

INTERNATIONAL STANDARD



**Empty enclosures for low-voltage switchgear and controlgear assemblies –
General requirements**

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General requirements**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**EMPTY ENCLOSURES FOR LOW-VOLTAGE
SWITCHGEAR AND CONTROLGEAR ASSEMBLIES –
GENERAL REQUIREMENTS**

FOREWORD

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This commented version (CMV) of the official standard IEC 62208:2023 edition 3.0 allows the user to identify the changes made to the previous IEC 62208:2011 edition 2.0. Furthermore, comments from IEC SC 121B experts are provided to explain the reasons of the most relevant changes, or to clarify any part of the content.

A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text. Experts' comments are identified by a blue-background number. Mouse over a number to display a pop-up note with the comment.

This publication contains the CMV and the official standard. The full list of comments is available at the end of the CMV.

IEC 62208 has been prepared by subcommittee 121B: Low-voltage switchgear and controlgear assemblies, of IEC technical committee 121: Switchgear and controlgear and their assemblies for low voltage. It is an International Standard.

This third edition cancels and replaces the second edition published in 2011. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) consideration of the modifications introduced in IEC 61439-1:2020;
- b) alignment of test procedures with the newest relevant standards.

The text of this International Standard is based on the following documents:

Draft	Report on voting
121B/180/FDIS	121B/180/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

The reader's attention is drawn to the fact that Annex A lists all of the "in-some-country" clauses on differing practices of a less permanent nature relating to the subject of this document.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

The purpose of this document is to harmonize as far as practicable all rules and requirements of a general nature applicable to empty enclosures for low-voltage switchgear and controlgear assemblies, in order to obtain uniformity of requirements and verification for empty enclosures and to avoid the need for verification in other standards.

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EMPTY ENCLOSURES FOR LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR ASSEMBLIES – GENERAL REQUIREMENTS

1 Scope

This document applies to empty enclosures, as provided by the enclosure manufacturer, prior to the incorporation of switchgear and controlgear components by ~~the user, as supplied by the enclosure~~ the assembly manufacturer. **1**

This document specifies general definitions, classifications, characteristics and test requirements of enclosures to be used as part of switchgear and controlgear assemblies (e.g. in accordance with the product standard in the IEC 61439 series), the rated voltage of which does not exceed 1 000 V AC or 1 500 V DC, and suitable for general use for either indoor or outdoor applications.

NOTE 1 Additional requirements ~~may~~ could apply for specific applications.

~~NOTE 2 The United States of America (USA) uses enclosure "Type" designations according to NEMA 250. The NEMA Enclosure Type designations specify additional environmental requirements for conditions such as corrosion, rust, icing, oil, and coolants. For this reason, the IEC Enclosure Classification Designations IP are used with an enclosure Type designation number appropriate for these markets.~~ **2**

NOTE 2 Empty enclosures according to this document are suitable for mounting of electrical components.

This document does not apply to enclosures which are covered by other specific products standards (e.g. ~~IEC 60670 series~~ IEC 60670-24).

Compliance with the safety requirements of the applicable product standard for the final product produced using an empty enclosure is the responsibility of the assembly manufacturer. **3**

NOTE 3 This document ~~may~~ could serve as a basis for other technical committees.

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.

IEC 60068-2-2:2007, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60068-2-11:1981/2021, ~~Basic~~ *Environmental testing – procedures* – Part 2-11: Tests – Test Ka: Salt mist

IEC 60068-2-30:2005, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60085:2007, *Electrical insulation – Thermal evaluation and designation*

IEC 60364 (all parts), *Low-voltage electrical installations*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*⁴

IEC 60529:1989/AMD1:1999

IEC 60529:1989/AMD2:2013

IEC 60695-2-10:20002021, *Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure*

IEC 60695-2-11:20002021, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test methods for end-products (GWEPT)*

IEC 60695-10-2:2014, *Fire hazard testing – Part 10-2: Abnormal heat – Ball pressure test method*

IEC 60695-11-5:2016; *Fire hazard testing – Part 11-5: Test flames – Needle-flame test method – Apparatus, confirmatory test arrangement and guidance*

IEC TR 60890:2014, *A method of temperature-rise verification of low-voltage switchgear and controlgear assemblies by calculation*

~~IEC 61439-1:2011, *low voltage switchgear and controlgear assemblies – Part 1: General rules*²~~

IEC 62262:2002, *Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)*

IEC 62262:2002/AMD1:2021

ISO 178:20012019, *Plastics – Determination of flexural properties*

~~ISO 179 (all parts), *Plastics – Determination of Charpy impact properties*~~

ISO 179-1:2010, *Plastics – Determination of Charpy impact properties – Part 1: Non-instrumented impact test*

ISO 179-2:2020, *Plastics – Determination of Charpy impact properties – Part 2: Instrumented impact test*

ISO 2409:20072020, *Paints and varnishes – Cross-cut test*

ISO 4628-3:20032016, *Paints and varnishes – Evaluation of degradation of coatings – Designation of quantity and size of defects, and of intensity of uniform changes in appearance – Part 3: Assessment of degree of rusting*

ISO 4892-2:20062013, *Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc sources lamps*
~~Amendment 1 (2009)~~

ISO 11469:20002016, *Plastics – Generic identification and marking of plastic products*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

⁴ ~~There is a consolidated edition 2.1 (2001) that includes IEC 60529 (1989) and its Amendment 1 (1999).~~

² ~~To be published.~~

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

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

3.1

empty enclosure

enclosure intended for support and installation of electrical equipment, whose internal space provides suitable protection against external influences as well as a specified degree of protection against approach to or contact with live parts and against contact with moving parts

Note 1 to entry: Throughout this document, the word enclosure is used for empty enclosure.

Note 2 to entry: For the purposes of this document, the terms boxes, cubicles, desks or cabinets are alternative terms for enclosures.

3.2

protected space

~~internal space or portion of the internal space of the enclosure as specified by the manufacturer intended for the mounting of switchgear and controlgear for which the specified protection is provided by the enclosure~~

internal space or portion of an enclosure as specified by the enclosure manufacturer intended to enclose electrical components, and which provides defined protection against external influences and contact with live parts **4**

3.3

cover

external part of the enclosure

3.4

door

hinged or sliding cover

3.5

mounting plate

separate internal accessory of the enclosure intended for the mounting of electrical components

3.6

cable gland plate

removable accessory of the enclosure, intended for securing and sealing of cables, conductors and conduits at their point of entry

3.7

removable cover

cover which is designed for closing an opening in the external enclosure and which can be removed for carrying out certain operations and maintenance work

Note 1 to entry: A lid is considered as a removable cover.

3.8

~~**enclosure manufacturer**~~

~~manufacturer of an enclosure or the vendor who resells under his own responsibility~~ **5**

3.8

inspection **6**

action comprising careful scrutiny, including visual scrutiny where conditions are obvious, of an item carried out either without dismantling, or with the addition of partial dismantling as required,

supplemented by means such as measurement, in order to arrive at a reliable conclusion as to the condition of an item

[SOURCE: IEC 60050-426:2020, 426-14-02, modified – "including visual scrutiny where conditions are obvious" has been added.]

3.9

rated insulation voltage 7

U_i

value of the RMS withstand voltage assigned by the enclosure manufacturer to the enclosure or to a part of it, characterizing the specified (long-term) withstand capability of its insulation

[SOURCE: IEC 60050-312:2014, 312-06-02, modified – Symbol U_i has been added, in the definition "rated value" has been replaced by "value", "enclosure" has been added to manufacturer, "equipment" has been replaced by "enclosure" and the Note has been deleted.]

3.10

class I enclosure 8

enclosure with at least one provision for a basic protection and a connection to a protective conductor as provision for fault protection

Note 1 to entry: See IEC 61140:2016, 7.3 for further details.

[SOURCE: IEC 61439-1:2020, 3.7.24, modified – "assembly" has been replaced by "enclosure" and Note 2 to entry has been deleted.]

3.11

class II enclosure 8

enclosure which is provided with the following:

- basic insulation as provision for basic protection, and
 - supplementary insulation as provision for fault protection,
- or in which
- basic protection and fault protection are provided by reinforced insulation

Note 1 to entry: See IEC 61140:2016, 7.4 for further details.

[SOURCE: IEC 61439-1:2020, 3.7.25, modified – "assembly" has been replaced by "enclosure".]

3.12

empty enclosure for indoor installation 9

empty enclosure that is designed for use in locations where the normal service conditions for indoor use as specified in Clause 7 apply

3.13

empty enclosure for outdoor installation 10

empty enclosure that is designed for use in locations where the normal service conditions for outdoor use as specified in Clause 7 apply

4 Classification

Enclosures are classified according to:

a) the type of material:

- insulating;

- metallic;
 - combination of insulating and metallic.
- b) method of ~~fixing~~ mounting:
- floor standing;
 - wall mounting;
 - flush mounting;
 - pole mounting.
- c) the intended location:
- outdoor;
 - indoor.
- d) the degree of protection:
- IP code, according to IEC 60529:1989 and IEC 60529:1989/AMD1:1999 and AMD2:2013;
 - IK code, according to IEC 62262:2002 and IEC 62262:2002/AMD1:2021.
- ~~e) the rated insulation voltage (for enclosures made of insulating materials).~~

5 Electromagnetic compatibility (EMC ~~requirements~~)

EMC requirements are not applicable for enclosures according to this document.

NOTE ~~For degrees of protection provided by enclosures against electromagnetic disturbances (EM code), see IEC 61000-5-7.~~ EMC is not a basic requirement for empty enclosures to this document. However, when enclosure manufacturers want to assign a degree of protection against electromagnetic disturbances (EM code) it is referred to IEC 61000-5-7:2001. **11**

6 Information to be given regarding the enclosure

6.1 General

The following information shall be given by the enclosure manufacturer.

6.2 Marking

The enclosure shall be identifiable, making it possible for the assembly manufacturer to obtain relevant information from the enclosure manufacturer. Such identification shall comprise:

- either the name, trade mark or identification mark of the enclosure manufacturer;
- type designation or identification number of the enclosure.

The marking shall be durable and easily legible and ~~may~~ can be inside the enclosure.

Compliance is checked according to the test of 9.3 and by inspection.

Marking for the recycling of plastic parts shall be as stated in ISO 11469.

NOTE ~~Marking of enclosures intended used for total insulation (equivalent to class II) assemblies with the symbol IEC 60417-5172  (2003-02) is the responsibility of the assembly manufacturer.~~ **12**

6.3 Documentation

6.3.1 General 13

The enclosure manufacturer's documentation shall include ~~all relevant constructional, mechanical characteristics;~~

- the enclosure classification (see Clause 4);
- any instruction necessary for the correct handling, assembling, mounting and service conditions of the enclosure;
- a reference to this document, and
- the following characteristics:
 - dimensions (see 6.3.2);
 - mounting arrangements (6.3.3);
 - permissible loads (see 6.3.4);
 - lifting and transport devices, if necessary (see 6.3.5);
 - ~~provisions for protection against electric shock (see 6.3.6);~~
 - protective measures (see 6.3.6);
 - ~~data of~~ thermal power dissipation capability (see 6.3.7);
 - applicable service conditions (see Clause 7);
 - location and size of protected space (see 3.2);
 - rated insulation voltage U_i of enclosures constructed of an insulating material and Class II enclosures (see 9.11.3, Table 4); 14
 - ~~degree of protection (IK and IP codes, see 8.7 and 8.8).~~
 - degree of protection against mechanical impact (IK code, see 8.6);
 - degree of protection against contact with hazardous live parts, ingress of solid foreign bodies and water (IP code, see 8.7);
 - maximum permissible temperatures inside for which enclosures constructed of insulating material is suitable (see 9.10.2). 15

~~The data for the thermal power dissipation capability are a function of the admissible temperature inside the enclosure. They shall be provided for the different installation methods (e.g. flush mounting, surface mounting) of the enclosure and of the design of the enclosure, i.e. with or without ventilation openings and number of horizontal partitions. They shall include at least temperature rise inside the enclosure, at the top, and external surfaces temperature rise, for a given power loss inside the enclosure. This will provide the user with the correct data for the selection of the enclosure according to electrical equipment to be installed. For the purpose of the calculation, it is assumed that the heat generated by the selected equipment is distributed uniformly inside the protected space. 16~~

6.3.2 Dimensions

The dimensions shall be given in millimetres.

The external dimensions (height, width and depth) are nominal values and shall be indicated in the catalogue of the enclosure manufacturer.

The projection of cable gland plates, removable covers and handles shall not be included in the external nominal dimensions, the dimensions of such shall be included in the enclosure manufacturer's documentation.

6.3.3 Mounting arrangements

The means and location of the enclosure mounting arrangements shall be defined in the enclosure manufacturer's documentation.

~~The location of the equipment mounting surfaces and their means of fixing shall be defined in the enclosure manufacturer's documentation.~~ 17

6.3.4 Permissible loads

The permissible loads that the enclosure, mounting plates, switchgear and controlgear supports and ~~its~~ doors are able to carry shall be defined in the enclosure manufacturer's documentation. The load shall be given in Newtons.

If the enclosure includes or can include a mounting plate or switchgear and controlgear supports, the permissible load that the accessory can carry, according to the fixing means provided inside the enclosure, shall be defined in the enclosure manufacturer's documentation. (see also 8.2).

6.3.5 Lifting and transport support

Where required, the correct location and installation of lifting and transport support and the thread size of lifting devices, ~~if applicable~~, shall be given in the enclosure manufacturer's documentation or in the instructions on how the enclosure has to be handled (see also 8.3).

6.3.6 Protective ~~circuit~~ measures

The enclosure manufacturer shall indicate in the technical documentation if the enclosure is suitable for a class I or class II assembly.

In the case of a class I enclosure, the enclosure manufacturer shall indicate if the enclosure ensures electrical continuity throughout by the conductive structural parts of the enclosure or if and how separate protective conductors to the protective circuits of the installation shall be carried out (see also 8.5).

6.3.7 Thermal power dissipation capability

The data for the thermal power dissipation capability are a function of the admissible temperature inside the enclosure. They shall be provided for the intended mounting methods (e.g. flush mounting, surface mounting) of the enclosure and of the design of the enclosure, i.e. with or without ventilation openings and number of horizontal partitions. They shall include at least temperature rise inside the enclosure at the top, for a given power loss inside the enclosure. This will provide the assembly manufacturer with the correct data for the selection of the enclosure according to electrical equipment to be installed. The data for the thermal power dissipation capability shall be defined in the enclosure manufacturer's documentation (see also 9.15).

7 Service conditions

7.1 General

Enclosures conforming to this document are intended for use under the following service conditions.

The enclosure manufacturer shall specify the locations for which the enclosure is intended.

7.2 Normal service conditions

7.2.1 Ambient air temperature

7.2.1.1 Ambient air temperature for indoor locations

The ambient air temperature does not exceed +40 °C and its average over a period of 24 h does not exceed +35 °C.

The lower limit of the ambient air temperature is –5 °C.

7.2.1.2 Ambient air temperature for outdoor locations

The ambient air temperature does not exceed +40 °C and its average over a period of 24 h does not exceed +35 °C.

The lower limit of the ambient air temperature is –25 °C.

7.2.2 Humidity conditions

7.2.2.1 Humidity conditions for indoor locations

The relative humidity of the air does not exceed 50 % at a maximum temperature of +40 °C. Higher relative humidity may be permitted at lower temperatures, for example 90 % at +20 °C. Moderate condensation should be borne in mind which may occasionally occur due to variations in temperature.

7.2.2.2 Humidity conditions for outdoor locations

The relative humidity may be temporarily as high as 100 % at a maximum temperature of +25 °C.

Enclosures conforming to this document are intended for use under the normal service conditions detailed in Table 1.

Table 1 – Climatic conditions 18

Environmental parameter	Indoor installations		Outdoor installations	
	Lower limit	Upper limit	Lower limit	Upper limit
Ambient air temperature	–5 °C	+40 °C average over a period of 24 h does not exceed +35 °C	–25 °C	+40 °C average over a period of 24 h does not exceed +35 °C
Humidity conditions ^a	5 %	–5...+30 °C: 95 % +35 °C: 70 % +40 °C: 57 %	15 %	–25...+27 °C: 100 % +35 °C: 60 % +40 °C: 46 %

^a Relationship between air temperature and humidity is given in IEC 60721-3-3:2019, Figure A.1. Moderate condensation should be borne in mind which can occasionally occur due to variations in temperature.

7.3 Special service conditions

Where any of the following special service conditions exist, the applicable particular requirements shall be subject to agreement between user and manufacturer.

Examples of such conditions may include the following:

- abnormal ambient air temperature and humidity;

- ~~• presence of corrosive substances;~~
- ~~• presence of particular dusts (coal, cement, etc.);~~
- ~~• abnormal mechanical stresses (seismic, etc.);~~
- ~~• presence of fauna, flora, mould;~~
- ~~• ionizing influences;~~
- ~~• electromagnetic interferences;~~
- ~~• vibrations;~~
- ~~• UV radiation other than solar.~~

~~Agreements reached shall not contradict any safety regulations in force.~~

Special service conditions can be induced by particular conditions required in product standards or by user requirement. The user shall inform the enclosure manufacturer if such special service conditions exist.

NOTE If any special condition requires a specific test or verification, and there is no standardized test method, the test method to be carried out will be by an agreement between the manufacturer and the user.

Examples of such conditions can include the following:

- values of ambient air temperature and/or humidity differing from those defined in Subclause 7.2, Table 1;
- applications where variations in climatic conditions are likely to result in exceptional condensation inside the enclosure;
- heavy pollution of the air due to presence of dust (coal, cement, etc.), smoke, corrosive or radioactive substances, vapours or salt;
- exposure to abnormal mechanical stresses (heavy vibrations, shocks, seismic occurrences, etc.);
- presence of fauna, flora, mould, fungus or small creatures;
- ionizing influences;
- electromagnetic interferences;
- exposure to any type of radiation (for example, solar radiation, X-rays, microwave, ultraviolet other than solar, lasers, etc.). **19**

7.4 Conditions during transport and storage

A special agreement shall be made between the enclosure manufacturer and the user if the conditions during transport, storage and installation, for example temperature and humidity conditions, differ from those defined in 7.2.

8 Design and construction

8.1 General

The enclosure shall be constructed only of materials capable of withstanding the mechanical, electrical and thermal stresses, as specified in Clause 9, as well as the effects of humidity which are likely to be encountered in normal use.

~~Protection against corrosion shall be ensured by the use of suitable materials or by the application of protective coating to the exposed surface, taking into account the intended conditions of use.~~

~~Compliance to this requirement is checked by the test of 9.13. **20**~~

~~In addition for enclosures or parts of enclosures made of insulating materials, thermal stability, resistance to heat, fire and weathering shall be verified according to the tests of 9.9 and 9.12. 21~~

The enclosure manufacturer shall state in its documentation if mounting accessories or methods of mounting affects the technical characteristics of the enclosure.

8.2 Static loads

~~Compliance of the permissible load that the enclosure and its doors are able to carry is checked according to the test of 9.4.~~

The enclosure manufacturer shall specify the maximum permissible static load that the enclosure and its doors are able to carry.

If the enclosure includes or can include a mounting plate or switchgear and controlgear supports, the enclosure manufacturer shall also specify the maximum permissible load of that accessory according to the fixing means provided, except when the mounting plate and any convenient support are designed, manufactured and tested for a specific equipment (e.g. for a specific brand or manufacturer).

If the enclosure manufacturer offers plinths, wheels, levelling feet or other similar accessories intended to be used for the enclosure, then the enclosure manufacturer shall declare the maximum static load with these accessories. 22

Compliance is checked according to the test of 9.4.

8.3 Lifting and transport support

~~Where required, enclosures shall be provided with the appropriate lifting devices or transport means.~~

If the enclosure is equipped or delivered together with lifting and transport supports, the enclosure manufacturer shall indicate in the technical documentation the correct location and installation of these supports, the thread size of lifting devices (if applicable), how the enclosure has to be handled, and the maximum weight for handling without lifting.

Compliance is checked according to the test of 9.5.

8.4 Access to the interior of the enclosure

Adequate access to the protected space shall be provided by means of (a) door(s) or removable cover(s). Access may be restricted by the use of a key or tool to provide a degree of protection to prevent contact with live parts with an enclosure used in an electric system, in accordance with 8.5.

Cable gland plates and covers which are removable from the outside shall require the use of a tool.

8.5 ~~Protective circuit~~

~~Metallic enclosures shall ensure electrical continuity throughout either by the conductive structural parts of the enclosure or provisions for a separate protective conductor to earth or both.~~

~~When a removable part of an enclosure is removed, the protective circuit for the remainder of the enclosure shall not be interrupted.~~

~~For lids, doors, removable covers and the like, the usual metal screwed connections and metal hinges may ensure continuity of the protective circuit provided no electrical equipment is attached to them. Where these are intended for mounting electrical equipment additional means shall be provided to ensure the continuity of the protective circuit.~~

~~Compliance is checked according to the test of 9.11.~~

~~The enclosure manufacturer shall provide means to facilitate the connection of the external protective conductor by the assembly manufacturer.~~

~~8.6 Dielectric strength~~

~~The enclosures constructed of an insulating material shall fulfil the dielectric test of 9.10. 23~~

8.5 Protection against electric shock

8.5.1 General

The following requirements are intended to ensure that the required protective measures are obtained when an enclosure is used in an electric system conforming to the IEC 60364 series.

8.5.2 Requirements for earth continuity within the class I enclosure 24

The enclosure manufacturer shall provide means for the connection of an external earthing or protective conductor.

All exposed-conductive-parts of the enclosure shall be interconnected together and to the means for the connection of an external earthing or protective conductor.

Certain exposed-conductive-parts (e.g., screws, rivets, nameplates) that do not constitute a danger need not be connected to the earthing arrangement, either:

- because they cannot be touched on large surfaces or grasped with the hand, or
- because they are of small size (approximately 50 mm by 50 mm) or so located as to exclude any contact with live parts.

These interconnections may be achieved either by metal screwed connections, welding or other conductive connections, or by a separate conductor providing earth continuity.

For lids, doors, cover plates and the like, the usual metal screwed connection and metal hinges are considered sufficient to ensure continuity provided that no electrical equipment is attached to them.

Compliance is checked according to the test of 9.12.

For the continuity of these connections, the following shall apply:

When a part of the enclosure is removed, for example for routine maintenance, the earth continuity for the remainder of the enclosure shall not be interrupted.

Means used for assembling the various metal parts of an enclosure are considered sufficient for ensuring earth continuity if the precautions taken guarantee permanent good conductivity (see also 9.12).

8.5.3 Requirements for class II enclosure 25

The enclosure shall be made of insulating material or of sheet metal with the inner walls fully insulated from internal live parts. In both cases, the insulation shall be equivalent of double or reinforced insulation.

The enclosure shall at no point be pierced by conducting parts in such a manner that there is the possibility of a fault voltage being brought out of the enclosure.

Compliance is checked according to the test of 9.11 and visual inspection.

8.6 ~~Degree of protection~~ Protection against mechanical impact (IK code) 26

The degree of protection against mechanical impact, as declared by the enclosure manufacturer, shall be in accordance with IEC 62262:2002 and IEC 62262:2002/AMD1:2021.

Compliance is checked according to the test of 9.8.

8.7 ~~Degree of protection~~ Protection against contact with live parts, ingress of solid foreign bodies and water (IP code) 27

The degree of protection against access to hazardous parts, against ingress of solid foreign objects and/or against ingress of water, as declared by the enclosure manufacturer, shall be in accordance with IEC 60529:1989 and IEC 60529:1989/AMD1:1999 and AMD2:2013.

Compliance is checked according to the test of 9.9.

NOTE An enclosure ~~may~~ can be assigned differing IP codes dependent upon the declared IK code.

8.8 Protection against corrosion 28

Protection against corrosion shall be ensured by the use of suitable materials or by the application of protective coating to the exposed surface, taking into account the intended conditions of use.

Compliance is checked according to the test of 9.14.

8.9 Enclosures constructed of or covered by insulating material 29

Enclosures or parts of enclosures constructed of insulating materials or covered by insulating materials shall fulfil the following additional requirements:

- thermal stability. If the thermal stability of the enclosure relies on insulating materials, then the compliance is checked according to the test of 9.10.1;
- resistance to normal heat. Compliance is checked according to the test of 9.10.2 (see 6.3.1);
- resistance to abnormal heat and fire. Compliance is checked according to the test of 9.10.3;
- dielectric strength. Compliance is checked according to the test of 9.11;
- resistance to ultra-violet (UV) radiation for outdoor applications, if applicable. Compliance is checked according to the test of 9.13.

9 Type tests

9.1 General

Tests according to this document are type tests.

9.2 General conditions of tests

The enclosures under test shall be mounted and installed as in normal use according to the enclosure manufacturer's instructions.

Unless otherwise specified, the tests shall be carried out at an ambient temperature of between +10 °C and +40 °C.

Table 2 shows the number of samples to be tested and the order of test per sample.

Table 2 – Number of samples to be tested and order of test per sample 30

Subclause	Test	Sample 1	Sample 2	Sample 3	Representative sample (see 9.12)
9.3	Marking	8			
9.4	Static loads	1			
9.5	Lifting	2			
9.6	Axial loads of metal inserts	3			
9.7	Degree of protection against external mechanical impacts (IK code)	4			
9.8	Degree of protection against access to hazardous parts and against ingress of solid objects and/or water (IP code)	5			
9.9.1	Thermal stability		1		
9.9.2	Resistance to heat		2		
9.9.3	Resistance to abnormal heat and fire		3		
9.10	Dielectric strength	6			
9.11	Continuity of the protective circuit	7		3	
9.12	Resistance to ultra violet (UV) radiation				^a
9.13	Resistance to corrosion			2	
9.14	Thermal power dissipation capability			1 ^b	
^a Tests carried out on representative sample only.					
^b Only applicable if verified by test.					

Sample 1	Sample 2	Sample 3	Representative sample (see 9.12)	Test	Subclause
Order of test					
1				Static loads	9.4
2				Lifting	9.5
3				Mechanical operation	9.6
4				Axial loads of metal inserts	9.7
5				Protection against mechanical impacts (IK code)	9.8
6				Protection against contact with live parts, ingress of solid foreign bodies and water (IP code)	9.9

7				Dielectric strength	9.11
8				Continuity of the protective circuit	9.12
9				Marking	9.3
	1			Thermal stability	9.10.1
	2			Resistance to normal heat	9.10.2
	3			Resistance to abnormal heat and fire	9.10.3
		1 ^{a, b}		Thermal power dissipation capability	9.15
		2 ^{b, c}		Resistance to corrosion	9.14
		3		Continuity of the protective circuit	9.12
			1	Resistance to ultra-violet (UV) radiation	9.13
^a Only applicable if verified by test. ^b Some tests are included in the sequences solely to reduce the number of samples required; the results have no significance for the preceding or following tests in the sequence. Therefore, for convenience of testing and by agreement with the enclosure manufacturer, these tests can be conducted on separate new samples and omitted from the relevant sequence. ^c Tests carried out on representative samples.					

All tests shall be carried out on complete enclosures. If this is not possible, they can be carried out on representative samples taken from the enclosure.

9.3 Marking

Marking made by moulding, pressing, engraving or similar method or means, including labels with a laminated plastic covering, shall not be submitted to the following test.

The test is made by rubbing the marking by hand for 15 s with a piece of cloth soaked in water and then for 15 s with a piece of cloth soaked with petroleum spirit.

~~NOTE The petroleum spirit is defined as a solvent hexane with a content of aromatics of maximum 0,1 % in volume, a kauributanol value of 29, an initial boiling point of 65 °C, a final boiling point of 69 °C and a density of approximately 0,68 g/cm³.~~

NOTE The petroleum spirits n-hexane or heptane are suitable solvents for this test. **31**

After the test, the marking shall be easily legible to normal or corrected vision without magnification.

9.4 Static loads

The enclosure fitted with all its required components to support the permissible load is loaded with a weight of 1,25 times the permissible load as declared by the enclosure manufacturer.

The loads are arranged on the mounting plate or switchgear and controlgear supports and on the door evenly distributed as specified by the enclosure manufacturer. The loads are retained for 1 h in the closed position.

~~The loads are retained for 1 h in the closed position.~~

~~For enclosures constructed of insulating material and metallic enclosures with parts (hinges, locks, etc.) of insulating material, this shall be carried out at 70 °C.~~

The closed door is opened and closed five times through 90°, the door is resting at least 1 min in the open position during each of the 5 operations.

For enclosures constructed of insulating material and metallic enclosures with parts (hinges, locks, etc.) of insulating material, ~~this part of the test may be carried out at ambient temperature external to the heating cabinet~~ the loads are retained for 1 h in the closed position at an ambient temperature of 70 °C.

The closed door is opened and closed five times through 90°, the door is resting at least 1 min in the open position during each of the 5 operations. This test can be conducted at ambient air temperature or during cool down. **32**

After the test, with the test loads in place, the enclosure shall show no cracks or permanent distortions and during the test no deflections which could impair any of its characteristics.

9.5 Lifting **33**

This test only applies to enclosures with provisions for lifting.

The enclosure is loaded as in 9.4 and with its door closed, is lifted with the specified lifting means and in the manner defined by the enclosure manufacturer.

~~From the standstill position, the enclosure is raised up three times in a vertical plane returning to the standstill position.~~

~~The enclosure is raised up and suspended for 30 min at a height of ≥ 1 m for 30 min without any movement.~~

~~Following this test, the enclosure is raised to a height of ≥ 1 m and moved $(10 \pm 0,5)$ m horizontally, then set down. This cycle, which should be carried out for $1 \text{ min} \pm 5 \text{ s}$ is repeated three times at uniform speed.~~

From a standstill position, the enclosure shall be raised smoothly without jerking in a vertical plane to a height ≥ 1 m and lowered in the same manner to a standstill position. This test is repeated a further two times after which the enclosure is raised up and suspended clear of the floor for 30 min without any movement.

Following this test, the enclosure shall be raised smoothly without jerking from a standstill position to a height ≥ 1 m and moved $(10 \pm 0,5)$ m horizontally, then lowered to a standstill position. This sequence shall be carried out three times at uniform speed, each sequence being carried out within 1 min.

After the test, with the test ~~loads~~ weights in place, the enclosure shall show no cracks or permanent distortions ~~and during the test no deflections~~, visible to normal or corrected vision without additional magnification, that could impair any of its characteristics.

9.6 Mechanical operation

If a door constitutes part of the enclosure, the operation of hinges, door latches and mechanical interlocks associated with its movements shall be verified. The number of operating cycles shall be 200. The test is passed if the operating conditions of these components and the specified degree of protection have not been impaired.

9.7 Axial loads of metal inserts

This test applies to ~~all kind of~~ enclosures when threaded metal inserts are provided to retain the mounting plate or switchgear and controlgear supports in place.

The test shall be carried out by applying an axial load for 10 s to representative samples, as indicated in Table 3.

Table 3 – Axial loads of metal inserts

Size of inserts M ^a	Axial load N
4	350
5	350
6	500
8	500
10	800
12	800
^a M: metric thread-size	

During the test, the enclosure shall fully rest on a supporting platform to allow the application of the above mentioned load.

At the end of the test, the insert shall still be in its original position; any sign of movement is not acceptable.

Cracks and splits in the material containing the insert are also not acceptable.

NOTE Small cracks or air bubbles that were visible before the test, but not caused by the application of the axial load, are ignored.

9.8 Degree of protection against external mechanical impacts (IK code)

Verification of the degree of protection against mechanical impacts shall be carried out in accordance with IEC 62262 by means of a test hammer suitable for the dimensions of the enclosure.

The enclosure shall be fixed on a rigid support as for normal use.

The impact energy shall be applied:

- three times to each exposed surface in normal use whose largest dimension is not above 1 m;
- five times to each exposed surface in normal use whose largest dimension is greater than 1 m.

The impacts shall be applied with even distribution over the faces of the enclosure.

The test shall not be applied to the enclosure components (e.g. locks, hinges).

After the test, the enclosure shall continue to provide the **protections as designated by the IP code** and, **if applicable, the dielectric strength**. Removable covers can be removed and reinstalled, doors opened and closed.

9.9 Degree of protection (IP code)

9.9.1 Degree of protection against access to hazardous parts and against the ingress of solid foreign objects indicated by first characteristic numeral

9.9.1.1 Protection against access to hazardous parts

IEC 60529:1989, 12.1 and 12.2 apply.

The access probes shall not enter the protected space.

NOTE In the United States of America (USA) and Canada, enclosure “Type” designations are used with IP code. See more information in Annex A.

9.9.1.2 Degree of protection against the ingress of solid foreign objects

For IP2X, IP3X, IP4X enclosures, IEC 60529:1989, 13.2 and 13.3 and IEC 60529:1989/AMD1:1999, 13.3 of apply.

For IP5X enclosures, IEC 60529:1989, 13.4, category 2 (without vacuum pump) and 13.5 (without vacuum pump) ~~of~~ and IEC 60529:1989/AMD1:1999, 13.4 apply. Ingress of talcum powder into protected space is verified as follows:

- Ingress of talcum powder is verified by using a watch glass installed at the centre of the base of the protected space of the enclosure in order to pick up the talcum powder entering the protected space during the test. After the test, talcum powder shall not form deposits of more than 1 g/m²;
- In practice the weight of the watch glass is measured before and at the end of the test and the difference between both measures is representative of the amount of the talcum powder which has entered the protected space.

For IP6X enclosures, IEC 60529:1989, 13.6 applies. No talcum powder shall be observable inside the enclosure at the end of the test.

Where the enclosure tested according to 9.8 is too large for the verification of IP5X or IP6X, an additional smaller enclosure having the same design details ~~may~~ can be used for this test.

9.9.2 Degree of protection against ingress of water as indicated by second characteristic numeral

IEC 60529:1989, 14.1 and 14.2 ~~of~~ and IEC 60529:1989/AMD2:2013, 14.1 and 14.2 apply.

After the test, water shall not have ingressed into the protected space.

Ingress of water is verified by the use of dry absorbent paper positioned to occupy the base area of each protected space.

For doors or covers intended to accommodate equipment, a strip of paper, bent to form a 90° angle profile, is attached to the base of the declared protected space for that surface.

The paper should project from the surface equal to the depth of the protected space or a maximum of 30 mm.

Where the enclosure has any uncovered aperture, a section of absorbent paper, equal to or greater than the size of the aperture, is positioned on the surface of the protected space in its immediate vicinity.

Immediately after the test, all indicator papers shall still be dry.

In practice, a coloured blotting or filter paper will show very clearly any moisture by its discolouration.

9.9.3 Degree of protection against hazardous parts as indicated by additional letter

IEC 60529:1989, Clause 15 applies.

The access probe shall not touch the surface of the protected space.

9.10 Properties of insulating materials

9.10.1 Thermal stability

Parts intended for decorative purposes that have no technical significance shall not be considered for the purpose of this test.

The thermal stability of enclosures manufactured from insulating material shall be verified by the dry heat test. The test shall be carried out according to IEC 60068-2-2 Test Bb, at a temperature of 70 °C, with natural air circulation, for a duration of 168 h (seven days).

The enclosure, mounted as for normal use, is subjected to a test in a heating cabinet with an atmosphere having the composition and pressure of the ambient air with no forced ventilation. If the dimensions of the enclosure are inconsistent with those of the heating cabinet, the test may be carried out on a representative sample of the enclosure.

NOTE 1—The sample of the enclosure should include portions in which the molding process would require the insulating material to flow in a non-linear path and consequently be highly stressed. Place of material sampling should be determined by agreement between the enclosure manufacturer and the testing laboratory.

The use of an electrically heated cabinet is recommended.

After the treatment, the enclosure or sample is removed from the cabinet and kept at ambient temperature and a relative humidity of between 45 % and 55 % for at least 96 h (four days).

The enclosure or sample shall show no crack visible to normal or corrected vision without additional magnification nor shall the material have become sticky or greasy, this being judged as follows:

With the forefinger wrapped in a dry piece of rough cloth, the sample is pressed with a force of 5 N.

NOTE 2—The force of 5 N can be obtained in the following way: the enclosure or sample is placed on one of the pans of a balance and the other pan is loaded with a mass equal to the mass of the sample plus 500 g. Equilibrium is then restored by pressing the sample with the forefinger wrapped in a dry piece of rough cloth.

No traces of the cloth shall remain on the sample and the material of the enclosure or sample shall not stick to the cloth.

9.10.2 Resistance to normal heat

The suitability of the insulating materials to resist effects of heat shall be verified either by reference to the insulation temperature index (determined e.g. by the methods of IEC 60216 series), or by compliance with IEC 60085:2007.

As alternative, the test procedure reported in IEC 60695-10-2:2014, method A, can be used. **34**

NOTE With recognition of the differences to other methods, insulating materials can also be selected based on the relative thermal index (RTI), UL 746B.

9.10.3 Resistance to abnormal heat and ~~to fire~~ due to internal electric effects

Compliance is checked by tests in accordance with the principles of IEC 60695-2-10:2021 and the details of IEC 60695-2-11:2021. For a description of the test, see IEC 60695-2-11:20002021, Clause 4.

The apparatus to be used shall be as described in IEC 60695-2-11:20002021, Clause 5.

If the dimensions of the enclosure are inconsistent with those of the test apparatus, the test shall be carried out on a sample. This sample shall be taken from an area of minimum thickness taken from the enclosure. In the case of doubt, the test shall be repeated on two further samples.

NOTE 1—The sample of the enclosure should include portions in which the molding process would require the insulating material to flow in a non-linear path and consequently be highly stressed. Place of material sampling should be determined by agreement between the enclosure manufacturer and the testing laboratory. **35**

The sample is stored for 24 h in an atmosphere having a temperature between 15 °C and 35 °C and a relative humidity of between ~~35~~ 45 % and ~~45~~ 75 % before starting the test.

The apparatus shall be placed in a substantially draught-free dark room, so that the flames occurring during the test are visible.

Before starting the test, the thermocouple is ~~calibrated~~ verified in accordance with IEC 60695-2-10:20002021, Clause 5.

During the test, the procedure given in IEC 60695-2-10:20002021, Clause 8 and IEC 60695-2-11:20002021, Clause 10 shall be followed.

After each test, it is necessary to clean the tip of the glow wire of any residue of insulating material, for example by means of a brush.

The temperature of the tip of the glow wire shall be as follows:

- for parts intended to retain current-carrying parts in position: (960 ± 15) °C;
- for parts intended to be installed in hollow walls: (850 ± ~~45~~10) °C;
- for all other parts, including parts not intended to retain current-carrying parts in position including the earth terminal and parts intended to be embedded in walls which are combustion-resistant: (650 ± ~~45~~10) °C.

NOTE 2 First bullet is only valid if the enclosure is equipped with supports for busbars.

The duration of application shall be (30 ± 1) s.

During application of the glow wire and during a further period of 30 s, the specimen, the parts surrounding the specimen and the layer of tissue paper placed below it shall be observed.

The time at which the specimen ignites and the time when flames extinguish during or after the period of application are noted.

The specimen is considered to have withstood the glow-wire test if

- there is no visible flame and no sustained glowing, or if
- flames and glowing of the specimen extinguish within 30 s after removal of the glow wire.

There shall be no burning of the tissue paper or scorching of the pinewood board.

NOTE 23 Higher temperatures, shorter times for the flame to extinguish and other times of application can be applied, subject to agreement between the enclosure manufacturer and the user.

For small parts having surface dimensions not exceeding 14 mm × 14 mm, an alternative test may be used (e.g. needle flame test, according to IEC 60695-11-5:2016, with a duration of 30 s ± 1 s.). The same procedure may be applicable for other practical reasons where the metal material of a part is large compared to the insulating material. 36

9.11 Dielectric strength

9.11.1 General

This test applies to enclosures where insulating material is used, even in combination with non-insulating materials.

Compliance is checked as indicated in 9.11.2 to 9.11.5.

9.11.2 Preconditioning

The enclosures are placed in a humidity cabinet containing air with relative humidity maintained at between 91 % and 95 %. The air temperature, where the enclosures are placed, is maintained at (40 ± 2) °C.

The enclosures are kept in the cabinet for 48 h (two days).

In most cases, the enclosures ~~may~~ can be brought to the specified temperature by keeping them at this temperature for at least 4 h before the humidity treatment. A relative humidity of between 91 % and 95 % can be obtained by placing in the cabinet a saturated solution of sodium sulphate (Na₂SO₄) or potassium nitrate (KNO₃) in water having a sufficiently large contact surface with the air.

In order to achieve the specified conditions within the cabinet, it is necessary to ensure a constant circulation of air and, in general, to use a cabinet which is thermally insulated.

9.11.3 Enclosures without metal elements inside the protected space 37

An AC RMS dielectric test voltage of substantially sine-wave form or DC dielectric test voltage at a value of 1,5 times to the values according to ~~10.9.4 of IEC 61439-1:2011~~ Table 4 is applied for 1 min between two metal foils, one in contact with the external surface and the other inside the enclosure at the limit of the protected space.

Initially, not more than half the prescribed voltage is applied. It is then raised rapidly to ~~the full value~~ 1,5 times of the values indicated in Table 4.

Table 4 – Dielectric test voltage

Rated insulation voltage U_i AC or DC V	Dielectric test voltage AC RMS V	Dielectric test voltage DC V
$U_i \leq 60$	1 000	1 415
$60 < U_i \leq 300$	1 500	2 120
$300 < U_i \leq 690$	1 890	2 670
$690 < U_i \leq 800$	2 000	2 830
$800 < U_i \leq 1\,000$	2 200	3 110
$1\,000 < U_i \leq 1\,500^a$	2 700	3 820
^a For DC only.		

9.11.4 Enclosures having metal elements inside the protected space 37

All internal metallic parts are connected to a copper bar, and an AC RMS dielectric test voltage of substantially sine wave form or DC dielectric test voltage at a value of 1,5 times to the values according to ~~10.9.4 of IEC 61439-1:2011~~ Table 4 is applied for 1 min between a metal foil in contact with the external surface and the bar. For enclosures with double or reinforced insulation, the test voltage for this test shall be twice the values according to Table 4.

Initially, not more than half the prescribed voltage is applied. It is then raised rapidly to the ~~full value~~ increased test voltage as determined in the previous paragraph.

~~NOTE~~ A hole in the external surface of the enclosure ~~enables~~ can enable the voltage to be connected to the bar. Creepage and clearance distances between the bar and the external surface should be taken into account. **38**

9.11.5 Results to be obtained

The samples shall show no damage impairing their further use; no flashover or breakdown shall occur during the test.

9.12 Effective earth continuity between the exposed-conductive-parts of the class I enclosure and the protective circuit 39

It shall be verified that the different exposed conductive parts of the enclosure are effectively connected to the ~~earthing terminal or contact of the protective circuit and that the resistance of the circuit does not exceed 0,1 Ω~~ terminal or contact for the incoming earthing or protective conductor.

Verification shall be made using a resistance-measuring instrument ~~or arrangement~~ that is capable of driving a current of at least 10 A (AC or DC). The current is passed between each exposed conductive-part and the ~~earthing termination point~~ means for the connection of an external earthing or protective conductor. ~~The voltage drop between these points is measured. The resistance calculated from the current and this voltage drop shall not exceed 0,1 Ω .~~

~~NOTE~~ In case of doubt, the test is carried out until a consistent measurement has been established.

9.13 Resistance to ultra-violet (UV) radiation 40

9.13.1 Verification by test

9.13.1.1 General

This test applies only to enclosures and external parts of enclosures intended to be installed outdoors and which are constructed of insulating materials or ~~metals~~ enclosures that are entirely coated by synthetic material. Representative samples of such parts shall be subjected to the following test.

~~UV test according to ISO 4892-2 method A, cycle 1 with a total test period of 500 h.~~

~~For enclosures constructed of insulating materials compliance is checked by verification that the flexural strength (according to ISO 178) and Charpy impact (according to ISO 179) of insulating materials have 70 % minimum retention. For the test carried out in accordance with ISO 178 the surface of the sample exposed to UV shall be turned face down and the pressure applied to the non-exposed surface. For the test carried out in accordance with ISO 179 no grooves shall be cut into the sample and the impact shall be applied to the exposed surface. After the test, samples shall be subjected to the glow-wire test of 9.9.3.~~

~~For compliance, enclosures constructed of metals entirely coated by synthetic material, the adherence of the insulating material shall have a minimum retention of category 3 according to ISO 2409 (a cross-cut area greater than 15 %, but not greater than 35 % is affected).~~

~~Samples shall not show cracks or deterioration visible to normal or corrected vision without additional magnification.~~

~~This test need not be carried out if the manufacturer can provide data from the material supplier to demonstrate that materials of the same thickness or thinner comply with this requirement.~~

9.13.1.2 Verification for enclosures and external parts of enclosures constructed of insulating materials 41

Test samples:

- six test specimens of standard size according to ISO 178:2019, and
- six test specimens of standard size according to ISO 179-1:2010 and ISO 179-2:2020

shall be prepared

The test specimens shall be made under the same conditions as those used for the manufacture of the enclosure being considered.

Test sequence:

- UV test on all twelve samples according to ISO 4892-2:2013, method A, cycle 1 providing a total test period of 500 h.
- Verification of the flexural strength in accordance with ISO 178:2019 (method A) with six of the samples. The surface of the sample exposed to UV radiation shall be turned face down and the pressure applied to the non-exposed surface.
- Verification of the Charpy impact in accordance with ISO 179-1:2010 or ISO 179-2:2020 on the other six samples. No notches shall be cut into the sample and the impact shall be applied to the exposed surface.

Results to be obtained:

- Samples shall not show cracks or deterioration visible to normal or corrected vision without additional magnification.

- The flexural strength according to ISO 178:2019 shall have 70 % minimum retention.
- The Charpy impact according to ISO 179-1:2010 or ISO 179-2:2020 shall have 70 % minimum retention. For materials whose impact bending strength cannot be determined prior to exposure because no rupture has occurred, not more than three of the exposed test specimens shall be allowed to break.

9.13.1.3 Verification for enclosures and external parts of enclosures coated on their exposed surface(s) by synthetic material 42

Test sample: Three representative samples of suitable size shall be tested. The test specimens shall be made under the same conditions as those used for the manufacture of the enclosure being considered.

Test sequence:

- a) UV test on all three samples according to ISO 4892-2:2013, method A, cycle 1 providing a total test period of 500 h.
- b) Verification of the retention of the coating according to ISO 2409:2020.

Results to be obtained:

The adherence of the synthetic material shall have a minimum retention of category 3 according to ISO 2409:2020.

9.13.2 Verification by comparison to a reference design 43

Enclosures and external parts made of the same insulating materials, irrespective of their shape and size, are covered by the test on the representative samples.

9.14 Resistance to corrosion 44

9.14.1 General

Ferrous metallic enclosures and external ferrous metallic parts of insulating and combined enclosures shall be tested to verify that they ensure protection against corrosion.

If it is not possible to carry out the test on the enclosure, the test shall be carried out on enclosure elements showing the same constructional detail as the enclosure itself: material, thickness, layer of coating, etc. ~~In all cases hinges, locks and fastenings shall be tested.~~

In all cases, hinges, locks and fastenings shall also be tested unless they have previously been subjected to an equivalent test and their resistance to corrosion has not been compromised by their application.

The enclosure subjected to the test shall be mounted as for normal use according to the enclosure manufacturer's instructions.

The enclosure or samples shall be new and in a clean condition.

NOTE For special service conditions (7.3) other criteria ~~may~~ can apply, subject to an agreement between the enclosure manufacturer and the user.

9.14.2 Test procedure

9.14.2.1 General

Enclosures shall be subjected to the test defined in 9.14.2.2 or in 9.14.2.3:

9.14.2.2 Severity test A

This test is applicable to:

- ferrous metallic indoor enclosures;
- external ferrous metallic parts of indoor enclosures;
- internal ferrous metallic parts of indoor and outdoor enclosures upon which intended mechanical operation ~~may~~ can depend.

The test consists of:

- 6 cycles of 24 h each to damp heat cycling test according to IEC 60068-2-30:2005 (Test Db) at $(40 \pm 3) ^\circ\text{C}$ and relative humidity of 95 %,

and

- 2 cycles of 24 h each to salt mist test according to IEC 60068-2-11:2021 (Test Ka: Salt mist), at a temperature of $(35 \pm 2) ^\circ\text{C}$.

9.14.2.3 Severity test B

This test is applicable to:

- ferrous metallic outdoor enclosures;
- external ferrous metallic parts of outdoor enclosures.

The test comprises two identical 12-day periods.

Each 12-day period comprises:

- 5 cycles of 24 h each to damp heat cycling test according to IEC 60068-2-30:2005 (Test Db) at $(40 \pm 3) ^\circ\text{C}$ and relative humidity of 95 %,

and

- 7 cycles of 24 h each to salt mist test according to IEC 60068-2-11:2021; (Test Ka: Salt mist), at a temperature of $(35 \pm 2) ^\circ\text{C}$.

9.14.3 Results to be obtained

After the test, the enclosure or samples shall be washed in running tap water for 5 min, rinsed in distilled or demineralized water then shaken or subjected to air blast to remove water droplets. The specimen under test shall then be stored under normal service conditions for 2 h.

Compliance is checked by visual inspection to determine that:

- there is no evidence of iron oxide, cracking or other deterioration more than that allowed by ISO 4628-3:2016 for a degree of rusting Ri1 (considering the sample as a whole). However, surface deterioration of the protective coating is allowed. In case of doubt associated with paints and varnishes, reference shall be made to ISO 4628-3:2016 to verify that the samples conform to the specimen Ri1;
- the mechanical integrity is not impaired;
- seals are not damaged;
- doors, hinges, locks, and fastenings work without abnormal effort.

9.15 Thermal power dissipation capability 45

~~The thermal power dissipation data provided by the manufacturer (see 6.3.1) shall be determined by test in accordance with 10.10.4.2.2 of IEC 61439-1:2011, or by a calculation method, e.g. according to IEC/TR 60890.~~

9.15.1 General

The thermal power dissipation data (see 6.3.7) provided by the enclosure manufacturer shall be determined by test or by calculation and comparison or by calculation method.

9.15.2 Determination of the power dissipation capability by test 46

The ambient air temperature shall be measured by means of at least two thermometers or thermocouples equally distributed around the enclosure at approximately half its height and at a distance of approximately 1 m from the enclosure. The thermometers or thermocouples shall be protected against air currents and heat radiation.

The ambient air temperature during the test shall be between +10 °C and +40 °C.

The air temperature-rise (air temperature inside the enclosure minus the average of the measured values of the ambient air temperature) shall be measured in the top of the enclosure. For accessible external enclosures and covers, it shall not exceed:

- metal surfaces 30 K
- insulating surfaces 40 K

The temperature-rise limits apply for a daily average ambient air temperature up to 35 °C under service conditions.

The power loss shall be simulated by means of heaters that produce heat equivalent to the intended power loss capability of the enclosure. The heating resistors shall be distributed evenly over the height of the enclosure and installed in suitable places inside the enclosure.

9.15.3 Determination of the power dissipation capability by calculation and comparison

The power dissipation capability can also be determined by calculation, and comparison with a tested reference design.

This method is used specially to interpolate different dimensions or technical variants into the same range of construction of enclosure.

This method requests that the following conditions are fulfilled:

- a) technical criteria (e.g. dimensions, raw material, thickness, IP degree, openings, installation condition with covered or exposed sides) of a reference design used for calculation shall be exactly the same as those of the tested reference design;
- b) the heat generated by the selected equipment is distributed uniformly inside the protected space;
- c) test on reference design is carried out in accordance with 9.15.2;
- d) for any reference enclosure configuration verified by test, the thermal power dissipation capability measured shall be strictly higher than the calculation method performed on the same enclosure configuration and specification;
- e) In case of interpolation to a full range sizing, at least the smallest and largest size of the range shall be tested. Enclosures shall have the same generic design and the same physical construction and refer to a suitable and a typical reference design verified by calculation and compared with a tested reference design.

9.15.4 Determination of the power dissipation capability by calculation method

The thermal power dissipation capability determined by calculation shall be performed in accordance with IEC TR 60890.

For the purpose of the calculation, it is assumed that the heat generated by the selected equipment is distributed uniformly inside the protected space.

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Annex A (informative)

List of notes concerning certain countries

Clause/Subclause	Text
1	Add a new Note after Note 1: The United States of America (USA) uses enclosure “Type” designations according to UL 50 and UL 50E. The enclosure Type designations specify additional environmental requirements for conditions such as corrosion, rust, icing, oil, and coolants. For this reason, the IEC Enclosure Classification Designations IP are used with an enclosure Type designation number appropriate for these markets.
1	Add a new Note after Note 1: Canada uses enclosure type designations in accordance with CSA standard C22.2 No. 94.1 and 94.2. Type designations specify additional environmental requirements for conditions such as corrosion, rust, icing, oil, and coolants. For this reason, the IEC enclosure classification designations IP are used with an enclosure type designation number appropriate for these applications.

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Bibliography

IEC 60050-312:2001, *International Electrotechnical Vocabulary (IEV) – Part 312: General terms relating to electrical measurements*

IEC 60050-426:2020, *International Electrotechnical Vocabulary (IEV) – Part 426: Explosive atmospheres*

IEC 60216 (all parts), *Electrical insulating materials – Thermal endurance properties*

IEC 60417, *Graphical symbols for use on equipment*, available at <http://www.graphical-symbols.info/equipment>

IEC 60670 (all parts), *Boxes and enclosures for electrical accessories for household and similar fixed electrical installations*

IEC 60670-24, *Boxes and enclosures for electrical accessories for household and similar fixed electrical installations – Part 24: Particular requirements for enclosures for housing protective devices and other power dissipating electrical equipment*

IEC 60715, *Dimensions of low-voltage switchgear and controlgear – Standardized mounting on rails for mechanical support of switchgear, controlgear and accessories*

IEC 60721-3-3:2019, *Classification of environmental conditions – Part 3-3: Classification of groups of environmental parameters and their severities – Stationary use at weather protected locations*

~~IEC/TR 60890, A method of temperature rise assessment by extrapolation for partially type-tested assemblies (PTTA) of low voltage switchgear and controlgear~~

IEC 61000-5-7:2001, *Electromagnetic compatibility (EMC) – Part 5-7: Installation and mitigation guidelines – Degrees of protection provided by enclosures against electromagnetic disturbances (EM code)*

IEC 61140:2016, *Protection against electric shock – Common aspects for installation and equipment*

IEC 61439 (all parts), *Low-voltage switchgear and controlgear assemblies*

IEC 61439-1:2020, *Low-voltage switchgear and controlgear assemblies – Part 1: General rules*

CSA C22.2 NO 94.1, *Enclosures for electrical equipment, non-environmental considerations*

CSA C22.2 NO 94.2, *Enclosures for electrical equipment, environmental considerations*

UL 50, *Standard for enclosures for electrical equipment*

UL 50E, *Compression Test for Gaskets and Seals*

UL 746B, *Polymeric Materials – Long Term Property Evaluations*

List of comments

- 1 Editorial change to avoid confusion, as the term “supplied” can be understood as supplied by the supply chain.
- 2 This wording is moved to Annex A (informative) “List of notes concerning certain countries”. Reference to Standard NEMA 250 is replaced with reference to Standards UL50 and UL50E, as these Standards are used together.
- 3 IEC 62208 is a product standard for the product “empty enclosure” and an empty enclosure may also be used for applications other than assemblies according to IEC 61439. It is considered suitable to avoid misunderstandings with the term “applicable product standard”.
- 4 This definition is reworded in order to align it with definition 3.4.15 “protected space” of IEC 61439-1:2020.
- 5 In the whole document it is stated if a requirement affects the enclosure or the assembly manufacturer; so, there is no longer a need to define the enclosure manufacturer.
- 6 This definition is taken from IEC 61439-1:2020 in order to align this edition 3.0 of IEC 62208 with IEC 61439-1:2020.
- 7 In Clause 4 and in Subclause 6.3.1, the term “rated insulation voltage” is mentioned; however, no definition nor explanation of this term is given in the document. As a consequence, it is deemed as necessary to include a definition.
- 8 This definition is taken from IEC 61439-1:2020 but modified in order to fit it to enclosures. The aim is to align this edition 3.0 of IEC 62208 with IEC 61439-1:2020.
- 9 This definition is the same than definition 3.5.1 in IEC 61439-1:2020. It is introduced in order to align this edition 3.0 of IEC 62208 with IEC 61439-1:2020.
- 10 This definition is the same than definition 3.5.2 in IEC 61439-1:2020. It is introduced in order to align this edition 3.0 of IEC 62208 with IEC 61439-1:2020.
- 11 The text is changed in order to make EMC a facultative feature of the enclosure.
- 12 The note is changed to normative text as it is a requirement.
- 13 The whole clause is reworded to ease reading and understanding.
- 14 Rated insulation voltage also needs to be given for Class II type enclosures.
- 15 There was no requirement related to check the suitability of insulating materials in relation with the temperatures that can be attained by the enclosure; also, there was no requirement for the enclosure manufacturer to state the verified temperature.
- 16 This text is about thermal power dissipation capability. It is considered that power dissipation is not a general characteristic, so a new Subclause 6.3.7 “Thermal power dissipation capability” is created and this text is moved to that subclause.
- 17 Deleted because it is considered as redundant with the first paragraph of 6.3.3.
- 18 Subclauses 7.2.1 to 7.2.2.2 are included in Table 1. Table 1 of this edition 3.0 of IEC 62208 is aligned with Table 15 of IEC 61439-1:2020.
- 19 This text is aligned with Subclause 7.2 of IEC 61439-1:2020.
- 20 This text is moved to new Subclause 8.8 “Protection against corrosion”; these are specific requirements, not general requirements.
- 21 This text is moved to new Subclause 8.9 “Enclosures constructed of or covered by insulating material”; these are specific requirements, not general requirements.
- 22 Enclosures are often sold with accessories (bases (plinths), wheels, etc.) that are specifically designed for these enclosures and, in consequence, shall withstand the same loads as the enclosure. Therefore, load-bearing capacity of accessories shall match with load-bearing capacity of the enclosure.
- 23 This text is moved to new Subclause 8.9 “Enclosures constructed of or covered by insulating material”.

- 24 The text of this subclause is aligned with subclause 8.4.3.2.2 of IEC 61439-1:2020.
- 25 The text of this subclause is aligned with subclause 8.4.4 of IEC 61439-1:2020.
- 26 The text of this subclause is aligned with Subclause 8.2.1 of IEC 61439-1:2020; in addition, Standard to be applied to check IK code are introduced.
- 27 The text of this subclause is aligned with Subclause 8.2.2 of IEC 61439-1:2020.
- 28 The text of this subclause is aligned with Subclause 8.1.2 of IEC 61439-1:2020.
- 29 It is considered as an improvement to gather all requirements for enclosures made of insulating material in this subclause.
- 30 This table was Table 1 in previous edition 2.0, and tests were ordered according to the number of clauses.
In this edition 3.0, tests are ordered according to the order in which tests are carried out; the aim is to make Standard easier to be read and understood.
- 31 Solvent as defined is not easily available; it is decided to replace it with more easily available solvents.
- 32 The wording is rewritten in order to precise test as much as possible.
- 33 The text of this subclause is aligned with Subclause 10.2.5 of IEC 61439-1:2020.
- 34 In IEC 60695-10-2, test methods A and B are described; the most suitable for empty enclosures is method A.
- 35 This text is converted into normative as it contains a recommendation, and a note cannot contain recommendations.
- 36 An alternative test is defined in this paragraph as it can be difficult testing small parts with glow wire.
- 37 In previous edition 2.0 of IEC 62208, reference to Subclause 10.9.4 of IEC 61439-1:2011 was made; in addition, in Subclause 10.9.4 of IEC 61439-1:2011 reference to Table 8 of IEC 61439-1 was made.
In order to avoid the need to read in two different Standards, Table 8 of IEC 61439-1:2020 is copied as Table 4 in this new edition 3.0 of IEC 62208 and reference to IEC 61439-1 is removed.
- 38 This text is converted into normative as it is a recommendation, and a note cannot contain recommendations.
- 39 The text of this subclause is aligned with Subclause 10.5.2 of IEC 61439-1:2020.
- 40 This subclause is replaced with the wording of Subclause 10.2.4 of IEC 61439-1:2020; it is more completed and updated than the existing in previous edition 2.0 of IEC 62208.
- 41 This test is aligned with IEC 61439-1:2020; this subclause is the same as 10.2.4.1.1 of IEC 61439-1:2020.
- 42 This test is aligned with IEC 61439-1:2020; this subclause is the same as 10.2.4.1.2 of IEC 61439-1:2020.
- 43 This test is aligned with IEC 61439-1:2020; this subclause is the same as 10.2.4.2 of IEC 61439-1:2020.
- 44 This test is aligned with IEC 61439-1:2020; this subclause is the same as 10.2.2 of IEC 61439-1:2020.
- 45 In previous edition 2.0, reference to Clause 10.10.4.2.2 of IEC 61439-1 was made; in order to avoid the need to read in two different Standards, subclauses for each of the different ways to assess power dissipation are created.
Also, Subclause 9.15 is aligned with requirements in IEC 61439-1:2020.
- 46 This subclause is aligned with Subclause 10.10 and Table 6, both of IEC 61439-1:2020.
- 47 In this table, Note 2 from the scope of edition 2.0 of IEC 62208 and a new note for Canada are included.

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Empty enclosures for low-voltage switchgear and controlgear assemblies –
General requirements**

**Enveloppes vides destinées aux ensembles d'appareillage à basse tension –
Exigences générales**

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**EMPTY ENCLOSURES FOR LOW-VOLTAGE
SWITCHGEAR AND CONTROLGEAR ASSEMBLIES –
GENERAL REQUIREMENTS**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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IEC 62208 has been prepared by subcommittee 121B: Low-voltage switchgear and controlgear assemblies, of IEC technical committee 121: Switchgear and controlgear and their assemblies for low voltage. It is an International Standard.

This third edition cancels and replaces the second edition published in 2011. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) consideration of the modifications introduced in IEC 61439-1:2020;
- b) alignment of test procedures with the newest relevant standards.

The text of this International Standard is based on the following documents:

Draft	Report on voting
121B/180/FDIS	121B/180/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

The reader's attention is drawn to the fact that Annex A lists all of the "in-some-country" clauses on differing practices of a less permanent nature relating to the subject of this document.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

The purpose of this document is to harmonize as far as practicable all rules and requirements of a general nature applicable to empty enclosures for low-voltage switchgear and controlgear assemblies, in order to obtain uniformity of requirements and verification for empty enclosures and to avoid the need for verification in other standards.

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EMPTY ENCLOSURES FOR LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR ASSEMBLIES – GENERAL REQUIREMENTS

1 Scope

This document applies to empty enclosures, as provided by the enclosure manufacturer, prior to the incorporation of switchgear and controlgear components by the assembly manufacturer.

This document specifies general definitions, classifications, characteristics and test requirements of enclosures to be used as part of switchgear and controlgear assemblies (e.g. in accordance with the product standard in the IEC 61439 series), the rated voltage of which does not exceed 1 000 V AC or 1 500 V DC, and suitable for general use for either indoor or outdoor applications.

NOTE 1 Additional requirements could apply for specific applications.

NOTE 2 Empty enclosures according to this document are suitable for mounting of electrical components.

This document does not apply to enclosures which are covered by other specific products standards (e.g. IEC 60670-24).

Compliance with the safety requirements of the applicable product standard for the final product produced using an empty enclosure is the responsibility of the assembly manufacturer.

NOTE 3 This document could serve as a basis for other technical committees.

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.

IEC 60068-2-2:2007, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60068-2-11:2021, *Environmental testing – Part 2-11: Tests – Test Ka: Salt mist*

IEC 60068-2-30:2005, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60085:2007, *Electrical insulation – Thermal evaluation and designation*

IEC 60364 (all parts), *Low-voltage electrical installations*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*

IEC 60529:1989/AMD1:1999

IEC 60529:1989/AMD2:2013

IEC 60695-2-10:2021, *Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure*

IEC 60695-2-11:2021, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test methods for end-products (GWEPT)*

IEC 60695-10-2:2014, *Fire hazard testing – Part 10-2: Abnormal heat – Ball pressure test method*

IEC 60695-11-5:2016; *Fire hazard testing – Part 11-5: Test flames – Needle-flame test method – Apparatus, confirmatory test arrangement and guidance*

IEC TR 60890:2014, *A method of temperature-rise verification of low-voltage switchgear and controlgear assemblies by calculation*

IEC 62262:2002, *Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)*
IEC 62262:2002/AMD1:2021

ISO 178:2019, *Plastics – Determination of flexural properties*

ISO 179-1:2010, *Plastics – Determination of Charpy impact properties – Part 1: Non-instrumented impact test*

ISO 179-2:2020, *Plastics – Determination of Charpy impact properties – Part 2: Instrumented impact test*

ISO 2409:2020, *Paints and varnishes – Cross-cut test*

ISO 4628-3:2016, *Paints and varnishes – Evaluation of degradation of coatings – Designation of quantity and size of defects, and of intensity of uniform changes in appearance – Part 3: Assessment of degree of rusting*

ISO 4892-2:2013, *Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc lamps*

ISO 11469:2016, *Plastics – Generic identification and marking of plastic products*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

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

3.1

empty enclosure

enclosure intended for support and installation of electrical equipment, whose internal space provides suitable protection against external influences as well as a specified degree of protection against approach to or contact with live parts and against contact with moving parts

Note 1 to entry: Throughout this document, the word enclosure is used for empty enclosure.

Note 2 to entry: For the purposes of this document, the terms boxes, cubicles, desks or cabinets are alternative terms for enclosures.

3.2**protected space**

internal space or portion of an enclosure as specified by the enclosure manufacturer intended to enclose electrical components, and which provides defined protection against external influences and contact with live parts

3.3**cover**

external part of the enclosure

3.4**door**

hinged or sliding cover

3.5**mounting plate**

separate internal accessory of the enclosure intended for the mounting of electrical components

3.6**cable gland plate**

removable accessory of the enclosure, intended for securing and sealing of cables, conductors and conduits at their point of entry

3.7**removable cover**

cover which is designed for closing an opening in the external enclosure and which can be removed for carrying out certain operations and maintenance work

Note 1 to entry: A lid is considered as a removable cover.

3.8**inspection**

action comprising careful scrutiny, including visual scrutiny where conditions are obvious, of an item carried out either without dismantling, or with the addition of partial dismantling as required, supplemented by means such as measurement, in order to arrive at a reliable conclusion as to the condition of an item

[SOURCE: IEC 60050-426:2020, 426-14-02, modified – "including visual scrutiny where conditions are obvious" has been added.]

3.9**rated insulation voltage**

U_i

value of the RMS withstand voltage assigned by the enclosure manufacturer to the enclosure or to a part of it, characterizing the specified (long-term) withstand capability of its insulation

[SOURCE: IEC 60050-312:2014, 312-06-02, modified – Symbol U_i has been added, in the definition "rated value" has been replaced by "value", "enclosure" has been added to manufacturer, "equipment" has been replaced by "enclosure" and the Note has been deleted.]

3.10

class I enclosure

enclosure with at least one provision for a basic protection and a connection to a protective conductor as provision for fault protection

Note 1 to entry: See IEC 61140:2016, 7.3 for further details.

[SOURCE: IEC 61439-1:2020, 3.7.24, modified – "assembly" has been replaced by "enclosure" and Note 2 to entry has been deleted.]

3.11

class II enclosure

enclosure which is provided with the following;

- basic insulation as provision for basic protection, and
 - supplementary insulation as provision for fault protection,
- or in which
- basic protection and fault protection are provided by reinforced insulation

Note 1 to entry: See IEC 61140:2016, 7.4 for further details.

[SOURCE: IEC 61439-1:2020, 3.7.25, modified – "assembly" has been replaced by "enclosure".]

3.12

empty enclosure for indoor installation

empty enclosure that is designed for use in locations where the normal service conditions for indoor use as specified in Clause 7 apply

3.13

empty enclosure for outdoor installation

empty enclosure that is designed for use in locations where the normal service conditions for outdoor use as specified in Clause 7 apply

4 Classification

Enclosures are classified according to:

a) the type of material:

- insulating;
- metallic;
- combination of insulating and metallic.

b) method of mounting:

- floor standing;
- wall mounting;
- flush mounting;
- pole mounting.

c) the intended location:

- outdoor;
- indoor.

d) the degree of protection:

- IP code, according to IEC 60529:1989 and IEC 60529:1989/AMD1:1999 and AMD2:2013;
- IK code, according to IEC 62262:2002 and IEC 62262:2002/AMD1:2021.

5 Electromagnetic compatibility (EMC)

EMC requirements are not applicable for enclosures according to this document.

NOTE EMC is not a basic requirement for empty enclosures to this document. However, when enclosure manufacturers want to assign a degree of protection against electromagnetic disturbances (EM code) it is referred to IEC 61000-5-7:2001.

6 Information to be given regarding the enclosure

6.1 General

The following information shall be given by the enclosure manufacturer.

6.2 Marking

The enclosure shall be identifiable, making it possible for the assembly manufacturer to obtain relevant information from the enclosure manufacturer. Such identification shall comprise:

- either the name, trade mark or identification mark of the enclosure manufacturer;
- type designation or identification number of the enclosure.

The marking shall be durable and easily legible and can be inside the enclosure.

Compliance is checked according to the test of 9.3 and by inspection.

Marking for the recycling of plastic parts shall be as stated in ISO 11469.

Marking of enclosures used for class II assemblies with the symbol IEC 60417-5172  (2003-02) is the responsibility of the assembly manufacturer.

6.3 Documentation

6.3.1 General

The enclosure manufacturer's documentation shall include:

- the enclosure classification (see Clause 4);
- any instruction necessary for the correct handling, assembling, mounting and service conditions of the enclosure;
- a reference to this document, and
- the following characteristics:
 - dimensions (see 6.3.2);
 - mounting arrangements (6.3.3);
 - permissible loads (see 6.3.4);
 - lifting and transport devices, if necessary (see 6.3.5);
 - protective measures (see 6.3.6);
 - thermal power dissipation capability (see 6.3.7);
 - applicable service conditions (see Clause 7);

- location and size of protected space (see 3.2);
- rated insulation voltage U_i of enclosures constructed of an insulating material and Class II enclosures (see 9.11.3, Table 4);
- degree of protection against mechanical impact (IK code, see 8.6);
- degree of protection against contact with hazardous live parts, ingress of solid foreign bodies and water (IP code, see 8.7);
- maximum permissible temperatures inside for which enclosures constructed of insulating material is suitable (see 9.10.2).

6.3.2 Dimensions

The dimensions shall be given in millimetres.

The external dimensions (height, width and depth) are nominal values and shall be indicated in the catalogue of the enclosure manufacturer.

The projection of cable gland plates, removable covers and handles shall not be included in the external nominal dimensions, the dimensions of such shall be included in the enclosure manufacturer's documentation.

6.3.3 Mounting arrangements

The means and location of the enclosure mounting arrangements shall be defined in the enclosure manufacturer's documentation.

6.3.4 Permissible loads

The permissible loads that the enclosure, mounting plates, switchgear and controlgear supports and doors are able to carry shall be defined in the enclosure manufacturer's documentation. The load shall be given in Newtons.

If the enclosure includes or can include a mounting plate or switchgear and controlgear supports, the permissible load that the accessory can carry, according to the fixing means provided inside the enclosure, shall be defined in the enclosure manufacturer's documentation. (see also 8.2).

6.3.5 Lifting and transport support

Where required, the correct location and installation of lifting and transport support and the thread size of lifting devices shall be given in the enclosure manufacturer's documentation or in the instructions on how the enclosure has to be handled (see also 8.3).

6.3.6 Protective measures

The enclosure manufacturer shall indicate in the technical documentation if the enclosure is suitable for a class I or class II assembly.

In the case of a class I enclosure, the enclosure manufacturer shall indicate if the enclosure ensures electrical continuity throughout by the conductive structural parts of the enclosure or if and how separate protective conductors to the protective circuits of the installation shall be carried out (see also 8.5).

6.3.7 Thermal power dissipation capability

The data for the thermal power dissipation capability are a function of the admissible temperature inside the enclosure. They shall be provided for the intended mounting methods (e.g. flush mounting, surface mounting) of the enclosure and of the design of the enclosure, i.e. with or without ventilation openings and number of horizontal partitions. They shall include at least temperature rise inside the enclosure at the top, for a given power loss inside the enclosure. This will provide the assembly manufacturer with the correct data for the selection of the enclosure according to electrical equipment to be installed. The data for the thermal power dissipation capability shall be defined in the enclosure manufacturer's documentation (see also 9.15).

7 Service conditions

7.1 General

Enclosures conforming to this document are intended for use under the following service conditions.

The enclosure manufacturer shall specify the locations for which the enclosure is intended.

7.2 Normal service conditions

Enclosures conforming to this document are intended for use under the normal service conditions detailed in Table 1.

Table 1 – Climatic conditions

Environmental parameter	Indoor installations		Outdoor installations	
	Lower limit	Upper limit	Lower limit	Upper limit
Ambient air temperature	–5 °C	+40 °C average over a period of 24 h does not exceed +35 °C	–25 °C	+40 °C average over a period of 24 h does not exceed +35 °C
Humidity conditions ^a	5 %	–5...+30 °C: 95 % +35 °C: 70 % +40 °C: 57 %	15 %	–25...+27 °C: 100 % +35 °C: 60 % +40 °C: 46 %
^a Relationship between air temperature and humidity is given in IEC 60721-3-3:2019, Figure A.1. Moderate condensation should be borne in mind which can occasionally occur due to variations in temperature.				

7.3 Special service conditions

Special service conditions can be induced by particular conditions required in product standards or by user requirement. The user shall inform the enclosure manufacturer if such special service conditions exist.

NOTE If any special condition requires a specific test or verification, and there is no standardized test method, the test method to be carried out will be by an agreement between the manufacturer and the user.

Examples of such conditions can include the following:

- values of ambient air temperature and/or humidity differing from those defined in Subclause 7.2, Table 1;
- applications where variations in climatic conditions are likely to result in exceptional condensation inside the enclosure;

- heavy pollution of the air due to presence of dust (coal, cement, etc.), smoke, corrosive or radioactive substances, vapours or salt;
- exposure to abnormal mechanical stresses (heavy vibrations, shocks, seismic occurrences, etc.);
- presence of fauna, flora, mould, fungus or small creatures;
- ionizing influences;
- electromagnetic interferences;
- exposure to any type of radiation (for example, solar radiation, X-rays, microwave, ultraviolet other than solar, lasers, etc.).

7.4 Conditions during transport and storage

A special agreement shall be made between the enclosure manufacturer and the user if the conditions during transport, storage and installation, for example temperature and humidity conditions, differ from those defined in 7.2.

8 Design and construction

8.1 General

The enclosure shall be constructed only of materials capable of withstanding the mechanical, electrical and thermal stresses, as specified in Clause 9, as well as the effects of humidity which are likely to be encountered in normal use.

The enclosure manufacturer shall state in its documentation if mounting accessories or methods of mounting affects the technical characteristics of the enclosure.

8.2 Static loads

The enclosure manufacturer shall specify the maximum permissible static load that the enclosure and its doors are able to carry.

If the enclosure includes or can include a mounting plate or switchgear and controlgear supports, the enclosure manufacturer shall also specify the maximum permissible load of that accessory according to the fixing means provided, except when the mounting plate and any convenient support are designed, manufactured and tested for a specific equipment (e.g. for a specific brand or manufacturer).

If the enclosure manufacturer offers plinths, wheels, levelling feet or other similar accessories intended to be used for the enclosure, then the enclosure manufacturer shall declare the maximum static load with these accessories.

Compliance is checked according to the test of 9.4.

8.3 Lifting and transport support

If the enclosure is equipped or delivered together with lifting and transport supports, the enclosure manufacturer shall indicate in the technical documentation the correct location and installation of these supports, the thread size of lifting devices (if applicable), how the enclosure has to be handled, and the maximum weight for handling without lifting.

Compliance is checked according to the test of 9.5.

8.4 Access to the interior of the enclosure

Adequate access to the protected space shall be provided by means of (a) door(s) or removable cover(s). Access may be restricted by the use of a key or tool to provide a degree of protection to prevent contact with live parts with an enclosure used in an electric system, in accordance with 8.5.

Cable gland plates and covers which are removable from the outside shall require the use of a tool.

8.5 Protection against electric shock

8.5.1 General

The following requirements are intended to ensure that the required protective measures are obtained when an enclosure is used in an electric system conforming to the IEC 60364 series.

8.5.2 Requirements for earth continuity within the class I enclosure

The enclosure manufacturer shall provide means for the connection of an external earthing or protective conductor.

All exposed-conductive-parts of the enclosure shall be interconnected together and to the means for the connection of an external earthing or protective conductor.

Certain exposed-conductive-parts (e.g., screws, rivets, nameplates) that do not constitute a danger need not be connected to the earthing arrangement, either:

- because they cannot be touched on large surfaces or grasped with the hand, or
- because they are of small size (approximately 50 mm by 50 mm) or so located as to exclude any contact with live parts.

These interconnections may be achieved either by metal screwed connections, welding or other conductive connections, or by a separate conductor providing earth continuity.

For lids, doors, cover plates and the like, the usual metal screwed connection and metal hinges are considered sufficient to ensure continuity provided that no electrical equipment is attached to them.

Compliance is checked according to the test of 9.12.

For the continuity of these connections, the following shall apply:

When a part of the enclosure is removed, for example for routine maintenance, the earth continuity for the remainder of the enclosure shall not be interrupted.

Means used for assembling the various metal parts of an enclosure are considered sufficient for ensuring earth continuity if the precautions taken guarantee permanent good conductivity (see also 9.12).

8.5.3 Requirements for class II enclosure

The enclosure shall be made of insulating material or of sheet metal with the inner walls fully insulated from internal live parts. In both cases, the insulation shall be equivalent of double or reinforced insulation.

The enclosure shall at no point be pierced by conducting parts in such a manner that there is the possibility of a fault voltage being brought out of the enclosure.

Compliance is checked according to the test of 9.11 and visual inspection.

8.6 Protection against mechanical impact (IK code)

The degree of protection against mechanical impact, as declared by the enclosure manufacturer, shall be in accordance with IEC 62262:2002 and IEC 62262:2002/AMD1:2021.

Compliance is checked according to the test of 9.8.

8.7 Protection against contact with live parts, ingress of solid foreign bodies and water (IP code)

The degree of protection against access to hazardous parts, against ingress of solid foreign objects and/or against ingress of water, as declared by the enclosure manufacturer, shall be in accordance with IEC 60529:1989 and IEC 60529:1989/AMD1:1999 and AMD2:2013.

Compliance is checked according to the test of 9.9.

NOTE An enclosure can be assigned differing IP codes dependent upon the declared IK code.

8.8 Protection against corrosion

Protection against corrosion shall be ensured by the use of suitable materials or by the application of protective coating to the exposed surface, taking into account the intended conditions of use.

Compliance is checked according to the test of 9.14.

8.9 Enclosures constructed of or covered by insulating material

Enclosures or parts of enclosures constructed of insulating materials or covered by insulating materials shall fulfil the following additional requirements:

- thermal stability. If the thermal stability of the enclosure relies on insulating materials, then the compliance is checked according to the test of 9.10.1;
- resistance to normal heat. Compliance is checked according to the test of 9.10.2 (see 6.3.1);
- resistance to abnormal heat and fire. Compliance is checked according to the test of 9.10.3;
- dielectric strength. Compliance is checked according to the test of 9.11;
- resistance to ultra-violet (UV) radiation for outdoor applications, if applicable. Compliance is checked according to the test of 9.13.

9 Type tests

9.1 General

Tests according to this document are type tests.

9.2 General conditions of tests

The enclosures under test shall be mounted and installed as in normal use according to the enclosure manufacturer's instructions.

Unless otherwise specified, the tests shall be carried out at an ambient temperature of between +10 °C and +40 °C.

Table 2 shows the number of samples to be tested and the order of test per sample.

Table 2 – Number of samples to be tested and order of test per sample

Sample 1	Sample 2	Sample 3	Representative sample (see 9.12)	Test	Subclause
Order of test					
1				Static loads	9.4
2				Lifting	9.5
3				Mechanical operation	9.6
4				Axial loads of metal inserts	9.7
5				Protection against mechanical impacts (IK code)	9.8
6				Protection against contact with live parts, ingress of solid foreign bodies and water (IP code)	9.9
7				Dielectric strength	9.11
8				Continuity of the protective circuit	9.12
9				Marking	9.3
	1			Thermal stability	9.10.1
	2			Resistance to normal heat	9.10.2
	3			Resistance to abnormal heat and fire	9.10.3
		1 ^a , b		Thermal power dissipation capability	9.15
		2 ^b , c		Resistance to corrosion	9.14
		3		Continuity of the protective circuit	9.12
			1	Resistance to ultra-violet (UV) radiation	9.13
^a Only applicable if verified by test. ^b Some tests are included in the sequences solely to reduce the number of samples required, the results have no significance for the preceding or following tests in the sequence. Therefore, for convenience of testing and by agreement with the enclosure manufacturer, these tests can be conducted on separate new samples and omitted from the relevant sequence. ^c Tests carried out on representative samples.					

All tests shall be carried out on complete enclosures. If this is not possible, they can be carried out on representative samples taken from the enclosure.

9.3 Marking

Marking made by moulding, pressing, engraving or similar method or means, including labels with a laminated plastic covering, shall not be submitted to the following test.

The test is made by rubbing the marking by hand for 15 s with a piece of cloth soaked in water and then for 15 s with a piece of cloth soaked with petroleum spirit.

NOTE The petroleum spirits n-hexane or heptane are suitable solvents for this test.

After the test, the marking shall be easily legible to normal or corrected vision without magnification.

9.4 Static loads

The enclosure fitted with all its required components to support the permissible load is loaded with a weight of 1,25 times the permissible load as declared by the enclosure manufacturer.

The loads are arranged on the mounting plate or switchgear and controlgear supports and on the door evenly distributed as specified by the enclosure manufacturer. The loads are retained for 1 h in the closed position.

The closed door is opened and closed five times through 90°, the door is resting at least 1 min in the open position during each of the 5 operations.

For enclosures constructed of insulating material and metallic enclosures with parts (hinges, locks, etc.) of insulating material, the loads are retained for 1 h in the closed position at an ambient temperature of 70 °C.

The closed door is opened and closed five times through 90°, the door is resting at least 1 min in the open position during each of the 5 operations. This test can be conducted at ambient air temperature or during cool down.

After the test, with the test loads in place, the enclosure shall show no cracks or permanent distortions and during the test no deflections which could impair any of its characteristics.

9.5 Lifting

This test only applies to enclosures with provisions for lifting.

The enclosure is loaded as in 9.4 and with its door closed, is lifted with the specified lifting means and in the manner defined by the enclosure manufacturer.

From a standstill position, the enclosure shall be raised smoothly without jerking in a vertical plane to a height ≥ 1 m and lowered in the same manner to a standstill position. This test is repeated a further two times after which the enclosure is raised up and suspended clear of the floor for 30 min without any movement.

Following this test, the enclosure shall be raised smoothly without jerking from a standstill position to a height ≥ 1 m and moved $(10 \pm 0,5)$ m horizontally, then lowered to a standstill position. This sequence shall be carried out three times at uniform speed, each sequence being carried out within 1 min.

After the test, with the test weights in place, the enclosure shall show no cracks or permanent distortions, visible to normal or corrected vision without additional magnification, that could impair any of its characteristics.

9.6 Mechanical operation

If a door constitutes part of the enclosure, the operation of hinges, door latches and mechanical interlocks associated with its movements shall be verified. The number of operating cycles shall be 200. The test is passed if the operating conditions of these components and the specified degree of protection have not been impaired.

9.7 Axial loads of metal inserts

This test applies to enclosures when threaded metal inserts are provided to retain the mounting plate or switchgear and controlgear supports in place.

The test shall be carried out by applying an axial load for 10 s to representative samples, as indicated in Table 3.

Table 3 – Axial loads of metal inserts

Size of inserts M ^a	Axial load N
4	350
5	350
6	500
8	500
10	800
12	800
^a M: metric thread-size	

During the test, the enclosure shall fully rest on a supporting platform to allow the application of the above mentioned load.

At the end of the test, the insert shall still be in its original position; any sign of movement is not acceptable.

Cracks and splits in the material containing the insert are also not acceptable.

NOTE Small cracks or air bubbles that were visible before the test, but not caused by the application of the axial load, are ignored.

9.8 Degree of protection against external mechanical impacts (IK code)

Verification of the degree of protection against mechanical impacts shall be carried out in accordance with IEC 62262 by means of a test hammer suitable for the dimensions of the enclosure.

The enclosure shall be fixed on a rigid support as for normal use.

The impact energy shall be applied:

- three times to each exposed surface in normal use whose largest dimension is not above 1 m;
- five times to each exposed surface in normal use whose largest dimension is greater than 1 m.

The impacts shall be applied with even distribution over the faces of the enclosure.

The test shall not be applied to the enclosure components (e.g. locks, hinges).

After the test, the enclosure shall continue to provide the protections as designated by the IP code and, if applicable, the dielectric strength. Removable covers can be removed and reinstalled, doors opened and closed.

9.9 Degree of protection (IP code)

9.9.1 Degree of protection against access to hazardous parts and against the ingress of solid foreign objects indicated by first characteristic numeral

9.9.1.1 Protection against access to hazardous parts

IEC 60529:1989, 12.1 and 12.2 apply.

The access probes shall not enter the protected space.

NOTE In the United States of America (USA) and Canada, enclosure "Type" designations are used with IP code. See more information in Annex A.

9.9.1.2 Degree of protection against the ingress of solid foreign objects

For IP2X, IP3X, IP4X enclosures, IEC 60529:1989, 13.2 and 13.3 and IEC 60529:1989/AMD1:1999, 13.3 of apply.

For IP5X enclosures, IEC 60529:1989, 13.4, category 2 (without vacuum pump) and 13.5 (without vacuum pump) and IEC 60529:1989/AMD1:1999, 13.4 apply. Ingress of talcum powder into protected space is verified as follows:

- Ingress of talcum powder is verified by using a watch glass installed at the centre of the base of the protected space of the enclosure in order to pick up the talcum powder entering the protected space during the test. After the test, talcum powder shall not form deposits of more than 1 g/m²;
- In practice the weight of the watch glass is measured before and at the end of the test and the difference between both measures is representative of the amount of the talcum powder which has entered the protected space.

For IP6X enclosures, IEC 60529:1989, 13.6 applies. No talcum powder shall be observable inside the enclosure at the end of the test.

Where the enclosure tested according to 9.8 is too large for the verification of IP5X or IP6X, an additional smaller enclosure having the same design details can be used for this test.

9.9.2 Degree of protection against ingress of water as indicated by second characteristic numeral

IEC 60529:1989, 14.1 and 14.2 and IEC 60529:1989/AMD2:2013, 14.1 and 14.2 apply.

After the test, water shall not have ingressed into the protected space.

Ingress of water is verified by the use of dry absorbent paper positioned to occupy the base area of each protected space.

For doors or covers intended to accommodate equipment, a strip of paper, bent to form a 90° angle profile, is attached to the base of the declared protected space for that surface.

The paper should project from the surface equal to the depth of the protected space or a maximum of 30 mm.

Where the enclosure has any uncovered aperture, a section of absorbent paper, equal to or greater than the size of the aperture, is positioned on the surface of the protected space in its immediate vicinity.

Immediately after the test, all indicator papers shall still be dry.

In practice, a coloured blotting or filter paper will show very clearly any moisture by its discolouration.

9.9.3 Degree of protection against hazardous parts as indicated by additional letter

IEC 60529:1989, Clause 15 applies.

The access probe shall not touch the surface of the protected space.

9.10 Properties of insulating materials

9.10.1 Thermal stability

Parts intended for decorative purposes that have no technical significance shall not be considered for the purpose of this test.

The thermal stability of enclosures manufactured from insulating material shall be verified by the dry heat test. The test shall be carried out according to IEC 60068-2-2 Test Bb, at a temperature of 70 °C, with natural air circulation, for a duration of 168 h (seven days).

The enclosure, mounted as for normal use, is subjected to a test in a heating cabinet with an atmosphere having the composition and pressure of the ambient air with no forced ventilation. If the dimensions of the enclosure are inconsistent with those of the heating cabinet, the test may be carried out on a representative sample of the enclosure.

The sample of the enclosure should include portions in which the molding process would require the insulating material to flow in a non-linear path and consequently be highly stressed. Place of material sampling should be determined by agreement between the enclosure manufacturer and the testing laboratory.

The use of an electrically heated cabinet is recommended.

After the treatment, the enclosure or sample is removed from the cabinet and kept at ambient temperature and a relative humidity of between 45 % and 55 % for at least 96 h (four days).

The enclosure or sample shall show no crack visible to normal or corrected vision without additional magnification nor shall the material have become sticky or greasy, this being judged as follows:

With the forefinger wrapped in a dry piece of rough cloth, the sample is pressed with a force of 5 N.

NOTE The force of 5 N can be obtained in the following way: the enclosure or sample is placed on one of the pans of a balance and the other pan is loaded with a mass equal to the mass of the sample plus 500 g. Equilibrium is then restored by pressing the sample with the forefinger wrapped in a dry piece of rough cloth.

No traces of the cloth shall remain on the sample and the material of the enclosure or sample shall not stick to the cloth.

9.10.2 Resistance to normal heat

The suitability of the insulating materials to resist effects of heat shall be verified either by reference to the insulation temperature index (determined e.g. by the methods of IEC 60216 series), or by compliance with IEC 60085:2007.

As alternative, the test procedure reported in IEC 60695-10-2:2014, method A, can be used.

NOTE With recognition of the differences to other methods, insulating materials can also be selected based on the relative thermal index (RTI), UL 746B.

9.10.3 Resistance to abnormal heat and fire due to internal electric effects

Compliance is checked by tests in accordance with the principles of IEC 60695-2-10:2021 and the details of IEC 60695-2-11:2021. For a description of the test, see IEC 60695-2-11:2021, Clause 4.

The apparatus to be used shall be as described in IEC 60695-2-11:2021, Clause 5.

If the dimensions of the enclosure are inconsistent with those of the test apparatus, the test shall be carried out on a sample. This sample shall be taken from an area of minimum thickness taken from the enclosure. In the case of doubt, the test shall be repeated on two further samples.

The sample of the enclosure should include portions in which the molding process would require the insulating material to flow in a non-linear path and consequently be highly stressed. Place of material sampling should be determined by agreement between the enclosure manufacturer and the testing laboratory.

The sample is stored for 24 h in an atmosphere having a temperature between 15 °C and 35 °C and a relative humidity of between 45 % and 75 % before starting the test.

The apparatus shall be placed in a substantially draught-free dark room, so that the flames occurring during the test are visible.

Before starting the test, the thermocouple is verified in accordance with IEC 60695-2-10:2021, Clause 5.

During the test, the procedure given in IEC 60695-2-10:2021, Clause 8 and IEC 60695-2-11:2021, Clause 10 shall be followed.

After each test, it is necessary to clean the tip of the glow wire of any residue of insulating material, for example by means of a brush.

The temperature of the tip of the glow wire shall be as follows:

- for parts intended to retain current-carrying parts in position: $(960 \pm 15) ^\circ\text{C}$;
- for parts intended to be installed in hollow walls: $(850 \pm 10) ^\circ\text{C}$;
- for all other parts, including parts not intended to retain current-carrying parts in position including the earth terminal and parts intended to be embedded in walls which are combustion-resistant: $(650 \pm 10) ^\circ\text{C}$.

NOTE 2 First bullet is only valid if the enclosure is equipped with supports for busbars.

The duration of application shall be (30 ± 1) s.

During application of the glow wire and during a further period of 30 s, the specimen, the parts surrounding the specimen and the layer of tissue paper placed below it shall be observed.

The time at which the specimen ignites and the time when flames extinguish during or after the period of application are noted.

The specimen is considered to have withstood the glow-wire test if

- there is no visible flame and no sustained glowing, or if
- flames and glowing of the specimen extinguish within 30 s after removal of the glow wire.

There shall be no burning of the tissue paper or scorching of the pinewood board.

NOTE 3 Higher temperatures, shorter times for the flame to extinguish and other times of application can be applied, subject to agreement between the enclosure manufacturer and the user.

For small parts having surface dimensions not exceeding 14 mm × 14 mm, an alternative test may be used (e.g. needle flame test, according to IEC 60695-11-5:2016, with a duration of 30 s ± 1 s.). The same procedure may be applicable for other practical reasons where the metal material of a part is large compared to the insulating material.

9.11 Dielectric strength

9.11.1 General

This test applies to enclosures where insulating material is used, even in combination with non-insulating materials.

Compliance is checked as indicated in 9.11.2 to 9.11.5.

9.11.2 Preconditioning

The enclosures are placed in a humidity cabinet containing air with relative humidity maintained at between 91 % and 95 %. The air temperature, where the enclosures are placed, is maintained at (40 ± 2) °C.

The enclosures are kept in the cabinet for 48 h (two days).

In most cases, the enclosures can be brought to the specified temperature by keeping them at this temperature for at least 4 h before the humidity treatment. A relative humidity of between 91 % and 95 % can be obtained by placing in the cabinet a saturated solution of sodium sulphate (Na₂SO₄) or potassium nitrate (KNO₃) in water having a sufficiently large contact surface with the air.

In order to achieve the specified conditions within the cabinet, it is necessary to ensure a constant circulation of air and, in general, to use a cabinet which is thermally insulated.

9.11.3 Enclosures without metal elements inside the protected space

An AC RMS dielectric test voltage of substantially sine-wave form or DC dielectric test voltage at a value of 1,5 times to the values according to Table 4 is applied for 1 min between two metal foils, one in contact with the external surface and the other inside the enclosure at the limit of the protected space.

Initially, not more than half the prescribed voltage is applied. It is then raised rapidly to 1,5 times of the values indicated in Table 4.

Table 4 – Dielectric test voltage

Rated insulation voltage U_i AC or DC V	Dielectric test voltage AC RMS V	Dielectric test voltage DC V
$U_i \leq 60$	1 000	1 415
$60 < U_i \leq 300$	1 500	2 120
$300 < U_i \leq 690$	1 890	2 670
$690 < U_i \leq 800$	2 000	2 830
$800 < U_i \leq 1\,000$	2 200	3 110
$1\,000 < U_i \leq 1\,500^a$	2 700	3 820
^a For DC only.		

9.11.4 Enclosures having metal elements inside the protected space

All internal metallic parts are connected to a copper bar, and an AC RMS dielectric test voltage of substantially sine wave form or DC dielectric test voltage at a value of 1,5 times to the values according to Table 4 is applied for 1 min between a metal foil in contact with the external surface and the bar. For enclosures with double or reinforced insulation, the test voltage for this test shall be twice the values according to Table 4.

Initially, not more than half the prescribed voltage is applied. It is then raised rapidly to the increased test voltage as determined in the previous paragraph.

A hole in the external surface of the enclosure can enable the voltage to be connected to the bar. Creepage and clearance distances between the bar and the external surface should be taken into account.

9.11.5 Results to be obtained

The samples shall show no damage impairing their further use; no flashover or breakdown shall occur during the test.

9.12 Effective earth continuity between the exposed-conductive-parts of the class I enclosure and the protective circuit

It shall be verified that the different exposed conductive parts of the enclosure are effectively connected to the terminal or contact for the incoming earthing or protective conductor.

Verification shall be made using a resistance-measuring instrument that is capable of driving a current of at least 10 A (AC or DC). The current is passed between each exposed conductive-part and the means for the connection of an external earthing or protective conductor. The resistance shall not exceed 0,1 Ω .

9.13 Resistance to ultra-violet (UV) radiation**9.13.1 Verification by test****9.13.1.1 General**

This test applies only to enclosures and external parts of enclosures intended to be installed outdoors and which are constructed of insulating materials or enclosures that are entirely coated by synthetic material. Representative samples of such parts shall be subjected to the following test.

9.13.1.2 Verification for enclosures and external parts of enclosures constructed of insulating materials

Test samples:

- six test specimens of standard size according to ISO 178:2019, and
- six test specimens of standard size according to ISO 179-1:2010 and ISO 179-2:2020

shall be prepared.

The test specimens shall be made under the same conditions as those used for the manufacture of the enclosure being considered.

Test sequence:

- a) UV test on all twelve samples according to ISO 4892-2:2013, method A, cycle 1 providing a total test period of 500 h.
- b) Verification of the flexural strength in accordance with ISO 178:2019 (method A) with six of the samples. The surface of the sample exposed to UV radiation shall be turned face down and the pressure applied to the non-exposed surface.
- c) Verification of the Charpy impact in accordance with ISO 179-1:2010 or ISO 179-2:2020 on the other six samples. No notches shall be cut into the sample and the impact shall be applied to the exposed surface.

Results to be obtained:

- Samples shall not show cracks or deterioration visible to normal or corrected vision without additional magnification.
- The flexural strength according to ISO 178:2019 shall have 70 % minimum retention.
- The Charpy impact according to ISO 179-1:2010 or ISO 179-2:2020 shall have 70 % minimum retention. For materials whose impact bending strength cannot be determined prior to exposure because no rupture has occurred, not more than three of the exposed test specimens shall be allowed to break.

9.13.1.3 Verification for enclosures and external parts of enclosures coated on their exposed surface(s) by synthetic material

Test sample: Three representative samples of suitable size shall be tested. The test specimens shall be made under the same conditions as those used for the manufacture of the enclosure being considered.

Test sequence:

- a) UV test on all three samples according to ISO 4892-2:2013, method A, cycle 1 providing a total test period of 500 h.
- b) Verification of the retention of the coating according to ISO 2409:2020.

Results to be obtained:

The adherence of the synthetic material shall have a minimum retention of category 3 according to ISO 2409:2020.

9.13.2 Verification by comparison to a reference design

Enclosures and external parts made of the same insulating materials, irrespective of their shape and size, are covered by the test on the representative samples.

9.14 Resistance to corrosion

9.14.1 General

Ferrous metallic enclosures and external ferrous metallic parts of insulating and combined enclosures shall be tested to verify that they ensure protection against corrosion.

If it is not possible to carry out the test on the enclosure, the test shall be carried out on enclosure elements showing the same constructional detail as the enclosure itself: material, thickness, layer of coating, etc..

In all cases, hinges, locks and fastenings shall also be tested unless they have previously been subjected to an equivalent test and their resistance to corrosion has not been compromised by their application.

The enclosure subjected to the test shall be mounted as for normal use according to the enclosure manufacturer's instructions.

The enclosure or samples shall be new and in a clean condition.

NOTE For special service conditions (7.3) other criteria can apply, subject to an agreement between the enclosure manufacturer and the user.

9.14.2 Test procedure

9.14.2.1 General

Enclosures shall be subjected to the test defined in 9.14.2.2 or in 9.14.2.3:

9.14.2.2 Severity test A

This test is applicable to:

- ferrous metallic indoor enclosures;
- external ferrous metallic parts of indoor enclosures;
- internal ferrous metallic parts of indoor and outdoor enclosures upon which intended mechanical operation can depend.

The test consists of:

- 6 cycles of 24 h each to damp heat cycling test according to IEC 60068-2-30:2005 (Test Db) at $(40 \pm 3) ^\circ\text{C}$ and relative humidity of 95 %,

and

- 2 cycles of 24 h each to salt mist test according to IEC 60068-2-11:2021 (Test Ka: Salt mist), at a temperature of $(35 \pm 2) ^\circ\text{C}$.

9.14.2.3 Severity test B

This test is applicable to:

- ferrous metallic outdoor enclosures;
- external ferrous metallic parts of outdoor enclosures.

The test comprises two identical 12-day periods.

Each 12-day period comprises:

- 5 cycles of 24 h each to damp heat cycling test according to IEC 60068-2-30:2005 (Test Db) at $(40 \pm 3)^\circ\text{C}$ and relative humidity of 95 %,

and

- 7 cycles of 24 h each to salt mist test according to IEC 60068-2-11:2021; (Test Ka: Salt mist), at a temperature of $(35 \pm 2)^\circ\text{C}$.

9.14.3 Results to be obtained

After the test, the enclosure or samples shall be washed in running tap water for 5 min, rinsed in distilled or demineralized water then shaken or subjected to air blast to remove water droplets. The specimen under test shall then be stored under normal service conditions for 2 h.

Compliance is checked by visual inspection to determine that:

- there is no evidence of iron oxide, cracking or other deterioration more than that allowed by ISO 4628-3:2016 for a degree of rusting Ri1 (considering the sample as a whole). However, surface deterioration of the protective coating is allowed. In case of doubt associated with paints and varnishes, reference shall be made to ISO 4628-3:2016 to verify that the samples conform to the specimen Ri1;
- the mechanical integrity is not impaired;
- seals are not damaged;
- doors, hinges, locks, and fastenings work without abnormal effort.

9.15 Thermal power dissipation capability

9.15.1 General

The thermal power dissipation data (see 6.3.7) provided by the enclosure manufacturer shall be determined by test or by calculation and comparison or by calculation method.

9.15.2 Determination of the power dissipation capability by test

The ambient air temperature shall be measured by means of at least two thermometers or thermocouples equally distributed around the enclosure at approximately half its height and at a distance of approximately 1 m from the enclosure. The thermometers or thermocouples shall be protected against air currents and heat radiation.

The ambient air temperature during the test shall be between $+10^\circ\text{C}$ and $+40^\circ\text{C}$.

The air temperature-rise (air temperature inside the enclosure minus the average of the measured values of the ambient air temperature) shall be measured in the top of the enclosure. For accessible external enclosures and covers, it shall not exceed:

- metal surfaces 30 K
- insulating surfaces 40 K

The temperature-rise limits apply for a daily average ambient air temperature up to 35°C under service conditions.

The power loss shall be simulated by means of heaters that produce heat equivalent to the intended power loss capability of the enclosure. The heating resistors shall be distributed evenly over the height of the enclosure and installed in suitable places inside the enclosure.

9.15.3 Determination of the power dissipation capability by calculation and comparison

The power dissipation capability can also be determined by calculation, and comparison with a tested reference design.

This method is used specially to interpolate different dimensions or technical variants into the same range of construction of enclosure.

This method requests that the following conditions are fulfilled:

- a) technical criteria (e.g. dimensions, raw material, thickness, IP degree, openings, installation condition with covered or exposed sides) of a reference design used for calculation shall be exactly the same as those of the tested reference design;
- b) the heat generated by the selected equipment is distributed uniformly inside the protected space;
- c) test on reference design is carried out in accordance with 9.15.2;
- d) for any reference enclosure configuration verified by test, the thermal power dissipation capability measured shall be strictly higher than the calculation method performed on the same enclosure configuration and specification;
- e) In case of interpolation to a full range sizing, at least the smallest and largest size of the range shall be tested. Enclosures shall have the same generic design and the same physical construction and refer to a suitable and a typical reference design verified by calculation and compared with a tested reference design.

9.15.4 Determination of the power dissipation capability by calculation method

The thermal power dissipation capability determined by calculation shall be performed in accordance with IEC TR 60890.

For the purpose of the calculation, it is assumed that the heat generated by the selected equipment is distributed uniformly inside the protected space.

Annex A

(informative)

List of notes concerning certain countries

Clause/Subclause	Text
1	Add a new Note after Note 1: The United States of America (USA) uses enclosure “Type” designations according to UL 50 and UL 50E. The enclosure Type designations specify additional environmental requirements for conditions such as corrosion, rust, icing, oil, and coolants. For this reason, the IEC Enclosure Classification Designations IP are used with an enclosure Type designation number appropriate for these markets.
1	Add a new Note after Note 1: Canada uses enclosure type designations in accordance with CSA standard C22.2 No. 94.1 and 94.2. Type designations specify additional environmental requirements for conditions such as corrosion, rust, icing, oil, and coolants. For this reason, the IEC enclosure classification designations IP are used with an enclosure type designation number appropriate for these applications.

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Bibliography

IEC 60050-312:2001, *International Electrotechnical Vocabulary (IEV) – Part 312: General terms relating to electrical measurements*

IEC 60050-426:2020, *International Electrotechnical Vocabulary (IEV) – Part 426: Explosive atmospheres*

IEC 60216 (all parts), *Electrical insulating materials – Thermal endurance properties*

IEC 60417, *Graphical symbols for use on equipment*, available at <http://www.graphical-symbols.info/equipment>

IEC 60670 (all parts), *Boxes and enclosures for electrical accessories for household and similar fixed electrical installations*

IEC 60670-24, *Boxes and enclosures for electrical accessories for household and similar fixed electrical installations – Part 24: Particular requirements for enclosures for housing protective devices and other power dissipating electrical equipment*

IEC 60715, *Dimensions of low-voltage switchgear and controlgear – Standardized mounting on rails for mechanical support of switchgear, controlgear and accessories*

IEC 60721-3-3:2019, *Classification of environmental conditions – Part 3-3: Classification of groups of environmental parameters and their severities – Stationary use at weather protected locations*

IEC 61000-5-7:2001, *Electromagnetic compatibility (EMC) – Part 5-7: Installation and mitigation guidelines – Degrees of protection provided by enclosures against electromagnetic disturbances (EM code)*

IEC 61140:2016, *Protection against electric shock – Common aspects for installation and equipment*

IEC 61439 (all parts), *Low-voltage switchgear and controlgear assemblies*

IEC 61439-1:2020, *Low-voltage switchgear and controlgear assemblies – Part 1: General rules*

CSA C22.2 NO 94.1, *Enclosures for electrical equipment, non-environmental considerations*

CSA C22.2 NO 94.2, *Enclosures for electrical equipment, environmental considerations*

UL 50, *Standard for enclosures for electrical equipment*

UL 50E, *Compression Test for Gaskets and Seals*

UL 746B, *Polymeric Materials – Long Term Property Evaluations*

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

ENVELOPPES VIDES DESTINÉES AUX ENSEMBLES D'APPAREILLAGE À BASSE TENSION – EXIGENCES GÉNÉRALES

AVANT-PROPOS

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Cette troisième édition annule et remplace la deuxième édition parue en 2011. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

- a) prise en compte des modifications introduites dans l'IEC 61439-1:2020;
- b) alignement des procédures d'essai sur les toutes nouvelles normes applicables.

Le texte de cette Norme internationale est issu des documents suivants:

Projet	Rapport de vote
121B/180/FDIS	121B/180/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

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INTRODUCTION

Le présent document a pour objet d'harmoniser autant que possible toutes les règles et exigences d'ordre général applicables aux enveloppes vides destinées aux ensembles d'appareillages à basse tension, afin d'uniformiser les exigences et la vérification des enveloppes vides et d'éviter de faire appel à d'autres normes pour la vérification.

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ENVELOPPES VIDES DESTINÉES AUX ENSEMBLES D'APPAREILLAGE À BASSE TENSION – EXIGENCES GÉNÉRALES

1 Domaine d'application

Le présent document s'applique aux enveloppes vides, dans l'état dans lequel elles sont fournies par le fabricant d'enveloppes, avant incorporation des composants d'appareillage par le fabricant de l'ensemble.

Le présent document spécifie les définitions, les classifications, les caractéristiques et les exigences d'essai générales des enveloppes à utiliser en tant que partie d'ensembles d'appareillage (selon par exemple la norme de produit de la série IEC 61439), dont la tension assignée ne dépasse pas 1 000 V en courant alternatif ou 1 500 V en courant continu pour usage général extérieur ou intérieur.

NOTE 1 Des exigences supplémentaires peuvent s'appliquer dans le cas de certaines applications particulières.

NOTE 2 Les enveloppes vides conformes au présent document sont adaptées au montage de composants électriques.

Le présent document ne s'applique pas aux enveloppes qui sont couvertes par d'autres normes de produits spécifiques (par exemple par l'IEC 60670-24).

La conformité aux exigences de sécurité de la norme de produit applicable au produit final réalisé à partir d'une enveloppe vide est de la responsabilité du fabricant de l'ensemble.

NOTE 3 Le présent document peut servir de base pour d'autres comités d'étude.

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60068-2-2:2007, *Essais d'environnement – Partie 2-2: Essais – Essai B: Chaleur sèche*

IEC 60068-2-11:2021, *Essais d'environnement – Partie 2-11: Essais – Essai Ka: Brouillard salin*

IEC 60068-2-30:2005, *Essais d'environnement – Partie 2-30: Essais – Essai Db: Essai cyclique de chaleur humide (cycle de 12 h + 12 h)*

IEC 60085:2007, *Isolation électrique – Évaluation et désignation thermiques*

IEC 60364 (toutes les parties), *Installations électriques à basse tension*

IEC 60529:1989, *Degrés de protection procurés par les enveloppes (Code IP)*

IEC 60529:1989/AMD1:1999

IEC 60529:1989/AMD2:2013

IEC 60695-2-10:2021, *Essais relatifs aux risques du feu – Partie 2-10: Essais au fil incandescent/chauffant – Appareillage et méthode commune d'essai*

IEC 60695-2-11:2021, *Essais relatifs aux risques du feu – Partie 2-11: Essais au fil incandescent/chauffant – Méthode d'essai d'inflammabilité pour produits finis (GWEPT)*

IEC 60695-10-2:2014, *Essais relatifs aux risques du feu – Partie 10-2: Chaleurs anormales – Essai à la bille*

IEC 60695-11-5:2016, *Essais relatifs aux risques du feu – Partie 11-5: Flammes d'essai – Méthode d'essai au brûleur-aiguille – Appareillage, dispositif d'essai de vérification et lignes directrices*

IEC TR 60890:2014, *Méthode de vérification par calcul des échauffements pour les ensembles d'appareillage à basse tension*

IEC 62262:2002, *Degrés de protection procurés par les enveloppes de matériels électriques contre les impacts mécaniques externes (Code IK)*
IEC 62262:2002/AMD1:2021

ISO 178:2019, *Plastiques – Détermination des propriétés en flexion*

ISO 179-1:2010, *Plastiques – Détermination des caractéristiques au choc Charpy – Partie 1: Essai de choc non instrumenté*

ISO 179-2:2020, *Plastiques – Détermination des caractéristiques au choc Charpy – Partie 2: Essai de choc instrumenté*

ISO 2409:2020, *Peintures et vernis – Essai de quadrillage*

ISO 4628-3:2016, *Peintures et vernis – Évaluation de la dégradation des revêtements – Désignation de la quantité et de la dimension des défauts, et de l'intensité des changements uniformes d'aspect – Partie 3: Évaluation du degré d'enrouillement*

ISO 4892-2:2013, *Plastiques – Méthodes d'exposition à des sources lumineuses de laboratoire – Partie 2: Lampes à arc au xénon*

ISO 11469:2016, *Plastiques – Identification générique et marquage des produits en matière plastique*

3 Termes et définitions

Pour les besoins du présent document, les termes et définitions suivants s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse <https://www.electropedia.org/>
- ISO Online browsing platform: disponible à l'adresse <https://www.iso.org/obp>

3.1

enveloppe vide

enveloppe prévue pour le support et l'installation du matériel électrique, dont l'espace interne procure un degré de protection convenable contre les influences externes et un degré de protection spécifié contre l'approche ou le contact avec des parties actives et contre le contact avec des pièces en mouvement

Note 1 à l'article: Dans le présent document, le mot enveloppe est utilisé pour désigner une enveloppe vide.

Note 2 à l'article: Pour les besoins du présent document, les termes boîtes, coffrets, pupitres ou armoires sont des termes alternatifs pour enveloppes.

3.2

espace protégé

espace ou partie interne d'une enveloppe, spécifié par le fabricant de l'enveloppe, destiné à contenir des composants électriques, et qui procure une protection définie contre les influences externes et le contact avec des parties actives

3.3

panneau

partie extérieure de l'enveloppe

3.4

porte

panneau pivotant ou glissant

3.5

plaque de montage

élément interne distinct de l'enveloppe destiné au montage des composants électriques

3.6

plaque passe-câble

élément amovible de l'enveloppe, destiné à assurer le maintien et l'étanchéité des câbles, des conducteurs et des conduits à leurs points d'entrée

3.7

panneau amovible

panneau prévu pour fermer une ouverture dans l'enveloppe extérieure et qui peut être ôté pour effectuer certaines opérations et des travaux de maintenance

Note 1 à l'article: Un capot est considéré comme un panneau amovible.

3.8

inspection

action comprenant l'examen minutieux, d'une entité, y compris un examen visuel lorsque les conditions sont évidentes, effectué sans désassemblage, ou avec un désassemblage partiel si exigé, complétée par des moyens tels que des mesurages, afin d'aboutir à une conclusion fiable sur l'état de l'entité

[SOURCE: IEC 60050-426:2020, 426-14-02, modifié – "y compris un examen visuel lorsque les conditions sont évidentes" a été ajouté.]

3.9

tension assignée d'isolement

U_i

valeur de la tension de tenue efficace fixée par le fabricant de l'enveloppe à l'enveloppe ou à une partie de celle-ci, caractérisant la capacité de tenue spécifiée (à long terme) de son isolation

[SOURCE: IEC 60050-312:2014, 312-06-02, modifié – Le symbole U_i a été ajouté, dans la définition "valeur assignée" a été remplacé par "valeur", "de l'enveloppe" a été ajouté après "fabricant", "matériels" a été remplacé par "enveloppe" et la Note a été supprimée.]

3.10

enveloppe de classe I

enveloppe ayant au moins une disposition de protection principale et une connexion à un conducteur de protection comme disposition de protection en cas de défaut

Note 1 à l'article: Pour plus de détails, voir l'IEC 61140:2016, 7.3.

[SOURCE: IEC 61439-1:2020, 3.7.24, modifié – "ensemble" a été remplacé par "enveloppe" et la Note 2 à l'article a été supprimée.]

3.11

enveloppe de classe II

enveloppe comprenant les éléments suivants:

- une isolation principale comme protection principale; et
- une isolation supplémentaire comme protection en cas de défaut;

ou dans laquelle:

- la protection principale et la protection en cas de défaut sont assurées par une isolation renforcée

Note 1 à l'article: Pour plus de détails, voir l'IEC 61140:2016, 7.4.

[SOURCE: IEC 61439-1:2020, 3.7.25, modifié – "ensemble" a été remplacé par "enveloppe".]

3.12

enveloppe vide pour installation à l'intérieur

enveloppe vide conçue pour être utilisée dans des endroits où les conditions normales d'emploi pour un usage à l'intérieur spécifiées à l'Article 7 s'appliquent

3.13

enveloppe vide pour installation à l'extérieur

enveloppe vide conçue pour être utilisée dans des endroits où les conditions normales d'emploi pour un usage à l'extérieur spécifiées à l'Article 7 s'appliquent

4 Classification

Les enveloppes sont classées selon:

a) le type de matériau:

- isolant;
- métallique;
- combinaison de matériaux isolants et métalliques;

b) la méthode de montage:

- au sol;
- mural;
- montage encastré;
- sur poteau;

c) le lieu d'utilisation prévu:

- à l'extérieur;
- à l'intérieur;

d) le degré de protection:

- code IP, selon l'IEC 60529:1989 et l'IEC 60529:1989/AMD1:1999 et AMD2:2013;
- code IK, selon l'IEC 62262:2002 et l'IEC 62262:2002/AMD1:2021.

5 Compatibilité électromagnétique (CEM)

Les exigences concernant la compatibilité électromagnétique ne s'appliquent pas aux enveloppes conformes au présent document.

NOTE La compatibilité électromagnétique n'est pas une exigence de base pour les enveloppes vides conformes au présent document. Toutefois, lorsque les fabricants d'enveloppes souhaitent attribuer un degré de protection contre les perturbations électromagnétiques (code EM), il est fait référence à l'IEC 61000-5-7:2001.

6 Renseignements à donner concernant l'enveloppe

6.1 Généralités

Les renseignements qui suivent doivent être donnés par le fabricant d'enveloppes.

6.2 Marquage

L'enveloppe doit être identifiable, de manière que le fabricant d'un ensemble puisse obtenir les renseignements appropriés auprès du fabricant d'enveloppes. Une telle identification doit comporter:

- le nom, la marque commerciale ou la marque d'identification du fabricant d'enveloppes;
- la désignation du type ou le numéro de référence de l'enveloppe.

Le marquage doit être durable et facilement lisible; il peut être placé à l'intérieur de l'enveloppe.

La conformité est vérifiée par l'essai défini en 9.3 et par inspection.

Le marquage pour le recyclage des pièces plastiques doit être conforme à l'ISO 11469.

Le marquage avec le symbole IEC 60417-5172  (2003-02) des enveloppes utilisées pour les ensembles de classe II est de la responsabilité du fabricant de l'ensemble.

6.3 Documentation

6.3.1 Généralités

La documentation du fabricant d'enveloppes doit inclure:

- la classification de l'enveloppe (voir Article 4);
- toute instruction nécessaire à la manutention, à l'assemblage et au montage corrects et les conditions d'emploi de l'enveloppe;
- une référence au présent document; et
- les caractéristiques suivantes:
 - dimensions (voir 6.3.2);
 - dispositions de montage (voir 6.3.3);
 - charges admissibles (voir 6.3.4);
 - dispositifs de levage et de transport, si nécessaire (voir 6.3.5);
 - mesures de protection (voir 6.3.6);
 - capacité à dissiper la chaleur (voir 6.3.7);
 - conditions d'emploi applicables (voir Article 7);
 - emplacement et dimensions de l'espace protégé (voir 3.2);

- tension assignée d'isolement U_i des enveloppes construites dans un matériau isolant et des enveloppes de classe II (voir 9.11.3, Tableau 4);
- degré de protection contre les impacts mécaniques (code IK, voir 8.6);
- degré de protection contre les contacts avec des parties actives dangereuses, contre la pénétration de corps solides étrangers et d'eau (code IP, voir 8.7);
- températures maximales admissibles à l'intérieur, pour lesquelles les enveloppes en matériau isolant sont adaptées (voir 9.10.2).

6.3.2 Dimensions

Les dimensions doivent être données en millimètres.

Les dimensions extérieures (hauteur, largeur et profondeur) sont des valeurs nominales et doivent être indiquées dans le catalogue du fabricant d'enveloppes.

La saillie des plaques passe-câble, panneaux amovibles et poignées ne doit pas être incluse dans les dimensions nominales extérieures; leurs dimensions doivent être indiquées dans la documentation du fabricant d'enveloppes.

6.3.3 Dispositions de montage

L'emplacement des fixations et les dispositions de montage de l'enveloppe doivent être indiqués dans la documentation du fabricant d'enveloppes.

6.3.4 Charges admissibles

Les charges admissibles que peuvent supporter l'enveloppe, les plaques de montage, les supports de l'appareillage et les portes doivent être définies dans la documentation du fabricant d'enveloppes. La charge doit être donnée en Newtons.

Si l'enveloppe comprend ou peut comprendre une plaque de montage ou des supports d'appareillage, la charge admissible que l'accessoire peut supporter, selon les moyens de fixation prévus à l'intérieur de l'enveloppe, doit être définie dans la documentation du fabricant d'enveloppes (voir également 8.2).

6.3.5 Support de levage et de transport

Lorsque cela est exigé, l'emplacement et l'installation corrects du support de levage et de transport ainsi que la dimension des filetages des dispositifs de levage doivent être indiqués dans la documentation du fabricant d'enveloppes ou dans les instructions de manutention de l'enveloppe (voir également 8.3).

6.3.6 Mesures de protection

Le fabricant d'enveloppes doit indiquer dans la documentation technique si l'enveloppe est adaptée à un ensemble de classe I ou de classe II.

Dans le cas d'une enveloppe de classe I, le fabricant d'enveloppes doit indiquer si l'enveloppe assure la continuité électrique par les parties conductrices de la structure de l'enveloppe, ou si, et comment, des conducteurs de protection séparés doivent être reliés au circuit de protection de l'installation (voir également 8.5).

6.3.7 Capacité à dissiper la chaleur

Les données relatives à la capacité à dissiper la chaleur dépendent de la température admissible à l'intérieur de l'enveloppe. Elles doivent être fournies pour les méthodes de montage prévues (par exemple, montage encastré, montage en surface) de l'enveloppe et de la conception de l'enveloppe, c'est-à-dire avec ou sans ouvertures de ventilation et nombre de