

**High-voltage switchgear and controlgear -
Part 303: Use and handling of sulphur hexafluoride (SF₆)
(IEC/TR 62271-303:2008)**

Appareillage à haute tension -
Partie 303: Utilisation et manipulation
de l'hexafluorure de soufre (SF₆)
(CEI/TR 62271-303:2008)

Hochspannungs-Schaltgeräte
und -Schaltanlagen -
Teil 303: Gebrauch von und Umgang
mit Schwefelhexafluorid (SF₆)
(IEC/TR 62271-303:2008)

This Technical Report was approved by CENELEC on 2009-07-03.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

The text of the Technical Report IEC/TR 62271-303:2008, prepared by SC 17A, High-voltage switchgear and controlgear, of IEC TC 17, Switchgear and controlgear, was circulated for voting in accordance with the Internal Regulations, Part 2, Subclause 11.4.3.3 (simple majority) and was approved by CENELEC as CLC/TR 62271-303 on 2009-07-03.

Annex ZA has been added by CENELEC.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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.

NOTE Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60050-441	- 1)	International Electrotechnical Vocabulary (IEV) - Chapter 441: Switchgear, controlgear and fuses	-	-
IEC 60376	- 1)	Specification of technical grade sulfur hexafluoride (SF ₆) for use in electrical equipment	EN 60376	2005 2)
IEC 60480	- 1)	Guidelines for the checking and treat- ment of sulphur hexafluoride (SF ₆) taken from electrical equipment and specification for its re-use	EN 60480	2004 2)
IEC 62271-1	- 1)	High-voltage switchgear and controlgear - Part 1: Common specifications	EN 62271-1	2008 2)
IEC 62271-100	- 1)	High-voltage switchgear and controlgear - Part 100: Alternating current circuit-breakers	EN 62271-100	2009 2)

1) Undated reference.

2) Valid edition at time of issue.

TECHNICAL REPORT

RAPPORT TECHNIQUE

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CONTENTS

FOREWORD.....	5
INTRODUCTION.....	7
1 Scope.....	8
2 Normative references	8
3 Terms and definitions	8
4 Storage and transportation of SF ₆	11
4.1 Storage of containers filled with SF ₆	11
4.2 Transportation of containers filled with SF ₆	13
4.3 Storage and transportation of electric power equipment containing SF ₆	14
4.4 Responsibilities	14
5 Safety and first aid	14
5.1 General safety rules	14
5.1.1 Protection of personnel.....	15
5.1.2 Handling of contaminated safety equipment and tools	16
5.1.3 Pressurised equipment and tools or measuring devices	17
5.1.4 Personal safety and protective equipment	17
5.1.5 Facilities and services	18
5.2 Additional safety measures in case of abnormal release of SF ₆ due to external fire or internal arc fault.....	18
5.3 First aid equipment and treatment.....	19
5.3.1 Irritation of the skin.....	19
5.3.2 Irritation of the eyes.....	19
5.3.3 Breathing difficulty.....	20
6 Training and certification	20
6.1 General.....	20
6.2 Training modules.....	20
6.2.1 Module A – Awareness	21
6.2.2 Module B1 – Maintenance not implying gas recovery.....	21
6.2.3 Module B2 – Installation and commissioning.....	22
6.2.4 Module C1 – Maintenance implying gas recovery	22
6.2.5 Module C2 – Decommissioning of electric power equipment at the end-of-life	23
6.3 Certification.....	23
7 SF ₆ handling during installation and commissioning	23
7.1 Evacuation, filling and checking the SF ₆ quality after filling	23
7.2 Topping-up of SF ₆ pre-filled compartments to the rated pressure/density	25
7.3 Filling sealed pressure systems.....	27
8 SF ₆ handling during normal service life	27
8.1 Re-filling of SF ₆ to the nominal pressure/density	27
8.2 Checking the SF ₆ quality	28
8.2.1 Measurement of the SF ₆ quality with portable equipment.....	29
8.2.2 Sampling and shipment of SF ₆ for off-site analysis	29
9 SF ₆ recovering and reclaiming during maintenance.....	30
9.1 Recovery and reclaiming of SF ₆ from any compartment of controlled and/or closed pressure systems containing non-arc'd and/or normally arc'd SF ₆	30

9.2	Recovery and reclaiming from any compartment of controlled and/or closed pressure systems containing heavily arced SF ₆	32
10	Dismantling of SF ₆ electric power equipment at the end-of-life	34
10.1	End-of-life of controlled and/or closed pressure systems	35
10.2	End-of-life of sealed pressure systems	35
10.3	Recovery and reclaiming of SF ₆ at the end-of-life of sealed pressure systems	36
10.4	Dismantling of electric power equipment at the end-of-life	38
10.5	By-products at the end-of-life	39
11	Description of SF ₆ handling equipment.....	40
11.1	Reclaimer.....	40
11.1.1	External and internal pre-filters.....	41
11.1.2	Filters	41
11.1.3	Vacuum pump	42
11.1.4	Main and auxiliary compressors.....	43
11.1.5	External and internal gas storage containers	43
11.1.6	Evaporator and gas storage container heater	43
11.1.7	Gas piping and pipe junctions.....	43
11.1.8	Control instruments	43
11.1.9	Safety valves.....	44
11.2	Flexible hose connections	44
11.3	Portable devices for gas measurement.....	44
11.3.1	Dew point meter	44
11.3.2	SF ₆ percentage measuring device.....	45
11.3.3	Reaction tubes sensitive to SO ₂	45
11.3.4	Portable SF ₆ detectors	45
11.3.5	Alarm system SF ₆ detectors	46
11.4	Cylinder for gas samples	46
Annex A (informative)	Sulphur hexafluoride	47
Annex B (informative)	Environmental effects of SF ₆	51
Annex C (informative)	SF ₆ by-products	54
Annex D (informative)	Potential effects on health of SF ₆ by-products.....	57
Bibliography		76
Figure 1	– Commissioning or re-commissioning of SF ₆ compartments	24
Figure 2	– Topping-up of SF ₆ pre-filled compartments to the rated pressure/density	26
Figure 3	– SF ₆ re-filling to the nominal pressure/density	28
Figure 4	– Checking the SF ₆ quality on-site	29
Figure 5	– SF ₆ sampling and shipment	30
Figure 6	– Recovering and reclaiming from any compartment of controlled and/or closed pressure systems containing non-arced and/or normally arced SF ₆	31
Figure 7	– Recovering and reclaiming from any compartment of controlled and/or closed pressure systems containing heavily arced SF ₆	33
Figure 8	– End-of-life of controlled and/or closed pressure systems.....	35
Figure 9	– End-of-life of sealed pressure systems.....	36
Figure 10	– SF ₆ recovery and reclaiming at the end-of-life of sealed pressure systems	37
Figure 11	– Dismantling of electric power equipment	39
Figure 12	– General purpose reclaimer	41

Figure A.1 – Pressure/temperature/density characteristics for SF ₆ [9].....	48
Table 1 – Methods for storage of SF ₆	12
Table 2 – Container types and labelling required for storage and transportation of SF ₆	13
Table 3 – International regulations for shipment of SF ₆	14
Table 4 – Measures when working with SF ₆ electric power equipment	15
Table 5 – Safety measures when opening and/or accessing gas compartments	16
Table 6 – Neutralising solutions	17
Table 7 – Additional safety measures	19
Table 8 – Commissioning or re-commissioning of SF ₆ compartments.....	25
Table 9 – Topping-up of SF ₆ pre-filled compartments to the rated pressure/density	27
Table 10 – SF ₆ re-filling to the nominal pressure/density	28
Table 11 – Checking the SF ₆ quality on-site	29
Table 12 – SF ₆ sampling and shipment.....	30
Table 13 – Recovering and reclaiming from any compartment of controlled and/or closed pressure systems containing non-arc'd and/or normally arc'd SF ₆	32
Table 14 – Recovering and reclaiming from any compartment of controlled and/or closed pressure systems containing heavily arc'd SF ₆	34
Table 15 – SF ₆ recovery at the end-of-life of sealed pressure systems	38
Table 16 – Expected SF ₆ characteristics and quantity of by-products	40
Table 17 – Typical filter types used during SF ₆ reclaiming	42
Table 18 – Gas measuring devices	44
Table A.1 – Main chemical characteristics of SF ₆ [9].....	47
Table A.2 – Main physical characteristics of SF ₆ [9].....	49
Table A.3 – Main electrical characteristics of SF ₆ [9]	49
Table D.1 – TLVs for SOF ₂ , SO ₂ , HF, and S ₂ F ₁₀	60
Table D.2 – Results of example calculations for leakage situations.....	63
Table D.3 – Results for leakage situations taking account of SOF ₂ hydrolysis	64
Table D.4 – Sample calculation of S ₂ F ₁₀ concentration for partial discharges	65
Table D.5 – Sample calculation of S ₂ F ₁₀ concentration for corona discharges	66
Table D.6 – Sample calculation of S ₂ F ₁₀ concentration for disconnector sparking.....	67
Table D.7 – Sample calculation of SOF ₂ concentrations for internal fault situations	68
Table D.8 – Switchgear volume and filling pressure	71
Table D.9 – Arc energies for interruptions.....	72
Table D.10 – Arc energies for internal faults	72
Table D.11 – SOF ₂ production rates	73
Table D.12 – Quantities of SOF ₂ formed.....	73
Table D.13 – SF ₆ leakage rates	73
Table D.14 – SOF ₂ leakage rates	74

INTERNATIONAL ELECTROTECHNICAL COMMISSION

HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR –**Part 303: Use and handling of sulphur hexafluoride (SF₆)**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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IEC 62271-303, which is a technical report, has been prepared by subcommittee 17A: High-voltage switchgear and controlgear, of IEC technical committee 17: Switchgear and controlgear.

This first edition of IEC/TR 62271-303 cancels and replaces the first edition of IEC 61634 published in 1995. This edition constitutes a technical revision.

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

IEC 62271-303 is a major revision of the old IEC 61634. The former sections of IEC 61634 are removed and replaced by the chapters of the CIGRE brochure n. 276.

IEC 61634 was issued in 1995 when the focus was on safety. In 2008, safety is a very well known and established concept and the focus is nowadays on the environmental compatibility. SF₆ must be kept in a closed cycle and any intentional release must be forbidden. The implementation of the SF₆ reuse concept suggested in the CIGRE brochure was updated with the most recent information. Today SF₆ can be recovered and reclaimed for either being reused on-site or given back to the gas supplier and reused as raw material for the production of "technical grade SF₆". Detailed procedures for appropriate SF₆ handling are given together with the description of the state-of-the-art equipments and measuring devices.

More in detail, clause by clause:

- The former Section 1 was removed and replaced with Clause 1 "Scope", Clause 2 "Normative references" and Clause 3 "Terms and Definitions".
- Clause 4 "Storage and transportation of SF₆", Clause 5 "Safety and first aid", Clause 6 "Training and certification", and Clause 11 "Description of SF₆ handling equipment" were taken from the CIGRE brochure and their content was revised.
- Clause 7 "SF₆ handling during installation and commissioning", Clause 8 "SF₆ handling during normal service life", Clause 9 "SF₆ recovery and reclaiming during maintenance", and Clause 10 "Dismantling of SF₆ electric power equipment at the end-of-life" were taken from the CIGRE brochure, their content was revised and replaces the former sections 2, 3, 4, 5, and 6.
- The former Annexes A, B, C, and D were revised while the Annexes E and F were dropped. The Bibliography replaces the former Annex G.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
17A/813/DTR	17A/817/RVC

Full information on the voting for the approval of this technical report 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.

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

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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.

INTRODUCTION

SF₆ technology is used in switchgear and controlgear, for more than 30 years. Its application is mainly in electric power equipment for rated voltages exceeding 1 kV up to the highest rated voltages for which switchgear and controlgear are manufactured. It is estimated that several millions of the different types of SF₆-filled units are currently in service.

Three methods for gas containment are technically available, according to IEC 62271-1:

- controlled pressure system;

NOTE 1 Controlled pressure systems are no longer used for new equipment, because of the unacceptable leakage rate (see IEC 62271-203).

- closed pressure system: modern high-voltage electric power equipments. The standardized values for leakage rates are 0,5 % and 1 % per year and per gas-filled compartment;
- sealed pressure system: modern medium-voltage electric power equipments (commercially designated as “sealed for life products” or “hermetically sealed systems”). The tightness of sealed pressure systems is specified by their expected operating life. The expected operating life with regard to leakage performance is specified by the manufacturer. Preferred values are 20, 30 and 40 years.

NOTE 2 To fulfil the expected operating life requirement the leakage rate of the SF₆ sealed pressure systems is considered to be less than 0,1 % per year.

The long experience with the use of SF₆ in switchgear and controlgear evidences that a certain number of elementary precautions and procedures should be adopted in order to achieve operational, safety at work and environmental benefits such as:

- safe operation of the equipment;
- optimisation of resources and tools required;
- minimisation of out-of-service time for equipment;
- standard training of personnel handling SF₆;
- reduction of the amount of gas released during handling operations down to the functional physical limit;
- avoidance of any deliberate release, for example flushing to the atmosphere;
- reduction of SF₆ losses and emissions during commissioning, service, operation and end-of-life treatment to a minimum.

Recently, the latest practical recommendations on the use of SF₆ technology applied to switchgear and controlgear have been published by WG B3.02 of CIGRE Study Committee B3 [1]¹. This information is used to revise IEC 61634 into the present technical report.

¹ Figures in square brackets refer to the **Bibliography**.

HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 303: Use and handling of sulphur hexafluoride (SF₆)

1 Scope

The scope of this technical report is to address the procedures for safe and environmental compatible handling of SF₆ during installation, commissioning, normal and abnormal operations, disposal at the end-of-life of high-voltage switchgear and controlgear. Storage and transportation of SF₆ are also covered.

These procedures should be regarded as minimum requirements to ensure the safety of personnel working with SF₆ and to minimize the SF₆ emission to the environment.

This technical report generally applies also to gas mixtures containing SF₆.

NOTE 1 For the use of this technical report, the term “high voltage” (reference IEC 601-01-27) is the rated voltage above 1 000 V. However, the term “medium voltage” (reference IEC 601-01-28) is commonly used for distribution systems with voltages above 1 kV and generally applied up to and including 52 kV.

NOTE 2 Throughout this technical report, the term “electric power equipment” stands for “high-voltage and medium voltage switchgear and/or controlgear”.

2 Normative references

The following referenced documents are indispensable for the application of this technical report. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

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

IEC 60480, *Guidelines for the checking and treatment of sulphur hexafluoride (SF₆) taken from electrical equipment and specifications for its reuse*

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

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

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

NOTE There are many different types of electric power equipment which use SF₆ as a dielectric and/or arc-quenching medium.

3.1

abnormal release of sulphur hexafluoride (SF₆)

release from equipment in service due to a failure in the pressure system