AS EN 50069—2013
EN 50069:1991
EN 50069:1991/A1:1993
EN 50069:1991/Cor.1:2007
(Incorporating Amendment No. 1)

Australian Standard®

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

A1 | *This national Standard is the identical adoption of EN 50069:1991 and is adopted with permission of CENELEC, Avenue Marnix 17, B-1000 Brussels, Belgium. All exploitation rights of the European Standards in any form and by any means are reserved world-wide to CEN and its National Members, and no reproduction may be undertaken without express permission in writing by CEN through Standards Australia Limited.*

STANDARDS Australia

This Australian Standard® was prepared by Committee EL-007, Power Switchgear. It was approved on behalf of the Council of Standards Australia on 10 August 2012.
This Standard was published on 30 May 2013.

The following are represented on Committee EL-007:

- Australian British Chamber of Commerce
- Australian Industry Group
- Energy Australia
- Energy Networks Association
- Engineers Australia
- University of New South Wales

This Standard was issued in draft form for comment as DR AS 50069.

Standards Australia wishes to acknowledge the participation of the expert individuals that contributed to the development of this Standard through their representation on the Committee and through the public comment period.

Keeping Standards up-to-date

Australian Standards® are living documents that reflect progress in science, technology and systems. To maintain their currency, all Standards are periodically reviewed, and new editions are published. Between editions, amendments may be issued.

Standards may also be withdrawn. It is important that readers assure themselves they are using a current Standard, which should include any amendments that may have been published since the Standard was published.

Detailed information about Australian Standards, drafts, amendments and new projects can be found by visiting **www.standards.org.au**

Standards Australia welcomes suggestions for improvements, and encourages readers to notify us immediately of any apparent inaccuracies or ambiguities. Contact us via email at **mail@standards.org.au**, or write to Standards Australia, GPO Box 476, Sydney, NSW 2001.

AS EN 50069—2013
(Incorporating Amendment No. 1)

Australian Standard®

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

First published as AS EN 50069—2013.
Reissued incorporating Amendment No. 1 (September 2013).

Published by SAI Global Limited under licence from Standards Australia Limited, GPO Box 476, Sydney, NSW 2001, Australia

ISBN 978 1 74342 473 5

PREFACE

This Standard was prepared by the Standards Australia Committee EL-007, Power Switchgear.

This Standard incorporates Amendment No. 1 (September 2013). The changes required by the Amendment are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure or part thereof affected.

The objective of this Standard is to provide 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 associate gas-filled equipment.

This Standard is identical with and has been reproduced from EN 50069:1991, *Welded composite enclosures of cast and wrought aluminum alloys for gas-filled high-voltage switchgear and controlgear* and its Amendment 1 (1993) and Corrigendum (2007), which are added at the end of the source text.

As this Standard is reproduced from a European Standard, the following applies:

(a) The European Standard number appears only on the cover.

(b) A full point substitutes for a comma when referring to a decimal marker.

(c) EN Annex A is addressed to EN member nations and should be deleted.

The references to European and International Standards should be replaced by references to the following Australian or Australian/New Zealand Standards:

Reference to European and International Standard		*Australian or Australian/New Zealand Standard*	
ISO		AS/NZS ISO	
6213	Welding; Items to be considered to ensure quality in welding structures	3834 series	Quality requirements for welding—Fusion welding of metallic materials
9000	Guidelines for selection and use of the standards on quality management, quality system elements and quality assurance	9000	Quality management systems—Fundamentals and vocabulary
EN		AS EN	
50052	Cast aluminium alloy enclosures for gas-filled high-voltage switchgear and controlgear	50052	Cast aluminium alloy enclosures for gas-filled high-voltage switchgear and controlgear
50064	Wrought aluminium and aluminium alloy enclosures for gas-filled high-voltage switchgear and controlgear	50064	Wrought aluminium and aluminium alloy enclosures for gas-filled high-voltage switchgear and controlgear
HD		AS	
35852 (IEC 517)	Gas-insulated metal-enclosed switchgear for rated voltages of 72,5 kV and above	62271 62271.203	High-voltage switchgear and controlgear Part 203: Gas-insulated metal-enclosed switchgear for rated voltages above 52 kV

Only European and international references that have been adopted as Australian or Australian/New Zealand Standards have been listed.

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

AUSTRALIAN STANDARD

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

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.

Table 1 - List of recommended cast aluminium alloys

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	SG 70B	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.

Table 2 - Examples of materials

AUSTRIA	SWITZERLAND	GERMANY	FRANCE	ITALY	SWEDEN	U.K.	SPAIN	INTERNATIONAL
Ö-NORM M 3430	SN 210 900	DIN 1725 Teil 1	AFNOR NF A50-411 NF A50-451	UNI	SS 14	BS 1470, 1471 1479, 4300 5500	UNE 38 301	ISO R 209
AlMgSi0,5	AlMgSi 0,5	AlMgSi0,5		3569			38 337 L 3441	AlMgSi 0,5
AlMg 3	Al Mg 3	AlMg 3	5754	3575			38 339 L 3390	Al Mg 3
AlMg 1	Al Mg 1	AlMg 1		5764	4104-05	5005	38 335 L 3350	Al Mg 1
AlMg4,5Mn	AlMg 4,5Mn	AlMg4,5Mn	5083	7790	4140-02	5083	38 340 L 3321	AlMg 4,5 Mn
AlMgSi 1	AlMgSi 1	AlMgSi 1			4212-06	6082	38 334 L 3451	Al Si 1 Mg
AlMg 2,5	AlMg 2,5				4120-02		38 336 L 3360	AlMg 2,5
	AlMg 2,7Mn		5454			5454		AlMg 3 Mn
			Al Type1100		4007-02			Al 99,0 Cu
			5086					Al Mg 4
			6061	6170		6061		AlMg 1 SiCu
			Al Cu * Type 2017					AlCu 4 MgSi *
						5154 A		Al Mg 3,5
					4005-02			
						5251		Al Mg 2
					4054-02			
					4010-02			

* For non-welded parts only!

Note: The list is not exhaustive; other materials may be used from National Standards.

5.2 Corrosion allowance

The enclosures are filled in service with a non-corrosive thoroughly dried gas, therefore, no internal corrosion allowance is necessary.

5.3 Design considerations

The geometry of an enclosure can be determined by electrical rather than mechanical considerations. This constraint can result in an enclosure geometry which requires an unacceptable degree of calculation or which cannot be calculated at all.

In the case of such an enclosure or an enclosure for which calculations are not made, a proof test of the individual housing is necessary before the internal parts are added.

When designing an enclosure, account shall be taken of the following, if applicable:

(a) The possible evacuation of the enclosures as part of the filling process.

For enclosures of this type it is usually necessary to evacuate the air before introducing gas pressure, this ensures purity of the gas. The evacuated condition is therefore not an operational condition and in most cases enclosures designed for internal pressure will be suitable for the evacuated condition without buckling.

For certain long lengths and large diameter busbar sections, however, it is possible that the enclosure will buckle due to external pressure. In such cases the design should be checked for external pressure and the enclosure strengthened, if necessary. Since this is not an operational condition, it is not a matter of safety.

(b) The full differential pressure possible across the enclosure wall.

(c) Superimposed loads and vibrations by external effects.

(d) Stresses caused by temperature differences including transient conditions and by differences in coefficients of thermal expansion.

(e) Effects of solar radiation.

Post weld heat treatment of aluminium and aluminium alloy enclosures is not normally necessary or desirable.

NOTE
Pressure stresses due to an internal electrical fault are

not considered in the design of an enclosure since after such an occurrence, the enclosure would be carefully checked and, if necessary, replaced.

For the case of arcing due to an internal fault, reference is made to HD 358 S2 (IEC 517 (1989) ed 2).

5.4 Design pressure

The design is based on the design pressure (p) as defined in 3.6.

5.5 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 at the design pressure (p).

5.6 Design stress basis

The nominal design strength (K) shall be selected from the material standards. For castings the nominal design strength of the material without heat treatment shall be used in the heat affected areas of the welds. For wrought aluminium parts the nominal design strength in the annealed condition shall be used in the design of welded structures.

5.7 Calculation

The castings shall be calculated, if any, as prescribed in EN 50 052, clause 5. The wrought aluminium parts shall be calculated as prescribed in EN 50 064, clause 5. It should be noted, however, that an additional wall thickness of the wrought aluminium parts is required to maintain the ratio 1,3/1,5 (stress at routine pressure test against yield strength) during the routine pressure test of castings with 2,0 times the design pressure (p), in order to ensure that yielding of the wrought aluminium parts does not occur.

6. Manufacture and workmanship

For castings the manufacture and workmanship shall be as specified in the clauses 6, 7 and 8 of EN 50 052.

For wrought aluminium parts the manufacture and workmanship shall be as specified in clause 6 of EN 50 064.

6.1 Surface Finish

The whole of the internal surface of the enclosure shall be cleaned and free from loose scale, grit, oil and grease.

7. Inspection and testing

7.1 General

Each enclosure shall be inspected during construction. Sufficient inspections shall be made to ensure, that the materials, construction and testing comply in all respects with the requirements of this standard.

7.2 Welding procedure specifications

The manufacturer shall produce and keep on file a list of all the welding procedure specifications required in the fabrication of the enclosures which are representative of the various thicknesses and materials to be used to prove each welding process (see annex B of EN 50 064 but omitting the bend test for welded castings).

NOTE
It may be necessary to carry out the welding procedure test on a joint of a complete enclosure.

7.3 Welder performance tests

All welders/operators engaged in the welding of pressure parts of enclosures fabricated in accordance with this standard shall pass welder performance tests which are designed to demonstrate their competence to make sound welds of the types on which each is to be employed (see annex B of EN 50 064 but omitting the bend test for welded castings).

7.4 Non-destructive testing

7.4.1 General

This standard specifies that non-destructive testing is required in all cases.

Non-destructive testing may also be used by the manufacturer during construction as part of the quality control process. A non-destructive testing procedure shall be prepared for each application used which should refer to the following:

(a) The timing of non-destructive testing in relation to the fabrication and testing procedures, and the specification of the stages at which non-destructive testing is mandatory.

The stages at which non-destructive testing may be employed are:

1) for the assessment of parent metals;

2) for the assessment of welding procedure and welder performance test as required in annex B of EN 50 064;

3) during welding, e.g. to monitor the quality of early runs in multi-run welds and/or after welding;

4) during and after weld repairs;

5) prior to stress relief or other post-weld heat treatment.

(b) The amount of non-destructive testing in relation to the type of material, the thickness and the stresses involved.

(c) The choice of non-destructive test method.

(d) The acceptance criteria for imperfections revealed and consequent actions.

(e) The qualifications to be required for the non-destructive testing personnel.

7.4.2 Amount of testing of welded joints between castings or between castings and wrought aluminium parts

At least 10 % of the length of all fully penetrated butt welds including the welds of butt welded forged branches shall be examined by radiographic or ultrasonic methods.

Such examination shall include each intersection of longitudinal and circumferential seams. For each circumferential seam and for each butt welded forged branch there shall be at least one radiograph or where ultrasonic examination is specified at least a 200 mm length shall be examined.

At least 10 % of the length of all other welds shall be examined by the penetrant method.

In addition, weld seams in or within 12 mm of openings shall be examined each side of the opening for a distance not less than the diameter of the opening.

7.4.3 Test methods for weld seams

7.4.3.1 Radiography

Radiographic examination of the weld seams shall be carried out in accordance with a recognized ISO or National Standard.

Each section of a weld seam radiographed shall have suitable symbols affixed to identify the following:

(a) the job or work piece serial number, order number or similar distinctive reference number;

(b) the joint;

(c) the section of the joint;

(d) arrows or other symbols, alongside but clear of the outer edges of the weld to clearly identify the position of the radiographed area.

NOTE
The location of the weld seam can be identified for instance with a letter symbol L for longitudinal seams, with a letter symbol C for circumferential seams added by a numeral (1, 2, 3 etc.) to indicate whether the seam was the first, second, third etc. of that type.

The symbols consisting of lead arrows, letters and/or numerals shall be positioned so that their images appear on the radiograph to ensure positive identification of the section.

Radiographs of repair welds shall be clearly marked R1, R2 etc. for the first repair, second repair etc.

7.4.3.2 Ultrasonics

Ultrasonic examination of the weld seams shall be carried out in accordance with a recognized National Standard. The choice is left to the manufacturer.

Before carrying out ultrasonic examinations of weld seams, the adjacent parent metal shall be ultrasonically examined to establish the thickness of the material and to locate any imperfection which prevent effective examination of the weld.

7.4.3.3 Penetrant method

Dye or fluorescent penetration examination of the weld seams shall be carried out in accordance with a recognized National Standard. The choice is left to the manufacturer.

7.4.4 Surface conditions and preparations for testing

(a) Radiography
Surfaces shall be dressed only where weld surface irregularities would interfere with the interpretation of the radiographs.

(b) Ultrasonics
The condition of the surfaces that come in contact with

the probe shall be such that satisfactory coupling can be achieved.

NOTE
Depending on the shape and surface conditions dressing of the weld seam can be necessary even when contact is only to be made with the parent metal.

(c) Penetrant method
The surfaces shall be free of any foreign matter which would interfere with the application and interpretation of the examination.

Care shall be taken to avoid masking of imperfections by the distortion of surface layers by any dressing process which may be used.

7.4.5 Marking of enclosure welds

Marking of the enclosure welds shall be used to provide reference points for the accurate location of the seam with respect to the evaluation.

7.4.6 Reporting

The following information shall be given on reports:

(a) the date of the examination and the report;

(b) the name and the qualification of the person responsible for the examination and the interpretation;

(c) the identification of the enclosure and the seam under examination;

(d) the kind of cleaning and surface preparation or dressing prior to non-destructive testing;

(e) the description and location of all relevant indications of imperfections, together with the reference to records, e.g. radiographs, photographs, drawings or sketches as appropriate;

(f) result of the examination.

7.4.7 Minimum acceptance levels

In addition to radiographic or ultrasonic testing, a visual inspection of all weld seams shall be carried out. Where any doubt exists, dye penetration or further radiographic examinations should be made.

The acceptance levels of imperfections given in table 7 of

EN 50 064 shall be imposed during fabrication as a means of quality control.

7.4.8 Assessment of imperfections

Imperfections can be assessed according to one or the other of the following alternatives:

(a) if the imperfections do not exceed the acceptance levels specified in table 7 of EN 50 064, the weld may be accepted without further action;

(b) particular imperfections in excess of those permitted in table 7 of EN 50 064 may be accepted after due consideration of the material, stress and environmental factors;

(c) if acceptance levels different from those specified in table 7 of EN 50 064 have been established for a particular application and being suitably documented, they may be adopted.

7.4.9 Repair of welds

Unacceptable imperfections shall be rejected or repaired. Repair welds shall be carried out to a documented procedure and subjected to the same acceptance criteria as the original work. The whole of the repaired areas shall be radiographed.

Where imperfections needing repair are found, the non-destructive testing shall be extended for a distance of 10 % of the length of the seam on both sides of the original radiograph or ultra sonic test length.

If, in those subsequent non-destructive tests, further imperfections needing repair are found, the non-destructive testing shall be extended to 100 % of the seam length.

7.5 Pressure tests

7.5.1 General

A pressure test is required on all enclosures constructed in accordance with this standard.

It is important to ensure that the first pressurization is carried out under controlled conditions with appropriate safety precautions.

Some permanent local dilation of an enclosure is likely on the first pressurization but this possibility needs special consideration only where fine dimensional tolerances are specified for the finished enclosure.

7.5.2 Routine pressure test

Every enclosure shall be subjected to a routine pressure test at 2 times the design pressure for not less than one minute.

Each compartment of an enclosure consisting of two or more separate compartments shall be subjected to the test pressure specified without support from a pressure higher than the atmospheric pressure in any adjoining compartment.

Enclosures which have been repaired subsequent to the routine pressure test shall be retested after completion of the repairs.

7.5.3 Proof test

A proof test shall be carried out on one enclosure of a particular design. The proof test shall be a burst test.

When proof tests are carried out on enclosures which are subjected to significant static superimposed loads in service, the effect of these loads shall be simulated during the test.

The burst test procedure is to be used for enclosures or enclosure parts under internal pressure. The design pressure of any part of the enclosure tested by this method shall be established by a pressure test.

The design pressure (p) for which an enclosure meets the requirements of this standard shall be calculated according to:

$$p = \frac{B}{3,5} \cdot 0,7$$

where B = burst pressure

3,5 = safety factor against bursting strength

The value 0,7 has been introduced to cover the possible variability of production enclosures. It is permitted to increase this factor to 1,0 if it can be justified.

All enclosures remaining intact after this pressure application shall be scrapped.

8. Pressure relief devices

8.1 General conditions

If necessary, enclosures within the scope of this standard shall be provided with protective devices which may be one of the following:

(a) bursting discs

(b) self-closing valves

(c) non-self-closing devices

The protective devices shall be constructed, located and installed so that they are accessible for inspection and repair. They shall be protected against accidental damage.

The devices need not be installed directly on the enclosure. The discharge areas and any connecting ports to or within the enclosure shall be of adequate size to permit effective relief in the event of overpressure.

Pressure relief devices shall be arranged so as to minimize the danger to an operator during the time he is performing his normal operating duties, if gases or vapours are escaping under pressure.

Pressure relief devices may be connected to the enclosure or in the gas supply lines of the gas-filling plant.

In the case of devices fitted to enclosures connected to an external source of pressure and devices fitted in gas supply lines of the gas-filling plant they shall be designed to limit the overpressure to 1,1 times the design pressure.

Each device shall be marked with its nominal opening pressure.

It might be considered necessary to design the pressure relief device in order to limit the pressure rise in the event of an internal electrical fault.

8.2 Bursting discs

Bursting discs can be manufactured from brittle or ductile materials.

The rupture pressure of the bursting disc should be chosen to ensure long service without premature bursting. The disc manufacturer should be consulted.

8.3 Self-closing pressure relief valves

Self-closing pressure relief valves shall be of the direct spring loaded type.

8.4 Non-self-closing pressure relief devices

Non-self-closing pressure relief devices which operate by the "breaking bolt" system may be used.

NOTE
The breaking bolt system pressure relief device is one whereby a diaphragm being secured by a bolt or bolts relieves pressure by fracture or bending of the bolt or bolts, the diaphragm being restrained after venting by other bolts or a cover.

9. Certification and marking

9.1 Design specification, drawings and data sheets

The manufacturer shall maintain a technical file of all date associated with the production of the enclosures. The file shall include drawings, material certificates, welder records, proof test records etc.

This file be kept available for a period of not less than ten years from the date of completion of the enclosures.

9.2 Certificates

On completion of the enclosure the manufacturer shall issue a certificate stating that the enclosure has been designed, constructed tested in every respect in accordance with the requirements of this standard.

Where the design and fabrication activities are carried out by separate companies, each company shall issue a certificate in respect of the work it has performed.

The final responsibility, however, rests with the switchgear manufacturer.

9.3 Marking

Each enclosure shall be stamped by visible marking in an area where operating stresses are low, e.g. on the outside edge of a flange, or on a permanently attached nameplate to indicate that it has passed the routine pressure test.

9.4 Final inspection

An internal and external inspection of the completed enclosures shall be carried out prior to dispatch, and the certificates and stamping checked.

A N N E X A (informative)
National deviations

A-deviations: National deviations due to regulations or requirements, the alteration of which is - at least for the time being - outside the competence of the National Committee of CENELEC. The National Committee should, however, contact the authorities concerned with regard to the removal of these deviations.

Clause	Member (regulation)
1	France (Ministerial Decree of July 23rd, 1943, Clause 17) An internal and external inspection of the enclosure is mandatory every 3 years, and the renewal of the pressure test every 5 years (in case of SF6 gas). Italy (Rules for the design, construction and service of pressure vessels, issued by I.S.P.E.S.L. = Instituto Superiore per la Prevenzione e la Sicurezza del Lavore (former A.N.C.C.) A pressure test is required during the installation at 1,1 times the rated pressure.
4	Italy (Rules of I.S.P.E.S.L. (former A.N.C.C.), clause M.8.C., collection M) Only cast aluminium alloys are permitted. Sweden (Applied practice in accordance with the Work Environmental Act SFS 1977: 1169) Only nationally standardized aluminium alloys with guaranteed mechanical strength values shall be used. For cast aluminium alloys the break elongation for a separately cast test bar shall be at least 2 %.

Clause	Member (regulation)
5.7	Italy (Rules of I.S.P.E.S.L. (former A.N.C.C.), collection VSR) Only the calculation method as specified in Collection VSR is accepted.
7	Italy (Rules of I.S.P.E.S.L. (former A.N.C.C.) Inspections, testing and certification are only carried out under authoritative/supervision.
7.5.3	Italy (Rules of I.S.P.E.S.L. (former A.N.C.C.), clauses VSR.7.A.3, collection VSR) The design pressure p shall be calculated by the following equation: $p \leq \frac{B}{7,8} \times v \times \frac{S_1}{S_2}$ where: v = weld joint factor (if any) B = burst pressure S_1 = minimum wall thickness of the enclosure S_2 = wall thickness of the enclosure tested Sweden (Applied practice in accordance with the Work Environmental Act SFS 1977: 1169) The factor 0,7 in the formular for calculation of the design pressure (p) is only permitted to be encreased to 1,0 if the material has a rupture prolongation A5 of at least 4 %.

Clause	Member (regulation)
8	Italy (Rules of I.S.P.S.E.I. (former A.N.C.C.), clauses E.1.D.2 and E.1.D.4, collection E) The bursting discs and pressure relief valves shall be designed to limit the overpressure to 1,1 times the design pressure. The rated rupture pressure of the burst discs and the nominal opening pressure of the valves shall be equal or lower than the design pressure of the enclosure.

AMENDMENT

2.1 Type of equipment (page 3)

The first paragraph has to be changed as follows (new text in bold letters):

..... of high-voltage switchgear and controlgear, **where the gas is used principally for its dielectric and/or arc-quenching properties, with rated voltages.**

- **1 kV and up to and including 52 kV and with gas-filled compartments with design pressure greater than 3 bar (gauge);**

- **and with rated voltage 72,5 kV and above.**

Annex A (page 12 and 13)

The National Deviations have to be amended by the following Austrian A-Deviations:

Clause	Member (regulation)
Clause 1 (last paragraph)	**Austria** (Dampfkesselverordnung (Fire Vessel Code) BGBl. Nr. 510/1986, Clause V and decree Nr. 143, GZ 43010/2-IV/81) The regulations for pressure vessels include specifications for tests which - are the responsibility of the manufacturer only; - have to be carried out in connection with a type approval (type test); - have to be carried out by independent experts. **NOTE** This principle is in accordance with the EC Directive 87/404/EEC and the Policy Statement of the EC Commission Doc. 74/88.
Clause 4	**Austria** (Werkstoff- und Bauvorschriften (Material and Construction Rules) BGBl.Nr. 524/73, Clause IV) The material characteristics are defined exactly (e. g. elongation > 14 %) and the material appropriate for the construction of pressure vessels are specified mandatorily.
Clause 6	**Austria** (Werkstoff- und Bauvorschriften (Material and Construction Rules) BGBl.Nr. 67/1979, Clause III/1) The welding regulations include precise instructions on welding procedures and welding personnel (welder, welding supervisor).
Clause 7.4.2	**Austria** (Werkstoff- und Bauvorschriften (Material and Construction Rules) BGBl.Nr. 67/1979, Clause III/5) The range of weld seam test is greater, in particular for longitudinal seams.
Clause 8	**Austria** (Dampfkesselverordnung (Fire Vessel Code) BGBl.Nr. 510/1986, § 30, paragraph 2) Pressure relief devices shall be provided mandatorily.

Corrigendum to EN 50069:1991

English version

Annex A

Delete the A-deviations for Sweden.

August 2007

AMENDMENT CONTROL SHEET

AS EN 50069—2013

Amendment No. 1 (2013)

CORRECTION

SUMMARY: This Amendment applies to the Cover.

Published on 30 September 2013.

NOTES

NOTES

Standards Australia

Standards Australia develops Australian Standards® and other documents of public benefit and national interest. These Standards are developed through an open process of consultation and consensus, in which all interested parties are invited to participate. Through a Memorandum of Understanding with the Commonwealth Government, Standards Australia is recognized as Australia's peak non-government national standards body. Standards Australia also supports excellence in design and innovation through the Australian Design Awards.

For further information visit **www.standards.org.au**

Australian Standards®

Committees of experts from industry, governments, consumers and other relevant sectors prepare Australian Standards. The requirements or recommendations contained in published Standards are a consensus of the views of representative interests and also take account of comments received from other sources. They reflect the latest scientific and industry experience. Australian Standards are kept under continuous review after publication and are updated regularly to take account of changing technology.

International Involvement

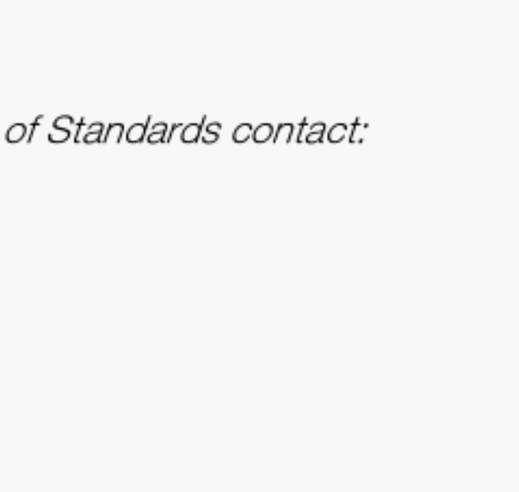
Standards Australia is responsible for ensuring the Australian viewpoint is considered in the formulation of International Standards and that the latest international experience is incorporated in national Standards. This role is vital in assisting local industry to compete in international markets. Standards Australia represents Australia at both the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC).

Sales and Distribution

Australian Standards®, Handbooks and other documents developed by Standards Australia are printed and distributed under license by SAI Global Limited.

For information regarding the development of Standards contact:
Standards Australia Limited
GPO Box 476
Sydney NSW 2001
Phone: 02 9237 6000
Fax: 02 9237 6010
Email: mail@standards.org.au
Internet: www.standards.org.au

For information regarding the sale and distribution of Standards contact:
SAI Global Limited
Phone: 13 12 42
Fax: 1300 65 49 49
Email: sales@saiglobal.com



ISBN 978 1 74342 473 5

This page has been left intentionally blank.