BS EN 62208:2011

BSI Standards Publication

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

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National foreword

This British Standard is the UK implementation of EN 62208:2011. It is identical to IEC 62208:2011. It supersedes BS EN 62208:2003, which will be withdrawn on 23 September 2014.

The UK participation in its preparation was entrusted by Technical Committee PEL/17, Switchgear, controlgear, and HV-LV co-ordination, to Subcommittee PEL/17/3, Low voltage switchgear and controlgear assemblies.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Compliance with a British Standard cannot confer immunity from legal obligations.

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

(IEC 62208:2011)

Enveloppes vides destinées aux ensembles d'appareillage à basse tension - Exigences générales (CEI 62208:2011)

Leergehäuse für Niederspannungs-Schaltgerätekombinationen - Allgemeine Anforderungen (IEC 62208:2011)

CENELEC

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Foreword

The text of document 17D/442/FDIS, future edition 2 of IEC 62208, prepared by SC 17D, "Low-voltage switchgear and controlgear assemblies", of IEC TC 17, "Switchgear and controlgear" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62208:2011.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2012-06-23
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2014-09-23

This document supersedes EN 62208:2003.

EN 62208:2011 constitutes a technical revision and includes the following significant technical changes with respect to EN 62208:2003:

– consideration of the restructured series of standards EN 61439;

– alignment of test procedures with the newest relevant standards.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 62208:2011 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60216 series	NOTE	Harmonized in EN 60216 series.
IEC 60670 series	NOTE	Harmonized in EN 60670 series.
IEC/TR 60890	NOTE	Harmonized as CLC/TR 60890.
IEC 61000-5-7:2001	NOTE	Harmonized as EN 61000-5-7:2001 (not modified).
IEC 61439 series	NOTE	Harmonized in EN 61439 series.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following referenced documents are indispensable for the application 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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60068-2-2	2007	Environmental testing - Part 2-2: Tests - Test B: Dry heat	EN 60068-2-2	2007
IEC 60068-2-11	1981	Environmental testing - Part 2: Tests - Test Ka: Salt mist	EN 60068-2-11	1999
IEC 60068-2-30	2005	Environmental testing - Part 2-30: Tests - Test Db: Damp heat, cyclic (12 h + 12 h cycle)	EN 60068-2-30	2005
IEC 60085	2007	Electrical insulation - Thermal evaluation and designation	EN 60085	2008
IEC 60529	1989	Degrees of protection provided by enclosures (IP Code)	EN 60529 + corr. May	1991 1993
IEC 60695-2-10	2000	Fire hazard testing - Part 2-10: Glowing/hot-wire based test methods - Glow-wire apparatus and common test procedure	EN 60695-2-10	2001
IEC 60695-2-11	2000	Fire hazard testing - Part 2-11: Glowing/hot-wire based test methods - Glow-wire flammability test method for end-products	EN 60695-2-11	2001
IEC 61439-1	2011	Low-voltage switchgear and controlgear assemblies - Part 1: General rules	EN 61439-1	2011
IEC 62262	2002	Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)	EN 62262	2002
ISO 178	2001	Plastics - Determination of flexural properties	EN ISO 178	2003
ISO 179	Series	Plastics - Determination of Charpy impact properties	EN ISO 179	Series
ISO 2409	2007	Paints and varnishes - Cross-cut test	EN ISO 2409	2007
ISO 4628-3	2003	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	EN ISO 4628-3	2003
ISO 4892-2 + A1	2006 2009	Plastics - Methods of exposure to laboratory light sources - Part 2: Xenon-arc lamps	EN ISO 4892-2 + A1	2006 2009
ISO 11469	2000	Plastics - Generic identification and marking of plastic products	EN ISO 11469	2000

CONTENTS

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

1 Scope

This International Standard applies to empty enclosures, prior to the incorporation of switchgear and controlgear components by the user, as supplied by the enclosure manufacturer.

This standard 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 IEC 61439 series), the rated voltage of which does not exceed 1 000 V a.c. or 1 500 V d.c., and suitable for general use for either indoor or outdoor applications.

NOTE 1 Additional requirements may 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.

This standard does not apply to enclosures, which are covered by other specific products standards (e.g. IEC 60670 series).

Compliance with the safety requirements of the applicable product standard is the responsibility of the assembly manufacturer.

NOTE 3 This standard may serve as a basis for other technical committees.

2 Normative references

The following referenced documents are indispensable for the application 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, *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 60529:1989, *Degrees of protection provided by enclosures (IP Code)*[1]

IEC 60695-2-10:2000, *Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure*

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

IEC 60695-2-11:2000, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test methods for end-products*

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)*

ISO 178:2001, *Plastics – Determination of flexural properties*

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

ISO 2409:2007, *Paints and varnishes – Cross-cut test*

ISO 4628-3:2003, *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 4892-2:2006, *Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc sources*
Amendment 1 (2009)

ISO 11469:2000, *Plastics – Generic identification and marking of plastic products*

3 Terms and definitions

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

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 Throughout this standard, the word enclosure is used for empty enclosure.

NOTE 2 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

3.3
cover
external part of the enclosure

3.4
door
hinged or sliding cover

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2 To be published.

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 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

4 Classification

Enclosures are classified according to:

a) the type of material:
   - insulating;
   - metallic;
   - combination of insulating and metallic;

b) method of fixing:
   - 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;
   - IK code, according to IEC 62262;

e) the rated insulation voltage (for enclosures made of insulating materials).

5 EMC requirements

EMC requirements are not applicable for enclosures to this standard.

NOTE For degrees of protection provided by enclosures against electromagnetic disturbances (EM code), see IEC 61000-5-7.

6 Information to be given regarding the enclosure

6.1 General

The following information shall be given by the 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 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 for total insulation (equivalent to class II) assemblies with the symbol IEC 60417-5172 is the responsibility of the assembly manufacturer.

6.3 Documentation

6.3.1 General

The manufacturer's documentation shall include all relevant constructional, mechanical characteristics, the enclosure classification (see Clause 4) and any instruction necessary for the correct handling, assembling, mounting and service conditions of the enclosure as well as reference to this standard:

- dimensions (see 6.3.2);
- mounting arrangements (see 6.3.3);
- permissible loads (see 6.3.4);
- lifting devices, if necessary (see 6.3.5);
- provisions for protection against electric shock (see 6.3.6);
- applicable service conditions (see Clause 7);
- location and size of protected space;
- data of thermal power dissipation capability;
- rated insulation voltage of enclosures constructed of an insulating material;
- degree of protection (IK and IP codes, see 8.7 and 8.8).

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.

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 manufacturer’s documentation.

6.3.3 Mounting arrangements

The means and location of the enclosure mounting 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.

6.3.4 Permissible loads

The permissible loads that the enclosure and its doors are able to carry 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

The enclosure manufacturer shall indicate in the technical documentation, 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).

7 Service conditions

7.1 General

Enclosures conforming to this standard 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.

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.

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.

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.

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.

8.3 Lifting and transport support

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

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.

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.

8.7 Degree of protection (IK code)

The degree of protection against mechanical impact, as declared by the manufacturer, shall be in accordance with IEC 62262.

Compliance is checked according to the test of 9.7.

8.8 Degree of protection (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 manufacturer, shall be in accordance with IEC 60529.

Compliance is checked according to the test of 9.8.

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

9 Type tests

9.1 General

Tests according to this standard 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 1 shows the number of samples to be tested and the order of test per sample.

Table 1 – Number of samples to be tested and order of test per sample

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.

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. 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/cm^3.

After the test the marking shall be easily legible.

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 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.

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 five times through 90 °, resting at least 1 min in the open position.

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.

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 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 ± 0,5) m horizontally, then set down. This cycle, which should be carried out for 1 min ± 5 s is repeated three times at uniform speed.

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.

9.6 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 2.

Table 2 – 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.

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

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

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

9.8 Degree of protection (IP code)

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

9.8.1.1 Protection against access to hazardous parts

Subclauses 12.1 and 12.2 of IEC 60529:1989 apply.

The access probes shall not enter the protected space.

9.8.1.2 Degree of protection against the ingress of solid foreign objects

For IP 2X, IP 3X, IP 4X enclosures, 13.2 and 13.3 of IEC 60529:1989 apply.

For IP 5X enclosures, 13.4, category 2 (without vacuum pump) and 13.5 (without vacuum pump) of IEC 60529:1989 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/m^2.
- 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 IP 6X enclosures, 13.6 of IEC 60529:1989 apply. No talcum powder shall be observable inside the enclosure at the end of the test.

Where the enclosure tested according to 9.7 is too large for the verification of IP 5X or 6X, an additional smaller enclosure having the same design details may be used for this test.

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

Subclauses 14.1 and 14.2 of IEC 60529:1989 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.

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

Clause 15 of IEC 60529:1989 applies.

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

9.9 Properties of insulating materials

9.9.1 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.

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 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 four days (96 h).

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

9.9.2 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 to IEC 60085.

9.9.3 Resistance to abnormal heat and to fire

Compliance is checked by tests in accordance with the principles of IEC 60695-2-10 and the details of IEC 60695-2-11. For a description of the test see Clause 4 of IEC 60695-2-11:2000.

The apparatus to be used shall be as described in Clause 5 of IEC 60695-2-11:2000.

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 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 35 % and 45 % 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 in accordance with Clause 6 of IEC 60695-2-10:2000.

During the test, the procedure given in Clause 8 of IEC 60695-2-10:2000 and Clause 10 of IEC 60695-2-11:2000 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 ± 15) °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 ± 15) °C.

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

9.10 Dielectric strength

9.10.1 General

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

Compliance is checked as follows:

9.10.2 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 two days (48 h).

In most cases, the enclosures may 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 (Na_2SO_4) or potassium nitrate (KNO_3) 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.

9.10.3 Enclosures without metal elements inside the protected space

An r.m.s. voltage of substantially sine-wave form at a value according to 10.9.4 of IEC 61439-1:2011 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.

9.10.4 Enclosures having metal elements inside the protected space

All internal metallic parts are connected to a bar, and an r.m.s. voltage of substantially sine wave form at a value according to 10.9.4 of IEC 61439-1:2011 is applied for 1 min between a metal foil in contact with the external surface and the bar.

Initially, not more than half the prescribed voltage is applied. It is then raised rapidly to the full value.

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

9.10.5 Results to be obtained

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

9.11 Continuity of the protective circuit

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.

Verification shall be made using a resistance measuring instrument or arrangement which is capable of driving a current of at least 10 A (a.c. or d.c.). The current is passed between each exposed conductive part and the earthing termination point. 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.

9.12 Resistance to ultra-violet (UV) radiation

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 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 Resistance to corrosion

9.13.1 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.

The enclosure subjected to the test shall be mounted as for normal use according to the 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 apply, subject to an agreement between manufacturer and user.

9.13.2 Test procedure

Enclosures shall be subjected to the following test:

9.13.2.1 Severity test A

This test is applicable to:

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

The test consists of:

6 cycles of 24 h each to damp heat cycling test according to IEC 60068-2-30 (Test Db) at (40 ± 3) ºC and relative humidity of 95 %

and

2 cycles of 24 h each to salt mist test according to IEC 60068-2-11; (Test Ka: Salt mist), at a temperature of (35 ± 2) ºC.

9.13.2.2 Severity test B

This test is applicable to:

- metallic outdoor enclosures;
- external 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 (Test Db) at (40 ± 3) ºC and relative humidity of 95 %

and

7 cycles of 24 h each to salt mist test according to IEC 60068-2-11; (Test Ka: Salt mist), at a temperature of (35 ± 2) ºC.

9.13.3 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 for a degree of rusting Ri1. 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 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.

9.14 Thermal power dissipation capability

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.

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