



# SLOVENSKI STANDARD

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**Visokonapetostne stikalne in krmilne naprave - S plinom polnjena ohišja iz gnetljivega jekla**

High-voltage switchgear and controlgear - Gas-filled wrought steel enclosures

Hochspannungs-Schaltgeräte und Schaltanlagen - Gasgefüllte Kapselungen aus Schmiedestahl

Appareillage électrique haute tension - Enveloppes sous pression en acier corroyé et en alliage d'acier

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EUROPEAN STANDARD

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## High-Voltage Switchgear and Controlgear - Gas-filled wrought steel enclosures

Appareillage électrique haute tension - Enveloppes sous pression en acier corroyé et en alliage d'acier

Hochspannungs-Schaltgeräte und Schaltanlagen - Gasgefüllte Kapselungen aus Schmiedestahl

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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.

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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**

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## European foreword

This document (EN 50068:2018) has been prepared by CLC/TC 17AC, “*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) 2019-08-27
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2021-08-27

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.

This document supersedes EN 50068:1991, EN 50068:1991/corrigendum Aug. 2007 and EN 50068:1991/A1:1993.

This document has been revised by CENELEC Technical Committee 17AC “High-voltage switchgear and controlgear”. It supplements the relevant product standards on gas-insulated switchgear and controlgear in that it provides specific requirements for pressurized high-voltage switchgear and controlgear.

The present document has been written to get a European specification for the design, construction, testing, inspection and certification of pressurized enclosures used in high-voltage switchgear and controlgear.

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

This document deals with gas-insulated switchgear enclosures of wrought steel and their welding. For different enclosure materials, other European Standards are available.

## Introduction

This document covers the requirements for the design, construction, testing, inspection and certification of gas-filled enclosures for use specifically in high-voltage switchgear and controlgear, or for associated gas-filled equipment.

Special consideration is given to these enclosures for the following reasons.

- (a) The enclosures usually form the containment of electrical equipment, thus their shape is determined by electrical rather than mechanical requirements.
- (b) The enclosures are installed in restricted access areas and the equipment is operated by instructed, authorized persons only.
- (c) As the thorough drying of the inert, non-corrosive gas-filling medium is fundamental to the satisfactory operation of the electrical equipment, the gas is periodically checked. For this reason, no internal corrosion allowance is required on the wall thickness of these enclosures.
- (d) The enclosures are subjected to only small fluctuations of pressure as the gas-filling density will be maintained within close limits to ensure satisfactory insulating and arc-quenching properties. Therefore, the enclosures are not liable to fatigue due to pressure cycling.
- (e) The operating pressure is relatively low.

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

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## 1 Scope

This document applies to wrought steel enclosures and their welding. These enclosures are pressurized with dry air, inert gases, for example sulphur hexafluoride or nitrogen or a mixture of such gases, used in indoor and outdoor installations of high-voltage switchgear and controlgear with rated voltages above 1kV, where the gas is used principally for its dielectric and/or arc-quenching properties with rated voltages:

- above 1 kV and up to and including 52 kV concerning gas-filled compartments with design pressure higher than 300 kPa relative pressure (gauge);
- above 52 kV concerning all gas-filled compartments.

The enclosures comprise parts of electrical equipment not necessarily limited to the following examples:

- circuit-breakers;
- switch-disconnectors;
- disconnectors;
- earthing switches;
- current transformers;
- voltage transformers;
- surge arrestors;
- busbars and connections;
- etc.

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The scope also covers enclosures of pressurized components such as the centre chamber of live tank switchgear, gas-insulated current transformers, etc.

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## 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 13445-2:2014, *Unfired pressure vessels — Part 2: Materials*

EN 13445-3, *Unfired pressure vessels — Part 3: Design*

EN ISO 15614-1, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys (ISO 15614-1)*

EN ISO 17636 (all parts), *Non-destructive testing of welds — Radiographic testing (ISO 17636)*

EN ISO 17640, *Non-destructive testing of welds — Ultrasonic testing — Techniques, testing levels, and assessment (ISO 17640)*

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

EN ISO 898-1:2013, *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 1: Bolts, screws and studs with specified property classes — Coarse thread and fine pitch thread (ISO 898-1:2013)*

EN ISO 898-2:2012, *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 2: Nuts with specified property classes — Coarse thread and fine pitch thread (ISO 898-2:2012)*



EN ISO 3452 (all parts), *Non-destructive testing — Penetrant testing (ISO 3452)*

EN ISO 9606-1, *Qualification testing of welders — Fusion welding — Part 1: Steels (ISO 9606-1)*

EN ISO 9712, *Non-destructive testing — Qualification and certification of NDT personnel (ISO 9712)*

### 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:

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

#### 3.1

##### **enclosure**

part of gas-insulated metal-enclosed switchgear 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

#### 3.2

##### **manufacturer**

organization that is responsible for the design of the enclosure and the production of the gas-insulated switchgear. In this standard this is the switchgear manufacturer

#### 3.3

##### **design pressure**

pressure, expressed in relative terms (gauge), used to determine the thickness of the enclosure

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

#### 3.4

##### **design temperature**

##### **design temperature of an enclosure**

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

Note 1 to entry: This is generally the upper limit of ambient air temperature increased by the temperature rise due to the flow of rated normal current.

Note 2 to entry: Solar radiation should be taken into account 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 some materials should be considered.

[SOURCE: EN 62271-203:2012, 3.112, modified – Note 1 to entry and Note 2 to entry have been added]

#### 3.5

##### **design stress**

maximum permissible stress on the enclosure imposed by conditions of operation, environment or test that determine the (material) characteristics of an enclosure

#### 3.6

##### **normal load**

load whose occurrence and level can be planned or predicted

#### 3.7

##### **exceptional load**

load whose probability of occurrence during the lifetime of product is very small or accidental

**EN 50068:2018 (E)****3.8****alloy**

substance having metallic properties and composed of two or more elements so combined that they cannot readily be separated by physical means

[SOURCE: EN 12258-1:2012, 2.2.1]

**3.9****weld defect**

imperfections in metallic fusion welds

**3.9.1****lack of fusion**

lack of union between the weld metal and the parent material or between the successive layers of weld metal

[SOURCE: EN ISO 6520-1:2007, Reference No. 401]

**3.9.2****overlap**

excessive weld metal covering the parent material surface but not fused to it

[SOURCE: EN ISO 6520-1:2007, Reference No. 506]

**3.9.3****undercut**

irregular groove at a toe of a run in the parent material or in previously deposited weld metal

[SOURCE: EN ISO 6520-1:2007, Reference No. 5011]

**3.9.4****hot crack****hot tear**

crack formed in a cast metal or in a welding because of internal stress developed upon cooling at the solidus temperature or slightly above

[SOURCE: EN 12258-1:2012, 5.2.8]

**3.9.5****inclusion**

extraneous material accidentally entrapped into the liquid metal during melting or melt treatment or entrapped into the metal surface during hot or cold working

[SOURCE: EN 12258-1:2012, 5.5.7]

**3.9.6****blister**

raised spot whose inside is hollow, that forms on the surface of products and is caused by the penetration of a gas into a subsurface zone typically during thermal treatment

[SOURCE: EN 12258-1:2012, 5.5.10]

Note 1 to entry: A void resulting from a blister that has ruptured is often termed "blow hole".

**3.10****thermal treatment**

heating, holding at elevated temperature and cooling of the solid metal in such a way as to obtain desired metallurgical structure or properties

[SOURCE: EN 12258-1:2012, 3.6.1]

Note 1 to entry: The term “heat treatment” is used for the same concept as a synonym.

**3.11****ductility**

ability of a material to deform plastically before fracturing

[SOURCE: EN 12258-1:2012, 4.3.15]

**3.12****fatigue**

tendency for a metal to break under conditions of repeated cyclic stressing considerably below the tensile strength

[SOURCE: EN 12258-1:2012, 4.3.23, modified – Note 1 to entry has been removed]

**3.13****tensile strength**

ratio of maximum load before rupture in a tensile test to original cross-sectional area

[SOURCE: EN 12258-1:2012, 4.3.3, modified – Note 1 to entry has been removed]

**3.14****yield stress**

stress necessary to produce a defined small plastic deformation in a material under uniaxial tensile or compressive load

[SOURCE: EN 12258-1:2012, 4.3.4, modified]

**3.15****test piece**

two or more parts of material welded together in accordance with a specified weld procedure, in order to make one or more test specimens

**3.16****test specimen**

portion detached from a test piece, in specified dimensions, finally prepared as required for testing

**4 Quality assurance**

It is the intention of this document that the switchgear manufacturer shall be responsible for achieving and maintaining a consistent and adequate quality of the product.

Sufficient examinations shall be made by the enclosure manufacturer to ensure that the materials, production and testing comply in all respects with the requirements of this document.

Inspection by the user`s inspectors shall not absolve the switchgear manufacturer from his responsibility to exercise such quality assurance procedures as to ensure that the requirements and the intent of this document are satisfied.

**5 Normal and special service conditions**

Clause 2 of EN 62271-1:2017 is applicable.