



BSI Standards Publication

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

National foreword

This British Standard is the UK implementation of EN IEC 62271-200:2021+A1:2024. It is identical to IEC 62271-200:2021, incorporating amendment 1:2024. It supersedes BS EN IEC 62271-200:2021, which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to IEC text carry the number of the IEC amendment. For example, text altered by IEC amendment 1 is indicated by A1 A1.

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.

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English Version

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 62271-200:2021)

Appareillage à haute tension - Partie 200: Appareillage sous enveloppe métallique pour courant alternatif de tensions assignées supérieures à 1 kV et inférieures ou égales à 52 kV
(IEC 62271-200:2021)

Hochspannungs-Schaltgeräte und -Schaltanlagen - Teil 200: Metallgekapselte Wechselstrom-Schaltanlagen für Bemessungsspannungen über 1 kV bis einschließlich 52 kV
(IEC 62271-200:2021)

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European foreword

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The following dates are fixed:

- latest date by which the document has to be implemented at national (dop) 2022-04-01 level by publication of an identical national standard or by endorsement
- latest date by which the national standards conflicting with the (dow) 2024-07-01 document have to be withdrawn

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In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 62271-214:2019	NOTE Harmonized as EN IEC 62271-214:2019 (not modified)
IEC 60059:1999	NOTE Harmonized as EN 60059:1999 (not modified)
IEC 60243-1:2013	NOTE Harmonized as EN 60243-1:2013 (not modified)
IEC/TR 62271-307:2015	NOTE Harmonized as CLC IEC/TR 62271-307:2019 (not modified)
IEC 60909-0:2016	NOTE Harmonized as EN 60909-0:2016 (not modified)

European foreword to Amendment 1

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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	-	International Electrotechnical Vocabulary - Part 151: Electrical and magnetic devices	-	-
IEC 60050-441	-	International Electrotechnical Vocabulary. Switchgear, controlgear and fuses	-	-
IEC 60060-1	2010	High-voltage test techniques - Part 1: General definitions and test requirements	EN 60060-1	2010
IEC 60270	2000	High-voltage test techniques - Partial discharge measurements	EN 60270	2001
+ A1	2015		+ A1	2016
IEC 60529	1989	Degrees of protection provided by enclosures (IP Code)	EN 60529	1991
-	-		+ corrigendum May 1993	
+ A1	1999		+ A1	2000
+ A2	2013		+ A2	2013
IEC 62262	2002	Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)	EN 62262	2002
IEC 62271-1	2017	High-voltage switchgear and controlgear - Part 1: Common specifications for alternating current switchgear and controlgear	EN 62271-1	2017
IEC 62271-100	2021	High-voltage switchgear and controlgear - Part 100: Alternating-current circuit-breakers	EN IEC 62271-100	2021
IEC 62271-102	2018	High-voltage switchgear and controlgear - Part 102: Alternating current disconnectors and earthing switches	EN IEC 62271-102	2018
IEC 62271-103	2021	High-voltage switchgear and controlgear - Part 103: Switches for rated voltages above 1 kV up to and including 52 kV	-	-

IEC 62271-105	2021	High-voltage switchgear and controlgear - Part 105: Alternating current switch-fuse combinations for rated voltages above 1 kV up to and including 52 kV	-	-
IEC 62271-106	2021	High-voltage switchgear and controlgear - Part 106: Alternating current contactors, contactor-based controllers and motor- starters	EN IEC 62271-106	2021
IEC 62271-107	2019	High-voltage switchgear and controlgear - Part 107: Alternating current fused circuit- switchers for rated voltages above 1 kV up to and including 52 kV	EN IEC 62271-107	2019
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	EN 62271-201	2014
IEC 62271-213	2021	High-voltage switchgear and controlgear - Part 213: Voltage detecting and indicating system	EN IEC 62271-213	2021
IEC 62271-215	2021	High-voltage switchgear and controlgear - Part 215: Phase comparator used with VDIS	EN IEC 62271-215	2021
IEC IEEE 62271-37-013	2015	High-voltage switchgear and controlgear - Part 37-013: Alternating-current generator circuit-breakers		
ISO 4126-2	-	Safety devices for protection against excessive pressure – Part 2: Bursting disc safety devices		-

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

FOREWORD

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IEC 62271-200 has been prepared by subcommittee 17C: Assemblies, of IEC technical committee 17: High-voltage switchgear and controlgear. It is an International Standard.

This third edition cancels and replaces the second edition published in 2011. This edition constitutes a technical revision.

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

- a) clause numbering aligned with IEC 62271-1:2017, including the adoption of the subclause names of Clause 3;
- b) in Clause 3 specific definitions are added for "in service", "normal operating condition" and "normal use";
- c) internal arc testing on pole-mounted switchgear is taken out of this document, as it is now covered by the specific standard IEC 62271-214:2019;

- d) a more precise description of earthing circuit is given with the inclusion of ratings and test requirements;
- e) number of mechanical tests on interlocks is reduced for type testing; a more precise description of forces to apply during type testing is given (refer to 7.102);
- f) resistance measuring on main circuit is only needed before continuous current tests (as reference for routine tests) and no longer needed after this continuous current test. Rationale for this deletion is that this measured resistance does not mean anything; as the temperature rise test was just finished, a new temperature rise test will not give new information;
- g) IEC 62271-100:2021, IEC 62271-103:2021, IEC 62271-105:2021 and IEC 62271-106:2021 are referred to in the document;
- h) IEC 62271-107:2019 and IEC IEEE 62271-37-013:2015 are also considered in 7.101.2;
- i) a more precise description of LSC category is given with the inclusion of an explanatory flowchart (Annex D);
- j) examples not covered by the IAC test are transferred from Clause 6 to 9.103;
- k) the term "assembly" is defined in Clause 3 and used as synonym for "metal-enclosed switchgear and controlgear" in this document;
- l) "metallic" is replaced by "metal" where applicable;
- m) 6.105 is now covered by 7.7;
- n) a 1 s rule was introduced for Criterion 4 during IAC tests regarding hot gases versus glowing particles as cause of ignition;
- o) a more precise description of internal arc tests for switchgear with protrusions is given in Annex A.

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

FDIS	Report on voting
17C/782/FDIS	17C/792/RVD

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 International Standard 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.

This document should be read in conjunction with IEC 62271-1:2017, 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 62271-1:2017. 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 C lists all of the "in-some-country" clauses on differing practices of a less permanent nature relating to the subject of this document.

A list of all parts in the IEC 62271 series, published 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,
- replaced by a revised edition, or
- amended.

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

High-voltage (IEC 60050-601:1985, 601-01-27) switchgear refers to rated voltages above 1 kV. However, medium-voltage is commonly used for distribution systems with rated voltages above 1 kV and generally applied up to and including 52 kV; refer to IEC 60050-601:1985, 601-01-28 [1]¹.

Although primarily dedicated to three-phase systems, this document can also be applied to single-phase and two-phase systems.

Switchgear and controlgear assemblies having a solid-insulation enclosure are covered by IEC 62271-201.

 Generally, gas-filled medium-voltage designs have design pressures below 500 kPa, as mentioned for example in the introduction of EN 50187. 

¹ Numbers in square brackets refer to the Bibliography.

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

1 Scope

This part of IEC 62271 is applicable to prefabricated metal-enclosed switchgear and controlgear assemblies designed for:

- alternating current;
- rated voltages above 1 kV and up to and including 52 kV;
- service frequencies up to and including 60 Hz;
- indoor and outdoor installation.

The assembly can include air-insulated and/or fluid-filled compartments.

For components installed in a metal-enclosed switchgear and controlgear, this document supplements or even replaces in some cases, the requirements as stated by the individual product standards.

The list of components which can be inside the metal-enclosed switchgear and controlgear is not limited to the ones explicitly cited in 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* (available at <http://www.electropedia.org>)

IEC 60050-441, *International Electrotechnical Vocabulary (IEV) – Part 441: Switchgear, controlgear and fuses* (available at <http://www.electropedia.org>)

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

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

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 62271-100:2021, *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 62271-103:2021, *High-voltage switchgear and controlgear – Part 103: Switches for rated voltages above 1 kV up to and including 52 kV*

IEC 62271-105:2021, *High-voltage switchgear and controlgear – Part 105: Alternating current switch-fuse combinations for rated voltages above 1 kV up to and including 52 kV*

IEC 62271-106:2021, *High-voltage switchgear and controlgear – Part 106: Alternating current contactors, contactor-based controllers and motor-starters*

IEC 62271-107:2019, *High-voltage switchgear and controlgear – Part 107: Alternating current fused circuit-switchers for rated voltages above 1 kV 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*

 Text deleted. 

IEC 62271-213:2021, *High-voltage switchgear and controlgear – Part 213: Voltage detecting and indicating system*

IEC 62271-215:2021, *High-voltage switchgear and controlgear – Part 215: Phase comparator used with VDIS*

IEC IEEE 62271-37-013:2015, *High-voltage switchgear and controlgear – Part 37-013: Alternating-current generator circuit-breakers*

 ISO 4126-2, *Safety devices for protection against excessive pressure – Part 2: Bursting disc safety devices* 

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62271-1, IEC 60050-151 and IEC 60050-441, and the following apply.

NOTE The classification system for definitions of IEC 62271-1:2017 is followed. Terms and definitions are referenced and prioritized in the following order:

- Clause 3 of this document;
- IEC 62271-1:2017;
- IEC 60050-441;
- IEC 60050-151.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1 General terms and definitions

The definitions in 3.1 of IEC 62271-1:2017 are applicable, with the following additions and/or modifications:

3.1.101**ambient air temperature**

<of an assembly> temperature, determined under specified conditions, of the air surrounding the enclosure of an assembly

[SOURCE: IEC 60050-441:1984, 441-11-13, modified – "prescribed" has been replaced by "specified", "complete switching device or fuse" by "enclosure of an assembly" and the note has been removed.]

3.1.102**disruptive discharge**

phenomenon associated with the failure of insulation under electric stress, in which the discharge completely bridges the insulation under test, reducing the voltage between the electrodes to zero or nearly to zero

Note 1 to entry: The term is applicable to discharges in solid, liquid and gaseous dielectrics and to combinations of these.

Note 2 to entry: A disruptive discharge in a solid dielectric produces permanent loss of dielectric strength (non-self-restoring insulation); in a liquid or gaseous dielectric, the loss can be only temporary (self-restoring insulation).

Note 3 to entry: The term "sparkover" is used when a disruptive discharge occurs in a gaseous or liquid dielectric. The term "flashover" is used when a disruptive discharge occurs over the surface of a solid dielectric in gaseous or liquid medium. The term "puncture" is used when a disruptive discharge occurs through a solid dielectric.

3.1.103**relative pressure**

pressure that refers to the local atmospheric pressure

Note 1 to entry: When defining a filling level it is in reference to the standard atmospheric pressure of 101,3 kPa, as defined in IEC 62271-1.

3.1.104**segregation**

<of conductors> arrangement of conductors with earthed metal interposed between them in such a manner that disruptive discharges can only occur to earth

Note 1 to entry: A segregation can be established between the conductors as well as between the open contacts of a switching device like a disconnecter.

Note 2 to entry: This definition does not specify any mechanical protection (IP and IK).

[SOURCE: IEC 60050-441:1984, 441-11-11, modified – Notes to entry have been added.]

3.1.105**in service**

<condition of an assembly> condition where at least one high voltage part in the assembly is energized

3.1.106**normal operating condition**

<of an assembly> in service condition with all doors and covers properly closed and secured

3.1.107**normal use**

<of an assembly> use of the assembly as defined by the manufacturer's instructions reference, corresponding to the conditions and operations in service

Note 1 to entry: "normal use" may include maintenance activities within an accessible high-voltage compartment.

3.2 Assemblies of switchgear and controlgear

The definitions in 3.2 of IEC 62271-1:2017 are applicable, with the following additions and/or modifications:

3.2.101

metal-enclosed switchgear and controlgear assembly

switchgear and controlgear assemblies with a metal enclosure intended to be earthed, and complete except for external connections

Note 1 to entry: This term generally is applicable to high-voltage switchgear and controlgear.

Note 2 to entry: The term "external connections" corresponds to "external conductors (cables or bars) connecting the assembly to the network or an external installation".

[SOURCE: IEC 60050-441:1984, 441-12-04, modified – The second preferred term "assembly" and Note 2 to entry have been added and in the definition "external" has been deleted.]

3.2.102

multi-tier design

design of an assembly in which the main switching devices of two or more functional units are arranged vertically (one above the other) within a common enclosure

3.3 Parts of assemblies

The definitions in 3.3 of IEC 62271-1:2017 are applicable.

3.4 Switching devices

The definitions in 3.4 of IEC 62271-1:2017 are applicable.

3.5 Parts of switchgear and controlgear

The definitions in 3.5 of IEC 62271-1:2017 are applicable, with the following additions and/or modifications:

3.5.101

enclosure

<of an assembly> part of an assembly providing a specified degree of protection of equipment against external influences and a specified degree of protection against approach to or contact with live parts and against contact with moving parts

[SOURCE: IEC 60050-441:1984, 441-13-01]

3.5.102

metal enclosure

<of an assembly> outermost enclosure made of metal, which can be composed of several elements, enclosing all high-voltage parts

3.5.103

functional unit

<of an assembly> part of an assembly comprising the main circuits, earthing circuit and auxiliary circuits that contribute to the fulfilment of a single function

Note 1 to entry: Functional units can be distinguished according to the function for which they are intended, e.g., incoming unit, through which electrical energy is normally fed into the assembly, outgoing unit, through which electrical energy is normally supplied to one or more external circuits

[SOURCE: IEC 60050-441:1984, 441-13-04, modified – "of switchgear and controlgear" and "all the components of" have been deleted; "earthing circuit" has been added.]

3.5.104

component

<of an assembly> essential part of the high-voltage or earthing circuits of an assembly which serves a specific function (e.g. circuit-breaker, disconnector, switch, fuse, earthing switch, instrument transformer, bushing, busbar)

3.5.105

main circuit

<of an assembly> all the high-voltage conductive parts of an assembly included in a circuit which is intended to carry the rated continuous current

[SOURCE: IEC 60050-441:1984, 441-13-02, modified – "high voltage" is added and "transmit electrical energy" is replaced by "carry the rated continuous current".]

3.5.106

auxiliary circuit

<of an assembly> all the conductive parts of an assembly of switchgear and controlgear included in a circuit (other than the high-voltage parts) intended to control, measure, signal and regulate

Note 1 to entry: The auxiliary circuits of an assembly include the control and auxiliary circuits of the switching devices.

[SOURCE: IEC 60050-441:1984, 441-13-03, modified – "main circuit" is replaced by "high-voltage parts".]

3.5.107

earthing circuit

<of an assembly> conductors, connections, and the conducting parts of earthing devices or of the metal frame, intended to connect the high-voltage conductive parts of an assembly to the earthing point provided

Note 1 to entry: The earthing circuit can include short-circuiting circuits between poles and phase-to-earth circuits from each pole to the earthing point and/or from the short-circuiting point of phase-to-earth circuits to the earthing point provided.

3.5.108

earthing point

<of an assembly> terminal which is provided on the assembly for connection of the intended earthed parts of the assembly to the earth system of the installation

3.5.109

high-voltage compartment

<of an assembly> compartment of an assembly containing high-voltage conducting parts, enclosed except for openings necessary for interconnection, control or ventilation

Note 1 to entry: A general definition of "compartment" is provided in IEC 60050-441:1984, 441-13-05, as "a part of an assembly enclosed except for openings necessary for interconnection, control or ventilation".

3.5.110

interlock-controlled accessible compartment

high-voltage compartment designed to be opened for normal use, in which access is controlled by the integral design of the assembly

3.5.111

procedure-based accessible compartment

high-voltage compartment designed to be opened for normal use, in which access is controlled by a suitable procedure combined with locking

3.5.112

tool-based accessible compartment

high-voltage compartment that can be opened only through the use of tools, but not designed to be opened for normal use

3.5.113

non-accessible compartment

high-voltage compartment that is designed not to be opened by the user

Note 1 to entry: By default, every high-voltage compartment not declared accessible by the manufacturer in the manufacturer's instructions reference, is considered as a non-accessible compartment.

3.5.114

fluid-filled compartment

high-voltage compartment of an assembly, filled with a fluid, either gas, other than ambient air, or liquid, for insulation purposes

Note 1 to entry: For fluid-filled compartments with gas, the term "gas-filled compartment" is used.

Note 2 to entry: The pressure is maintained by one of the following systems:

- a) controlled pressure system;
- b) closed pressure system;
- c) sealed pressure system.

Note 3 to entry: For pressure systems, refer to 3.6.6 of IEC 62271-1:2017.

3.5.115

pressure relief device

device intended to relieve overpressure from a compartment

3.5.116

partition

<of an assembly> part of an assembly separating one high-voltage compartment from other compartments and providing a specified degree of protection

Note 1 to entry: Partitions can be fitted with parts that allow interconnection between compartments (e.g. bushings).

[SOURCE: IEC 60050-441:1984, 441-13-06, modified – "high-voltage" and "and providing a specified degree of protection" have been added.]

3.5.117

bushing

insulator forming a passage for a conductor through a non-insulating partition

[SOURCE: IEC 60050-151:2001, 151-15-40]

3.5.118

shutter

<of an assembly> part of an assembly that can be moved from a position where it permits contacts of a removable part, or moving contact of a disconnector, to engage fixed contacts, to a position where it becomes a part of the enclosure or partition shielding the fixed contacts

[SOURCE: IEC 60050-441:1984, 441-13-07, modified – "moving contact of a disconnector" has been added.]

3.5.119**removable part**

<of an assembly> part of an assembly that may be removed entirely from the assembly and replaced

[SOURCE: IEC 60050-441:1984, 441-13-08, modified – "even though the main circuit is alive" has been deleted.]

3.5.120**withdrawable part**

<of an assembly> removable part of an assembly that can be moved to one or more positions in which an isolating distance or a segregation between open contacts is established, while the part remains mechanically attached to the assembly, even though the main circuit to which it was connected is live

[SOURCE: IEC 60050-441:1984, 441-13-09, modified – "even though the main circuit to which it was connected is live" has been added; the Note has been deleted.]

3.5.121**fuse-link**

the part of a fuse (including the fuse-element(s)) intended to be replaced after the fuse has operated

Note 1 to entry: In this document the term is exclusively used in relation with high-voltage fuses.

[SOURCE: IEC 60050 441:1984, 441-18-09, modified – The Note to entry has been added.]

3.6 Operational characteristics of switchgear and controlgear

The definitions in 3.6 of IEC 62271-1:2017 are applicable, with the following additions and/or modifications:

3.6.101**A1 loss of service continuity category****LSC**

<of a functional unit> category defining the possibility to keep other high-voltage compartments and/or functional units energized when opening its connection compartment or any other of its high-voltage compartment(s) accessible in normal use, as stated in definitions 3.5.110 and 3.5.111, giving access to at least part of the high-voltage circuit contained within

Note 1 to entry: The LSC category describes the extent to which the assembly is intended to remain operational where access to a high-voltage compartment is provided. The extent to which it is considered necessary to open high-voltage compartments of an installation in service might be dependent on several aspects (refer to 9.101).

Note 2 to entry: The LSC category does not describe or relate to different levels of reliability of assemblies (refer to 9.101).

Note 3 to entry: In relation to providing access to high-voltage compartments and the associated service continuity, four categories are defined: LSC1, LSC2, LSC2A, LSC2B (refer to Annex D). A1

3.6.102**category LSC2**

<of a functional unit> category of functional units having at least a separate accessible compartment for the high-voltage connection of that functional unit (called connection compartment), such that, when this compartment is open, at least one busbar may remain energized and all other functional units of the assembly may be operated normally

3.6.103**category LSC2A**

<of a functional unit> category of functional units of category LSC2 such that, when any accessible compartment (other than its connection compartment and the busbar compartment

of single-busbar assemblies) is open, at least one busbar may remain energized and all other functional units of the assembly may be operated normally

3.6.104

category LSC2B

<of a functional unit> category of functional units of category LSC2A, where the high-voltage connections (e.g. cable connections) to the functional unit may remain energized when any other accessible high-voltage compartment (other than its connection compartment and the busbar compartment of single-busbar assemblies) of the corresponding functional unit is open

3.6.105

category LSC1

<of a functional unit> category of functional units having one or more high-voltage accessible compartments, such that, when any of these accessible high-voltage compartments is open, at least one other functional unit shall not remain energized

3.6.106

partition class

<of an assembly> class defining whether only metal or also non-metal material is used for partitions

3.6.107

class PM

<of an assembly> partition class for an assembly providing continuous metal partitions and/or shutters (if applicable), intended to be earthed, between opened accessible compartments and high-voltage live parts

3.6.108

class PI

<of an assembly> partition class for an assembly having one or more non-metal partitions or shutters between opened accessible compartments and high-voltage live parts

3.6.109

service position

connected position

<of a removable part> position of a removable part in which it is fully connected for its intended function

[SOURCE: IEC 60050-441:1984, 441-16-25]

3.6.110

test position

<of a withdrawable part> position of a withdrawable part in which an isolating distance or segregation is established in the main circuit and in which the auxiliary circuits are connected

[SOURCE: IEC 60050-441:1984, 441-16-27]

3.6.111

disconnected position

isolated position

<of a withdrawable part> position of a withdrawable part in which an isolating distance or segregation is established in all the circuits of the withdrawable part, that part remaining mechanically attached to the assembly

Note 1 to entry: In enclosed high-voltage switchgear and controlgear, the auxiliary circuits are generally not disconnected.

[SOURCE: IEC 60050-441:1984, 441-16-28, modified – In the Note 1 to entry, "may not be" has been replaced by "are generally not".]

3.6.112**removed position**

<of a removable part> position of a removable part when it is outside and mechanically and electrically separated from the assembly

[SOURCE: IEC 60050-441:1984, 441-16-29]

3.6.113**degree of protection**

extent of protection provided by an enclosure, partition or shutter if applicable, against access to hazardous parts, against ingress of solid foreign objects and/or ingress of water and verified by standardized test methods

Note 1 to entry: Refer to 3.3 of IEC 60529:1989.

3.6.114**minimum functional level**

<of fluid-filled compartments> pressure (or density) according to definitions 3.6.5.5 and 3.6.5.6 of IEC 62271-1:2017, or liquid mass at and above which the rated values of the assembly are maintained

3.6.115**design pressure**

<of fluid-filled compartments> upper limit of the relative pressure between the pressure inside a compartment at the design temperature, under defined installation conditions, and the pressure outside that compartment, that is used to determine the design of the compartment.

Note 1 to entry: The transient pressure occurring during and after a breaking operation (e.g. circuit-breaker) is not considered in the determination of the design pressure.

3.6.116**design temperature**

<of fluid-filled compartments> highest average temperature over the compartment, which can be reached by the gas or liquid under service conditions

3.6.117**internal arc classification****IAC**

<of an assembly> classification of an assembly for which specified criteria, for protection of persons, are met in the event of internal arc for specified installation conditions, as demonstrated by type tests

Note 1 to entry: The internal arc classification is completed with the characteristics indicated in definitions 3.6.118, 3.6.119, 3.7.101 and 3.7.102.

3.6.118**type of accessibility**

<of IAC> characteristic related to the level of protection given to people accessing a defined area around the enclosure of an assembly in the event of internal arc

3.6.119**classified sides**

<of IAC> accessible sides of the assembly having a defined level of protection of persons in the event of internal arc

3.7 Characteristic quantities

The definitions in 3.7 of IEC 62271-1:2017 are applicable, with the following additions and/or modifications:

3.7.101

arc fault current

<of IAC> three-phase and, where applicable, the single-phase-to-earth RMS value of the internal arc fault current for which the assembly is designed to protect persons in the event of an internal arc

3.7.102

arc fault duration

<of IAC> duration of the internal arc fault current for which the assembly is designed to protect persons in the event of an internal arc

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4 Normal and special service conditions

Clause 4 of IEC 62271-1:2017 is applicable with the following addition:

Unless otherwise specified in this document, the assembly is designed to be used under normal service conditions.

Assemblies, under the scope of IEC TS 62271-304:2019 [2] and intended to be used in service conditions more severe with respect to condensation and pollution than the normal service conditions specified in this document, can be classified as "class 1" or "class 2" according to IEC TS 62271-304:2019 to indicate its ability to withstand such severe conditions.

NOTE IEC TS 62271-304:2019 proposes, to gain experience, further classes for service conditions with associated testing procedure in its informative Annex E.

5 Ratings

5.1 General

Subclause 5.1 of IEC 62271-1:2017 is applicable with the following additions:

- k) rated short-time withstand current for earthing circuits (I_{ke});
- l) rated peak withstand current for earthing circuits (I_{pe});
- m) rated duration of short-circuit for earthing circuits (t_{ke});
- n) ratings of the components forming part of the assembly including their operating devices and auxiliary equipment;

Optional ratings:

- o) rated voltage for AC cable test voltage ($U_{ct(AC)}$);
- p) rated voltage for DC cable test voltage ($U_{ct(DC)}$);
- q) rated duration for DC cable test voltage ($t_{ct(DC)}$);
- r) ratings of the internal arc classifications (IAC).

5.2 Rated voltage (U_r)

Subclauses 5.2.1 and 5.2.2 of IEC 62271-1:2017 are applicable.

NOTE Components forming part of an assembly can have individual values of rated voltage in accordance with their relevant standards.

5.3 Rated insulation level (U_d , U_p , U_s)

Subclause 5.3 of IEC 62271-1:2017 is applicable.

5.4 Rated frequency (f_r)

Subclause 5.4 of IEC 62271-1:2017 is applicable.

5.5 Rated continuous current (I_r)

Subclause 5.5 of IEC 62271-1:2017 is applicable with the following addition:

Some main circuits of an assembly (e.g. busbars, feeder circuits) may have different values of rated continuous current.

5.6 Rated short-time withstand currents (I_k , I_{ke})

Subclause 5.6 of IEC 62271-1:2017 is applicable with the following additions:

5.6.101 Rated short-time withstand current (I_k)

In principle, an assembly has one rated short-time withstand current value. However, there are several situations where it is permissible to assign different rated short-time withstand current values to different portions of the main circuit, including:

- circuits protected by current-limiting fuses;
- circuits under interlocked switching devices commutating two branches of a circuit.

The rated short-time withstand current values (I_k) assigned to the assembly are also applicable to the short-circuiting parts of the related earthing circuits, including earthing devices.

5.6.102 Rated short-time phase-to-earth withstand current (I_{ke})

A rated short-time withstand phase-to-earth current (I_{ke}) shall be assigned to the assembly for the parts of the earthing circuit connecting each phase of the main circuit to the earthing point provided or, where applicable, connecting the short-circuiting point between phases to the earthing point provided. This value may be lower than that of the main circuit.

NOTE The short-circuit current ratings assigned to the earthing circuit define the possible earthing conditions of the system neutral of the network on which the assembly can be installed. Refer to 9.102.

5.7 Rated peak withstand currents (I_p , I_{pe})

Subclause 5.7 of IEC 62271-1:2017 is applicable with the following additions:

5.7.101 Rated peak withstand current (I_p)

In principle, an assembly has one rated peak withstand current value. However, there are several situations where it is permissible to assign different rated peak withstand current values to different portions of the main circuit, including:

- circuits protected by current-limiting fuses;
- circuits under interlocked switching devices commutating two branches of a circuit.

The rated peak withstand current values (I_p) assigned to the assembly are also applicable to the short-circuiting parts of the related earthing circuits, including earthing devices.

5.7.102 Rated peak phase-to-earth withstand current (I_{pe})

A rated peak phase-to-earth withstand current (I_{pe}) shall be assigned to the assembly for the parts of the earthing circuit connecting each phase of the main circuit to the earthing point provided or, where applicable, connecting the short-circuiting point between phases to the earthing point provided. This value may be lower than that of the main circuit.

5.8 Rated durations of short-circuit (t_k , t_{ke})

Subclause 5.8 of IEC 62271-1:2017 is applicable with the following additions:

5.8.101 Rated duration of short-circuit (t_k)

In principle, an assembly has one rated duration of short-circuit. However, there are several situations where it is permissible to assign different rated durations of short-circuit to different portions of the main circuit including:

- circuits protected by current-limiting fuses and/or circuit-breakers;
- circuits under interlocked switching devices commutating two branches of a circuit.

The rated short-time withstand current values (t_k) assigned to the assembly are also applicable to the short-circuiting parts of the related earthing circuits, including earthing devices.

5.8.102 Rated duration of phase-to-earth short-circuit (t_{ke})

A rated duration of phase-to-earth short-circuit (t_{ke}) shall also be assigned to the assembly for the parts of the earthing circuit connecting each phase of the main circuit to the earthing point

provided or, where applicable, connecting the short-circuiting point between phases to the earthing point provided. This value may be lower than that of the main circuit.

5.9 Rated supply voltage of auxiliary and control circuits (U_a)

Subclause 5.9 of IEC 62271-1:2017 is applicable.

5.10 Rated supply frequency of auxiliary and control circuits

Subclause 5.10 of IEC 62271-1:2017 is applicable.

5.11 Rated pressure of compressed gas supply for controlled pressure systems

Subclause 5.11 of IEC 62271-1:2017 is applicable.

5.101 Classification of earthing function through main switching device

When the earthing function is performed by the main switching device in combination with a class E0 earthing switch, class E1 or E2, as defined in IEC 62271-102:2018, may be assigned to that earthing function.

The classification for the earthing function is not applicable when the earthing is performed by a circuit-breaker with the protection operative until the earthed situation is attained.

5.102 Rated cable test voltages (U_{ct} (AC), U_{ct} (DC))

5.102.1 General

If the assembly is designed to allow for dielectric testing of connected high-voltage cables while the busbar(s) of the associated functional unit remain in service, one or more rated cable test voltages shall be assigned.

5.102.2 Rated power-frequency cable test voltage U_{ct} (AC)

The rated power-frequency cable test voltage is the maximum AC test voltage with a duration of 1 min. that may be applied to cables when connected to the assembly, which may be in service.

5.102.3 Rated DC cable test voltage U_{ct} (DC) with rated duration t_{ct} (DC)

The rated DC cable test voltage is the maximum DC test voltage that may be applied to cables when connected to the assembly, which may be in service.

A rated DC cable test voltage is considered covering very low frequency testing (e.g. 0,1 Hz) with peak value up to the rated DC value for the same rated duration.

If no rated duration t_{ct} (DC) is specified, then by default this duration is 15 min.

NOTE Guidance can be found in IEEE 400.2 [3].

5.103 Ratings of the internal arc classification (IAC)

5.103.1 General

If an IAC classification is assigned by the manufacturer, several ratings shall be specified. These ratings shall be indicated by means of a designation as follows:

- Classification: IAC (Internal Arc Classification);

- Type of accessibility: A, B;
- Classified sides of the enclosure: F, L, R;
- Rated three-phase arc fault values: current I_A [kA] and duration t_A [s];
- Rated single-phase arc fault values (where applicable): current I_{Ae} [kA] and duration t_{Ae} [s].

5.103.2 Types of accessibility

Two types of accessibility to the enclosure of an assembly at the site of installation are defined:

- Accessibility Type A: restricted to authorized personnel only;
- Accessibility Type B: unrestricted accessibility, including that of the general public.

NOTE 1 For pole-mounted switchgear and controlgear, refer to IEC 62271-214 [4].

NOTE 2 IAC classification as defined in this document does not apply to opened compartments and to arc protection between compartments, except if opening is necessary to perform switching operations. IEEE C37.20.7 defines Suffix B designation for opened low-voltage compartments and Suffix C designation for arc protection between compartments [5].

5.103.3 Classified sides

In case of IAC, at least the front side of the assembly shall be classified for at least accessibility type A, by the manufacturer. The sides of the assembly which meet the criteria of the internal arc test are designated as

- F for front side;
- L for lateral side;
- R for rear side.

The front side shall be clearly stated by the manufacturer.

5.103.4 Rated arc fault currents (I_A , I_{Ae})

The value of rated arc fault currents should be selected from the R10 series specified in IEC 60059 [6].

Two ratings of the arc fault currents are recognized:

- a) three-phase arc fault current (I_A);
- b) single-phase-to-earth arc fault current (I_{Ae}), when applicable.

The manufacturer shall specify the compartments to which the single-phase-to-earth arc fault current rating is applicable. Such value may be assigned to an assembly where its construction will prevent the arc from becoming multiphase, as demonstrated during the internal arc test.

In the case where all high-voltage compartments are only designed for single-phase-to-earth arc faults, instead of I_A , the I_{Ae} rating shall be assigned.

NOTE Information about the relationship between the type of network neutral earthing and the single-phase-to-earth arc fault current is provided in 9.103.6.

5.103.5 Rated arc fault duration (t_A , t_{Ae})

Recommended values for the three-phase arc fault duration (t_A) are 0,1 s, 0,5 s and 1 s.

If applicable, the rated duration (t_{Ae}) of the single-phase-to-earth arc fault shall be assigned by the manufacturer.

NOTE It is in general not possible to calculate the permissible arc duration for a current which differs from that used in the test.

6 Design and construction

6.1 Requirements for liquids in switchgear and controlgear

Subclause 6.1 of IEC 62271-1:2017 is applicable.

6.2 Requirements for gases in switchgear and controlgear

Subclause 6.2 of IEC 62271-1:2017 is applicable

NOTE For the handling of SF₆ and its mixtures refer to IEC 62271-4 [7].

6.3 Earthing of switchgear and controlgear

Subclause 6.3 of IEC 62271-1:2017 is applicable with the following additions:

6.3.101 Earthing of the high-voltage conductive parts

All high-voltage conductive parts to which access is provided with the assembly in service, shall have the possibility of being earthed prior to becoming accessible. This is not applicable to removable parts which become accessible after being separated from the assembly and to withdrawable parts in test position or in disconnected position (refer to 6.101).

Where earthing connections shall be able to carry the full three-phase short-circuit current (as in the case of the short-circuiting connections used for earthing devices), these connections shall be dimensioned accordingly.

The connection from the short-circuiting point between phases to the earthing circuit may be dimensioned to the specifications of the earthing circuit.

6.3.102 Earthing of enclosure(s)

Metal enclosure(s) shall be electrically connected (directly or indirectly) to the earthing point provided. Small parts fixed to metal enclosure(s), up to a maximum of 12,5 mm in diameter, for example screw heads, need not be electrically connected to the earthing point provided. All the metallic parts intended to be earthed and not belonging to a high-voltage or auxiliary circuit shall also be electrically connected to the earthing point provided.

The interconnections within each functional unit shall be made by adequate means (e.g. fastening by bolting or welding), providing electrical continuity between the frame, covers, doors, metal partitions or other structural parts to the earthing point. Doors of the high-voltage compartments shall be electrically connected to the frame by adequate means.

NOTE 1 Enclosure and doors are considered in 6.102.

NOTE 2 EMC demands for the complete installation can require a special approach of the earthing circuit of the assembly.

6.3.103 Earthing of withdrawable and removable parts

The normally earthed metallic parts of a withdrawable part shall remain connected to earth in the test and disconnected positions and in any intermediate position. Connections to earth in any position shall provide a current-carrying capability not less than that required for enclosures (refer to 6.102.1).

On insertion, the normally earthed metallic parts of a removable part shall be connected to earth prior to the making of the contacts of the fixed and removable parts of the main circuit.

If the withdrawable or removable part includes any earthing device, intended to earth the main circuit, then the earthing connection in the service position shall be considered as part of the earthing circuit with associated rated values (refer to 5.6, 5.7 and 5.8).

6.3.104 Earthing circuit

The parts of the earthing circuit of the assembly connecting each functional unit to the earthing point shall be capable of carrying the rated short-time and peak phase-to-earth withstand current (I_{ke} , I_{pe}) and duration (t_{ke}).

NOTE 1 It is assumed that the short-circuiting point between phases of the earthing circuit is within each functional unit.

For transport units to be assembled during final installation, the resulting earthing circuit shall be capable of carrying its rated short-time and peak withstand currents and duration.

Parts of metal enclosures may form part of the earthing circuit.

If a dedicated earthing conductor is applied as earthing circuit of the assembly, its cross-section shall be not less than 30 mm².

NOTE 2 If the earthing circuit consists of an earthing copper conductor extending the whole length of the assembly, for the rated short-time withstand current, a current density in the earthing conductor, not exceeding 200 A/mm² for a rated duration of 1 s or 125 A/mm² for a rated duration of 3 s is generally sufficient.

NOTE 3 A method of calculating cross-sectional areas of conductors is given in IEC 60724 [8].

The earthing circuit is normally designed to withstand one occurrence of a single short-circuit fault, and maintenance could be needed after such an event; refer also to 9.102.

6.4 Auxiliary and control equipment and circuits

Subclause 6.4 of IEC 62271-1:2017 is applicable.

6.5 Dependent power operation

Subclause 6.5 of IEC 62271-1:2017 is applicable.

6.6 Stored energy operation

Subclause 6.6 of IEC 62271-1:2017 is applicable.

6.7 Independent unlatched operation (independent manual or power operation)

Subclause 6.7 of IEC 62271-1:2017 is applicable.

6.8 Manually operated actuators

Subclause 6.8 of IEC 62271-1:2017 is applicable.

6.9 Operation of releases

Subclause 6.9 of IEC 62271-1:2017 is applicable.