength (non-self-restoring insulation); in a liquid or gaseous dielectric, the loss may be only temporary (self-restoring insulation).

NOTE 3 The term "sparkover" is used when a disruptive discharge occurs in a gaseous or liquid dielectric. The term "flashover" is used when a disruptive discharge occurs over the surface of a solid dielectric in a gaseous or liquid medium. The term "puncture" is used when a disruptive discharge occurs through a solid dielectric.

3.1.113**restrike performance**

expected probability of restrike during insertion current test-duty as demonstrated by specified type test

NOTE Specific numeric probabilities cannot be applied throughout a by-pass switch service life.

3.1.114**re-ignition (of an a.c. mechanical switching device)**

[IEV 441-17-45]

3.1.115
restrike (of an a.c. mechanical switching device)
[IEV 441-17-46]

3.1.116
non-sustained disruptive discharge (NSDD)
disruptive discharge associated with current interruption, that does not result in the resumption of power frequency current or, in the case of insertion does not result in current in the series capacitor bank

NOTE Oscillations following NSDDs are associated with the parasitic capacitance and inductance local to or of the by-pass switch itself. NSDDs may also involve the stray capacitance to ground of nearby equipment.

3.2 Assemblies

No particular definitions.

3.3 Parts of assemblies

No particular definitions.

3.4 Switching devices

3.4.101
switching device
[IEV 441-14-01]

3.4.102
mechanical switching device
[IEV 441-14-02]

3.4.103
by-pass switch
three-phase switching device used in parallel with a series capacitor and its overvoltage protector to shunt line current of a specified level for a specified time, or continuously. By-pass switches may be three-pole or single-pole operated

NOTE 1 Besides by-passing the capacitor, this device normally has the capability to insert the capacitor into a circuit that carries a specified level of current.

NOTE 2 By-pass switches are normally used in conjunction with a fast by-passing device for example spark-gap (for special applications without the use of a fast by-passing device, see Annex E).

Examples of series capacitor layouts using a fast by-passing device in parallel with the by-pass switch (see IEC 60143-1) are shown below: