

INTERNATIONAL STANDARD

NORME INTERNATIONALE



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

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



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2019 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, 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 either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, 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'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Recherche de publications IEC - webstore.iec.ch/advsearchform

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

Electropedia - www.electropedia.org

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 000 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

67 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

INTERNATIONAL STANDARD

NORME INTERNATIONALE



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

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

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 29.130.10

ISBN 978-2-8322-6673-1

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	9
1 Scope.....	11
2 Normative references	11
3 Terms and definitions	12
3.1 General terms and definitions	12
3.2 Assemblies	15
3.3 Parts of assemblies	15
3.4 Switching devices	15
3.5 Parts of by-pass switches	17
3.6 Operational characteristics of by-pass switches	20
3.7 Characteristic quantities	22
3.8 Terms and definitions related to series capacitor banks	30
3.9 Index of definitions.....	33
4 Normal and special service conditions	37
5 Ratings.....	37
5.1 General.....	37
5.2 Rated voltage (U_r)	38
5.2.1 General	38
5.2.2 Range I for rated voltage of 245 kV and below	38
5.2.3 Range II for rated voltage above 245 kV	38
5.3 Rated insulation level (U_p, U_d, U_s)	38
5.3.101 Rated insulation level to earth (U_{pe}, U_{de}, U_{se})	38
5.3.102 Rated insulation level across the by-pass switch (U_{pp}, U_{dp}, U_{sp})	38
5.4 Rated frequency (f_r).....	39
5.5 Rated continuous current (I_r)	39
5.6 Rated short-time withstand current (I_k)	39
5.7 Rated peak withstand current (I_p)	39
5.8 Rated duration of short-circuit (t_k).....	39
5.9 Rated supply voltage of auxiliary and control circuits (U_a)	39
5.10 Rated supply frequency of auxiliary and control circuits	39
5.11 Rated pressures of compressed gas supply for controlled pressure systems.....	39
5.101 Rated operating sequence	39
5.102 Rated by-pass making current (I_{BP})	40
5.103 Rated by-pass insertion current (I_{INS})	41
5.104 Rated reinsertion voltage (U_{INS})	41
5.12 Number of mechanical operations	41
6 Design and construction	41
6.1 Requirements for liquids in by-pass switches	41
6.2 Requirements for gases in by-pass switches.....	42
6.3 Earthing of by-pass switches.....	42
6.4 Auxiliary and control equipment and circuits	42
6.4.1 General	42
6.4.2 Protection against electrical shock.....	42
6.4.3 Components installed in enclosures.....	42
6.5 Dependent power operation	43
6.6 Stored energy operation.....	43

6.7	Independent unlatched operation (independent manual or power operation)	43
6.8	Manually operated actuators	43
6.9	Operation of releases	43
6.9.1	General	43
6.9.2	Shunt closing releases	43
6.9.3	Shunt opening releases	43
6.9.4	Capacitor operation of shunt releases	44
6.9.5	Under-voltage release	44
6.9.101	Multiple releases	44
6.9.102	Operation limits of releases	44
6.9.103	Power consumption of releases	44
6.10	Pressure/level indication	44
6.10.101	Low- and high-pressure interlocking devices	44
6.11	Nameplates	44
6.12	Locking devices	46
6.13	Position indication	46
6.14	Degrees of protection provided by enclosures	46
6.15	Creepage distances for outdoor insulators	46
6.16	Gas and vacuum tightness	46
6.17	Tightness for liquid systems	46
6.18	Fire hazard (flammability)	46
6.19	Electromagnetic compatibility	46
6.20	X-ray emission	46
6.21	Corrosion	46
6.22	Filling levels for insulation, by-passing, insertion and/or operation	46
6.101	Requirements for simultaneity within a pole	46
6.102	General requirement for operation	46
6.103	Pressure limits of fluids for operation	47
6.104	Vent outlets	47
6.105	Time quantities	47
6.106	Static mechanical loads	48
7	Type tests	48
7.1	General	48
7.1.1	Basic	48
7.1.2	Information for identification of test objects	49
7.1.3	Information to be included in type test reports	49
7.1.101	Invalid tests	50
7.1.102	Type tests to repeat for by-pass switches with alternative operating mechanisms	50
7.2	Dielectric tests	50
7.2.1	General	50
7.2.2	Ambient air conditions during tests	50
7.2.3	Wet test procedure	51
7.2.4	Arrangement of the equipment	51
7.2.5	Criteria to pass the test	51
7.2.6	Application of test voltage and test conditions	51
7.2.7	Tests of by-pass switches of $U_{re} \leq 245$ kV or $U_{rp} \leq 245$ kV	51
7.2.8	Tests of by-pass switches of $U_{re} > 245$ kV or $U_{rp} > 245$ kV	52
7.2.9	Artificial pollution tests for outdoor insulators	52

7.2.10	Partial discharge tests	52
7.2.11	Dielectric tests on auxiliary and control circuits	53
7.2.12	Voltage test as condition check	53
7.3	Radio interference voltage (RIV) tests	54
7.4	Resistance measurement	54
7.5	Continuous current tests	55
7.5.1	Conditions of the test object	55
7.5.2	Arrangement of the equipment	55
7.5.3	Test current and duration	55
7.5.4	Temperature measurement during test	56
7.5.5	Resistance of the main circuit	56
7.5.6	Criteria to pass test	56
7.6	Short-time withstand current and peak withstand current tests	56
7.6.1	General	56
7.6.2	Arrangement of the by-pass switch and of the test circuit	56
7.6.3	Test current and duration	56
7.6.4	Condition of the by-pass switch after test	56
7.7	Verification of the protection	56
7.7.1	Verification of the IP coding	56
7.7.2	Verification of the IK coding	56
7.8	Tightness tests	56
7.9	Electromagnetic compatibility tests (EMC)	56
7.9.1	Emission tests	56
7.9.2	Immunity tests on auxiliary and control circuits	57
7.9.3	Additional EMC tests on auxiliary and control circuits	57
7.10	Additional tests on auxiliary and control circuits	57
7.10.1	General	57
7.10.2	Functional tests	57
7.10.3	Verification of the operational characteristics of auxiliary contacts	57
7.10.4	Environmental tests	57
7.10.5	Dielectric test	58
7.11	X-Radiation test on vacuum interrupters	58
7.101	Mechanical and environmental tests	58
7.101.1	Miscellaneous provisions for mechanical and environmental tests	58
7.101.2	Mechanical operation test at ambient air temperature	60
7.101.3	Low and high temperature tests	62
7.101.4	Humidity test	68
7.101.5	Test to prove the operation under severe ice conditions	68
7.102	Miscellaneous provisions for by-pass making and insertion tests	68
7.102.1	General	68
7.102.2	Number of test specimens	69
7.102.3	Arrangement of by-pass switch for tests	69
7.102.4	General considerations concerning testing methods	70
7.102.5	Synthetic tests	73
7.102.6	No-load operations before tests	73
7.102.7	Alternative operating mechanisms	73
7.102.8	Behaviour of by-pass switch during tests	74
7.102.9	Condition of by-pass switch after tests	74

7.103	By-pass making current test-duty and insertion current test-duty, sequence of tests	76
7.103.1	General	76
7.103.2	By-pass making current test-duty	76
7.103.3	Insertion current test-duty	79
7.103.4	Criteria to pass the test duties	88
8	Routine tests	88
8.1	General	88
8.2	Dielectric test on the main circuit	88
8.3	Tests on auxiliary and control circuits	90
8.3.1	Inspection of auxiliary and control circuits, and verification of conformity to circuit diagrams and wiring diagrams	90
8.3.2	Functional tests	90
8.3.3	Verification of protection against electrical shock	90
8.3.4	Dielectric tests	90
8.4	Measurement of the resistance of the main circuit	90
8.5	Tightness test	90
8.5.1	General	90
8.5.2	Controlled pressure systems for gas	90
8.5.3	Closed pressure systems for gas	91
8.5.4	Sealed pressure systems	91
8.5.5	Liquid tightness tests	91
8.6	Design and visual checks	91
8.101	Mechanical operating tests	91
9	Guide to the selection of by-pass switches (informative)	93
10	Information to be given with enquiries, tenders and orders (informative)	93
10.1	General	93
10.2	Information with enquiries and orders	93
10.3	Information with tenders	94
11	Transport, storage, installation, operating instructions and maintenance	96
11.1	General	96
11.2	Conditions during transport, storage and installation	96
11.3	Installation	96
11.4	Operating instruction	96
11.5	Maintenance	96
11.101	Guide for commissioning tests	96
11.101.1	General	96
11.101.2	Commissioning checks and test programme	97
11.101.3	Resistors and capacitors (if applicable)	102
12	Safety	102
12.1	General	102
12.2	Precautions by manufacturers	103
12.3	Precautions by users	103
13	Influence of the product on environment	103
Annex A (normative)	Tolerances on test quantities during type tests	104
Annex B (normative)	Records and reports of type tests	108
B.1	Information and results to be recorded	108
B.2	Information to be included in type test reports	108

B.2.1	General	108
B.2.2	Apparatus tested	108
B.2.3	Rated characteristics of by-pass switch, including its operating devices and auxiliary equipment.....	108
B.2.4	Test conditions (for each series of tests; if applicable).....	108
B.2.5	Short-time withstand current and peak withstand current test	109
B.2.6	No-load operation	109
B.2.7	By-pass making current test-duty.....	109
B.2.8	Insertion current test-duty.....	109
B.2.9	Oscillographic and other records	110
Annex C (informative) (Void).....		11
Annex D (informative) Examples of by-pass switch ratings.....		12
Annex E (normative) By-pass switches used as the primary by-passing devices		119
Annex F (informative) Explanatory note regarding recovery voltage during reinsertion		121
Annex G (normative) Use of mechanical characteristics and related requirements		131
Bibliography.....		134
Figure 1 – Different layouts for series capacitor banks.....		16
Figure 2 – By-pass switch – Opening and closing operations		23
Figure 3 – By-pass switch – Close-open cycle		24
Figure 4 – By-pass switch – Open-close cycle		25
Figure 5 – Example of wind velocity measurement.....		64
Figure 6 – Test sequences for low and high temperature tests		65
Figure 7 – Equivalent testing set-up for unit testing of by-pass switches with more than one separate by-pass units		71
Figure 8 – Typical test circuit for the by-pass making current test-duty		77
Figure 9 – Oscillogram obtained from the typical test circuit for the by-pass making current test-duty		78
Figure 10 – Typical LC test circuit for the insertion current test-duty		81
Figure 11 – Oscillogram obtained from the typical LC test circuit for the insertion current test-duty		82
Figure 12 – Typical test circuit for the insertion current test-duty (mainly for high rated insertion current)		83
Figure 13 – Oscillogram obtained from the typical test circuit shown in Figure 12 for the insertion current test-duty		84
Figure 14 – Typical direct test circuit for the insertion current test-duty.....		85
Figure 15 – Oscillogram obtained from the typical direct test circuit for the insertion current test-duty		86
Figure 16 – Reference mechanical travel characteristics (idealized curve).....		92
Figure E.1 – Typical component layout for by-pass switches used as the primary by-passing device.....		119
Figure F.1 – Typical example of the 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.....		128
Figure F.2 – Typical example of the reinsertion voltage across a by-switch for a high compensation factor scheme ($k = 0,5$) and for a power swing of 1,8 p.u.....		128
Figure F.3 – Comparison of the calculated reinsertion voltage examples and possible testing envelopes for 50 Hz systems.....		129

Figure F.4 – Comparison of the calculated reinsertion voltage examples and possible testing envelopes for 60 Hz systems	129
Figure G.1 – Reference mechanical travel characteristics (idealized curve)	132
Figure G.2 – Reference mechanical travel characteristics (idealized curve) with the prescribed envelopes centered over the reference curve ($\pm 5\%$), contact separation in this example at time $t = 20$ ms	132
Figure G.3 – Reference mechanical travel characteristics (idealized curve) with the prescribed envelopes fully displaced upward from the reference curve ($+10\%$), contact separation in this example at time $t = 20$ ms	133
Figure G.4 – Reference mechanical travel characteristics (idealized curve) with the prescribed envelopes fully displaced downward from the reference curve (-10%), contact separation in this example at time $t = 20$ ms	133
Table 1 – Number of mechanical operations	41
Table 2 – Nameplate information	45
Table 3 – Examples of static horizontal and vertical forces for static terminal load	48
Table 4 – Type tests	49
Table 5 – Invalid tests	50
Table 6 – Number of operating sequences	61
Table 7 – Limits of supply voltage for closing and opening releases	69
Table 8 – Test procedures for by-pass making current tests	79
Table 9 – Application of voltage for dielectric test in the main circuit	88
Table 10 – Test voltage for partial discharge test	90
Table A.1 – Tolerances on test quantities for type tests (1 of 3)	105
Table D.1 – Typical ratings for a series capacitor bank by-pass switch – Cases 1 to 6	113
Table D.2 – Typical series capacitor bank by-pass switch ratings – Cases 7 to 12	115
Table D.3 – Typical series capacitor bank by-pass switch ratings – Cases 13 to 18	117
Table F.1 – Typical examples of 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	122
Table F.2 – Typical examples of 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	122
Table F.3 – Typical examples of 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	123
Table F.4 – Typical examples of 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	123
Table F.5 – Typical examples of 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	123
Table F.6 – Typical examples of 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	124
Table F.7 – Typical examples of 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	124
Table F.8 – Typical examples of 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	124

Table F.9 – Typical examples of 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 125

Table F.10 – Typical examples of 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 125

Table F.11 – Typical examples of 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 125

Table F.12 – Typical examples of 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 126

Table F.13 – Typical examples of 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 126

Table F.14 – Typical examples of 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 126

Table F.15 – Typical examples of 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 127

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 127

currently in preview, click buy full version

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 itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 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.

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

This third edition cancels and replaces the second edition published in 2008 and Amendment 1:2013. This edition constitutes a technical revision.

This edition contains the following significant technical changes with respect to the previous edition:

- a) the document has been restructured according to edition 2.0 of IEC 62271-1;
- b) the rated voltage assignation across the by-pass switch has been aligned to the rule defined in IEC 60143-1;
- c) clarification has been given regarding rated continuous current of compensated and uncompensated line;
- d) some clarifications have been given following a loss of "suitable precautions";

- e) as per Amendment 2 of IEC 62271-100, the section "Rated time quantities" has been moved to Clause 6 under "Time quantities";
- f) as per Amendment 2 of IEC 62271-100, the section "Test for static mechanical loads" have been moved to Clause 6 under "Static mechanical loads";
- g) additional rules have been introduced for vacuum interrupters during impulse tests;
- h) additional clarifications have been given regarding the number of reduced impulses during impulse tests;
- i) a wider tolerance on the current damping during by-pass making current test-duty has been introduced.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
17A/1208/FDIS	17A/1215/RVD

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

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

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 62271-100:2008 with its Amendment 1:2012 and Amendment 2:2017, and IEC 62271-1:2017, 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 62271-1:2017. 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 document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document 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 document using a colour printer.

HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

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

1 Scope

This part of IEC 62271 is applicable to AC 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 document is also applicable to the operating devices of by-pass switches and to their auxiliary equipment.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60050-614:2016, *International Electrotechnical Vocabulary – Part 614: Generation, transmission and distribution of electricity – Operation*

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

IEC 60137:2017, *Insulated bushings for alternating voltages above 1000 V*

IEC 60143-1:2015, *Series capacitors for power systems – Part 1: General*

IEC 60143-2:2012, *Series capacitors for power systems – Part 2: Protective equipment for series capacitor banks*

IEC 60270, *High-voltage test techniques – Partial discharge measurements*

IEC 60376, *Specification of technical grade sulphur hexafluoride (SF₆) and complementary gases to be used in its mixtures 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*