SLOVENSKI STANDARD
SIST EN 50069:1998

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Welded composite enclosures of cast and wrought aluminium alloys for gas-filled high-voltage switchgear and controlgear

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Geschweißte Kapselungen von Teilen aus Leichtmetallguß und Aluminium-Knetlegierungen für gasgefüllte Hochspannungs-Schaltgeräte und -Schaltanlagen

Enveloppes soudées en alliage d'aluminium comportant des parties moulées et des parties en métal corroyé pour l'appareillage à haute tension sous pression de gaz

Ta slovenski standard je istoveten z: **EN 50069:1991**

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ENGLISH VERSION

WELDED COMPOSITE ENCLOSURES OF CAST AND WROUGHT ALUMINIUM ALLOYS FOR GAS-FILLED HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR

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This European Standard was approved by CENELEC on 1990-03-05. 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 list and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat 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 Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

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

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FOREWORD

At the request of CENELEC technical committee TC 17C, the text of the draft EN 50069 prepared by TC 17C, was submitted to the Unique Acceptance Procedure (UAP).

The text of the draft was approved by all CENELEC members with the exception of Austria and Sweden as EN 50069 on 5 March 1990.

The following dates were fixed:

- latest date of publication of an identical national standard (dop) 1991-06-01
- latest date of withdrawal of conflicting national standards (dow) 1991-06-01

For products which have complied with the relevant national standard before 1991-06-01, as shown by the manufacturer or by a certification body, this previous standard may continue to apply for production until 1996-06-01.

This document forms a supplement to EN 50 052 (1986): "Cast aluminium alloy enclosures for gas-filled high-voltage switchgear and controlgear" and EN 50 064 (1989): "Wrought aluminium and aluminium alloy enclosures for gas-filled high-voltage switchgear and controlgear", concerning welded enclosures for the same type of switchgear and controlgear but composed of parts made of cast and wrought aluminium alloys. It is based on the general specifications given in HD 358 S2 (IEC 517 (1986) ed 2) which are however not sufficient to satisfy the conditions for the service allowance of pressurized high-voltage switchgear and controlgear.

These specifications are appropriate for pressurized switchgear enclosures allowing an economic production without sacrificing aspects of safety. For unusual shapes dictated by electrical conditions they permit the verification of sound design by proof tests instead of calculations. Nevertheless this European Standard makes use of many internationally well acknowledged calculation rules and the Technical Committee will in addition pursue the progress in standardization in CEN/TC 121 and ISO/TC 44 on welding and allied processes.

For the time being reference can only be made to published international standards as far as they are appropriate for the purpose of production of enclosures to be used in gas-filled switchgear and controlgear.

The present EN has been established as an international specification for the design, construction, testing, inspection and certification of pressurized enclosures used in high-voltage switchgear and controlgear. This standard follows to that extent also Article 2 of the Directive 76/767/EEC.

The European Standard contains one informative annex:
"National Deviations"

List of standards referred to in this standard:

HD 358 S2 (IEC 517 (1986) ed 2)	Gas-insulated metal-enclosed switchgear for rated voltages of 72,5 kV and above.
ISO 6213:1983	Welding; Items to be considered to ensure quality in welding structures.
ISO 9000:1987	Guidelines for selection and use of the standards on quality management, quality system elements and quality assurance.
ISO/IEC Guide 2: 1986	General terms and their definitions concerning standardization and related activities.
ISO 6520:1982	Classification of imperfections in metallic fusion welds, with explanations.
ISO 3134:1985	Light metals and their alloys; Terms and definitions.

C O N T E N T S

1. 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 considerations.

(b) The enclosures are installed in restricted access areas and the equipment is operated by experts and instructed 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 it is periodically checked. For this reason, no internal corrosion allowance is required on the wall thickness of these enclo-

(d) The enclosures are subjected to only small fluctuations of pressure as the gas-filling density shall 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.

For the foregoing reasons, and to ensure the minimum disturbance hence reducing the risk of moisture and dust entering the enclosures which would prevent correct electrical operation of the switchgear, no pressure tests shall be carried out after installation and before placing in service and no periodic inspection of the enclosure interiors or pressure tests shall be carried out after the equipment is placed in service.

2. Scope and field of application

2.1 Type of equipment

This standard applies to welded composite enclosures of cast and wrought aluminium and aluminium alloy enclosures pressurized with dry air, inert gases, for example sulphur hexafluoride or nitrogen or a mixture of such gases, used in indoor or outdoor installations of high-voltage switchgear and controlgear with rated voltages of 72,5 kV and above, where the gas is used principally for its dielectric and/or arc-quenching properties.

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

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

2.2 Production

The production of the enclosures shall be in accordance with documented welding procedures which shall be carried out by well trained and supervised welding personnel. Where International Standards (ISO or CEN) are not available, National Standards may be used.

NOTE
This standard will be revised as soon as possible when ISO or CEN standards covering the various aspects are available.

2.3 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 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 and ISO 6213:1983. 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.

NOTE
Reference should be made to the ISO 9000 series of standards for quality assurance systems.

3. Definitions

3.1 National Standard

A technical specification established by general agreement with the important part of the concerned interests, approved by a recognized national standards organization and made available to the public. (ISO/IEC Guide 2:1986)

3.2 Enclosure

A 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. HD 358 S2 (IEC 517 (1989) ed 2).

3.3 Manufacturer

Individual or body responsible for designing and producing the

enclosure. In this standard this is the switchgear manufacturer.

3.4 Designer

Individual or body who determines the shape, dimensions and wall thickness of the enclosure and selects the materials and method of construction and testing.

3.5 Founder

Individual or body who produces the raw casting.

3.6 Design pressure (of an enclosure)

Pressure used to determine the wall thickness of the enclosure. It is at least the upper limit of pressure reached within the enclosure at the design temperature. HD 358 S2 (IEC 517 (1989) ed 2).

3.7 Design temperature (of an enclosure)

Highest temperature reached by the enclosure which can occur under service conditions. This is generally the upper limit of ambient air temperature increased by the temperature rise due to the flow of rated normal current. HD 358 S2 (IEC 517 (1989) ed 2).

NOTE
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 some materials. Similarly the effects of low temperatures on the properties of some materials should be considered.

3.8 Casting

A general term for products at or near finished shape, formed by solidification of a metal or alloy in a mould. ISO 3134/4:1985.

3.9 Alloy

A metallic substance consisting of a mixture of the basic metallic element (the element predominating by mass) and other elements such as alloying elements and impurities. ISO 3134/1:1985.

3.10 Aluminium alloy

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

3.11 Cast and weld imperfections

3.11.1 Gas cavity

A cavity formed by entrapped gas. ISO 6520:1982, No. 201.

3.11.2 Shrinkage cavity

A cavity due to shrinkage during solidification. ISO 6520:1982, No. 202.

3.11.3 Solid inclusion

Solid foreign substances entrapped in the cast or weld metal. ISO 6520:1982, No. 300.

3.11.4 Lack of fusion

Lack of union between weld metal and parent metal or weld metal and weld metal. ISO 6520:1982, No. 401.

3.11.5 Lack of penetration

Lack of fusion between parent metal and parent metal due to failure of weld metal to extend into the root of the joint. ISO 6520:1982, No. 402.

3.11.6 Imperfect shape

Imperfect shape of the external surfaces of the weld or defective joint geometry. ISO 6520:1982, No. 500.

3.11.7 Cracks

A discontinuity produced by a local rupture which may arise from the effect of cooling or stresses. ISO 6520:1982, No. 100.

3.12 Heat treatment

Process in which the metal or the alloy in the solid state is subjected to one or more temperature cycles, to confer certain desired properties.

3.13 Tensile strength

The maximum unit stress related to the initial cross-section of the test specimen at which the material ruptures.

3.14 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.

3.15 Test specimen

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

4. Materials

Any suitable aluminium or aluminium alloy is permissible; a list of examples of cast materials is given in table 1 and a list of examples for wrought aluminium is given in table 2. The properties of the materials should be taken from the applicable standards.

NOTE 1
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.

5. Design

5.1 General

The rules for the design of enclosures of gas-insulated switchgear and controlgear prescribed in this clause are solely for the purpose of determining the dimensions and the minimum thickness to ensure safety of the enclosures.

The rules take into account that these enclosures are subjected to particular operating conditions (see clause 1) which distinguish them from conventional compressed air receivers and similar storage vessels.

The thicknesses determined by the various equations are minima and therefore, the specific nominal thickness shall be increased by the amount of any negative tolerance permitted by the material specification.

NOTE
There are designs of enclosures which differ in geometry from those for which equations are given. These designs are permitted provided the calculation is justified or proof tests are carried out as prescribed in 7.5.3.

A Ö-NORM M 3429	CH VSM 10895	D DIN 1725 Teil 2	F NF A 57 — 702	I UNI 3059	S SS	UK BS 1490	USA AA	 ASTM	E UNE 38.201
G — Al Si 7 Mg (wa) (ta)	G — Al Si 7 Mg (wa) (ta)	G — Al Si 7 Mg (wa)	A-S7G03-Y.. A-S7G06-Y..	3599 7257-73	14 4244-04 14 4245-04	LM 25 (M) (TE) (TB7) (TF)	A 356	SG70B	38.267 L-2651
G — Al Si 9 Mg (wa)	G — Al Si 9 Mg (wa)	G — Al Si 9 Mg (wa)							
G — Al Si 10 Mg (wa) (ta)	G — Al Si 10 Mg (wa)	G — Al Si 10 Mg (wa)	A-S10-Y..	3049*) 3051	14 4253-04	LM 9 (M) *) (TE) (TF)			38.256 L-2560
G — Al Si 12							A 357		
	G — Al Si 13		A-S13-Y..	4514	14 4255-03 14 4261-03	LM 6 (M)	A 13	S 12A	38.252 L-2520
	G — Al Cu 4 Ti Mg (ka) (wa) (ta)	G — Al Cu 4 Ti Mg (ka) (wa)	A-U5GT-Y..				204		38.214 L-2140

* Equivalence only approximate!

Note: The materials can be used in any condition; care should be taken, however, to ensure that materials in the same condition are compared.