

INTERNATIONAL STANDARD



**Mechanical structures for electrical and electronic equipment – Outdoor enclosures –
Part 1: Design guidelines**

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INTERNATIONAL STANDARD



**Mechanical structures for electrical and electronic equipment – Outdoor enclosures –
Part 1: Design guidelines**

INTERNATIONAL
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COMMISSION

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CONTENTS

FOREWORD.....	3
INTRODUCTION.....	2
1 Scope.....	6
2 Normative references	7
3 Terms and definitions	7
4 Coordination dimensions	9
5 Environmental requirements, tests and safety aspects.....	9
5.1 Classification of environmental conditions.....	9
5.2 Static load.....	9
5.2 Transportation and installation related mechanical loads	11
5.3 Operational related mechanical loads	11
5.3 Dynamic stress.....	12
5.4 Static load capacity.....	12
5.5 Seismic performance	12
6 Electromagnetic shielding.....	12
7 Thermal management and acoustic noise suppression emission.....	12
Bibliography.....	14
Figure 1 – Typical outdoor enclosure	6
Figure 2 – Locations of outdoor enclosures.....	9
Table 1 – Environmental Operating and transportation conditions	10
Table 2 – Safety aspects	11

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**MECHANICAL STRUCTURES FOR ELECTRICAL AND
ELECTRONIC EQUIPMENT – OUTDOOR ENCLOSURES –****Part 1: Design guidelines**

FOREWORD

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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 61969-1:2020. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

IEC 61969-1 has been prepared by subcommittee 48D: Mechanical structures for electrical and electronic equipment, of IEC technical committee 48: Electrical connectors and mechanical structures for electrical and electronic equipment. It is an International Standard.

This fourth edition cancels and replaces the third edition published in 2020. This edition constitutes a technical revision.

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

- a) added references to the environmental conditions defined by ETSI EN 300 019-1 and IEC 60721-2 series;
- b) reference made to the correct test specifications;
- c) addition of laser hazard warning in case opto-electronic equipment is used.

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

Draft	Report on voting
48D/752/CDV	48D/758/RVC

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 61969 series, published under the general title *Mechanical structures for electrical and electronic equipment – Outdoor enclosures*, can be found on the IEC website.

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

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

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INTRODUCTION

This part of IEC 61969 is intended as a generic guide for the development of further parts within this series of standards, and it provides design guidelines for outdoor enclosures.

The products covered by the IEC 61969 series are empty enclosures for outdoor locations, to be equipped with application-specific combinations of electrical and electronic equipment, and to be used at non-weatherprotected locations above ground.

The IEC 61969 series consists of:

- a design guidelines general part: IEC 61969-1;
- a coordination dimensions standard: IEC 61969-2;
- an environmental requirements and tests, safety aspects standard: IEC 61969-3.

IEC 61969-2 and IEC 61969-3 should be read in conjunction with this document.

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MECHANICAL STRUCTURES FOR ELECTRICAL AND ELECTRONIC EQUIPMENT – OUTDOOR ENCLOSURES –

Part 1: Design guidelines

1 Scope

This part of IEC 61969 contains design guidelines for outdoor enclosures for electrical and electronic equipment and is applicable over a wide field of mechanical, electromechanical and electronic equipment and its installation where a modular design is used.

The objectives of this document are:

- to provide an overview of specifications for enclosures focused on requirements for outdoor applications for stationary use at non-weatherprotected locations, and
- to achieve product integrity under outdoor conditions and to ease product selection for the sourcing of outdoor enclosures from different vendors.

These enclosures are considered to contain any equipment and provide protection for the outdoor installed facilities against unwanted environmental impacts. The installed equipment can be, but is not limited to, subracks or chassis in accordance with the IEC 60917 series or IEC 60297 series. A typical outdoor enclosure is shown in Figure 1.

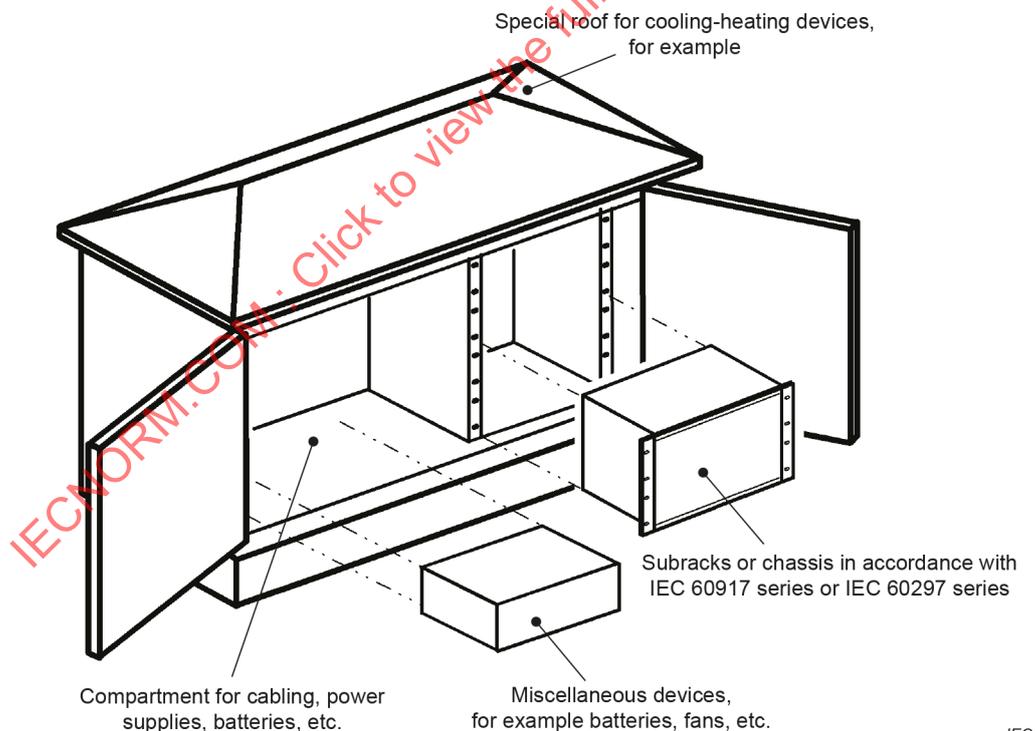


Figure 1 – Typical outdoor enclosure

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, Environmental testing – Part 2-75: Tests – Test Eh: Hammer tests~~

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

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

IEC 60695-11-10, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods*

IEC 60721-3-2, *Classification of environmental conditions – Part 3-2: Classification of groups of environmental parameters and their severities – Transportation and handling*

IEC 60721-3-4, *Classification of environmental conditions – Part 3-4: Classification of groups of environmental parameters and their severities – Stationary use at non-weatherprotected locations*

IEC 60754-2, *Test on gases evolved during combustion of materials from cables – Part 2: Determination of acidity (by pH measurement) and conductivity*

IEC 60825-1, *Safety of laser products – Part 1: Equipment ~~specification~~ classification and requirements*

~~IEC 60950-1, Information technology equipment – Safety – Part 1: General requirements~~

~~IEC 61010-1, Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements~~

IEC 61034-1, *Measurement of smoke density of cables burning under defined conditions – Part 1: Test apparatus*

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

IEC 61439-5, *Low-voltage switchgear and controlgear assemblies – Part 5: Assemblies for power distribution in public networks*

IEC 61587-1, *Mechanical structures for electrical and electronic equipment – Tests for IEC 60917 and IEC 60297 series – Part 1: Environmental requirements, test setups and safety aspects ~~for cabinets, racks, subracks and chassis under indoor condition use and transportation~~*

IEC 61587-2, *Mechanical structures for electronic equipment – Tests for IEC 60917 and IEC 60297 – Part 2: Seismic tests for cabinets and racks*

IEC 61587-3, *Mechanical structures for electronic equipment – Tests for IEC 60917 and IEC 60297 – Part 3: Electromagnetic shielding performance tests for cabinets and subracks*

IEC 61969-2, *Mechanical structures for electronic equipment – Outdoor enclosures – Part 2: Coordination dimensions*

IEC 61969-3, *Mechanical structures for electrical and electronic equipment – Outdoor enclosures – Part 3: Environmental requirements, tests and safety aspects*

IEC 62194, *Method of evaluating the thermal performance of enclosures*

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

IEC 62305-4, *Protection against lightning – Part 4: Electrical and electronic systems within structures*

IEC 62368-1, *Audio/video, information and communication technology equipment – Part 1: Safety requirements*

ISO 1518-1, *Paints and varnishes – Determination of scratch resistance – Part 1: Constant-loading method*

ISO 3864-2, *Graphical symbols – Safety colours and safety signs – Part 2: Design principles for product safety labels*

ISO 7779, *Acoustics – Measurement of airborne noise emitted by information technology and telecommunications equipment*

ETSI EN 300 019-1-2, *Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-2: Classification of environmental conditions; Transportation*

ETSI EN 300 019-1-4, ~~Equipment~~ *Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-4: Classification of environmental conditions; Stationary use at non-weatherprotected locations*

ETSI EN 300 019-2-2, *Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 2-2: Specification of environmental tests; Transportation*

ETSI EN 300 019-2-4, ~~Equipment~~ *Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 2-4: Specification of environmental tests – Stationary use at non-weatherprotected locations*

ETSI EN 300 753, ~~Equipment~~ *Environmental Engineering (EE); Acoustic noise emitted by telecommunications equipment*

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

outdoor enclosure

enclosure exposed to an outdoor environment, for stationary use at non-weatherprotected locations, for the protection of electrical and electronic equipment installed inside against outdoor environmental conditions

Note 1 to entry: An outdoor enclosure is applicable for a wide field of equipment (e.g. communication system, industrial or signal control, etc.).

Note 2 to entry: The typical installation locations of outdoor enclosures are shown in Figure 2.

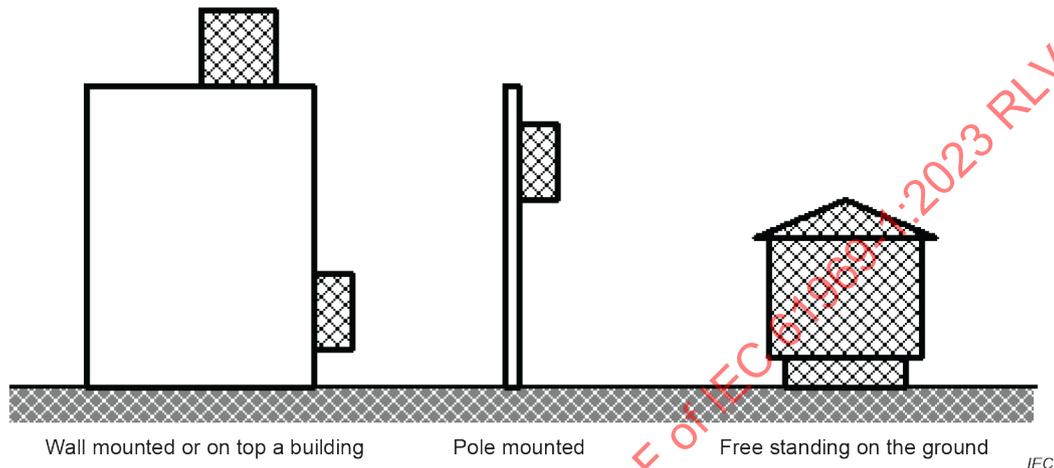


Figure 2 – Locations of outdoor enclosures

3.2

heat transfer rate

k

property with units of $W/(m^2K)$, a measure of the rate of heat transfer

Note 1 to entry: Detailed calculations for determination of the enclosure design dependent heat management properties, including the heat transfer rate, are described in IEC 62194.

3.3

static load

~~maximum mechanical load that an enclosure is able to sustain in static condition without mechanical failure, as the gross weight of enclosure including all deemed equipment, multiplied by a safety factor 1,25~~

4 Coordination dimensions

The dimensions of outdoor enclosures shall consist of coordination dimensions as given in IEC 61969-2. The coordination dimensions provide the range and systematic stipulation of possible enclosure internal and external dimensions.

5 Environmental requirements, tests and safety aspects

5.1 Classification of environmental conditions

~~The classification of environmental conditions for outdoor enclosures is based on requirements as defined in IEC 60721-3-2 and IEC 60721-3-4, and the tests are in accordance with the relevant parts of the IEC 60068 series.~~

The environmental requirements for outdoor enclosures are based on the classification of environmental conditions as defined in IEC 60721-3-2 (transportation) and IEC 60721-3-4

(operating conditions). The relevant tests from the IEC 60068 series with tests severities are given in ETSI EN 300 019-2-2 and ETSI EN 300 019-2-4.

The selection of relevant requirements, as indicated in Table 1 and Table 2, was made with the focus on outdoor specific conditions and on structural design and safety aspects. Details about the selected classes of environmental conditions are given in IEC 61969-3.

Table 1 – Environmental Operating and transportation conditions

Requirement	Conditions	Test-specification requirements
Temperature	IEC 60721-3-2 and IEC 60721-3-4 (or ETSI EN 300 019-1-2 and ETSI EN 300 019-1-4)	ETSI EN 300 019-2-4 or IEC 61587-1 IEC 61969-3
Humidity	IEC 60721-3-2 and IEC 60721-3-4 (or ETSI EN 300 019-1-2 and ETSI EN 300 019-1-4)	ETSI EN 300 019-2-4 or IEC 61587-1 IEC 61969-3
Atmospheric pressure	IEC 60721-3-2 and IEC 60721-3-4 (or ETSI EN 300 019-1-2 and ETSI EN 300 019-1-4)	ETSI EN 300 019-2-2 and ETSI EN 300 019-2-4
Corrosive gases	ETSI EN 300 019-1-4	ETSI EN 300 019-2-4 or IEC 61587-1
Corrosive liquids	ETSI EN 300 019-1-4	ETSI EN 300 019-2-4
Chemical active substances	IEC 60721-3-2 and IEC 60721-3-4 (or ETSI EN 300 019-1-2 and ETSI EN 300 019-1-4)	IEC 61969-3
Solar (UV light) resistance	IEC 60721-3-2 and IEC 60721-3-4 (or ETSI EN 300 019-1-2 and ETSI EN 300 019-1-4)	ETSI EN 300 019-2-4 IEC 61969-3
Biological resistance	IEC 60721-3-2 and IEC 60721-3-4 (or ETSI EN 300 019-1-2 and ETSI EN 300 019-1-4)	ETSI EN 300 019-2-4 IEC 61969-3
Protection against rodents and birds	Requirements and tests may be part of the user specification	
Protection against insects and termites	Requirements and tests may be part of the user specification	
Weather resistance (rain and wind driven dust or sand)	Climatic conditions IEC 60721-3-2 and IEC 60721-3-4 (or ETSI EN 300 019-1-2 and ETSI EN 300 019-1-4)	Additional IEC 60529 for tightness IEC 61969-3 (including IEC 60529 requirements for intrusion protection)
Thermal management and heat transfer rate k	Temperature inside and on surface of enclosure. Requirements may be application specific.	For thermal enclosure properties see Methods of evaluating the thermal performance of enclosures IEC 62194
Resistance to mechanical stresses	Mechanical loads during transport, installation and operation: – impact (IK code according to IEC 62262); – crush; – vibration and shock; – wind resistance; – firearms resistance (optional).	IEC 61969-3
Acoustical noise suppression emission	ETSI EN 300 753	ISO 7779
Paint (colour, gloss, adhesion, flex, scratch, etc.)	May be part of the users' specification For extreme conditions, anti-graffiti may be required Paints and varnishes – Scratch test	ISO 1518-1, etc.
Heat transfer rate k	Methods of evaluating the thermal performance of enclosures IEC 62194	

~~NOTE—For details about classifications of environmental conditions, see IEC 61969-3.~~

Table 2 – Safety aspects

	Requirement	Test specification
Earth bonding	The responsibility of the vendor is to provide sufficient conductivity between different parts of the enclosure and means for the earth bonding of equipment IEC 61140 to protect the user against electric shock as described in IEC 61140	Using IEC 60950-1 IEC 62368-1 and IEC 61439-5 for equipped enclosure IEC 61010-1/IEC 60825-1
Lifting and stiffness	Requirements for strength of enclosure during installation	IEC 61587-1
Lightning strike	To be observed in the total “bonding network” concept	IEC 62305-4
Mechanical safety	IK code according to IEC 62262	For testing IEC 60068-2-75
Vandalism	Requirements shall be part of the vendor specification	Tests may be part of the vendor specification
Warning labels ^a	General warning, caution, risk of danger Caution, risk of life Caution, risk of electric shock Caution, hot surface Caution, laser hazard	ISO 3864-2 ISO 3864-2 ISO 3864-2 IEC 60417 IEC 60825-1
Security, vandalism protection	Requirements for the resistance of the enclosure and the locking devices against unauthorized access	Tests may be part of the user specifications
Flammability	Material properties (e.g. low smoke, zero halogen, flame retardant) may be specified by user. Local regulations can also exist.	IEC 61034-1, IEC 60754-2 IEC 60695-11-10
^a Application of warning labels (on the outside accessible surface and/or inside an outdoor enclosure) is the responsibility of the system integrator, as it depends on a risk assessment on the outdoor enclosure completely populated with the application-specific electrical and electronic equipment.		

~~5.2 – Static load~~

~~The static load capacity definition of an outdoor enclosure shall be based on the intended transport and handling conditions as they occur at the installation place.~~

5.2 Transportation and installation related mechanical loads

The mechanical loads during transportation and handling at the place of installation shall be considered. If the enclosure is loaded with equipment, the maximum weight should be specified by the vendor in respect to the classification of environmental conditions as under 5.1.

5.3 Operational related mechanical loads

The mechanical loads of the installed product caused by possible environmental influences during operation and maintenance (e.g. vibration, shock, wind, impact and crush) shall be considered. Outdoor enclosures deemed to be installed on ground are considered street enclosures, typically e.g. for traffic controls or last mile telephone line distribution, which need special precautions against physical impacts.

Pole- and wall-mounted enclosures may be out of the reach of persons whereas the weather impact may cause special precaution for the stability of the installation.

5.3 ~~Dynamic stress~~

~~Dynamic stress shall be considered during transportation, handling at the place of installation and in respect to possible environmental impacts. If the enclosure is loaded with equipment, the maximum weight should be specified by the vendor in respect to the classification of environmental conditions as under 5.1.~~

5.4 Static load capacity

The design of the enclosure shall take into account the weight capacity of the installed enclosure to avoid collapse or damage of a fully equipped enclosure. The static load capacity of an outdoor enclosure shall be based on the intended transport and handling conditions and the operating conditions at the installation place. The gross weight of enclosure shall include all deemed equipment, multiplied by a safety factor 1,25.

5.5 Seismic performance

In case of installation deemed to occur in a seismic hazard zone, a standard enclosure may be tested with internally mounted dummy loads simulating the equipment and structural anchoring simulating the place of installation.

The results of such tests can be used as reference for the product offering by a standard enclosure vendor, but it does not exempt from final equipment testing.

The test conditions ~~are described~~ shall be as specified in IEC 61587-2.

6 Electromagnetic shielding

In order to achieve electromagnetic compatibility of a final installation, the enclosure may be part of the total shielding concept. As a pre-test, the shielding performance test may be performed in order to gain the required level of attenuation by the enclosure. The test set-up and the test procedure ~~are described~~ shall be as specified in IEC 61587-3.

7 Thermal management and acoustic noise ~~suppression~~ emission

Thermal management is the key to survival of electrical and electronic equipment in general but especially if exposed to an outdoor environment.

The heat transfer rate k is important for designing the outdoor enclosure because the value affects the temperature difference between inside and outside of the enclosure.

As a prime measure, thermal insulation against heat and cold from the outside environment shall be considered for the enclosure.

Next, measurement of the heat dissipation from the inside out shall be performed.

If low external temperatures will be experienced, internal heating should be considered.

Depending on the climate conditions and the heat generated inside the enclosure, thermal management may be achieved by passive cooling only.

In cases where the internal temperature of the enclosure would exceed temperature limits, the enclosure may be fitted with active cooling devices, such as filter fans, air to air heat exchangers or air conditioners.

For selection of a suitable active cooling system the required energy consumption (cost factor and impact to the environment) and the local noise level limits should be carefully considered (regulatory requirements in rural and urban areas).

For the method of enclosure thermal performance evaluations, see IEC 62194.

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- IEC 60068-2-6, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*
- IEC 60068-2-10, *Environmental testing – Part 2-10: Tests – Test J and guidance: Mould growth*
- IEC 60068-2-11, ~~Basic Environmental testing procedures~~ – Part 2-11: Tests – Test Ka: Salt mist
- IEC 60068-2-14, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*
- IEC 60068-2-27, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*
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- IEC 60068-2-31, *Environmental testing – Part 2-31: Tests – Test Ec: Rough handling shocks, primarily for equipment-type specimens*
- IEC 60068-2-60, *Environmental testing – Part 2-60: Tests – Test Ke: Flowing mixed gas corrosion test*
- IEC 60068-2-64, *Environmental testing – Part 2-64: Tests – Test Fh: Vibration, broadband random and guidance*
- IEC 60068-2-75, *Environmental testing – Part 2-75: Tests – Test Eh: Hammer tests*
- IEC 60068-2-78, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*
- IEC 60297 (all parts), *Mechanical structures for electrical and electronic equipment – Dimensions of mechanical structures of the 482,6 mm (19 in) series*
- ~~IEC 60297-3-100, Mechanical structures for electronic equipment – Dimensions of mechanical structures of the 482,6 mm (19 in) series – Part 3-100: Basic dimensions of front panels, subracks, chassis, racks and cabinets~~
- IEC 60917 (all parts), *Modular order for the development of mechanical structures for electrical and electronic equipment practices*
- ~~IEC 60917-1, Modular order for the development of mechanical structures for electrical and electronic equipment practices – Part 1: Generic standard~~
- ~~IEC 60917-2, Modular order for the development of mechanical structures for electronic equipment practices – Part 2: Sectional specification – Interface co-ordination dimensions for the 25 mm equipment practice~~
- ~~IEC 61587-2, Mechanical structures for electronic equipment – Tests for IEC 60917 and IEC 60297 – Part 2: Seismic tests for cabinets and racks~~

~~IEC 61587-3, Mechanical structures for electronic equipment—Tests for IEC 60917 and 60297—Part 3: Electromagnetic shielding performance tests for cabinets and subracks~~

~~IEC 61969-2, Mechanical structures for electronic equipment—Outdoor enclosures—Part 2: Coordination dimensions~~

~~IEC 61969-3, Mechanical structures for electrical and electronic equipment—Outdoor enclosures—Part 3: Environmental requirements, tests and safety aspects~~

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NORME INTERNATIONALE

**Mechanical structures for electrical and electronic equipment – Outdoor enclosures –
Part 1: Design guidelines**

**Structures mécaniques pour équipement électrique et électronique –
Enveloppes de plein air –
Partie 1: Lignes directrices pour la conception**

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CONTENTS

FOREWORD.....	3
INTRODUCTION.....	5
1 Scope.....	6
2 Normative references	7
3 Terms and definitions	8
4 Coordination dimensions	9
5 Environmental requirements, tests and safety aspects.....	9
5.1 Classification of environmental conditions.....	9
5.2 Transportation and installation related mechanical loads	11
5.3 Operational related mechanical loads	11
5.4 Static load capacity.....	11
5.5 Seismic performance	12
6 Electromagnetic shielding.....	12
7 Thermal management and acoustic noise emission	12
Bibliography.....	13
Figure 1 – Typical outdoor enclosure	6
Figure 2 – Locations of outdoor enclosures.....	9
Table 1 – Operating and transportation conditions.....	10
Table 2 – Safety aspects	11

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FOREWORD

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IEC 61969-1 has been prepared by subcommittee 48D: Mechanical structures for electrical and electronic equipment, of IEC technical committee 48: Electrical connectors and mechanical structures for electrical and electronic equipment. It is an International Standard.

This fourth edition cancels and replaces the third edition published in 2020. This edition constitutes a technical revision.

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

- a) added references to the environmental conditions defined by ETSI EN 300 019-1 and IEC 60721-2 series;
- b) reference made to the correct test specifications;
- c) addition of laser hazard warning in case opto-electronic equipment is used.

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

Draft	Report on voting
48D/752/CDV	48D/758/RVC

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 61969 series, published under the general title *Mechanical structures for electrical and electronic equipment – Outdoor enclosures*, can be found on the IEC website.

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

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

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INTRODUCTION

This part of IEC 61969 is intended as a generic guide for the development of further parts within this series of standards, and it provides design guidelines for outdoor enclosures.

The products covered by the IEC 61969 series are empty enclosures for outdoor locations, to be equipped with application-specific combinations of electrical and electronic equipment, and to be used at non-weatherprotected locations above ground.

The IEC 61969 series consists of:

- a design guidelines general part: IEC 61969-1;
- a coordination dimensions standard: IEC 61969-2;
- an environmental requirements and tests, safety aspects standard: IEC 61969-3.

IEC 61969-2 and IEC 61969-3 should be read in conjunction with this document.

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MECHANICAL STRUCTURES FOR ELECTRICAL AND ELECTRONIC EQUIPMENT – OUTDOOR ENCLOSURES –

Part 1: Design guidelines

1 Scope

This part of IEC 61969 contains design guidelines for outdoor enclosures for electrical and electronic equipment and is applicable over a wide field of mechanical, electromechanical and electronic equipment and its installation where a modular design is used.

The objectives of this document are:

- to provide an overview of specifications for enclosures focused on requirements for outdoor applications for stationary use at non-weatherprotected locations, and
- to achieve product integrity under outdoor conditions and to ease product selection for the sourcing of outdoor enclosures from different vendors.

These enclosures are considered to contain any equipment and provide protection for the outdoor installed facilities against unwanted environmental impacts. The installed equipment can be, but is not limited to, subracks or chassis in accordance with the IEC 60917 series or IEC 60297 series. A typical outdoor enclosure is shown in Figure 1.

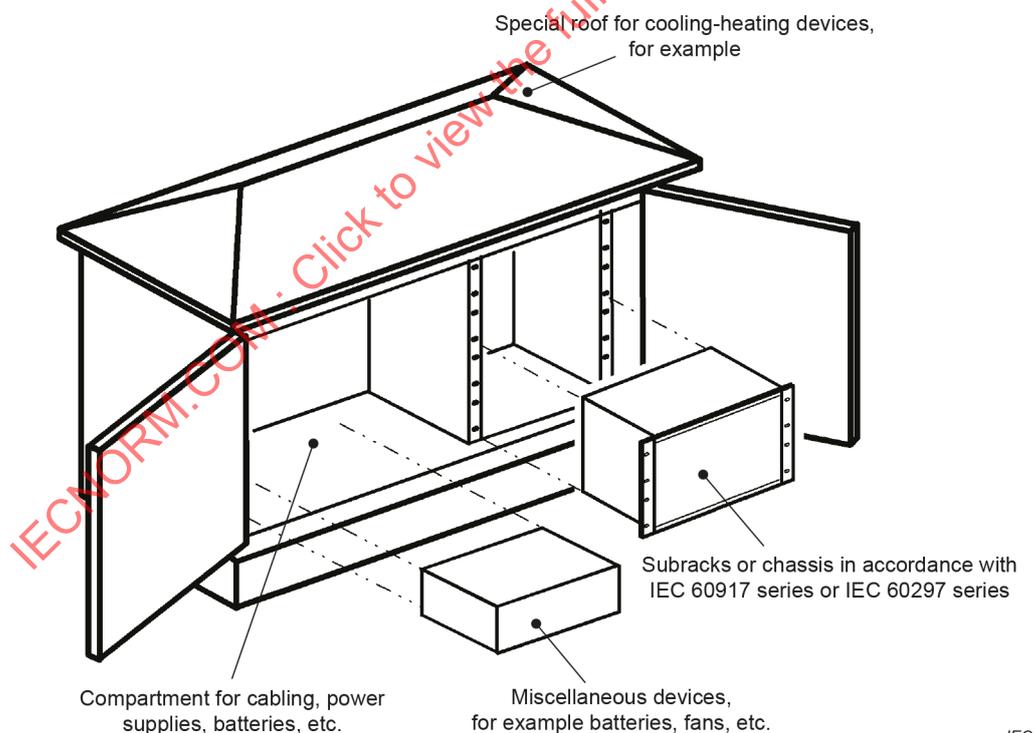


Figure 1 – Typical outdoor enclosure

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

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

IEC 60695-11-10, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods*

IEC 60721-3-2, *Classification of environmental conditions – Part 3-2: Classification of groups of environmental parameters and their severities – Transportation and handling*

IEC 60721-3-4, *Classification of environmental conditions – Part 3-4: Classification of groups of environmental parameters and their severities – Stationary use at non-weatherprotected locations*

IEC 60754-2, *Test on gases evolved during combustion of materials from cables – Part 2: Determination of acidity (by pH measurement) and conductivity*

IEC 60825-1, *Safety of laser products – Part 1: Equipment classification and requirements*

IEC 61034-1, *Measurement of smoke density of cables burning under defined conditions – Part 1: Test apparatus*

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

IEC 61439-5, *Low-voltage switchgear and controlgear assemblies – Part 5: Assemblies for power distribution in public networks*

IEC 61587-1, *Mechanical structures for electrical and electronic equipment – Tests for IEC 60917 and IEC 60297 series – Part 1: Environmental requirements, test setups and safety aspects*

IEC 61587-2, *Mechanical structures for electronic equipment – Tests for IEC 60917 and IEC 60297 – Part 2: Seismic tests for cabinets and racks*

IEC 61587-3, *Mechanical structures for electronic equipment – Tests for IEC 60917 and IEC 60297 – Part 3: Electromagnetic shielding performance tests for cabinets and subracks*

IEC 61969-2, *Mechanical structures for electronic equipment – Outdoor enclosures – Part 2: Coordination dimensions*

IEC 61969-3, *Mechanical structures for electrical and electronic equipment – Outdoor enclosures – Part 3: Environmental requirements, tests and safety aspects*

IEC 62194, *Method of evaluating the thermal performance of enclosures*

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

IEC 62305-4, *Protection against lightning – Part 4: Electrical and electronic systems within structures*

IEC 62368-1, *Audio/video, information and communication technology equipment – Part 1: Safety requirements*

ISO 1518-1, *Paints and varnishes – Determination of scratch resistance – Part 1: Constant-loading method*

ISO 3864-2, *Graphical symbols – Safety colours and safety signs – Part 2: Design principles for product safety labels*

ISO 7779, *Acoustics – Measurement of airborne noise emitted by information technology and telecommunications equipment*

ETSI EN 300 019-1-2, *Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-2: Classification of environmental conditions; Transportation*

ETSI EN 300 019-1-4, *Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-4: Classification of environmental conditions; Stationary use at non-weatherprotected locations*

ETSI EN 300 019-2-2, *Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 2-2: Specification of environmental tests; Transportation*

ETSI EN 300 019-2-4, *Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 2-4: Specification of environmental tests – Stationary use at non-weatherprotected locations*

ETSI EN 300 753, *Environmental Engineering (EE); Acoustic noise emitted by telecommunications equipment*

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

outdoor enclosure

enclosure exposed to an outdoor environment, for stationary use at non-weatherprotected locations, for the protection of electrical and electronic equipment installed inside against outdoor environmental conditions

Note 1 to entry: An outdoor enclosure is applicable for a wide field of equipment (e.g. communication system, industrial or signal control, etc.).

Note 2 to entry: The typical installation locations of outdoor enclosures are shown in Figure 2.

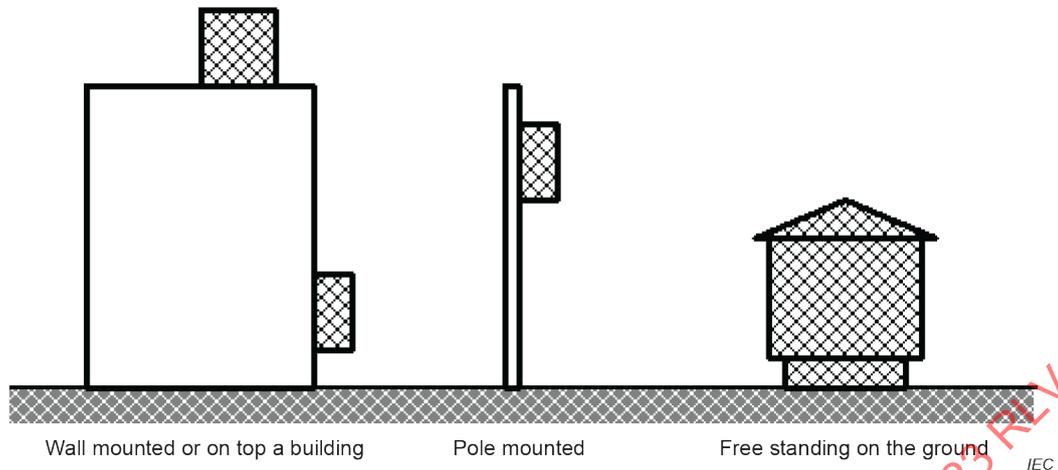


Figure 2 – Locations of outdoor enclosures

3.2 heat transfer rate

k

property with units of $W/(m^2K)$, a measure of the rate of heat transfer

Note 1 to entry: Detailed calculations for determination of the enclosure design dependent heat management properties, including the heat transfer rate, are described in IEC 62194.

4 Coordination dimensions

The dimensions of outdoor enclosures shall consist of coordination dimensions as given in IEC 61969-2. The coordination dimensions provide the range and systematic stipulation of possible enclosure internal and external dimensions.

5 Environmental requirements, tests and safety aspects

5.1 Classification of environmental conditions

The environmental requirements for outdoor enclosures are based on the classification of environmental conditions as defined in IEC 60721-3-2 (transportation) and IEC 60721-3-4 (operating conditions). The relevant tests from the IEC 60068 series with tests severities are given in ETSI EN 300 019-2-2 and ETSI EN 300 019-2-4.

The selection of relevant requirements, as indicated in Table 1 and Table 2, was made with the focus on outdoor specific conditions and on structural design and safety aspects. Details about the selected classes of environmental conditions are given in IEC 61969-3.

Table 1 – Operating and transportation conditions

Conditions		Test requirements
Temperature	IEC 60721-3-2 and IEC 60721-3-4 (or ETSI EN 300 019-1-2 and ETSI EN 300 019-1-4)	IEC 61969-3
Humidity	IEC 60721-3-2 and IEC 60721-3-4 (or ETSI EN 300 019-1-2 and ETSI EN 300 019-1-4)	IEC 61969-3
Atmospheric pressure	IEC 60721-3-2 and IEC 60721-3-4 (or ETSI EN 300 019-1-2 and ETSI EN 300 019-1-4)	ETSI EN 300 019-2-2 and ETSI EN 300 019-2-4
Chemical active substances	IEC 60721-3-2 and IEC 60721-3-4 (or ETSI EN 300 019-1-2 and ETSI EN 300 019-1-4)	IEC 61969-3
Solar (UV light) resistance	IEC 60721-3-2 and IEC 60721-3-4 (or ETSI EN 300 019-1-2 and ETSI EN 300 019-1-4)	IEC 61969-3
Biological resistance	IEC 60721-3-2 and IEC 60721-3-4 (or ETSI EN 300 019-1-2 and ETSI EN 300 019-1-4)	IEC 61969-3
Protection against rodents and birds	Requirements and tests may be part of the user specification	
Protection against insects and termites	Requirements and tests may be part of the user specification	
Weather resistance (rain and wind driven dust or sand)	IEC 60721-3-2 and IEC 60721-3-4 (or ETSI EN 300 019-1-2 and ETSI EN 300 019-1-4)	IEC 61969-3 (including IEC 60529 requirements for intrusion protection)
Thermal management and heat transfer rate k	Temperature inside and on surface of enclosure. Requirements may be application specific	Methods of evaluating the thermal performance of enclosures IEC 62194
Resistance to mechanical stresses	Mechanical loads during transport, installation and operation: <ul style="list-style-type: none"> – impact (IK code according to IEC 62262); – crush; – vibration and shock; – wind resistance; – firearms resistance (optional). 	IEC 61969-3
Acoustical noise emission	ETSI EN 300 753	ISO 7779
Paint (colour, gloss, adhesion, flex, scratch, etc.)	May be part of the users' specification For extreme conditions, anti-graffiti may be required Paints and varnishes – Scratch test	ISO 1518-1, etc.

Table 2 – Safety aspects

Requirement		Test specification
Earth bonding	The responsibility of the vendor is to provide sufficient conductivity between different parts of the enclosure and means for the earth bonding of equipment to protect the user against electric shock as described in IEC 61140	Using IEC 62368-1 and IEC 61439-5 for equipped enclosure
Lifting and stiffness	Requirements for strength of enclosure during installation	IEC 61587-1
Lightning strike	To be observed in the total “bonding network” concept	IEC 62305-4
Vandalism	Requirements shall be part of the vendor specification	Tests may be part of the vendor specification
Warning labels ^a	General warning, caution, risk of danger Caution, risk of life Caution, risk of electric shock Caution, hot surface Caution, laser hazard	ISO 3864-2 ISO 3864-2 ISO 3864-2 IEC 60417 IEC 60825-1
Security, vandalism protection	Requirements for the resistance of the enclosure and the locking devices against unauthorized access	Tests may be part of the user specifications
Flammability	Material properties (e.g. low smoke, zero halogen, flame retardant) may be specified by user. Local regulations can also exist.	IEC 61034-1, IEC 60754-2 IEC 60695-11-10
^a Application of warning labels (on the outside accessible surface and/or inside an outdoor enclosure) is the responsibility of the system integrator, as it depends on a risk assessment on the outdoor enclosure completely populated with the application-specific electrical and electronic equipment.		

5.2 Transportation and installation related mechanical loads

The mechanical loads during transportation and handling at the place of installation shall be considered. If the enclosure is loaded with equipment, the maximum weight should be specified by the vendor in respect to the classification of environmental conditions as under 5.1.

5.3 Operational related mechanical loads

The mechanical loads of the installed product caused by possible environmental influences during operation and maintenance (e.g. vibration, shock, wind, impact and crush) shall be considered. Outdoor enclosures deemed to be installed on ground are considered street enclosures, typically e.g. for traffic controls or last mile telephone line distribution, which need special precautions against physical impacts.

Pole- and wall-mounted enclosures may be out of the reach of persons whereas the weather impact may cause special precaution for the stability of the installation.

5.4 Static load capacity

The design of the enclosure shall take into account the weight capacity of the installed enclosure to avoid collapse or damage of a fully equipped enclosure. The static load capacity of an outdoor enclosure shall be based on the intended transport and handling conditions and the operating conditions at the installation place. The gross weight of enclosure shall include all deemed equipment, multiplied by a safety factor 1,25.

5.5 Seismic performance

In case of installation deemed to occur in a seismic hazard zone, a standard enclosure may be tested with internally mounted dummy loads simulating the equipment and structural anchoring simulating the place of installation.

The results of such tests can be used as reference for the product offering by a standard enclosure vendor, but it does not exempt from final equipment testing.

The test conditions shall be as specified in IEC 61587-2.

6 Electromagnetic shielding

In order to achieve electromagnetic compatibility of a final installation, the enclosure may be part of the total shielding concept. As a pre-test, the shielding performance test may be performed in order to gain the required level of attenuation by the enclosure. The test set-up and the test procedure shall be as specified in IEC 61587-3.

7 Thermal management and acoustic noise emission

Thermal management is the key to survival of electrical and electronic equipment in general but especially if exposed to an outdoor environment.

The heat transfer rate k is important for designing the outdoor enclosure because the value affects the temperature difference between inside and outside of the enclosure.

As a prime measure, thermal insulation against heat and cold from the outside environment shall be considered for the enclosure.

Next, measurement of the heat dissipation from the inside out shall be performed.

If low external temperatures will be experienced, internal heating should be considered.

Depending on the climate conditions and the heat generated inside the enclosure, thermal management may be achieved by passive cooling only.

In cases where the internal temperature of the enclosure would exceed temperature limits, the enclosure may be fitted with active cooling devices, such as filter fans, air to air heat exchangers or air conditioners.

For selection of a suitable active cooling system the required energy consumption (cost factor and impact to the environment) and the local noise level limits should be carefully considered (regulatory requirements in rural and urban areas).

For the method of enclosure thermal performance evaluations, see IEC 62194.

Bibliography

- IEC 60068-2-1, *Environmental testing – Part 2-1: Tests – Test A: Cold*
- IEC 60068-2-2, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*
- IEC 60068-2-5, *Environmental testing – Part 2-5: Tests – Test Sa: Simulated solar radiation at ground level and guidance for solar radiation testing and weathering*
- IEC 60068-2-6, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*
- IEC 60068-2-10, *Environmental testing – Part 2-10: Tests – Test J and guidance: Mould growth*
- IEC 60068-2-11, *Environmental testing – Part 2-11: Tests – Test Ka: Salt mist*
- IEC 60068-2-14, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*
- IEC 60068-2-27, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*
- IEC 60068-2-30, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)*
- IEC 60068-2-31, *Environmental testing – Part 2-31: Tests – Test Ec: Rough handling shocks, primarily for equipment-type specimens*
- IEC 60068-2-60, *Environmental testing – Part 2-60: Tests – Test Ke: Flowing mixed gas corrosion test*
- IEC 60068-2-64, *Environmental testing – Part 2-64: Tests – Test Fh: Vibration, broadband random and guidance*
- IEC 60068-2-75, *Environmental testing – Part 2-75: Tests – Test Eh: Hammer tests*
- IEC 60068-2-78, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*
- IEC 60297 (all parts), *Mechanical structures for electrical and electronic equipment – Dimensions of mechanical structures of the 482,6 mm (19 in) series*
- IEC 60917 (all parts), *Modular order for the development of mechanical structures for electrical and electronic equipment practices*
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SOMMAIRE

AVANT-PROPOS	15
INTRODUCTION.....	17
1 Domaine d'application	18
2 Références normatives	19
3 Termes et définitions	20
4 Dimensions de coordination.....	21
5 Exigences et essais d'environnement, et aspects liés à la sécurité	21
5.1 Classification des conditions d'environnement	21
5.2 Charges mécaniques liées au transport et à l'installation	23
5.3 Charges mécaniques liées au fonctionnement	23
5.4 Capacité de charge statique.....	24
5.5 Performance sismique	24
6 Blindage électromagnétique.....	24
7 Maîtrise de la chaleur et émission de bruit acoustique	24
Bibliographie.....	25
Figure 1 – Enveloppe de plein air typique	18
Figure 2 – Emplacements des enveloppes de plein air.....	21
Tableau 1 – Conditions de fonctionnement et de transport.....	22
Tableau 2 – Aspects de sécurité	23

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

**STRUCTURES MÉCANIQUES POUR ÉQUIPEMENT ÉLECTRIQUE
ET ÉLECTRONIQUE – ENVELOPPES DE PLEIN AIR –****Partie 1: Lignes directrices pour la conception****AVANT-PROPOS**

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L'IEC 61969-1 a été établie par le sous-comité 48D: Structures mécaniques pour les équipements électriques et électroniques, du comité d'études 48 de l'IEC: Connecteurs électriques et structures mécaniques pour les équipements électriques et électroniques. Il s'agit d'une Norme internationale.

Cette quatrième édition annule et remplace la troisième édition parue en 2020. Cette édition constitue une révision technique.

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

- a) ajout de références aux conditions d'environnement définies par les séries ETSI EN 300 019-1 et IEC 60721-2;
- b) référence aux spécifications d'essai correctes;

c) ajout d'un avertissement de danger laser en cas d'utilisation d'équipement optoélectronique.

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

Projet	Rapport de vote
48D/752/CDV	48D/758/RVC

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.

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/publications/.

Une liste de toutes les parties de la série IEC 61969, publiées sous le titre général *Structures mécaniques pour équipement électrique et électronique – Enveloppes de plein air*, se trouve sur le site web de l'IEC.

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

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- amendé.

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INTRODUCTION

La présente partie de l'IEC 61969 est destinée à servir de guide générique pour le développement d'autres parties au sein de cette série de normes, et fournit des lignes directrices pour la conception d'enveloppes de plein air.

Les produits couverts par la série IEC 61969 sont les enveloppes vides pour les emplacements de plein air, destinées à être équipées de combinaisons d'équipements électriques et électroniques spécifiques à l'application, et à être utilisées dans des emplacements non protégés contre les intempéries au-dessus du sol.

La série IEC 61969 comprend:

- une partie générale qui donne les lignes directrices pour la conception: IEC 61969-1;
- une norme qui traite des dimensions de coordination: IEC 61969-2;
- une norme qui traite des exigences et des essais d'environnement et des aspects liés à la sécurité: IEC 61969-3.

Il convient de lire l'IEC 61969-2 et l'IEC 61969-3 conjointement avec le présent document.

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STRUCTURES MÉCANIQUES POUR ÉQUIPEMENT ÉLECTRIQUE ET ÉLECTRONIQUE – ENVELOPPES DE PLEIN AIR –

Partie 1: Lignes directrices pour la conception

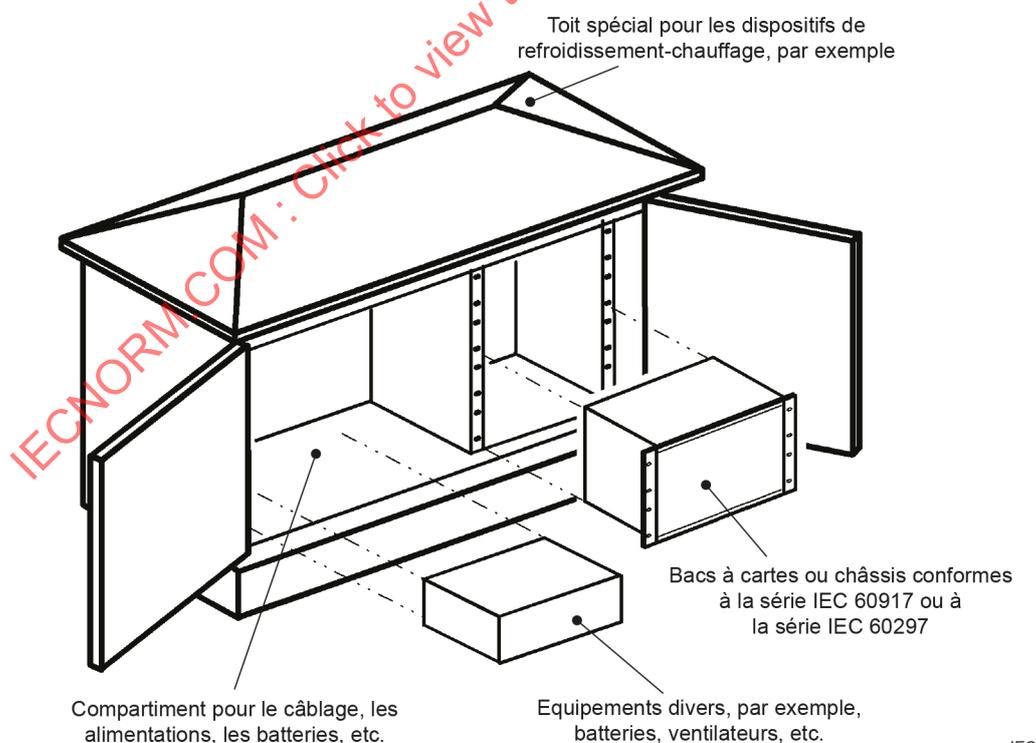
1 Domaine d'application

La présente partie de l'IEC 61969 fournit des lignes directrices pour la conception des enveloppes de plein air pour équipements électriques et électroniques et s'applique à une grande variété d'équipements mécaniques, électromécaniques et électroniques et à leur installation en configuration modulaire.

Le présent document est destiné:

- à fournir une vue d'ensemble des spécifications applicables aux enveloppes, portant essentiellement sur les exigences propres aux applications de plein air pour une utilisation à poste fixe à des emplacements non protégés contre les intempéries; et
- à assurer l'intégrité du produit dans des conditions extérieures et à faciliter le choix du produit lors de l'approvisionnement en enveloppes de plein air auprès des différents fournisseurs.

Ces enveloppes sont supposées contenir tous types d'équipements et protéger les installations situées en plein air contre les effets indésirables dus à l'environnement. L'équipement installé peut, entre autres, être constitué de bacs ou de châssis conformes à la série IEC 60917 ou à la série IEC 60297. Une enveloppe de plein air typique est représentée à la Figure 1.



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Figure 1 – Enveloppe de plein air typique