SLOVENSKI STANDARD
SIST EN 50064:2019

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Nadomešča:
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Visokonapetostne stikalne in krmilne naprave - S plinom polnjena ohišja iz gnetljivega aluminija in aluminijevih zlitin

High-voltage switchgear and controlgear - Gas-filled wrought aluminium and aluminium alloy enclosures

Hochspannungs-Schaltgeräte und Schaltanlagen - Gasgefüllte Kapselungen aus Aluminium und Aluminium-Knetlegierungen

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

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High-voltage switchgear and controlgear - Gas-filled wrought aluminium and aluminium alloy enclosures

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European foreword

This document (EN 50064:2018) 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• latest date by which the national standards conflicting with this document have to be withdrawn	(dow)	2021-08-27

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This document supersedes EN 50064:1989.

This European Standard 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 EN 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 European Standard 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 standard deals with gas-insulated switchgear enclosures of wrought aluminium and aluminium alloy and their welding. For different enclosure materials, other European Standards are available.

Introduction

This standard 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 may 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.

1 Scope

This document applies to wrought aluminium and aluminium alloy 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 1 kV, 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.

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

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

EN 13445-8:2014, *Unfired pressure vessels — Part 8: Additional requirements for pressure vessels of aluminium and aluminium alloys*

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

EN ISO 898 (all parts), *Mechanical properties of fasteners made of carbon steel and alloy steel (ISO 898)*

EN ISO 9606-2, *Qualification test of welders — Fusion welding — Part 2: Aluminium and aluminium alloys (ISO 9606-2)*

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

EN ISO 15614-2, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 2: Arc welding of aluminium and its alloys (ISO 15614-2)*

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)*

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

Note 1 to entry: 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 (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

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
aluminium alloy
metallic substance in which aluminium predominates by mass and the other elements exceed 1% of the total content by weight

3.10
weld defect
imperfections in metallic fusion welds

3.10.1
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]

3.10.2
overlap
excessive weld metal covering the parent material surface but not fused to it

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

3.10.3
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]

3.10.4
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]

3.10.5
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]

3.10.6
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 blister that has ruptured is often termed “blow hole”.

3.11
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.

3.12
ductility
ability of a material to deform plastically before fracturing

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

3.13
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]

3.14
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]

3.15
yield strength
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]

3.16
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

3.17
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 standard 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 standard.

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 standard are satisfied.

5 Normal and special service conditions

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

6 Materials

6.1 Selection of material

Any aluminium or aluminium alloy is permissible. A list of recommended materials is given in Table 1 based on information from EN 13445-8:2014.

The elongation after fraction of any aluminium or aluminium alloy shall comply with EN 13445-8:2014, 5.2.

NOTE Contact with more noble metals, particularly copper and its alloys, can lead to heavy galvanic corrosion. Austenitic stainless steel is an exception to this rule because of its protective oxide film and can often be used in contact with aluminium.

Aluminium enclosures should be protected externally where, for example, they come into contact with mild steel supports.

Bitumen, thin zinc sheet (which gives sacrificial protection) or a combination of these are useful in this respect. Alternatively, the mild steel supports can be galvanized or zinc or aluminium sprayed.

It should be noted that contact with certain gasket materials can cause corrosion of aluminium. The gasket manufacturer should be consulted.

Table 1 — List of recommended aluminium alloys [1]

Group	Sub Group	Type of aluminium and aluminium alloys	Designation		
			EN AW number	Chemical symbol	Temper
22	Non heat treatable alloys				
	22.1	Aluminium-manganese alloys	EN AW — 3003 EN AW — 3103 EN AW — 3105	EN AW-Al Mn1Cu EN AW-Al Mn1 EN AW-Al Mn0,5Mg0,5	O, H111, H112 O, H111, H112 O, H111
	22.2	Aluminium-magnesium alloys with Mg ≤ 1,5 %	EN AW — 5005 EN AW — 5005A EN AW — 5050	EN AW-Al Mg1(B) EN AW-Al Mg1(C) EN AW-Al Mg1,5(C)	O, H111, H112 O, H111, H112 O, H111
	22.3	Aluminium-magnesium alloys with 1,5 % < Mg ≤ 3,5 %	EN AW — 5049 EN AW — 5052 EN AW — 5154A EN AW — 5251 EN AW — 5454 EN AW — 5754	EN AW-Al Mg2Mn0,8 EN AW-Al Mg2,5 EN AW-Al Mg3,5(A) EN AW-Al Mg2 EN AW-Al Mg3Mn(A) EN AW-Al Mg3	O, H111, H112 O, H111, H112 O, H111, H112 O, H111, H112 O, H111, H112 O, H111, H112
	22.4	Aluminium-magnesium alloys with Mg > 3,5 %	EN AW — 5083 EN AW — 5086	EN AW-Al Mg4,5Mn0,7 EN AW-Al Mg4	O, H111, H112 O, H111
23	Heat treatable alloys				
	23.1	Aluminium-magnesium-silicon alloys	EN AW — 6060 EN AW — 6061 EN AW — 6082	EN AW-Al MgSi EN AW-Al Mg1SiCu EN AW-Al Si1MgMn	T4 [a] T4 [b], T6 [c] T4 [b], T6 [c]

[a] For profiles only.
[b] For seamless pipes and flanges only.
[c] For flanges only.