

INTERNATIONAL STANDARD

NORME INTERNATIONALE

High-voltage switchgear and controlgear –
Part 204: Rigid gas-insulated transmission lines for rated voltage above 52 kV
(standards.iteh.ai)

Appareillage à haute tension –
Partie 204: Lignes de transport rigides à isolation gazeuse de tension assignée
supérieure à 52 kV





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CONTENTS

| | |
|---|----|
| FOREWORD..... | 5 |
| 1 General | 7 |
| 1.1 Scope..... | 7 |
| 1.2 Normative references | 7 |
| 2 Normal and special service conditions..... | 8 |
| 2.101 Installation in open air | 8 |
| 2.102 Buried installation | 9 |
| 2.103 Installation in tunnel, shaft or similar situation | 9 |
| 3 Terms and definitions | 9 |
| 4 Ratings..... | 11 |
| 4.1 Rated voltage (U_r) | 11 |
| 4.2 Rated insulation level..... | 11 |
| 4.3 Rated frequency (f_r)..... | 11 |
| 4.4 Rated normal current and temperature rise | 11 |
| 4.5 Rated short-time withstand current (I_k) | 12 |
| 4.6 Rated peak withstand current (I_p) | 12 |
| 4.7 Rated duration of short circuit (t_k)..... | 12 |
| 4.8 Rated supply voltage of closing and opening devices and of auxiliary and control circuits (U_a) | 12 |
| 4.9 Rated supply frequency of closing and opening devices and of auxiliary circuits | 12 |
| 4.10 Rated pressure of compressed gas supply for controlled pressure systems | 13 |
| 4.11 Rated filling levels for insulation and/or operation | 13 |
| 5 Design and construction..... | 13 |
| 5.1 Requirements for liquids in GIL | 13 |
| 5.2 Requirements for gases in GIL..... | 13 |
| 5.3 Earthing..... | 13 |
| 5.4 Auxiliary and control equipment | 14 |
| 5.5 Dependent power operation | 14 |
| 5.6 Stored energy operation..... | 14 |
| 5.7 Independent manual or power operation (independent unlatched operation) | 14 |
| 5.8 Operation of releases | 14 |
| 5.9 Low- and high-pressure interlocking and monitoring devices | 14 |
| 5.10 Nameplates | 15 |
| 5.11 Interlocking devices | 15 |
| 5.12 Position indication..... | 16 |
| 5.13 Degree of protection provided by enclosures | 16 |
| 5.14 Creepage distances for outdoor insulators | 16 |
| 5.15 Gas and vacuum tightness..... | 16 |
| 5.16 Liquid tightness | 17 |
| 5.17 Fire hazard (flammability) | 17 |
| 5.18 Electromagnetic compatibility (EMC)..... | 17 |
| 5.19 X-ray emission..... | 17 |
| 5.20 Corrosion | 17 |
| 5.101 Internal fault | 18 |
| 5.102 Enclosures..... | 19 |

| | | |
|-------|--|----|
| 5.103 | Partitions and partitioning..... | 20 |
| 5.104 | Sections of a GIL system | 21 |
| 5.105 | Pressure relief | 21 |
| 5.106 | Compensation of thermal expansion..... | 22 |
| 5.107 | External vibration | 22 |
| 5.108 | Supporting structures for non-buried GIL..... | 22 |
| 6 | Type tests..... | 23 |
| 6.1 | General | 23 |
| 6.2 | Dielectric tests..... | 24 |
| 6.3 | Radio interference voltage (r.i.v.) test | 26 |
| 6.4 | Measurement of the resistance of circuits | 26 |
| 6.5 | Temperature-rise tests..... | 26 |
| 6.6 | Short-time withstand current and peak withstand current tests..... | 26 |
| 6.7 | Verification of the protection | 27 |
| 6.8 | Tightness tests | 27 |
| 6.9 | Electromagnetic compatibility tests (EMC)..... | 28 |
| 6.10 | Additional test on auxiliary and control circuits | 28 |
| 6.11 | X-radiation test procedure for vacuum interrupters | 28 |
| 6.101 | Proof tests for enclosures | 28 |
| 6.102 | Destructive pressure tests..... | 28 |
| 6.103 | Anti-corrosion tests for buried installation | 28 |
| 6.104 | Special mechanical test on sliding contacts | 29 |
| 6.105 | Test under conditions of arcing due to internal fault..... | 30 |
| 6.106 | Weatherproofing test..... | 31 |
| 7 | Routine tests | 31 |
| 7.1 | Dielectric tests on the main circuits..... | 31 |
| 7.2 | Dielectric tests on auxiliary and control circuits | 31 |
| 7.3 | Measurement of the resistance of the main circuit..... | 31 |
| 7.4 | Tightness test..... | 31 |
| 7.5 | Design and visual checks..... | 31 |
| 7.101 | Partial discharge measurement | 31 |
| 7.102 | Pressure tests of factory made enclosures | 32 |
| 8 | Guide to the selection of GIL..... | 32 |
| 8.101 | Short time overload capability | 32 |
| 8.102 | Forced cooling | 32 |
| 9 | Information to be given with enquiries, tenders and orders | 32 |
| 9.101 | Information with enquiries and orders | 32 |
| 9.102 | Information with tenders and contract documentation | 34 |
| 10 | Transport, storage, installation, operation and maintenance | 35 |
| 10.1 | Conditions during transport, storage and installation | 35 |
| 10.2 | Installation..... | 35 |
| 10.3 | Operation | 36 |
| 10.4 | Maintenance..... | 40 |
| 11 | Safety..... | 40 |
| 11.1 | Precautions by manufacturers..... | 41 |
| 11.2 | Precautions by users | 41 |
| 11.3 | Electrical aspects | 41 |

| | |
|---|----|
| 11.4 Mechanical aspects | 41 |
| 11.5 Thermal aspects | 41 |
| 11.101 Maintenance aspects | 41 |
| 12 Influence of the product on the environment | 42 |
| Annex A (informative) Estimation of continuous current | 43 |
| Annex B (informative) Earthing | 48 |
| Annex C (normative) Long-term testing of buried installations | 52 |
| Bibliography | 54 |
| | |
| Figure B.1 – Example of earthing system together with active anti-corrosion system in the case of solid bonding of the enclosure at both ends | 51 |
| | |
| Table 1 – Second characteristic numeral of IP coding | 16 |

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

**Part 204: Rigid gas-insulated transmission lines
for rated voltage above 52 kV**

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International Standard IEC 62271-204 has been prepared by subcommittee 17C: High-voltage switchgear and controlgear assemblies, of IEC technical committee 17: Switchgear and controlgear.

This standard cancels and replaces IEC/TS 61640:1998. It is a technical revision.

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

- update to be in line with IEC 62271-1:2007 and 62271-203 and alignment of the voltage ratings and the test voltages;
- addition of new information for gas tightness and corrosion protection.

The text of this standard is based on the following documents:

| FDIS | Report on voting |
|--------------|------------------|
| 17C/510/FDIS | 17C/520/RVD |

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

This International Standard should be read in conjunction with IEC 62271-1:2007, 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. Amendments to these clauses and subclauses are given under the same numbering, whilst additional subclauses, are numbered from 101. It should also be read in conjunction with IEC 62271-203.¹

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

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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¹ To be published.

HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 204: Rigid gas-insulated transmission lines for rated voltage above 52 kV

1 General

1.1 Scope

This part of IEC 62271 applies to rigid HV gas-insulated transmission lines (GIL) in which the insulation is obtained, at least partly, by a non-corrosive insulating gas, other than air at atmospheric pressure, for alternating current of rated voltages above 52 kV, and for service frequencies up to and including 60 Hz.

It is intended that this international standard be used where the provisions of IEC 62271-203 do not cover the application of GIL (see NOTE 3).

At each end of the HV gas-insulated transmission line, a specific element may be used for the connection between the HV gas-insulated transmission line and other equipment like bushings, power transformers or reactors, cable boxes, metal-enclosed surge arresters, voltage transformers or GIS, covered by their own specification.

Unless otherwise specified, the HV gas-insulated transmission line is designed to be used under normal service conditions.

NOTE 1 In this international standard, the term "HV gas-insulated transmission line" is abbreviated to "GIL".

NOTE 2 In this international standard, the word "gas" means gas or gas mixture, as defined by the manufacturer.

NOTE 3 Examples of GIL applications are given:

- where all or part of the HV gas-insulated transmission line is directly buried; or
- where the HV gas-insulated transmission line is located, wholly or partly, in an area accessible to public; or
- where the HV gas-insulated transmission line is long and the typical gas compartment length exceeds the common practice of GIS technology.

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.

IEC 60050-151, *International Electrotechnical Vocabulary (IEV) – Part 151: Electrical and magnetic devices*

IEC 60050-441:1984, *International Electrotechnical Vocabulary (IEV) – Chapter 441: Switchgear, controlgear and fuses*

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

IEC 60068-1, *Environmental testing – Part 1: General and guidance*

IEC 60229:2007, *Electric cables – Tests on extruded oversheaths with a special protective function*

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

IEC 60287-3-1:1995, *Electric cables – Calculation of the current rating – Part 3-1: Sections on operating conditions – Reference operating conditions and selection of cable type*

IEC 60376, *Specification of technical grade sulfur hexafluoride (SF₆) for use in electrical equipment*

IEC 60480, *Guidelines for the checking and treatment of sulfur hexafluoride (SF₆) taken from electrical equipment and specification or its re-use*

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

IEC 62271-1:2007, *High-voltage switchgear and controlgear – Part 1: Common specifications*

IEC 62271-203:2011, *High-voltage switchgear and controlgear – Part 203: Gas-insulated metal-enclosed switchgear for rated voltages above 52 kV²*

IEC 62271-303, *High-voltage switchgear and controlgear – Part 303: Use and handling of sulphur hexafluoride (SF₆)*

ISO/IEC Guide 51, *Safety aspects – Guidelines for their inclusion in standards*

2 Normal and special service conditions

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Clause 2 of IEC 62271-1 is applicable with the following addition:

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

The normal service conditions which apply to a GIL depending on the installation conditions are given in 2.101, 2.102 and 2.103. When more than one of these installation conditions apply, the relevant subclause shall apply to each section of the GIL.

2.101 Installation in open air

For determining the ratings of GIL for open air installation, the normal service conditions of IEC 62271-1 shall apply. Typical rating conditions are also valid for open trenches.

If the actual service conditions differ from the normal service conditions, the ratings shall be adapted accordingly.

Unless otherwise specified by the user, the special service conditions given in the IEC 62271-1 shall apply.

² To be published.

2.102 Buried installation

Typical values for thermal resistivity and soil temperature are:

- 1,2 K · m/W, and 20 °C in summer;
- 0,85 K · m/W, and 10 °C in winter.

For guidance, values given in IEC 60287-3-1 may be considered.

NOTE 1 For long distance transmission lines (several kilometres) site measurement of soil resistivity should also be considered.

NOTE 2 The use of controlled backfill with a given soil thermal resistivity may also be considered.

NOTE 3 A risk of thermal runaway exists if the soil surrounding the buried GIL becomes dry. In order not to dry out the soil, a maximum service temperature of the enclosure in the range of 50 °C to 60 °C is generally considered acceptable.

The depth of laying shall be agreed between manufacturer and user. The determination of depth of laying shall take into account thermo mechanical stresses, safety requirements and local regulations.

2.103 Installation in tunnel, shaft or similar situation

Forced cooling is an adequate method and used in case of tunnel, shaft or similar installations.

In the case of long vertical shafts and inclined tunnels or sections thereof, attention shall be paid to thermal and density gradients, especially if a gas mixture is used.

3 Terms and definitions

[IEC 62271-204:2011](https://standards.iteh.ai/catalog/standards/sist/4a783d78-1550-4bc5-8d7b-440362dca57/iec-62271-204-2011)

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

3.101

area accessible to public

access not restricted to authorized personnel

NOTE A GIL installed above ground and outside a substation is considered to be "installed in an area accessible to public".

3.102

gas-insulated transmission lines

GIL

metal-enclosed lines in which the insulation is obtained, at least partly, by an insulating gas other than air at atmospheric pressure, with the external enclosure intended to be earthed

3.103

GIL enclosure

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

3.104

compartment

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

3.105

partition

part of gas-insulated line separating one compartment from other compartments

3.106

main circuit

all conductive parts of gas-insulated line included in a circuit which is intended to transmit electrical energy

[IEC 60050-441:1984, 441-13-02, modified]

3.107

ambient air temperature (of gas-insulated line)

temperature, determined under prescribed conditions, of the air surrounding the external GIL enclosure of gas-insulated line in case of installation in open air, open trenches or tunnels

[IEC 60050-441:1984, 441-11-13, modified]

3.108

design temperature (of the enclosure)

highest temperature which can be reached by the enclosure under service conditions

3.109

design pressure (of the enclosure)

relative pressure used to determine the design of the enclosure

NOTE 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.

3.110

design pressure (of the partition)

pressure used to determine the design of the partition

3.111

disconnecting unit

unit to separate gas compartments mainly for site testing or maintenance

3.112

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

NOTE 1 The term applies to discharges in solid, liquid and gaseous dielectrics and to combinations of these.

NOTE 2 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 may be only temporary (self-restoring insulation).

NOTE 3 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 a gaseous or liquid medium. The term "puncture" is used when a disruptive discharge occurs through a solid dielectric.

3.113

GIL section

a GIL section is defined by operational or other requirements such as maximum length for dielectric testing or installation sequence

NOTE 1 It may consist of one or more compartments.

NOTE 2 Sections may be segregated by disconnecting units.

4 Ratings

Clause 4 of IEC 62271-1 is not applicable, except as follows.

The rating of a GIL consists of the following:

- a) rated voltage (U_r) and number of phases;
- 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 a GIL, including auxiliary equipment;
- i) rated filling pressure of insulating gas.

4.1 Rated voltage (U_r)

Subclause 4.1 of IEC 62271-203 is applicable.

4.2 Rated insulation level

Subclause 4.2 of IEC 62271-1 is applicable with the following addition:

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Rated insulation levels shall be chosen from IEC 62271-203 on the basis of insulation coordination study for the specific installation in order to consider parameters like overvoltages, voltage reflections, etc. Specific insulation coordination studies are recommended for each installation.

Although internal arcing faults can largely be avoided by the choice of a suitable insulation level, measures to limit external over-voltages at each end of the installation (e.g. surge arresters) should be considered.

4.3 Rated frequency (f_r)

Subclause 4.3 of IEC 62271-1 is applicable.

4.4 Rated normal current and temperature rise

4.4.1 Rated normal current (I_r)

Subclause 4.4.1 of IEC 62271-1 is applicable with the following addition:

The rated normal current is defined for a single, three-phase circuit installed above ground with an ambient air temperature at 40 °C. For other installation conditions, see Annex A.

4.4.2 Temperature rise

Subclause 4.4.2 of IEC 62271-1 is applicable with the following addition:

The temperature of the enclosure shall not exceed the maximum allowable temperature of the anti-corrosion coating if applicable.

The temperature rise of components contained in the GIL which are subject to standards not covered by the scope of IEC 62271-1 shall not exceed the temperature-rise limits permitted in the relevant standard for those components.

For open air, tunnel and shaft installations, the maximum temperature of the enclosure shall not exceed 80 °C. Parts normally touched during operation not to exceed 70 °C. Reference is made to Clause 11 of this standard.

For direct buried installation, the maximum temperature of the enclosure shall be limited to minimise soil drying. A temperature in the 50 °C and 60 °C range is generally considered applicable.

4.4.3 Particular points of Table 3

Subclause 4.4.3 of IEC 62271-1 is applicable.

4.4.101 Particular requirements for temperature rise

Where a non-oxidizing gas is used as the dielectric, the limits of the temperature and temperature rise shall be as specified for SF₆ in Table 3 of IEC 62271-1.

Where compressed air is used as the dielectric, the limits of the temperature and temperature rise shall be as specified for air in Table 3 of IEC 62271-1.

Where an oxidizing gas (other than air) is used as the dielectric, lower limits of temperature and temperature rise shall be agreed between manufacturer and user.

4.5 Rated short-time withstand current (I_k)

Subclause 4.5 of IEC 62271-1 is applicable, with the following addition:

In selecting a rated short-time withstand current for an installation, or part of an installation, consideration may be given to the fact that the maximum fault current in a circuit reduces as the distance from the substation increases.

4.6 Rated peak withstand current (I_p)

Subclause 4.6 of IEC 62271-1 is applicable.

4.7 Rated duration of short circuit (t_k)

Subclause 4.7 of IEC 62271-1 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 62271-1 is applicable.

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

Subclause 4.9 of IEC 62271-1 is applicable with the following addition:

The rated supply frequency of 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 controlled pressure systems

Subclause 4.10 of IEC 62271-1 is not applicable.

4.11 Rated filling levels for insulation and/or operation

Subclause 4.11 of IEC 62271-1 is applicable.

5 Design and construction

Clause 5 of IEC 62271-1 is not applicable, except as follows.

Any component which requires routine preventive maintenance or diagnostic testing shall be easily accessible.

GIL shall be designed so that normal service, inspection and maintenance operations can be carried out safely, including the checking of phase sequence after erection and extension.

The equipment shall be designed such that the mechanical stress caused by all relevant loads, for example thermal expansion, agreed permitted movement of foundations, external vibration, earthquakes, soil loading, wind and ice 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.

5.1 Requirements for liquids in GIL

Clause 5.1 of IEC 62271-1 is not applicable.

5.2 Requirements for gases in GIL

Subclause 5.2 of IEC 62271-1 is applicable.

In case a gas mixture is used, the manufacturer should provide information about the gas characteristics such as dielectric strength, mixing ratio, process of mixing and filling pressure.

NOTE See references [6], [7] and [8] in the Bibliography.

5.3 Earthing

Subclause 5.3 of IEC 62271-1 is applicable, except as follows.

5.3.101 Earthing of main circuits

To ensure safety during maintenance work all parts of the main circuits to which access is required or provided shall be capable of being earthed. In addition, it shall be possible, after the opening of the enclosure, to connect earth electrodes to the conductor for the duration of the work.

Earthing may be made by

- a) earthing switches with a making current capacity equal to the rated peak withstand current, if there is no certainty that the circuit connected is not live;
- b) earthing switches without a making current capacity or with a making capacity lower than the rated peak withstand current, if there is certainty that the circuit connected is not live;