

High-voltage switchgear and controlgear —

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

The European Standard EN 62271-203:2004 has the status of a
British Standard

ICS 29.130.10

National foreword

This British Standard is the official English language version of EN 62271-203:2004. It is identical with IEC 62271-203:2003. It supersedes BS EN 60517:1997 which will be withdrawn on 2007-02-01.

The UK participation in its preparation was entrusted to Technical Committee PEL/17/1, High-voltage switchgear and controlgear, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

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High-voltage switchgear and controlgear
Part 203: Gas-insulated metal-enclosed switchgear
for rated voltages above 52 kV
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This European Standard was approved by CENELEC on 2004-02-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

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CENELEC

European Committee for Electrotechnical Standardization
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Foreword

The text of document 17C/312/FDIS, future edition 1 of IEC 62271-203, prepared by SC 17C, High-voltage switchgear and controlgear assemblies, of IEC TC 17, Switchgear and controlgear, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 62271-203 on 2004-02-01.

This European Standard supersedes EN 60517:1996 + A11:1999.

Significant technical changes with respect to EN 60517:1996 are as follows: deleting not used technologies, like 3-phase PD measurements, adopting the content of EN 62271-1, Common clauses (under preparation), and harmonisation with IEEE C37.122. This makes the standard more up to date to today's products on the world market.

This standard is to be read in conjunction with EN 60694:1996 + A1:2000 + A2:2001, 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 EN 60694. Amendments to these clauses and subclauses are given under the same numbering, whilst additional subclauses are numbered from 101.

The following dates were fixed:

- latest date by which the EN has to be implemented
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Annexes ZA and ZB have been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 62271-203:2003 was approved by CENELEC as a European Standard without any modification.

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**COMMON NUMBERING OF IEC 62271 PUBLICATIONS FALLING UNDER
THE RESPONSIBILITY OF SUBCOMMITTEES SC 17A AND SC 17C**

In accordance with the decision taken at the joint SC 17A/SC 17C meeting in Frankfurt, June 1998 (item 20.7 of 17A/535/RM), a common numbering system has been established for the publications falling under the responsibility of SC 17A and SC 17C. IEC 62271 – *High-voltage switchgear and controlgear* is the publication number and main title element for the common publications.

The numbering of these publications will apply the following principle.

- a) Common standards prepared by SC 17A and SC 17C will start with IEC 62271-1.
- b) Standards of SC 17A will start with IEC 62271-100.
- c) Standards of SC 17C will start with number IEC 62271-200.
- d) Publications prepared by SC 17A and SC 17C will start with number IEC 62271-300.

The table below relates the new numbers to the old numbers. The parts numbered (xxx) will be given a final number pending the decision to publish the revised publication as standard or technical report.

**Common numbering of IEC 62271 publications falling under the responsibility
of subcommittees SC 17A and SC 17C**

IEC 62271 series	HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR	Old IEC number, if any
Part	New title	
1	Common specifications	IEC 60694
2	Seismic qualification for rated voltages of 72,5 kV and above	-
100	High-voltage alternating current circuit-breakers	IEC 60056
101	Synthetic testing	IEC 60427
102	High-voltage alternating current disconnectors and earthing switches	IEC 60129
103	Switches for rated voltages above 1 kV and less than 52 kV	IEC 60265-1
104	Switches for rated voltages of 52 kV and above	IEC 60265-2
105	Alternating current switch-fuse combinations	IEC 60420
106	Alternating current contactors and contactor-based motor-starters	IEC 60470
107	Alternating current switchgear-fuse combinations	-
108	Switchgear having combined functions	-
109	Series capacitor by-pass switches	-
200	AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV	IEC 60298
201	Insulation-enclosed switchgear and controlgear for rated voltages up to and including 52 kV	IEC 60466
202	High-voltage/low-voltage prefabricated substations	IEC 61330
203	Gas-insulated metal-enclosed switchgear for rated voltages above 52 kV	IEC 60517
204	High-voltage gas-insulated transmission lines for rated voltages of 72,5 kV and above	IEC 61640
(300)	Guide for seismic qualification of high-voltage alternating current circuit-breakers	IEC 61166
(301)	Guide for inductive load switching	IEC 61233
(302)	Guide for short-circuit and switching test procedures for metal-enclosed and dead tank circuit-breakers	IEC 61633
(303)	Use and handling of sulphur hexafluoride (SF ₆) in high-voltage switchgear and controlgear	IEC 61634
(304)	Additional requirements for enclosed switchgear and controlgear from 1 kV to 72,5 kV to be used in severe climatic conditions	IEC 60932
(305)	Cable connections for gas-insulated metal-enclosed switchgear for rated voltages above 52 kV	IEC 60859
(306)	Direct connection between power transformers and gas-insulated metal-enclosed switchgear for rated voltages above 52 kV	IEC 61639
(307)	Use of electronic and associated technologies in auxiliary equipment of switchgear and controlgear	IEC 62063
308	Guide for asymmetrical short-circuit breaking test duty T100a	-
309	TRV parameters for high-voltage switchgear and controlgear for rated voltages above 1 kV and less than 100 kV	-
310	Electrical endurance testing for circuit-breakers rated 72,5 kV and above	-

HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

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

1 General

1.1 Scope

This standard specifies requirements for gas-insulated, metal-enclosed switchgear in which the insulation is obtained, at least partly, by an insulating gas 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 standard, the terms “GIS” and “switchgear” are used for “gas-insulated metal-enclosed switchgear”.

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

This standard completes and amends, if necessary, the various relevant standards applying to the individual components constituting GIS.

1.2 Normative references

The following referenced documents are indispensable for the application 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.

Subclause 1.2 of IEC 60694 is applicable with the following additions:

IEC 60044-1, *Instrument transformers – Part 1: Current transformers*

IEC 60044-2, *Instrument transformers – Part 2: Inductive voltage transformers*

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

IEC 60137, *Insulating 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 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 60859, *Cable connections for gas-insulated metal-enclosed switchgear for rated voltages of 72,5 kV and above – Fluid-filled and extruded insulation cables – Fluid-filled and dry type cable-terminations*

IEC 61462, *Composite insulators – Hollow insulators for use in outdoor and indoor electrical equipment – Definitions, test methods, acceptance criteria and design recommendations*

IEC 61639, *Direct connection between power transformers and gas-insulated metal-enclosed switchgear for rated voltages of 72,5 kV and above*

IEC 61672-1, *Electroacoustics – Sound level meters – Part 1: Specifications*

IEC 61672-2, *Electroacoustics – Sound level meters – Part 2: Pattern evaluation tests*

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 62155, *Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1 000 V*

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

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

ISO 3231, *Paints and varnishes – Determination of resistance to humid atmospheres containing sulfur dioxide*

NOTE Other standards are referred to for information in this standard. They are listed in the Bibliography.

2 Normal and special service conditions

Clause 2 of IEC 60694 is applicable with the following additions:

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

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

2.1 Normal service conditions

Subclause 2.1 of IEC 60694 is applicable, taking into the account Table 101 of this standard.

2.2 Special service conditions

Subclause 2.2 of IEC 60694 is applicable, taking into account Table 101 of this standard.

In case where higher than (>) is used in the table the value shall be specified by the user as described in IEC 60694.

Table 101 – Reference table of service conditions relevant to GIS

Item	Normal		Special	
	Indoor	Outdoor	Indoor	Outdoor
Ambient air temperature:				
Minimum (°C)	–5 or –25	–25 or –40	–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
Pollution class ^a	Not applicable	II	II, III or IV	III or IV
Ice coating (mm)	Not applicable	1, 10 or 20	Not applicable	>20
Wind (m/s)	Not applicable	34	Not applicable	>34
Humidity (%)	95	100	98	100
Condensation or precipitation	Occasional	Yes	Yes	Yes
Vibration class	Not applicable	Not applicable	IEC 61166	IEC 61166
Induced electromagnetic disturbances in secondary system (kV)	1,6	1,6	>1,6	>1,6
NOTE The user's specification may use any combination of normal or special service conditions above.				
^a Pollution class II, III and IV according to Table 1 of IEC 60815.				

3 Terms and definitions

For the purposes of this document, the definitions given in IEC 60694, together with the following definitions, apply.

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

[IEV 441-12-04]

3.102

gas-insulated metal-enclosed switchgear

metal-enclosed switchgear in which the insulation is obtained, at least partly, by an insulating gas other than air at atmospheric pressure

NOTE 1 This term generally applies to high-voltage switchgear and controlgear.

[IEV 441-12-05]

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

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

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 The enclosure can be single-phase or three-phase.

3.104

removable link

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

3.105

compartment

part of gas-insulated metal-enclosed switchgear, totally enclosed except for openings necessary for interconnection and control

NOTE A compartment may be designated by the main component contained therein, e.g. circuit-breaker compartment, busbar compartment.

3.106

component

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

3.107

support insulator

internal insulator supporting one or more conductors

3.108

partition

support insulator of gas-insulated metal-enclosed switchgear separating one compartment from other compartments

3.109

bushing

structure carrying one or more conductors at the terminal of the enclosure and insulating it therefrom, including the means of attachment (e.g. air bushings)

3.110

main circuit

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

[IEV 441-13-02, modified]

3.111

auxiliary circuit

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

NOTE The auxiliary circuits of gas-insulated metal-enclosed switchgear include the control and auxiliary circuits of the switching devices.

3.112

design temperature of enclosures

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

3.113

design pressure of enclosures

relative pressure used to determine the design of the enclosure

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

NOTE 2 The transient pressure occurring during and after a breaking operation (e.g. circuit-breaker) is not to be considered in the determination of the design pressure.

3.114

design pressure of partitions

relative pressure across the partition

3.115

operating pressure of pressure relief device

relative pressure chosen for the opening operation of pressure relief devices

3.116

routine test pressure of enclosures and partitions

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

3.117

type test pressure of enclosures and partitions

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

3.118

fragmentation

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

NOTE The term "no fragmentation of the enclosure" is interpreted as follows:

- no explosion of the compartment;
- no solid parts flying off from the compartment.

Exceptions are:

- parts of the pressure relief device, if their ejection is directed;
- glowing particles and molten material resulting from burn-through of the enclosure.

3.119

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

3.120

service period

time until a maintenance, including opening of the gas compartments, is required

3.121

transport unit

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

4 Ratings

The ratings of GIS comprise the following:

- a) rated voltage, equal to highest voltage for equipment (U_r);
- b) rated insulation level;
- c) rated frequency (f_r);
- d) rated normal current (I_r) (for main circuits);
- 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);
- g) rated duration of short-circuit (t_k);
- h) rated values of the components forming part of gas-insulated metal-enclosed switchgear, including their operating devices and auxiliary equipment.

4.1 Rated voltage for equipment (U_r)

Subclause 4.1 of IEC 60694 is applicable with the following addition:

NOTE 1 Components forming part of the GIS may have individual values of rated voltage for equipment in accordance with the relevant standards.

NOTE 2 For the purpose of this standard, the rated voltage (U_r) defined in IEC 60694 is rated voltage of equipment (U_r).

4.2 Rated insulation level

Subclause 4.2 and Tables 1 and 2 of IEC 60694 are applicable. Tables 102 and 103 below are the preferred values for GIS.

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 1 According to CIGRE studies the natural ratio between the withstand voltages under standard tests, for SF₆ gas insulation is $U_d / U_p = 0,45$ and $U_s / U_p = 0,75$. The values U_d shown in Table 103 are calculated with this factors.

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

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 should be based on insulation coordination studies, taking into account also the self-generated transient overvoltages due to switching.

**Table 102 – Preferred rated insulation levels for rated voltages
for equipment of range I**

Rated voltage for equipment U_r kV (r.m.s. value)	Rated short-duration power-frequency withstand voltage U_d kV (r.m.s. value)		Rated lightning impulse withstand voltage U_p kV (peak value)	
	Phase-to-earth, across open switching device and between phases	Across the isolating distance	Phase-to-earth, across open switching device and between phases	Across 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
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.				

Table 103 – Preferred rated insulation levels for rated voltages for equipment of range II

Rated voltage for equipment U_r kV (r.m.s. value)	Rated short-duration power-frequency withstand voltage U_d kV (r.m.s. value)		Rated switching impulse withstand voltage U_s kV (peak value)			Rated lightning impulse withstand voltage U_p kV (peak value)	
	Phase-to-earth and between phases (note 3)	Across open switching device and/or isolating distance (note 3)	Phase-to-earth and across open switching device	Between phases (notes 3 and 4)	Across isolating distance (notes 1, 2 and 3)	Phase-to-earth and between phases	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)

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

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). See Annex D of IEC 60694.

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 (1993).

4.3 Rated frequency (f_r)

Subclause 4.3 of IEC 60694 is applicable.

4.4 Rated normal current and temperature rise

4.4.1 Rated normal current (I_r)

Subclause 4.4.1 of IEC 60694 is applicable with the following addition:

Some main circuits of GIS (e.g. busbars, feeder circuits, etc.) may have different values of rated normal current.

4.4.2 Temperature rise

Subclause 4.4.2 of IEC 60694 is applicable with the following addition:

The temperature rise of components contained in the GIS which are subject to standards not covered by the scope of IEC 60694 shall not exceed the temperature-rise limits permitted in the relevant standard for those components.

NOTE When applying a temperature rise equal to or higher than 65 K for parts of the enclosure not accessible to the operator, every precaution is to be taken to ensure that no damage is caused to the surrounding insulating materials.

4.5 Rated short-time withstand current (I_k)

Subclause 4.5 of IEC 60694 is applicable.

4.6 Rated peak withstand current (I_p)

Subclause 4.6 of IEC 60694 is applicable with the following addition:

NOTE In principle, the rated short-time withstand current and the rated peak withstand current of a main circuit cannot exceed the corresponding rated values of the weakest of its series connected components.

4.7 Rated duration of short-circuit (t_k)

Subclause 4.7 of IEC 60694 is applicable.

4.8 Rated supply voltage of closing and opening devices and of auxiliary and control circuits (U_a)

Subclause 4.8 of IEC 60694 is applicable.

4.9 Rated supply frequency of closing and opening devices and of auxiliary circuits

Subclause 4.9 of IEC 60694 is applicable with the following addition:

The rated supply frequency of operating devices and auxiliary circuits is the frequency at which the conditions of operation and temperature rise of these devices and circuits are determined.

4.10 Rated pressure of compressed gas supply for insulation and/or operation

Subclause 4.10 of IEC 60694 is not applicable.

5 Design and construction

GIS shall be designed so that normal service, inspection and maintenance operations, earthing of connected cables, locating of cable faults, voltage tests on connected cables or other apparatus and the elimination of dangerous electrostatic charges, can be carried out safely, including the checking of phase sequence after installation and extension.

The design of the equipment shall be such that the agreed permitted movement of foundations and mechanical or thermal effects do not impair the assigned performance of the equipment.

All components of the same rating and construction which may need to be replaced shall be interchangeable.

The various components contained within the enclosure are subject to their relevant standards except where modified by this standard.

5.1 Requirements for liquids in switchgear and controlgear

Subclause 5.1 of IEC 60694 is not applicable.

5.2 Requirements for gases in switchgear and controlgear

Subclause 5.2 of IEC 60694 is applicable with the following addition:

For GIS new SF₆ in accordance with IEC 60376 and used SF₆ in accordance with IEC 60480 can be used.

NOTE 1 For checking of sulphur hexafluoride in service, refer to IEC 60480.

NOTE 2 For handling of sulphur hexafluoride, refer to IEC 61634.

NOTE 3 Values for used SF₆ are under consideration in TC 10, WG 15, and will be included in the next revision of IEC 60480.

5.3 Earthing of switchgear and controlgear

Subclause 5.3 of IEC 60694 is applicable, with the additional subclauses.

5.3.101 Earthing of the main circuit

To ensure safety during maintenance work, all parts of the main circuit to which access is required or provided shall be capable of being earthed.

Earthing may be made by

- a) earthing switches with a making capacity equal to the rated peak withstand current, if there is still a possibility that the circuit connected is live;
- b) earthing switches without a making capacity or with a making capacity lower than the rated peak withstand current, if there is certainty that the circuit connected is not live.

Furthermore, it shall be possible, after opening the enclosure, to connect removable earthing devices for the duration of the work on a circuit element previously earthed via an earthing switch.

5.3.102 Earthing of the enclosure

The enclosures shall be connected to earth. All metal parts which do not belong to a main or an auxiliary circuit shall be earthed. For the interconnection of enclosures, frames, etc., fastening (e.g. bolting or welding) is acceptable for providing electrical continuity.

The continuity of the earthing circuits shall be ensured taking into account the thermal and electrical stresses caused by the current they may have to carry.

If using single-phase enclosed switchgear, a looping circuit, i.e. an interconnection between the enclosures of the three phases, should be installed for the induced current. Each of these looping circuits should be linked as directly as possible to the general earthing grid by a conductor capable to carry the short-circuit current.

NOTE The looping circuits are intended to avoid induced currents in the enclosures from flowing in the earthing circuits and earthing grid. They are usually dimensioned for rated current and located at the end of each section.

5.4 Auxiliary and control equipment

Subclause 5.4 of IEC 60694 is applicable.

5.5 Dependent power operation

Subclause 5.5 of IEC 60694 is applicable.

5.6 Stored energy operation

Subclause 5.6 of IEC 60694 is applicable.

5.7 Independent manual operation

Subclause 5.7 of IEC 60694 is not applicable.

5.8 Operation of releases

Subclause 5.8 of IEC 60694 is applicable.

5.9 Low- and high-pressure interlocking and monitoring devices

Subclause 5.9 of IEC 60694 is applicable with the following addition:

For GIS only gas density is of importance.

The gas density or temperature compensated gas pressure in each compartment shall be continuously monitored. The monitoring device shall provide at least two sets of alarm levels for pressure or density (alarm and minimum functional pressure or density).

NOTE 1 When the rated filling density differs between adjacent compartments, a third alarm indicating overdensity may be used.

NOTE 2 Tolerances of the monitoring device, as well as possible differences in temperature between the monitoring device and the volume of gas being monitored, should be considered.

Gas monitoring devices shall be capable of being checked with the high-voltage equipment in service.

NOTE 3 Checking of gas monitoring may initiate wrong alarms which may initiate or inhibit switching operations.

5.10 Nameplates

Subclause 5.10 of IEC 60694 is applicable with the following addition:

GIS and all its operating devices and main components shall be provided with nameplates, as agreed between manufacturer and user. The nameplates shall be durable and clearly legible.

The individual nameplates of the components can be simplified, provided common information for the GIS is stated on one nameplate.

The manufacturer shall give information about the total amount of SF₆ contained in the GIS installation.

5.11 Interlocking devices

Subclause 5.11 of IEC 60694 is applicable with the following addition:

The following provisions are mandatory for apparatus installed in main circuits which are used as isolating distance and earthing:

- apparatus installed in main circuits, which are used for ensuring isolating distances during maintenance work, shall be provided with locking facilities to prevent closing;
- earthing switches shall be provided with locking facilities to avoid opening.

Earthing switches having a short-circuit making capacity less than the rated peak withstand current of the circuit should be interlocked with the associated disconnectors.

Switches having a short-circuit making capacity less than the rated peak withstand current, or a breaking capacity less than the rated normal current, and disconnectors should be interlocked with the associated circuit-breaker to prevent opening or closing of the switch or disconnector unless the associated circuit-breaker is open. However, on-load bus-transfer switching operations at multiple busbar substations shall be possible.

5.12 Position indication

Subclause 5.12 of IEC 60694 is applicable with the following addition:

Subclause 5.104.3.1 of IEC 62271-102 is applicable.

5.13 Degrees of protection by enclosures

Subclause 5.13 of IEC 60694 is applicable.

5.14 Creepage distances

Subclause 5.14 of IEC 60694 does not apply to GIS.

5.15 Gas and vacuum tightness

Subclause 5.15 of IEC 60694 is applicable with the following addition:

Leakage losses and handling losses shall be considered separately.

NOTE 1 The objective is to achieve a total loss (leakage and handling) as low as possible. A value of less than 15 % averaged over all gas compartments and for the service period of minimum 25 years should be achieved.

NOTE 2 The cause of abnormal leakage in service should be investigated carefully and corrective actions should be considered.

5.15.1 Controlled pressure systems for gas

Subclause 5.15.1 of IEC 60694 is not applicable.

5.15.2 Closed pressure systems for gas

Subclause 5.15.2 of IEC 60694 is applicable.

5.15.3 Sealed pressure systems

Subclause 5.15.3 of IEC 60694 is applicable.

5.15.101 Leakage

GIS shall be a closed pressure system or a sealed pressure system.

If it is a closed pressure system, the leakage rate from any single compartment of GIS to atmosphere and between compartments shall not exceed 0,5 % per year for the service life of the equipment.

NOTE The procedure of Annex E of IEC 60694 may be used.

5.15.102 Gas handling

The GIS shall be designed so as to minimize gas-handling losses during service life. The manufacturer shall specify test and maintenance procedures for minimizing gas-handling losses and shall identify the gas loss associated with each procedure.

The manufacturer shall recommend procedures for SF₆ handling according to IEC 60480 and IEC 61634.

5.16 Liquid tightness

Subclause 5.16 of IEC 60694 is not applicable.

5.17 Flammability

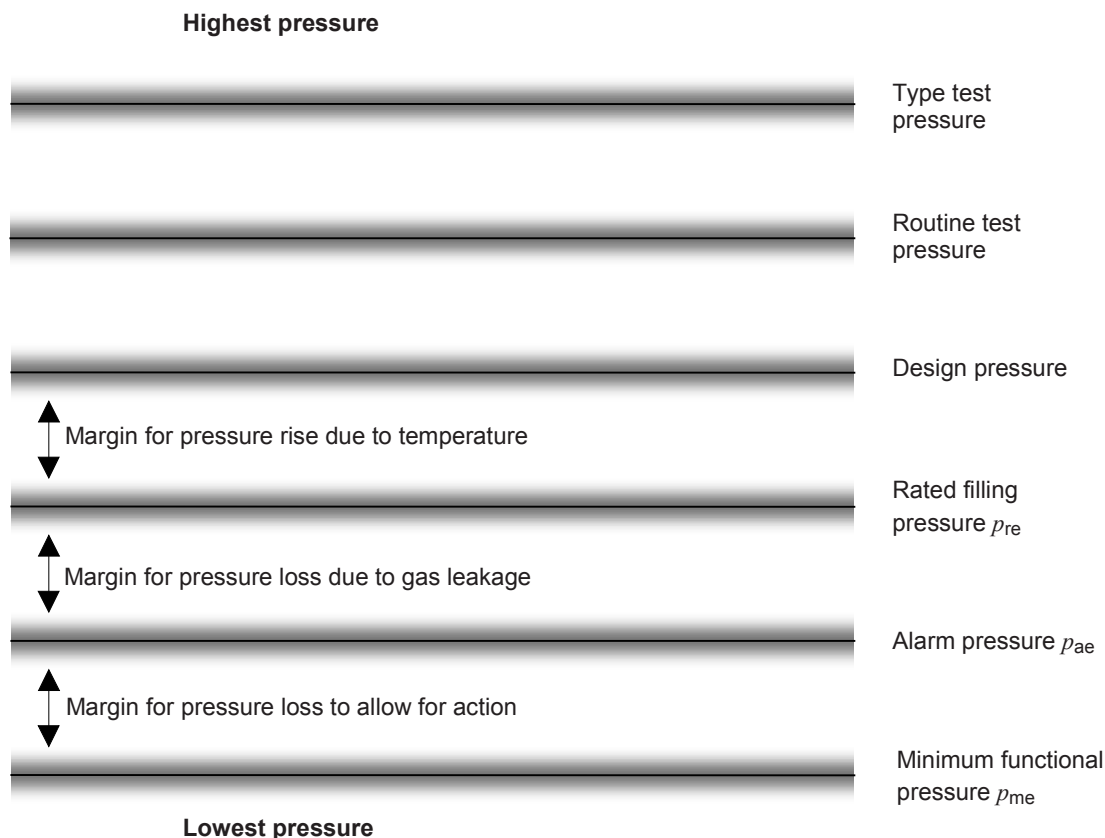
Subclause 5.17 of IEC 60694 is applicable.

5.18 Electromagnetic compatibility (EMC)

Subclause 5.18 of IEC 60694 is applicable.

5.101 Pressure coordination

The pressure inside a GIS may vary from the rated filling pressure level due to different service conditions. Pressure increase due to temperature and leakage between compartments may impose additional mechanical stresses. Pressure decrease due to leakage may reduce the insulation properties. Figure 101 shows the various pressure levels and their relationship.



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Figure 101 – Pressure coordination

The manufacturer is responsible for choosing the minimum functional pressure for insulation and operation p_{me} . The rated filling pressure p_{re} is related to the alarm pressure p_{ae} and the leakage rate in order to reach a sufficient period for refilling.

The time between the alarm pressure p_{ae} and the minimum functional pressure p_{me} should allow sufficient reaction time to permit actions. The tolerances of the gas monitor devices should be considered.

In service conditions, the mechanical stresses are associated with the internal pressure which depends on the gas temperature. Consequently, the design pressure corresponds to the rated filling pressure at the maximum temperature the gas can reach.

Routine test pressure and type test pressure are based on design pressure taking into account material and manufacturing process factors.

5.102 Internal fault

5.102.1 General

A fault leading to arcing within GIS built to this standard has a low order of probability. This results from the application of an insulating gas other than air at atmospheric pressure which will not be altered by pollution, humidity or vermin.