IEC TS 62271-315

Edition 1.0 2025-03

TECHNICAL SPECIFICATION

High-voltage switchgear and controlgear – Part 315: Direct current (DC) transfer switches

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ICS 29.130.10

ISBN 978-2-8327-0244-4

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

® Registered trademark of the International Electrotechnical Commission

CONTENTS

FOREWORD 7
1 Scope 9
2 Normative references 9
3 Terms and definitions 10
3.1 General terms and definitions 10
3.2 Assemblies of switchgear and controlgear 10
3.3 Parts of assemblies 10
3.4 Switching devices 10
3.5 Parts of switchgear and controlgear 12
3.6 Operational characteristics of DC transfer switches 13
3.7 Characteristic quantities 13
3.8 Index of definitions 14
4 Normal and special service conditions 15
5 Ratings 16
5.1 General 16
5.2 Rated direct voltage (U_{rd}) 16
5.3 Rated insulation level (U_{dd}, U_p, U_s) 16
5.4 Rated continuous current (I_{rd}) 17
5.5 Rated values of short-time withstand current 17
5.5.1 Typical waveform of short-circuit current 17
5.5.2 Rated short-time withstand direct current (I_{kd}) 17
5.5.3 Rated peak withstand current (I_{pd}) 17
5.5.4 Rated duration of short circuit (t_{kd}) 17
5.6 Rated supply voltage of auxiliary and control circuits (U_a) 17
5.6.1 General 17
5.6.2 Rated supply voltage (U_a) 17
5.7 Rated supply frequency of auxiliary and control circuits 17
5.8 Rated pressure of compressed gas supply for controlled pressure systems 18
5.101 Rated direct voltage of transfer switch (U_{rts}) 18
5.102 Rated transfer current (I_t) 18
5.103 Rated commutation voltage (U_c) 18
5.104 Rated dissipated energy during transfer operation (E_{rd}) 18
5.105 Rated operating sequence 19
5.106 Rated open-close time 19
6 Design and construction 19
6.1 Requirements for liquids in switchgear and controlgear 19
6.2 Requirements for gases in switchgear and controlgear 19
6.3 Earthing of switchgear and controlgear 19
6.4 Auxiliary and control equipment and circuits 19
6.5 Dependent power operation 20
6.6 Stored energy operation 20
6.7 Independent unlatched operation (independent manual or power operation) 20
6.8 Manually operated actuators 20
6.9 Operation of releases 20

6.10 Pressure/level indication 20
6.11 Nameplates 20
6.12 Locking devices 22
6.13 Position indication 22
6.14 Degrees of protection by enclosures 22
6.15 Creepage distances for outdoor insulators 22
6.16 Gas and vacuum tightness 22
6.17 Tightness for liquid system 22
6.18 Fire hazard (flammability) 22
6.19 Electromagnetic compatibility (EMC) 22
6.20 X-ray emission 22
6.21 Corrosion 22
6.22 Filling levels for insulation, switching and operation 22
6.101 Seismic requirement for operation 22
6.102 Commutation switch 22
6.102.1 General requirement for operation 22
6.102.2 Pressure limits of fluids for operation. 23
6.102.3 Vent outlets 23
6.102.4 Time quantities 23
6.102.5 Static mechanical loads 23
6.102.6 Classification 24
6.102.7 Arcing withstand capability 24
6.103 Insulated platform 25
6.104 Commutation capacitor 25
6.105 Energy dissipation device 25
6.106 Reactor 25
6.107 Making switch (if applicable) 25
6.108 Charging device (if applicable) 25
7 Type tests 25
7.1 General 25
7.1.1 Basics 25
7.1.2 Information for identification of test objects 27
7.1.3 Information to be included in type-test reports 27
7.2 Dielectric tests 27
7.2.1 General 27
7.2.2 Ambient air conditions during tests 27
7.2.3 Wet test procedure 27
7.2.4 Arrangement of the equipment 27
7.2.5 Criteria to pass the test 27
7.2.6 Application of the test voltage and test conditions 27
7.2.7 Tests of switchgear and controlgear 28
7.2.8 Artificial pollution tests for outdoor insulators 29
7.2.9 Partial discharge tests 29
7.2.10 Dielectric tests on auxiliary and control circuits 29
7.2.11 Voltage test as condition check 29
7.3 Resistance measurement 29
7.3.1 Measurement of the resistance of auxiliary contacts class 1 and class 2 29
7.3.2 Measurement of the resistance of auxiliary contacts class 3 29
7.3.3 Electrical continuity of earthed metallic parts test 29

7.3.4 Resistance measurement of contacts and connections in the main circuit as a condition check 29
7.4 Continuous current tests 30
7.4.1 Condition of the test object 30
7.5 Short-time withstand current and peak withstand current tests 30
7.5.1 General 30
7.5.2 Arrangement of the equipment and of the test circuit 30
7.5.3 Test current and duration 30
7.5.4 Conditions of the test object after test 30
7.6 Verification of the protection 30
7.7 Tightness tests 30
7.8 Electromagnetic compatibility tests (EMC) 31
7.9 Additional tests on auxiliary and control circuits 31
7.10 X-radiation test for vacuum interrupters 31
7.101 Mechanical and environmental tests 31
7.101.1 Miscellaneous provisions for mechanical and environmental tests 31
7.101.2 Mechanical operation tests at ambient air temperature 33
7.101.3 Low and high temperature tests 35
7.101.4 Humidity test 40
7.101.5 Test to prove the operation under severe ice conditions 42
7.102 Seismic tests 42
7.103 Direct current commutation tests 42
7.103.1 General 42
7.103.2 Arrangement of the transfer switch during test 43
7.103.3 Test circuit 44
7.103.4 Test procedure 45
7.103.5 Behaviour of DC transfer switch during test 46
7.103.6 Criteria to pass the test 46
7.104 Direct arc withstand tests 46
7.104.1 General 46
7.104.2 Arrangement of the transfer switch during test 47
7.104.3 Test circuit 47
7.104.4 Test procedure 48
7.104.5 Behaviour of DC transfer switch during test 48
7.104.6 Criteria to pass the test 48
8 Routine tests 49
8.1 General 49
8.2 Dielectric test on the main circuit 49
8.3 Tests on auxiliary and control circuits 49
8.4 Measurement of the resistance of the main circuit 49
8.5 Tightness test 49
8.6 Design and visual checks 49
8.101 Mechanical operating tests 49
9 Guide to the selection of DC transfer switches （informative） 51
9.1 General 51
9.2 Selection of rated values 51
9.2.101 General 51
9.2.102 Selection of rated direct voltage of transfer switch and rated insulation level 51

9.2.103 Selection of rated operating sequence 51
9.2.104 Selection of rated continuous current 52
9.2.105 Selection of rated values of short time withstand current 52
9.2.106 Selection of rated transfer current 52
9.2.107 Selection of rated commutation voltage 52
9.3 Cable-interface considerations 52
9.4 Continuous or temporary overload due to changed service conditions 52
9.5 Environmental aspects 52
9.101 Selection of the application 52
9.101.1 MRTS 52
9.101.2 ERTS 53
9.101.3 NBS 53
9.101.4 NBES 54
10 Information to be given with enquiries, tenders and orders (informative) 55
10.1 General 55
10.2 Information with enquiries and orders 55
10.3 Information with tenders 56
11 Transport, storage, installation, operating instructions and maintenance 58
12 Safety 58
13 Influence of the product on the environment 58
Annex A (normative) Test requirements for component of DC transfer switches 59
A.1 Commutation switch 59
A.2 Making switch 59
A.3 Commutation capacitor 59
A.4 Energy dissipation device 60
A.5 Reactor 60
A.6 Charging device 60
A.6.1 Type tests for charging device 60
A.6.2 Routine test for charging device 61
Annex B (informative) Additional information about test circuit and measured signals for DC transfer switches having an oscillation branch 62
B.1 Test circuits for direct current transfer test 62
B.2 Test circuits for direct arc withstand test 64
Annex C (normative) Tolerances on test quantities during tests 66
Annex D (normative) Records and reports of type tests 69
D.1 Information and results to be recorded 69
D.2 Information to be included in type test reports 69
D.2.1 General 69
D.2.2 Apparatus tested 69
D.2.3 Rated characteristics of DC transfer switch, including its operating devices and auxiliary equipment 69
D.2.4 Test conditions (for each series of tests) 70
D.2.5 Direct current commutation tests 70
D.2.6 Direct arc withstand tests 70
D.2.7 Short-time withstand current test 70
D.2.8 No-load operation 71
D.2.9 Oscillographic and other records 71
Annex E (informative) Extension of validity of type tests 72

E.1 General 72
E.2 Dielectric tests 72
E.3 Continuous current test 72
E.4 Electromagnetic immunity test on auxiliary and control circuits 72
E.5 Environmental tests on auxiliary and control circuits 73
E.6 DC transfer current test 73
Bibliography 74

Figure 1 – Test sequence for low temperature test 37
Figure 2 – Test sequence for high temperature test 39
Figure 3 – Humidity test 41
Figure 4 – General layout of test circuit for direct current commutation test 44
Figure 5 – Current commutation test with low-frequency alternating current 45
Figure 6 – General layout of test circuit for direct arc withstand test 47
Figure 7 – Equivalent transfer circuit of MRTS and ERTS 53
Figure 8 – Equivalent transfer circuit of NBS 54
Figure 9 – Equivalent transfer circuit of NBES 55
Figure B.1 – Test circuit with measuring points 62
Figure B.2 – Measured signals during test (overview) 63
Figure B.3 – Measured signals during test (expanded in time) 64
Figure B.4 – Test circuit of direct arc withstand tests 65

Table 1 – Rated insulation levels for transfer switches 17
Table 2 – Nameplate information 21
Table 3 – Classification of commutation switches and making switches 24
Table 4 – Type tests 26
Table 5 – Number of operating sequences for commutation switches 34
Table 6 – Number of operating sequences for making switches 35
Table B.1 – Legend of measuring points 65
Table C.1 – Tolerances on test quantities for type test 66

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 315: Direct current (DC) transfer 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. IEC shall not be held responsible for identifying any or all such patent rights.

IEC TS 62271-315 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/1412/DTS	17A/1417/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/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 order to simplify the indication of corresponding requirements, the same numbering of clauses and subclauses is used as in IEC TS 62271-5. Amendments 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 in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 315: Direct current (DC) transfer switches

1 Scope

This part of IEC 62271 is applicable to direct current (DC) transfer switches designed for indoor or outdoor installation and for operation on HVDC transmission systems having direct voltages of 100 kV and above.

DC transfer switches normally include metallic return transfer switches (MRTS), earth return transfer switches (ERTS), neutral bus switches (NBS) and neutral bus earthing switches (NBES).

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

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

IEC 60076-6, *Power transformers– Part 6: Reactors*

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

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

IEC 60871-1, *Shunt capacitors for a.c. power systems having a rated voltage above 1 000 V – Part 1: General*

IEC 61000-4-18:2019, *Electromagnetic compatibility (EMC) – Part 4-18: Testing and measurement techniques – Damped oscillatory wave immunity test*

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

IEC 62271-100:2021, *High-voltage switchgear and controlgear – Part 100: Alternating-current circuit-breakers*

IEC 62271-102:2018, *High-voltage switchgear and controlgear – Part 102: Alternating-current disconnectors and earthing switches*

IEC 62271-207, *High-voltage switchgear and controlgear – Part 207: Seismic qualification for gas-insulated switchgear assemblies for rated voltages above 52 kV*

IEC TS 63014-1, *High-voltage direct current (HVDC) power transmission – System requirements for DC-side equipment Part 1: Using line-commutated converters*