



BSI Standards Publication

High-voltage switchgear and controlgear

Part 100: Alternating current circuit-breakers

bsi.

This is a preview. [Click here to purchase the full publication.](#)

National foreword

This British Standard is the UK implementation of EN IEC 62271-100:2021. It is identical to IEC 62271-100:2021. It supersedes BS EN 62271-100:2009+A2:2017, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PEL/17, High voltage switchgear, controlgear and assemblies.

A list of organizations represented on this committee can be obtained on request to its committee manager.

Contractual and legal considerations

This publication has been prepared in good faith, however no representation, warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability is or will be accepted by BSI in relation to the adequacy, accuracy, completeness or reasonableness of this publication. All and any such responsibility and liability is expressly disclaimed to the full extent permitted by the law.

This publication is provided as is, and is to be used at the recipient's own risk.

The recipient is advised to consider seeking professional guidance with respect to its use of this publication.

This publication is not intended to constitute a contract. Users are responsible for its correct application.

© The British Standards Institution 2021
Published by BSI Standards Limited 2021

ISBN 978 0 539 00300 0

ICS 29.130.10

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 September 2021.

Amendments/corrigenda issued since publication

Date	Text affected
------	---------------

EUROPEAN STANDARD

EN IEC 62271-100

NORME EUROPÉENNE

EUROPÄISCHE NORM

August 2021

ICS 29.130.10

Supersedes EN 62271-100:2009 and all of its amendments and corrigenda (if any)

English Version

High-voltage switchgear and controlgear - Part 100: Alternating current circuit-breakers (IEC 62271-100:2021)

Appareillage à haute tension - Partie 100: Disjoncteurs à courant alternatif
(IEC 62271-100:2021)

Hochspannungs-Schaltgeräte und -Schaltanlagen - Teil 100: Wechselstrom-Leistungsschalter
(IEC 62271-100:2021)

This European Standard was approved by CENELEC on 2021-08-11. 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 CEN-CENELEC Management Centre 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 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, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.



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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

The text of document 17A/1299/FDIS, future edition 3 of IEC 62271-100, prepared by SC 17A “Switching devices” of IEC/TC 17 “High-voltage switchgear and controlgear” was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 62271-100:2021.

The following dates are fixed:

- latest date by which the document has to be implemented at national (dop) 2022-05-11 level by publication of an identical national standard or by endorsement
- latest date by which the national standards conflicting with the (dow) 2024-08-11 document have to be withdrawn

This document supersedes EN 62271-100:2009 and all of its amendments and corrigenda (if any).

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

Any feedback and questions on this document should be directed to the users’ national committee. A complete listing of these bodies can be found on the CENELEC website.

Endorsement notice

The text of the International Standard IEC 62271-100:2021 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 60137:2017 NOTE Harmonized as EN 60137:2017 (not modified)

IEC 62271-110 NOTE Harmonized as EN IEC 62271-110

IEC 60296 NOTE Harmonized as EN IEC 60296

IEC 60376 NOTE Harmonized as EN IEC 60376

IEC 60480 NOTE Harmonized as EN IEC 60480

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

<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	-	-
+A1	2013			
+A2	2014			
+A3	2019			
+A4	2020			
IEC 60050-441	1984	International Electrotechnical Vocabulary (IEV) - Part 441: Switchgear, controlgear and fuses	-	-
+A1	2000			
IEC 60050-442	1998	International Electrotechnical Vocabulary (IEV) - Part 442: Electrical accessories	-	-
+A1	2015			
+A2	2015			
+A3	2019			
IEC 60050-461	2008	International Electrotechnical Vocabulary (IEV) - Part 461: Electric cables	-	-
IEC 60050-601	1985	International Electrotechnical Vocabulary (IEV) - Part 601: Generation, transmission and distribution of electricity - General	-	-
+A1	1998			
+A2	2020			
IEC 60050-614	2016	International Electrotechnical Vocabulary (IEV) - Part 614: Generation, transmission and distribution of electricity - Operation	-	-
IEC 60059	-	IEC standard current ratings	EN 60059	-
IEC 60060-1	-	High-voltage test techniques - Part 1: General definitions and test requirements	EN 60060-1	-

EN IEC 62271-100:2021 (E)

IEC 60255-151	2009	Measuring relays and protection equipment - Part 151: Functional requirements for over/under current protection	EN 60255-151	2009
IEC 60270	-	High-voltage test techniques - Partial discharge measurements	EN 60270	-
IEC 62271-1	2017	High-voltage switchgear and controlgear - Part 1: Common specifications for alternating current switchgear and controlgear	EN 62271-1	2017
IEC 62271-101	-	High-voltage switchgear and controlgear - Part 101: Synthetic testing	EN 62271-101	-
IEC 62271-102	2018	High-voltage switchgear and controlgear - Part 102: Alternating current disconnectors and earthing switches	EN IEC 62271-102	2018
IEC 62271-200	2021	High-voltage switchgear and controlgear - Part 200: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV	EN IEC 62271-200	2021
IEC 62271-203	-	High-voltage switchgear and controlgear - Part 203: Gas-insulated metal-enclosed switchgear for rated voltages above 52 kV	EN 62271-203	-

CONTENTS

FOREWORD.....	11
1 Scope.....	13
2 Normative references	13
3 Terms and definitions	14
3.1 General terms and definitions	15
3.2 Assemblies	19
3.3 Parts of assemblies	19
3.4 Switching devices	19
3.5 Parts of circuit-breakers	21
3.6 Operational characteristics	25
3.7 Characteristic quantities	27
3.8 Index of definitions.....	43
4 Normal and special service conditions	47
5 Ratings.....	47
5.1 General.....	47
5.2 Rated voltage (U_r)	48
5.3 Rated insulation level (U_d , U_p , U_s)	48
5.4 Rated frequency (f_r).....	48
5.5 Rated continuous current (I_r)	48
5.6 Rated short-time withstand current (I_k)	48
5.7 Rated peak withstand current (I_p)	48
5.8 Rated duration of short-circuit (t_k).....	48
5.9 Rated supply voltage of auxiliary and control circuits (U_a)	48
5.10 Rated supply frequency of auxiliary and control circuits	48
5.11 Rated pressure of compressed gas supply for controlled pressure systems	48
5.101 Rated short-circuit breaking current (I_{SC})	49
5.102 Rated first-pole-to-clear factor (k_{pp}) for terminal fault	52
5.103 Rated short-circuit making current	52
5.104 Rated operating sequence	52
5.105 Rated out-of-phase making and breaking current	52
5.106 Rated capacitive currents.....	53
6 Design and construction	55
6.1 Requirements for liquids	55
6.2 Requirements for gases	55
6.3 Earthing	55
6.4 Auxiliary and control equipment and circuits	56
6.5 Dependent power operation	56
6.6 Stored energy operation.....	56
6.7 Independent unlatched operation (independent manual or power operation)	56
6.8 Manually operated actuators	56
6.9 Operation of releases.....	56
6.10 Pressure/level indication	57
6.11 Nameplates.....	58

6.12	Locking devices	60
6.13	Position indication.....	60
6.14	Degrees of protection provided by enclosures.....	60
6.15	Creepage distances for outdoor insulators	60
6.16	Gas and vacuum tightness	60
6.17	Tightness for liquid systems.....	60
6.18	Fire hazard (flammability)	60
6.19	Electromagnetic compatibility (EMC).....	60
6.20	X-ray emission	60
6.21	Corrosion	60
6.22	Filling levels for insulation, switching and/or operation.....	61
6.101	Requirements for simultaneity of poles during single closing and single opening operations	61
6.102	General requirement for operation	61
6.103	Pressure limits of fluids for operation	61
6.104	Vent outlets	62
6.105	Time quantities	62
6.106	Mechanical loads	62
6.107	Circuit-breaker classification	63
7	Type tests	65
7.1	General.....	65
7.2	Dielectric tests	67
7.3	Radio interference voltage (RIV) test	72
7.4	Resistance measurement.....	72
7.5	Continuous current tests	73
7.6	Short-time withstand current and peak withstand current tests	74
7.7	Verification of the protection	74
7.8	Tightness tests	74
7.9	Electromagnetic compatibility tests (EMC)	74
7.10	Additional tests on auxiliary and control circuits	75
7.11	X-radiation test procedure for vacuum interrupters.....	75
7.101	Mechanical and environmental tests	75
7.102	Miscellaneous provisions for making and breaking tests	88
7.103	General considerations for making and breaking tests	106
7.104	Demonstration of arcing times.....	113
7.105	Short-circuit test quantities	132
7.106	Short-circuit test procedure	155
7.107	Terminal fault tests	157
7.108	Additional short-circuit tests	161
7.109	Short-line fault tests.....	164
7.110	Out-of-phase making and breaking tests	175
7.111	Capacitive current tests	177
7.112	Requirements for making and breaking tests on class E2 circuit-breakers having a rated voltage above 1 kV up to and including 52 kV	191
8	Routine tests	192
8.1	General.....	192
8.2	Dielectric test on the main circuit	193
8.3	Tests on auxiliary and control circuits	195

8.4	Measurement of the resistance of the main circuit.....	195
8.5	Tightness test	195
8.6	Design and visual checks.....	195
8.101	Mechanical operating tests	195
9	Guide to the selection of switchgear and controlgear (informative)	197
9.101	General.....	197
9.102	Selection of rated values for service conditions.....	199
9.103	Selection of rated values for fault conditions	201
9.104	Selection for electrical endurance in networks of rated voltage above 1 kV and up to and including 52 kV	205
9.105	Selection for switching of capacitive loads	205
10	Information to be given with enquiries, tenders and orders (informative).....	205
10.1	General.....	205
10.2	Information with enquiries and orders	205
10.3	Information to be given with tenders.....	206
11	Transport, storage, installation, operation instructions and maintenance.....	208
11.1	General.....	208
11.2	Conditions during transport, storage and installation.....	208
11.3	Installation	208
11.4	Operating instructions	214
11.5	Maintenance	214
11.101	Resistors and capacitors.....	215
12	Safety.....	215
13	Influence of the product on the environment	215
Annex A (normative) Calculation of TRVs for short-line faults from rated characteristics		216
A.1	Basic approach	216
A.2	Transient voltage on line side	219
A.3	Transient voltage on source side	219
A.4	Examples of calculations.....	223
Annex B (normative) Tolerances on test quantities during type tests.....		226
Annex C (normative) Records and reports of type tests.....		235
C.1	Information and results to be recorded	235
C.2	Information to be included in type test reports.....	235
Annex D (normative) Method of determination of the prospective TRV		239
D.1	General.....	239
D.2	Drawing the envelope	239
D.3	Determination of parameters	240
Annex E (normative) Methods of determining prospective TRV waves		243
E.1	General.....	243
E.2	General summary of the recommended methods.....	245
E.3	Detailed consideration of the recommended methods	246
E.4	Comparison of methods	257
Annex F (informative) Requirements for breaking of transformer-limited faults by circuit-breakers with rated voltage higher than 1 kV		261
F.1	General.....	261
F.2	Circuit-breakers with rated voltage less than 100 kV	262

F.3	Circuit-breakers with rated voltage from 100 kV to 800 kV	264
F.4	Circuit-breakers with rated voltage higher than 800 kV.....	264
Annex G (normative) Use of mechanical characteristics and related requirements		265
Annex H (normative) Requirements for making and breaking test procedures for metal-enclosed and dead tank circuit-breakers		266
H.1	General.....	266
H.2	Reduced number of making and breaking units for testing purposes	266
H.3	Tests for single pole in one enclosure	267
H.4	Tests for three poles in one enclosure	270
Annex I (normative) Requirements for circuit-breakers with opening resistors		272
I.1	General.....	272
I.2	Switching performance to be verified	272
I.3	Insertion time of the resistor.....	285
I.4	Current carrying performance	285
I.5	Dielectric performance	285
I.6	Mechanical performance	285
I.7	Requirements for the specification of opening resistors.....	285
I.8	Examples of recovery voltage waveshapes	285
Annex J (normative) Verification of capacitive current breaking in presence of single or two-phase earth faults		292
J.1	General.....	292
J.2	Test voltage	292
J.3	Test current	292
J.4	Test-duty	293
J.5	Criteria to pass the tests	293
Bibliography.....		294
Figure 1 – Typical oscillogram of a three-phase short-circuit make-break cycle.....		29
Figure 2 – Circuit-breaker without switching resistors – Opening and closing operations.....		30
Figure 3 – Circuit breaker without switching resistors – Close-open cycle		31
Figure 4 – Circuit-breaker without switching resistors – Reclosing (auto-reclosing).....		32
Figure 5 – Circuit-breaker with switching resistors – Opening and closing operations		33
Figure 6 – Circuit-breaker with switching resistors – Close-open cycle.....		34
Figure 7 – Circuit-breaker with switching resistors – Reclosing (auto-reclosing).....		35
Figure 8 – Determination of short-circuit making and breaking currents, and of percentage DC component.....		50
Figure 9 – Percentage DC component in relation to the time interval from the initiation of the short-circuit for the different time constants.....		51
Figure 10 – Example of wind velocity measurement		82
Figure 11 – Test sequence for low temperature test.....		84
Figure 12 – Test sequence for high temperature test		85
Figure 13 – Humidity test.....		87
Figure 14 – Example of reference mechanical characteristics (idealised curve)		91
Figure 15 – Reference mechanical characteristics of Figure 14 with the envelopes centred over the reference curve (+5 %, –5 %)		92

Figure 16 – Reference mechanical characteristics of Figure 14 with the envelope fully displaced upward from the reference curve (+10 %, –0 %)	93
Figure 17 – Reference mechanical characteristics of Figure 14 with the envelope fully displaced downward from the reference curve (+0 %, –10 %)	93
Figure 18 – Equivalent testing set-up for unit testing of circuit-breakers with more than one separate making and breaking units	95
Figure 19 – Earthing of test circuits for single-phase short-circuit tests, $k_{pp} = 1,5$	96
Figure 20 – Earthing of test circuits for single-phase short-circuit tests, $k_{pp} = 1,3$	97
Figure 21 – Test circuit for single-phase out-of-phase tests	97
Figure 22 – Test circuit for out-of-phase tests using two voltages separated by 120 electrical degrees	98
Figure 23 – Test circuit for out-of-phase tests with one terminal of the circuit-breaker earthed (subject to agreement of the manufacturer)	98
Figure 24 – Example of prospective test TRV with four-parameter envelope which satisfies the conditions to be met during type test – Case of specified TRV with four-parameter reference line	99
Figure 25 – Example of prospective test TRV with two-parameter envelope which satisfies the conditions to be met during type test: case of specified TRV with two-parameter reference line	100
Figure 26 – Example of prospective test TRV-waves and their combined envelope in two-part test	101
Figure 27 – Earthing of test circuits for three-phase short-circuit tests, $k_{pp} = 1,5$	108
Figure 28 – Earthing of test circuits for three-phase short-circuit tests, $k_{pp} = 1,3$	109
Figure 29 – Determination of power frequency recovery voltage	111
Figure 30 – Graphical representation of the time parameters for the demonstration of arcing times in three-phase tests of test-duty T100a	114
Figure 31 – Graphical representation of an example of the three valid symmetrical breaking operations for $k_{pp} = 1,5$	115
Figure 32 – Graphical representation of the three valid symmetrical breaking operations for $k_{pp} = 1,2$ or $1,3$	116
Figure 33 – Graphical representation of an example of the three valid asymmetrical breaking operations for $k_{pp} = 1,5$	120
Figure 34 – Graphical representation of an example of the three valid asymmetrical breaking operations for $k_{pp} = 1,2$ or $1,3$	121
Figure 35 – Example of a graphical representation of the three valid symmetrical breaking operations for single-phase tests in substitution of three-phase conditions for $k_{pp} = 1,5$	125
Figure 36 – Example of a graphical representation of an example of the three valid symmetrical breaking operations for single-phase tests in substitution of three-phase conditions for $k_{pp} = 1,2$ or $1,3$	126
Figure 37 – Example of a graphical representation of an example of the three valid asymmetrical breaking operations for single-phase tests in substitution of three-phase conditions for $k_{pp} = 1,5$	128
Figure 38 – Example of a graphical representation of an example of the three valid asymmetrical breaking operations for single-phase tests in substitution of three-phase for $k_{pp} = 1,2$ and $1,3$	129