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INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

Appareillage à haute tension – <u>FC 62271-203-2022</u> Partie 203: Appareillage sous enveloppe métallique à isolation gazeuse et à courant alternatif de tensions assignées supérieures à 52 kV





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CONTENTS

FOF	REWORD	4
1	Scope	6
2	Normative references	6
3	Terms and definitions	7
4	Normal and special service conditions	10
5	Ratings	11
6	Design and construction	14
7	Type tests	27
8	Routine tests	41
9	Guide to the selection of switchgear and controlgear (informative)	44
10	Information to be given with enquiries, tenders and orders (informative)	44
11	Transport, storage, installation, operating instructions and maintenance	44
12	Safety	50
13	Influence of the product on the environment	51
Ann GIS	ex A (normative) Test procedure for dielectric test on three-phase encapsulated , range II (above 245 kV)	52
Ann und	ex B (normative) Methods for testing gas-insulated metal-enclosed switchgear er conditions of arcing due to an internal fault	53
Ann	ex C (informative) Technical and practical considerations of site testing	56
Ann	ex D (informative) Calculation of pressure rise due to an internal fault	61
Ann	ex E (informative) Information to be given with enquiries, tenders and orders	62
Ann	ex F (informative) Service continuity	^{ec} 68
Ann	ex G (informative) List of notes concerning certain countries	76
Bibli	iography	77
Figu	re 1 – Pressure coordination	19
Figu	re 2 – Example of arrangement of enclosures and gas compartments	24
Figu	re F.1 – MRE1X (e.g. repair of disconnector to busbar)	71
Figu	re F.2 – MRE00 (e.g. during visual inspection)	71
Figu	ıre F.3 – MRE01 (e.g. repair of circuit-breaker)	72
Figu	ıre F.4 – MRE11 (e.g. repair of disconnector)	72
Figu	re F.5 – MRE11 (e.g. extension of switchgear with a feeder bay)	73
Figu	ıre F.6 – MRE13 (e.g. repair of disconnector)	73
Figu	re F.7 – MRE2X (e.g. on-site dielectric test of busbar section A)	74
Figu	re F.8 – MRE2X (e.g. on-site dielectric test of busbar section 1)	74
Figu	re F.9 – MRE00 (e.g. repair of circuit-breaker)	75
Tab	le 1 – Reference table of service conditions relevant to GIS	11
Tabl and	le 2 – Rated insulation levels for rated voltages for equipment of range I (245 kV below)	12
Tabl 245	le 3 – Rated insulation levels for rated voltages for equipment of range II (above kV)	13

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Table 4 – Performance criteria	20
Table 5 – Type tests	
Table 6 – Test voltage for measuring PD intensity	31
Table 7 – On-site test voltages	48
Table A.1 – Switching impulse test conditions above 245 kV	52
Table E.1 – Normal and special service conditions	62
Table E.2 – Ratings	63
Table E.3 – Design and construction	64
Table E.4 – Bus ducts	65
Table E.5 – Bushing	65
Table E.6 – Cable connection	66
Table E.7 – Transformer connection	66
Table E.8 – Current transformer	66
Table E.9 – Inductive voltage transformer	66
Table E.10 – Documentation for enquiries and tenders	67

- 3 -

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR -

Part 203: AC gas-insulated metal-enclosed switchgear for rated voltages above 52 kV

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IEC 62271-203 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) the document has been aligned with IEC 62271-1:2017;
- b) beside SF₆ also alternative gases have been implemented where needed;
- c) the terms and definitions have been updated and terms not used have been removed;
- d) Subclause 6.16 "Gas and vacuum tightness" has been updated;

- e) Subclause 6.16.3 "Closed pressure systems": Two classes of gas has been introduced:
 - 1) GWP ≤ 1 000
 - 2) GWP > 1 000

and the tightness requirements for type tests for gasses with GWP > 1 000 has been reduced from 0.5 % to 0.1 % per year per gas compartment;

- f) Subclause 6.108 "Interfaces": Typical maximum pressures in service for interfaces connected to GIS have been defined;
- g) Subclauses 7.2 through 7.8 have been restructured;
- h) Subclause 7.107 "Corrosion test on earthing connections" has been updated;
- i) Subclause 7.108 "Corrosion tests on sealing systems of enclosures and auxiliary equipment" has been updated;
- j) Annex F 'Service Continuity' has been modified and aligned with the recommendations of CIGRE WG B3.51.

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

Draft	Report on voting			
17C/835/FDIS	17C/844/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.

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.

HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 203: AC gas-insulated metal-enclosed switchgear for rated voltages above 52 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 alternating current of rated voltages above 52 kV, for indoor and outdoor installation, and for service frequencies up to and including 60 Hz.

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

The 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 standards applying to the individual components constituting GIS.

2 Normative references standards.iteh.ai)

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

IEC 60068-2-17, Basic environmental testing procedures – Part 2-17: Tests – Test Q: Sealing

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

IEC 60141-1, Tests on oil-filled and gas-pressure cables and their accessories – Part 1: Oil-filled, paper or polypropylene paper laminate insulated, metal-sheathed cables and accessories for alternating voltages up to and including 500 kV

IEC 60270, High-voltage test techniques – Partial discharge measurements

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

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

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IEC 60840, Power cables with extruded insulation and their accessories for rated voltages above 30 kV (U_m = 36 kV) up to 150 kV (U_m = 170 kV) – Test methods and requirements

IEC 61869-1, Instrument transformers – Part 1: General requirements

IEC 61869-2, Instrument transformers – Part 2: Additional requirements for current transformers

IEC 61869-3, Instrument transformers – Part 3: Additional requirements for inductive voltage transformers

IEC 62067, Power cables with extruded insulation and their accessories for rated voltages above 150 kV (U_m = 170 kV) up to 500 kV (U_m = 550 kV) – Test methods and requirements

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

IEC 62271-4, High-voltage switchgear and controlgear – Part 4: Handling procedures for sulphur hexafluoride (SF₆) and its mixtures

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 62271-209:2019, 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

https://standards.iteh.ai/catalog/standards/sist/5c6038e4-aa47-4e12-bc62-e215bf3f5fcb/iec-

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

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62271-1:2017 and the following, apply.

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

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

3.101

metal-enclosed switchgear and controlgear

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

[SOURCE: IEC 60050-441:1984, 441-12-04, modified – The note was deleted.]

3.102

gas-insulated metal-enclosed switchgear

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

- 8 -

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

Note 2 to entry: Three-phase enclosed gas-insulated switchgear applies to switchgear with the three phases enclosed in a common enclosure.

Note 3 to entry: Single-phase enclosed gas-insulated switchgear applies to switchgear with each phase enclosed in a single independent enclosure.

[SOURCE: IEC 60050-441:1984, 441-12-05, modified – "or gas mixture" has been added in the definition, and Note 2 and 3 to entry have been added.]

3.103

gas-insulated switchgear enclosure

part of gas-insulated metal-enclosed switchgear retaining the insulating gas under the prescribed conditions necessary to maintain safely the highest insulation level, protecting the equipment against external influences and providing a high degree of protection to personnel

Note 1 to entry: The enclosure can be single-phase or three-phase.

3.104

isolating link

part of the conductor which can easily be opened or removed in order to isolate two parts of the GIS from each other

standards.iteh.ai)

Note 1 to entry: The open gap is designed to withstand the test voltages across isolating distance according Table 2 and Table 3.

Note 2 to entry: The purpose of an isolating link is to ensure electrical isolation between sections of a GIS e.g. during maintenance and repair work.

62271-203-202

3.105

removable link

part of the conductor which can easily be opened or removed in order to separate two parts of the GIS from each other

Note 1 to entry: The open gap is designed to withstand the phase-to-earth test voltages according to Table 2 and Table 3.

Note 2 to entry: The purpose of a removable link is to ensure electrical separation between sections of a GIS, where the equipment is separated from the rest of the GIS, e.g. in front of voltage transformers, surge arresters, cable connections and transformer connections during high voltage testing of GIS or testing of the components.

3.106

compartment

part of gas-insulated metal-enclosed switchgear, which is gastight and enclosed

Note 1 to entry: A compartment can be designated by the main component contained therein, e.g. circuit-breaker compartment, busbar compartment.

3.107

component

essential part of the main or earthing circuits of gas-insulated metal-enclosed switchgear which serves a specific function (for example circuit-breaker, disconnector, switch, fuse, instrument transformer, bushing, busbar, etc.)

3.108 support insulator

internal insulator supporting one or more conductors

3.109

partition

gas tight support insulator of gas-insulated metal-enclosed switchgear separating two adjacent compartments

3.110

bushing

a device that enables one or several conductors to pass through an enclosure and insulate the conductors from it

[SOURCE: IEC 60050-471:2007, 471-02-01, modified – "an enclosure" inserted after "pass through" and "a partition such as a wall or a tank" deleted. Notes 1 and 2 were deleted.]

3.111

main circuit

all the conductive parts of gas-insulated metal-enclosed switchgear included in a circuit which is intended to transmit electrical energy

[SOURCE: IEC 60050-441:1984, 441-13-02, modified – "gas-insulated metal-enclosed switchgear" inserted after "parts of" and "an assembly" deleted]

3.112

auxiliary circuit

all the conductive parts of gas-insulated metal-enclosed switchgear included in a circuit intended to control, measure, signal and regulate

Note 1 to entry: The auxiliary circuits of gas-insulated metal-enclosed switchgear include the control and auxiliary circuits of the switching devices.

3.113

IEC 62271-203:2022

enclosure design temperature maximum temperature that the enclosures can reach under specified maximum service conditions

3.114

enclosure design pressure

relative pressure used to determine the design of the enclosure

Note 1 to entry: It is at least equal to the maximum pressure in the enclosure at the highest temperature that the gas used for insulation can reach under specified maximum service conditions.

Note 2 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.

3.115

partition design pressure

relative pressure across the partition used to determine the design of the partition

Note 1 to entry: It is at least equal to the maximum differential pressure across the partition during maintenance activities.

Note 2 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.

3.116

operating pressure

<pressure relief device> relative pressure chosen for the opening operation of pressure relief devices

3.117

routine test pressure

<enclosures and partitions> relative pressure to which all enclosures and partitions are subjected after manufacturing

- 10 -

3.118

type test pressure

<enclosures and partitions> relative pressure to which enclosures and partitions are subjected for type test

3.119

fragmentation

damage to enclosure due to pressure rise with projection of solid material

3.120

disruptive discharge

phenomena 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 almost zero

3.121

transport unit

part of gas-insulated metal-enclosed switchgear suitable for shipment without being dismantled

3.122

functional unit

part of metal-enclosed switchgear and controlgear comprising all the components of the main circuits 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, for example complete single-phase or three-phase bay or functional parts of a bay like complete circuit-breaker, disconnector, earthing switch, voltage transformer, current transformer, operating mechanism, enclosure, etc.

[SOURCE: IEC 60050-441:1984, 441-13-04, modified – In the definition, "metal-enclosed" inserted after "part of" and "an assembly of" deleted. In the note the examples have been exchanged with examples relevant for GIS.]

4 Normal and special service conditions

4.1 Normal service conditions

Subclause 4.1 of IEC 62271-1:2017 is applicable, taking into account the recommended values presented in Table 1 of this document.

4.2 Special service conditions

Subclause 4.2 of IEC 62271-1:2017 is applicable, taking into account the recommended values presented in Table 1 of this document.

In the cases where higher than (>) is used in Table 1, the values shall be specified by the user as described in IEC 62271-1:2017.

4.101 General

Table 1 – R	Reference t	able of	service	conditions	relevant to	o GIS

ltom	Nor	mal	Special				
item	Indoor Outdoor		Indoor	Outdoor			
Ambient air temperature:							
Minimum (°C)	-5	-25	-25	-50			
Maximum (°C)	+40	+40 +50		+50			
Solar radiation (W/m ²)	Not applicable	1 000	Not applicable	>1 000			
Altitude (m)	1 000	1 000	>1 000	>1 000			
Site pollution severity ^a	Not applicable	с	c, d or e	d or e			
Ice coating (mm)	Not applicable	20	Not applicable	>20			
Wind (m/s)	Not applicable	34	Not applicable	>34			
Average humidity over 24 h (%)	95	100	98	100			
Condensation or precipitation	Occasional	Yes	Yes	Yes			
Abnormal vibrations, shock or tilting	Not applicable	Not applicable	ot applicable Applicable				
NOTE The user's specification can use any combination of normal or special service conditions above.							
^a Site pollution severity c, d or e according to IEC TS 60815-1:2008, 8.3 [5] ¹							

At any altitude the dielectric characteristics of the internal insulation are identical with those measured at sea-level. For this internal insulation no specific requirements concerning the altitude are applicable.

IEC 62271-203:2022

Some items of a GIS such as pressure relief devices and pressure and density monitoring devices can be affected by altitude. The manufacturer shall take appropriate measures if necessary.

5 Ratings

5.1 General

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

- e) rated short-time withstand current (I_k) (for main and earthing circuits);
- f) rated peak withstand current (I_p) (for main and earthing circuits);

and with the following addition:

k) rated values of the components forming part of gas-insulated metal-enclosed switchgear, including their operating devices and auxiliary equipment.

5.2 Rated voltage (U_r)

Subclause 5.2 of IEC 62271-1:2017 is applicable with the following addition:

Components forming part of the GIS can have individual values of rated for equipment in accordance with the relevant standards.

¹ Numbers in square brackets refer to the Bibliography.

5.3 Rated insulation level (U_d, U_p, U_s)

Subclause 5.3 of IEC 62271-1:2017 is applicable with the following addition:

Tables 1, 2, 3 and 4 in Subclause 5.3 of IEC 62271-1:2017 are replaced with Table 2 and Table 3 below.

NOTE 1 The higher values for GIS in IEC 62271-203 compared to the values in IEC 62271-1 were introduced with revision 1 in 2003. They have now been established as standard values.

The GIS comprises components having a definite insulation level. Although internal faults can largely be avoided by the choice of a suitable insulation level, measures to limit external overvoltages (e.g. surge arresters,) should be considered.

NOTE 2 Regarding the external parts of bushings (if any), see to IEC 60137:2017.

NOTE 3 The waveforms are standardized lightning impulse and switching impulse shapes, pending the results of studies on the ability of this equipment to withstand other types of impulses.

NOTE 4 The choice between alternative insulation levels for a particular rated voltage for equipment can be based on insulation coordination studies, taking into account also the self-generated transient overvoltages due to switching.

Rated voltage for equipment	Rated short-duratic withstan L kV (RM	on power-frequency d voltage d d S value)	Rated lightning impulse withstand voltage Up kV (peak value)		
U _r kV (RMS value)	Phase-to-earth, it clacross open star switching device and between phases	Across the isolating distance	Phase-to-earth, across open 02- switching device and between phases	215b Across flec- the isolating distance	
(1)	(2)	(3)	(4)	(5)	
72,5	140	160	325	375	
100	185	210	450	520	
123	230	265	550	630	
145	275	315	650	750	
170	325	375	750	860	
245	460	530	1 050	1 200	

Table 2 – Rated insulation levels for rated voltages for equipment of range I (245 kV and below)

NOTE Values in column (2) are applicable:

a) for type tests, phase-to-earth and between phases;

b) for routine tests, phase-to-earth, phase-to-phase, and across the open switching device.

Values in columns (3), (4) and (5) are applicable for type tests only.

Rated voltage for	Rated shoi power-fr withstand U kV (RMS	rt-duration equency d voltage d S value)	Rated switching impulse withstand voltage U _s kV (peak value)			Rated lightning impulse withstand voltage U _p kV (peak value)	
equipment U _r kV (RMS value)	Phase-to- earth and between phases (Notes 3 and 5)	Across open switching device and/or isolating distance (Note 3)	Phase-to- earth and across open switching device (Note 5)	Between phases (Notes 3 and 4)	Across isolating distance (Notes 1, 2 and 3)	Phase-to- earth and between phases (Note 5)	Across open switching device and/or isolating distance (Notes 2 and 3)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
300	460	595	850	1 275	700 (+245)	1 050	1 050 (+170)
362	520	675	950	1 425	800 (+295)	1 175	1 175 (+205)
420	650	815	1 050	1 575	900 (+345)	1 425	1 425 (+240)
550	710	925	1 175	1 760	900 (+450)	1 550	1 550 (+315)
800	960	1 270	1 425	2 420	1 100 (+650)	2 100	2 100 (+455)
	1 100	1 100	1 550	2 635	1 550 +(900)	2 250	2 250 + (630)
1 100		1 100 +(635)	1 800	2 880	1 675 +(900)	2 400	2 400 + (630)
	1 200	1 200	1 800	2 970	1 675 +(980)	2 400	2 400 + (685)
1 200		1 200 +(695)	1 950	3 120		2 550	2 550 + (685)

Table 3 – Rated insulation levels for rated voltages for equipment of range II (above 245 kV)

NOTE 1 Column (6) is also applicable to some circuit-breakers, see IEC 62271-100:2021.

https://standards.iteh.ai/catalog/standards/sist/5c6038e4-aa47-4e12-bc62-e215bf3f5fcb/iec-NOTE 2 In column (6), values in brackets are the peak values of the power-frequency voltage $U_r \sqrt{2} / \sqrt{3}$ applied to the opposite terminal (combined voltage).

In column (8), values in brackets are the peak values of the power-frequency voltage 0,7 $U_r \sqrt{2} / \sqrt{3}$ applied to the opposite terminal (combined voltage).

NOTE 3 Values in column (2) are applicable:

a) for type tests, phase-to-earth and between phases;

b) for routine tests, phase-to-earth, phase-to-phase, and across the open switching device.

Values in columns (3), (4), (5), (6), (7) and (8) are applicable for type tests only.

NOTE 4 These values are derived using the multiplying factors stated in Table 3 of IEC 60071-1:2019 [4].

NOTE 5 For earthing switches only phase-to-earth tests according column (2), (4) and (7) are 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 GIS (e.g. busbars, feeder circuits, etc.) can have different values of rated continuous current. However, these values should also be selected from R10 series.