



# TECHNICAL SPECIFICATION



---

## High-voltage switchgear and controlgear – Part 314: Direct current disconnectors and earthing switches

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

---

ICS 29.130.10

ISBN 978-2-8322-8938-9

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

## CONTENTS

FOREWORD.....	8
1 Scope.....	10
2 Normative references .....	10
3 Terms and definitions .....	11
3.1 General terms and definitions .....	11
3.2 Assemblies of switchgear and controlgear .....	11
3.3 Parts of assemblies .....	12
3.4 Switching devices .....	12
3.5 Parts of switchgear and controlgear .....	13
3.6 Operational characteristics of switchgear and controlgear.....	16
3.7 Characteristic quantities .....	18
3.8 Index of definitions.....	21
4 Normal and special service conditions .....	23
5 Ratings.....	23
5.1 General.....	23
5.2 Rated direct voltage ( $U_{rd}$ ).....	24
5.3 Rated insulation level ( $U_{dd}$ , $U_p$ , $U_s$ ).....	24
5.4 Rated continuous current ( $I_{rd}$ ) .....	27
5.5 Rated values of short-time withstand current.....	27
5.5.1 Typical waveform of short-circuit current.....	27
5.5.2 Rated short-time withstand current ( $I_{kd}$ ) .....	27
5.5.3 Rated peak withstand current ( $I_{pd}$ ) .....	27
5.5.4 Rated duration of short circuit ( $t_{kd}$ ).....	27
5.6 Rated supply voltage of auxiliary and control circuits ( $U_a$ ) .....	27
5.7 Rated supply frequency of auxiliary circuits and control circuits .....	27
5.8 Rated pressure of compressed gas supply for controlled pressure systems .....	27
5.101 Rated contact zone.....	28
5.102 Rated static mechanical terminal load.....	28
5.103 Classification of disconnectors for mechanical endurance.....	29
5.104 Classification of earthing switches for mechanical endurance .....	30
5.105 Rated ice-coating.....	30
5.106 Rated cable discharge current making capability .....	30
6 Design and construction .....	31
6.1 Requirements for liquids in disconnectors and earthing switches .....	31
6.2 Requirements for gases in disconnectors and earthing switches .....	31
6.3 Earthing of disconnectors and earthing switches.....	31
6.4 Auxiliary and control equipment and circuits .....	31
6.5 Dependent power operation .....	31
6.6 Stored energy operation.....	31
6.7 Independent unlatched operation (independent manual or power operation) .....	32
6.8 Manually operated actuators .....	32
6.9 Operation of releases.....	32
6.10 Pressure/level indication .....	32
6.11 Nameplates.....	32
6.12 Locking devices .....	33

6.13	Position Indication .....	34
6.14	Degree of protection provided by enclosures .....	34
6.15	Creepage distances for outdoor insulators .....	34
6.16	Gas and vacuum tightness .....	34
6.17	Tightness for liquid systems .....	34
6.18	Fire hazard (flammability) .....	34
6.19	Electromagnetic compatibility (EMC) .....	34
6.20	X-ray emission .....	34
6.21	Corrosion .....	34
6.22	Filling levels for insulation, switching and/or operation .....	34
6.101	Particular requirements for earthing switches .....	35
6.102	Requirements in respect of the isolating distance of disconnectors .....	35
6.103	Mechanical strength .....	35
6.104	Operation of disconnectors and earthing switches – Position of the movable contact system and its indicating and signalling devices .....	35
6.104.1	Securing of position .....	35
6.104.2	Additional requirements for power-operated mechanisms .....	35
6.104.3	Indication and signalling of position .....	36
6.104.3.1	General requirements .....	36
6.104.3.2	Indication of position .....	37
6.104.3.3	Signalling of position by auxiliary contacts .....	37
6.105	Maximum force required for manual (dependent or independent) operation .....	37
6.105.1	General .....	37
6.105.2	Operation requiring more than one revolution .....	37
6.105.3	Operation requiring up to one revolution .....	37
6.106	Dimensional tolerances .....	37
6.107	Earthing switches with short-circuit making current capability .....	38
7	Type tests .....	38
7.1	General .....	38
7.1.1	Basics .....	38
7.1.2	Information for identification of test objects .....	39
7.1.3	Information to be included in type test reports .....	39
7.2	Dielectric tests .....	40
7.2.1	General .....	40
7.2.2	Ambient air conditions during tests .....	40
7.2.3	Wet test procedure .....	40
7.2.4	Arrangement of the equipment .....	40
7.2.5	Criteria to pass the test .....	40
7.2.6	Application of the test voltage and test conditions .....	40
7.2.7	Test of disconnectors and earthing switches .....	41
7.2.8	Artificial pollution tests for outdoor insulators .....	41
7.2.9	Partial discharge tests .....	41
7.2.10	Dielectric tests on auxiliary and control circuits .....	42
7.2.11	Voltage test as condition check .....	42
7.3	Resistance measurement .....	42
7.4	Continuous current tests .....	42
7.5	Short-time withstand current and peak withstand current tests .....	42
7.5.1	General .....	42

7.5.2	Arrangement of the disconnectors and earthing switches and of the test circuit .....	42
7.5.3	Test current and duration.....	48
7.5.4	Conditions of disconnectors and earthing switches after test .....	48
7.6	Verification of the protection .....	48
7.7	Tightness tests .....	48
7.8	Electromagnetic compatibility tests (EMC) .....	48
7.9	Additional tests on auxiliary and control circuits .....	49
7.10	X-ray radiation test for vacuum interrupters.....	49
7.101	Capacitive current making test – Cable discharging test .....	49
7.101.1	General .....	49
7.101.2	Classification of earthing switches with cable discharging current making capability .....	49
7.101.3	Discharging making tests .....	49
7.101.3.1	Arrangement of the earthing switch for tests .....	49
7.101.3.2	Earthing of the test circuit .....	50
7.101.3.3	Test procedure .....	50
7.101.3.4	Test duty 1 (without current limiting resistor).....	50
7.101.3.4.1	General.....	50
7.101.3.4.2	Alternative test method for test-duty 1.....	50
7.101.3.4.3	Test frequency test duty 1.....	50
7.101.3.4.4	Test current test duty 1 .....	51
7.101.3.4.5	Test voltage test duty 1.....	51
7.101.3.4.6	Tests at reduced voltage test duty 1 .....	51
7.101.3.4.7	Test circuits test duty 1 .....	51
7.101.3.5	Test duty 2 (with current limiting resistor) .....	53
7.101.3.5.1	General.....	53
7.101.3.5.2	Alternative test method for test duty 2.....	53
7.101.3.5.3	Test frequency test duty 2.....	54
7.101.3.5.4	Test current test duty 2 .....	54
7.101.3.5.5	Test voltage test duty 2.....	54
7.101.3.5.6	Tests at reduced voltage at test duty 2.....	54
7.101.3.5.7	Test circuits test duty 2 .....	54
7.101.4	Behaviour of the earthing switch during tests .....	55
7.101.5	Condition of earthing switch after tests .....	56
7.101.6	Test reports .....	56
7.102	Operating and mechanical endurance tests .....	56
7.102.1	General test conditions .....	56
7.102.2	Contact zone test.....	57
7.102.3	Mechanical endurance test .....	59
7.102.3.1	Test procedure .....	59
7.102.3.2	Verification of successful operation.....	60
7.102.4	Operation during the application of rated static mechanical terminal loads.....	61
7.102.5	Extended mechanical endurance tests .....	61
7.102.6	Testing of mechanical interlocking devices .....	62
7.103	Operation under severe ice conditions .....	62
7.103.1	General .....	62
7.103.2	Test arrangement .....	63
7.103.3	Test procedure .....	63

7.103.3.1	Checks before the formation of ice coating .....	63
7.103.3.2	Formation of ice coating .....	63
7.103.3.3	Checks after the formation of ice coating .....	64
7.104	Low- and high-temperature tests .....	65
7.104.1	General .....	65
7.104.2	Measurement of ambient air temperature .....	65
7.104.3	Low-temperature test .....	65
7.104.4	High-temperature test .....	67
7.105	Tests to verify the proper functioning of the position-indicating device .....	68
7.105.1	General .....	68
7.105.2	Tests on the power kinematic chain and the position-indicating kinematic chain .....	69
8	Routine tests .....	69
8.1	General .....	69
8.2	Dielectric test on the main circuit .....	70
8.3	Tests on auxiliary and control circuits .....	70
8.4	Measurement of the resistance of the main circuit .....	70
8.5	Tightness test .....	70
8.6	Design and visual checks .....	70
8.101	Mechanical operating tests .....	70
8.102	Verification of earthing function .....	71
9	Guide to the selection of disconnectors and earthing switches (informative) .....	71
9.1	General .....	71
9.2	Selection of rated values .....	71
9.2.101	General .....	72
9.2.102	Selection of rated voltage and preferred rated insulation level .....	72
9.2.103	Selection of rated continuous current .....	72
9.2.104	Selection of rated contact zone .....	72
9.2.105	Selection of rated static mechanical terminal load .....	72
9.2.106	Selection of rated short-time withstand current and of rated duration of short-circuit .....	73
9.2.107	Selection of rated peak withstand current .....	73
9.3	Cable-interface considerations .....	73
9.4	Continuous or temporary overload due to changed service conditions .....	73
9.5	Environmental aspects .....	73
9.5.101	Local environmental conditions .....	73
10	Information to be given with enquiries, tenders and orders .....	74
10.1	General .....	74
10.2	Information with enquiries and orders .....	74
10.3	Information with tenders .....	75
11	Transport, storage, installation, operating instructions, and maintenance .....	76
11.1	General .....	76
11.2	Conditions during transport, storage and installation .....	76
11.3	Installation .....	76
11.4	Operating instruction .....	76
11.5	Maintenance .....	76
12	Safety .....	77
12.1	General .....	77
12.2	Precautions by manufacturers .....	77

12.3	Precautions by users .....	77
13	Influence of the product on the environment .....	77
Annex A	(normative) Identification of test objects .....	78
Annex B	(informative) Induced current switching tests on earthing switches .....	79
Annex C	(normative) Tolerances on test quantities for type tests .....	80
Annex D	(informative) Cable discharging test .....	81
D.1	General .....	81
D.2	Surge impedance .....	82
D.3	Cable capacity of single-core cable with radial electrical field .....	82
D.4	Cable inductance of single-core cable .....	82
D.5	Time constant of high-voltage cables .....	84
D.6	Example and formulas according to Table D.3 .....	84
Annex E	(informative) Extension of validity of type tests .....	86
E.1	General .....	86
E.2	Dielectric tests .....	87
E.3	Short-time withstand current tests .....	87
E.4	Operating and mechanical endurance tests .....	87
E.4.1	General .....	87
E.4.2	Operation under severe ice condition test .....	88
E.4.3	Low and high temperature test .....	88
E.5	Cable charging / Discharging current making test .....	88
Annex F	(informative) Example of location of neutral bus disconnector for one pole in an HVDC substation .....	89
Bibliography	.....	91
Figure 1	– Position indicating/signalling device(s) .....	36
Figure 2	– Examples of test arrangement from a) to g) of different type of disconnectors (horizontal and vertical) with and without earthing switch combined .....	46
Figure 3	– Typical test circuit of oscillating RLC discharge .....	52
Figure 4	– Example of damped oscillating discharge of 525 kV XLPE cable of 300 km length, cross-section 2 000 mm <sup>2</sup> and with a residual voltage of $U_{res} = 100$ kV .....	52
Figure 5	– Alternative test circuit of test duty 1 .....	53
Figure 6	– Typical test circuit with damped RLC discharging oscillation (aperiodic) .....	55
Figure 7	– Example of discharging impulse (damped discharging oscillation, aperiodic) of 525 kV XLPE cable of 300 km length at system voltage by using a discharge resistor of 5 kΩ .....	55
Figure 8	– Fixed contact parallel to support .....	57
Figure 9	– Fixed contact perpendicular to support .....	58
Figure 10	– Example of the application of rated static mechanical terminal loads to a (divided support) pantograph disconnector (or earthing switch) .....	58
Figure 11	– Example of the application of rated static mechanical terminal loads to a two-column disconnector .....	59
Figure 12	– Test sequences for low and high temperature tests .....	66
Figure D.1	– Oscillation with parameters of 525 kV XLPE cable .....	85
Figure D.2	– Oscillation with parameters of 525 kV XLPE cable and residual voltage values .....	85
Figure F.1	– Location of (NBD) neutral bus disconnector .....	89

Table 1 – Multiterminal – Preferred rated insulation levels .....	24
Table 2 – Two-terminal – Preferred rated insulation levels .....	26
Table 3 – Preferred contact zones for "fixed" contacts supported by flexible conductors – outdoor installation .....	28
Table 4 – Preferred contact zones for "fixed" contacts supported by rigid conductors outdoor installation .....	28
Table 5 – Preferred static mechanical terminal loads –outdoor.....	29
Table 6 – Classification of disconnectors for mechanical endurance .....	29
Table 7 – Classification of earthing switches for mechanical endurance.....	30
Table 8 – Discharge classes based on energy amounts related to test duty 1 .....	30
Table 9 – Discharge classes based on energy amounts related to test duty 2 .....	30
Table 10 – Product information .....	32
Table 11 – List of type tests .....	38
Table 12 – Test voltages.....	41
Table C.1 – Tolerances on test quantities for type tests .....	80
Table D.1 – Common values of electrical characteristics of HV single-core copper cables (type XLPE) .....	81
Table D.2 – Common values of electrical characteristics of HV overhead lines .....	82
Table D.3 – Calculations regarding energy classification relating to test duty 1 (direct cable discharge) of earthing switches cable type: XLPE.....	83
Table E.1 – List of type tests valid according to IEC 62271-102 .....	86
Table F.1 – Neutral bus disconnector – Preferred rated insulation levels for rated voltages.....	90

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR –****Part 314: Direct current disconnectors and earthing 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) 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> or [www.iso.org/patents](http://www.iso.org/patents). IEC shall not be held responsible for identifying any or all such patent rights.

IEC TS 62271-314 has been prepared by subcommittee 17A: Switching devices, 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
17A/1377/DTS	17A/1388B/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](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/publications](http://www.iec.ch/publications).

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

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

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](http://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.**

# HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

## Part 314: Direct current disconnectors and earthing switches

### 1 Scope

This part of IEC 62271, which is a Technical Specification, applies to high-voltage direct current disconnectors and earthing switches, designed for indoor and outdoor installations and for operation on HVDC transmission systems having direct voltages of 100 kV and above.

It also applies to the operating devices of these disconnectors and earthing switches and their auxiliary equipment.

NOTE Disconnectors in which the fuse forms an integral part are not covered by this document.

### 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, *International Electrotechnical Vocabulary (IEV) – Part 151: Electrical and magnetic devices*

IEC 60050-441, *International Electrotechnical Vocabulary (IEV) – Part 441: Switchgear, controlgear and fuses*

IEC 60050-471, *International Electrotechnical Vocabulary (IEV) – Part 471: Insulators*

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

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

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*

IEC 60529:1989/AMD1:1999

IEC 60529:1989/AMD2:2013

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

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*

IEC 62271-201:2014, *High-voltage switchgear and controlgear – Part 201: AC solid-insulation enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV*

IEC 62271-203:2022, *High-voltage switchgear and controlgear – Part 203: AC gas-insulated metal-enclosed switchgear for rated voltages above 52 kV*