IEC 60670-24

Edition 3.0 2024-12
EXTENDED VERSION

INTERNATIONAL STANDARD

colour inside

This full version of IEC 60670-24:2024 includes the content of the references made to IEC 60670-1:2024

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 60670-24:2024-12 EXV(en)

IEC Secretariat
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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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

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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This extended version (EXV) of the official IEC Standard provides the user with the full content of the Standard.

IEC 60670-24:2024 EXV includes the content of IEC 60670-24:2024, and the references made to IEC 60670-1:2024.

The specific content of IEC 60670-24:2024 is displayed on a blue background.

IEC 60670-24 has been prepared by subcommittee 23B: Plugs, socket-outlets and switches, of IEC technical committee 23: Electrical accessories. 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) revision of requirements for protection against electric shock in Clause 10;
b) addition of requirements for functional earthing in 11.101;
c) revision of the requirements for fixing of flush type and semi-flush type enclosures in 12.12;
d) revision of the requirements for resistance of insulating material to abnormal heat and to fire in Clause 18;
e) addition of calculations to take into account the power loss of electronic devices in Clause AA.6;
f) addition of tests and requirements for enclosures exposed to direct sunlight with the related Annex CC;
g) addition of tests and requirements for enclosures with separate area to accommodate multimedia-equipment with the related Annex DD;
h) addition of tests and requirements for enclosures used with connected devices or equipment with the related Annex EE.

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

Draft	Report on voting
23B/1536/FDIS	23B/1554/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.

A list of all parts in the IEC 60670 series, published under the general title *Boxes and enclosures for electrical accessories for household and similar fixed installations*, can be found on the IEC website.

This document is to be used in conjunction with IEC 60670-1:2024. It lists the changes necessary to convert that standard into a specific standard for housing protective devices and other power dissipating electrical equipment.

Where this document states "addition", "modification" or "replacement", the relevant requirement, test specifications or explanatory matter in IEC 60670-1:2024 shall be adapted accordingly.

Clauses and subclauses, notes, figures or tables which are additional to those in IEC 60670-1:2024 are numbered starting from 101.

Additional annexes to IEC 60670-1:2024 are numbered AA, BB, etc.

In this publication the following print types are used:

- requirements proper: in roman type.
- *test specifications: in italic type.*
- notes: in smaller roman type.

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, or
- revised.

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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

1 Scope

This part of IEC 60670 applies to enclosures and parts of them for housing protective devices and other power dissipating electrical equipment intended to be used with a rated voltage not exceeding 400 V and a total incoming load current not exceeding 125 A for household and similar fixed electrical installations.

These enclosures are intended to be installed in locations where unskilled persons have access. They are intended to be equipped with electrical equipment by skilled persons (installers).

These enclosures are intended to be installed where the prospective short circuit current does not exceed 10 kA unless they are protected by current limiting protective devices with a cut-off current not exceeding 17 kA.

Enclosures complying with this document are suitable for use at ambient temperature not normally exceeding 40 °C, but their average temperature over a period of 24 h does not exceed 35 °C, with a lower limit of the ambient air temperature of −5 °C.

An enclosure which is an integral part of an electrical accessory and provides protection against external influences (e.g. mechanical impacts, ingress of solid objects or of water), is covered by the relevant standard for such an accessory.

This document does not apply to a low-voltage switchgear and controlgear assembly as defined in the IEC 60439 series or IEC 61439 series nor to a main entrance panel which can be part of the distribution board.

This document does not apply to surface type boxes, flush and semi-flush type boxes suitable for the housing of accessories for household and similar use such as switches, electronic switches, socket-outlets, which are covered by IEC 60670-1 only.

NOTE 1 Enclosures according to this document are mainly used for distribution board for housing protective devices and other power dissipating electrical equipment and are installed at the beginning of the electrical circuit whereas boxes according to IEC 60670-1 are installed at the end of it.

NOTE 2 A main entrance panel is a set composed of a panel or an enclosure equipped with a meter and/or the main incoming device. Main entrance panels comply with their appropriate standards or the requirements of the local supplier, if any.

NOTE 3 In the following country this document cannot be used in installations with a 230 V single-phase supply rated up to 100 A that is under the control of ordinary persons. Integration of mechanical and electrical devices into an enclosure must be verified by compliance with IEC 61439-3 [British standard EN 61439-3]: UK.

NOTE 4 In the following country this document can only be used for GP enclosures with the instructions according to Annex A. For the other types of enclosures the integration of mechanical and electrical devices into an enclosure is verified by compliance with DS EN 61439-3: DK.

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 60068-2-75:2014, *Environmental testing – Part 2-75: Tests – Test Eh: Hammer tests*

IEC 60112:2020, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

IEC 60364-4-41:2005, *Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock*
IEC 60364-4-41:2005/AMD1:2017

IEC 60364-5-54:2011, *Low-voltage electrical installations – Part 5-54: Selection and erection of electrical equipment – Earthing arrangements and protective conductors*
IEC 60364-5-54:2011/AMD1:2021

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

IEC 60423:2007, *Conduit systems for cable management – Outside diameters of conduits for electrical installations and threads for conduits and fittings*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*
IEC 60529:1989/AMD1:1999
IEC 60529:1989/AMD2:2013

IEC 60664-1, *Insulation coordination for equipment within low-voltage supply systems – Part 1: Principles, requirements and tests*

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

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

IEC 60898-1, *Electrical accessories – Circuit-breakers for overcurrent protection for household and similar installations – Part 1: Circuit-breakers for a.c. operation*

IEC 60981:2019, *Extra-heavy duty rigid steel conduits*

IEC 61008-2-1, *Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCB's) – Part 2-1: Applicability of the general rules to RCCB's functionally independent of line voltage*

IEC 61009-2-1, *Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBO's) – Part 2-1: Applicability of the general rules to RCBO's functionally independent of line voltage*

IEC 61032:1997, *Protection of persons and equipment by enclosures – Probes for verification*

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

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

ISO/IEC Guide 51, *Safety aspects – Guidelines for their inclusion in standards*

ISO/IEC 11801-1:2017, *Information technology – Generic cabling for customer premises – Part 1: General requirements*

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 4892-2:2013, *Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc lamps*
ISO 4892-2:2013/AMD1:2021

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
enclosure
combination of parts, such as boxes, backplates, covers, cover-plates, lids, box extensions, accessories, etc., providing after assembly and installation as in normal use, an appropriate protection against external influences, and a defined protection against contact with enclosed live parts from any accessible direction

Note 1 to entry: See Annex A.

3.2
box
part of an enclosure provided with means for fixing a cover, cover-plate, accessory, etc., and intended to receive accessories (such as socket-outlets, switches, etc.)

Note 1 to entry: The accessory can be entirely or partly inside the enclosure.

3.3
box extension
part of an enclosure which is intended to extend a box for the purpose of either increasing the internal volume of the box or enclosure or to adjust for mounting the box flush or semi-flush with the finished surface of a wall or the like

3.4
backplate
part of a surface mounting enclosure provided with means for fixing a cover, cover-plate, accessory (such as socket-outlets, switches, etc)

3.5
lid
cover
cover-plate
part of an enclosure, not integral with or part of an accessory, which may either retain an accessory in position or enclose it

3.6
raised cover
cover intended for mounting directly onto a box to provide for the attachment of accessories and to increase the internal volume of the enclosure

Note 1 to entry: The centre portion of the cover is raised to accommodate a specific wall or ceiling thickness and to permit the mounting of the accessory on it, flush with the surface of the wall or ceiling.

3.7
exposed conductive part
conductive part of electrical equipment, which can be touched, and which is not normally live, but which can become live when basic insulation fails

3.8
surface mounting enclosure
surface mounting box
box or enclosure which is intended for mounting on a surface

Note 1 to entry: See Annex A.

3.9
flush-mounting box
flush-mounting enclosure
box or enclosure which is intended for mounting flush with the surface

Note 1 to entry: See Annex A.

3.10
semi-flush mounting box
semi-flush mounting enclosure
box or enclosure which is intended to fit within a mounting surface and partially projects from the mounting surface

3.11
cable gland
device designed to permit the entry of a cable, flexible cable or insulated conductor into an enclosure, and which provides sealing and retention and eventually may also provide other functions such as earthing, bonding, insulation, cable guarding, strain relief or a combination of these

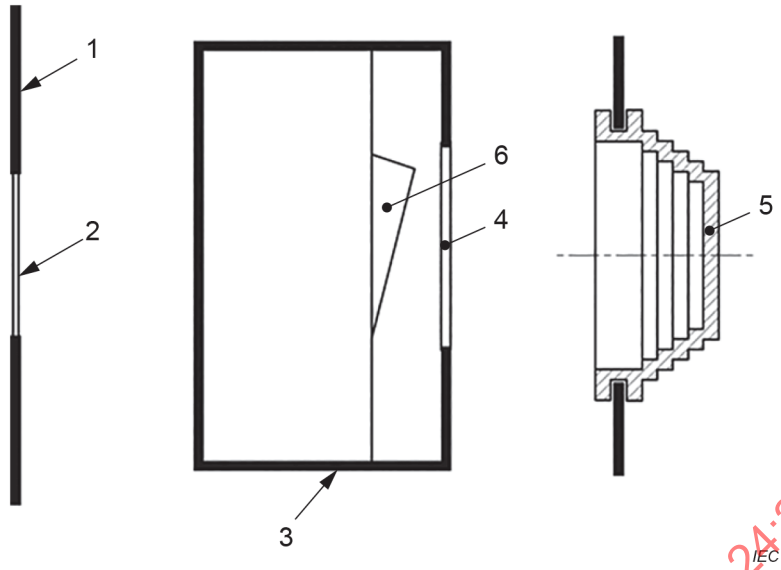
3.12
seal
material used to fill up the space between the inside of a gland and the cable passing through, usually compressed by the gland and thereby forming a joint

3.13
gasket
material introduced between mating surfaces of an enclosure which when under compression forms a joint

3.14
grommet
component used to support and protect the cable or conduit at the point of entry; it may also prevent the ingress of moisture or contaminants

Note 1 to entry: See Figure 1.

[SOURCE: IEC 60050-581:2008, 581-27-19, modified – The words "part of", "or an accessory" and "wires or" have been omitted from the definition and "or conduit" added; Note 1 to entry added.]



Key

1 box
2 entry membrane
3 enclosure
4 protective membrane
5 grommet
6 electrical accessory

Figure 1 – Examples of membranes and grommets

3.15
entry membrane
component or an integral part of an enclosure used to protect the cable which may be used to support the cable or conduit at the point of entry

Note 1 to entry: An entry membrane may also prevent the ingress of moisture or contaminants and may be part of a grommet (see Figure 1).

3.16
protective membrane
component or an integral part of an enclosure that is not intended to be penetrated in normal use and is intended to provide protection against ingress of water or solid objects and/or to allow the operation of an accessory

Note 1 to entry: See Figure 1.

3.17
composite material
combination of metal and insulating material

3.18
spout
hub
open entry of a box permitting the insertion and containment of a conduit

3.19
cable retention
ability to limit the displacement of a fitted cable against pull forces

3.20
cable anchorage
ability to limit the displacement of a fitted flexible cable against pull and push forces and torques

3.21
blanking-plug
component used to close an open inlet or an open knock-out

3.22
***U*n**
rated voltage
voltage assigned by the manufacturer for a specific operating condition of the box or enclosure

[SOURCE: IEC 60050-442:1998, 442-01-03, modified – The symbol has been added as a term, the domain "(of accessories)" has been deleted; in the definition, "accessory" has been replaced with "box or enclosure".]

3.101
general purpose enclosure
GP enclosure
enclosure where integration of mechanical and electrical devices has been verified by tests carried out by the manufacturer according to this document and where the installer has to verify the installed equipment according to the instructions given in Annex AA

3.102
enclosure for pre-determined equipment
PD enclosure
enclosure where the capability to integrate pre-determined mechanical and electrical equipment has been verified according to design rules and tests according to this document carried out by the manufacturer where the installer has to verify the installed equipment following the manufacturer's instructions according to Annex BB

3.103
manufacturer's instructions
instructions in accordance with Annex AA and Annex BB leading to a configuration of the enclosure ensuring the necessary heat dissipation

Note 1 to entry: References to standards can be given in the manufacturer's instructions.

3.104
maximum capability to dissipate power
P_{de}
maximum capability of the enclosure to dissipate in normal use the power losses of the installed devices, as declared by the manufacturer

Note 1 to entry: P_{de} is expressed in watts (W).

3.105
rated current
I_n
maximum current assigned by the manufacturer of the enclosure which can be distributed by the enclosure

3.106
blanking plate
component used for closing the opening, for protective devices and other power dissipating electrical equipment, of an enclosure to provide basic insulation

3.107
enclosures with separate area to accommodate multimedia and communication equipment
enclosure providing an area where multimedia and communication equipment are intended to be integrated according to the additional requirements given in Annex DD

Note 1 to entry: An enclosure with separate area to accommodate multimedia and communication equipment can be a GP or PD enclosure.

3.108
enclosure for use with connected devices or equipment
enclosure intended to accommodate protection devices, electrical equipment dissipating power and connected devices or equipment according to the additional requirements given in Annex EE

Note 1 to entry: An enclosure for use with connected devices or equipment can be a GP or PD enclosure.

3.109
connected devices or equipment
physical unit that can connect with other units into an interconnected infrastructure

Note 1 to entry: This physical unit can operate and communicate with the physical world through detection and action. Such equipment or device allows the switchboard to participate in this IoT infrastructure.

3.110
rated current of the equipped GP enclosure
I_{nq}
rated current to be calculated as I_{ne} multiplied by K_e

Note 1 to entry: In the absence of incoming protective and control devices, the rated current of the equipped GP enclosure is the outgoing rated current (I_{nu}).

3.111
incoming rated current
I_{ne}
rated current or sum of the rated currents of all incoming protective and control devices, expected to be used at the same time

3.112
outgoing rated current
I_{nu}
sum of the rated currents of all outgoing protective and control devices, expected to be used at the same time

3.113
utilisation factor
K_e
ratio of the actual current flowing through any main incoming protective device inside the enclosure to the rated current of this device

Note 1 to entry: The utilisation factor for incoming circuits is assumed to be 0,85.

3.114
diversity factor
K
ratio, calculated by the installer, of the rated current of the equipped GP enclosure (I_{nq}) to the outgoing rated current (I_{nu})

4 General requirements

Boxes and enclosures shall be so designed and constructed that, in normal use, their performance is reliable, and safety is achieved by reducing risk to a tolerable level, as defined in ISO/IEC Guide 51.

Compliance is checked by meeting all the relevant requirements and tests specified.

5 General remarks on tests

5.1 Test conditions and number of samples

Tests according to this document are type tests.

Unless otherwise specified in this document, boxes and enclosures are tested as delivered.

Accessories complying with other standards are not tested again.

Tests on boxes and enclosures of insulating material shall be performed after a preconditioning period of at least 48 h at ambient temperature between +15 °C and +35 °C and relative air humidity between 45 % and 85 %.

NOTE For some materials a longer preconditioning period can be requested by the manufacturer.

Unless otherwise specified, the tests are carried out in the order of the clauses, at an ambient temperature between +15 °C and +35 °C on a set of three specimens.

It is recommended that the tests are carried out at an ambient temperature of (20 ± 5) °C.

5.2 Compliance general requirement

The specimens are submitted to all the relevant tests and the requirements are satisfied if all the applicable tests are deemed to have been passed.

If one of the specimens does not satisfy a test due to an assembly or a manufacturing fault, that test and any preceding ones which may have influenced the results of the test shall be repeated and also the tests which follow shall be carried out in the required sequence on another full set of specimens, all of which shall comply with the requirements.

NOTE When submitting the first set of specimens, the applicant can also submit the additional set of specimens which can be necessary, if one specimen fails. The testing station will then, without further request, test the additional set of specimens and will only reject if a further failure occurs. If the additional set of specimens is not submitted at the same time, the failure of one specimen will entail rejection.

In this document the term "instructions" is understood to mean manufacturer's instructions.

6 Ratings

Rated values are defined as given in Annex AA and Annex BB.

7 Classification

Boxes and enclosures are classified according to Table 1.

Table 1 – Classification of boxes and enclosures

Classification criteria 7.2.2.2, 7.2.2.3, 7.8.1 and 7.9 do not apply.

Classification criteria		
7.1 The nature of their material	7.1.1 Insulating	
	7.1.2 Metallic	
	7.1.3 Composite	
	7.1.4 Natural or synthetic rubber or a mixture of both	
7.2 The type of installation	7.2.1 Flush, semi-flush in solid walls, ceilings or floors	7.2.1.1 Not suitable for installation into concrete
		7.2.1.2 Suitable for installation into concrete with a maximum temperature during the casting process of +60 °C
		7.2.1.3 Suitable for installation into concrete with a maximum temperature during the casting process of +90 °C
	7.2.2 Flush or semi-flush in hollow walls, hollow ceilings, hollow floors or furniture	7.2.2.1 Class Ha
		7.2.2.2 Class Hb for walls
		7.2.2.3 Class Hb for ceilings
	7.2.3 Surface mounting on walls, ceilings, floors or furniture	
7.3 The type(s) of inlets [a]	7.3.1 With inlets for sheathed cables for fixed installations	
	7.3.2 With inlets for flexible cables	
	7.3.3 With inlets for plain or corrugated conduits	
	7.3.4 With inlets for threaded conduits	
	7.3.5 With inlets for other types of conductors/cables or conduits	
	7.3.6 With spouts (hubs)	
	7.3.7 Without inlets. Inlet openings will be made during installation	
7.4 The clamping means	7.4.1 With cable retention	
	7.4.2 With cable anchorage	
	7.4.3 With clamping means for flexible conduit	
	7.4.4 Without clamping means	

Classification criteria		
7.5 The minimum temperature during installation and use.	7.5.1 −5 °C	
	7.5.2 −15 °C	
	7.5.3 −25 °C	
	7.5.4 −25 °C during installation, −25 °C to −40 °C during use, as declared.	
7.6 The degree of protection against access to hazardous parts and against harmful effects due to the ingress of solid foreign objects according to IEC 60529		
7.7 The degree of protection against harmful effects due to the ingress of water according to IEC 60529		
7.8 The degree of protection of the part mounted inside the hollow walls of the boxes classified according to 7.2.2.1	7.8.1 IP2X	
	7.8.2 > IP2X	
7.9 The provision for fixing accessories to boxes	7.9.1 Boxes supplied with screws	
	7.9.2 Boxes intended to receive screws	
	7.9.3 Boxes intended to receive claws	
	7.9.4 Boxes intended to receive other means	
7.101 Enclosure	7.101.1 GP enclosure	
	7.101.2 PD enclosure	
[a] Boxes and enclosures may have more than one type of inlet. Owing to installation rules, boxes class Hb for walls and class Hb for ceilings have some specific additional requirements and are tested according to 11.2, 12.13, 16.3. NOTE In the following countries only class Ha boxes and enclosures are used: BE, BR, CH, DE, FR, IT, JP, NL, NO, PT, SE, UK. NOTE 101 In the following countries only enclosures classified according to 7.101.2 can be used: BE, DE, FR and GR. NOTE 102 In the following country only enclosures according to 7.101.1 can be used: DK.		

8 Marking

8.1 General

Enclosures shall be marked with

a) the name, trade mark or identification mark of the manufacturer or the responsible vendor;

b) IP code against ingress of solid foreign objects and against access to hazardous parts if higher than IP3X and/or if IP code against harmful ingress of water is higher than IPX0.

The IP code, if applicable, shall be marked on the outside of the enclosure so as to be easily discernible when the enclosure is mounted and wired as for normal use. The visibility of the marking is also possible after opening the door or the lid if a minimum degree of IP20 is maintained after opening;

c) the symbol for class II protection, if applicable (IEC 60417-5172 (2003-02))  ;

d) type designation, reference number or catalogue number;

e) letter N for terminals intended exclusively for the neutral conductor, if any;

f) symbol  according to IEC 60417-5019 (2006-08) for earthing terminals for the connection of the protective conductor, if any, and/or symbol  according to IEC 60417-5018 (2011-07) for functional earthing terminal for the connection of the functional earthing, if any.

Markings of neutral terminals and earthing terminals shall not be placed on screws, or any other easily removable parts.

NOTE 1 Easily removable parts are those parts which can be removed during the normal installation of the enclosure.

The following information shall be marked on enclosures or provided by the manufacturer on the smallest package unit or in the manufacturer's instructions, which are not required to be provided with the product:

g) rated voltage;

NOTE 2 For three-phase systems, the combined voltage values can be considered e.g. 230/400 V.

h) rated current as declared by the manufacturer for enclosures classified according to 7.101.2;

i) reference number of this document i.e. IEC 60670-24;

j) information for parts of enclosures intended to withstand +90 °C during the casting process of concrete into shuttering according to classification 7.2.1.3;

k) for enclosures classified according to 7.3.7 (without inlets), the necessary information concerning the openings that can be made during installation;

l) for enclosures classified according to 7.101.1, the maximum capability to dissipate power (P_{de});

In the case of an enclosure designed with ventilation openings that can be closed, for example with an accessory, the maximum capability to dissipate power (P_{de}) shall be declared by the manufacturer, for both closed and open positions.

m) for enclosures classified according to 7.2.2, their usability or not for installation in hollow walls, hollow ceilings, hollow floors or furniture;

n) the corresponding dimension sheet, if any;

Annex Afor enclosures classified according to

- 7.101.1 the marking "GP";
- 7.101.2 the marking "PD";

o) IK-code if declared.

8.2 Durability of the marking on the boxes and enclosures

Marking shall be easily legible, durable and indelible.

Laser marking directly on the product and marking made by moulding, pressing or engraving are not subjected to this test.

Compliance is checked by inspection, using normal or corrected vision, without additional magnification and, if necessary, by the following test.

The test is done by rubbing the marking for 15 s with a piece of cotton cloth soaked with water and again for 15 s with a piece of cotton cloth soaked with n-hexane 95 % (Chemical Abstracts Service Registry Number, CAS RN, 110-54-3).

NOTE n-hexane 95 % (Chemical Abstracts Service Registry Number, CAS RN, 110-54-3) is available from a variety of chemical suppliers as a high-pressure liquid chromatography (HPLC) solvent.

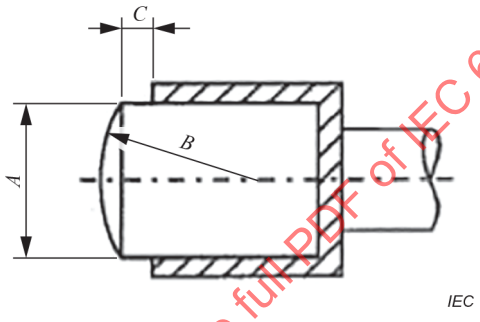
When using the liquid specified for the test, precautions as stated in the relative material safety datasheet provided by the chemical supplier shall be taken to safeguard the laboratory technicians.

The marking surface to be tested shall be dried after the test with water.

Rubbing shall commence immediately after soaking the piece of cotton, applying a compression force of (5 ± 1) N at a rate of about one cycle per second (a cycle comprising a forward and backward movement along the length of the marking). For markings longer than 20 mm, rubbing can be limited to a part of the marking, over a path of at least 20 mm length.

The compression force is applied by means of a test piston which is wrapped with cotton comprising cotton wool covered by a piece of cotton medical gauze.

The test piston shall have the dimensions specified in Figure 2 and shall be made of an elastic material which is inert against the test liquids and has a Shore-A hardness of 47 ± 5 (for example synthetic rubber).



Dimensions mm			
°	*A*	*B*	*C*
Dimensions	20	20	2
Tolerance	+2, −0	±0,5	+1, −0

Figure 2 – Test piston dimensions

When it is not possible to carry out the test on the specimens due to the shape/size of the product or the marking is not accessible with the test piston:

– *a suitable piece having the same characteristics as the product can be submitted to the test*

or

– *another test piston with a different shape can be used on the condition that radius B is kept.*

8.101 Required information for instruction sheet and/or documentation

The manufacturer shall:

– provide appropriate instructions regarding the means (for instance glands, grommets, barriers, etc.) to be used to obtain the intended degree of protection;

– give information to the installer concerning the verification of the electrical continuity of the protective circuit (see Clause 11);

– give the installer the necessary instructions:

- for enclosures classified according to 7.101.1, the manufacturer shall include in the documentation the necessary instructions for installation and how to integrate accessories as given in Annex AA;
- for enclosures classified according to 7.101.2, the manufacturer shall include in the documentation the necessary instructions for installation according to the appropriate mounting environment as given in Annex BB.

9 Dimensions

Boxes and enclosures shall comply with the appropriate standard sheets, if any.

Compliance is checked by inspection and measurement.

10 Protection against electric shock

Enclosures shall have a degree of protection of at least IPXXC according to IEC 60529, when mounted and installed as for normal use, according to the manufacturer's instruction.

Enclosures are tested completed with the necessary means (such as grommets, etc.) indicated in the manufacturer's instructions and the window opening(s), if any, completely filled up with blank inserts delivered by the manufacturer and/or samples of products as declared by the manufacturer.

If doors or covers of the enclosure can be opened without the use of a key or tool, they shall be left open during the test.

Compliance is checked by the following tests.

Tests shall be carried out on parts which are accessible after installation.

The test shall be carried out in accordance with IEC 60529 where probe C of IEC 61032:1997 is applied to all places including knock-outs except membranes or the like, where yielding of insulating material could impair the safety, with a force of 3 N.

In addition, enclosures having class II protection, when mounted and installed as for normal use, shall:

a) cover live parts of the installed equipment with insulation material, and

b) at no point be pierced by conducting parts in such a manner that there is a possibility of a fault voltage being brought out of the enclosure, and

c) not have conductive parts, such as plates, cover-plates or frames connected to the protective circuit.

Compliance is checked by inspection.

11 Provision for earthing

Subclauses 11.1 to 11.3 are not applicable for enclosures with class II protection.

11.1 Boxes and enclosures with exposed conductive parts

Boxes and enclosures with exposed conductive parts shall be provided with an earthing means of low resistance or have provision for the fitting of such an earthing means. For the purpose of this requirement, small screws and the like, for fixing bases, covers or cover-plates, etc. isolated from live parts, are not considered as exposed conductive parts.

Exposed conductive parts of covers or cover-plates shall be connected through a low resistance connection to the earthing means when fitted as for normal use.

Compliance is checked by the following test.

A current derived from an AC or DC source having a no-load voltage not exceeding 12 V and equal to (25 ± 1) A is passed between the earthing terminal and each exposed conductive part in turn. The voltage drop between the earthing terminal and each of the exposed conductive parts is measured, and the resistance is calculated from the current and this voltage drop.

In no case shall the resistance exceed 0,05 Ω.

Care should be taken such that the contact resistance between the tip of the measuring probe and the exposed conductive part under test does not influence the test results.

In boxes and enclosures of insulating or composite material having an IP degree higher than IPX0, provisions can be made for the addition of means for the effective continuity of the earthing conductor, when more than one inlet is provided.

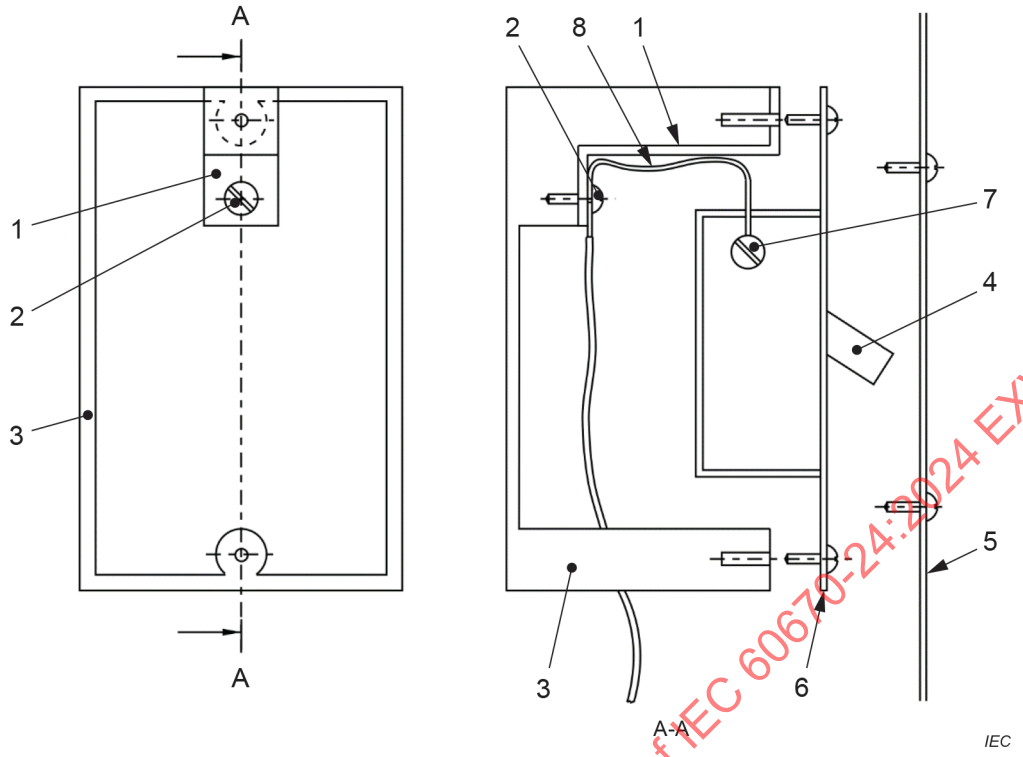
The earthing means or the provision for the fitting of such an earthing means shall be located so that:

– the means is readily accessible through the open face of the box, and
– the removal of an accessory mounted in the box does not disturb the continuity of the earthing circuit, and
– the means is not part of a removable cover, back, or side of the box or enclosure.

Compliance is checked by inspection.

11.2 Boxes and enclosures of insulating material classified according to 7.2.2.2 and 7.2.2.3

Boxes and enclosures of insulating material shall be provided with a minimum of one earthing strap having one screw terminal for earthing purposes with a connecting capacity of at least 4 mm^2. The design of the earthing strap shall ensure that the metal mounting yokes of accessories mounted inside the box and metallic covers mounted on the box are connected to the earthing conductors (see Figure 4 and Figure 5).



Key

1 earthing strap
2 earthing terminal screw
3 plastic box
4 accessory
5 metal cover
6 accessory's metal mounting yoke
7 accessory earthing terminal
8 bonding jumper

Figure 4 – Earthing strap

Dimensions in millimetres

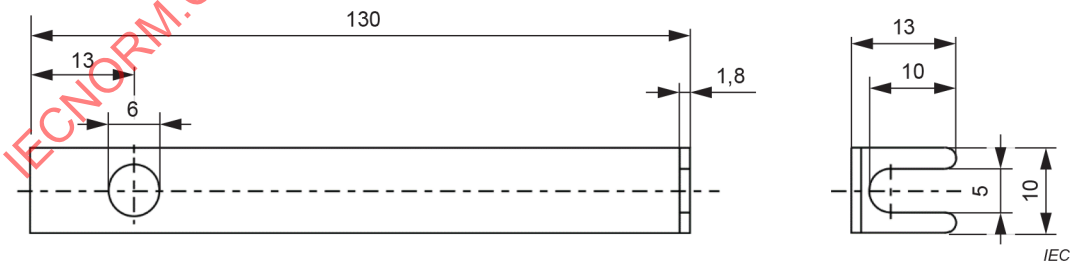


Figure 5 – Test strap

Compliance is checked by inspection.

The earthing strap shall be securely fastened to the box or enclosure.

Compliance is checked by the test in 16.3.2.

11.3 Boxes or enclosures with removable sides according to 7.1.2

A box or enclosure classified according to 7.1.2 that has removable sides shall be constructed so that the electrical bond between separable parts includes at least one threaded screw connection.

Compliance is checked by inspection.

11.4 Earthing terminal threads

The threads of the earthing terminal delivered with or integrated in boxes and enclosures shall not be stripped when the torque shown in the relevant column of Table 4 is applied.

Compliance is checked by inspection and by the following test.

The screws are tightened and loosened 5 times.

The test is carried out using a suitable screwdriver or an appropriate tool applying a torque as indicated in Table 4.

If a screw has a hexagonal head with a slot, only the test with the screwdriver is carried out, with the relevant torque given in column II of Table 4.

Greater values of torque may be used if so stated by the manufacturer, when the relevant information is provided.

Column I of Table 4 applies to screws which cannot be tightened by means of a screwdriver with a blade wider than the nominal diameter of the thread of the screw.

Column II of Table 4 applies to other screws which are tightened by means of a screwdriver.

Column III of Table 4 applies to screws and nuts which are tightened by means other than a screwdriver.

Column IV of Table 4 applies to screws which are tightened by means of a square blade screwdriver.

During the test, there shall be no damage, such as breakage of screw or damage to the head slot (rendering the use of the appropriate screwdriver impossible) or to the threads or to the enclosure impairing the further use of the fixing means. The screws shall be gradually tightened in one smooth and continuous movement.

11.101 The electrical continuity of the protective circuit, if any, shall be checked.

Except for enclosures having class II protection, all exposed conductive parts of the enclosure shall be connected separately or in groups to the protective circuit terminals.

Compliance is checked by inspection and, if necessary, by a continuity test of the protective circuit.

A measurement shall be carried out to verify that the resistance between the terminal of the incoming protective conductor and the exposed conductive parts shall be less than 0,05 Ω with a current of 10 A AC or 10 A DC.

11.102 Functional earthing

In order to ensure the robustness of the functional earthing conductor, if any, the minimum cross-sectional area shall be at least 1,5 mm^2. The colour of the functional earthing conductor shall be pink (see IEC 60445).

Compliance is checked by inspection.

12 Construction

12.1 General

Boxes and enclosures shall be constructed without sharp edges. Burrs shall be removed from mould lines of interior surfaces so that there are no sharp edges or undue obstructions to the passage of wiring or coupling of parts in the intended use of the product.

The inner and outer surfaces of a box or cover shall not be subject to peeling, scaling or flaking and shall be smooth and free from blisters, cracks, and other defects.

Compliance is checked by inspection.

12.2 Lids, covers or cover-plates or parts of them

12.2.1 General

Lids, covers, cover plates or parts of them, which are intended to ensure protection against electric shock, shall be held in place effectively. They shall be removable only by the use of a tool and/or a key.

It is recommended that the fixing means of covers or cover-plates be captive. The use of tight-fitting washers of cardboard or the like is deemed to be an adequate method for securing screws intended to be captive.

12.2.2 Screw-type fixing

A box or enclosure intended to accept a lid, cover, or cover plate by means of screw fixing shall be provided with means to accommodate the intended screws.

For lids, covers or cover plates whose fixing is of the screw type, compliance is checked by inspection.

12.2.3 Non-screw-type fixing operable without the use of a tool or a key

12.2.3.1 General

A box or enclosure intended to accept a lid, cover, or cover plate with non-screw-type fixing operable without the use of a tool or a key shall be provided with means to fix the lid, cover, or cover plate.

For lids, covers or cover-plates whose removal is obtained by applying a force according to the requirements in Table 2 in a direction approximately perpendicular to the mounting/supporting surface when their removal may give access with test probe B of IEC 61032:

– *to live parts;*
– *to non-earthed conductive parts separated from live parts by basic insulation;*
– *only to*
  - *insulating parts, or,*

- *earthed conductive parts, or*
- *conductive parts separated from live parts by double or reinforced insulation, or*
- *live parts of SELV circuits according to IEC 61140 having a voltage not greater than 25 V AC or 60 V DC.*

Compliance is checked by the tests of 12.2.3.2 and 12.2.3.3.

Table 2 – Forces to be applied to lids, covers, cover-plates or actuating members whose fixing is not dependent on screws

Accessibility with the test probe B of IEC 61032 after removal of lids, covers or cover-plates or parts of them	Force to be applied N			
	Enclosures complying with 12.2.3.4 and 12.2.3.5		Enclosures not complying with 12.2.3.4 and 12.2.3.5	
	Shall not come off	Shall come off*	Shall not come off	Shall come off*
To live parts	40	120	80	120
To non-earthed conductive parts separated from live parts by basic insulation	10	120	20	120
To insulating parts or earthed conductive parts or conductive parts separated from live parts by double or reinforced insulation or live parts of SELV circuits according to IEC 61140 having a voltage not greater than 25 V AC or 60 V DC	10	120	10	120
* This column does not apply for 12.2.4.				

Boxes and enclosures are mounted as for normal use.

Flush-type boxes and enclosures are fixed and installed as for normal use. If they are provided with locking means which can be operated without the aid of a tool, these means are unlocked.

This Subclause 12.2.3 is not applicable for blanking plates.

12.2.3.2 Verification of the non-removal of the lids, covers or cover-plates

Forces are gradually applied in one smooth and continuous movement in a direction perpendicular to the mounting surfaces, in such a way that the resulting force acting on the centre of the lids, covers or cover-plates, or parts of them, is as specified in the relevant column of Table 2.

The force is applied for 1 min.

The lids, covers or cover-plates, shall not come off or break.

For flush-mounting boxes or enclosures, the test is then repeated on new specimens, the lid, cover or cover-plate is mounted on the box, after a sheet of hard material (1 ± 0,1) mm thick, has been fitted on the wall F around the supporting frame, as shown in Figure 6.

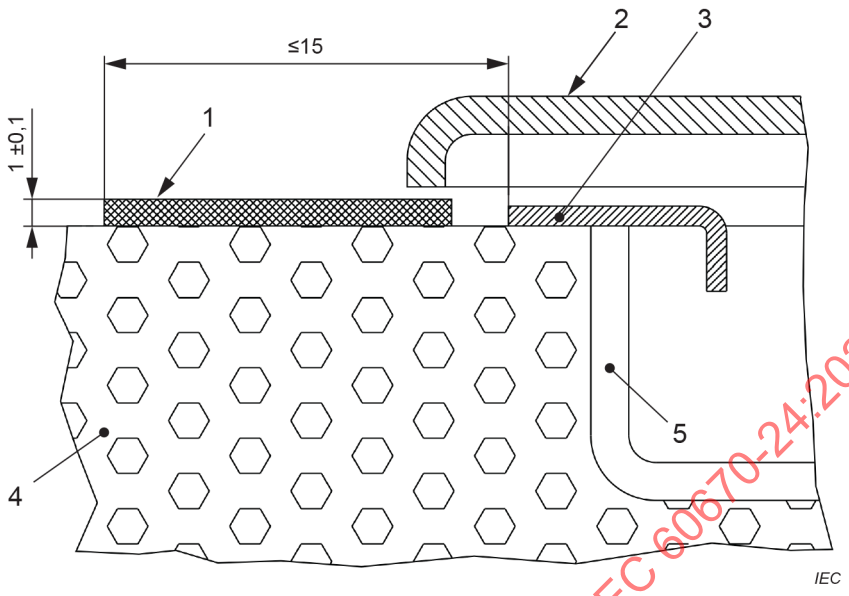
The sheet of hard material is used to simulate wallpaper and may consist of a number of pieces.

In addition, for boxes and enclosures classified according to 7.5.2 or 7.5.3, the test shall be repeated at (−15 ± 2) °C and (−25 ± 2) °C respectively and at the declared temperature of use ± 2 °C for boxes and enclosures according to 7.5.4.

The boxes and enclosures are kept for 2 h in a freezer at the declared temperature.

Immediately afterwards, within 1 min, the test is initiated.

Dimensions in millimetres



Key

1 sheet of hard material
2 cover-plate
3 supporting frame
4 wall
5 mounting box

Figure 6 – Arrangement for test on covers or cover-plates (see 12.2.3.2 and 12.2.3.3)

12.2.3.3 Verification of the removal of the lids, covers or cover-plates

A force not exceeding that specified in the relevant column of *Table 2 is gradually applied in one smooth and continuous movement, in a direction perpendicular to the mounting/supporting surfaces, to lids, covers or cover-plates, or parts of them by means of a hook placed in turn in each of the grooves, holes, spaces or the like, provided for removing them.*

The lids, covers or cover-plates shall come off.

The test is made 10 times on each separable part the fixing of which is not dependent on screws (equally distributing as far as practicable the application points); the removal force is applied each time to the different grooves, holes or the like provided for removing the separable part.

For flush-mounting boxes or enclosures the test is then repeated on new specimens.

The lid, cover or cover-plate is mounted on the box after a sheet of hard material (1 ± 0,1) mm thick has been fitted on the wall around the supporting frame, as shown in Figure 6.

After the test, the specimens shall show no damage within the meaning of this document.

12.2.3.4 Verification of the outline of lids, covers and cover-plates

The gauge shown in Figure 7 is pushed towards each side of each lid, cover or cover-plate which is fixed without screws on a mounting or supporting surface, as shown in Figure 8. The

face B resting on the mounting/supporting surface, with the face A perpendicular to it, the gauge is applied at right angles to each side under test.

In the case of a lid, cover or cover-plate fixed without screws to another lid, cover or cover-plate or to a mounting box, having the same outline dimensions, the face B of the gauge shall be placed at the same level as the junction; the outline of the lid, cover or cover-plate shall not exceed the outline of the supporting surface.

The distances between the face C of the gauge and the outline of the side under test, measured parallel to face B, shall not decrease (with the exception of grooves, holes, reverse tapers or the like, placed at a distance less than 7 mm from a plane including face B and complying with the test of 12.2.3.5) when measurements are repeated starting from point X in the direction of the arrow Y (see Figure 9).

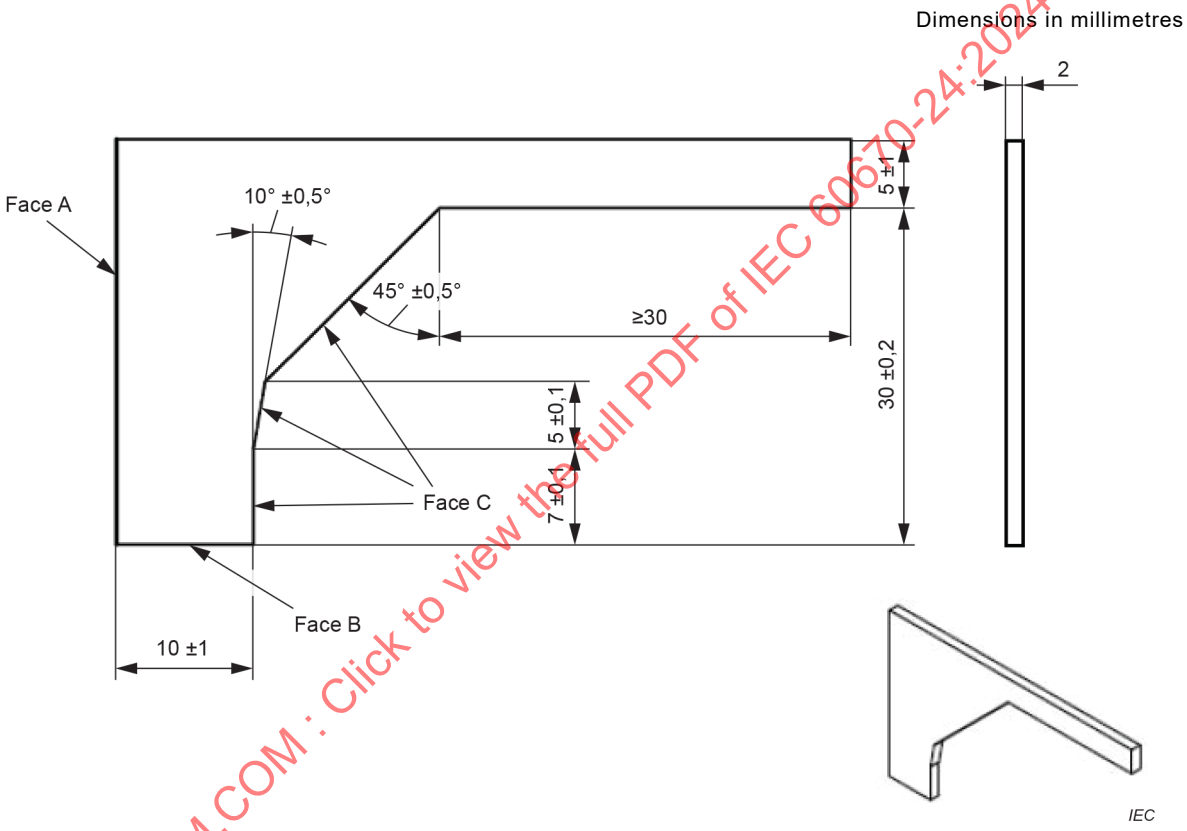
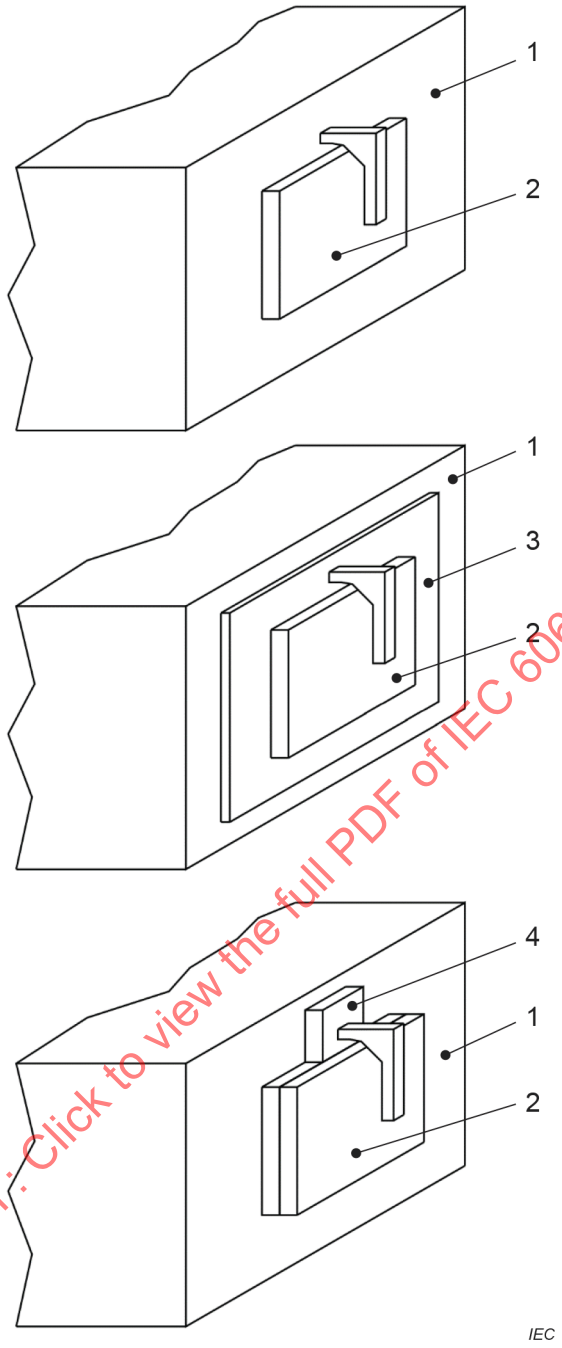


Figure 7 – Gauge for the verification of the outline of lids, covers or cover-plates



Key

1 mounting surface

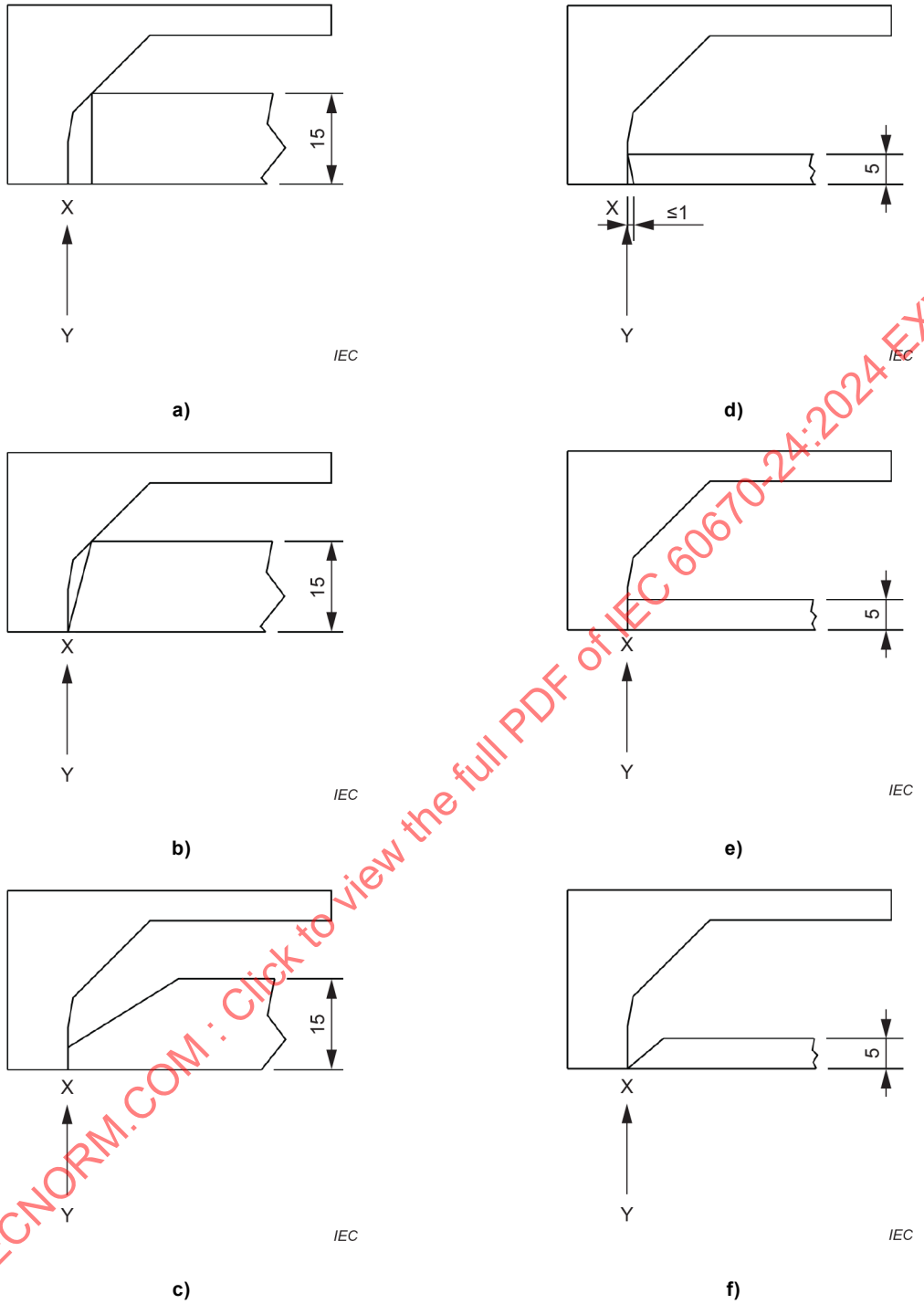
2 cover

3 surface support

4 spacing piece with the same thickness as that of the supporting part

Figure 8 – Examples of application of the gauge of Figure 7 on covers fixed without screws on a mounting surface or supporting surface

Dimensions in millimetres



Cases a) and b) do not comply.

Cases c), d), e) and f) comply (compliance shall, however, also be checked with the requirements of 12.2.3.5 using the gauge shown in Figure 10).

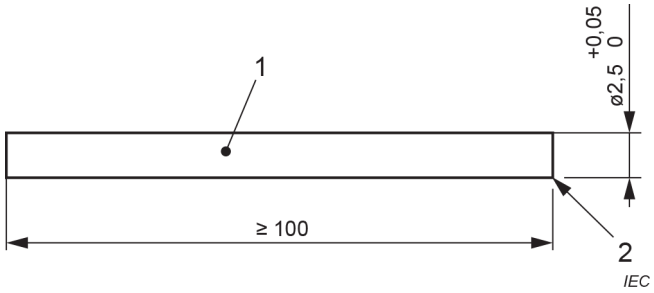
Figure 9 – Compliance criteria of application of the gauge of Figure 7

12.2.3.5 Verification of grooves, holes and reverse tapers

A gauge according to Figure 10, applied with a force of (1 ± 0,2) N, shall not enter more than 1,0 mm from the upper part of any groove, hole or reverse taper or the like when the gauge is applied parallel to the mounting/supporting surface and at right angles to the part under test, as shown in Figure 11.

NOTE Verification as to whether, according to Figure 11, the gauge has entered by more than 1,0 mm is made with reference to a surface perpendicular to face B and including the upper part of the outline of the grooves, holes, reverse tapers or the like.

Dimensions in millimetres

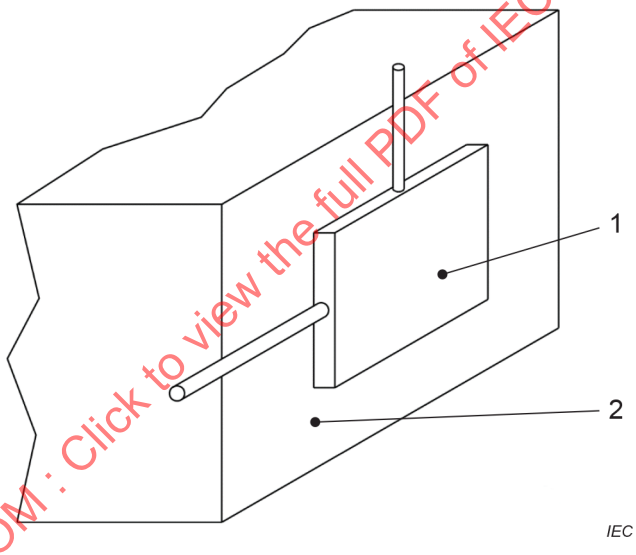


Key

1 test rod (metal)

2 right-angled sharp edges

Figure 10 – Gauge for verification of grooves, holes and reverse tapers



Key

1 cover

2 mounting support

Figure 11 – Sketch showing the direction of application of the gauge of Figure 10

12.2.4 Non-screw-type fixing operable with the use of a tool or a key

For lids, covers or cover-plates whose fixing is not dependent on screws and whose removal is obtained by using a tool and/or a key, in accordance with the instructions, compliance is checked by the same tests of 12.2.3 except that the lids, covers or cover-plates or parts of them are not required to come off when applying a force not exceeding 120 N in directions perpendicular to the mounting/supporting surface.

This Subclause 12.2.4 is not applicable for blanking plates.

12.3 Drain holes

Surface and semi-flush mounting enclosures with a degree of protection IPX1 to IPX6 shall be designed to allow the opening of a drain hole of at least 5 mm in diameter or 20 mm^2 in area with a minimum width or length of 3 mm.

Drain holes shall be so located and available in such a number that one of the holes can always become effective in any intended mounting position of the enclosure.

Compliance is checked by inspection and measurement.

12.4 Mounting of enclosures

Enclosures shall have provisions for their suitable attachment according to the type of installation (see 7.2).

Enclosures of insulating material shall be constructed in such a way that any conductive parts of fixing means inside the box or enclosure intended to be used for mounting the enclosure are surrounded by insulation which projects above the top of the fixing means by an amount of not less than 10 % of the maximum width of the cavity for the fixing means.

Compliance is checked by inspection and by measurement.

If there is a cavity, the head of the screw can be protected by an additional cap of insulating material. In this case the instructions shall give information concerning the cap to be used.

If there is no cavity the head of the screw shall be protected with a cap of insulating material, and the cap shall be delivered with the box.

The cap shall stay in position during normal use.

Compliance is checked by the following test:

The caps are fixed to the boxes according to the instructions and subjected to the ageing test of 13.1.

After 1 h, the boxes are then turned to a position with the opening in the direction of the floor.

The cap shall not become detached.

12.5 Boxes and enclosures with inlets for flexible cables

Inlets provided in boxes and enclosures classified according to 7.3.2 shall be so designed and constructed that the flexible cables can be easily introduced and that the inlets will not damage the flexible cables where they enter the box or enclosure impairing their further use.

Compliance is checked by manual test.

12.6 Boxes and enclosures with inlets for applications other than flexible cables

Inlet openings classified according to 7.3 other than 7.3.2 shall allow the introduction of

– a conduit or suitable fitting connecting it to the box or enclosure, and/or
– the protective covering of the cable

so as to provide mechanical protection of the conductors where they enter the box or enclosure.

An inlet opening for conduit entries, or at least two of them if there is more than one, shall be capable of accepting either conduits of sizes, or a combination of sizes, in accordance with the requirements of IEC 60423, or for extra heavy-duty electrical rigid steel conduits, the requirements of IEC 60981.

Compliance is checked by inspection with the appropriate cables or conduits installed.

Inlet openings of adequate size may also be obtained by the use of knock-outs or suitable insertion pieces or by means of an appropriate cutting tool.

NOTE In the following countries, it is required that inlet openings in boxes intended to receive switches or socket outlets have spout(s) with inlets stops: NL.

12.7 Boxes and enclosures with a cable anchorage(s)

Clamping means of boxes and enclosures classified according to 7.4.2 shall be such that the connection of the conductors of the flexible cable are relieved from strain when this flexible cable is accessible and likely to be stressed after installation.

It shall be clear how the relief from strain and the prevention of twisting are intended to be effected.

Cable anchorages shall be:

– suitable for the different types of flexible cable for which the box is intended to be used;
– constructed in such a way that at least one part of the cable anchorage is integral with, or permanently fixed to, one of the component parts of the box;
– of insulating material or be provided with an insulating lining fixed to the metal parts.

Compliance is checked by inspection and the following test.

The effectiveness of the cable anchorage is checked by means of an apparatus as shown in Figure 12.

The cable anchorage is applied as in normal use, clamping screws, if any, being tightened with a torque equal to the 2/3 of the relevant torque specified in Table 4 or, for glands, equal to the relevant torque specified in Table 4.

After reassembly of the specimen, it shall not be possible to push the flexible cable into the specimen by more than 1 mm with the relevant force as specified in Table 3.

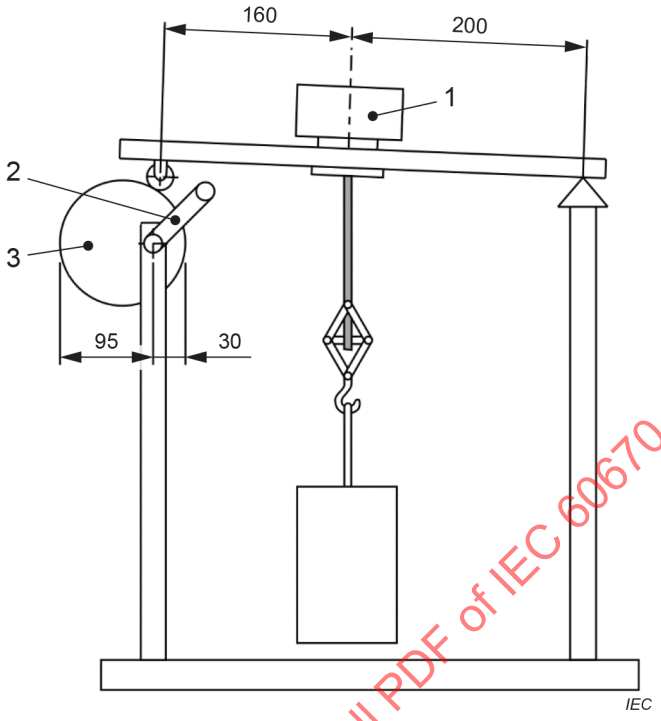
The cable is then subjected 50 times for 1 s to a pull force as specified in Table 3 and immediately afterwards the flexible cable is subjected to a torque not less than the relevant value specified in Table 4 for (15 ± 1) s applied as near as practicable to the cable entry.

Table 3 – Forces and torques to be applied to cable anchorages

External dimensions of flexible cable	Force	Torque
mm	N	Nm
Up to and including 5,2 × 7,6	40 ± 2	0,05
Up to and including 8	50 ± 2	0,1
Above 8 up to and including 11	60 ± 2	0,15
Above 11 up to and including 16	80 ± 2	0,35
Above 16	100 ± 2	0,42

After the tests, the flexible cable shall not have been displaced by more than 2 mm and the cable anchorage shall not show any damage which leads to non-compliance with this document.

Dimensions in millimetres



Key

1 box

2 crank

3 eccentric

Figure 12 – Apparatus for testing the cable anchorage

12.8 Boxes and enclosures with cable retention means

Cable retention means of boxes and enclosures classified according to 7.4.1 shall retain the cable in place.

NOTE In the following countries, a cable retention is required for boxes and enclosures for hollow walls due to installation practices: DE.

Compliance is checked by the following test which is carried out on three specimens of retention means.

For boxes and enclosures classified according to 7.5.2 or 7.5.3, the test shall be carried out at (−15 ± 2) °C and (−25 ± 2) °C respectively and at the declared temperature of use ± 2 °C for boxes and enclosures according to 7.5.4.

First a cable of the maximum nominal cross-sectional area and, subsequently, a cable with the minimum nominal cross-sectional area as declared by the manufacturer shall be used.

The cable is fitted in the cable retention means according to the instructions.

The cable is loaded with an axial force of (20 ± 1) N.

The load is maintained for 1 min and at the end of this period the displacement of the cable shall not exceed 3 mm following the removal of the load.

12.9 Knock-outs intended to be removed by mechanical impact

12.9.1 General

It shall be possible to remove knock-outs intended to be removed by mechanical impact without damaging the box.

Knock-outs intended for use with cables shall be free from chips or burrs.

In knock-outs intended for use with conduits and/or a grommet or a membrane, chips and burrs are disregarded.

In order to close an open knock-out in a box or an enclosure classified according to 7.1.2, a blanking-plug can be used.

This blanking-plug used without a locknut

– shall not become dislodged or damaged, and
– its effectiveness shall not be impaired, and
– it shall fulfil all requirements for knock-outs.

This requirement does not apply to a blanking-plug which is assembled by threading into a threaded inlet.

Compliance is checked by inspection and by the tests as specified in 12.9.2 and 12.9.3.

12.9.2 Knock-out retention

For boxes and enclosures having knock-outs that

– *do not provide access to live parts and are accessible after installation, a force of (30 ± 1) N shall be applied to a knock-out for (15 ± 1) s,*
– *provide direct access to live parts after installation, a force of (40 ± 1) N shall be applied to a knock-out for (60 ± 1) s,*

by means of a 6 mm diameter mandrel with a flat end.

The force is to be applied without a blow in a direction perpendicular to the plane of the knock-out and at a point most likely to cause movement.

When the box is provided with a multi-stage knock-out, the force shall be applied to the smallest knock-out.

The knock-out shall remain in place and the degree of protection of the box or enclosure shall be unchanged when measured 1 h after the force has been removed.

12.9.3 Knock-out removal

The knock-outs shall be removed by means of a tool, as stated by the manufacturer. The side edge of a screwdriver may be run along the edge of the knock-out opening once to remove any fragile tabs remaining along the edge.

For boxes or enclosures according to 7.1.1 or 7.1.3 the test is repeated with one previously untested box or enclosure which has been conditioned for 5 h ± 10 min in air maintained at the minimum temperature during installation and use as specified according to 7.5, but not lower than −25 °C for boxes according to 7.5.4. Immediately following this conditioning, the knock-out is to be removed as specified in the first paragraph of this Subclause 12.9.3.

For a box or enclosure employing multi-stage knock-outs, there shall be no displacement of a larger stage when a smaller stage is removed.

After the test, there shall be no sharp edges, except for knock-outs for conduits and/or for use with a grommet or a membrane and the box and enclosure shall not be damaged.

12.9.4 Flat surfaces surrounding knock-outs

Knock-outs intended for the use of grommets, glands or fittings shall be located on flat surfaces to permit grommets, glands or fittings to be seated fully against these surfaces when installed as intended.

Projections or indentations in the flat surface area shall be prohibited, however holes shall be allowed. The flat surface areas of adjacent knock-outs that partially or wholly overlap meet the intent of this requirement.

Compliance is checked by inspection and by measurement according to the appropriate national standard sheet, if any.

12.10 Screw fixings

Fixing means for lids, covers, cover plates, accessories, terminals, connecting devices, strain reliefs, etc. effected by screws shall be so designed and constructed that these means withstand the mechanical stresses occurring during installation and normal use.

Screws or other fixing means made from insulating material similar to screws without standardized thread which have to be tightened by any tool for fixing covers shall be tested according to the instructions.

NOTE In the following country flush-type boxes shall have metal inserts and be provided with metal screws having ISO metric thread: NL.

Thread-forming and thread-cutting screws intended only for mechanical assembly may be used provided they are supplied together with one of the pieces with which they are intended to be assembled.

For thread-forming and thread-cutting screws, the screw assembly operation shall be done before carrying out the tests.

Compliance is checked by inspection and by the following test.

The screws of the fixing means are tightened and loosened:

– *10 times for metal screws in engagement with a thread of insulating material;*
– *5 times in all other cases.*

Screws and nuts in engagement with a thread of insulating material and screws of insulating material are completely removed and reinserted each time. The test is carried out by using a suitable screwdriver or an appropriate tool applying a torque as indicated in Table 4.

If a screw has a hexagonal head with a slot, only the test with the screwdriver is carried out, with the relevant torque given in column II of Table 4.

Greater values of torque may be used if specified in the instructions.

Column I of Table 4 applies:

- *to screws which cannot be tightened by means of a screwdriver with a blade wider than the nominal diameter of the thread of the screw,*
- *to non-metallic screws,*
- *to metallic screws in a thread of insulating material. In this latter case, the width of the profile of the recess to tighten the screw is chosen instead of the diameter of the thread when this profile width is smaller than the nominal diameter of the thread with a minimum of 3 mm.*

Column II of Table 4 applies to other screws which are tightened by means of a screwdriver.

Column III of Table 4 applies to screws and nuts which are tightened by means other than a screwdriver.

Column IV of Table 4 applies to screws which are tightened by means of a square blade screwdriver.

During the test, there shall be no damage, such as breakage of screw or damage to the head slot (rendering the use of the appropriate screwdriver impossible) or to the threads or to the enclosure impairing the further use of the fixing means. The screws shall be gradually tightened in one smooth and continuous movement.

Table 4 – Tightening torques for the verification of the mechanical strength of screws

Nominal diameter of screw thread mm	Torque for metallic and non-metallic screws Nm			
	I	II	III	IV
Up to and including 2,8	0,20	0,40	0,40	0,70
Over 2,8 up to and including 3,0	0,25	0,50	0,50	0,90
Over 3,0 up to and including 3,2	0,30	0,60	0,60	1,10
Over 3,2 up to and including 3,6	0,40	0,80	0,80	1,40
Over 3,6 up to and including 4,1	0,70	1,20	1,20	1,80
Over 4,1 up to and including 4,7	0,80	1,80	1,80	2,30
Over 4,7 up to and including 5,3	0,80	2,00	2,00	4,00
Over 5,3 up to and including 6,0	1,20	2,50	3,00	4,40
Over 6,0 up to and including 8,0	2,50	3,50	6,00	4,70
Over 8,0	3,00[a]	4,00	10,00	5,00
[a] Or to be specified by the manufacturer.				

12.11 Fixing of boxes and enclosures classified according to 7.2.1

Flush type boxes and enclosures other than for hollow walls shall be provided with fixing means for their suitable attachment to the wall, ceiling or floor. These fixing means may be supplied separately. Screws intended to fix the box or enclosure to the building structure are not required to be supplied with the box or enclosure but can be provided by the installer according to the instructions.

Separately supplied fixing means for a box or enclosure shall comply with the requirements for the fixing means of the box or enclosure with which they are intended to be used and shall include a means for fixing to the box or enclosure.

Screws, additional mechanical supports or design features, which prevent the displacement of the box or the enclosure, are considered to be adequate fixing means.

NOTE Edges, ribs, recesses, partial edges and the like are examples of design features intended to prevent the displacement of the box or the enclosure.

Compliance is checked by inspection.

Boxes and enclosures not fulfilling at least one of the above requirements in this Subclause 12.11 and having an internal volume less than 400 cm^3, shall be tested as follows.

The internal volume of the box or enclosure shall be checked by inspection or by the test in 12.16.

For boxes and parts of enclosures to be embedded in masonry the specimen is mounted into the mounting block shown in Figure 13 and fixed according to the instructions.

The gap between the main external profile of the specimen and the internal profile of the recess in the mounting block shall be at least 20 mm and for parts that project from the main profile the gap shall never be less than 10 mm. The block is filled by the material specified in the instructions, or by plaster where the instructions do not specify the material.

The assembly is kept at ambient temperature for (10 + 1/0) days.

The auxiliary device described in Figure 14 is mounted on the specimen and the screws are tightened with a torque equal to two thirds of the applicable torque given in Table 4.

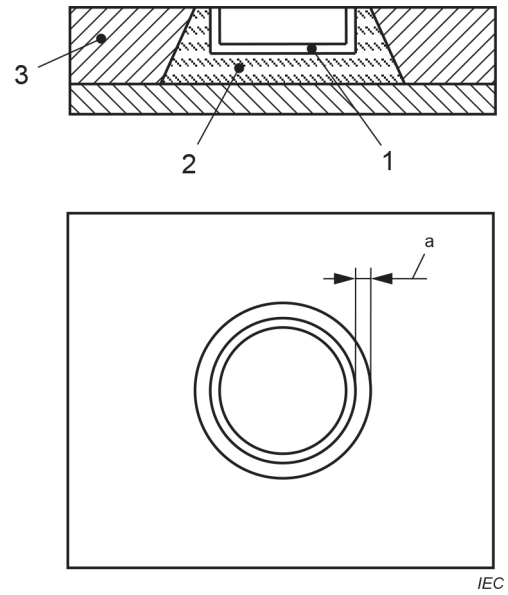
The assembly is then fixed to the mounting plate (A) of an apparatus shown in Figure 15, so that the axes of the screws are normal to the mounting plane.

The total weight of the device including the principal weight (PW) shall be (72 ± 0,1) N, and the supplementary weight (SW) shall be (8 ± 0,1) N.

The supplementary weight (SW) and the principal weight (PW) are introduced on the axis of the device and fixed by the carrier (C) (see Figure 15).

The supplementary weight shall fall from a height of 50 mm onto the principal weight 10 times.

After the test the specimen shall not have been displaced by more than 0,5 mm from the mounting block.



Key

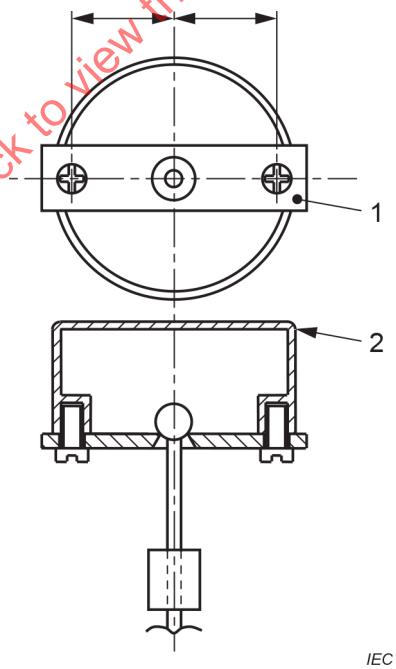
1 specimen

2 plaster

3 block of wood

[a] The gap between the main external profile of the box and the internal profile of the recess in the mounting block shall be at least 20 mm, and for parts which project from the main profile, the gap shall never be less than 10 mm.

Figure 13 – Example of mounting block for boxes to be embedded in masonry (flush type and semi-flush type)

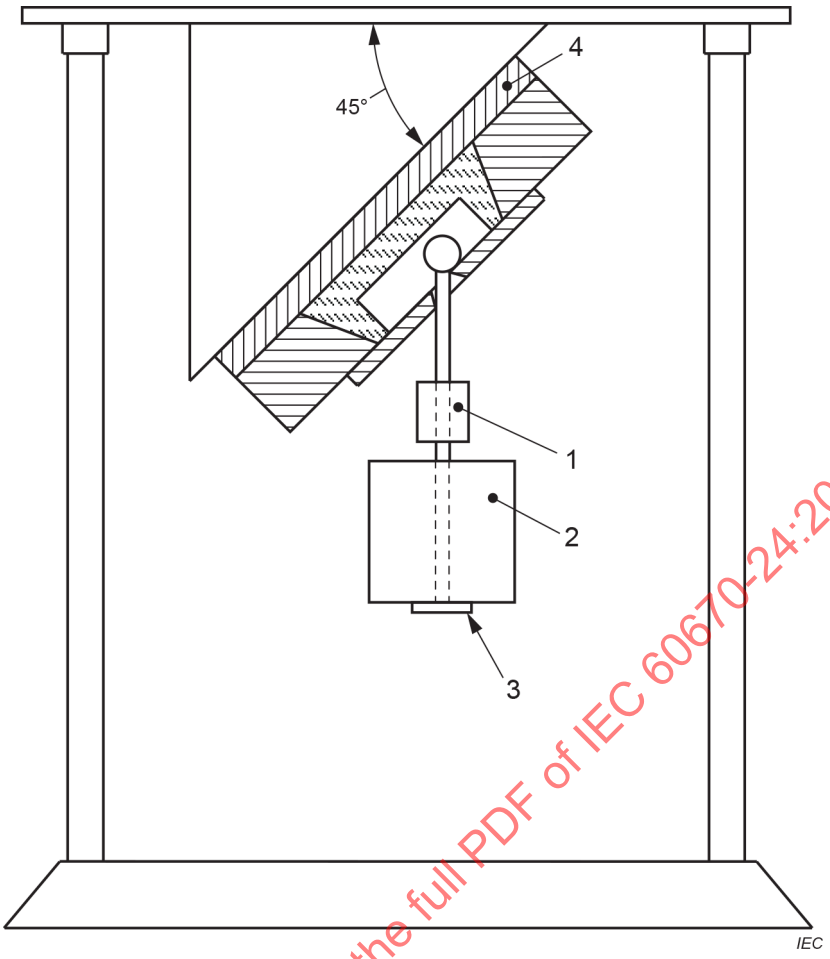


Key

1 auxiliary device

2 specimen

Figure 14 – Example of the fixing of the auxiliary device mounted on a specimen



Key

1 supplementary weight (SW)

2 principal weight (PW)

3 carrier (C)

4 mounting plate (A)

Figure 15 – Example of test apparatus for the test

12.12 Fixing of flush type and semi-flush type boxes and enclosures classified according to 7.2.2.1

Enclosures for hollow walls classified according to 7.2.2.1 shall provide suitable means for fixing the enclosure to hollow walls.

Compliance is checked by the following test.

A specimen of the enclosure is mounted in a test wall in accordance with the manufacturer's instructions. Where the manufacturer's instructions are not specific regarding the type of wall, a sheet of plywood (10 ± 1) mm thick is used.

The enclosure is subjected to a force F of 100 N applied on the main axis of the enclosure perpendicular to the mounting surface. Alternatively, the force can be applied by pushing through a testing means which distributes evenly this force at the rear of the enclosure.

After this test, the specimens shall show no damage impairing their further use. and the enclosure shall not have been displaced by more than 2 mm in comparison to the mounting surface.

12.101 Enclosures for hollow walls shall have provisions for retention means for cables or means to use a separate retention device or devices.

NOTE 101 In the following country, cables are retained using fixing means applied during installation by the installer: UK.

Compliance is checked by inspection.

12.102 Enclosures shall have enough space to allow mounting and connection of the accessories (fully equipped) as declared by the manufacturer, in safe way.

Compliance is checked by inspection and in case of doubt by manual test using samples of products as declared by the manufacturer and complying with the relevant standard, if any.

Any generally available conductors having the largest nominal cross-sectional area as declared by the manufacturer shall be used.

12.13 Boxes and enclosures classified according to 7.2.2.2 and 7.2.2.3

12.13.1 General

Boxes and enclosures for hollow walls or the like classified according to 7.2.2.2 and 7.2.2.3 shall have suitable means for fixing the box or the enclosure to hollow walls and hollow ceilings.

The fixing means shall not rely on the cable management system.

Compliance is checked by the tests in 12.13.2, 12.13.3, 12.13.4 or 12.13.6 as applicable.

12.13.2 Boxes intended for mounting on a wooden structural member of a wall

The box shall be mounted as in normal use to a (38 mm × 90 mm) wood structural member of any convenient length so that the plane of the front of the box is in vertical position.

The assembly shall withstand a force of 225 N gradually applied centrally from the base of the box for a period of 5 min.

After the removal of the force, there shall be no pulling out of the nails or screws used to mount the box or movement of the face of the box in the horizontal plane of more than 3 mm.

12.13.3 Boxes intended for mounting to a wooden structural member of a ceiling

The box shall be mounted as in normal use to a (38 mm × 190 mm) wood structural member of any convenient length so that the plane of the front of the box is in horizontal position.

The assembly shall withstand a force of 225 N gradually applied centrally from the face of the box for a period of 1 min.

With the force still applied, the deflection of the face of the box shall not exceed 6 mm measured from a plane parallel to the horizontal face of the structural member.

12.13.4 Boxes intended for mounting to a steel-stud structural member of a wall

The box shall be mounted as in normal use to a steel-stud structural member as shown in Figure 17.

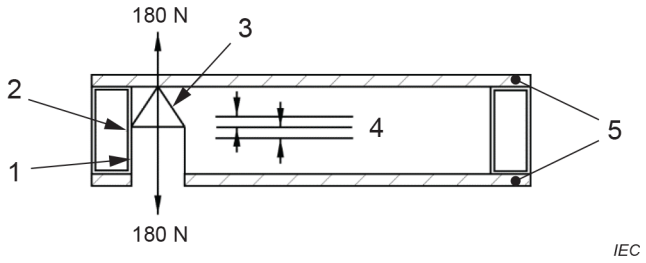
The assembly shall withstand a force of 180 N gradually applied centrally from the face of the box for a period of 5 min, first in a direction tending to push the box into the wall opening and then in the opposite direction, tending to pull the box out of the opening.

With the force still applied, the deflection of the box shall not exceed 2 mm in either direction.

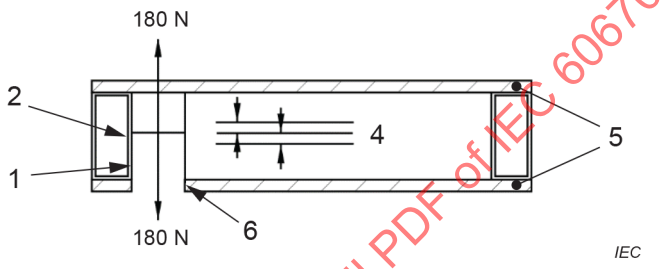
Additional support for the box can be necessary to minimize deflection.

Application of the force and measurement of the displacement are shown in Figure 17.

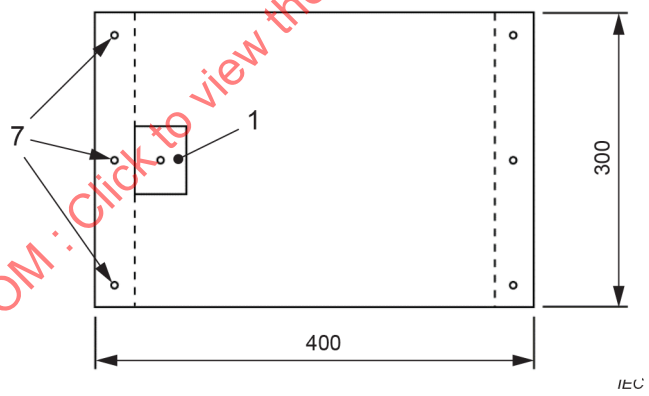
Dimensions in millimetres



a) Box with permanently attached additional support



b) Bracket providing additional support (for field installation)



c) Front view

Key

1 box
2 steel stud
3 additional support
4 maximum deflection
5 plywood
6 bracket
7 three screws per side per panel

Figure 17 – Test of the force and measurement of the displacement

12.13.5 Internal volume of boxes and enclosures classified according to 7.2.2.2 and 7.2.2.3

For boxes, enclosures, raised covers and box extensions classified according to 7.2.2.2 and 7.2.2.3, the declared internal volume of a box, enclosure, raised cover or box extension shall be verified.

A box or enclosure provided with a partition shall have the volume of each partitioned section verified.

Compliance is checked by the test of 12.16.

12.13.6 Boxes intended for mounting in a finished structure

The supporting means of a box intended for installation in a finished structure shall not crack or break nor shall the face of the box be permanently displaced more than 3,2 mm from the plane of the face of the test surface when measured 1 min after the test load is removed.

NOTE In a finished structure, structural framing members are not typically accessible for mounting and supporting boxes or enclosures flush or semi-flush in hollow walls.

Compliance is checked by the following test:

Six boxes intended for use in walls or eight boxes intended for use in ceilings shall be installed in a 9,5 mm thick plywood sheet reinforced with a support 152 mm from one edge of the opening for the boxes, or in a finished surface in accordance with the instructions.

Screws for the box supporting means shall be tightened in accordance with the instructions. In the absence of instructions, screws shall be tightened in accordance with column IV of Table 4. A screw that strips before being tightened to the torque specified shall not override more than once.

Following installation, a force of 222 N shall be applied for 5 min consecutively to each of two boxes in a direction normal to the plane of the face of the test surface along the centerline of the box and tending to push the box into the opening. The same force is to be applied to each of two previously untested boxes in a direction tending to pull the box out of the opening. Following this test, the screw shall be capable of being removed by a screwdriver.

Two additional samples of a box secured so that the plane of the front of the box is vertical, shall be subjected to a force of 222 N applied for 5 min suspended from the lower rear corner of the outer back edge of the box.

12.14 Cable gland entry

Cable glands shall not damage the box or enclosure when used as intended.

Compliance is checked by the following test.

Cable glands are fitted with a cylindrical metal rod having a diameter, in millimetres, equal to the internal diameter of the gasket rounded to the nearest whole number as specified in the first column of Table 5. The cable glands are then tightened and loosened 10 times by means of a suitable tool with the torque specified in Table 5 with a tolerance of $(^{+5}_{0})$ %, the relevant torque being applied for 1 min ± 5 s.

Table 5 – Torque test values for cable glands

Diameter of test rod mm	Torque Nm	
	Metal glands	Glands of insulating material
Up to and including 8	4,0	2,5
Over 8 up to and including 14	6,3	3,8
Over 14 up to and including 20	7,5	5,0
Over 20	10,0	7,5

After the test, the boxes and enclosures shall show no damage within the meaning of this document.

12.15 Boxes and enclosures with inlets or spouts (hubs) for conduits

12.15.1 *Boxes and enclosures classified according to 7.3.4 and conical spouts as in 7.3.6 shall withstand the tests of 12.15.2, 12.15.3 and 12.15.4.*

Threaded spouts are not submitted to the tests of 12.15.2 and 12.15.3.

Boxes and enclosures classified according to 7.4.3 shall withstand the tests of 12.15.2 and 12.15.3.

The tests are carried out with conduits of minimum nominal size according to IEC 60423 or IEC 60981 after installation as in normal use or assembly according to the instructions.

12.15.2 *Enclosures with the spout for conduits shall be tested so that a minimum size piece of conduit is pressed for 1 min ± 5 s with a force of (100 ± 2) N. The spout shall prevent further entry of the conduit into the box.*

12.15.3 *A pull-out test shall be carried out after the test according to 12.15.2, as follows. The conduit with the minimum size corresponding to the insert opening shall be loaded axially for 1 min with a tensile force of (20 ± 2) N. The conduit shall not come loose from the spout of the enclosure.*

12.15.4 *The resistance to bending strain of a spout shall be tested as follows. A piece of a conduit shall be inserted into the spout with a compressible force of (100 ± 2) N and loaded with a bending moment of 3 Nm. The strain shall slowly rise from zero to full value and the test shall be carried out in six different directions through the centre line of the spout with an interval of (60 ± 2)°. At each angle position the spout shall be loaded for 1 min. The spout shall not come loose or be damaged and the conduit shall stay within the spout.*

NOTE An inlet stop can be designed as a rib on the inside of the spout.

12.16 Internal volume of boxes and enclosures

When referred to in this document, the declared internal volume of the box or enclosure, each partitioned section of a box or enclosure, raised covers and box extensions shall be measured in the following manner.

a) All internal screws, clamps, etc., shall be removed except earthing terminals and assembly screws.

a) Any projections such as a cover or flush-mounting ears that extend beyond the normal edge of the box or enclosure shall be ground flush with the edge.

b) All knock-outs shall be left as punched and shall be sealed externally.

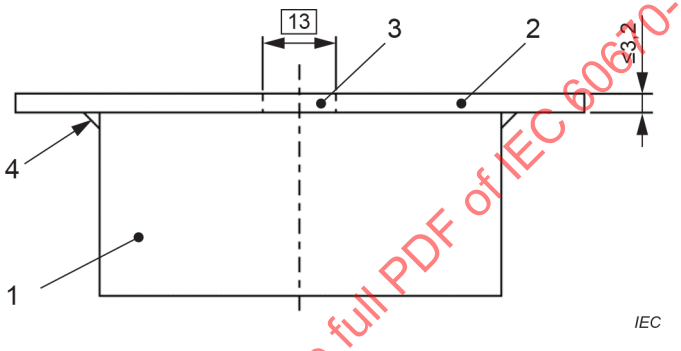
c) All openings shall be plugged with modelling clay, putty, wax or other material(s) and shall be filled flush with the internal surface.

d) The box, enclosure, or raised covers shall be covered with a flat plate of any convenient transparent material not more than 3,2 mm thick. In the centre of the plate a hole with a nominal diameter of 13 mm shall be provided (see Figure 18). If necessary, the gap between the box, enclosure or raised cover and the plate shall be sealed with the material used to seal the other openings.

e) Using any convenient graduated cylinder or measuring flask filled with water at room temperature, the box, enclosure, or raised cover shall be filled without overflowing. The difference in the volume of water in the measuring cylinder measured before and after the filling of the box, enclosure or raised cover indicates the volume of the box.

The volume of a side pocket provided to increase the volume of a box or enclosure shall be calculated using a depth-of-pocket not more than the smallest dimension of the opening into that side pocket.

Dimensions in millimetres



Key

1 box
2 cover
3 opening for water fill
4 seal, if necessary

Figure 18 – Volume measurement

13 Resistance to ageing, protection against ingress of solid objects and against harmful ingress of water

13.1 Resistance to ageing

13.1.1 Boxes and enclosures, glands, grommets and replaceable membranes of insulating or composite material, shall be resistant to ageing.

Compliance is checked as follows:

Boxes and enclosures of insulating or composite material with provision for glands or grommets are mounted and assembled as in normal use or according to the instructions.

Boxes and enclosures of insulating or composite material without provision for glands, grommets, or membranes are assembled according to the instructions.

Parts intended for decorative purposes which can be removed without the aid of a tool, shall be removed before the tests.

For boxes and enclosures provided with glands or grommets, approximately half of the number of glands or grommets of each of the boxes and enclosures are fitted with seals together with cylindrical metal rods having a diameter equal to the lower limit specified for the mean overall diameter of the smallest cable as declared by the manufacturer. The remainder of the glands or grommets of the same boxes and enclosures are fitted with seals together with cylindrical metal rods having a diameter equal to the upper limit specified for the mean overall diameter of the largest cable as declared by the manufacturer.

Where the number of glands or grommets in a box is greater than six, the test is carried out with three glands or grommets equipped for the smallest cable size and three glands or grommets equipped for the largest cable size on each box.

In the case of grommets, the rod shall be kept in place in such a way that the rod cannot move. The means to keep the rod in place shall have no influence on the results of the tests.

The glands are tightened with a torque equal to two-thirds of that applied during the test of 12.14 (Table 5) any other openings being closed. Greater values of torque may be used if so stated by the manufacturer.

The specimens are then subjected to a test in a heating cabinet with an atmosphere having the composition and pressure of the ambient air.

The temperature in the heating cabinet is (70 ± 2) °C.

The specimens are kept in the cabinet for (168 $^{+4}_{0}$) h.

After the treatment, the specimens are removed from the cabinet and kept at room temperature for (96 $^{+4}_{0}$) h.

After the test, the specimen shall show no harmful deformation or similar damage, which may impair their further use within the meaning of this document.

13.1.2 Grommets, blanking plugs and entry membranes in inlet openings and protective membranes shall be reliably fixed and shall not be displaced by the mechanical and thermal stresses occurring in normal use.

Compliance is checked by the following test, which shall be applied to all grommets, blanking plugs, replaceable and non-replaceable membranes.

Grommets, blanking plugs and membranes are tested while being fixed to the enclosures.

First, the enclosures that have been subjected to the treatment specified in 13.1.1 are placed for 2 h ± 15 min in a heating cabinet as described in 13.1.1, the temperature being maintained at (40 ± 2) °C.

Immediately after this period, a force of (30 $^{0}_{-2}$) N is applied for (5 ± 1) s to various parts of the grommets, blanking plugs and/or membranes by means of the tip of test probe 11 according to IEC 61032.

During these tests, the grommets, blanking plugs and/or membranes shall not be deformed to such an extent that live parts of any included accessory become accessible.

For grommets, blanking plugs and/or membranes likely to be subjected to an axial pull in normal use, an axial pull of (30 $^{0}_{-2}$) N shall be applied for (5 ± 1) s.

The test is then repeated on the same enclosures fitted with grommets, blanking plugs and/or membranes which have not been subjected to any treatment.

After the test, grommets, blanking plugs and/or membranes shall show no harmful deformation, cracks or similar damage which would lead to non-compliance with this document.

13.1.3 Grommets, blanking plugs and entry membranes in inlet openings of boxes and enclosures classified according to 7.5.2, 7.5.3 and 7.5.4 shall be so designed and made of such material that the introduction of the cables and conduits is permitted when ambient temperature is low.

Compliance is checked by the following test.

The enclosure is fitted with grommets, blanking plugs and/or entry membranes which have not been subjected to any ageing treatment.

After being left to cool down to the ambient temperature, the boxes and enclosures are then kept for 2 h in a freezer

– *at a temperature of (−15 ± 2) °C for boxes and enclosures classified according to 7.5.2, or*
– *at a temperature of (−25 ± 2) °C for boxes classified according to 7.5.3 and 7.5.4.*

Immediately after conditioning, while the boxes and enclosures are still cold and, in the freezer, it shall be possible to pierce any blind grommets, blanking plugs and entry membranes and to introduce cables and conduits of the maximum diameter intended, the cables and conduits having been submitted to the same conditioning as the boxes and enclosures.

After the test, the grommets, blanking plugs or entry membranes shall show no harmful deformation, cracks or similar damage which would lead to non-compliance with this document.

13.2 Protection against the ingress of solid objects

Enclosures shall provide a degree of protection of at least IP3X against the ingress of solid foreign objects in accordance with their declared IP code with the lid closed, if any.

In the case of an enclosure with a door or a lid which can be opened without the use of a tool during normal use, a minimum degree of IP20 shall be maintained after opening the door or the lid.

NOTE In the following countries in the case of an enclosure with a door or a lid which can be opened without the use of a tool during normal use, a minimum degree of IP30 shall be maintained after opening the door or the lid: DE, DK.

For boxes and enclosures classified according to 7.2.2.1 the above requirement applies also to the part mounted inside the hollow wall according to classification 7.8.

NOTE In the following countries a minimum protection degree of IP30 is required for parts of boxes and enclosures inside hollow walls due to installation practices: DE, DK, SE, NO

Compliance is checked by the appropriate test of IEC 60529 under the following test conditions.

Enclosures are mounted as for normal use according to the instructions.

For boxes and enclosures classified according to 7.2.2.1, the test on the part mounted inside the wall is made on a box mounted so that the rear part is accessible for the test.

Unless otherwise stated in this document, where the enclosure has drain holes, at least one open drain hole shall be in the lowest position.

Enclosures with screwed glands or grommets are fitted with cables having the smallest and the largest cross-sectional area and/or conduit having the smallest and the largest diameter or dimensions, if any, as declared by the manufacturer.

Fixing screws of the cover or cover-plate of the box are tightened with a torque equal to two- thirds of the values from Table 4 used for the test of 12.10.

Greater values of torque may be used if so stated by the manufacturer, when the relevant information is provided.

Other fixing means shall be fastened as in normal use or, if provided, according to the instructions.

Cable and/or conduit entry means are made according to the instructions.

Parts which can be removed without the aid of a tool are removed.

Glands are not filled with sealing compound or the like.

For degree of protection IP5X, the test is carried out according to IEC 60529 category 2 and the drain holes, if any, shall not be open.

For degrees of protection up to and including IP4X, the protection is satisfactory if the full diameter of the probe does not pass through any opening other than through drain holes, in which case the probe shall not touch live parts within the enclosure.

For degree of protection IP5X, the protection is satisfactory if the dust does not cover the whole inner surface.

For degree of protection IP6X, the test is carried out according to IEC 60529 and the drain hole, if any, shall not be open. The protection is satisfactory if there is no dust inside the box or enclosure.

13.3 Protection against harmful ingress of water

13.3.1 Enclosures with a degree of protection higher than IPX0 shall provide a degree of protection against harmful ingress of water in accordance with the declared IP Code.

Compliance is checked by the appropriate tests of IEC 60529 under the following test conditions.

For surface enclosures and flush and semi-flush enclosures with dimensions $S \leq 0{,}04\ m^2$ or perimeter ≤ 0,8 m, see 13.3.2 and 13.3.3.

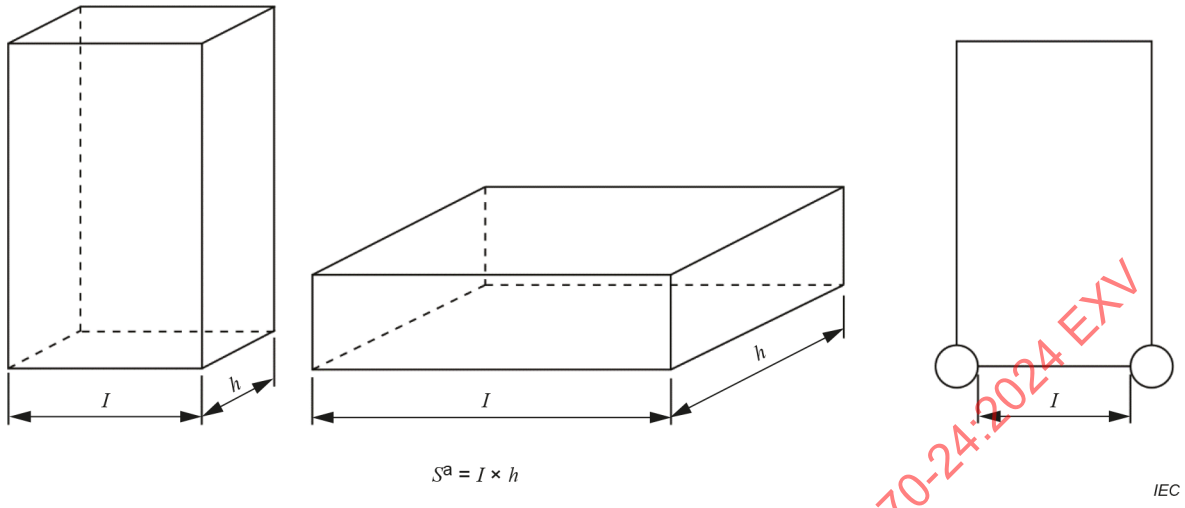
For surface enclosures and flush and semi-flush enclosures with dimensions $S > 0{,}04\ m^2$ and perimeter > 0,8 m, see 13.3.2 and 13.3.4.

The reference surface S to be chosen for verification is calculated as follows.

- *For square and rectangular boxes and enclosures, the surface to take into account is the smallest interior width (l) multiplied by the depth (h) (see Figure 19 a)).*
- *For round boxes and enclosures, the surface to take into account is the interior depth (h) of the box or enclosure multiplied by the smallest diameter (d) divided by 4 (see Figure 19 b)).*

Enclosures with screwed glands or grommets are fitted with cables having the smallest and the largest cross-sectional area and/or conduit having the smallest and the largest diameter/dimensions, if any, as declared by the manufacturer.

Fixing screws of the cover or cover-plate of the box are tightened with a torque equal to two-thirds of the values from Table 4 used for the test of 12.10.



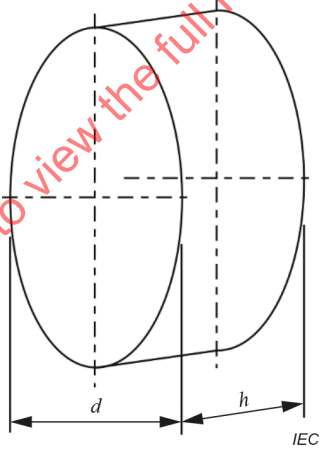
Key

h depth

I internal width

[a] For a rectangular box placed horizontally, the surface *S* to take into account is the smallest one.

a) Reference surface for square boxes and enclosures



Key

h internal depth

d smallest diameter

b) Reference surface for round boxes and enclosures

Figure 19 – Reference surfaces for boxes and enclosures

13.3.2 *Surface-mounting enclosures are mounted as for normal use according to the instructions with any open drain holes in the lowest position unless otherwise specified in the instructions.*

Flush type and semi-flush type enclosures are fixed in a test wall in accordance with the instructions.

In this case, the instructions shall specify a type of wall, as well as the mounting method. These shall be described in sufficient detail to ensure reproducible tests.

Where the instructions do not specify a type of wall, the test wall according to Figure 20 is used.

Dimensions in millimetres

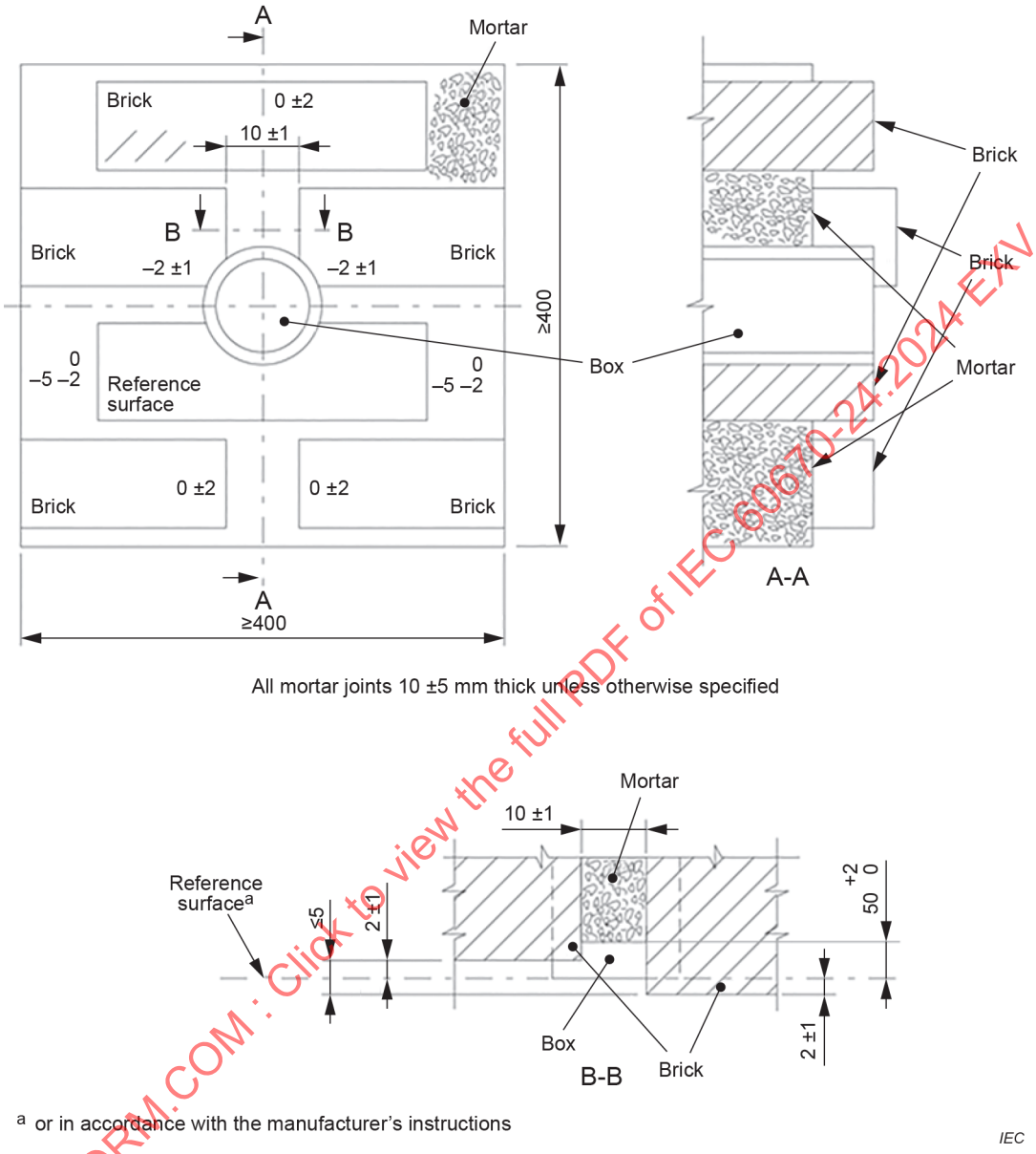


Figure 20 – Test wall

The test wall of Figure 20 is made with bricks having smooth surfaces. When the box is mounted in the test wall, it shall fit tight against the wall so that water cannot enter between the box and the wall.

If sealing material is used in order to seal the box into the wall, the sealing compound should not influence the sealing properties of the specimen to be tested.

NOTE Figure 20 shows an example where the edge of the box is positioned in the reference plane, other positions are possible according to the instructions of the manufacturer.

The test wall is placed in a vertical position.

Enclosures are mounted as in normal use and fitted with cables having conductors of the largest and smallest cross-sectional area as declared by the manufacturer.

For IPX3 and IPX4, the oscillating tube according to Figure 4 of IEC 60529:1989 is used unless the dimensions of the enclosure imply the use of the spray nozzle according to Figure 5 of IEC 60529:1989.

During the tests of enclosures of degree of protection higher than IPX4, drain holes, if any, shall not be opened.

Care shall be taken not to disturb, for example, to knock or shake, the enclosure, in such a manner that the test result will be affected.

13.3.3 *Immediately after the test, there shall be no more than 0,2 ml × S (cm^2) water in the enclosure.*

NOTE For a degree of protection higher than IPX4, it can be necessary to open the drain holes for inspection.

If the enclosure is not provided with drain holes, consideration should be given to any accumulation of water which may occur, for example, condensation.

After the test, the specimens of boxes and enclosures classified according to 7.1.1, 7.1.3 and 7.1.4, as appropriate, shall withstand an electric strength test specified in 14.2 which shall be started within 5 min of the completion of the test according to this Subclause 13.3.3.

13.3.4 *Ingress of water is verified by the use of dry absorbent paper positioned to cover the base area of the protected volume.*

NOTE The base is always the bottom of the protected volume when installed.

Unless it is decided otherwise by the manufacturer the protected volume shall correspond to the total internal space of the box reduced by 5 % on each face of the box, i.e. 10 % on each dimension of the enclosure (see Figure 21).

$$V_p = 0{,}9\ L \times 0{,}9\ D \times 0{,}9\ H$$

where

V_p is the protected volume;

L is the length;

D is the depth;

H is height.

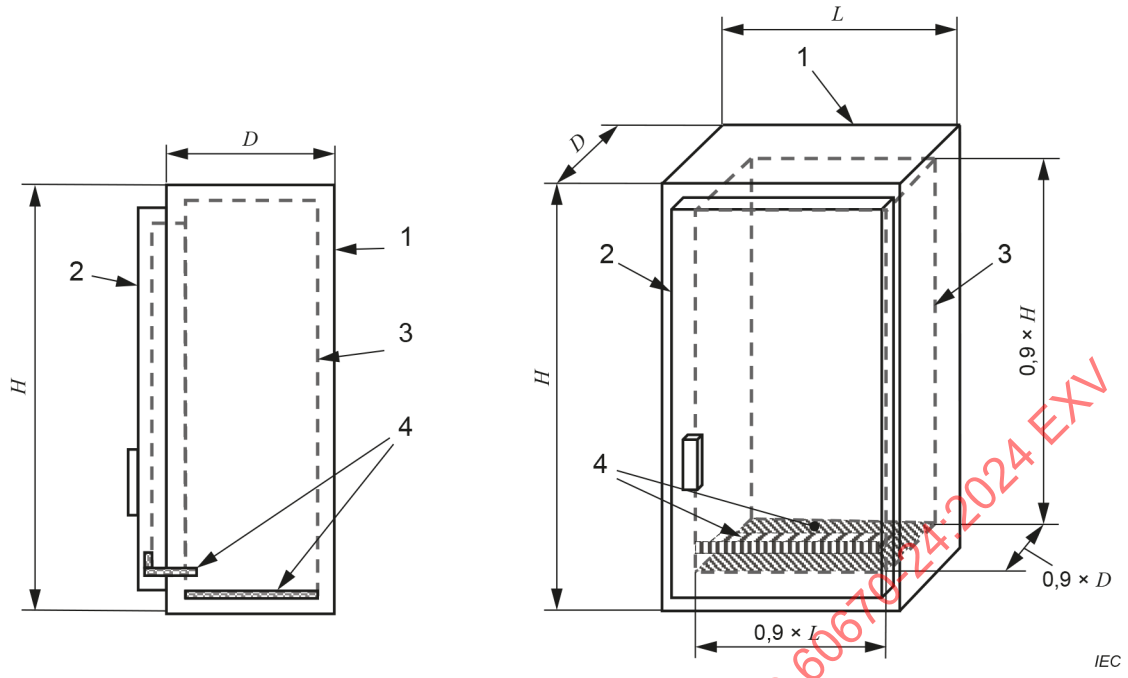
In case of a round box the protected volume is equal to $V_p = 0{,}9\ H \times \pi(0{,}9 \times d)^2 / 4$.

In order to have the absorbent paper properly placed, the manufacturer should provide a specimen where the absorbent paper is suspended by a reliable suspension means.

For doors or covers intended to accommodate accessories, a strip of paper, bent to form a 90° angle profile, is attached to the cover or lid in the lowest position in order to protrude inside the box until it reaches the internal protected volume of the box (see Figure 21).

If the enclosure can have more than one position of installation the test shall be carried out in all possible installation positions.

Immediately after the test, the indicator paper shall still be dry.



Key

1 box
2 cover
3 protected volume
4 absorbent paper

Figure 21 – Example of the protected volume

14 Insulation resistance and electric strength

14.1 The insulation resistance and the electric strength of enclosures classified according to 7.1.1, 7.1.3 and 7.1.4 shall be adequate.

Compliance is checked by the tests of 14.2, these tests being made immediately after the following humidity treatment.

The specimens are placed in a humidity cabinet containing air with a relative humidity maintained between 91 % and 95 %.

The temperature of the air where the specimens are placed is maintained within ± 2 °C of any convenient value t between +20 °C and +30 °C.

Before being placed in the humidity cabinet, the specimens are brought to a temperature between t and (t + 4) °C.

The specimens are kept in the cabinet for

- *2 days (48 $^{+2}_{0}$) h for enclosures classified IPX0;*
- *7 days (168 $^{+4}_{0}$) h for other enclosures.*

NOTE In most cases, the specimens 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 between 91 % and 95 % can be obtained by placing 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 the humidity cabinet.

After this treatment, the specimen shall show no damage impairing its further use and shall pass the following tests.

When a solid material is intended to provide electrical insulation between live parts and the body, the insulation resistance between the body and a metal foil in contact with the internal surface of the box and enclosure, is measured with a DC voltage of approximately 500 V, the measurement being made 1 min after application of the voltage.

The term "body" includes all accessible metal parts, metal foil in contact with the outer surface of accessible external parts of insulating material, fixing screws of backplates or covers and external assembly screws.

If metal foil is used for testing the insulation resistance and the electric strength, one metal foil is placed in contact with the inner surfaces and another metal foil, having a size not exceeding 200 mm × 100 mm, is placed in contact with the external surfaces and, if necessary, is moved so as to test all parts.

During the test, the distance between the inner and the outer metal foil shall be arranged in such a way that there is no flashover in the surroundings of holes, premoulded knock-outs, membranes, etc.

When there are holes in the enclosure, they are not tested, and the metal foil is interrupted at these places because there is no more solid insulation.

The insulation resistance shall be not less than 5 MΩ.

14.2 The electric strength is tested by applying a voltage of a substantially sinusoidal waveform, having a nominal frequency of 50 Hz or 60 Hz and a value as specified in Table 6, for 1 min between the parts listed in 14.2.

The test voltage is taken from Table 6 according to the rated voltage as declared by the manufacturer.

For enclosures having class II protection, the test voltage according to Table 6 is multiplied by 1,5.

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

No flashover or breakdown shall occur during the test.

Table 6 – Test voltage for electric strength test

Rated voltage	Test voltage
V	V
≤ 130	1 250
> 130 and ≤ 250	2 000
> 250 and ≤ 450	2 500
> 450 and ≤ 750	3 000
> 750	3 500

The high-voltage transformer used for the test is so designed that, when the output terminals are short-circuited after the output voltage has been adjusted to the appropriate test voltage, the output current is at least 200 mA. The overcurrent relay shall not trip when the output current is less than 100 mA.

The RMS value of the test voltage applied is measured within ±3 %.

Glow discharges without a drop in voltage are disregarded.

During the test a metal foil, as described in 14.2, is placed in contact with the inner surfaces and another metal foil is placed in contact with the external surfaces and, if necessary, moved so as to test all the parts.

15 Mechanical strength

15.1 General

Boxes and enclosures shall have adequate strength to withstand the mechanical stresses occurring during installation and normal use.

Compliance is checked by the appropriate tests of 15.2 to 15.5 as follows:

– *for non-metallic boxes and enclosures intended for use in cast concrete classified according to 7.2.1.2 or 7.2.1.3, by the test of 15.2;*

– *for non-metallic boxes and enclosures intended for use in cast concrete and able to withstand 90 °C during the casting process classified according to 7.2.1.3, by the test of 15.3;*

– *for non-metallic boxes and enclosures classified according to:*

  a) 7.2.3,

  b) 7.2.1.1 or 7.2.2 and also classified according to 7.5.2 or 7.5.3, by the test of 15.4;

– *for non-metallic boxes and enclosures, the parts which are intended to be accessible after the completion of the building-process, by the test of 15.4;*

– *for boxes and enclosures classified according to 7.1.4, by the test of 15.5.*

When an enclosure is too large to fit the test apparatus shown in Annex D of IEC 60068-2-75:2014, or where it is impractical to use the pendulum hammer for tests at low temperature, the tests are carried out in the same conditions as those specified in 15.2 or 15.4, but using the spring hammer according to IEC 60068-2-75 calibrated to the impact energy corresponding to the impact required by the relevant subclause, 15.2 or 15.4.

15.2 Impact test at low temperature

The specimen shall be subjected to an impact test with a vertical hammer test apparatus (see Figure 22) placed on a pad of closed cell expanded sponge rubber 40 mm thick when uncompressed and having a density of approximately 538 kg/m^3.

The whole arrangement together with the specimens shall be placed in a freezer, the temperature within being maintained for 2 h ± 15 min at:

- *(−5 ± 2) °C for types classified according to 7.5.1;*
- *(−15 ± 2) °C for types classified according to 7.5.2;*
- *(−25 ± 2) °C for types classified according to 7.5.3;*
- *The declared temperature of use ± 2 °C for types classified according to 7.5.4.*

At the end of this period, each specimen is subjected to an impact by means of a mass of 1 kg falling vertically from a height of 100 mm.

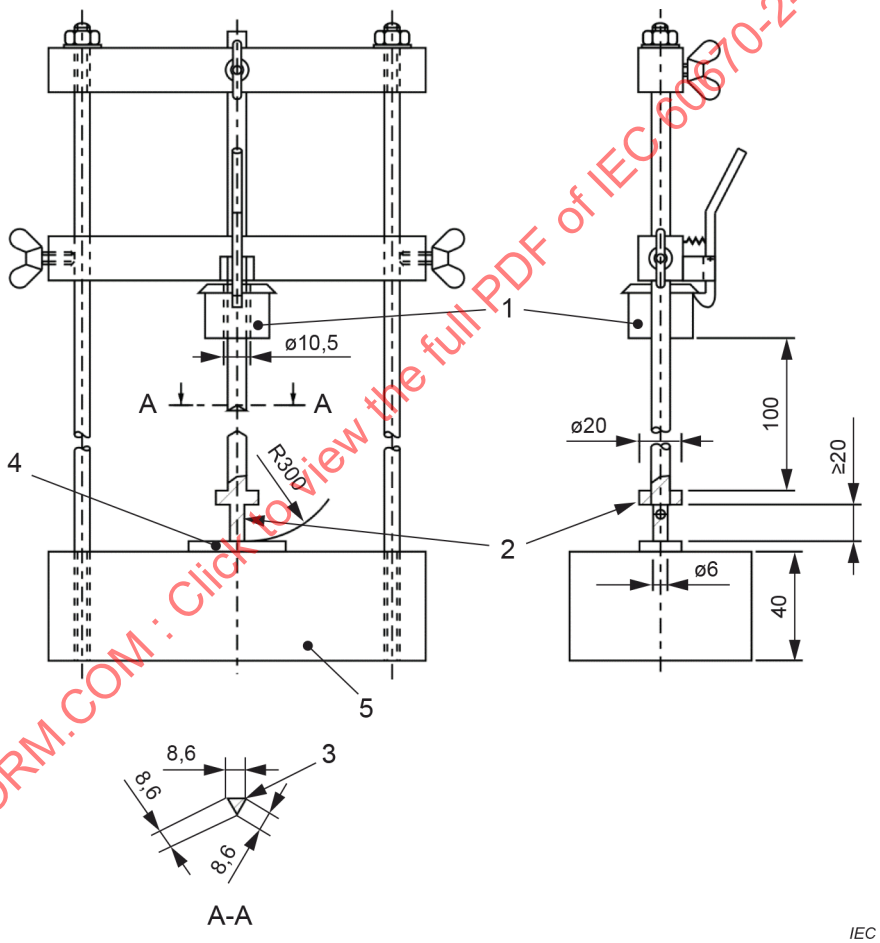
One blow is applied on the back and four equally spaced blows are applied on the side walls.

After the test, the specimens shall show no damage leading to non-compliance with this document.

Damage to the finish, small dents and small chips which do not adversely affect the protection against electric shock or harmful ingress of water are disregarded.

Cracks passing through the material not visible with normal or corrected vision without magnification, surface cracks in fibre-reinforced mouldings and small indentations are disregarded.

Dimensions in millimetres



Key

1 falling weight (1 000 ± 1) g

2 steel intermediate piece 100 g

3 slightly rounded edges

4 specimen

5 steel support (10 ± 1) kg

Figure 22 – Apparatus for impact test at low temperature

15.3 Compression test

The boxes and enclosures are placed in a heating cabinet for (60 $^{+15}_{0}$) min at a temperature of (+90 ± 5) °C.

The boxes and enclosures are then allowed to cool down to ambient temperature.

After the test, the boxes and enclosures shall show neither deformation nor damage leading to non-compliance with this document.

The boxes and enclosures are then placed between two flat hardwood plates each having a surface area sufficient to cover the face and back of the box. The plates are then loaded without impact with a force of (500 ± 5) N for 1 min ± 5 s which is applied away from the front face of the box towards the back.

After the test, the box and the enclosure shall show no deformation or damage leading to non-compliance with this document or affecting its further intended use.

During these two tests, the boxes and enclosures shall be fitted according to the instructions, with the special part, if any, intended to improve the mechanical behaviour of the boxes and enclosures during the casting of the concrete.

For the test, any special part shall be delivered together with the box and the enclosure.

15.4 Impact test for boxes and enclosures

The specimens are checked by applying blows by means of the pendulum hammer test apparatus as described in IEC 60068-2-75 (test EHA), with an equivalent mass of 250 g.

For boxes classified according to 7.5.2 or 7.5.3, this test shall be performed by placing the assembly including the specimen and the mounting block to which it is attached in a freezer, the temperature within being maintained for 2 h ± 15 min at the following temperature:

- *(−15 ± 2) °C for types as classified according to 7.5.2;*
- *(−25 ± 2) °C for types as classified according to 7.5.3;*
- *The declared temperature of use ± 2 °C for types as classified according to 7.5.4.*

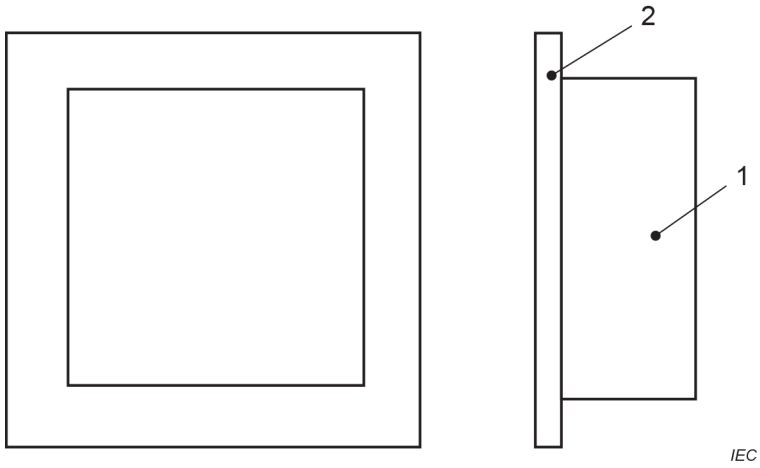
At the end of this period the specimens are removed from the freezer and immediately submitted to the impact test.

Specimens classified according to 7.2.1.1 intended to be flush-mounted in normal use are reverse-mounted for the purpose of the test, so that the rear surface of the specimen is accessible as shown in Figure 23.

Test specimens are mounted on a mounting block made from an 8 mm thick, 175 mm × 175 mm plywood sheet which is secured at its top and bottom edges by a rigid bracket. Inlet openings without knock-outs are left open. Where inlet openings are provided with knock-outs, one is opened.

Specimens classified according to 7.2.3 are mounted in accordance with the instructions.

The mounting support as shown in Figure 23 shall be designed to allow the specimen to be moved horizontally and turned about an axis perpendicular to the surface of the plywood sheet.



Key

1 box

2 mounting plate

Figure 23 – Mounting block for flush-type boxes and enclosures in order to apply blows on the rear surface

The design of the mounting support shall be such that

– *the mounting support has a mass of (10 ± 1) kg and is mounted on a rigid frame;*

– *the specimen can be mounted so that the point of impact lies in the vertical plane through the axis of the pivot;*

– *the plywood sheet can be turned about a vertical axis.*

Parts are submitted to an impact energy and a specified number of blows dependent on the distance of the accessible surface of the specimen from the surface of the plywood sheet when mounted as specified in this Subclause 15.4. Distances A, B, C, D, E, F and G are defined as indicated in Table 7.

Table 7 – Determination of parts A, B, C, D E, F and G

Part to be tested	Distance (*d*) from the surface of the plywood sheet mm	Parts
Front surfaces of covers and cover-plates of enclosures which are intended to be accessible after installation, and Rear surfaces of boxes and enclosures classified according to 7.5.2 or 7.5.3	Not applicable	A
Parts of boxes and enclosures intended to be accessible after installation and classified according to 7.2.1 semi-flush, 7.2.2 semi-flush or 7.2.3, with the exception of front surfaces already tested as parts A	$5 \leq d < 15$	B
	$15 \leq d < 25$	C
	$25 \leq d < 50$	D
	$50 \leq d < 100$	E
	$100 \leq d < 200$	F
	$200 \leq d$	G

The striking element shall fall from a height which is specified in Table 8.

Table 8 – Height of fall for impact test

Height of fall mm	impact energy J	Parts of enclosures to be subjected to the impact
80	0,2	A
120	0,3	B
160	0,4	C
200	0,5	D
240	0,6	E
320	0,8	F
400	1,0	G

The height of fall is the vertical distance between the position of the checking point, when the pendulum is released, and the position of that point at the moment of impact. The checking point is marked on the surface of the striking element where the line through the point of intersection of the axis of the steel tube of the pendulum and the striking element, perpendicular to the place through both axes, meets the surface.

The specimens are subjected to blows, which are evenly distributed over the specimen.

The following blows are applied:

– *for each part A (as far as applicable), five blows as follows:*
  - *one blow in the centre;*
  - *then, after the specimen has been moved horizontally, one on each of the two least favourable points between the centre and the edges;*
  - *and then, after the specimen has been turned 90° ± 2° about its axis perpendicular to the plywood, one on each of two similar points;*
– *for parts B (as far as applicable), C, D, E, F and G, four blows (see Figure 24) as follows:*
  - *one blow is applied on the side of the specimen on which the blow can be applied after the plywood sheet has been turned 60° ± 2° about a vertical axis;*
  - *one blow is applied on the opposite side on which the blow can be applied after the plywood sheet has been turned 60° ± 2° about a vertical axis in the opposite direction;*
  - *after the specimen is turned 90° ± 2° about its axis perpendicular to the plywood, one blow is applied on one of the sides of the specimen on which the blow can be applied after the plywood sheet has been turned 60° ± 2° about a vertical axis;*
  - *one blow is applied on the opposite side of the specimen on which the blow can be applied after the plywood sheet has been turned 60° ± 2° about a vertical axis in the opposite direction.*

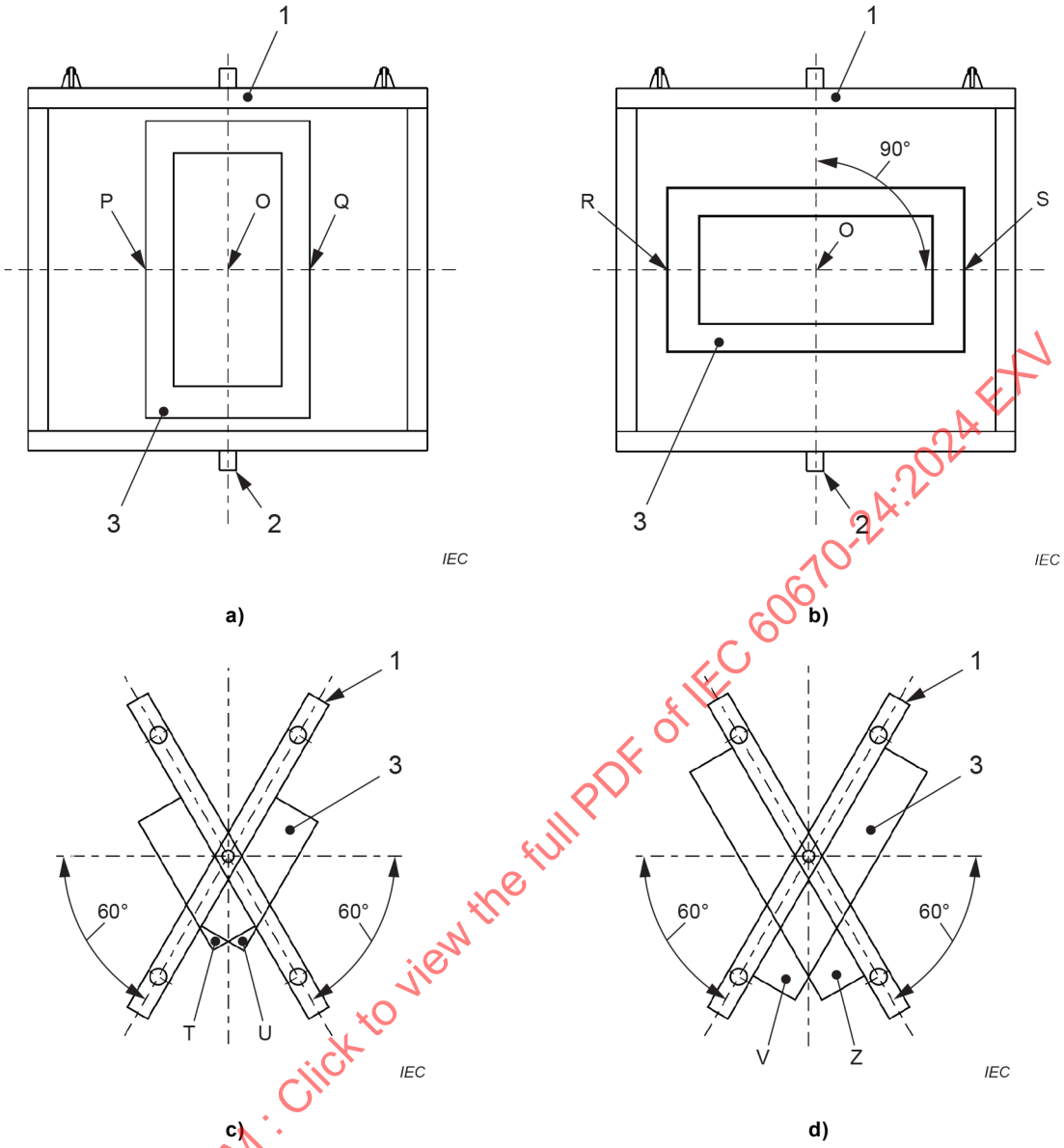
The blows shall not be applied to

– *knock-outs or to an area within 10 mm of them,*
– *other parts not necessary to achieve the declared IP of the enclosure,*
– *accessories and equipment complying with the other relevant standards,*
– *fixing means recessed below the surface that are not subject to impacts in normal use.*

If inlet openings are provided, the specimen is so mounted that the two lines of blows are as nearly as possible equidistant from these openings.

After the test, the specimens shall show no damage leading to non-compliance with this document.

There shall be no cracks passing through the material which are visible to normal or corrected vision without magnification. Surface cracks in fibre-reinforced mouldings and small indentations are ignored.



Key

1 mounting support

2 pivot

3 specimen

Application of the blows			
Sketch	**Total number of blows**	**Points of application**	**Parts to be tested**
a)	3	One at the centre One between O and P* One between O and Q*	Front surfaces and rear surfaces of boxes or enclosures classified according to 7.2.1.1
b)	2	One between O and R* One between O and S*	
c)	2	One on the surface T* One on the surface U*	Accessible parts of boxes or enclosures intended to be surface mounted in normal use except front surfaces and rear surfaces of boxes or enclosures classified according to 7.2.1.1
d)	2	One on the surface V* One on the surface Z*	
* The blow is applied to the most unfavourable point.			

Figure 24 – Sequence of blows for parts A, B, C, D, E, F and G

15.5 Compression test for enclosures made of natural or synthetic rubber or a mixture of both

Boxes and enclosures classified according to 7.1.4 shall withstand a load which can be expected in normal use.

Compliance is checked by the following test:

The enclosure shall be mounted according to the instructions of the manufacturer in a horizontal position in or on a sheet of plywood. Then, the cover of the enclosure and special parts, if any, are loaded as follows (see Figure 25).

a) The cover is loaded with a force of 50 N, applied gradually on an area of 1 cm^2 at the foreseeable point of maximum deflection of the cover.

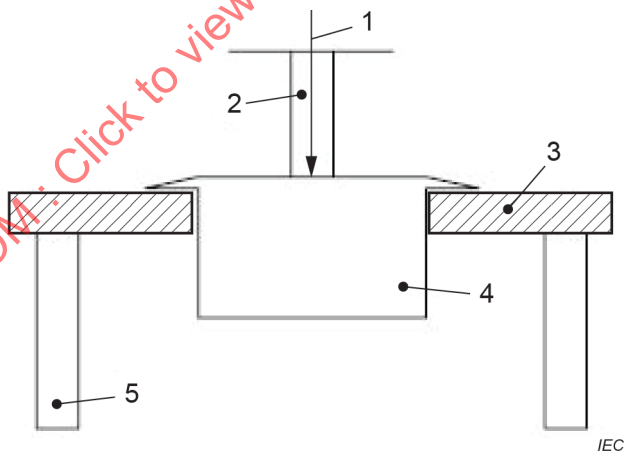
The enclosure shall support the test load for 1 min without deflecting more than 3 mm. The deflection is to be measured when the force reaches the specified value, excluding any influence resulting from the deflection of the plywood and gasket compression.

The permanent deformation at any point on the cover, excluding the deflection of the plywood and gasket compression, shall not exceed 1 mm, measured 1 h after the load is removed.

b) A pressure of 50 N/cm^2 is gradually applied (up to a maximum force of 1 000 N) by means of a sheet of plywood with a thickness of (9 ± 1) mm, in contact with the whole area of the cover.

The enclosure shall support the test load for 1 min and there shall be no damage to the enclosure.

After the test, the boxes or enclosures shall show no damage leading to non-compliance with this document.



Key

1 test force

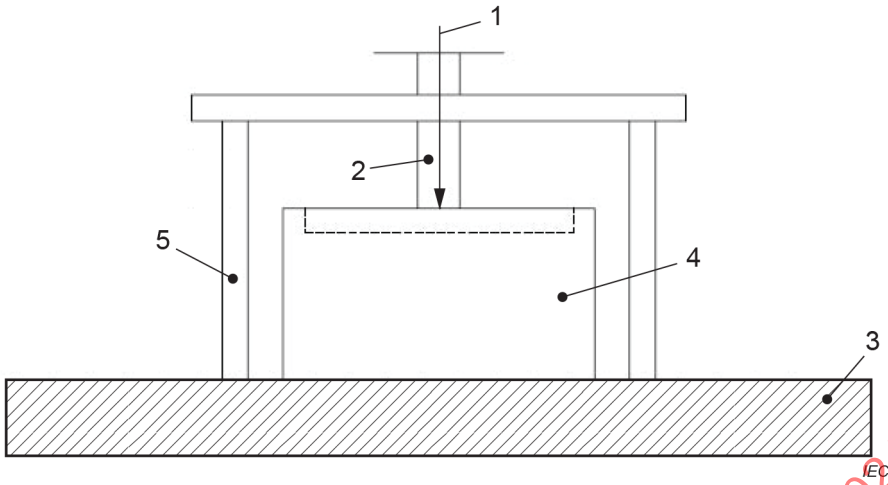
2 cylinder

3 plywood panel

4 boxes made of natural or synthetic rubber or a mixture of both

5 support

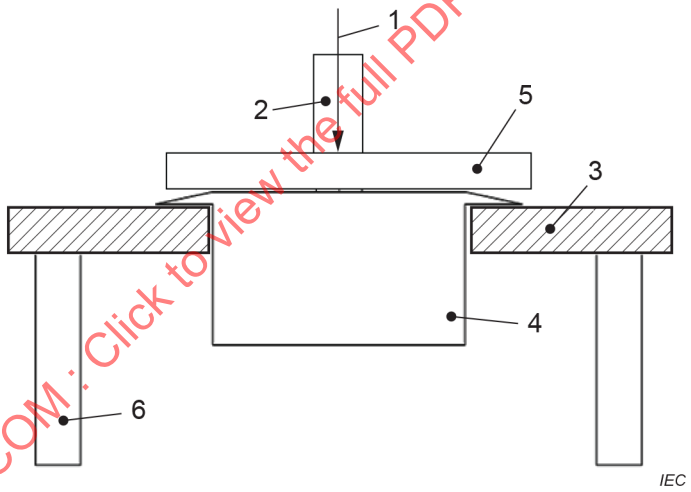
a) For test a (flush-mounted enclosures)



Key

1 test force
2 cylinder
3 solid surface
4 boxes made of natural or synthetic rubber or a mixture of both
5 support

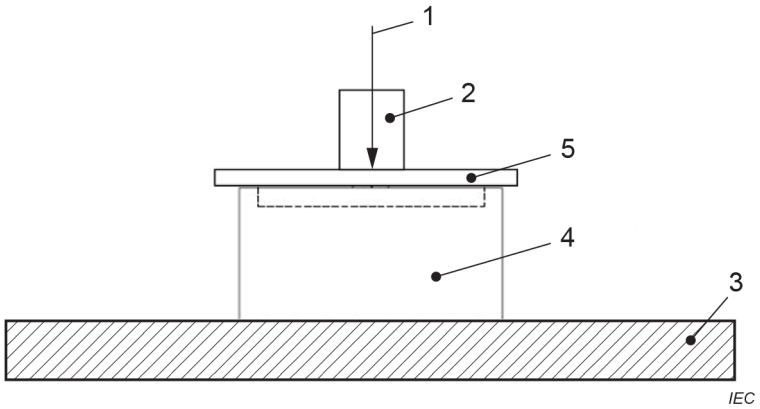
b) For test a (surface-mounted enclosures)



Key

1 test force
2 weight
3 solid surface
4 boxes made of natural or synthetic rubber or a mixture of both
5 plywood (9 ± 1) mm thick
6 support

c) For test b (flush-mounted enclosures)



Key

1 test force

2 weight

3 solid surface

4 boxes made of natural or synthetic rubber or a mixture of both

5 plywood (9 ± 1) mm thick

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

d) For test b (surface-mounted enclosures)

Figure 25 – Test devices for load compression test for enclosures made of natural or synthetic rubber or a mixture of both

15.6 Test for boxes and enclosures declared with IK code

When boxes or enclosures are declared with an IK code according to IEC 62262, they are tested according to Annex B of this document.

15.101 Additional requirements for enclosure exposed to direct sunlight

If enclosures are declared to be resistant to UV radiation, the UV test and the relevant mechanical test shall be carried out in accordance with Annex CC.

This test applies only to boxes and enclosures classified according to 7.1.1, 7.1.3 and 7.1.4.

16 Resistance to heat

16.1 Parts of insulating material necessary to retain current-carrying parts

Parts of insulating material necessary to retain current-carrying parts and/or parts of the earthing circuit in position are subjected to a ball-pressure test by means of the apparatus according to IEC 60695-10-2 except that insulating parts necessary to retain earthing terminals in position shall be tested as specified in 16.2.

The test is made on one specimen.

In case of doubt, the test shall be repeated on two further specimens.

When it is not possible to carry out the test on the specimen, the test should be carried out on a piece at least 2 mm thick which is cut from the specimen. If this is not possible, no more than four layers, each cut from the same specimen, may be used, in which case the total thickness of the layers should be not less than 2,5 mm.

The part under test shall be placed on a steel plate at least 3 mm thick and in direct contact with it.

The surface of the part to be tested is placed in the horizontal position and a steel ball of 5 mm diameter is pressed against the surface with a force of (20 ± 0,5) N.

The test is made in a heating cabinet at a temperature of (+125 ± 2) °C. After (60 $^{+5}_{0}$) min, the ball is removed from the specimen, and the specimen is then cooled down within 10 s to approximately room temperature by immersion in cold water.

The diameter of the impression caused by the ball is measured and shall not exceed 2 mm.

16.2 Parts of insulating material not necessary to retain current-carrying parts

Parts of insulating material not necessary to retain current-carrying parts and/or parts of the earthing circuit in position, even though they are in contact with them, except for parts made of natural or synthetic rubber or a mixture of both are subjected to a ball pressure test in accordance with 16.1, but the test is carried out at a temperature of (+70 ± 2) °C.

Parts of insulating material of flush-mounted enclosures classified according to 7.2.1.3 are subjected to the test described in 16.1 but at a temperature of (+90 ± 2) °C.

If the test cannot be carried out on a complete enclosure, a suitable part may be cut from it for the purpose of the test.

16.3 Boxes and enclosures of insulating materials classified according to 7.2.2.2 or 7.2.2.3

16.3.1 Mechanical strength

Boxes and enclosures of insulating material(s) classified according to 7.2.2.2 or 7.2.2.3 shall have adequate mechanical strength at high temperature.

Compliance is checked by the following test.

A specimen of a box of each type and size involved, each having at least two threaded or unthreaded holes shall be tested.

A rigid crossbar (Figure 26) shall be secured across the face of each box with the size and type of screws normally provided by the box or wiring device manufacturer. The screws shall be secured in the threaded or unthreaded holes located at the face of the box by applying a torque according to the relevant column of Table 4.

A total force of 180 N, including the force exerted by the crossbar and any associated suspension means, shall be applied to the face of the box.

The boxes and enclosures shall be mounted, with the open face downward, in an air-circulating oven for 24 h at the following temperatures:

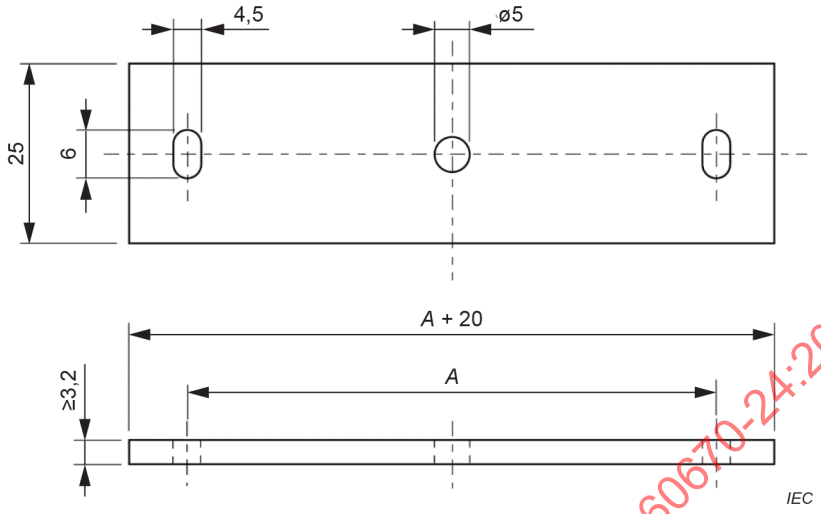
- *(+80 ± 2) °C for boxes and enclosures classified according to 7.2.2.2;*
- *(+105 ± 2) °C for boxes and enclosures classified according to 7.2.2.3.*

The box shall be supported at its open face by a flat plate that does not obstruct the test load support bracket.

After the oven ageing, the assembly shall be allowed to cool down to approximately ambient temperature in the oven, with the power switched off and the door opened.

The screws securing the crossbar to the box shall not have pulled out more than 6,3 mm. The screws shall be able to be removed by a screwdriver using a torque not exceeding 2,3 Nm.

Dimensions in millimetres



Key

A To align with the holes located at the face of the box.

Figure 26 – Rigid crossbar

16.3.2 Parts of insulating material necessary to retain parts of the earthing circuit

Parts of insulating material necessary to retain the earthing strap described in 11.2 shall be subjected to a pull test before and after ageing. After each test, the earthing strap shall not become loose or detached from the specimen.

Compliance is checked by the following tests.

The test shall be conducted on one specimen in the condition as delivered and on one specimen after it has been conditioned in an air-circulating oven for 168 h at 90 °C and then cooled to room temperature.

The test strap shown in Figure 5 shall be attached to the earthing strap by placing the slotted end under the earthing terminal screw. The threads of the earthing terminal shall not be stripped when the torque shown in the relevant column of Table 4 is applied.

For testing of the conditioned sample the test strap shall be attached prior to the conditioning.

With the specimen secured, a force of 45 N shall be applied to the test strap for 5 min in the direction perpendicular to the open face of the specimen.

The force shall be gradually applied in one smooth and continuous movement. If a tensile machine is used, a jaw separation speed of 10 mm/min shall be applied.

17 Creepage distances, clearances and distances through sealing compound

Creepage distances, clearances and distances through sealing compound shall not be less than the value shown in Table 101.

Table 101 – Creepage distances, clearances and distances through sealing compound

Working voltage[a] V	Creepage distance, clearance and distance through sealing compound mm	Alternative impulse voltage test (1,2/50 µs) according to IEC 60664-1 for clearances kV (at 2 000 m)
130	1,5	2,5
> 130 and ≤ 250	3,0	4
> 250 and ≤ 400	4,0	5

[a] Depending on the effective voltage between the considered parts.

NOTE The values of clearance and creepages are given based on overvoltage category III.

Compliance is checked by measurement between the following parts:

Creepage distances and clearances:

– *between live parts of different polarity;*
– *between live parts and*
  - *metal covers and enclosures without insulating lining;*
  - *the surface on which the enclosure is mounted.*

Distances through sealing compound:

– *between live parts covered with sealing compound and the surface on which the enclosure is mounted.*

For multi-way terminal devices and terminals without fixing means but with protection, distances are measured between live parts and any opening which represents the closest point liable to touch any other part when the terminal is fitted with conductors having the largest cross-sectional area.

In cases where various terminals or connecting devices may be mounted in the enclosure, the most unfavourable combinations shall be tested.

If the values for the clearance distances are smaller than those defined in Table 101, the requirement shall be met by the impulse voltage withstand test in accordance with the values in Table 101.

18 Resistance of insulating material to abnormal heat and fire

Parts of insulating material which might be exposed to thermal stresses due to electric effects, the deterioration of which might impair safety, shall not be unduly affected by abnormal heat and by fire.

Compliance is checked by means of the glow-wire test performed according to Clause 4 to Clause 10 of IEC 60695-2-11:2021, under the following conditions.

– By the test made at 960 °C
  - for parts of insulating material necessary to retain current-carrying parts in position.
– By the test made at 850 °C
  - for parts of insulating material, necessary to retain parts of the earthing circuit in position (with the exception of parts of insulating material needed to retain the earth terminal in position in an enclosure), and

- for parts of insulating material of enclosures classified according to 7.2.2, with the exception of parts protruding from the wall and internal parts of the enclosure (e.g. separator) not necessary to retain current carrying parts in position.

– By the test made at 650 °C

- for parts of insulating material not necessary to retain current-carrying parts in position (even though they are in contact with them), and
- for parts of insulating material retaining earthing terminal in position;
- for parts of insulating material of enclosures classified according to 7.2.2, protruding from the wall and internal parts of enclosure (e.g. separator) not necessary to retain current carrying parts in position.

NOTE 1 Accessories complying with other standards, e.g. connecting devices incorporated but not integrated into the enclosure, are not considered as part of the enclosures.

NOTE 2 Examples of parts protruding from the wall but that can be partially in the wall are doors, cover plates, latches or similar.

A current-carrying part or a part of the earthing circuit retained by a mechanical means is considered to be retained in position. The use of grease or the like is not considered to be mechanical means.

External conductors cannot be considered as retaining the current-carrying parts.

In case of doubt, to determine whether an insulating material is necessary to retain current-carrying parts and parts of the earthing circuit in position, the device is examined without conductors while held in positions with the insulating material in question removed.

If the tests specified have to be made at more than one place on the same specimen, care shall be taken to ensure that any deterioration caused by previous tests does not affect the result of the test to be made.

Small parts, where each surface lies completely within a circle 15 mm in diameter, or where any part of the surface lies outside a 15 mm diameter circle and where it is not possible to fit a circle 8 mm in diameter on any of the surfaces, are not subjected to the test of this Clause 18 (see Figure 27 for a diagrammatic representation).

When checking a surface, projections on the surfaces and holes which are not greater than 2 mm on the largest dimension are disregarded.

The tests are not made on parts of ceramic material.

The glow-wire test is applied to ensure that an electrically heated test wire under defined test conditions does not cause ignition of insulating parts or to ensure that a part of insulating material, which can be ignited by the heated test wire under defined conditions, has a limited time to burn without spreading fire by flame or burning parts or droplets falling down from the tested parts onto the pinewood board covered with a tissue paper.

If possible, the specimen should be a complete box or enclosure.

If the test cannot be made on a complete box or enclosure, a suitable part of it may be cut out for the purpose of the test.

The test is made on one specimen.

In case of doubt, the test shall be repeated on two further specimens.

The test is made by applying the glow wire once for (30 ± 1) s.

The specimen shall be positioned during the test in the most unfavourable position of its intended use (with the surface tested in a vertical position).

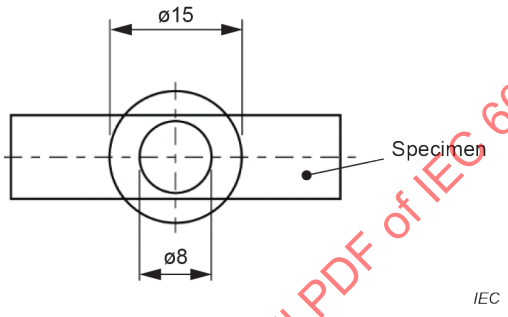
The tip of the glow wire shall be applied to the specified surface of the specimen taking into account the conditions of the intended use under which a heated or glowing element may come into contact with the specimen.

The specimen is regarded as having passed the glow-wire test if:

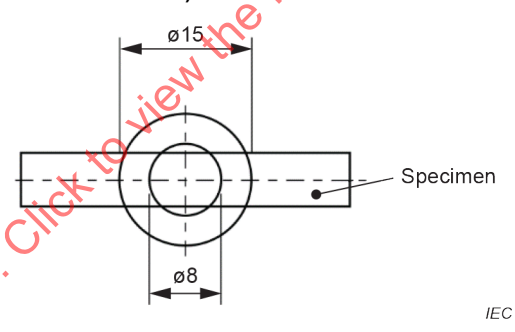
– *there is no visible flame and no sustained glowing, or if*
– *flames and glowing at the specimen extinguish within 30 s after the removal of the glow wire.*

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

Dimensions in millimetres



a) To be tested



b) No test is required

Figure 27 – Diagrammatic representation of the glow-wire test

19 Resistance to tracking

For boxes and enclosures with protection degree higher than IPX0, all parts of the insulating material retaining live parts in position shall be made of a material resistant to tracking.

For materials other than ceramic and where the creepage distances are less than twice the values specified in Clause 17, compliance is checked by the test of IEC 60112 on three specimens.

A flat surface of the part to be tested, if possible, at least 15 mm × 15 mm and at least 3 mm thick, is placed in the horizontal position.

The material under test shall pass a proof-tracking index of 175 using test solution A with a time interval between drops of (30 ± 5) s.

No flashover or breakdown between electrodes shall occur before a total of 50 drops has fallen.

Alternatively, the CTI value for the material may be used. The CTI value shall not be less than 175.

20 Resistance to corrosion

Ferrous parts of boxes and enclosures shall be adequately protected against rusting.

The test can be made on representative parts of the box or enclosure.

Compliance is checked by the following test.

All grease is removed from the parts to be tested by immersion in a degreasing agent for (10 ± 1) min.

The parts are then immersed for (10 ± 1) min in a 10 % solution of ammonium chloride in water at a temperature of (20 ± 5) °C.

Without drying, but after shaking off any drops, the parts are placed for (10 ± 1) min in a box containing air saturated with moisture to a level of 91 % to 95 % at a temperature of (20 ± 5) °C.

After the parts have been dried for (10 ± 1) min in a heating cabinet at a temperature of (100 ± 5) °C, their surface shall show no sign of rust.

Traces of rust on cut edges and any yellowish film removable by rubbing are ignored. Cut edges also include punched holes and thread surfaces of tapped holes.

21 Electromagnetic compatibility (EMC)

Products covered by this document are, in normal use, passive in respect to electromagnetic influences (emission and immunity).

Therefore, no tests are necessary.

101 Verification of the maximum capability to dissipate power (P_{de})

Enclosures according to 7.101.1 shall fulfil the following requirements and tests.

These enclosures shall have the capability to dissipate the declared power (P_{de}) according to 8.1 l).

Compliance is checked by the following test.

The maximum capability to dissipate power is determined using heating resistors.

NOTE 101 The test simulates the power dissipated by devices when mounted and wired in the intended circuit as for normal use.

The test is carried out on specimens equipped with the heating resistor fitted in the most unfavourable position.

NOTE 102 For example, the different positions of a rail, etc.

The cross-sectional area of the conductors for the connection of the heating resistors shall be 1,5 mm^2 and the opening for this cable is sealed, if needed.

Other openings for cables, if any, and for devices, are closed as in normal use.

For enclosures according to 7.2.1.1 and 7.2.2.1 the test is carried out with the specimen mounted as declared by the manufacturer.

For enclosures according to 7.2.3 the specimen is mounted on a minimum 19 mm thick plywood painted black.

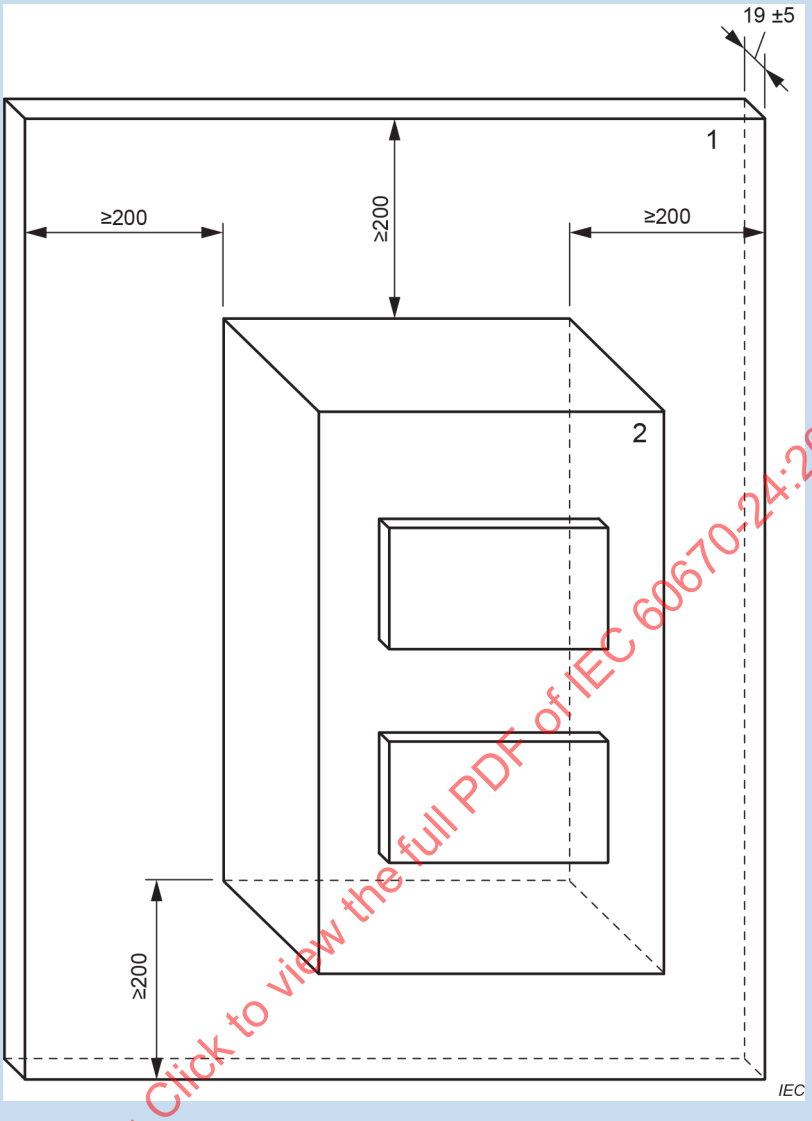
For enclosures according to 7.2.1.2 and 7.2.1.3 the test is carried out with the specimen cast in a concrete wall of thickness not less than 100 mm on each surface; it is permitted to cast the specimen in walls of different material, with equivalent thermal conductivity.

The test in concrete represents the conventional mounting condition.

For declared mounting conditions other than in concrete the manufacturer shall declare the appropriate P_{de} value in the documentation according to the declared mounting condition.

A distance of at least 200 mm is provided between each surface of the specimen and the relevant edge of the test surface (Figure 101).

Dimensions in millimetres



Key

1 plywood

2 enclosure

Figure 101 – Arrangement for the verification of the maximum capability to dissipate power (P_{de}) and for verification of temperature rise of surface type enclosures

A heating resistor (Figure 102) with uniformly distributed winding on an insulating support (such as mica) is placed into the specimen under test.

Dimensions in millimetres

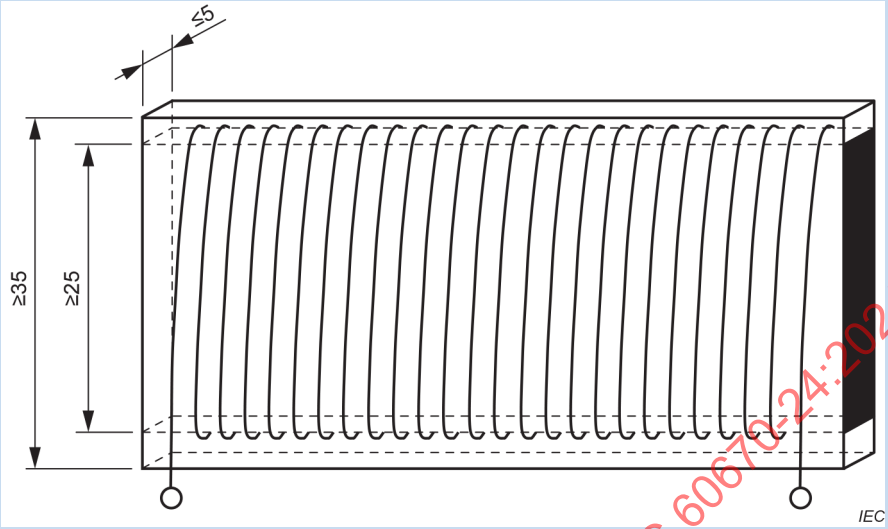
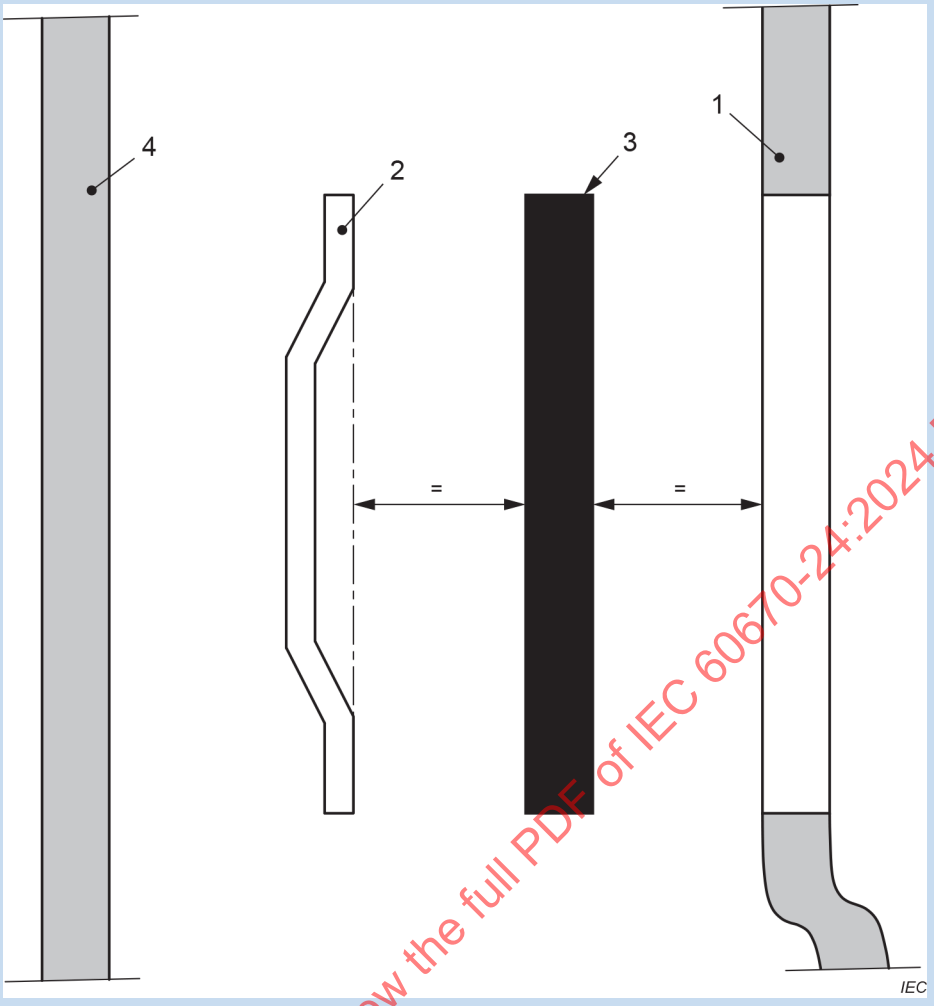


Figure 102 – Heating resistor for the verification of the maximum capability to dissipate power (P_{de})

The winding and the insulating support shall provide a uniform thermal flow.

For enclosures intended to be fitted with rail mounting accessories and electrical equipment, the heating resistor is located at half the distance between the rail and the window, as shown in Figure 103.



Key

1 door, lid or cover

2 rail for rail mounting accessories and electrical devices

3 resistor

4 rear surface of the enclosure

= +/- 5 mm

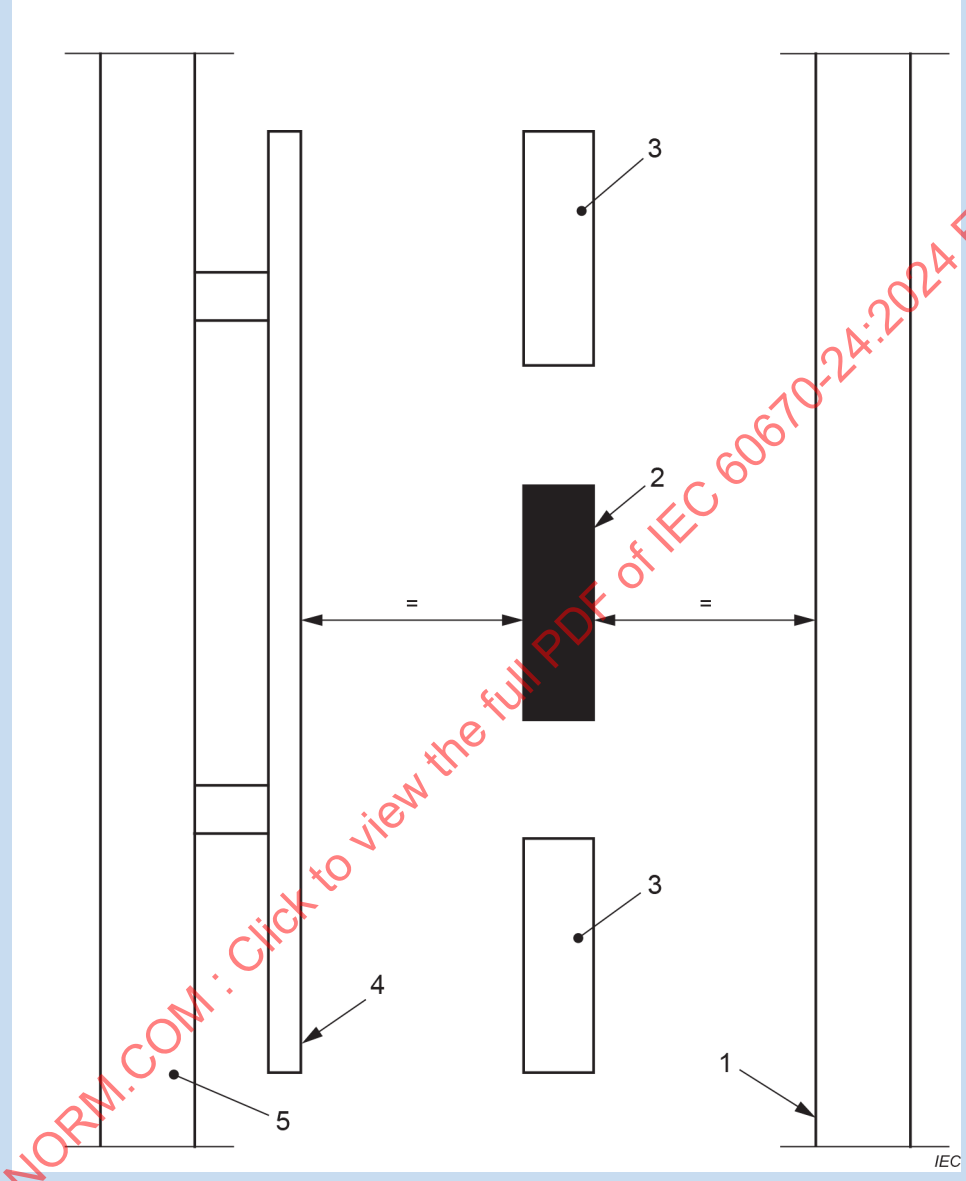
Figure 103 – Position of the resistor for enclosures designed or intended to be fitted with rail mounting modular accessories and electrical equipment

If there is more than one row of rail mounting accessories and electrical equipment, the test is carried out by equalising the power loss on all rows using equal heating resistors on each row.

The heating resistor(s) length is (are) equal to the length of the window(s) with a tolerance of 0 mm to 10 mm. The window or windows are closed with their own blank covers provided by the manufacturer.

For enclosures other than those intended to be fitted with modular devices, the heating resistor is located at half the distance between the door or lid and the inner bottom surface of the specimen (or the mounting surface for the device intended by the manufacturer) as shown in Figure 104. The distance of the heating resistor(s) ends from the lateral and from the upper and lower edges of the mounting surface shall be equal to (50 ± 5) mm.

If the dimensions of the specimen allow the mounting of several devices in different positions, the test is carried out by equalising the power loss using equal heating resistors mounted as shown in Figure 104 and Figure 105, and the distance between the heating resistors being (90 ± 5) mm, the distance of the heating resistor(s) from the upper and lower edge of the mounting surface of the specimen being not be less than 50 mm as shown in Figure 105.



Key

1 door, lid or cover

2 resistor

3 resistors, if more than one

4 mounting plate

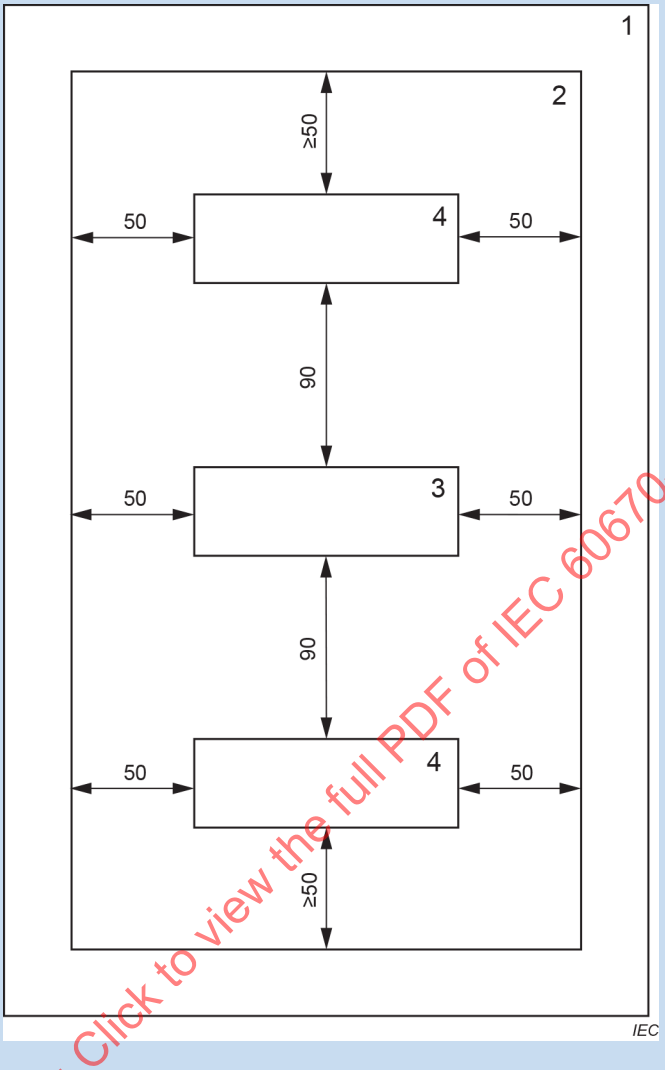
5 rear surface of the enclosure

= +/- 5 mm

Figure 104 – Position of the resistor(s) for enclosures other than those designed or intended to be fitted with rail mounting accessories and electrical equipment

Dimensions in millimetres

Tolerance ± 5 mm



Key

1 enclosure

2 mounting surface

3 resistor

4 resistors, if more than one row

Figure 105 – Position of the resistor(s) for enclosures other than those designed or intended to be fitted with rail mounting accessories and electrical equipment and allowing the mounting of several accessories and electrical equipment in different positions

The temperature rise of the accessible parts of the enclosure or of parts that can become accessible during normal use, including the blank covers, if any, is measured. This test shall be performed with the door or lid, if any, closed.

The current passing through the heating resistor is such that the temperature at the hottest point of the heating resistor(s) is not greater than 200 °C, and the temperature rise measured in a steady state condition (variation less than 1 K/h) on the hottest accessible part shall not be greater than 30 K. The power dissipated by the heating resistor(s) is then measured.

The value rounded to the next lower integer number shall not be less than the declared value of the maximum capability of the dissipated power (P_{de}).

After the test, the enclosure shall show no damage or deformation which would impair its further use.

102 Verification of temperature rise

Enclosures according to 7.101.2 shall fulfil the following requirements and tests.

These enclosures shall have an acceptable temperature rise when equipped with the most onerous configuration of electrical equipment declared by the manufacturer.

Compliance is checked by the following tests.

The temperature rise test is performed with an enclosure arranged as follows.

The enclosure shall be equipped and mounted as in normal use, including electrical devices, lids, covers, doors, connections, terminals, etc., according to the manufacturer's instructions.

The thermometers or thermocouples for the measure of the internal and ambient temperatures shall be installed at appropriate locations and protected against air currents and heat radiation.

For enclosures according to 7.2.1.1 and 7.2.2.1 the test is carried out with the specimen mounted as indicated in the manufacturer's instructions.

For enclosures according to 7.2.3 the specimen is mounted on a minimum 19 mm thick plywood painted black.

For enclosures according to 7.2.1.2 and 7.2.1.3 the test is carried out with the specimen cast in a concrete wall of thickness not less than 100 mm on each surface; it is permitted to cast the specimen in walls of different material, with equivalent thermal conductivity.

The test in concrete represents the conventional mounting condition.

For declared mounting conditions other than in concrete the manufacturer shall declare a correction factor in the documentation according to the declared mounting condition.

A distance of at least 200 mm is provided between each surface of the specimen and the relevant edge of the test surface (Figure 101).

The test shall be carried out for a time sufficient for the temperature rise to reach a constant value. In practice, this condition is reached when the variation does not exceed 1 K/h.

The specimen is loaded with its rated current (I_n). This current shall be distributed amongst the smallest possible number of outgoing circuits, with a minimum of two, so that each of these circuits is loaded with its rated current multiplied by the rated diversity factor, as stated in Table 102. In the case where the exact total load cannot be obtained by a number of devices loaded to this current, only the last loaded circuit shall be loaded to a lower value to give the correct total.

When only one incoming device is possible, the specimen is loaded at I_n with one device. The device rating is selected taking into consideration the diversity factor as given in Table 102 and the value adjusted to the closest higher rating.

NOTE As an example, a 50 A enclosure would be tested with a 63 A device.

Table 9 – Diversity factor

Number of main circuits	Diversity factor K
1, 2 and 3	0,8
4 and 5	0,7
6 to 9	0,6
10 and more	0,5

After the test, the enclosure shall show no damage which would impair its further use.

The temperature rise measured on the terminals for external conductors of the outgoing devices shall not exceed the values defined in the relevant standard in a steady-state condition (variation less than 1 K/h).

The temperature of the accessible surfaces of the enclosure shall not exceed the values as given in Table 103.

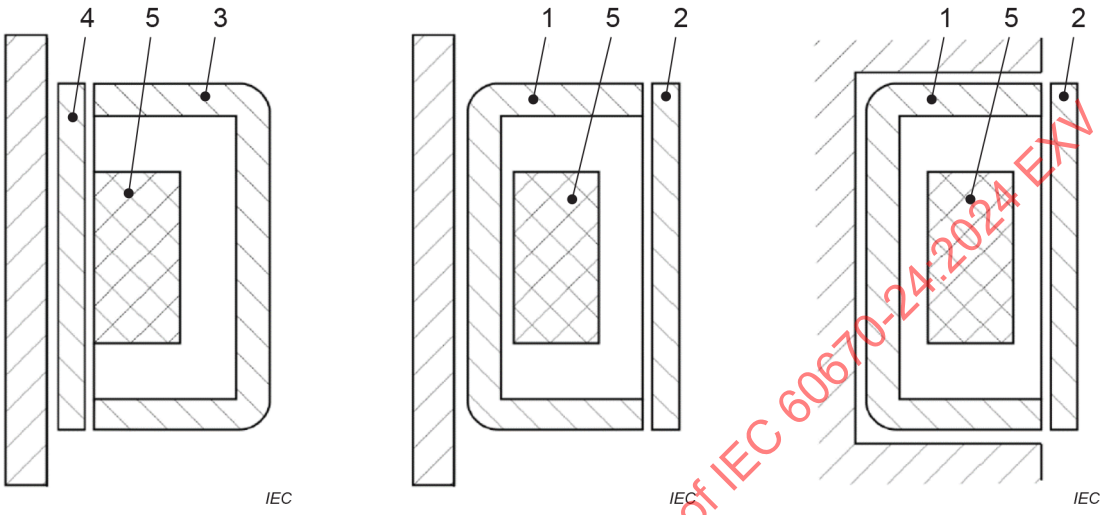
Table 10 – Temperatures of accessible surfaces

Accessible external enclosures and covers:	Temperature rise K
– metal surfaces	30
– insulating surfaces	40

Annex A
(informative)

Examples of enclosures and parts thereof

Figure A.1 shows examples of enclosures and parts thereof.



a) Backplate and cover (only surface-type) **b) Box and cover-plate (surface-type)** **c) Box and cover-plate (flush-type)**

Key

1 box
2 cover-plate
3 cover
4 backplate
5 accessory

Figure A.1 – Examples of enclosures and parts thereof

Annex B
(normative)

Test for boxes and enclosures declared with IK code

Boxes and enclosures declared with an IK code shall comply with the test and requirements of this Annex B.

Compliance is checked by the following test.

Specimens shall be tested according to IEC 62262 by means of a test hammer apparatus described in IEC 60068-2-75, suitable for the dimension of the enclosure, using impact energy related to the protection code as stated in IEC 62262:2002/AMD1:2021, Table 1.

The test is performed on a new set of specimens.

The box or enclosure shall be installed on a rigid support of sufficient dimension and arranged as in normal use.

The test shall be carried out under the conditions indicated in 5.1 of this document.

Three blows shall be applied on each surface accessible in normal use.

After the test, visual inspection shall verify that the specified IP code and dielectric properties have been maintained.

Removable covers shall still be removable and reinstallable, lids or doors shall still be openable and closable.

Damage to the finish, small dents and small chips which do not adversely affect the protection against electric shock or harmful ingress of water are disregarded.

Cracks passing through the material not visible with normal or corrected vision without magnification, surface cracks in fibre-reinforced mouldings and small indentations are disregarded.

Annex AA
(normative)

Instructions to be given by the manufacturer of the GP enclosure to the installer on how to integrate accessories, and providing an example of calculation

AA.1 Selection of the GP enclosure

In the field of household and similar applications, an installer takes into consideration different configurations of suitable equipment on site by choosing from a large variety of components such as protective devices, switches, transformers, etc., available on the market.

When selecting components for incorporation in these enclosures the component power loss characteristics should be used as illustrated in this Annex AA.

The following equivalence shall be verified by the installer to select the correct GP enclosure in which to integrate protective devices and other power dissipating electrical equipment to make an equipped GP enclosure and make sure that the temperature rise measured on the hottest accessible part of the equipped GP enclosure shall not be greater than 30 K:

$$P_{tot} \leq P_{de}$$

where

P_{de} is the maximum capability of the enclosure to dissipate power, in watts, declared by the manufacturer in normal use;

P_{tot} is the total power loss of the electrical accessories and protecting devices to be incorporated into the GP enclosure and their connections calculated as follows:

$$P_{tot} = P_{dp} + 0{,}2\ P_{dp} + P_{au} + P_{el} + 0{,}2\ P_{el}$$

where

P_{dp} is the power loss of the protective devices;

$0{,}2\ P_{dp}$ is the increase of P_{dp} to consider power lost by connections, socket-outlets, relays, time delay switches, small appliances;

P_{au} is the power loss of electrical accessories, other than the previous ones (for example transformers, socket-outlets, signal lamps, etc.);

P_{el} is the power loss of electronic accessories, in watts, taking into account the utilization factor (K_e) for multi-way devices;

$0{,}2\ P_{el}$ is the increase of P_{el} to consider power lost by connections of the power circuit of electronic devices;

P_{dp} is calculated as follows:

$$P_{dp} = \sum p_e \times P_e \times K_e^2 + \sum p_n \times P_n \times K^2$$

where

p_e is the number of poles of the devices of the incoming circuits;

P_e is the dissipated power for each pole of the device of the incoming circuits;

K_e = 0,85;

P_n is the number of poles of the devices inside the enclosure except those of the incoming circuits;

P_n is the dissipated power for each pole of the devices inside the enclosure except those of the incoming circuits;

K is the value (≤ 1) depending on the contemporary use of the connected loads.

Compliance is checked by calculation.

NOTE An example is given in Clause AA.5.

AA.2 Diversity factor

In the absence of information concerning the actual currents, the conventional values of K as specified in Table AA.1 may be used.

Table AA.1 – Diversity factor

Number of main circuits	Diversity factor K
2 and 3	0,8
4 and 5	0,7
6 to 9	0,6
10 and more	0,5

AA.3 Markings

The following markings shall be given on the equipped GP enclosure:

- Name or identification of the installer,
- Type reference or other means used by the installer to identify the equipped GP enclosure,
- Rated current (I_{nq}) in amperes,
- Rated voltage in volts,
- Symbol for nature of supply,
- Degree of protection of the equipped GP enclosure,
- Symbol for class II protection, if applicable,
- Letter N for terminals intended exclusively for the neutral conductor,

- Symbol  according to IEC 60417-5019 (2006-08) for earthing terminals for the connection of the protective conductor.

These markings shall be placed on a label, that may be placed also behind the lids or doors and shall be durable and easily legible.

These markings shall not be placed on screws, or any other easily removable parts.

NOTE Easily removable parts are those parts which can be removed during the normal installation of the equipped GP enclosure.

The installer shall provide the following information on the documentation which accompanies the equipped GP enclosure:

– declaration of conformity that the equipped GP enclosure is made according to the relevant requirements,
– information concerning the calculation made (not required for equipped GP enclosure single phase having a $I_{nq} \leq 32$ A).

AA.4 Test and verification to be carried out by the installer

AA.4.1 General

Electrical accessories (protective devices, switches, time-delay switches, transformers, terminals, etc.) shall comply with their relevant standards, if any.

For electrical accessories not covered by a standard, refer to their manufacturer's instruction sheets.

Tests and verification shall be performed on the equipped GP enclosure (including lids, covers, doors, protective devices and similar power consuming devices, etc.), wired and mounted as for normal use, as indicated in Table AA.2.

Table AA.2 – Tests and verifications

Clause	Characteristics	Tests and verifications
	Identification	Inspection of the marking and of the compliance of the equipped GP enclosure with the wiring diagrams, etc.
AA.4.2	Protection by class II	Verification of the protection by class II protection requirements
AA.4.3	Effectiveness of the protective circuit	Verification and test of the effectiveness of the protective circuit
AA.4.4	Wiring, mechanical operation and, if necessary, electrical operation	Verification of the correct wiring, mechanical operation and, if necessary, electrical operation tests
AA.4.5	Resistance to ageing, protection against ingress of foreign solid objects and against harmful ingress of water	Verification of protection against ingress of foreign solid objects and against harmful ingress of water
AA.4.6	Insulation resistance	Test of the insulation resistance
	Temperature rise limits	Covered by calculation according to this Annex AA

AA.4.2 Protection by class II

For protection, by total insulation, against indirect contact, the following requirements shall be met.

a) The live parts of accessories shall be covered with insulating material.

b) The GP enclosure shall be made of an insulating material which is capable of withstanding the mechanical, electrical and thermal stresses to which it is liable to be subjected under normal use and it shall be resistant to ageing.

c) The GP 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 GP enclosure.

This means that metal parts, such as an actuating member which for constructional reasons must be brought through the GP enclosure, shall be insulated on the inside or the outside of the GP enclosure from the live parts for the maximum rated insulation voltage and, if applicable, the maximum rated impulse withstand voltage of all circuits in the equipped GP enclosure.

If an actuating member is made of metal (whether covered by insulating material or not), it shall be provided with insulation rated for the maximum rated insulation voltage and, if applicable, the maximum impulse withstand voltage of all circuits in the equipped GP enclosure.

If an actuating member is principally made of insulating material, any of its metal parts which may become accessible in the event of insulation failure shall also be insulated from live parts for the maximum rated insulation voltage and, if applicable, the maximum rated impulse withstand voltage of all circuits in the equipped GP enclosure.

d) The equipped GP enclosure shall cover live parts of the installed equipment with insulation material and parts belonging to a protective circuit in such a manner that they cannot be touched.

If a protective conductor, which is extended to electrical equipment connected to the load side of the equipped GP enclosure, is to be passed through an equipped GP enclosure whose exposed conductive parts are insulated, the necessary terminals for connecting the external protective conductors shall be provided and identified by suitable marking. Inside the equipped GP enclosure, the protective conductor and its terminal shall be insulated from the live parts and the exposed conductive parts in the same way as the live parts are insulated.

e) Exposed conductive parts within the equipped GP enclosure shall not be connected to the protective circuit, i.e. they shall not be included in a protective measure involving the use of a protective circuit. This applies also to built-in apparatus, even if they have a connecting terminal for a protective conductor;

f) If doors or covers of the equipped GP enclosure can be opened without the use of a key or tool, an obstacle of insulating material shall be provided which will afford protection against unintentional contact not only with the accessible live parts, but also with the exposed conductive parts which are only accessible after the cover has been opened; this obstacle, however, shall not be removable except with the use of a tool,

Compliance is checked by inspection.

AA.4.3 Provisions for earthing

The electrical continuity of the protective circuit, if any, is verified for each equipped GP enclosure (including lids, covers, doors, protective devices and similar power consuming devices, etc.), wired and mounted as for normal use.

Except for equipped GP enclosure protected by class II, all exposed conductive parts shall be connected to the earthing circuit.

An exposed conductive part cannot be used as bonding between two connections.

Compliance is checked by inspection and, if necessary, by a continuity test of the protective circuit.

A measurement shall be carried out to verify that the resistance between the terminal of the incoming protective conductor and the exposed conductive parts shall be less than 0,05 Ω with a current of 10 A AC or 10 A DC.

AA.4.4 Inspection of the wiring and the mechanical and electric operation

The correct positioning of cables, effectiveness of connecting means and the correct mounting of the protective devices and other electrical accessories shall be verified.

The effectiveness of the mechanical actuating elements, interlock, etc., if any, shall be checked.

Depending on the complexity of the equipped GP enclosure (including lids, covers, doors, protective devices and similar power consuming devices, etc.), wired and mounted as for normal use, it may be necessary to carry out an electrical functioning test.

Compliance is checked by inspection and manual test(s).

AA.4.5 Degree of protection

The IP degree of the equipped GP enclosure shall be verified according to IEC 60529.

The test is not carried out if:

– the GP enclosure has not been modified by the installer in such a way to impair its degree of protection against electric shocks declared by the manufacturer;
– the GP enclosure has been installed according to the manufacturer's instructions.

AA.4.6 Insulating

This verification is not mandatory for a single-phase equipped GP enclosure having I_{nq} ≤ 32 A.

The verification is made with a test apparatus at a test voltage at least 500 V. The measurement is made between each live conductor and accessible conductive part and between each live conductor.

The test is considered satisfactory if the measured insulating resistance is higher than 1 000 Ω/V with reference to the rated voltage to earth of each circuit.

NOTE During the verification, electronic accessories installed in the equipped GP enclosure can be disconnected to avoid their damaging.

AA.4.7 Total incoming load

The total incoming load current shall not exceed 125 A.

AA.5 Example of calculation without electronic devices

AA.5.1 General

The calculation is based on the following steps.

AA.5.2 Diagram of the equipped GP enclosure

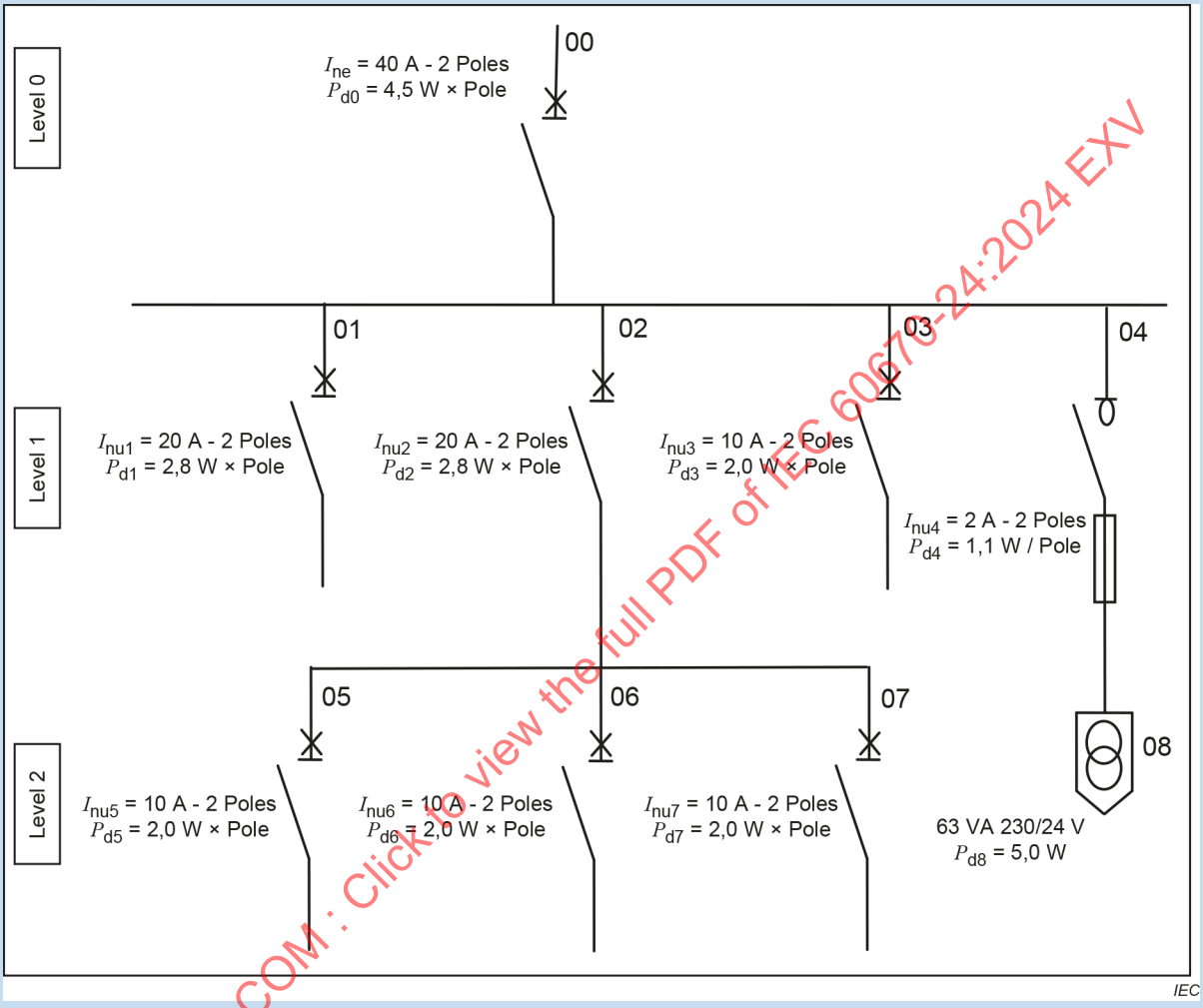


Figure AA.1 – Diagram of the equipped GP enclosure

AA.5.3 Calculation of the power loss within the equipped GP enclosure

The calculation of the power loss is shown in Table AA.3 and Table AA.4.

Table AA.3 is an example calculation of the power loss of the protective devices according to Figure AA.1.

Table AA.4 is an example calculation of the power loss of other electrical accessories according to Figure AA.1.

Determination of the utilisation factor (K_e) and of the diversity factor (K)

– Level 0 incoming circuit: K_e = 0,85

– Level 1 circuits: $K = I_{nq} / (I_{nu1} + I_{nu2} + I_{nu3} + I_{nu4}) = 34 / 52 = 0,653$

– Level 2 circuits: $K = I_{nu2} \times 0,653 / (I_{nu5} + I_{nu6} + I_{nu7}) = 13 / 30 = 0,433$

Table AA.3 – Calculation of P_{dp}

	Number of the circuit	Power loss per pole W	Number of poles	Power loss per protective and control device P_d W	Utilisation factor (K_e) for incoming circuits Diversity factor (K) for outgoing circuits	Power loss of each device W
		a	b	c		d
Incoming circuits	00	4,50	2	9,00	0,85	6,50
Outgoing circuits	01	2,80	2	5,60	0,653	2,39
	02	2,80	2	5,60	0,653	2,39
	03	2,00	2	4,00	0,653	1,71
	04	1,10	2	2,20	0,653	0,94
	05	2,00	2	4,00	0,433	0,75
	06	2,00	2	4,00	0,433	0,75
	07	2,00	2	4,00	0,433	0,75
					P_{dp} =	16,17

[a] Data indicated by the manufacturer of the device.

[b] With reference to the thermal effects, only 3 poles are considered in the case of 4-pole switches.

[c] Power loss per pole multiplied by the number of poles.

[d] Incoming circuits: $K_e^2 \times P_d$

Outgoing circuits: $K^2 \times P_d$

K_e and K are squared as the power is proportional to the square of the current.

P_{dp} = 16,17 W

Table AA.4 – Calculation of P_{au}

Number of the circuit	Description of the electrical accessory with a significant power loss in normal use	Power loss per accessory W	Number of accessories	Power loss W
08	Safety transformer	5	1	5
			P_{au}	5

AA.5.4 Total power loss of the equipped GP enclosure

$$P_{tot} = P_{dp} + 0,2\ P_{dp} + P_{au} = \mathbf{16,17 + 3,23 + 5 = 24,4\ W}$$

where

P_{dp} is the power loss of the protective devices;

P_{au} is the sum of the power losses of other electrical accessories.

AA.5.5 Conclusions

An enclosure, complying with this document, with a maximum capability to dissipate power (P_{de}), declared by the manufacturer of at least **25 W** has been chosen for the construction of the equipped GP enclosure.

The temperature rise limits of the equipped GP enclosure are deemed to be satisfactory since

$$P_{tot} = 24{,}4 \text{ W} < P_{de} = 25 \text{ W}$$

AA.6 Example calculation to take into account the power loss of electronic devices

AA.6.1 General

The calculation is based on the following steps (AA.6.2 to AA.6.5).

AA.6.2 Diagram of the equipped GP enclosure

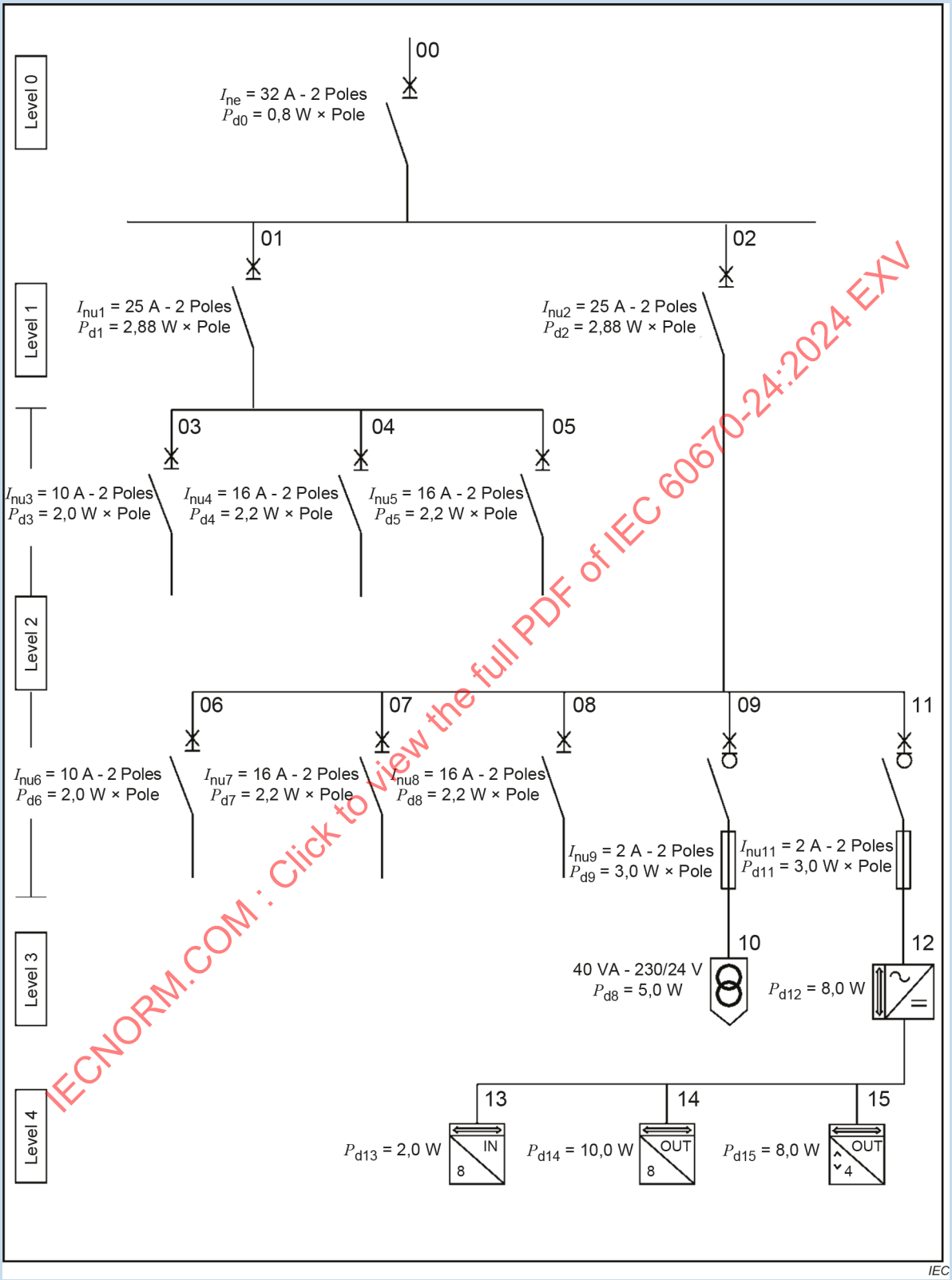


Figure AA.2 – Diagram of the equipped GP enclosure

AA.6.3 Calculation of the power loss within the equipped GP enclosure

The calculation of the power loss is shown in Table AA.5, Table AA.6 and Table AA.7.

Table AA.5 is an example calculation of the power loss of the protective devices and control devices according to Figure AA.2.

Table AA.6 is an example calculation of the power loss of other electrical accessories according to Figure AA.2.

Table AA.7 is an example calculation of the power loss of electronic devices according to Figure AA.2.

Determination of the utilisation factor (K_e) and of the diversity factor (K)

– *Level 0 incoming circuit – K_e = 0,85*

– *Level 1 circuits – $K = I_{nq} / (I_{nu1} + I_{nu2}) = 27 / 50 = 0,54$*

– *Level 2 circuit 1 – $K = I_{nu1} \times 0,54 / (I_{nu3} + I_{nu4} + I_{nu5}) = 13,5 / 42 = 0,321$*

– *Level 2 circuit 2 – $K = I_{nu2} \times 0,54 / (I_{nu6} + I_{nu7} + I_{nu8} + I_{nu9} + I_{nu11}) = 13,5 / 46 = 0,293$*

Table AA.5 – Calculation of P_{dp}

	Number of the circuit	Power loss per pole W	Number of poles	Power loss per protective and control device P_d W	Utilisation factor (K_e) for incoming circuits Diversity factor (K) for outgoing circuits	Power loss of each device W
Incoming circuits	00	0,8	2	1,6	0,85	1,16
Outgoing circuits	01	2,88	2	5,76	0,54	1,68
	02	2,88	2	5,76	0,54	1,68
	03	2,00	2	4,00	0,321	0,41
	04	2,2	2	4,4	0,321	0,45
	05	2,2	2	4,4	0,321	0,45
	06	2,00	2	4,00	0,293	0,34
	07	2,2	2	4,4	0,293	0,38
	08	2,2	2	4,4	0,293	0,38
	09	3	2	6	0,293	0,52
	11	3	2	6	0,293	0,52
					P_{dp} =	7,97

P_{dp} = 7,97 W

Table AA.6 – Calculation of P_{au}

Number of the circuit	Description of the electrical accessory with a significant power loss in normal use	Power loss per accessory W	Number of accessories	Power loss W
10	Safety transformer	5	1	5
			P_{au}	5

P_{au} = 5 W

Table AA.7 – Calculation of P_{el}

	Number of the circuit	Number of ways	Power loss per electronic device P_{el} W	Utilisation factor (K_e) for incoming circuits Diversity factor (K) for outgoing circuits	Power loss of each device W
Power supply	12	-	8	0,85	5,78
Electronic devices	13	8	2	0,6	0,72
	14	8	10	0,6	3,6
	15	4	8	0,7	3,92
				P_{dp} =	14,02

P_{au} = 14,02 W

AA.6.4 Total power loss of the equipped GP enclosure

$$P_{tot} = P_{dp} + 0,2\ P_{dp} + P_{au} + P_{EL} + 0,2\ P_{EL} = 7,97 + 1,59 + 5 + 14,02 + 2,80 = 31,38\ W$$

where

P_{dp} is the power loss of the protective devices;

P_{au} is the sum of the power losses of other electrical accessories;

P_{el} is the power loss of the electronic devices.

AA.6.5 Conclusions

An enclosure, complying with this document, with a maximum capability to dissipate power (P_{de}), declared by the manufacturer of at least 41 W has been chosen for the construction of the equipped GP enclosure.

The temperature rise limits of the equipped GP enclosure are deemed to be satisfactory since

$$P_{tot} = 31,38\ W < P_{de} = 41\ W$$

Annex BB
(normative)

Instructions to be given by the manufacturer of the PD enclosure to the installer on how to integrate accessories

BB.1 General

This Annex BB contains information to be given by the manufacturer to the installer in order that the installer can install the enclosure for pre-determined equipment (PD enclosure) according to 7.101.2:

– so that the temperature rise of the completed enclosure minimizes hazards for the environment, and

– so that a proper combination of electrical equipment for normal operation is guaranteed.

BB.2 Rated current and main characteristics

The maximum incoming current shall be equal to or lower than the maximum rated current of the enclosure as declared by the manufacturer. The incoming current to be considered is the sum of all incoming sources (e.g. photovoltaic sources).

The manufacturer shall inform the installer about the main characteristics of the devices which can be integrated (e.g. product range name, maximum rated current, power dissipated per pole, etc.).

BB.3 Devices to be integrated by the installer

The devices integrated in the enclosure by the installer shall comply with their product standard (e.g. MCB shall comply with IEC 60898-1, RCCB shall comply with IEC 61008-2-1 and RCBO shall comply with IEC 61009-2-1), if any.

The manufacturer shall provide information in its documentation to define the maximum number of modules per row at a given width of one module.

BB.4 Dimensions

The manufacturer shall provide all the necessary dimensions in order to integrate devices in the enclosure so as to ensure the safe operation of the equipment.

This information shall be provided

– by reference to a standard, if any, or

– by providing the following details:

- external dimensions of the enclosure (length, width, depth) for correct mounting;
- distances between parallel routed mounting rails;
- distance between mounting rails for related built-in devices and the protective cover;
- installation depths for built-in devices in conjunction with mounted lids or doors;
- dimensions at the top and at the bottom of the enclosure for incoming and outgoing cable(s).

BB.5 Connections

The minimum number and type of terminal to be installed shall be as follows:

– 1 PE terminal able to connect simultaneously:
  - 1 conductor with cross-section equal to 16 mm^2, and
  - 1 conductor with cross-section equal to 6 mm^2, and
  - 1 conductor with cross-section equal to 4 mm^2, and
  - 2 conductors with cross-section equal to 2,5 mm^2.

– 1 N terminal for incoming connections, if required, able to connect at minimum:
  - 1 rigid conductor with cross-section equal to 16 mm^2, or
  - 1 flexible conductor with cross-section equal to 10 mm^2.

– 1 L terminal for incoming connections, if required, able to connect at minimum:
  - 1 rigid conductor with cross-section equal to 16 mm^2, or
  - 1 flexible conductor with cross-section equal to 10 mm^2.

The manufacturer shall provide information about the number of each type of terminal (e.g. L, N and PE) installed and the reference to the relevant standard for terminal (e.g. IEC 60999, IEC 60998).

BB.6 Protection against electric shock

The manufacturer shall provide information to the installer so that devices can be mounted and wired in such a way to provide protection against electric shocks.

Active parts shall remain inaccessible when devices are installed and wired.

Devices mounted in the enclosure shall have a minimum IP degree of IP2X.

BB.7 IP degree and IK code

The declared IP degree, and the declared IK code if any, shall be provided by the manufacturer.

BB.8 Wiring

The manufacturer shall provide the following information to the installer:

– the internal wiring shall be such that minimum creepage distances between live parts and metallic accessible or non-accessible parts are not lower than 3 mm, and

– cross-sectional area of conductors shall be chosen according to the installation rules.

Annex CC
(normative)

Additional requirements for enclosures exposed to direct sunlight

Enclosures declared to be resistant to UV radiation shall comply with the following tests.

The tests shall be made on six test specimens of standard size according to ISO 178:2019 and on six test specimens of standard size according to ISO 179-1 exposed for 500 h to Xenon-arc, Method A, Cycle 1 in accordance with ISO 4892-2. The specimens shall be mounted in the UV apparatus in an appropriate manner,

– *suitable for both the product to be tested and the test equipment and*
– *so that the samples do not touch each other.*

Compliance is checked by verification that the flexural strength (according to ISO 178) and Charpy impact (according to ISO 179-1) of synthetic materials have 70 % minimum retention.

For the test carried out in accordance with ISO 178, the surface of the specimens exposed to UV shall be turned face down and the pressure is applied to the non-exposed surface.

For the test carried out in accordance with ISO 179-1 no notch shall be cut into the specimens and the impact shall be applied to the exposed surface. 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.

The specimens shall not show cracks or deterioration visible to normal or corrected vision without additional magnification.

These tests are not required to 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.

Annex DD
(normative)

Additional requirements for enclosures to accommodate multimedia and communication equipment

DD.1 Overview

This Annex DD specifies requirements for enclosures with separate area to accommodate multimedia and communication equipment. Multimedia and communication equipment typically include:

– RJ45 sockets
– coaxial (e.g. F-type) sockets
– optical network termination
– ethernet routers
– internet provider equipment
– Local Access Network (LAN) switches
– Digital Video Broadcasting (DVB) switches

The objective of this Annex DD is to ensure safety of the user when integrating, configurating or using multimedia and communication equipment.

This Annex DD does not specify requirements for the multimedia and communication equipment which shall comply with their product standard.

DD.2 Instructions

For enclosures intended to accommodate multimedia and communication equipment, the information provided in the manufacturer's instructions is recommended to be on the packaging or be marked on the enclosure itself.

DD.3 Protection against electric shock

Add a new item d) in Clause 10 as follows:

d) ensure that accessible conductive parts (e.g. mounting plates or frames) are insulated from live parts by double or reinforced insulation. The connection of these mounting plates or frames to the functional earth is allowed.

DD.4 Construction of separate area to accommodate multimedia equipment

Enclosures shall provide a separated area to accommodate the multimedia and communication equipment and their accessible cable and connection.

Metallic fixing means (e.g. fixing plate) of class II enclosures shall not be connected to the protective earthing. However, these means may be connected to the functional earth.

NOTE Connection of fixing means to functional earth is not a protective measure. It will not lead to a change of the equipment protection class.

Between the dedicated area for multimedia and communication equipment and the area used for protection devices, a minimum degree of IP2XC shall be required to protect against electrical shock.

The dedicated area to accommodate the multimedia equipment shall contain at least one socket-outlet to provide power supply to the installed equipment.

Accessible flexible cables to supply a socket-outlet shall comply with their relevant standards (e.g. IEC 60227-5, IEC 60245-4, IEC 60245-3, IEC 62821-3, or IEC 63010-1). Rigid cables shall comply with their relevant standards (e.g. IEC 60227-4).

Compliance is checked by inspection.

DD.5 Fixing of multimedia equipment

Add the following at the end of Clause 12:

The area to accommodate multimedia equipment shall provide suitable means for fixing the multimedia equipment. Their fixation shall not rely on the cables or connectors.

When connectors are accessible, it is recommended that the insertion and extraction of cables, connectors or plugs be straightforward and without obstacle, and that this insertion and extraction does not affect the equipment's fixing and stability.

Compliance is checked by inspection.

DD.6 Verification of temperature rise

Addition to Clause 102:

For enclosures with an area for the accommodation of multimedia equipment, the contribution of this multimedia equipment in terms of temperature rise is less onerous compared to the same area used for the integration of protection devices. Therefore, this area can be neglected for the purposes of the temperature rise, and no further tests are required.

Annex EE
(normative)

Additional requirements for enclosures for use with connected devices or equipment

EE.1 General

With the emergence of IoT, switchboards are concerned by new types of connected devices that must be used together with protection type devices.

These combinations of devices in switchboards are used, for example, for the purpose of energy management and monitoring, energy efficiency, remote or centralized management and control, diagnostic, and maintenance of equipment.

EE.2 Application

This Annex EE provides requirements for the integration of connected devices or equipment in an enclosure, in order to ensure the safety and proper functioning of the equipped enclosure when installed in an enclosure according to this document.

This Annex EE covers enclosures for use with connected devices or equipment classified according to 7.102.1 or 7.102.2 of this Annex EE.

EE.3 General requirements

This Annex EE does not replace the general requirements of this document and its Annex AA and Annex BB.

The safety and the best operation of a switchboard equipped with connected equipment or devices depends on:

– enclosure choice and classical devices dedicated to distribution and protection (general requirements),
– connected equipment or device and cable selection,
– assembly and cabling in accordance with rules,
– respect of instructions provided by the enclosure manufacturer and equipment or device manufacturer,
– verification of the proper functioning of connected equipment or devices through the design (by manufacturer for PD enclosure), the assembly and installation on site by installer.

EE.4 Additional classification

7.102 Enclosure for use with connected devices or equipment	7.102.1 Enclosure for use with connected devices or equipment GP
	7.102.2 Enclosure for use with connected devices or equipment PD

EE.5 Instructions

Manufacturers of connected enclosures classified according to 7.102.1 (GP) or 7.102.2 (PD) shall provide instructions for the proper incorporation of connected equipment or devices in addition to those required in Annex AA or Annex BB.

EE.6 Marking

When an enclosure classified according to 7.102.1 or 7.102.2 of this Annex EE does not require any adaptation or transformation to receive connected equipment or functions, no additional marking is required.

When an enclosure classified according to 7.102.1 or 7.102.2 of this Annex EE includes or contains dedicated features or is especially designed to prepare and facilitate accommodation of connected equipment or device, additional information can be provided in the technical documentation, instruction sheet, on the packaging or be marked on the enclosure.

EE.7 Construction requirements

EE.7.1 Selection and installation of connected equipment or devices

Connected equipment or devices incorporated in enclosures classified according to 7.102.1 or 7.102.2 of this Annex EE shall be compliant with their applicable product standard.

The arrangement of connected equipment in an enclosure shall be carefully organized to minimize any potential interference with other devices. The enclosure manufacturer is responsible for providing guidelines to prevent such issues.

If the placement of connected equipment or devices noticeably affects their performance, the enclosure manufacturer shall provide instructions to help optimize their operation.

EE.7.2 Equipotential functional earthing connection

When an enclosure is equipped with a functional earthing terminal, all functional earthing circuits of the connected switchboard shall be connected to it.

This functional earthing terminal shall be connected to the functional earthing bonding according to IEC 60364-5-54:2011/AMD1:2021, Clause 545.

EE.7.3 Cable selection and arrangement

Cables used for data transmission (e.g. Ethernet) shall be determined in accordance with ISO/IEC 11801-1 category 5 at least. Their features depend on performance targeted for the final network, the manufacturer instructions and the immunity requirement of the connected equipment or device.

In domestic environments, several types of data cables can be used depending on performance targets.

Examples of cables are unshielded twisted pair cable (UTP), foiled twisted pair cable (FTP), shielded twisted pair cable (STP), shielded and foiled twisted pair (F/STP).

Cables used for other applications shall conform to their respective standard (e.g. coaxial cables).

The quality of this protection depends on the effectiveness of the screen or shield. Functional earthing shall be established at one extremity of the metal screen or shield to enhance protection against low-frequency electric fields. For an improved protection, functional earthing shall be established at both extremities of the metal screen or shield for high frequency.

For electrical safety protection, any wiring system dedicated to data transmission shall be separated from the live parts of other circuits according to IEC 60364-4-41:2005, Clause 414.4.

A suitable distance between data wiring and power wiring shall be ensured to prevent electromagnetic pollution. Guidelines are given in ISO/IEC 14763-2.

Wiring paths should be optimized and be as short as possible, with the minimum radius respected.

EE.7.4 Interfaces

Enclosures equipped with or prepared for dedicated pre-connection interfaces between internal connected equipment or devices and external wired or wireless data network should comply with the following:

– when an interface containing metal parts (e.g. screen foil or shielding, antenna ground, etc.) crosses through the enclosure, insulation provisions shall comply with 10 b) of this document.
– when an interface is intended to supply external equipment with ELV, the access to this interface shall comply with IP2XC.

EE.8 Verification

EE.8.1 General

The verifications listed in this Annex EE address functional aspects. They help installers to prepare and set up a connected enclosure that meets the performance requirements within a household environment.

EE.8.2 Functional verification of the system

The manufacturer of an enclosure classified according to 7.102.2 (PD) who delivers an empty enclosure intended to be equipped with connected equipment or devices according to pre-determined compositions and configurations shall carry out relevant verifications to ensure the safety and functionality and provide the list of verifications to be carried out by the installer.

The verifications such as those listed below are carried out by the installer on the installation site for an enclosure classified according to 7.102.1 (GP) or 7.102.2 (PD):

– connected equipment or devices are correctly supplied and can operate (gateway, router, wireless network receiver, active switch, etc.),
– quality and reliability of wired connection or wireless,
– connectivity between the devices is operational,
– means intended to ensure visualization and monitoring are operational, if any,
– remote command or actions are operational, if any,
– remote settings of devices or parameters depending on technologies are operational, if any,
– measurement devices are operational, if any.

EE.8.3 Verification of maximum capability to dissipate power (P_{de})

Connected equipment or device integrated in an enclosure are assimilated to electronic equipment or device and their verification shall be carried out in accordance with the calculation method defined in Annex AA.

EE.8.4 Verification of temperature rise

When determining the most onerous case for the temperature rise verification it should be considered whether it is appropriate to carry out the temperature test with connected equipment or device if this would significantly influence the temperature test compared to conventional distribution or protection circuits.

EE.9 EMC aspects

When an installer equips an empty enclosure classified according to 7.102.1 (GP) or 7.102.2 (PD) with connected equipment or device for a dedicated fixed domestic electrical installation, no further verification is required if the installer conforms to the manufacturer's instructions for the installation of the enclosures, equipment or devices.

Bibliography

IEC 60227-4, *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V – Part 4: Sheathed cables for fixed wiring*

IEC 60227-5, *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V – Part 5: Flexible cables (cords)*

IEC 60245-3, *Rubber insulated cables – Rated voltages up to and including 450/750 V – Part 3: Heat resistant silicone insulated cables*

IEC 60245-4, *Rubber insulated cables – Rated voltages up to and including 450/750 V – Part 4: Cords and flexible cables*

IEC 60670-21, *Boxes and enclosures for electrical accessories for household and similar fixed electrical installations – Part 21: Particular requirements for boxes and enclosures with provision for suspension means*

IEC 60670-22, *Boxes and enclosures for electrical accessories for household and similar fixed electrical installations – Part 22: Particular requirements for connecting boxes and enclosures*

IEC 60670-23, *Boxes and enclosures for electrical accessories for household and similar fixed electrical installations – Part 23: Particular requirements for floor boxes and enclosures*

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 61084 (all parts), *Cable trunking systems and cable ducting systems for electrical installations*

IEC 62444, *Cable glands for electrical installations*

IEC 62821-3, *Electric cables – Halogen-free, low smoke, thermoplastic insulated and sheathed cables of rated voltages up to and including 450/750 V – Part 3: Flexible cables (cords)*

IEC 63010-1, *Halogen-free thermoplastic insulated and sheathed flexible cables of rated voltages up to and including 300/300 V – Part 1: General requirements and cables*

IEC 61439-3:2024, *Low-voltage switchgear and controlgear assemblies – Part 3: Distribution boards intended to be operated by ordinary persons (DBO)*

ISO/IEC 14763-2:2019, *Information technology – Implementation and operation of customer premises cabling – Part 2: Planning and installation*

IEC 60670-24

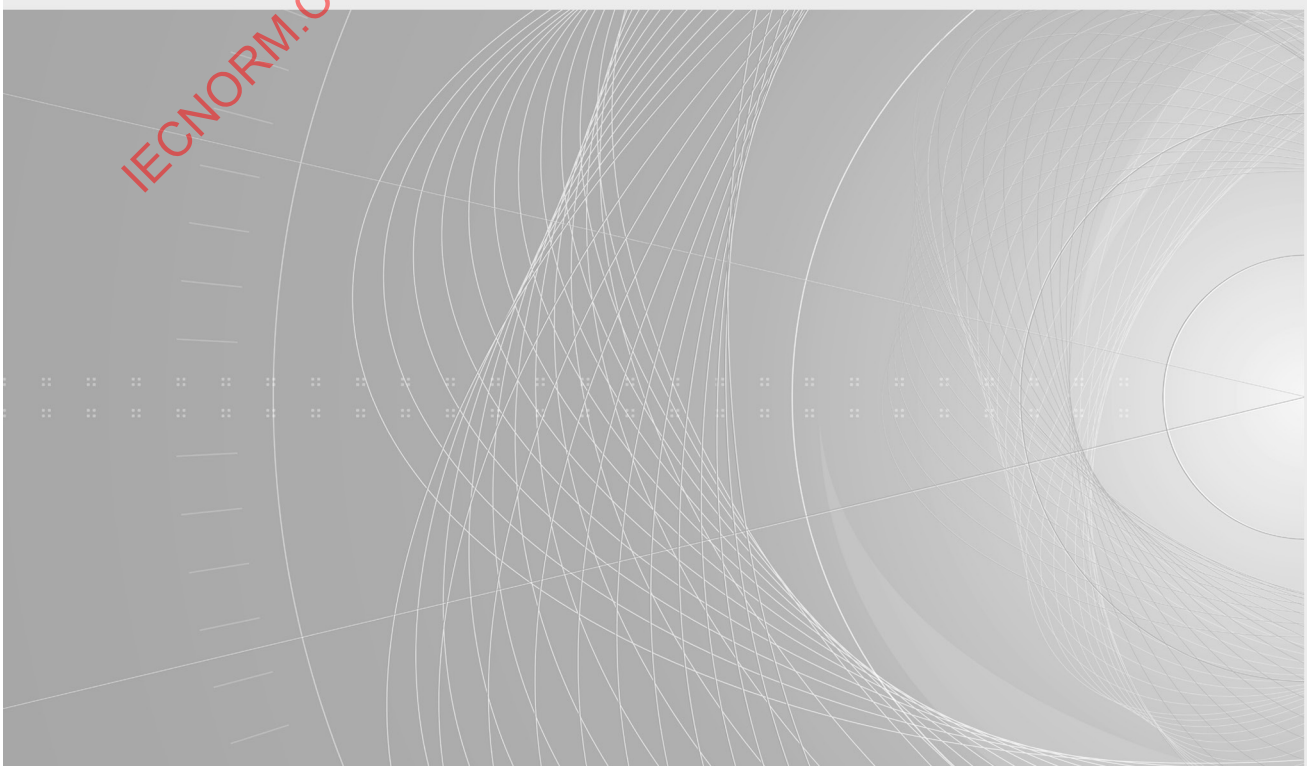
Edition 3.0 2024-12

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

Boîtes et enveloppes pour appareillage électrique pour installations électriques fixes pour usages domestiques et analogues –
Partie 24: Exigences particulières pour les enveloppes pour dispositifs de protection et autres matériels électriques ayant une puissance dissipée



IEC 60670-24:2024-12(en-fr)

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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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

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 60670-24 has been prepared by subcommittee 23B: Plugs, socket-outlets and switches, of IEC technical committee 23: Electrical accessories. 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) revision of requirements for protection against electric shock in Clause 10;
b) addition of requirements for functional earthing in 11.101;
c) revision of the requirements for fixing of flush type and semi-flush type enclosures in 12.12;

d) revision of the requirements for resistance of insulating material to abnormal heat and to fire in Clause 18;

e) addition of calculations to take into account the power loss of electronic devices in Clause AA.6;

f) addition of tests and requirements for enclosures exposed to direct sunlight with the related Annex CC;

g) addition of tests and requirements for enclosures with separate area to accommodate multimedia-equipment with the related Annex DD;

h) addition of tests and requirements for enclosures used with connected devices or equipment with the related Annex EE.

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

Draft	Report on voting
23B/1536/FDIS	23B/1554/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.

A list of all parts in the IEC 60670 series, published under the general title *Boxes and enclosures for electrical accessories for household and similar fixed installations*, can be found on the IEC website.

This document is to be used in conjunction with IEC 60670-1:2024. It lists the changes necessary to convert that standard into a specific standard for housing protective devices and other power dissipating electrical equipment.

Where this document states "addition", "modification" or "replacement", the relevant requirement, test specifications or explanatory matter in IEC 60670-1:2024 shall be adapted accordingly.

Clauses and subclauses, notes, figures or tables which are additional to those in IEC 60670-1:2024 are numbered starting from 101.

Additional annexes to IEC 60670-1:2024 are numbered AA, BB, etc.

In this publication the following print types are used:

- requirements proper: in roman type.
- *test specifications: in italic type.*
- notes: in smaller roman type.

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, or
- revised.

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

1 Scope

Replacement:

This part of IEC 60670 applies to enclosures and parts of them for housing protective devices and other power dissipating electrical equipment intended to be used with a rated voltage not exceeding 400 V and a total incoming load current not exceeding 125 A for household and similar fixed electrical installations.

These enclosures are intended to be installed in locations where unskilled persons have access. They are intended to be equipped with electrical equipment by skilled persons (installers).

These enclosures are intended to be installed where the prospective short circuit current does not exceed 10 kA unless they are protected by current limiting protective devices with a cut-off current not exceeding 17 kA.

Enclosures complying with this document are suitable for use at ambient temperature not normally exceeding 40 °C, but their average temperature over a period of 24 h does not exceed 35 °C, with a lower limit of the ambient air temperature of −5 °C.

An enclosure which is an integral part of an electrical accessory and provides protection against external influences (e.g. mechanical impacts, ingress of solid objects or of water), is covered by the relevant standard for such an accessory.

This document does not apply to a low-voltage switchgear and controlgear assembly as defined in the IEC 60439 series or IEC 61439 series nor to a main entrance panel which can be part of the distribution board.

This document does not apply to surface type boxes, flush and semi-flush type boxes suitable for the housing of accessories for household and similar use such as switches, electronic switches, socket-outlets, which are covered by IEC 60670-1 only.

NOTE 1 Enclosures according to this document are mainly used for distribution board for housing protective devices and other power dissipating electrical equipment and are installed at the beginning of the electrical circuit whereas boxes according to IEC 60670-1 are installed at the end of it.

NOTE 2 A main entrance panel is a set composed of a panel or an enclosure equipped with a meter and/or the main incoming device. Main entrance panels comply with their appropriate standards or the requirements of the local supplier, if any.

NOTE 3 In the following country this document cannot be used in installations with a 230 V single-phase supply rated up to 100 A that is under the control of ordinary persons. Integration of mechanical and electrical devices into an enclosure must be verified by compliance with IEC 61439-3 [British standard EN 61439-3]: UK.

NOTE 4 In the following country this document can only be used for GP enclosures with the instructions according to Annex A. For the other types of enclosures the integration of mechanical and electrical devices into an enclosure is verified by compliance with DS EN 61439-3: DK.

2 Normative references

Addition:

IEC 60364-4-41:2005, *Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock*
IEC 60364-4-41:2005/AMD1:2017

IEC 60364-5-54:2011, *Low-voltage electrical installations – Part 5-54: Selection and erection of electrical equipment – Earthing arrangements and protective conductors*
IEC 60364-5-54:2011/AMD1:2021

IEC 60664-1, *Insulation coordination for equipment within low-voltage supply systems – Part 1: Principles, requirements and tests*

IEC 60898-1, *Electrical accessories – Circuit-breakers for overcurrent protection for household and similar installations – Part 1: Circuit-breakers for a.c. operation*

IEC 61008-2-1, *Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCB's) – Part 2-1: Applicability of the general rules to RCCB's functionally independent of line voltage*

IEC 61009-2-1, *Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBO's) – Part 2-1: Applicability of the general rules to RCBO's functionally independent of line voltage*

ISO/IEC 11801-1:2017, *Information technology – Generic cabling for customer premises – Part 1: General requirements*

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 4892-2:2013, *Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc lamps*
ISO 4892-2:2013/AMD1:2021

3 Terms and definitions

Additions:

3.101
general purpose enclosure
GP enclosure
enclosure where integration of mechanical and electrical devices has been verified by tests carried out by the manufacturer according to this document and where the installer has to verify the installed equipment according to the instructions given in Annex AA

3.102
enclosure for pre-determined equipment
PD enclosure
enclosure where the capability to integrate pre-determined mechanical and electrical equipment has been verified according to design rules and tests according to this document carried out by the manufacturer where the installer has to verify the installed equipment following the manufacturer's instructions according to Annex BB

3.103
manufacturer's instructions
instructions in accordance with Annex AA and Annex BB leading to a configuration of the enclosure ensuring the necessary heat dissipation

Note 1 to entry: References to standards can be given in the manufacturer's instructions.

3.104
maximum capability to dissipate power
P_{de}
maximum capability of the enclosure to dissipate in normal use the power losses of the installed devices, as declared by the manufacturer

Note 1 to entry: P_{de} is expressed in watts (W).

3.105
rated current
I_n
maximum current assigned by the manufacturer of the enclosure which can be distributed by the enclosure

3.106
blanking plate
component used for closing the opening, for protective devices and other power dissipating electrical equipment, of an enclosure to provide basic insulation

3.107
enclosures with separate area to accommodate multimedia and communication equipment
enclosure providing an area where multimedia and communication equipment are intended to be integrated according to the additional requirements given in Annex DD

Note 1 to entry: An enclosure with separate area to accommodate multimedia and communication equipment can be a GP or PD enclosure.

3.108
enclosure for use with connected devices or equipment
enclosure intended to accommodate protection devices, electrical equipment dissipating power and connected devices or equipment according to the additional requirements given in Annex EE

Note 1 to entry: An enclosure for use with connected devices or equipment can be a GP or PD enclosure.

3.109
connected devices or equipment
physical unit that can connect with other units into an interconnected infrastructure

Note 1 to entry: This physical unit can operate and communicate with the physical world through detection and action. Such equipment or device allows the switchboard to participate in this IoT infrastructure.

3.110
rated current of the equipped GP enclosure
I_{nq}
rated current to be calculated as Ine multiplied by Ke

Note 1 to entry: In the absence of incoming protective and control devices, the rated current of the equipped GP enclosure is the outgoing rated current (I_{nu}).

3.111
incoming rated current
I_{ne}
rated current or sum of the rated currents of all incoming protective and control devices, expected to be used at the same time

3.112
outgoing rated current
I_{nu}
sum of the rated currents of all outgoing protective and control devices, expected to be used at the same time

3.113
utilisation factor
K_e
ratio of the actual current flowing through any main incoming protective device inside the enclosure to the rated current of this device

Note 1 to entry: The utilisation factor for incoming circuits is assumed to be 0,85.

3.114
diversity factor
K
ratio, calculated by the installer, of the rated current of the equipped GP enclosure (I_{nq}) to the outgoing rated current (I_{nu})

4 General requirements

Clause 4 of IEC 60670-1:2024 is applicable.

5 General notes on tests

Clause 5 of IEC 60670-1:2024 is applicable.

6 Ratings

Replacement:

Rated values are defined as given in Annex AA and Annex BB.

7 Classification

Clause 7 of IEC 60670-1:2024 is applicable with the following modifications:

Table 1 – Classification of boxes and enclosures

Classification criteria 7.2.2.2, 7.2.2.3, 7.8.1 and 7.9 do not apply.

Addition:

7.101 Enclosure	7.101.1 GP enclosure	
	7.101.2 PD enclosure	
NOTE 101 In the following countries only enclosures classified according to 7.101.2 can be used: BE, DE, FR and GR. NOTE 102 In the following country only enclosures according to 7.101.1 can be used: DK.		

8 Marking

Clause 8 of IEC 60670-1:2024 is applicable with the following modifications:

Replacement:

8.1 General

Enclosures shall be marked with

a) the name, trade mark or identification mark of the manufacturer or the responsible vendor;

b) IP code against ingress of solid foreign objects and against access to hazardous parts if higher than IP3X and/or if IP code against harmful ingress of water is higher than IPX0.

The IP code, if applicable, shall be marked on the outside of the enclosure so as to be easily discernible when the enclosure is mounted and wired as for normal use. The visibility of the marking is also possible after opening the door or the lid if a minimum degree of IP20 is maintained after opening;

c) the symbol for class II protection, if applicable (IEC 60417-5172 (2003-02))  ;

d) type designation, reference number or catalogue number;

e) letter N for terminals intended exclusively for the neutral conductor, if any;

f) symbol  according to IEC 60417-5019 (2006-08) for earthing terminals for the connection of the protective conductor, if any, and/or symbol  according to IEC 60417-5018 (2011-07) for functional earthing terminal for the connection of the functional earthing, if any.

Markings of neutral terminals and earthing terminals shall not be placed on screws, or any other easily removable parts.

NOTE 1 Easily removable parts are those parts which can be removed during the normal installation of the enclosure.

The following information shall be marked on enclosures or provided by the manufacturer on the smallest package unit or in the manufacturer's instructions, which are not required to be provided with the product:

g) rated voltage;

NOTE 2 For three-phase systems, the combined voltage values can be considered e.g. 230/400 V.

h) rated current as declared by the manufacturer for enclosures classified according to 7.101.2;

i) reference number of this document i.e. IEC 60670-24;

j) information for parts of enclosures intended to withstand +90 °C during the casting process of concrete into shuttering according to classification 7.2.1.3;

k) for enclosures classified according to 7.3.7 (without inlets), the necessary information concerning the openings that can be made during installation;

l) for enclosures classified according to 7.101.1, the maximum capability to dissipate power (P_{de});

In the case of an enclosure designed with ventilation openings that can be closed, for example with an accessory, the maximum capability to dissipate power (P_{de}) shall be declared by the manufacturer, for both closed and open positions.

m) for enclosures classified according to 7.2.2, their usability or not for installation in hollow walls, hollow ceilings, hollow floors or furniture;

n) the corresponding dimension sheet, if any;

p) for enclosures classified according to

- 7.101.1 the marking "GP";
- 7.101.2 the marking "PD";

q) IK-code if declared.

Addition:

8.101 Required information for instruction sheet and/or documentation

The manufacturer shall:

– provide appropriate instructions regarding the means (for instance glands, grommets, barriers, etc.) to be used to obtain the intended degree of protection;

– give information to the installer concerning the verification of the electrical continuity of the protective circuit (see Clause 11);

– give the installer the necessary instructions:

- for enclosures classified according to 7.101.1, the manufacturer shall include in the documentation the necessary instructions for installation and how to integrate accessories as given in Annex AA;
- for enclosures classified according to 7.101.2, the manufacturer shall include in the documentation the necessary instructions for installation according to the appropriate mounting environment as given in Annex BB.

9 Dimensions

Clause 9 of IEC 60670-1:2024 is applicable.

10 Protection against electric shock

Clause 10 of IEC 60670-1:2024 is replaced by following:

Enclosures shall have a degree of protection of at least IPXXC according to IEC 60529, when mounted and installed as for normal use, according to the manufacturer's instruction.

Enclosures are tested completed with the necessary means (such as grommets, etc.) indicated in the manufacturer's instructions and the window opening(s), if any, completely filled up with blank inserts delivered by the manufacturer and/or samples of products as declared by the manufacturer.

If doors or covers of the enclosure can be opened without the use of a key or tool, they shall be left open during the test.

Compliance is checked by the following tests.

Tests shall be carried out on parts which are accessible after installation.

The test shall be carried out in accordance with IEC 60529 where probe C of IEC 61032:1997 is applied to all places including knock-outs except membranes or the like, where yielding of insulating material could impair the safety, with a force of 3 N.

In addition, enclosures having class II protection, when mounted and installed as for normal use, shall:

a) cover live parts of the installed equipment with insulation material, and

b) at no point be pierced by conducting parts in such a manner that there is a possibility of a fault voltage being brought out of the enclosure, and

c) not have conductive parts, such as plates, cover-plates or frames connected to the protective circuit.

Compliance is checked by inspection.

11 Provisions for earthing

Clause 11 of IEC 60670-1:2024 is applicable with the following modifications:

Subclauses 11.1 to 11.3 are not applicable for enclosures with class II protection.

Add the following subclauses:

11.101 The electrical continuity of the protective circuit, if any, shall be checked.

Except for enclosures having class II protection, all exposed conductive parts of the enclosure shall be connected separately or in groups to the protective circuit terminals.

Compliance is checked by inspection and, if necessary, by a continuity test of the protective circuit.

A measurement shall be carried out to verify that the resistance between the terminal of the incoming protective conductor and the exposed conductive parts shall be less than 0,05 Ω with a current of 10 A AC or 10 A DC.

11.102 Functional earthing

In order to ensure the robustness of the functional earthing conductor, if any, the minimum cross-sectional area shall be at least 1,5 mm^2. The colour of the functional earthing conductor shall be pink (see IEC 60445).

Compliance is checked by inspection.

12 Construction

Clause 12 of IEC 60670-1:2024 is applicable with the following modifications:

12.2 Lids, covers or cover-plates or parts of them

Replacement of the first paragraph:

Lids, covers, cover plates or parts of them, which are intended to ensure protection against electric shock, shall be held in place effectively. They shall be removable only by the use of a tool and/or a key.

12.2.3 Non-screw-type fixing operable without the use of a tool or a key

Addition at the end of the subclause of following sentence:

"This Subclause 12.2.3 is not applicable for blanking plates."

12.2.4 Non-screw-type fixing operable with the use of a tool or a key

Addition at the end of the subclause of following sentence:

"This Subclause 12.2.4 is not applicable for blanking plates."

12.12 Fixing of flush type and semi-flush type enclosures classified according to 7.2.2.1

Replacement:

Enclosures for hollow walls classified according to 7.2.2.1 shall provide suitable means for fixing the enclosure to hollow walls.

Compliance is checked by the following test.

A specimen of the enclosure is mounted in a test wall in accordance with the manufacturer's instructions. Where the manufacturer's instructions are not specific regarding the type of wall, a sheet of plywood (10 ± 1) mm thick is used.

The enclosure is subjected to a force F of 100 N applied on the main axis of the enclosure perpendicular to the mounting surface. Alternatively, the force can be applied by pushing through a testing means which distributes evenly this force at the rear of the enclosure.

After this test, the specimens shall show no damage impairing their further use. and the enclosure shall not have been displaced by more than 2 mm in comparison to the mounting surface.

Addition:

12.101 Enclosures for hollow walls shall have provisions for retention means for cables or means to use a separate retention device or devices.

NOTE 101 In the following country, cables are retained using fixing means applied during installation by the installer: UK.

Compliance is checked by inspection.

12.102 Enclosures shall have enough space to allow mounting and connection of the accessories (fully equipped) as declared by the manufacturer, in safe way.

Compliance is checked by inspection and in case of doubt by manual test using samples of products as declared by the manufacturer and complying with the relevant standard, if any.

Any generally available conductors having the largest nominal cross-sectional area as declared by the manufacturer shall be used.

13 Resistance to ageing, protection against ingress of solid foreign objects and against harmful ingress of water

Clause 13 of IEC 60670-1:2024 is applicable with the following modification:

13.2 Protection against the ingress of solid foreign objects

Replacement of the first paragraph:

Enclosures shall provide a degree of protection of at least IP3X against the ingress of solid foreign objects in accordance with their declared IP code with the lid closed, if any.

In the case of an enclosure with a door or a lid which can be opened without the use of a tool during normal use, a minimum degree of IP20 shall be maintained after opening the door or the lid.

NOTE In the following countries in the case of an enclosure with a door or a lid which can be opened without the use of a tool during normal use, a minimum degree of IP30 shall be maintained after opening the door or the lid: DE, DK.

14 Insulation resistance and electric strength

Clause 14 of IEC 60670-1:2024 is applicable.

15 Mechanical strength

Clause 15 of IEC 60670-1:2024 is applicable.

Addition:

15.101 Additional requirements for enclosure exposed to direct sunlight

If enclosures are declared to be resistant to UV radiation, the UV test and the relevant mechanical test shall be carried out in accordance with Annex CC.

This test applies only to boxes and enclosures classified according to 7.1.1, 7.1.3 and 7.1.4.

16 Resistance to heat

Clause 16 of IEC 60670-1:2024 is applicable.

17 Creepage distances, clearances and distances through sealing compound

Replacement:

Creepage distances, clearances and distances through sealing compound shall not be less than the value shown in Table 101.

Table 101 – Creepage distances, clearances and distances through sealing compound

Working voltage[a] V	Creepage distance, clearance and distance through sealing compound mm	Alternative impulse voltage test (1,2/50 µs) according to IEC 60664-1 for clearances kV (at 2 000 m)
130	1,5	2,5
> 130 and ≤ 250	3,0	4
> 250 and ≤ 400	4,0	5
[a] Depending on the effective voltage between the considered parts. NOTE The values of clearance and creepages are given based on overvoltage category III.		

Compliance is checked by measurement between the following parts:

Creepage distances and clearances:

– *between live parts of different polarity;*
– *between live parts and*
  - *metal covers and enclosures without insulating lining;*
  - *the surface on which the enclosure is mounted.*

Distances through sealing compound:

– *between live parts covered with sealing compound and the surface on which the enclosure is mounted.*

For multi-way terminal devices and terminals without fixing means but with protection, distances are measured between live parts and any opening which represents the closest point liable to touch any other part when the terminal is fitted with conductors having the largest cross-sectional area.

In cases where various terminals or connecting devices may be mounted in the enclosure, the most unfavourable combinations shall be tested.

If the values for the clearance distances are smaller than those defined in Table 101, the requirement shall be met by the impulse voltage withstand test in accordance with the values in Table 101.

18 Resistance of insulating material to abnormal heat and to fire

Clause 18 of IEC 60670-1:2024 is applicable with the following modifications:

Replacement of the bullet points by the following:

– By the test made at 960 °C
  - for parts of insulating material necessary to retain current-carrying parts in position.
– By the test made at 850 °C
  - for parts of insulating material, necessary to retain parts of the earthing circuit in position (with the exception of parts of insulating material needed to retain the earth terminal in position in an enclosure), and
  - for parts of insulating material of enclosures classified according to 7.2.2, with the exception of parts protruding from the wall and internal parts of the enclosure (e.g. separator) not necessary to retain current carrying parts in position.
– By the test made at 650 °C
  - for parts of insulating material not necessary to retain current-carrying parts in position (even though they are in contact with them), and
  - for parts of insulating material retaining earthing terminal in position;
  - for parts of insulating material of enclosures classified according to 7.2.2, protruding from the wall and internal parts of enclosure (e.g. separator) not necessary to retain current carrying parts in position.

NOTE 1 Accessories complying with other standards, e.g. connecting devices incorporated but not integrated into the enclosure, are not considered as part of the enclosures.

NOTE 2 Examples of parts protruding from the wall but that can be partially in the wall are doors, cover plates, latches or similar.

19 Resistance to tracking

Clause 19 of IEC 60670-1:2024 is applicable.

20 Resistance to corrosion

Clause 20 of IEC 60670-1:2024 is applicable.

21 Electromagnetic compatibility

Clause 21 of IEC 60670-1:2024 is applicable.

Addition:

101 Verification of the maximum capability to dissipate power (P_{de})

Enclosures according to 7.101.1 shall fulfil the following requirements and tests.

These enclosures shall have the capability to dissipate the declared power (P_{de}) according to 8.1 l).

Compliance is checked by the following test.

The maximum capability to dissipate power is determined using heating resistors.

NOTE 101 The test simulates the power dissipated by devices when mounted and wired in the intended circuit as for normal use.

The test is carried out on specimens equipped with the heating resistor fitted in the most unfavourable position.

NOTE 102 For example, the different positions of a rail, etc.

The cross-sectional area of the conductors for the connection of the heating resistors shall be 1,5 mm^2 and the opening for this cable is sealed, if needed.

Other openings for cables, if any, and for devices, are closed as in normal use.

For enclosures according to 7.2.1.1 and 7.2.2.1 the test is carried out with the specimen mounted as declared by the manufacturer.

For enclosures according to 7.2.3 the specimen is mounted on a minimum 19 mm thick plywood painted black.

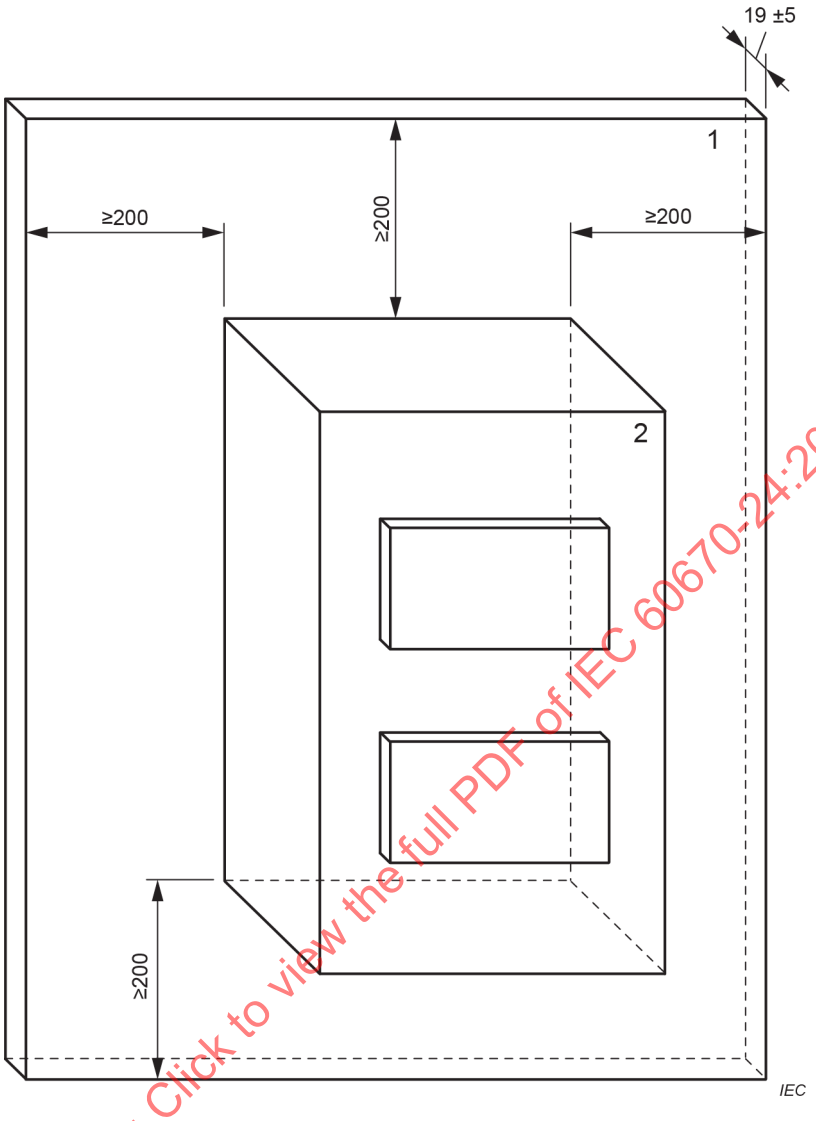
For enclosures according to 7.2.1.2 and 7.2.1.3 the test is carried out with the specimen cast in a concrete wall of thickness not less than 100 mm on each surface; it is permitted to cast the specimen in walls of different material, with equivalent thermal conductivity.

The test in concrete represents the conventional mounting condition.

For declared mounting conditions other than in concrete the manufacturer shall declare the appropriate P_{de} value in the documentation according to the declared mounting condition.

A distance of at least 200 mm is provided between each surface of the specimen and the relevant edge of the test surface (Figure 101).

Dimensions in millimetres



Key

1 plywood

2 enclosure

Figure 101 – Arrangement for the verification of the maximum capability to dissipate power (P_{de}) and for verification of temperature rise of surface type enclosures

A heating resistor (Figure 102) with uniformly distributed winding on an insulating support (such as mica) is placed into the specimen under test.

Dimensions in millimetres

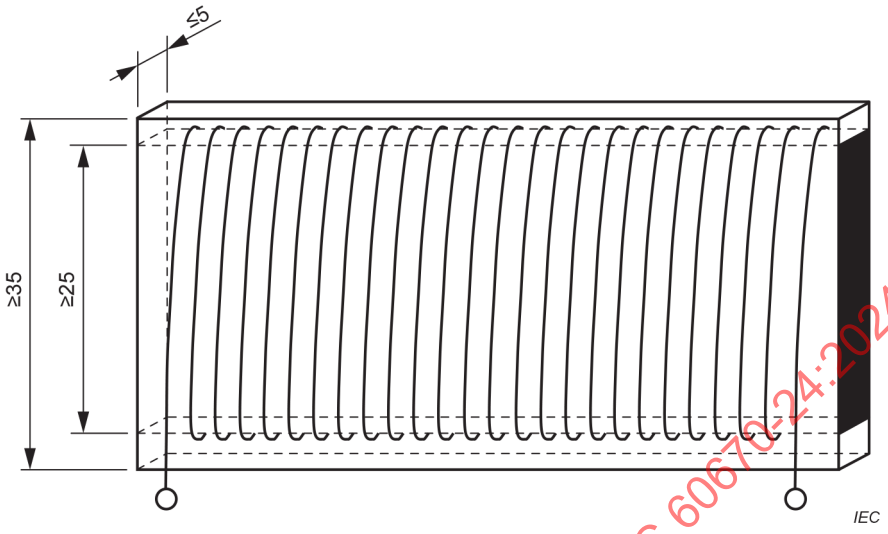
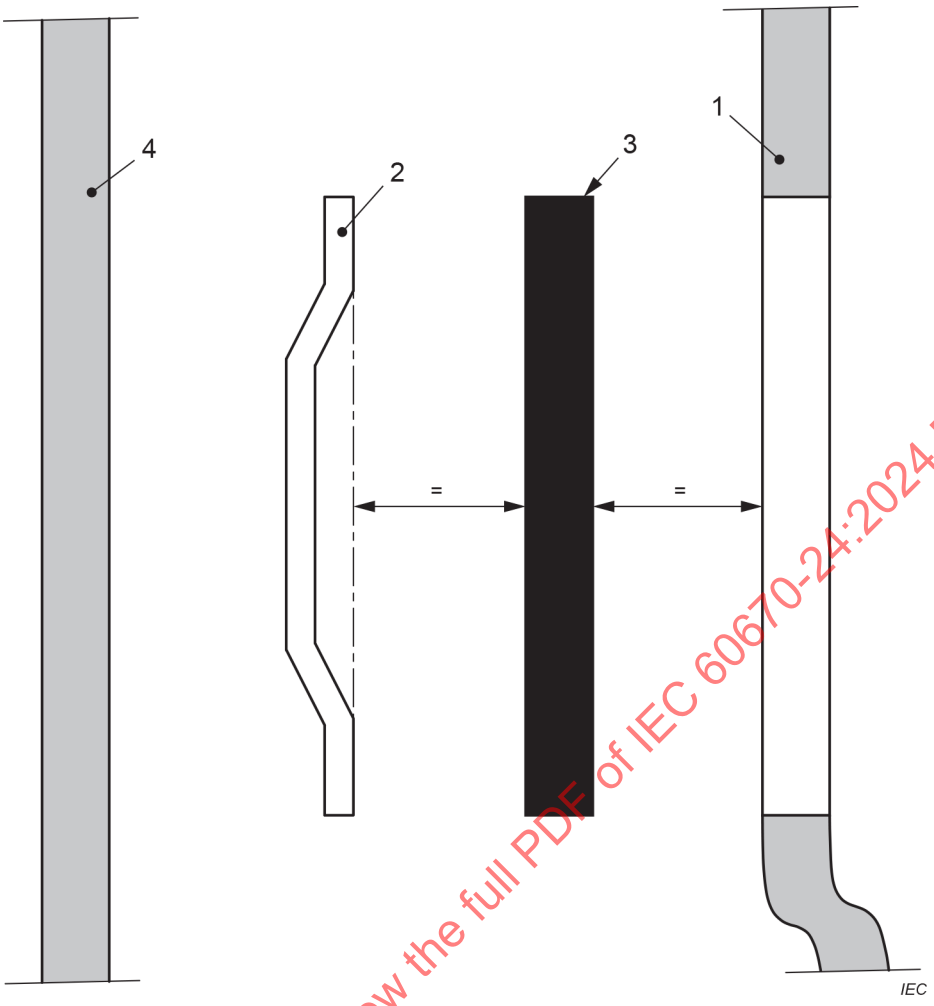


Figure 102 – Heating resistor for the verification of the maximum capability to dissipate power (P_{de})

The winding and the insulating support shall provide a uniform thermal flow.

For enclosures intended to be fitted with rail mounting accessories and electrical equipment, the heating resistor is located at half the distance between the rail and the window, as shown in Figure 103.



Key

1 door, lid or cover

2 rail for rail mounting accessories and electrical devices

3 resistor

4 rear surface of the enclosure

= +/- 5 mm

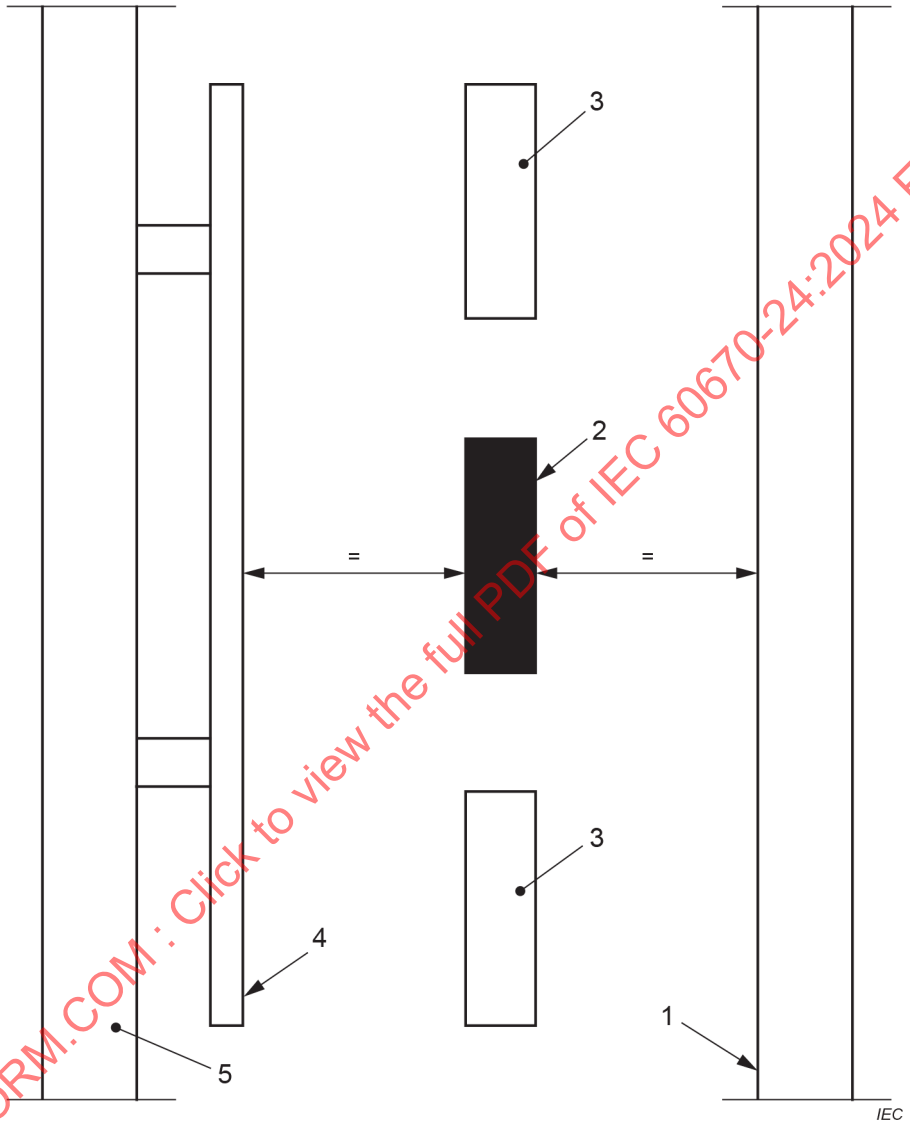
Figure 103 – Position of the resistor for enclosures designed or intended to be fitted with rail mounting modular accessories and electrical equipment

If there is more than one row of rail mounting accessories and electrical equipment, the test is carried out by equalising the power loss on all rows using equal heating resistors on each row.

The heating resistor(s) length is (are) equal to the length of the window(s) with a tolerance of 0 mm to 10 mm. The window or windows are closed with their own blank covers provided by the manufacturer.

For enclosures other than those intended to be fitted with modular devices, the heating resistor is located at half the distance between the door or lid and the inner bottom surface of the specimen (or the mounting surface for the device intended by the manufacturer) as shown in Figure 104. The distance of the heating resistor(s) ends from the lateral and from the upper and lower edges of the mounting surface shall be equal to (50 ± 5) mm.

If the dimensions of the specimen allow the mounting of several devices in different positions, the test is carried out by equalising the power loss using equal heating resistors mounted as shown in Figure 104 and Figure 105, and the distance between the heating resistors being (90 ± 5) mm, the distance of the heating resistor(s) from the upper and lower edge of the mounting surface of the specimen being not be less than 50 mm as shown in Figure 105.



Key

1 door, lid or cover

2 resistor

3 resistors, if more than one

4 mounting plate

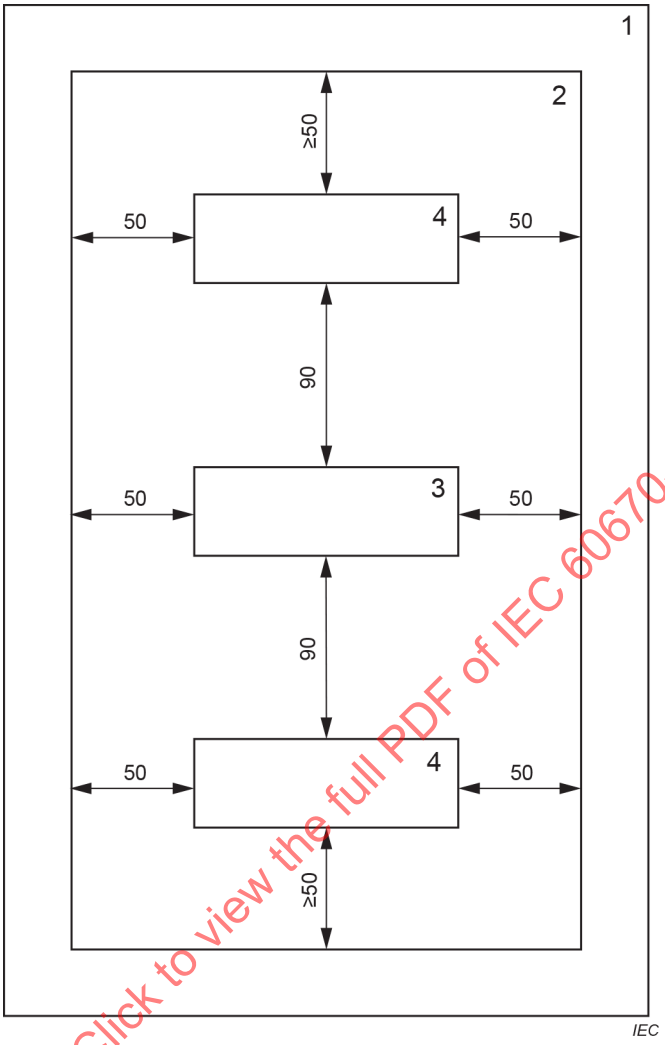
5 rear surface of the enclosure

= +/- 5 mm

Figure 104 – Position of the resistor(s) for enclosures other than those designed or intended to be fitted with rail mounting accessories and electrical equipment

Dimensions in millimetres

Tolerance ± 5 mm



Key

1 enclosure

2 mounting surface

3 resistor

4 resistors, if more than one row

Figure 105 – Position of the resistor(s) for enclosures other than those designed or intended to be fitted with rail mounting accessories and electrical equipment and allowing the mounting of several accessories and electrical equipment in different positions

The temperature rise of the accessible parts of the enclosure or of parts that can become accessible during normal use, including the blank covers, if any, is measured. This test shall be performed with the door or lid, if any, closed.

The current passing through the heating resistor is such that the temperature at the hottest point of the heating resistor(s) is not greater than 200 °C, and the temperature rise measured in a steady state condition (variation less than 1 K/h) on the hottest accessible part shall not be greater than 30 K. The power dissipated by the heating resistor(s) is then measured.

The value rounded to the next lower integer number shall not be less than the declared value of the maximum capability of the dissipated power (P_{de}).

After the test, the enclosure shall show no damage or deformation which would impair its further use.

102 Verification of temperature rise

Enclosures according to 7.101.2 shall fulfil the following requirements and tests.

These enclosures shall have an acceptable temperature rise when equipped with the most onerous configuration of electrical equipment declared by the manufacturer.

Compliance is checked by the following tests.

The temperature rise test is performed with an enclosure arranged as follows.

The enclosure shall be equipped and mounted as in normal use, including electrical devices, lids, covers, doors, connections, terminals, etc., according to the manufacturer's instructions.

The thermometers or thermocouples for the measure of the internal and ambient temperatures shall be installed at appropriate locations and protected against air currents and heat radiation.

For enclosures according to 7.2.1.1 and 7.2.2.1 the test is carried out with the specimen mounted as indicated in the manufacturer's instructions.

For enclosures according to 7.2.3 the specimen is mounted on a minimum 19 mm thick plywood painted black.

For enclosures according to 7.2.1.2 and 7.2.1.3 the test is carried out with the specimen cast in a concrete wall of thickness not less than 100 mm on each surface; it is permitted to cast the specimen in walls of different material, with equivalent thermal conductivity.

The test in concrete represents the conventional mounting condition.

For declared mounting conditions other than in concrete the manufacturer shall declare a correction factor in the documentation according to the declared mounting condition.

A distance of at least 200 mm is provided between each surface of the specimen and the relevant edge of the test surface (Figure 101).

The test shall be carried out for a time sufficient for the temperature rise to reach a constant value. In practice, this condition is reached when the variation does not exceed 1 K/h.

The specimen is loaded with its rated current (I_n). This current shall be distributed amongst the smallest possible number of outgoing circuits, with a minimum of two, so that each of these circuits is loaded with its rated current multiplied by the rated diversity factor, as stated in Table 102. In the case where the exact total load cannot be obtained by a number of devices loaded to this current, only the last loaded circuit shall be loaded to a lower value to give the correct total.

When only one incoming device is possible, the specimen is loaded at I_n with one device. The device rating is selected taking into consideration the diversity factor as given in Table 102 and the value adjusted to the closest higher rating.

NOTE As an example, a 50 A enclosure would be tested with a 63 A device.

Table 102 – Diversity factor

Number of main circuits	Diversity factor K
1, 2 and 3	0,8
4 and 5	0,7
6 to 9	0,6
10 and more	0,5

After the test, the enclosure shall show no damage which would impair its further use.

The temperature rise measured on the terminals for external conductors of the outgoing devices shall not exceed the values defined in the relevant standard in a steady-state condition (variation less than 1 K/h).

The temperature of the accessible surfaces of the enclosure shall not exceed the values as given in Table 103.

Table 103 – Temperatures of accessible surfaces

Accessible external enclosures and covers:	Temperature rise K
– metal surfaces	30
– insulating surfaces	40

Annex AA
(normative)

Instructions to be given by the manufacturer of the GP enclosure to the installer on how to integrate accessories, and providing an example of calculation

AA.1 Selection of the GP enclosure

In the field of household and similar applications, an installer takes into consideration different configurations of suitable equipment on site by choosing from a large variety of components such as protective devices, switches, transformers, etc., available on the market.

When selecting components for incorporation in these enclosures the component power loss characteristics should be used as illustrated in this Annex AA.

The following equivalence shall be verified by the installer to select the correct GP enclosure in which to integrate protective devices and other power dissipating electrical equipment to make an equipped GP enclosure and make sure that the temperature rise measured on the hottest accessible part of the equipped GP enclosure shall not be greater than 30 K:

$$P_{tot} \leq P_{de}$$

where

P_{de} is the maximum capability of the enclosure to dissipate power, in watts, declared by the manufacturer in normal use;

P_{tot} is the total power loss of the electrical accessories and protecting devices to be incorporated into the GP enclosure and their connections calculated as follows:

$$P_{tot} = P_{dp} + 0{,}2\ P_{dp} + P_{au} + P_{el} + 0{,}2\ P_{el}$$

where

P_{dp} is the power loss of the protective devices;

$0{,}2\ P_{dp}$ is the increase of P_{dp} to consider power lost by connections, socket-outlets, relays, time delay switches, small appliances;

P_{au} is the power loss of electrical accessories, other than the previous ones (for example transformers, socket-outlets, signal lamps, etc.);

P_{el} is the power loss of electronic accessories, in watts, taking into account the utilization factor (K_e) for multi-way devices;

$0{,}2\ P_{el}$ is the increase of P_{el} to consider power lost by connections of the power circuit of electronic devices;

P_{dp} is calculated as follows:

$$P_{dp} = \sum p_e \times P_e \times K_e^2 + \sum p_n \times P_n \times K^2$$

where

p_e is the number of poles of the devices of the incoming circuits;

P_e is the dissipated power for each pole of the device of the incoming circuits;

K_e = 0,85;

P_n is the number of poles of the devices inside the enclosure except those of the incoming circuits;

P_n is the dissipated power for each pole of the devices inside the enclosure except those of the incoming circuits;

K is the value (≤ 1) depending on the contemporary use of the connected loads.

Compliance is checked by calculation.

NOTE An example is given in Clause AA.5.

AA.2 Diversity factor

In the absence of information concerning the actual currents, the conventional values of K as specified in Table AA.1 may be used.

Table AA.1 – Diversity factor

Number of main circuits	Diversity factor K
2 and 3	0,8
4 and 5	0,7
6 to 9	0,6
10 and more	0,5

AA.3 Markings

The following markings shall be given on the equipped GP enclosure:

- Name or identification of the installer,
- Type reference or other means used by the installer to identify the equipped GP enclosure,
- Rated current (I_{nq}) in amperes,
- Rated voltage in volts,
- Symbol for nature of supply,
- Degree of protection of the equipped GP enclosure,
- Symbol for class II protection, if applicable,
- Letter N for terminals intended exclusively for the neutral conductor,

- Symbol  according to IEC 60417-5019 (2006-08) for earthing terminals for the connection of the protective conductor.

These markings shall be placed on a label, that may be placed also behind the lids or doors and shall be durable and easily legible.

These markings shall not be placed on screws, or any other easily removable parts.

NOTE Easily removable parts are those parts which can be removed during the normal installation of the equipped GP enclosure.

The installer shall provide the following information on the documentation which accompanies the equipped GP enclosure:

– declaration of conformity that the equipped GP enclosure is made according to the relevant requirements,
– information concerning the calculation made (not required for equipped GP enclosure single phase having a $I_{nq} \leq 32$ A).

AA.4 Test and verification to be carried out by the installer

AA.4.1 General

Electrical accessories (protective devices, switches, time-delay switches, transformers, terminals, etc.) shall comply with their relevant standards, if any.

For electrical accessories not covered by a standard, refer to their manufacturer's instruction sheets.

Tests and verification shall be performed on the equipped GP enclosure (including lids, covers, doors, protective devices and similar power consuming devices, etc.), wired and mounted as for normal use, as indicated in Table AA.2.

Table AA.2 – Tests and verifications

Clause	Characteristics	Tests and verifications
	Identification	Inspection of the marking and of the compliance of the equipped GP enclosure with the wiring diagrams, etc.
AA.4.2	Protection by class II	Verification of the protection by class II protection requirements
AA.4.3	Effectiveness of the protective circuit	Verification and test of the effectiveness of the protective circuit
AA.4.4	Wiring, mechanical operation and, if necessary, electrical operation	Verification of the correct wiring, mechanical operation and, if necessary, electrical operation tests
AA.4.5	Resistance to ageing, protection against ingress of foreign solid objects and against harmful ingress of water	Verification of protection against ingress of foreign solid objects and against harmful ingress of water
AA.4.6	Insulation resistance	Test of the insulation resistance
	Temperature rise limits	Covered by calculation according to this Annex AA

AA.4.2 Protection by class II

For protection, by total insulation, against indirect contact, the following requirements shall be met.

a) The live parts of accessories shall be covered with insulating material.

b) The GP enclosure shall be made of an insulating material which is capable of withstanding the mechanical, electrical and thermal stresses to which it is liable to be subjected under normal use and it shall be resistant to ageing.

c) The GP 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 GP enclosure.

   This means that metal parts, such as an actuating member which for constructional reasons must be brought through the GP enclosure, shall be insulated on the inside or the outside of the GP enclosure from the live parts for the maximum rated insulation voltage and, if applicable, the maximum rated impulse withstand voltage of all circuits in the equipped GP enclosure.

   If an actuating member is made of metal (whether covered by insulating material or not), it shall be provided with insulation rated for the maximum rated insulation voltage and, if applicable, the maximum impulse withstand voltage of all circuits in the equipped GP enclosure.

   If an actuating member is principally made of insulating material, any of its metal parts which may become accessible in the event of insulation failure shall also be insulated from live parts for the maximum rated insulation voltage and, if applicable, the maximum rated impulse withstand voltage of all circuits in the equipped GP enclosure.

d) The equipped GP enclosure shall cover live parts of the installed equipment with insulation material and parts belonging to a protective circuit in such a manner that they cannot be touched.

   If a protective conductor, which is extended to electrical equipment connected to the load side of the equipped GP enclosure, is to be passed through an equipped GP enclosure whose exposed conductive parts are insulated, the necessary terminals for connecting the external protective conductors shall be provided and identified by suitable marking. Inside the equipped GP enclosure, the protective conductor and its terminal shall be insulated from the live parts and the exposed conductive parts in the same way as the live parts are insulated.

e) Exposed conductive parts within the equipped GP enclosure shall not be connected to the protective circuit, i.e. they shall not be included in a protective measure involving the use of a protective circuit. This applies also to built-in apparatus, even if they have a connecting terminal for a protective conductor;

f) If doors or covers of the equipped GP enclosure can be opened without the use of a key or tool, an obstacle of insulating material shall be provided which will afford protection against unintentional contact not only with the accessible live parts, but also with the exposed conductive parts which are only accessible after the cover has been opened; this obstacle, however, shall not be removable except with the use of a tool,

Compliance is checked by inspection.

AA.4.3 Provisions for earthing

The electrical continuity of the protective circuit, if any, is verified for each equipped GP enclosure (including lids, covers, doors, protective devices and similar power consuming devices, etc.), wired and mounted as for normal use.

Except for equipped GP enclosure protected by class II, all exposed conductive parts shall be connected to the earthing circuit.

An exposed conductive part cannot be used as bonding between two connections.

Compliance is checked by inspection and, if necessary, by a continuity test of the protective circuit.

A measurement shall be carried out to verify that the resistance between the terminal of the incoming protective conductor and the exposed conductive parts shall be less than 0,05 Ω with a current of 10 A AC or 10 A DC.

AA.4.4 Inspection of the wiring and the mechanical and electric operation

The correct positioning of cables, effectiveness of connecting means and the correct mounting of the protective devices and other electrical accessories shall be verified.

The effectiveness of the mechanical actuating elements, interlock, etc., if any, shall be checked.

Depending on the complexity of the equipped GP enclosure (including lids, covers, doors, protective devices and similar power consuming devices, etc.), wired and mounted as for normal use, it may be necessary to carry out an electrical functioning test.

Compliance is checked by inspection and manual test(s).

AA.4.5 Degree of protection

The IP degree of the equipped GP enclosure shall be verified according to IEC 60529.

The test is not carried out if:

– the GP enclosure has not been modified by the installer in such a way to impair its degree of protection against electric shocks declared by the manufacturer;
– the GP enclosure has been installed according to the manufacturer's instructions.

AA.4.6 Insulating

This verification is not mandatory for a single-phase equipped GP enclosure having I_{nq} ≤ 32 A.

The verification is made with a test apparatus at a test voltage at least 500 V. The measurement is made between each live conductor and accessible conductive part and between each live conductor.

The test is considered satisfactory if the measured insulating resistance is higher than 1 000 Ω/V with reference to the rated voltage to earth of each circuit.

NOTE During the verification, electronic accessories installed in the equipped GP enclosure can be disconnected to avoid their damaging.

AA.4.7 Total incoming load

The total incoming load current shall not exceed 125 A.

AA.5 Example of calculation without electronic devices

AA.5.1 General

The calculation is based on the following steps.

AA.5.2 Diagram of the equipped GP enclosure

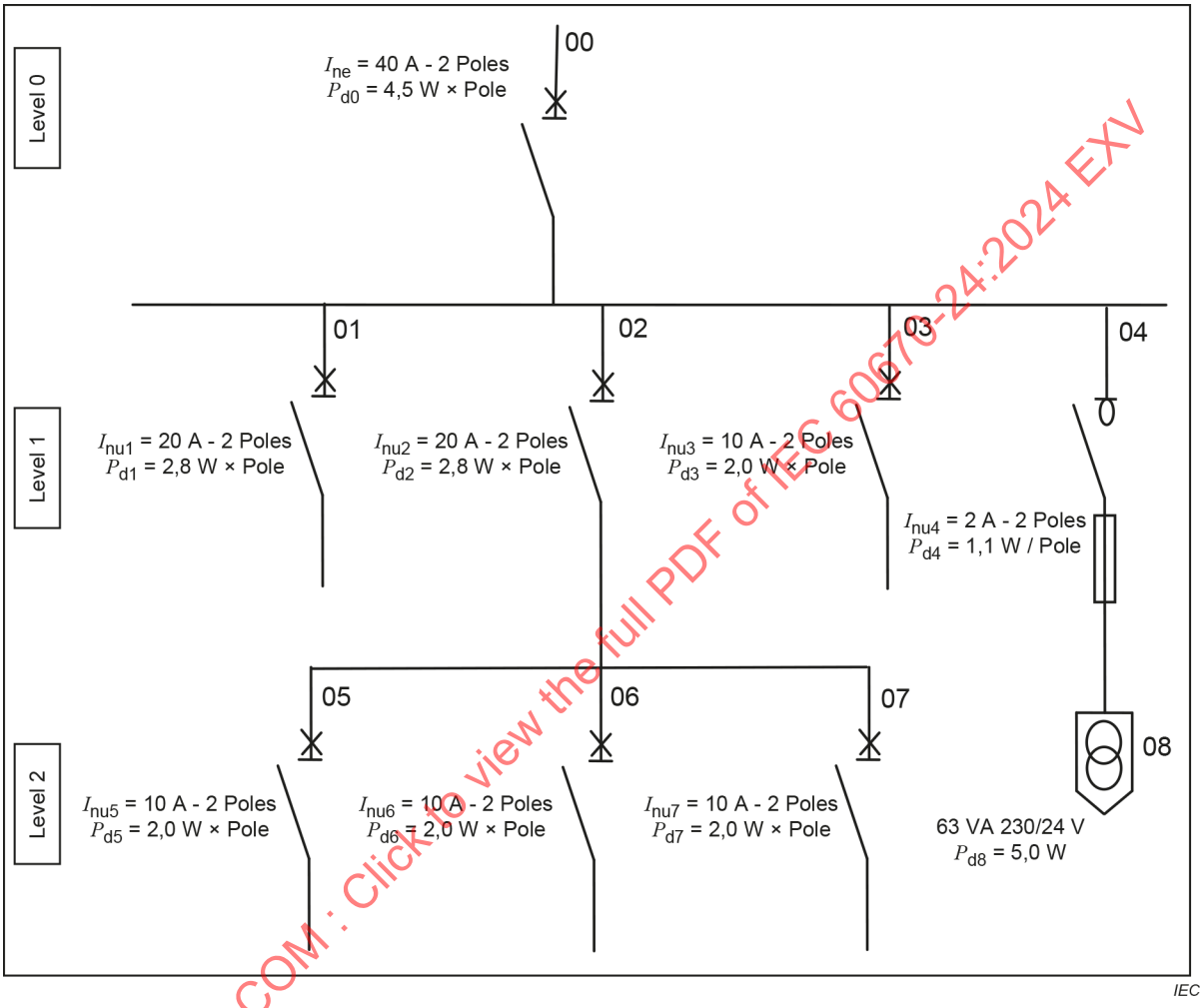


Figure AA.1 – Diagram of the equipped GP enclosure

AA.5.3 Calculation of the power loss within the equipped GP enclosure

The calculation of the power loss is shown in Table AA.3 and Table AA.4.

Table AA.3 is an example calculation of the power loss of the protective devices according to Figure AA.1.

Table AA.4 is an example calculation of the power loss of other electrical accessories according to Figure AA.1.

Determination of the utilisation factor (K_e) and of the diversity factor (K)

– Level 0 incoming circuit: K_e = 0,85

– Level 1 circuits: $K = I_{nq} / (I_{nu1} + I_{nu2} + I_{nu3} + I_{nu4}) = 34 / 52 = 0,653$

– Level 2 circuits: $K = I_{nu2} \times 0,653 / (I_{nu5} + I_{nu6} + I_{nu7}) = 13 / 30 = 0,433$

Table AA.3 – Calculation of P_{dp}

	Number of the circuit	Power loss per pole W	Number of poles	Power loss per protective and control device P_d W	Utilisation factor (K_e) for incoming circuits Diversity factor (K) for outgoing circuits	Power loss of each device W
		a	b	c		d
Incoming circuits	00	4,50	2	9,00	0,85	6,50
Outgoing circuits	01	2,80	2	5,60	0,653	2,39
	02	2,80	2	5,60	0,653	2,39
	03	2,00	2	4,00	0,653	1,71
	04	1,10	2	2,20	0,653	0,94
	05	2,00	2	4,00	0,433	0,75
	06	2,00	2	4,00	0,433	0,75
	07	2,00	2	4,00	0,433	0,75
					P_{dp} =	16,17

[a] Data indicated by the manufacturer of the device.

[b] With reference to the thermal effects, only 3 poles are considered in the case of 4-pole switches.

[c] Power loss per pole multiplied by the number of poles.

[d] Incoming circuits: $K_e^2 \times P_d$

Outgoing circuits: $K^2 \times P_d$

K_e and K are squared as the power is proportional to the square of the current.

P_{dp} = 16,17 W

Table AA.4 – Calculation of P_{au}

Number of the circuit	Description of the electrical accessory with a significant power loss in normal use	Power loss per accessory W	Number of accessories	Power loss W
08	Safety transformer	5	1	5
			P_{au}	5

AA.5.4 Total power loss of the equipped GP enclosure

$$P_{tot} = P_{dp} + 0,2\ P_{dp} + P_{au} = \mathbf{16,17 + 3,23 + 5 = 24,4\ W}$$

where

P_{dp} is the power loss of the protective devices;

P_{au} is the sum of the power losses of other electrical accessories.

AA.5.5 Conclusions

An enclosure, complying with this document, with a maximum capability to dissipate power (P_{de}), declared by the manufacturer of at least **25 W** has been chosen for the construction of the equipped GP enclosure.

The temperature rise limits of the equipped GP enclosure are deemed to be satisfactory since

$$P_{tot} = 24{,}4 \text{ W} < P_{de} = 25 \text{ W}$$

AA.6 Example calculation to take into account the power loss of electronic devices

AA.6.1 General

The calculation is based on the following steps (AA.6.2 to AA.6.5).

AA.6.2 Diagram of the equipped GP enclosure

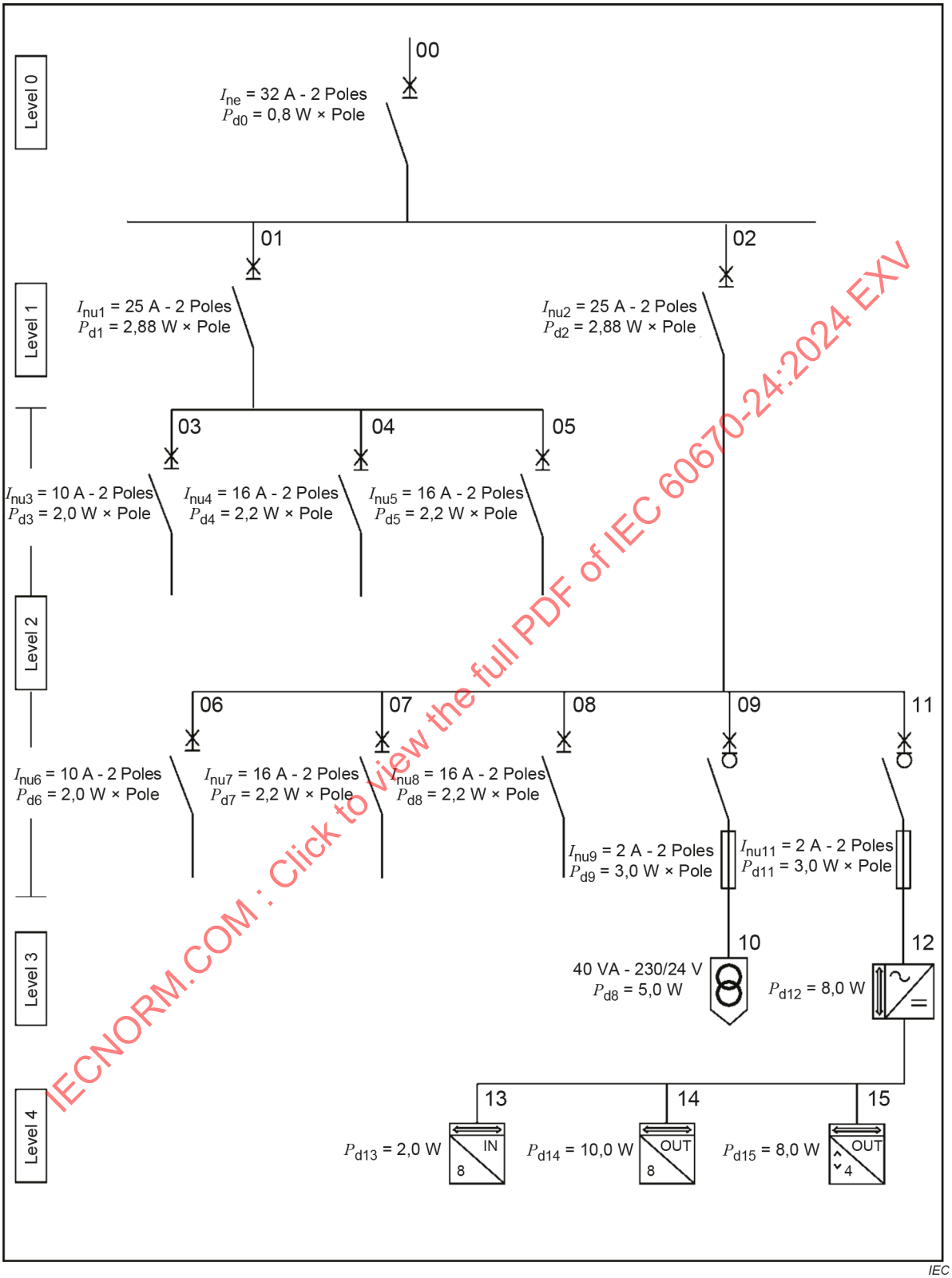


Figure AA.2 – Diagram of the equipped GP enclosure

AA.6.3 Calculation of the power loss within the equipped GP enclosure

The calculation of the power loss is shown in Table AA.5, Table AA.6 and Table AA.7.

Table AA.5 is an example calculation of the power loss of the protective devices and control devices according to Figure AA.2.

Table AA.6 is an example calculation of the power loss of other electrical accessories according to Figure AA.2.

Table AA.7 is an example calculation of the power loss of electronic devices according to Figure AA.2.

Determination of the utilisation factor (K_e) and of the diversity factor (K)

– *Level 0 incoming circuit – $K_e = 0,85$*

– *Level 1 circuits – $K = I_{nq} / (I_{nu1} + I_{nu2}) = 27 / 50 = 0,54$*

– *Level 2 circuit 1 – $K = I_{nu1} \times 0,54 / (I_{nu3} + I_{nu4} + I_{nu5}) = 13,5 / 42 = 0,321$*

– *Level 2 circuit 2 – $K = I_{nu2} \times 0,54 / (I_{nu6} + I_{nu7} + I_{nu8} + I_{nu9} + I_{nu11}) = 13,5 / 46 = 0,293$*

Table AA.5 – Calculation of P_{dp}

	Number of the circuit	Power loss per pole W	Number of poles	Power loss per protective and control device P_d W	Utilisation factor (K_e) for incoming circuits Diversity factor (K) for outgoing circuits	Power loss of each device W
Incoming circuits	00	0,8	2	1,6	0,85	1,16
Outgoing circuits	01	2,88	2	5,76	0,54	1,68
	02	2,88	2	5,76	0,54	1,68
	03	2,00	2	4,00	0,321	0,41
	04	2,2	2	4,4	0,321	0,45
	05	2,2	2	4,4	0,321	0,45
	06	2,00	2	4,00	0,293	0,34
	07	2,2	2	4,4	0,293	0,38
	08	2,2	2	4,4	0,293	0,38
	09	3	2	6	0,293	0,52
	11	3	2	6	0,293	0,52
					P_{dp} =	7,97

P_{dp} = 7,97 W

Table AA.6 – Calculation of P_{au}

Number of the circuit	Description of the electrical accessory with a significant power loss in normal use	Power loss per accessory W	Number of accessories	Power loss W
10	Safety transformer	5	1	5
			P_{au}	5

P_{au} = 5 W

Table AA.7 – Calculation of P_{el}

	Number of the circuit	Number of ways	Power loss per electronic device P_{el} W	Utilisation factor (K_e) for incoming circuits Diversity factor (K) for outgoing circuits	Power loss of each device W
Power supply	12	-	8	0,85	5,78
Electronic devices	13	8	2	0,6	0,72
	14	8	10	0,6	3,6
	15	4	8	0,7	3,92
				P_{dp} =	14,02

P_{au} = 14,02 W

AA.6.4 Total power loss of the equipped GP enclosure

$$P_{tot} = P_{dp} + 0,2\ P_{dp} + P_{au} + P_{EL} + 0,2\ P_{EL} = 7,97 + 1,59 + 5 + 14,02 + 2,80 = 31,38\ W$$

where

P_{dp} is the power loss of the protective devices;

P_{au} is the sum of the power losses of other electrical accessories;

P_{el} is the power loss of the electronic devices.

AA.6.5 Conclusions

An enclosure, complying with this document, with a maximum capability to dissipate power (P_{de}), declared by the manufacturer of at least 41 W has been chosen for the construction of the equipped GP enclosure.

The temperature rise limits of the equipped GP enclosure are deemed to be satisfactory since

$$P_{tot} = 31,38\ W < P_{de} = 41\ W$$

Annex BB
(normative)

Instructions to be given by the manufacturer of the PD enclosure to the installer on how to integrate accessories

BB.1 General

This Annex BB contains information to be given by the manufacturer to the installer in order that the installer can install the enclosure for pre-determined equipment (PD enclosure) according to 7.101.2:

– so that the temperature rise of the completed enclosure minimizes hazards for the environment, and

– so that a proper combination of electrical equipment for normal operation is guaranteed.

BB.2 Rated current and main characteristics

The maximum incoming current shall be equal to or lower than the maximum rated current of the enclosure as declared by the manufacturer. The incoming current to be considered is the sum of all incoming sources (e.g. photovoltaic sources).

The manufacturer shall inform the installer about the main characteristics of the devices which can be integrated (e.g. product range name, maximum rated current, power dissipated per pole, etc.).

BB.3 Devices to be integrated by the installer

The devices integrated in the enclosure by the installer shall comply with their product standard (e.g. MCB shall comply with IEC 60898-1, RCCB shall comply with IEC 61008-2-1 and RCBO shall comply with IEC 61009-2-1), if any.

The manufacturer shall provide information in its documentation to define the maximum number of modules per row at a given width of one module.

BB.4 Dimensions

The manufacturer shall provide all the necessary dimensions in order to integrate devices in the enclosure so as to ensure the safe operation of the equipment.

This information shall be provided

– by reference to a standard, if any, or

– by providing the following details:

- external dimensions of the enclosure (length, width, depth) for correct mounting;
- distances between parallel routed mounting rails;
- distance between mounting rails for related built-in devices and the protective cover;
- installation depths for built-in devices in conjunction with mounted lids or doors;
- dimensions at the top and at the bottom of the enclosure for incoming and outgoing cable(s).

BB.5 Connections

The minimum number and type of terminal to be installed shall be as follows:

– 1 PE terminal able to connect simultaneously:
  - 1 conductor with cross-section equal to 16 mm^2, and
  - 1 conductor with cross-section equal to 6 mm^2, and
  - 1 conductor with cross-section equal to 4 mm^2, and
  - 2 conductors with cross-section equal to 2,5 mm^2.
– 1 N terminal for incoming connections, if required, able to connect at minimum:
  - 1 rigid conductor with cross-section equal to 16 mm^2, or
  - 1 flexible conductor with cross-section equal to 10 mm^2.
– 1 L terminal for incoming connections, if required, able to connect at minimum:
  - 1 rigid conductor with cross-section equal to 16 mm^2, or
  - 1 flexible conductor with cross-section equal to 10 mm^2.

The manufacturer shall provide information about the number of each type of terminal (e.g. L, N and PE) installed and the reference to the relevant standard for terminal (e.g. IEC 60999, IEC 60998).

BB.6 Protection against electric shock

The manufacturer shall provide information to the installer so that devices can be mounted and wired in such a way to provide protection against electric shocks.

Active parts shall remain inaccessible when devices are installed and wired.

Devices mounted in the enclosure shall have a minimum IP degree of IP2X.

BB.7 IP degree and IK code

The declared IP degree, and the declared IK code if any, shall be provided by the manufacturer.

BB.8 Wiring

The manufacturer shall provide the following information to the installer:

– the internal wiring shall be such that minimum creepage distances between live parts and metallic accessible or non-accessible parts are not lower than 3 mm, and
– cross-sectional area of conductors shall be chosen according to the installation rules.

Annex CC
(normative)

Additional requirements for enclosures exposed to direct sunlight

Enclosures declared to be resistant to UV radiation shall comply with the following tests.

The tests shall be made on six test specimens of standard size according to ISO 178:2019 and on six test specimens of standard size according to ISO 179-1 exposed for 500 h to Xenon-arc, Method A, Cycle 1 in accordance with ISO 4892-2. The specimens shall be mounted in the UV apparatus in an appropriate manner,

– *suitable for both the product to be tested and the test equipment and*
– *so that the samples do not touch each other.*

Compliance is checked by verification that the flexural strength (according to ISO 178) and Charpy impact (according to ISO 179-1) of synthetic materials have 70 % minimum retention.

For the test carried out in accordance with ISO 178, the surface of the specimens exposed to UV shall be turned face down and the pressure is applied to the non-exposed surface.

For the test carried out in accordance with ISO 179-1 no notch shall be cut into the specimens and the impact shall be applied to the exposed surface. 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.

The specimens shall not show cracks or deterioration visible to normal or corrected vision without additional magnification.

These tests are not required to 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.

Annex DD
(normative)

Additional requirements for enclosures to accommodate multimedia and communication equipment

DD.1 Overview

This Annex DD specifies requirements for enclosures with separate area to accommodate multimedia and communication equipment. Multimedia and communication equipment typically include:

– RJ45 sockets
– coaxial (e.g. F-type) sockets
– optical network termination
– ethernet routers
– internet provider equipment
– Local Access Network (LAN) switches
– Digital Video Broadcasting (DVB) switches

The objective of this Annex DD is to ensure safety of the user when integrating, configurating or using multimedia and communication equipment.

This Annex DD does not specify requirements for the multimedia and communication equipment which shall comply with their product standard.

DD.2 Instructions

For enclosures intended to accommodate multimedia and communication equipment, the information provided in the manufacturer's instructions is recommended to be on the packaging or be marked on the enclosure itself.

DD.3 Protection against electric shock

Add a new item d) in Clause 10 as follows:

d) ensure that accessible conductive parts (e.g. mounting plates or frames) are insulated from live parts by double or reinforced insulation. The connection of these mounting plates or frames to the functional earth is allowed.

DD.4 Construction of separate area to accommodate multimedia equipment

Enclosures shall provide a separated area to accommodate the multimedia and communication equipment and their accessible cable and connection.

Metallic fixing means (e.g. fixing plate) of class II enclosures shall not be connected to the protective earthing. However, these means may be connected to the functional earth.

NOTE Connection of fixing means to functional earth is not a protective measure. It will not lead to a change of the equipment protection class.

Between the dedicated area for multimedia and communication equipment and the area used for protection devices, a minimum degree of IP2XC shall be required to protect against electrical shock.

The dedicated area to accommodate the multimedia equipment shall contain at least one socket-outlet to provide power supply to the installed equipment.

Accessible flexible cables to supply a socket-outlet shall comply with their relevant standards (e.g. IEC 60227-5, IEC 60245-4, IEC 60245-3, IEC 62821-3, or IEC 63010-1). Rigid cables shall comply with their relevant standards (e.g. IEC 60227-4).

Compliance is checked by inspection.

DD.5 Fixing of multimedia equipment

Add the following at the end of Clause 12:

The area to accommodate multimedia equipment shall provide suitable means for fixing the multimedia equipment. Their fixation shall not rely on the cables or connectors.

When connectors are accessible, it is recommended that the insertion and extraction of cables, connectors or plugs be straightforward and without obstacle, and that this insertion and extraction does not affect the equipment's fixing and stability.

Compliance is checked by inspection.

DD.6 Verification of temperature rise

Addition to Clause 102:

For enclosures with an area for the accommodation of multimedia equipment, the contribution of this multimedia equipment in terms of temperature rise is less onerous compared to the same area used for the integration of protection devices. Therefore, this area can be neglected for the purposes of the temperature rise, and no further tests are required.

Annex EE
(normative)

Additional requirements for enclosures for use with connected devices or equipment

EE.1 General

With the emergence of IoT, switchboards are concerned by new types of connected devices that must be used together with protection type devices.

These combinations of devices in switchboards are used, for example, for the purpose of energy management and monitoring, energy efficiency, remote or centralized management and control, diagnostic, and maintenance of equipment.

EE.2 Application

This Annex EE provides requirements for the integration of connected devices or equipment in an enclosure, in order to ensure the safety and proper functioning of the equipped enclosure when installed in an enclosure according to this document.

This Annex EE covers enclosures for use with connected devices or equipment classified according to 7.102.1 or 7.102.2 of this Annex EE.

EE.3 General requirements

This Annex EE does not replace the general requirements of this document and its Annex AA and Annex BB.

The safety and the best operation of a switchboard equipped with connected equipment or devices depends on:

– enclosure choice and classical devices dedicated to distribution and protection (general requirements),
– connected equipment or device and cable selection,
– assembly and cabling in accordance with rules,
– respect of instructions provided by the enclosure manufacturer and equipment or device manufacturer,
– verification of the proper functioning of connected equipment or devices through the design (by manufacturer for PD enclosure), the assembly and installation on site by installer.

EE.4 Additional classification

7.102 Enclosure for use with connected devices or equipment	7.102.1 Enclosure for use with connected devices or equipment GP
	7.102.2 Enclosure for use with connected devices or equipment PD

EE.5 Instructions

Manufacturers of connected enclosures classified according to 7.102.1 (GP) or 7.102.2 (PD) shall provide instructions for the proper incorporation of connected equipment or devices in addition to those required in Annex AA or Annex BB.

EE.6 Marking

When an enclosure classified according to 7.102.1 or 7.102.2 of this Annex EE does not require any adaptation or transformation to receive connected equipment or functions, no additional marking is required.

When an enclosure classified according to 7.102.1 or 7.102.2 of this Annex EE includes or contains dedicated features or is especially designed to prepare and facilitate accommodation of connected equipment or device, additional information can be provided in the technical documentation, instruction sheet, on the packaging or be marked on the enclosure.

EE.7 Construction requirements

EE.7.1 Selection and installation of connected equipment or devices

Connected equipment or devices incorporated in enclosures classified according to 7.102.1 or 7.102.2 of this Annex EE shall be compliant with their applicable product standard.

The arrangement of connected equipment in an enclosure shall be carefully organized to minimize any potential interference with other devices. The enclosure manufacturer is responsible for providing guidelines to prevent such issues.

If the placement of connected equipment or devices noticeably affects their performance, the enclosure manufacturer shall provide instructions to help optimize their operation.

EE.7.2 Equipotential functional earthing connection

When an enclosure is equipped with a functional earthing terminal, all functional earthing circuits of the connected switchboard shall be connected to it.

This functional earthing terminal shall be connected to the functional earthing bonding according to IEC 60364-5-54:2011/AMD1:2021, Clause 545.

EE.7.3 Cable selection and arrangement

Cables used for data transmission (e.g. Ethernet) shall be determined in accordance with ISO/IEC 11801-1 category 5 at least. Their features depend on performance targeted for the final network, the manufacturer instructions and the immunity requirement of the connected equipment or device.

In domestic environments, several types of data cables can be used depending on performance targets.

Examples of cables are unshielded twisted pair cable (UTP), foiled twisted pair cable (FTP), shielded twisted pair cable (STP), shielded and foiled twisted pair (F/STP).

Cables used for other applications shall conform to their respective standard (e.g. coaxial cables).

The quality of this protection depends on the effectiveness of the screen or shield. Functional earthing shall be established at one extremity of the metal screen or shield to enhance protection against low-frequency electric fields. For an improved protection, functional earthing shall be established at both extremities of the metal screen or shield for high frequency.

For electrical safety protection, any wiring system dedicated to data transmission shall be separated from the live parts of other circuits according to IEC 60364-4-41:2005, Clause 414.4.

A suitable distance between data wiring and power wiring shall be ensured to prevent electromagnetic pollution. Guidelines are given in ISO/IEC 14763-2.

Wiring paths should be optimized and be as short as possible, with the minimum radius respected.

EE.7.4 Interfaces

Enclosures equipped with or prepared for dedicated pre-connection interfaces between internal connected equipment or devices and external wired or wireless data network should comply with the following:

– when an interface containing metal parts (e.g. screen foil or shielding, antenna ground, etc.) crosses through the enclosure, insulation provisions shall comply with 10 b) of this document.
– when an interface is intended to supply external equipment with ELV, the access to this interface shall comply with IP2XC.

EE.8 Verification

EE.8.1 General

The verifications listed in this Annex EE address functional aspects. They help installers to prepare and set up a connected enclosure that meets the performance requirements within a household environment.

EE.8.2 Functional verification of the system

The manufacturer of an enclosure classified according to 7.102.2 (PD) who delivers an empty enclosure intended to be equipped with connected equipment or devices according to pre-determined compositions and configurations shall carry out relevant verifications to ensure the safety and functionality and provide the list of verifications to be carried out by the installer.

The verifications such as those listed below are carried out by the installer on the installation site for an enclosure classified according to 7.102.1 (GP) or 7.102.2 (PD):

– connected equipment or devices are correctly supplied and can operate (gateway, router, wireless network receiver, active switch, etc.),
– quality and reliability of wired connection or wireless,
– connectivity between the devices is operational,
– means intended to ensure visualization and monitoring are operational, if any,
– remote command or actions are operational, if any,
– remote settings of devices or parameters depending on technologies are operational, if any,
– measurement devices are operational, if any.

EE.8.3 Verification of maximum capability to dissipate power (P_{de})

Connected equipment or device integrated in an enclosure are assimilated to electronic equipment or device and their verification shall be carried out in accordance with the calculation method defined in Annex AA.

EE.8.4 Verification of temperature rise

When determining the most onerous case for the temperature rise verification it should be considered whether it is appropriate to carry out the temperature test with connected equipment or device if this would significantly influence the temperature test compared to conventional distribution or protection circuits.

EE.9 EMC aspects

When an installer equips an empty enclosure classified according to 7.102.1 (GP) or 7.102.2 (PD) with connected equipment or device for a dedicated fixed domestic electrical installation, no further verification is required if the installer conforms to the manufacturer's instructions for the installation of the enclosures, equipment or devices.

Bibliography

Addition:

IEC 60227-4, *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V – Part 4: Sheathed cables for fixed wiring*

IEC 60227-5, *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V – Part 5: Flexible cables (cords)*

IEC 60245-3, *Rubber insulated cables – Rated voltages up to and including 450/750 V – Part 3: Heat resistant silicone insulated cables*

IEC 60245-4, *Rubber insulated cables – Rated voltages up to and including 450/750 V – Part 4: Cords and flexible cables*

IEC 62821-3, *Electric cables – Halogen-free, low smoke, thermoplastic insulated and sheathed cables of rated voltages up to and including 450/750 V – Part 3: Flexible cables (cords)*

IEC 63010-1, *Halogen-free thermoplastic insulated and sheathed flexible cables of rated voltages up to and including 300/300 V – Part 1: General requirements and cables*

IEC 61439-3:2024, *Low-voltage switchgear and controlgear assemblies – Part 3: Distribution boards intended to be operated by ordinary persons (DBO)*

ISO/IEC 14763-2:2019, *Information technology – Implementation and operation of customer premises cabling – Part 2: Planning and installation*

SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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BOÎTES ET ENVELOPPES POUR APPAREILLAGE ÉLECTRIQUE POUR INSTALLATIONS ÉLECTRIQUES FIXES POUR USAGES DOMESTIQUES ET ANALOGUES –

Partie 24: Exigences particulières pour les enveloppes pour dispositifs de protection et autres matériels électriques ayant une puissance dissipée

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L'IEC 60670-24 a été établie par le sous-comité 23B: Prises de courant et interrupteurs, du comité d'études 23 de l'IEC: Petit appareillage. Il s'agit d'une Norme internationale.

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) les exigences pour la protection contre les chocs électriques à l'Article 10 ont été révisées;
b) des exigences pour la mise à la terre fonctionnelle ont été ajoutées au 11.101;
c) les exigences pour la fixation des enveloppes pour montage encastré et semi-encastré ont été révisées au 12.12;
d) les exigences pour la résistance du matériau isolant à la chaleur anormale et au feu à l'Article 18 ont été révisées;
e) des calculs ont été ajoutés à l'Article AA.6 pour prendre en compte la puissance dissipée par les appareils électroniques;
f) des essais et exigences ont été ajoutés pour les enveloppes exposées à la lumière directe du soleil, ainsi que l'Annexe CC associée;
g) des essais et exigences ont été ajoutés pour les enveloppes avec espace séparé pour accueillir le matériel multimédia, ainsi que l'Annexe DD associée;
h) des essais et exigences ont été ajoutés pour les enveloppes utilisées avec des appareils ou des équipements connectés, ainsi que l'Annexe EE associée.

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

Projet	Rapport de vote
23B/1536/FDIS	23B/1554/RVD

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

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

La version française de la norme n'a pas été soumise au vote.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/standardsdev/publications.

Une liste de toutes les parties de la série IEC 60670, publiées sous le titre général *Boîtes et enveloppes pour appareillage électrique pour installations fixes pour usages domestiques et analogues*, se trouve sur le site web de l'IEC.

Le présent document doit être utilisé conjointement avec l'IEC 60670-1:2024. Il répertorie les modifications nécessaires pour transformer cette norme en une norme spécifique pour les dispositifs de protection et autres matériels électriques ayant une puissance dissipée.

Lorsque le présent document mentionne "addition", "modification" ou "remplacement", l'exigence, les modalités d'essais ou le texte explicatif correspondant de l'IEC 60670-1:2024 doit être adapté en conséquence.

Les articles et paragraphes, notes, figures ou tableaux qui sont ajoutés à ceux de l'IEC 60670-1:2024 sont numérotés à partir de 101.

Les annexes supplémentaires dans l'IEC 60670-1:2024 sont numérotées AA, BB, etc.

Dans la présente publication, les caractères d'imprimerie suivants sont utilisés:

- exigences proprement dites: caractères romains;
- *modalités d'essais: caractères italiques;*
- notes: petits caractères romains.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous webstore.iec.ch dans les données relatives au document recherché. À cette date, le document sera

- reconduit,
- supprimé, ou
- révisé.

BOÎTES ET ENVELOPPES POUR APPAREILLAGE ÉLECTRIQUE POUR INSTALLATIONS ÉLECTRIQUES FIXES POUR USAGES DOMESTIQUES ET ANALOGUES –

Partie 24: Exigences particulières pour les enveloppes pour dispositifs de protection et autres matériels électriques ayant une puissance dissipée

1 Domaine d'application

Remplacement:

La présente partie de l'IEC 60670 s'applique aux enveloppes et parties d'enveloppes pour dispositifs de protection et autres matériels électriques ayant une puissance dissipée, destinés à être utilisés avec une tension assignée qui ne dépasse pas 400 V et un courant de charge total à l'arrivée qui ne dépasse pas 125 A pour les installations électriques fixes pour usages domestiques et analogues.

Ces enveloppes sont destinées à être installées dans des lieux accessibles aux personnes non qualifiées. Elles sont destinées à incorporer des matériels électriques montés par des personnes qualifiées (installateurs).

Ces enveloppes sont destinées à être installées dans des lieux où le courant de court-circuit présumé ne dépasse pas 10 kA, sauf si elles sont protégées par des dispositifs de protection limiteurs de courant, avec un courant coupé limité inférieur ou égal à 17 kA.

Les enveloppes conformes au présent document sont adaptées à un usage à des températures ambiantes qui ne dépassent pas habituellement 40 °C, mais dont la moyenne sur une période de 24 h ne dépasse pas 35 °C, avec une limite basse de la température ambiante de –5 °C.

Une enveloppe qui fait partie intégrante d'un appareillage électrique et qui fournit une protection contre les influences externes (par exemple, chocs mécaniques, pénétration de corps solides ou d'eau) est couverte par la norme pertinente pour cet appareillage.

Le présent document ne s'applique pas à un ensemble d'appareillage à basse tension, tel qu'il est défini dans la série IEC 60439 ou la série IEC 61439, ni à un tableau de distribution principal qui peut faire partie du tableau de répartition.

Le présent document ne s'applique pas aux boîtes pour montage en saillie, pour montage encastré et pour montage semi-encastré adaptées à la protection des appareillages pour usage domestique et analogue tels que les interrupteurs, interrupteurs électroniques et socles de prises de courant, couverts par l'IEC 60670-1 uniquement.

NOTE 1 Les enveloppes conformes au présent document sont essentiellement utilisées comme tableau de répartition pour accueillir des dispositifs de protection et d'autres matériels électriques ayant une puissance dissipée, et sont installées au début du circuit électrique tandis que les boîtes conformes à l'IEC 60670-1 sont installées à la fin du circuit électrique.

NOTE 2 Un tableau de distribution principal est un ensemble composé d'un tableau ou d'une enveloppe, équipé d'un compteur et/ou de l'appareil principal d'arrivée. Les tableaux de distribution principaux satisfont à leurs normes respectives ou aux exigences du fournisseur local, le cas échéant.

NOTE 3 Dans le pays suivant, le présent document ne peut pas être utilisé dans les installations alimentées en 230 V monophasé jusqu'à une puissance assignée de 100 A, qui sont supervisées par des personnes ordinaires. L'intégration de dispositifs mécaniques et électriques dans une enveloppe doit être vérifiée par la conformité à l'IEC 61439-3 [Norme britannique EN 61439-3]: UK.

NOTE 4 Dans le pays suivant, le présent document ne peut être utilisé que pour les enveloppes GP, avec les instructions conformes à l'Annexe A. Pour les autres types d'enveloppes, l'intégration de dispositifs mécaniques et électriques dans une enveloppe est vérifiée par la conformité à la DS EN 61439-3: DK.

2 Références normatives

Addition:

IEC 60364-4-41:2005, *Installations électriques à basse tension – Partie 4-41: Protection pour assurer la sécurité – Protection contre les chocs électriques*
IEC 60364-4-41:2005/AMD1:2017

IEC 60364-5-54:2011, *Installations électriques basse tension – Partie 5-54: Choix et mise en œuvre des matériels électriques – Installations de mise à la terre et conducteurs de protection*
IEC 60364-5-54:2011/AMD1:2021

IEC 60664-1, *Coordination de l'isolement des matériels dans les réseaux d'énergie électrique à basse tension – Partie 1: Principes, exigences et essais*

IEC 60898-1, *Petit appareillage électrique – Disjoncteurs pour la protection contre les surintensités pour installations domestiques et analogues – Partie 1: Disjoncteurs pour le fonctionnement en courant alternatif*

IEC 61008-2-1, *Interrupteurs automatiques à courant différentiel résiduel pour usages domestiques et analogues sans dispositif de protection contre les surintensités incorporé (ID) – Partie 2-1: Applicabilité des règles générales aux ID fonctionnellement indépendants de la tension d'alimentation*

IEC 61009-2-1, *Interrupteurs automatiques à courant différentiel résiduel avec protection contre les surintensités incorporée pour installations domestiques et analogues (DD) – Partie 2-1: Applicabilité des règles générales aux DD fonctionnellement indépendants de la tension d'alimentation*

ISO/IEC 11801-1:2017, *Information technology – Generic cabling for customer premises – Part 1: General requirements* (disponible en anglais seulement)

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 4892-2:2013, *Plastiques – Méthodes d'exposition à des sources lumineuses de laboratoire – Partie 2: Lampes à arc au xénon*
ISO 4892-2:2013/AMD1:2021