



TECHNICAL SPECIFICATION



This full version of IEC TS 62271-318:2024 includes the content of the references made to TS IEC 62271-5:2024

**High-voltage switchgear and controlgear –
Part 318: DC gas-insulated metal-enclosed switchgear for rated voltages
including and above 100 kV**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 29.130.10

ISBN 978-2-8322-9762-9

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD.....	12
INTRODUCTION to IEC TS 62271-5:2024	14
1 Scope.....	15
2 Normative references	15
3 Terms and definitions	18
3.1 General terms and definitions	19
3.2 Assemblies of switchgear and controlgear	23
3.3 Parts of assemblies	24
3.4 Switching devices	24
3.5 Parts of switchgear and controlgear	25
3.6 Operational characteristics of switchgear and controlgear.....	29
3.6.5 Terms and definitions relative to pressure (or density).....	30
3.6.6 Terms and definitions relating to gas and vacuum tightness	31
3.6.7 Terms and definitions relating to liquid tightness.....	33
3.7 Characteristic quantities	34
3.8 Index of definitions.....	39
4 Normal and special service conditions	41
4.1 Normal service conditions	41
4.1.1 General	41
4.1.2 Indoor switchgear and controlgear	41
4.1.3 Outdoor switchgear and controlgear	42
4.2 Special service conditions.....	43
4.2.1 General	43
4.2.2 Altitude	43
4.2.3 Exposure to pollution	43
4.2.4 Temperature and humidity	43
4.2.5 Exposure to abnormal vibrations, shock or tilting	44
4.2.6 Wind speed	44
4.2.7 Other parameters	44
4.101 General.....	44
5 Ratings.....	45
5.1 General.....	45
5.2 Rated direct voltage (U_{rd}).....	45
5.2.1 General	45
5.2.2 Rated voltages	46
5.3 Rated insulation level (U_{dd} , U_p , U_s).....	46
5.4 Rated continuous current (I_{rd})	49
5.5 Rated values of short-time withstand current.....	49
5.5.1 Typical waveform of short-circuit current.....	49
5.5.2 Rated short-time withstand direct current (I_{kd})	52
5.5.3 Rated peak withstand current (I_{pd}).....	52
5.5.4 Rated duration of short-circuit (t_{kd}).....	52
5.6 Rated supply voltage of auxiliary and control circuits (U_a)	52
5.6.1 General	52
5.6.2 Rated supply voltage (U_a)	53

- 5.7 Rated supply frequency of auxiliary and control circuits 53
- 6 Design and construction 54**
- 6.1 Requirements for liquids in switchgear and controlgear 54
- 6.2 Requirements for gases in switchgear and controlgear 54
- 6.3 Earthing of switchgear and controlgear 54
 - 6.3.101 Earthing of the main circuit 54
 - 6.3.102 Earthing of the enclosure 55
- 6.4 Auxiliary and control equipment and circuits 55
 - 6.4.1 General 55
 - 6.4.2 Protection against electric shock 56
 - 6.4.3 Components installed in enclosures 56
- 6.5 Dependent power operation 59
- 6.6 Stored energy operation 59
 - 6.6.1 General 59
 - 6.6.2 Energy storage in gas receivers or hydraulic accumulators 59
 - 6.6.3 Energy storage in springs (or weights) 59
 - 6.6.4 Manual charging 59
 - 6.6.5 Motor charging 60
 - 6.6.6 Energy storage in capacitors 60
- 6.7 Independent unlatched operation (independent manual or power operation) 60
- 6.8 Manually operated actuators 60
- 6.9 Operation of releases 60
 - 6.9.1 General 60
 - 6.9.2 Shunt closing release 60
 - 6.9.3 Shunt opening release 60
 - 6.9.4 Capacitor operation of shunt releases 61
 - 6.9.5 Under-voltage release 61
- 6.10 Pressure/level indication 61
 - 6.10.1 Gas pressure 61
 - 6.10.2 Liquid level 62
- 6.11 Nameplates 62
 - 6.11.1 General 62
 - 6.11.2 Application 62
- 6.12 Locking devices 63
- 6.13 Position indication 64
- 6.14 Degrees of protection provided by enclosures 64
 - 6.14.1 General 64
 - 6.14.2 Protection of persons against access to hazardous parts and protection of the equipment against ingress of solid foreign objects (IP coding) 64
 - 6.14.3 Protection against ingress of water (IP coding) 64
 - 6.14.4 Protection against mechanical impact under normal service conditions (IK coding) 64
- 6.15 Creepage distances for outdoor insulators 65
- 6.16 Gas and vacuum tightness 65
 - 6.16.1 General 65
 - 6.16.2 Controlled pressure systems for gas 65
 - 6.16.3 Closed pressure systems for gas 66
 - 6.16.4 Sealed pressure systems 66
 - 6.16.101 Leakage 66

6.16.102	Gas handling	67
6.17	Tightness for liquid systems	67
6.18	Fire hazard (flammability)	67
6.19	Electromagnetic compatibility (EMC)	67
6.20	X-ray emission	67
6.21	Corrosion	67
6.22	Filling levels for insulation, switching and/or operation	67
6.101	General requirements for DC GIS	68
6.102	Pressure coordination	68
6.103	Internal arc fault	69
6.103.1	General	69
6.103.2	External effects of the arc	69
6.103.3	Internal fault location	70
6.104	Enclosures	70
6.104.1	General	70
6.104.2	Design of enclosures	70
6.105	Partitions	71
6.105.1	Design of partitions	71
6.105.2	Partitioning	72
6.106	Pressure relief	73
6.106.1	General	73
6.106.2	Non-reclosing pressure relief device	74
6.106.3	Pressure relief valve	74
6.106.4	Limitation of pressure rise in the case of an internal fault	74
6.107	Noise	74
6.108	Interfaces	74
6.108.1	General	74
6.108.2	Cable connections	75
6.108.3	Direct transformer connections	75
6.108.4	Bushings	76
6.108.5	Interfaces for future extensions	76
6.109	Interlocking	76
7	Type tests	76
7.1	General	76
7.1.1	Basics	76
7.1.2	Information for identification of test objects	78
7.1.3	Information to be included in type-test reports	78
7.2	Dielectric tests	78
7.2.1	General	78
7.2.2	Ambient air conditions during tests	79
7.2.3	Wet test procedure	79
7.2.4	Arrangement of the equipment	79
7.2.5	Criteria to pass the test	80
7.2.6	Application of the test voltage and test conditions	81
7.2.7	Tests of switchgear and controlgear	83
7.2.8	Artificial pollution tests for outdoor insulators	86
7.2.9	Partial discharge tests	86
7.2.10	Dielectric tests on auxiliary and control circuits	87
7.2.11	Voltage test as condition check	88

7.2.101	DC insulation system test	88
7.2.102	Long-term energized test	91
7.3	Resistance measurement	91
7.3.1	Measurement of the resistance of auxiliary contacts class 1 and class 2	91
7.3.2	Measurement of the resistance of auxiliary contacts class 3	92
7.3.3	Electrical continuity of earthed metallic parts test	92
7.3.4	Resistance measurement of contacts and connections in the main circuit as a condition check	92
7.4	Continuous current tests	93
7.4.1	Condition of the test object	93
7.4.2	Arrangement of the equipment	93
7.4.3	Test current and duration	94
7.4.4	Temperature measurement during test	95
7.4.5	Resistance of the main circuit	96
7.4.6	Criteria to pass test	96
7.5	Short-time withstand current and peak withstand current tests	100
7.5.1	General	100
7.5.2	Arrangement of the equipment and of the test circuit	100
7.5.3	Test current and duration	101
7.5.4	Conditions of the test object after test	102
7.5.101	Tests on the main circuits	102
7.5.102	Tests on earthing circuits	102
7.6	Verification of the protection	102
7.6.1	Verification of the IP coding	102
7.6.2	Verification of the IK coding	103
7.7	Tightness tests	103
7.7.1	General	103
7.7.2	Controlled pressure systems for gas	105
7.7.3	Closed pressure systems for gas	105
7.7.4	Sealed pressure systems	105
7.7.5	Liquid tightness tests	106
7.8	Electromagnetic compatibility tests (EMC)	106
7.8.1	Emission tests	106
7.8.2	Immunity tests on auxiliary and control circuits	109
7.8.3	Additional EMC tests on auxiliary and control circuits	111
7.9	Additional tests on auxiliary and control circuits	112
7.9.1	General	112
7.9.2	Functional tests	112
7.9.3	Verification of the operational characteristics of auxiliary contacts	112
7.9.4	Environmental tests	113
7.9.5	Dielectric test	114
7.10	X-radiation test for vacuum interrupters	114
7.10.1	General requirements	114
7.10.2	Test voltage and measurement procedure	116
7.10.3	Acceptance criteria	116
7.101	Verification of making and breaking capacities	117
7.102	Mechanical and environmental tests	117
7.102.1	General	117
7.102.2	Mechanical operation test at ambient temperature	117

7.102.3	Low- and high-temperature test	117
7.103	Proof tests for enclosures	117
7.103.1	General	117
7.103.2	Burst test procedure	117
7.103.3	Strain measurement test.....	118
7.104	Pressure test on partitions	119
7.105	Test under conditions of arcing due to an internal fault	119
7.106	Insulator tests	119
7.106.1	General	119
7.106.2	Thermal performance.....	120
7.106.3	Tightness test for partitions	120
7.107	Corrosion test on earthing connections	120
7.107.1	General	120
7.107.2	Test procedure	121
7.107.3	Criteria to pass the test	121
7.108	Corrosion tests on sealing systems of enclosures and auxiliary equipment	121
7.108.1	General	121
7.108.2	Test procedure	121
7.108.3	Criteria to pass the test	121
8	Routine tests	121
8.1	General.....	121
8.2	Dielectric test on the main circuit	122
8.2.101	Alternating or direct voltage tests on the main circuit.....	123
8.2.102	Partial discharge measurement.....	123
8.3	Tests on auxiliary and control circuits	123
8.3.1	Inspection of auxiliary and control circuits, and verification of conformity to the circuit diagrams and wiring diagrams	123
8.3.2	Functional tests	124
8.3.3	Verification of protection against electrical shock.....	124
8.3.4	Dielectric tests.....	124
8.4	Measurement of the resistance of the main circuit.....	124
8.5	Tightness test	125
8.5.1	General	125
8.5.2	Controlled pressure systems for gas.....	125
8.5.3	Closed pressure systems for gas	125
8.5.4	Sealed pressure systems.....	125
8.5.5	Liquid tightness tests	125
8.6	Design and visual checks.....	126
8.101	Pressure tests of enclosures	126
8.102	Mechanical operation tests	126
8.103	Tests on auxiliary circuits, equipment and interlocks in the control mechanism	126
8.104	Pressure test on partitions	126
9	Guide to the selection of switchgear and controlgear (informative)	127
9.1	General.....	127
9.2	Selection of rated values.....	127
9.3	Cable-interface considerations.....	127
9.4	Continuous or temporary overload due to changed service conditions.....	127
9.5	Environmental aspects.....	127

9.5.1	Service conditions	127
9.5.2	Clearances affected by service conditions	128
9.5.3	High humidity.....	128
9.5.4	Solar radiation	128
10	Information to be given with enquiries, tenders and orders (informative).....	128
10.1	General.....	128
10.2	Information with enquiries and orders	128
10.3	Information with tenders.....	129
11	Transport, storage, installation, operating instructions and maintenance.....	130
11.1	General.....	130
11.2	Conditions during transport, storage and installation	130
11.3	Installation	131
11.3.1	General	131
11.3.2	Unpacking and lifting	131
11.3.3	Assembly.....	131
11.3.4	Mounting	131
11.3.5	Connections	131
11.3.6	Information about gas and gas mixtures for controlled and closed pressure systems	131
11.3.7	Final installation inspection.....	132
11.3.8	Basic input data by the user	132
11.3.9	Basic input data by the manufacturer	133
11.4	Operating instructions	133
11.5	Maintenance	133
11.5.1	General	133
11.5.2	Information about fluids and gas to be included in maintenance manual	133
11.5.3	Recommendations for the manufacturer.....	134
11.5.4	Recommendations for the user	135
11.5.5	Failure report.....	135
11.101	Tests after installation on-site	137
11.101.1	General	137
11.101.2	Dielectric tests on the main circuits.....	137
11.101.3	Dielectric tests on auxiliary circuits	141
11.101.4	Measurement of the resistance of the main circuit	141
11.101.5	Gas tightness tests	141
11.101.6	Checks and verifications.....	141
11.101.7	Gas quality verifications.....	141
12	Safety.....	142
12.1	General.....	142
12.2	Precautions by manufacturers.....	142
12.3	Precautions by users	142
13	Influence of the product on the environment	143
Annex A (informative) Examples of HVDC side switchgear arrangement for one pole in an HVDC substation		144
Annex B (informative) Exposure to pollution.....		146
B.1	General.....	146
B.2	Minimum requirements for switchgear in normal service condition.....	146
B.3	Minimum requirements for switchgear in special service condition	146
Annex C (informative) Preferred insulation levels for rated voltages lower than 105 kV		147

Annex D (informative) Short-circuit current in HVDC systems	148
D.1 VSC HVDC	148
D.2 LCC HVDC	149
D.3 Special case of LCC HVDC DC faults – LCC as diode bridge	149
D.4 HVDC systems with DC circuit-breakers.....	151
D.5 Calculation of the rated short-time withstand direct current	152
D.6 Calculation of Joule integral value (E_j)	153
Annex E (informative) References for auxiliary and control circuit components	154
Annex F (informative) List of symbols	156
Annex G (normative) Method for the weatherproofing test for outdoor switchgear and controlgear	158
Annex H (normative) Tolerances on test quantities during tests	161
Annex I (informative) Extension of validity of type tests.....	164
I.1 General.....	164
I.2 Dielectric tests	164
I.3 Short-time withstand current and peak withstand current tests	164
I.4 Electromagnetic immunity test on auxiliary and control circuits	164
I.5 Environmental tests on auxiliary and control circuits	164
Annex J (normative) Identification of test objects	166
J.1 General.....	166
J.2 Data.....	166
J.3 Drawings.....	166
Annex K (informative) Test circuit for superimposed impulse voltage tests	168
K.1 General.....	168
K.2 Test circuit using blocking capacitor.....	168
K.3 Test circuit using sphere gap	168
Annex L (informative) Information and technical requirements to be given with enquiries, tenders and orders	170
L.1 General.....	170
L.2 Normal and special service conditions (refer to Clause 4)	170
L.3 Ratings (refer to Clause 5).....	171
L.4 Design and construction (refer to Clause 6)	171
L.5 System information	172
L.6 Documentation for enquiries and tenders	172
Annex M (informative) Electromagnetic compatibility on site	173
Annex N (informative) Standardization activities of HVDC	174
Annex A (normative) Methods for alternating current testing of DC gas-insulated metal-enclosed switchgear under conditions of arcing due to an internal fault.....	175
A.1 General.....	175
A.2 Short-circuit current arcing test	175
A.2.1 Test arrangements.....	175
A.2.2 Current and voltage applied.....	175
A.2.3 Test procedure	176
A.2.4 Criteria to pass the test	176
A.2.5 Test report.....	177
A.2.6 Extension of the test results.....	177
A.3 Composite verification by calculation and separate tests.....	177
Annex B (informative) Technical and practical considerations of site testing	178

B.1	Test voltage generators	178
B.2	Locating discharges	178
B.3	Special test procedures	178
B.3.1	General	178
B.3.2	Testing at reduced voltage.....	179
B.3.3	Testing at reduced gas density	179
B.4	Partial discharge measurements	179
B.5	Electrical conditioning	179
B.6	Repetition tests.....	179
B.6.1	General	179
B.6.2	Recommended procedure	180
B.7	Partial discharge detection method	180
B.7.1	General	180
B.7.2	Conventional method according to IEC 60270.....	180
B.7.3	VHF/UHF method	180
B.7.4	Acoustic method	181
B.7.5	Sensitivity verification of acoustic and UHF method	182
Annex C (informative)	Calculation of pressure rise due to an internal fault.....	183
Annex D (informative)	Information to be given with enquiries, tenders and orders	184
D.1	General.....	184
D.2	Normal and special service conditions	184
D.3	Ratings	185
D.4	Design and construction.....	186
D.5	Bus ducts.....	186
D.6	Disconnecter and earthing switch.....	186
D.7	Bushing	187
D.8	Cable connection	187
D.9	Transformer connection	188
D.10	Current transducer.....	188
D.11	Voltage transducer.....	188
D.12	Metal-oxide surge arrester	188
D.13	Documentation for enquiries and tenders	189
Annex E (informative)	List of notes concerning certain countries.....	190
Annex F (informative)	Long-term energized test.....	191
F.1	Test objects	191
F.2	Test sequence	191
F.3	Pre-test.....	192
F.4	Condition check	193
F.5	Success criteria, re-testing and interruptions	193
Annex G (informative)	Application of DC GIS under composite voltage of alternating and direct voltage components	195
G.1	General.....	195
G.2	Composite voltage consisting of alternating and direct voltage components.....	195
G.3	Recommendation for application of DC GIS in bipolar DC schemes under composite voltage stress.....	196
Annex H (informative)	DC switchgear located on neutral buses.....	197
Bibliography	198

Figure 1 – Schematic representation of superimposed impulse voltage tests	49
Figure 2 – Typical waveform of a short-circuit current in an HVDC system	51
Figure 3 – Examples of classes of contacts	58
Figure 1 – Pressure coordination	68
Figure 2 – Example of arrangement of enclosures and gas compartments	73
Figure 4 – Diagram of connections of a switching device	82
Figure 5 – Test sequence for polarity reversal tests	85
Figure 6 – Diagram of a test circuit for the radio interference voltage test	107
Figure 7 – Test location of radiation survey instrument	116
Figure A.1 – Example of HVDC side switchgear arrangement for one pole in an HVDC substation	145
Figure D.1 – VSC HVDC under worst-case, pole-pole DC fault	148
Figure D.2 – LCC HVDC under worst-case, pole-pole DC fault	149
Figure D.3 – Special case LCC HVDC under worst-case, pole-pole DC fault	150
Figure D.4 – HVDC system with DC circuit-breaker under worst-case, pole-pole DC fault	151
Figure D.5 – DC circuit-breaker simple model	151
Figure D.6 – Equivalent fault current for calculation of rated short time withstand direct current	152
Figure G.1 – Arrangement for weatherproofing test	159
Figure G.2 – Nozzle for weatherproofing test	160
Figure K.1 – Test circuit for superimposed impulse tests using blocking capacitor	168
Figure K.2 – Test circuit for superimposed impulse tests using sphere gap	169
Figure G.1 – Composite phase-to-earth voltage at midpoint of converter pole including third harmonic content and simplified voltage curve	195
Table 1 – Reference table of service conditions relevant to DC GIS	44
Table 1 – Preferred rated insulation levels	47
Table 2 – Direct voltage of auxiliary and control circuits	53
Table 3 – Alternating voltage of auxiliary and control circuits	53
Table 4 – Auxiliary contact classes	58
Table 5 – Nameplate information	63
Table 2 – Performance criteria	70
Table 3 – Type tests	77
Table 6 – Test conditions in general case	82
Table 7 – Test conditions in case of impulse voltage tests across the isolating distance (or open switching device)	83
Table 8 – Test conditions in case of superimposed impulse voltage tests	83
Table 9 – Test conditions for polarity reversal tests	85
Table 4 – Test voltage for measuring PD intensity	87
Table 5 – Sequence of DC insulation system test	90
Table 10 – Limits of temperature and temperature rise for various parts, materials and dielectrics of high-voltage switchgear and controlgear	97
Table 11 – Permissible leakage rates for gas systems	104
Table 12 – Application of voltages at the fast transient/burst test	110

Table 13 – Application of voltage at the damped oscillatory wave test..... 110

Table 14 – Assessment criteria for transient disturbance immunity..... 111

Table 6 – On-site test voltages 139

Table C.1 – Preferred insulation levels for rated voltages lower than 105 kV..... 147

Table E.1 – List of reference documents for auxiliary and control circuit components..... 154

Table H.1 – Tolerances on test quantities for type test..... 161

Table J.1 Drawing list and contents 166

Table D.1 – Normal and special service conditions 184

Table D.2 – Ratings 185

Table D.3 – Design and construction..... 186

Table D.4 – Bus ducts 186

Table D.5 – Bushing 187

Table D.6 – Cable connection 187

Table D.7 – Transformer connection 188

Table D.8 – Current transducer 188

Table D.9 – Voltage transducer..... 188

Table D.10 – Documentation for enquiries and tenders 189

Table F.1 – Test sequence for long-term energized test..... 191

Table F.2 – Test sequence for long-term energized test with combined switching and lightning impulse voltage tests and changed sequence 192

Table F.3 – Test procedure for the long-term energized test 193

Table F.4 – Condition check for the long-term energized test..... 193

INTERNATIONAL ELECTROTECHNICAL COMMISSION

HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 318: DC gas-insulated metal-enclosed switchgear for rated voltages including and above 100 kV

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) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at <https://patents.iec.ch>. IEC shall not be held responsible for identifying any or all such patent rights.

This extended version (EXV) of the official IEC Standard provides the user with the full content of the Standard.

IEC TS 62271-318:2024 EXV includes the content of IEC TS 62271-318:2024, and the references made to IEC TS 62271-5:2024.

The specific content of IEC TS 62271-318:2024 is displayed on a blue background.

IEC TS 62271-318 has been prepared by subcommittee 17C: Assemblies, of IEC technical committee 17: High-voltage switchgear and controlgear. It is a Technical Specification.

The text of this Technical Specification is based on the following documents:

Draft	Report on voting
17C/930/DTS	17C/937/RVDTS

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

The language used for the development of this Technical Specification is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

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

This document should be read in conjunction with IEC TS 62271-5:2024, to which it refers and which is applicable unless otherwise specified. In order to simplify the indication of corresponding requirements, the same numbering of clauses and subclauses is used as in IEC TS 62271-5:2024. Amendments to these clauses and subclauses are given under the same numbering, whilst additional subclauses, are numbered from 101.

The reader's attention is drawn to the fact that Annex E lists all of the "in-some-country" clauses on differing practices of a less permanent nature relating to the subject of this document.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

IMPORTANT – The "colour inside" logo on the cover page of this document 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.

INTRODUCTION to IEC TS 62271-5:2024

This Technical Specification has been prepared by TC 17 and it defines common specifications for high-voltage direct current (HVDC) switchgear and controlgear covering both types of air insulated (AIS) and gas insulated (GIS) equipment of HVDC substations. This document includes rules for service conditions, ratings, design and construction requirements. Test requirements and criteria to proof for passing type and routine tests are defined in this document for development and manufacturing of HVDC switchgear.

This specification is applicable for both LCC and VSC HVDC technology.

SC 17A is in the process of preparing documents for the following HVDC switching devices:

- circuit-breakers (IEC TS 62271-313 [1])¹;
- disconnectors and earthing switches (IEC TS 62271-314 [2]);
- transfer switches (IEC TS 62271-315 [3]);
- by-pass switches and paralleling switches (IEC TS 62271-316 [4]).

SC 17C is in the process of preparing a document for DC gas insulated switchgears (IEC TS 62271-318 [5]).

Standardization of direct voltages is the responsibility of TC 8 (System aspects of electrical energy supply).

TC 99 (Insulation co-ordination and system engineering of high voltage electrical power installations above 1,0 kV AC and 1,5 kV DC) defines requirements of DC substations for safety of insulation, equipment, installation and earthing (IEC 61936-2).

TC 115 (High Voltage Direct Current (HVDC) transmission for DC voltages above 100 kV) is responsible for DC transmission system aspects. It is the responsibility of TC 115 to define requirements for different equipment (e. g. switching devices) from system point of view. These definitions are implemented in documents from other TCs. Several Working Groups and Maintenance Teams are preparing documents on reliability, EMC, asset management, system design, DC harmonics, testing, HVDC grids, VSC and LCC converter and insulation coordination for HVDC systems.

¹ Numbers in square brackets refer to the Bibliography.

HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 318: DC gas-insulated metal-enclosed switchgear for rated voltages including and above 100 kV

1 Scope

This part of IEC 62271 specifies requirements for gas-insulated metal-enclosed switchgear in which the insulation is obtained, at least partly, by an insulating gas or gas mixture other than air at atmospheric pressure, for direct current of rated voltages including and above 100 kV, for indoor and outdoor installation. This document includes rules for service conditions, ratings, design, and construction requirements. Test requirements and criteria for proof for passing type and routine tests are defined in this document for development and manufacturing of DC switchgear.

For the purpose of this document, the terms "DC GIS" and "DC switchgear" are used for "DC gas-insulated metal-enclosed switchgear".

This specification is applicable for both Line Commutated Converter (LCC) and Voltage Sourced Converter (VSC) for HVDC systems.

The DC gas-insulated metal-enclosed switchgear covered by this document consists of individual components intended to be directly connected together and able to operate only in this manner.

This document completes and amends, if applicable, the various relevant documents applying to the individual components constituting DC gas-insulated metal-enclosed switchgear.

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 60038:2009, *IEC standard voltages*

IEC 60050-614:2016, *International Electrotechnical Vocabulary (IEV) – Part 614: Generation, transmission and distribution of electricity – Operation*

IEC 60050-811, *International Electrotechnical Vocabulary (IEV) – Part 811: Electric traction*

IEC 60050-826:2022, *International Electrotechnical Vocabulary (IEV) – Part 826: Electrical installations*

IEC 60060-1:2010, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60068-2-1:2007, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-2:2007, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60068-2-11:2021, *Environmental testing – Part 2-11: Tests – Test Ka: Salt mist*

IEC 60068-2-17:2023, *Environmental testing – Part 2-17: Tests – Test Q: Sealing*

IEC 60068-2-30:2005, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60071-1:2019, *Insulation co-ordination – Part 1: Definitions, principles and rules*

IEC 60071-2:2018, *Insulation co-ordination – Part 2: Application guidelines*

IEC 60071-11:2022, *Insulation co-ordination – Part 11: Definitions, principles and rules for HVDC system*

IEC 60085:2007, *Electrical insulation – Thermal evaluation and designation*

IEC 60099-4:2014, *Surge arresters – Part 4: Metal-oxide surge arresters without gaps for a.c. systems*

IEC 60099-9:2014, *Surge arresters – Part 9: Metal-oxide surge arresters without gaps for HVDC converter stations*

IEC 60137:2017, *Insulated bushings for alternating voltages above 1 000 V*

IEC 60255-21-1:1988, *Electrical relays – Part 21: Vibration, shock, bump and seismic tests on measuring relays and protection equipment – Section One: Vibration tests (sinusoidal)*

IEC 60270:2000, *High-voltage test techniques – Partial discharge measurements*
IEC 60270:2000/AMD1:2015

IEC 60296, *Fluids for electrotechnical applications – Mineral insulating oils for electrical equipment*

IEC 60376:2018, *Specification of technical grade sulphur hexafluoride (SF₆) and complementary gases to be used in its mixtures for use in electrical equipment*

IEC 60417:2006, *Graphical symbols for use on equipment (available at <http://www.graphical-symbols.info/equipment>)*

IEC 60437, *Radio interference test on high-voltage insulators*

IEC 60480:2019, *Specifications for the re-use of sulphur hexafluoride (SF₆) and its mixtures in electrical equipment*

IEC 60512-2-2, *Connectors for electronic equipment – Tests and measurements – Part 2-2: Electrical continuity and contact resistance tests – Test 2b: Contact resistance – Specified test current method*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*
IEC 60529:1989/AMD1:1999
IEC 60529:1989/AMD2:2013

IEC 60633:2019, *High-voltage direct current (HVDC) transmission – Vocabulary*

IEC TS 60815-1:2008, *Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 1: Definitions, information and general principles*

IEC TS 60815-4:2016, *Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 4: Insulators for DC systems*

IEC 61869-15:2018, *Instrument transformers – Part 15: Additional requirements for voltage transformers for DC applications*

IEC 61000-4-4, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61000-4-11, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests for equipment with input current up to 16 A per phase*

IEC 61000-4-17:1999, *Electromagnetic compatibility (EMC) – Part 4-17: Testing and measurement techniques – Ripple on d.c. input power port immunity test*

IEC 61000-4-18, *Electromagnetic compatibility (EMC) – Part 4-18: Testing and measurement techniques – Damped oscillatory wave immunity test*

IEC 61000-4-29, *Electromagnetic compatibility (EMC) – Part 4-29: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations on DC input power port immunity tests*

IEC 61000-6-2, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity standard for industrial environments*

IEC 61000-6-5, *Electromagnetic compatibility (EMC) – Part 6-5: Generic standards – Immunity for equipment used in power station and substation environment*

IEC 61180, *High-voltage test techniques for low-voltage equipment – Definitions, test and procedure requirements, test equipment*

IEC TS 61245, *Artificial pollution tests on high-voltage ceramic and glass insulators to be used on DC systems*

IEC 61810-7:2006, *Electromechanical elementary relays – Part 7: Test and measurement procedures*

IEC 62262:2002, *Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)*

IEC 62271-1:2017, *High-voltage switchgear and controlgear – Part 1: Common specifications for alternating current switchgear and controlgear*

IEC 62271-1:2017/AMD1:2021

IEC 62271-4, *High-voltage switchgear and controlgear – Part 4: Handling procedures for gases for insulation and/or switching*

IEC TS 62271-5:2024, *High-voltage switchgear and controlgear – Part 5: Common specifications for direct current switchgear*

IEC 62271-209:2019, *High-voltage switchgear and controlgear – Part 209: Cable connections for gas-insulated metal-enclosed switchgear for rated voltages above 52 kV – Fluid-filled and*

extruded insulation cables – Fluid-filled and dry-type cable terminations
IEC 62271-209:2019/AMD1:2022

IEC 62271-211:2014, *High-voltage switchgear and controlgear – Part 211: Direct connection between power transformers and gas-insulated metal-enclosed switchgear for rated voltages above 52 kV*

IEC TR 62271-306:2012, *High-voltage switchgear and controlgear – Part 306: Guide to IEC 62271-100, IEC 62271-1 and other IEC standards related to alternating current circuit-breakers*
IEC TR 62271-306:2012/AMD1:2018

IEC TS 62271-313, *High-voltage switchgear and controlgear – Part 314: Direct current disconnectors and earthing switches*

IEC TS 62271-314:2024, *High-voltage switchgear and controlgear – Part 314: Direct current disconnectors and earthing switches*

IEC TS 62271-315:20^{–2}, *High voltage switchgear and controlgear – Part 315: Direct current (DC) transfer switches*

IEC 62895:2017, *High voltage direct current (HVDC) power transmission – Cables with extruded insulation and their accessories for rated voltages up to 320 kV for land applications – Test methods and requirements*

IEC/IEEE 60076-57-129:2017, *Power transformers – Part 57-129: Transformers for HVDC applications*

IEC/IEEE 65700-19-03:2014, *Bushings for DC application*

ISO 22479:2019, *Corrosion of metals and alloys – Sulfur dioxide test in a humid atmosphere (fixed gas method)*

CISPR 11:2015, *Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement*

CISPR 16-1 (all parts), *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1: Radio disturbance and immunity measuring apparatus*

CISPR TR 18-2, *Radio interference characteristics of overhead power lines and high-voltage equipment – Part 2: Methods of measurement and procedure for determining limits*

² Under preparation. Stage at the time of publication: IEC CDTS 62271-315:2024.