SLOVENSKI STANDARD
SIST EN 50187:2023

01-januar-2023

Nadomešča:
SIST EN 50187:2001

Visokonapetostne stikalne in krmilne naprave - Plinske pregrade za stikalne in krmilne naprave z izmeničnim tokom z naznačeno napetostjo nad 1 kV do vključno 52 kV

High-voltage switchgear and controlgear - Gas-filled compartments of AC switchgear and controlgear with rated voltages above 1 kV up to and including 52 kV

Gasgefullte Schottraume für Wechselstrom-Schaltgerate und -Schaltanlagen mit Nennspannungen über 1 kV bis einschliel3lich 52 kV

Appareillage à haute tension - Compartiments sous pression de gaz pour appareillage à courant alternatif de tensions assignées supérieures à 1 kV et inférieures ou égales à 52 kV

Ta slovenski standard je istoveten z: **EN 50187:2022**

ICS:

29.130.99	Druge stikalne in krmilne naprave	Other switchgear and controlgear

SIST EN 50187:2023 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 50187

November 2022

ICS 29.130.99

Supersedes EN 50187:1996/corrigendum Sep. 1996;
EN 50187:1996

English Version

High-voltage switchgear and controlgear - Gas-filled compartments of AC switchgear and controlgear with rated voltages above 1 kV up to and including 52 kV

Appareillage à haute tension - Compartiments sous pression de gaz pour appareillage à courant alternatif de tensions assignées supérieures à 1 kV et inférieures ou égales à 52 kV

Hochspannungs-Schaltgeräte und -Schaltanlagen - Gasgefüllte Schotträume für Wechselstrom-Schaltgeräte und -Schaltanlagen mit Bemessungsspannungen über 1 kV bis einschließlich 52 kV

This European Standard was approved by CENELEC on 2022-10-03. 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 CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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

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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Ref. No. EN 50187:2022 E

Contents

Page

European foreword

This document (EN 50187:2022) has been prepared by CLC/TC17AC “High-voltage switchgear and controlgear”.

The following dates are fixed:

- latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2023-10-03
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2025-10-03

This document supersedes EN 50187:1996 and all its amendments and corrigenda (if any).

This edition includes the following significant technical changes with respect to EN 50187:1996:

- Consistency with EN IEC 62271-200:2021;
- Added references to quality standards for welding;
- Added Clause 10 on transport;
- Removal of the limitation on maximum product pressure x volume of 2 000 bar litres in the scope;
- Removal of the 300 kPa design pressure limitation;
- Extend scope to non-corrosive gases and gas mixtures in the conditions that prevail inside.

The present document has been established as an international specification for the design, construction, testing and certification of pressurized compartments used in high-voltage switchgear and controlgear for rated voltage above 1kV and up to and including 52kV regarding safety aspects.

In this respect, this document constitutes the exclusion of HV switchgear and controlgear from the scope of the Directive 2014/68/EU (superseding 97/23/EC) concerning pressure equipment. Article 1, 2. (l) excludes “compartments for high-voltage electrical equipment such as switchgear, controlgear, transformers, and rotating machines” from the scope of the Directive.

This document supplements the general specifications given in EN IEC 62271-200:2021 in that it provides specific requirements for pressurized gas-filled compartments of high-voltage switchgear and controlgear for rated voltage above 1kV and up to and including 52kV.

Due to compartment geometries that are determined by electrical requirements and by installation conditions, validation of the design requires physical proof testing. Common pressure vessel geometries and their calculation codes mostly cannot be applied.

National deviations from this document are listed in Annex A (informative).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

Any feedback and questions on this document should be directed to the users’ national committee. A complete listing of these bodies can be found on the CENELEC website.

Introduction

This document covers the requirements for the design, construction, testing, transportation, inspection and certification (for filling pressure above 50 kPa relative) of gas-filled compartments, for use in AC switchgear and controlgear for rated voltage above 1 kV and up to and including 52 kV or for associated gas-filled equipment. Special consideration is given to these compartments for the following reasons:

a) The compartments form the containment of electrical equipment; thus, their shape is determined by electrical rather than mechanical requirements.

b) The compartments are part of equipment installed in public or restricted areas, but the equipment is operated by instructed authorized persons only.

c) Compartments are filled with a thoroughly dried gas or gas mixture that is stable and non-corrosive in the conditions that prevail inside the compartment. For this reason, no internal corrosion allowance is required on the wall thickness of these compartments.

d) The compartments are subjected to only small fluctuations of pressure as the gas-filling density will be maintained within close product related limitations to ensure satisfactory insulating and arc-quenching properties. Therefore, the compartments are not liable to fatigue due to pressure cycling.

e) The design pressure is below 500 kPa (rel.).

Due to the foregoing reasons and to ensure the maximum service continuity as well as to reduce the risk of moisture and dust entering the compartments which could endanger safe electrical operation of the switchgear and controlgear, no pressure tests should be carried out after installation and before placing in service and no periodic inspection of the compartment interiors or pressure tests should be carried out after the equipment is placed in service.

Examples of gases and gas mixtures which have been applied or proposed to be applied in high-voltage gas-filled switchgear and controlgear for rated voltage above 1 kV and up to and including 52 kV are mentioned in IEC 62271-4.

It is possible to apply this document to both other gases and gas mixtures based - or not - on those mentioned above which comply with the condition c) above.

In this document, the term pressure is referring to the relative pressure unless otherwise specified.

1 Scope

This document applies to pressurized gas-filled compartments of AC switchgear and controlgear with rated voltages above 1 kV and up to and including 52 kV for indoor or outdoor installations, where the gas or gas mixture is being used principally for its dielectric and/or arc-quenching properties and where the gases or gas mixtures in the compartment can be considered in conditions being chemically stable over its lifetime and non-corrosive to the material of the pressurized compartment in the conditions that prevail inside.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 62271-1:2017, *High-voltage switchgear and controlgear — Part 1: Common specifications for alternating current switchgear and controlgear*

EN ISO 3834 (all parts), *Quality requirements for fusion welding of metallic materials (ISO 3834)*

EN ISO 5817, *Welding — Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) — Quality levels for imperfections (ISO 5817)*

EN ISO 9606 (all parts), *Qualification testing of welders — Fusion welding (ISO 9606)*

EN ISO 14732, *Welding personnel — Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials (ISO 14732)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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 https://www.electropedia.org/

3.1
(gas-filled) compartment
high-voltage compartment in which the insulating gas is at a pressure greater than the pressure outside such compartment

3.2
manufacturer
individual or body finally responsible for designing and producing the compartment

Note 1 to entry: In this document, this is the switchgear and controlgear manufacturer, even when the compartment is produced by a sub-manufacturer.

3.3
design pressure (of a compartment)
upper limit of the relative pressure between the pressure inside a compartment at the design temperature, under defined installation and operating conditions, and the pressure outside that compartment, that is used to determine the design of the compartment

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

Note 2 to entry: Design pressure includes the total cumulative pressure increase from gas decomposition by the arc along lifetime which can happen during normal operation of the switching devices installed inside the gas-filled compartment, for which they are rated.

Note 3 to entry: This term is equivalent to the “maximum allowable pressure PS” as defined in Directive 2014/68/EU.

3.4
design temperature (of a compartment)
highest average temperature over the compartment, which can be reached by the gas under service conditions as defined by the manufacturer

Note 1 to entry: Solar radiation should be considered when it has a significant effect on the temperature of the gas and on the mechanical properties of materials. Similarly, the effects of low temperatures on the properties of materials should be considered.

Note 2 to entry: This term is equivalent to the “maximum allowable temperature TS” as defined in Directive 2014/68/EU.

3.5
filling pressure (of a compartment)
pressure in kPa (relative) assigned by the manufacturer referred to atmospheric air conditions of 20 °C and 1 013 hPa at which the gas-filled compartment is filled before being put into service

Note 1 to entry: Complete gas filling is done during manufacturing or at the installation site.

3.6
bursting disc safety device
non-reclosing pressure relief device actuated by differential pressure and designed to function by the bursting of the bursting disc(s), and which is the complete assembly of installed components including, where appropriate, the bursting disc holder

Note 1 to entry: The term pressure relief device is defined in 3.5.115 of EN IEC 62271-200:2021.

[SOURCE: ISO 4126-2:2018, 3.1, modified – Note 1 to entry added]

3.7
pressure relief safety device
gas tight non-reclosing pressure relief device actuated by differential pressure and designed to open once at a specified opening pressure, and which is the complete assembly of components including, where appropriate, the sealing element(s), the pressure-sensitive element(s), the covering element and the holder

Note 1 to entry: The term pressure relief device is defined in 3.5.115 of EN IEC 62271-200:2021.

Note 2 to entry: Bursting disc safety device is just one kind of pressure relief safety device.

3.8
spring loaded safety valve
self-closing safety valve which is closed by a spring

Note 1 to entry: These safety valves are part of the gas handling equipment and not of the switchgear and controlgear itself.

3.9
integrated pressure relief device
safety device which consists of intentionally weakened integral parts or areas of the compartment with the functionality of a bursting disc

4 Normal and special service conditions

Unless otherwise specified in this document, the pressurized compartments of high-voltage switchgear and controlgear are designed to be used under normal service conditions according to 4.1 of EN 62271-1:2017.

For pressurized compartments of high-voltage switchgear and controlgear intended to be used in special service conditions, 4.2 of EN 62271-1:2017 is applicable.

5 Design and construction

5.1 General

Design of gas-filled compartments for high-voltage switchgear and controlgear prescribed in this clause considers that the compartments are subjected to particular operating conditions (see introduction) which distinguishes them from parts for compressed air receivers and similar storage vessels.

5.2 Materials

Any suitable materials or combination of materials may be used for the manufacturing of compartments. Typical examples are:

- Wrought mild steel;
- Wrought austenitic stainless steel;
- Wrought aluminium;
- Cast aluminium;
- Cast resin.

The properties of the materials should be taken from the applicable standards.

The material properties should be provided either by information from the supplier or tests carried out by the switchgear and controlgear manufacturer.

5.3 Corrosion allowance

Compartments are filled with a thoroughly dried gas or gas mixture that is stable and non-corrosive in the conditions that prevail inside the compartment. For this reason, no internal corrosion allowance is required on the wall thickness of these compartments.

5.4 Manholes and inspection openings

No manholes or inspection openings are necessary for inspection of the condition of the compartment.

5.5 Design pressure

The design is based on the design pressure as defined in 3.3.

5.6 Design temperature

The selection of material and the determination of the design stress depend upon the highest wall temperature which can be expected during service. Thus, the design of a compartment is based on the design temperature as defined in 3.4.

5.7 Design of compartments

5.7.1 General

The geometry of a compartment can be determined by electrical rather than mechanical considerations. This constraint can result in a compartment geometry which requires an unacceptable degree of calculation or which cannot be calculated at all. In such a case, a test in accordance with 8.1 is sufficient to verify the design of the pressurized compartment against pressure increase with a safety margin.

When designing a compartment, account shall be taken of the following, if applicable:

a) The possible evacuation of the compartments as part of the filling process;

   For compartments of this type it can be necessary to evacuate the air before introducing gas pressure, this ensures purity of the gas. However, the evacuated condition is not an operational condition, and, in most cases, compartments are evacuated inside an evacuation chamber with compensated pressure to reduce the stress and possible damages to the compartment.

b) The resulting pressure in the event of an accidental leak between compartments having different pressures;

c) The full differential pressure possible across the compartment wall;

d) Superimposed loads and vibrations by external effects;

e) Stresses caused by temperature differences including transient conditions and by differences in coefficients of thermal expansion;

f) Effects of solar radiation, when applicable;

g) Dynamic stress due to short-circuit current.

5.7.2 Calculation methods

Because of the various shapes, sizes, and materials used it is not possible to design such compartments using analytical calculations from conventional pressure vessel codes. However, it is possible to use numerical calculation tools to estimate stress and deformations using design pressure and the design temperature as defined in 3.3 and 3.4.

The nominal design strength should be selected from the material standards or according to validated material test. The nominal design strength of the annealed material without heat treatment should be used in areas of mechanical prestress and of heat affected welds.

Design stresses can be established either by calculation and/or pressure tests, where elastic and permanent plastic deformations or tensile stresses are measured at several locations of the compartment in order to verify the calculation and/or the design.

The permissible design stress (f_a) at the design pressure and at the design temperature including the safety factor of the appropriate equations is given by:

$$f_a = R_m / 3{,}0$$

where

R_m is minimum tensile strength of the material at the design temperature taken from the material standard;

3,0 is the safety factor.

The calculation may be made on different values of tensile strength if the values are guaranteed by a material certification (metal sheet) or by quality control and testing for moulded pieces, e.g. cast resin composite.