



NSAI
Standards

Irish Standard
I.S. EN 62271-109:2009

High-voltage switchgear and controlgear -- Part 109: Alternating-current series capacitor by-pass switches (IEC 62271-109:2008 (EQV))

I.S. EN 62271-109:2009

Incorporating amendments/corrigenda issued since publication:

EN 62271-109:2009/A1:2013

The National Standards Authority of Ireland (NSAI) produces the following categories of formal documents:

I.S. xxx: Irish Standard – national specification based on the consensus of an expert panel and subject to public consultation.

S.R. xxx: Standard Recommendation - recommendation based on the consensus of an expert panel and subject to public consultation.

SWiFT xxx: A rapidly developed recommendatory document based on the consensus of the participants of an NSAI workshop.

| | | |
|--|--|---|
| <i>This document replaces:</i> EN 62271-109:2001 | <i>This document is based on:</i> EN 62271-109:2009 | <i>Published:</i> 8 April, 2009 |
| This document was published under the authority of the NSAI and comes into effect on: 11 July, 2009 | | ICS number: 29.130.10 |
| NSAI 1 Swift Square, Northwood, Santry Dublin 9 | T +353 1 807 3800 F +353 1 807 3838 E standards@nsai.ie W NSAI.ie | Sales: T +353 1 857 6730 F +353 1 857 6729 W standards.ie |
| Údarás um Chaighdeáin Náisiúnta na hÉireann | | |

**High-voltage switchgear and controlgear -
Part 109: Alternating-current series capacitor by-pass switches
(IEC 62271-109:2008/A1:2013)**

Appareillage à haute tension -
Partie 109: Interrupteurs de
contournement pour condensateurs série
à courant alternatif
(CEI 62271-109:2008/A1:2013)

Hochspannungs-Schaltgeräte und -
Schaltanlagen -
Teil 109: Wechselstrom-
Überbrückungsschalter für
Reihencondensatoren
(IEC 62271-109:2008/A1:2013)

This amendment A1 modifies the European Standard EN 62271-109:2009; it was approved by CENELEC on 2013-07-02. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this amendment 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 CEN-CENELEC Management Centre or to any CENELEC member.

This amendment 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 CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

CENELEC

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

Management Centre: Avenue Marnix 17, B - 1000 Brussels

Foreword

The text of document 17A/1038/FDIS, future IEC 62271-109:2008/A1, prepared by SC 17A, "High-voltage switchgear and controlgear", of IEC TC 17, "Switchgear and controlgear" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62271-109:2009/A1:2013.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2014-04-02
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2016-07-02

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 62271-109:2008/A1:2013 was approved by CENELEC as a European Standard without any modification.

Annex ZB (informative)

A-deviations

A-deviation: National deviation due to regulations, the alteration of which is for the time being outside the competence of the CENELEC national member.

This European Standard does not fall under any Directive of the EU.

In the relevant CENELEC countries these A-deviations are valid instead of the provisions of the European Standard until they have been removed.

| <u>Clause</u> | <u>Deviation</u> |
|---------------|------------------|
|---------------|------------------|

| | |
|------------|--|
| 1.1 | |
|------------|--|

| | |
|--|--------------|
| | Italy |
|--|--------------|

| | |
|--|--|
| | (I.S.P.E.S.L. (*) Rules, 95 revision: VSR.8.B.1; VSR.8.B.2; M.15.D.2 to .4.) |
|--|--|

For high-voltage alternating current circuit-breakers containing gas-filled compartments, the design pressure is limited to a maximum of 0,5 bar (gauge) and the volume is limited to a maximum of 2 m³. Gas filled compartments having a design pressure exceeding 0,5 bar (gauge) or a volume exceeding 2 m³ shall be designed according to Italian pressure vessel code for electrical switchgear (DM1 December 1980 and DM 10 September 1981 published on Gazzetta Ufficiale n°285 dated 16.10.1981). This requirement is not applicable for gas filled compartments having a design pressure exceeding 0,5 bar (gauge) but a volume not exceeding 25 dm³. Italian laws apply to gas pressurised enclosures made of both insulating and metallic materials with a capacity of 25 litres or above, a design pressure higher than 0,05 kg/cm² and a temperature range: -25 °C/+100 °C (only for insulating materials). Moreover, the manufacturer of any electrical equipment which comprehends gas pressurised enclosures shall submit the design of the pressurised enclosures itself to a proper legal Authority indicating the stresses and the loads which have any influence on the design itself. For each of the stresses the manufacturer shall indicate the design values and the relevant computations. Only the use of porcelain type A or S (Aluminous or Siliceous) is permitted.

(*) I.S.P.E.S.L.: Istituto Superiore per la Prevenzione e la Sicurezza del Lavoro.

English version

**High-voltage switchgear and controlgear -
Part 109: Alternating-current series capacitor by-pass switches
(IEC 62271-109:2008)**

Appareillage à haute tension -
Partie 109: Interrupteurs
de contournement
pour condensateurs série
à courant alternatif
(CEI 62271-109:2008)

Hochspannungs-Schaltgeräte
und -Schaltanlagen -
Teil 109: Wechselstrom-
Überbrückungsschalter
für Reihenkondensatoren
(IEC 62271-109:2008)

This European Standard was approved by CENELEC on 2009-03-01. 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.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

CENELEC

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

Central Secretariat: avenue Marnix 17, B - 1000 Brussels

Foreword

The text of document 17A/837/FDIS, future edition 2 of IEC 62271-109, prepared by SC 17A, High-voltage switchgear and controlgear, of IEC TC 17, Switchgear and controlgear, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 62271-109 on 2009-03-01.

This European Standard supersedes EN 62271-109:2006.

This standard is to be read in conjunction with EN 62271-100 and EN 62271-1:2008, 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 EN 62271-1. Amendments to these clauses and subclauses are given under the same references whilst additional subclauses are numbered from 101.

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) 2009-12-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2012-03-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 62271-109:2008 was approved by CENELEC as a European Standard without any modification.

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

| | | |
|---------------|------|---|
| IEC 60071-1 | NOTE | Harmonized as EN 60071-1:2006 (not modified). |
| IEC 60071-2 | NOTE | Harmonized as EN 60071-2:1997 (not modified). |
| IEC 60137 | NOTE | Harmonized as EN 60137:2008 (not modified). |
| IEC 62271-200 | NOTE | Harmonized as EN 62271-200:2004 (not modified). |
| IEC 62271-203 | NOTE | Harmonized as EN 62271-203:2004 (not 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 When 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 60050-151 | 2001 | International Electrotechnical Vocabulary (IEV) - Part 151: Electrical and magnetic devices | - | - |
| IEC 60050-436 | 1990 | International Electrotechnical Vocabulary (IEV) - Chapter 436: Power capacitors | - | - |
| IEC 60050-441 | 1984 | International Electrotechnical Vocabulary (IEV) - Chapter 441: Switchgear, controlgear and fuses | - | - |
| IEC 60050-604 | 1987 | International Electrotechnical Vocabulary (IEV) - Chapter 604: Generation, transmission and distribution of electricity - Operation | - | - |
| IEC 60060 | Series | High-voltage test techniques | EN 60060 | Series |
| IEC 60143-1 | 2004 | Series capacitors for power systems - Part 1: General | EN 60143-1 | 2004 |
| IEC 60143-2 | 1994 | Series capacitors for power systems - Part 2: Protective equipment for series capacitor banks | EN 60143-2 | 1994 |
| IEC 60296 | - ¹⁾ | Fluids for electrotechnical applications - Unused mineral insulating oils for transformers and switchgear | EN 60296 + corr. September | 2004 ²⁾ 2004 |
| IEC 60376 | - ¹⁾ | Specification of technical grade sulfur hexafluoride (SF ₆) for use in electrical equipment | EN 60376 | 2005 ²⁾ |
| IEC 60480 | - ¹⁾ | Guidelines for the checking and treatment of sulphur hexafluoride (SF ₆) taken from electrical equipment and specification for its re-use | EN 60480 | 2004 ²⁾ |
| IEC 60529 | - ¹⁾ | Degrees of protection provided by enclosures (IP Code) | EN 60529 + corr. May | 1991 ²⁾ 1993 |
| IEC 62271-1 | 2007 | High-voltage switchgear and controlgear - Part 1: Common specifications | EN 62271-1 | 2008 |
| IEC 62271-100 | 2008 | High-voltage switchgear and controlgear - Part 100: Alternating current circuit-breakers | EN 62271-100 | 2009 |

¹⁾ Undated reference.

²⁾ Valid edition at date of issue.

I.S. EN 62271-109:2009

EN 62271-109:2009

– 4 –

| <u>Publication</u> | <u>Year</u> | <u>Title</u> | <u>EN/HD</u> | <u>Year</u> |
|---|----------------------|---|-------------------------------|--------------------|
| IEC 62271-101 | - ¹⁾ | High-voltage switchgear and controlgear - Part 101: Synthetic testing | EN 62271-101 | 2006 ²⁾ |
| IEC 62271-102 + corr. April + corr. May | 2001 2002 2003 | High-voltage switchgear and controlgear - Part 102: Alternating current disconnectors and earthing switches | EN 62271-102 + corr. March | 2002 2005 |
| IEC/TR 62271-303 | - ¹⁾ | High-voltage switchgear and controlgear - Part 303: Use and handling of sulphur hexafluoride (SF ₆) | - | - |

CONTENTS

| | |
|--|----|
| FOREWORD..... | 8 |
| 1 General..... | 10 |
| 1.1 Scope..... | 10 |
| 1.2 Normative references..... | 10 |
| 2 Normal and special service conditions..... | 11 |
| 3 Terms and definitions..... | 11 |
| 3.1 General terms..... | 11 |
| 3.2 Assemblies..... | 13 |
| 3.3 Parts of assemblies..... | 13 |
| 3.4 Switching devices..... | 13 |
| 3.5 Parts of by-pass switches..... | 15 |
| 3.6 Operation..... | 17 |
| 3.7 Characteristic quantities..... | 18 |
| 3.8 Definitions related to series capacitor banks..... | 23 |
| 3.9 Index of definitions..... | 25 |
| 4 Ratings..... | 28 |
| 4.1 Rated voltage (U_r)..... | 29 |
| 4.2 Rated insulation level..... | 29 |
| 4.2.101 Rated insulation level to earth..... | 29 |
| 4.2.102 Rated insulation level across the by-pass switch..... | 29 |
| 4.3 Rated frequency (f_r)..... | 29 |
| 4.4 Rated normal current (I_r) and temperature rise..... | 30 |
| 4.5 Rated short-time withstand current (I_k)..... | 30 |
| 4.6 Rated peak withstand current (I_p)..... | 30 |
| 4.7 Rated duration of short-circuit (t_k)..... | 30 |
| 4.8 Rated supply voltage of closing and opening devices and of auxiliary and control circuits (U_a)..... | 30 |
| 4.9 Rated supply frequency of closing and opening devices and auxiliary circuits..... | 30 |
| 4.10 Rated pressures of compressed gas supply for insulation, operation and/or by-passing and insertion..... | 30 |
| 4.101 Rated operating sequence..... | 30 |
| 4.102 Rated by-pass making current (I_{BP})..... | 31 |
| 4.104 Rated reinsertion voltage (U_{INS})..... | 31 |
| 4.105 Rated time quantities..... | 32 |
| 4.106 Number of mechanical operations..... | 32 |
| 5 Design and construction..... | 33 |
| 5.1 Requirements for liquids in by-pass switches..... | 33 |
| 5.2 Requirements for gases in by-pass switches..... | 33 |
| 5.3 Earthing of by-pass switches..... | 33 |
| 5.4 Auxiliary equipment..... | 33 |
| 5.5 Dependent power operation..... | 34 |
| 5.6 Stored energy operation..... | 34 |
| 5.7 Independent manual operation..... | 34 |
| 5.8 Operation of releases..... | 34 |

| | | |
|---------|---|----|
| 5.8.1 | Shunt closing releases | 34 |
| 5.8.2 | Shunt opening releases | 34 |
| 5.8.3 | Capacitor operation of shunt releases | 34 |
| 5.8.4 | Under-voltage release | 34 |
| 5.8.101 | Multiple releases | 34 |
| 5.8.102 | Operation limits of releases | 35 |
| 5.8.103 | Power consumption of releases | 35 |
| 5.9 | Low- and high-pressure interlocking devices | 35 |
| 5.10 | Nameplates | 35 |
| 5.11 | Interlocking devices | 37 |
| 5.12 | Position indication | 37 |
| 5.13 | Degrees of protection by enclosures | 37 |
| 5.14 | Creepage distances | 37 |
| 5.15 | Gas and vacuum tightness | 37 |
| 5.16 | Liquid tightness | 37 |
| 5.17 | Fire hazard (flammability) | 37 |
| 5.18 | Electromagnetic compatibility | 37 |
| 5.19 | X-ray emission | 38 |
| 5.20 | Corrosion | 38 |
| 5.101 | Requirements for simultaneity within a pole | 38 |
| 5.102 | General requirement for operation | 38 |
| 5.103 | Pressure limits of fluids for operation | 38 |
| 5.104 | Vent outlets | 38 |
| 6 | Type tests | 39 |
| 6.1 | General | 40 |
| 6.1.1 | Grouping of tests | 40 |
| 6.1.2 | Information for identification of specimens | 40 |
| 6.1.3 | Information to be included in type test reports | 40 |
| 6.2 | Dielectric tests | 41 |
| 6.2.1 | Ambient air conditions during tests | 41 |
| 6.2.2 | Wet test procedure | 41 |
| 6.2.3 | Condition of by-pass switch during dielectric tests | 41 |
| 6.2.4 | Criteria to pass the test | 41 |
| 6.2.5 | Application of test voltage and test conditions | 42 |
| 6.2.6 | Tests of by-pass switches of $U_{re} \leq 245$ kV or $U_{rp} \leq 245$ kV | 42 |
| 6.2.7 | Tests of by-pass switches of $U_{re} > 245$ kV or $U_{rp} > 245$ kV | 42 |
| 6.2.8 | Artificial pollution tests | 43 |
| 6.2.9 | Partial discharge tests | 43 |
| 6.2.10 | Tests on auxiliary and control circuits | 43 |
| 6.2.11 | Voltage test as a condition check | 43 |
| 6.3 | Radio interference voltage (r.i.v.) tests | 44 |
| 6.4 | Measurement of the resistance of the main circuit | 44 |
| 6.5 | Temperature-rise tests | 45 |
| 6.5.1 | Conditions of the by-pass switch to be tested | 45 |
| 6.5.2 | Arrangement of the equipment | 45 |
| 6.5.3 | Measurement of the temperature and the temperature rise | 45 |
| 6.5.4 | Ambient air temperature | 45 |
| 6.5.5 | Temperature-rise tests of the auxiliary and control equipment | 45 |

| | | |
|---------|--|----|
| 6.5.6 | Interpretation of the temperature-rise tests | 45 |
| 6.6 | Short-time withstand current and peak withstand current tests | 45 |
| 6.6.1 | Arrangement of the by-pass switch and of the test circuit | 45 |
| 6.6.2 | Test current and duration..... | 45 |
| 6.6.3 | Behaviour of the by-pass switch during test..... | 45 |
| 6.6.4 | Conditions of the by-pass switch after test..... | 45 |
| 6.7 | Verification of the degree of protection | 45 |
| 6.7.1 | Verification of the IP coding..... | 45 |
| 6.7.2 | Mechanical impact test (verification of the IK coding) | 45 |
| 6.8 | Tightness tests | 46 |
| 6.9 | Electromagnetic compatibility (EMC) tests..... | 46 |
| 6.10 | Additional tests on auxiliary and control circuits | 46 |
| 6.10.1 | General | 46 |
| 6.10.2 | Functional tests | 46 |
| 6.10.3 | Electrical continuity of earthed metallic parts test | 46 |
| 6.10.4 | Verification of the operational characteristics of auxiliary contacts..... | 46 |
| 6.10.5 | Environmental tests | 46 |
| 6.11 | X-Radiation test procedure for vacuum interrupters | 47 |
| 6.101 | Mechanical and environmental tests | 47 |
| 6.101.1 | Miscellaneous provisions for mechanical and environmental tests..... | 47 |
| 6.101.2 | Mechanical operation test at ambient air temperature..... | 49 |
| 6.101.3 | Low and high temperature tests | 51 |
| 6.101.4 | Humidity test..... | 55 |
| 6.101.5 | Test to prove the operation under severe ice conditions | 55 |
| 6.101.6 | Static terminal load test..... | 55 |
| 6.102 | Miscellaneous provisions for by-pass making and insertion tests | 57 |
| 6.102.1 | General..... | 57 |
| 6.102.2 | Number of test specimens | 57 |
| 6.102.3 | Arrangement of by-pass switch for tests | 57 |
| 6.102.4 | General considerations concerning testing methods..... | 59 |
| 6.102.5 | Synthetic tests | 61 |
| 6.102.6 | No-load operations before tests..... | 61 |
| 6.102.7 | Alternative operating mechanisms..... | 61 |
| 6.102.8 | Behaviour of by-pass switch during tests..... | 62 |
| 6.102.9 | Condition of by-pass switch after tests | 62 |
| 6.103 | Sequence of the tests | 64 |
| 6.104 | By-pass making current test-duty..... | 64 |
| 6.104.1 | General..... | 64 |
| 6.104.2 | Characteristics of supply circuit..... | 64 |
| 6.104.3 | Test voltage | 65 |
| 6.104.4 | Test current..... | 65 |
| 6.105 | Insertion current test-duty..... | 66 |
| 6.105.1 | General..... | 66 |
| 6.105.3 | Test voltage | 67 |
| 6.105.4 | Test current..... | 67 |
| 6.105.5 | Number of operations | 67 |
| 6.106 | Criteria to pass the test duties | 68 |
| 7 | Routine tests | 68 |

| | | |
|---------------------------------|--|-----|
| 7.1 | Dielectric test on the main circuit | 68 |
| 7.2 | Dielectric test on auxiliary and control circuits | 69 |
| 7.3 | Measurement of the resistance of the main circuit | 69 |
| 7.4 | Tightness test | 69 |
| 7.5 | Design and visual checks | 69 |
| 7.101 | Mechanical operating tests | 69 |
| 8 | Guide to the selection of by-pass switches for service | 71 |
| 9 | Information to be given with enquiries, tenders and orders | 71 |
| 9.101 | Information to be given with enquiries and orders | 71 |
| 9.102 | Information to be given with tenders | 72 |
| 10 | Rules for transport, storage, installation, operation and maintenance | 74 |
| 10.1 | Conditions during transport, storage and installation | 74 |
| 10.2 | Installation | 74 |
| 10.2.101 | Guide for commissioning tests | 74 |
| 10.2.102 | Commissioning checks and test programme | 75 |
| 10.3 | Operation | 80 |
| 10.4 | Maintenance | 80 |
| 10.4.101 | Resistors and capacitors (if applicable) | 80 |
| 11 | Safety | 80 |
| 12 | Influence of the product on environment | 81 |
| | | |
| Annex A (normative) | Tolerances on test quantities during type tests | 99 |
| Annex B (normative) | Records and reports of type tests | 103 |
| Annex C (informative) | List of symbols and abbreviations used | 106 |
| Annex D (informative) | Examples of by-pass switch ratings | 108 |
| Annex E (informative normative) | By-pass switches used as the primary by-passing devices | 115 |
| Annex F (informative) | Explanatory note regarding transient recovery voltage during reinsertion | 117 |
| Annex G (normative) | Use of mechanical characteristics and related requirements | 127 |
| Bibliography | | 129 |
| | | |
| Figure 1 | – By-pass switch – Opening and closing operations | 82 |
| Figure 2 | – By-pass switch – Close-open cycle | 83 |
| Figure 3 | – By-pass switch – Open-close cycle | 84 |
| Figure 4 | – Test sequences for low and high temperature tests | 85 |
| Figure 5 | – Static terminal load forces | 86 |
| Figure 6 | – Directions for static terminal load tests | 87 |
| Figure 7 | – Reference mechanical travel characteristics (idealized curve) | 88 |
| Figure 8 | – Reference mechanical travel characteristics (idealized curve) with the prescribed envelopes centred over the reference curve ($\pm 5\%$), contact separation in this example at time $t = 20$ ms | 88 |
| Figure 9 | – Reference mechanical travel characteristics (idealized curve) with the prescribed envelopes fully displaced upward from the reference curve ($^{+10}_0\%$), contact separation in this example at time $t = 20$ ms | 89 |

| | |
|---|-----------|
| Figure 10 – Reference mechanical travel characteristics (idealized curve) with the prescribed envelopes fully displaced downward from the reference curve ($-10^0\%$), contact separation in this example at time $t = 20$ ms | 89 |
| Figure 11 – Equivalent testing set-up for unit testing of by-pass switches with more than one separate by-pass units | 90 |
| Figure 12 – Typical test circuit for the by-pass making current test-duty | 91 |
| Figure 13 – Oscillogram obtained from the typical test circuit for the by-pass making current test-duty | 92 |
| Figure 14 – Typical LC test circuit for the insertion current test-duty | 93 |
| Figure 15 – Oscillogram obtained from the typical LC test circuit for the insertion current test-duty | 94 |
| Figure 16 – Typical test circuit for the insertion current test-duty (mainly for high rated insertion current) | 95 |
| Figure 17 – Oscillogram obtained from the typical test circuit shown in Figure 16 for the insertion current test-duty | 96 |
| Figure 18 – Typical direct test circuit for the insertion current test-duty | 97 |
| Figure 19 – Oscillogram obtained from the typical direct test circuit for the insertion current test-duty | 98 |
| Figure E.1 – Typical components layout for by-pass switches used as the primary by-passing device | 115 |
| Figure F.1 – Typical example of the transient reinsertion voltage across a by-switch for a low compensation factor scheme ($k = 0,2$) and for a power swing of 1,8 p.u. | 123 |
| Figure F.2 – Typical example of the transient reinsertion voltage across a by-switch for an high compensation factor scheme ($k = 0,5$) and for a power swing of 1,8 p.u. | 124 |
| Figure F.3 – Comparison of the calculated transient reinsertion voltage examples and possible testing envelopes for 50 Hz systems | 124 |
| Figure F.4 – Comparison of the calculated transient reinsertion voltage examples and possible testing envelopes for 60 Hz systems | 125 |
| | |
| Table 1 – Nameplate information | 36 |
| Table 2 – Type tests | 40 |
| Table 3 – Invalid tests | 41 |
| Table 4 – Number of operating sequences | 50 |
| Table 5 – Examples of static horizontal and vertical forces for static terminal load test | 56 |
| Table 6 – Application of voltage for dielectric test on the main circuit | 69 |
| Table 7 – Test procedures for by-pass making current tests | 66 |
| Table A.1 – Tolerances on test quantities for type tests | 100 |
| Table D.1 – Typical ratings for a series capacitor bank by-pass switch – Cases 1 to 6 | 109 |
| Table D.2 – Typical series capacitor bank by-pass switch ratings – Cases 7 to 12 | 111 |
| Table D.3 – Typical series capacitor bank by-pass switch ratings – Cases 13 to 18 | 113 |
| Table F.1 – Typical examples of transient reinsertion voltages for systems not having power swing nor emergency overload, $I_{load} = 1,0$ p.u.; $U_{PL} = 2,2$ p.u.; $\beta = 0,85$ and $f = 50$ Hz | 118 |
| Table F.2 – Typical examples of transient reinsertion voltages for systems not having power swing but with an emergency overload, $I_{load} = 1,2$ p.u.; $U_{PL} = 2,2$ p.u.; $\beta = 0,85$ and $f = 50$ Hz | 118 |

| | |
|---|-----|
| Table F.3 – Typical examples of transient reinsertion voltages for systems not having power swing but with an emergency overload, $I_{load} = 1,4$ p.u.; $U_{PL} = 2,2$ p.u.; $\beta = 0,85$ and $f = 50$ Hz | 118 |
| Table F.4 – Typical examples of transient reinsertion voltages for systems not having power swing but with an emergency overload, $I_{load} = 1,6$ p.u.; $U_{PL} = 2,2$ p.u.; $\beta = 0,85$ and $f = 50$ Hz | 119 |
| Table F.5 – Typical examples of transient reinsertion voltages for systems having power swing, $I_{load} = 1,8$ p.u.; $U_{PL} = 2,2$ p.u.; $\beta = 0,85$ and $f = 50$ Hz | 119 |
| Table F.6 – Typical examples of transient reinsertion voltages for systems having power swing, $I_{load} = 2,0$ p.u.; $U_{PL} = 2,2$ p.u.; $\beta = 0,85$ and $f = 50$ Hz | 119 |
| Table F.7 – Typical examples of transient reinsertion voltages for systems having power swing, $I_{load} = 2,3$ p.u.; $U_{PL} = 2,2$ p.u.; $\beta = 0,85$ and $f = 50$ Hz | 120 |
| Table F.8 – Typical examples of transient reinsertion voltages for systems having power swing, $I_{load} = 2,5$ p.u.; $U_{PL} = 2,2$ p.u.; $\beta = 0,85$ and $f = 50$ Hz | 120 |
| Table F.9 – Typical examples of transient reinsertion voltages for systems not having power swing nor emergency overload, $I_{load} = 1,0$ p.u.; $U_{PL} = 2,2$ p.u.; $\beta = 0,85$ and $f = 60$ Hz | 120 |
| Table F.10 – Typical examples of transient reinsertion voltages for systems not having power swing but with an emergency overload, $I_{load} = 1,2$ p.u.; $U_{PL} = 2,2$ p.u.; $\beta = 0,85$ and $f = 60$ Hz | 121 |
| Table F.11 – Typical examples of transient reinsertion voltages for systems not having power swing but with an emergency overload, $I_{load} = 1,4$ p.u.; $U_{PL} = 2,2$ p.u.; $\beta = 0,85$ and $f = 60$ Hz | 121 |
| Table F.12 – Typical examples of transient reinsertion voltages for systems not having power swing but with an emergency overload, $I_{load} = 1,6$ p.u.; $U_{PL} = 2,2$ p.u.; $\beta = 0,85$ and $f = 60$ Hz | 121 |
| Table F.13 – Typical examples of transient reinsertion voltages for systems having power swing, $I_{load} = 1,8$ p.u.; $U_{PL} = 2,2$ p.u.; $\beta = 0,85$ and $f = 60$ Hz | 122 |
| Table F.14 – Typical examples of transient reinsertion voltages for systems having power swing, $I_{load} = 2,0$ p.u.; $U_{PL} = 2,2$ p.u.; $\beta = 0,85$ and $f = 60$ Hz | 122 |
| Table F.15 – Typical examples of transient reinsertion voltages for systems having power swing, $I_{load} = 2,3$ p.u.; $U_{PL} = 2,2$ p.u.; $\beta = 0,85$ and $f = 60$ Hz | 122 |
| Table F.16 – Typical examples of reinsertion recovery voltages for systems having power swing, $I_{load} = 2,5$ p.u.; $U_{PL} = 2,2$ p.u.; $\beta = 0,85$ and $f = 60$ Hz | 123 |
| Table G.1 – Summary of type tests related to mechanical characteristics | 128 |

INTERNATIONAL ELECTROTECHNICAL COMMISSION

HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

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

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.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

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.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

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

IMPORTANT – The “colour inside” logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this publication using a colour printer.

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*

This is a free preview. Purchase the entire publication at the link below:

[Product Page](#)

-
- [Looking for additional Standards? Visit Intertek Inform Infostore](#)
 - [Learn about LexConnect, All Jurisdictions, Standards referenced in Australian legislation](#)
-