

INTERNATIONAL STANDARD



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

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

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**MECHANICAL STRUCTURES FOR ELECTRICAL
AND ELECTRONIC EQUIPMENT – OUTDOOR ENCLOSURES –****Part 3: Environmental requirements, tests and safety aspects**

FOREWORD

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International Standard IEC 61969-3 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.

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) alignment with the content of ETSI EN 300 019 and IEC 60721 series latest editions, particularly with the actualization of climate conditions;
- b) new requirements added to reflect market requirements on environmental issues;
- c) improvement on terminology and overall editorial improvement.

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

FDIS	Report on voting
48D/721/FDIS	48D/724/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

This International Standard is to be used in conjunction with IEC 61969-1:2020.

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.

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://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

~~IEC 61969-3 Ed.2.0 provides basic environmental test requirements to be used in the absence of local regulatory or application specific environmental test requirements. This provides manufacturers and users of generic outdoor enclosure solutions with minimum performance compliance criteria; thermal solutions pending on the environment an outdoor enclosure is subjected to.~~

The products covered by IEC 61969 (all parts) are empty enclosures for outdoor locations, to be equipped with application-specific combinations of electrical and electronic equipment, and to be used at non-weather protected locations above ground.

IEC 61969 (all parts) 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).

This document provides basic environmental requirements and tests, as well as safety aspects, to be used for outdoor enclosures in absence of local regulatory documents, or of application-specific environmental test requirements.

This document provides manufacturers and users of generic outdoor enclosures with minimum performance compliance criteria. The thermal management solution depends on the specific environment of the outdoor enclosure.

Since forced air heat dissipation and acoustic noise are closely related, noise limitations are typically defined by local regulatory ~~limitations~~ documents.

~~Typically, it becomes the~~ It is responsibility of the outdoor enclosure vendor to provide a solution for thermal management within the local regulatory noise limitations.

MECHANICAL STRUCTURES FOR ELECTRICAL AND ELECTRONIC EQUIPMENT – OUTDOOR ENCLOSURES –

Part 3: Environmental requirements, tests and safety aspects

1 Scope

This part of IEC 61969 specifies a set of basic environmental requirements and tests, as well as safety aspects for outdoor enclosures under conditions of non-weather protected locations above ground.

The purpose of this document is to define a minimum level of environmental performance in order to meet requirements of storage, transport and final installation. The intention is to establish basic environmental performance criteria for outdoor enclosure compliance.

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 (all parts), Environmental testing~~

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 60068-2-6, *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*

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 60068-2-78, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

~~IEC 60417, Graphical symbols for use on 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: Classification of groups of environmental parameters and their severities – Section 2: Transportation~~

~~IEC 60721-3-4, Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 4: Stationary use at non-weather-protected locations~~

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

~~IEC 60950 (all parts), Information technology equipment – Safety~~

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

~~IEC 61010, Safety requirements for electrical equipment for measurement, control, and laboratory use~~

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

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

IEC 61587-1, *Mechanical structures for electronic equipment – Tests for IEC 60917 and IEC 60297 series – Part 1: Climatic, mechanical tests Environmental requirements, test set-up 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 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, racks and subracks~~

IEC 61969-1:2020, *Mechanical structures for electrical and electronic equipment – Outdoor enclosures – Part 1: Design guidelines*

~~IEC 62194, Methods 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 2533, Standard atmosphere~~

ISO 3744, *Acoustics – Determination of sound power levels and sound energy levels of noise sources using sound pressure – Engineering methods for an essentially free field over a reflecting plane*

~~ISO 3864, Graphical symbols – Safety colours and safety signs~~

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

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

3 Terms and definitions

For the purposes of this document, the ~~following~~ terms and definitions given in IEC 61969-1 apply.

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

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

~~3.1~~

~~outdoor enclosure~~

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

~~3.2~~

~~non-weatherprotected location~~

~~place with direct weather influence~~

4 Coordination dimensions

This clause of IEC 61969-1:2020 applies.

5 Environmental requirements, tests and safety aspects – Classification of environmental conditions

The environmental conditions are derived from IEC 60721-3-4, with the focus on empty outdoor enclosures relevant requirements.

Class 1: Non-weatherprotected location: Covers all regions with a moderate climate.

Class 2: Non-weatherprotected locations, extended: Covers all regions with severe climate.

The individual outdoor enclosure ~~product solution~~ tested to these basic environmental test requirements may claim compliance to either class 1 or class 2 or a combination of class 1/class 2.

6 Test conditions

6.1 General

The basic test conditions shown in Table 1, Table 2, Table 3 and Table 4 reflect typical outdoor enclosure environments to be endured.

6.2 Climatic tests

Table 1 – Climatic conditions for environmental classes 1 and 2

	Environmental parameters	Test severity		Duration	IEC method
		Class 1	Class 2		
a	Low air temperature	-45 °C	-65 °C	16 h	60068-2-1: A
b	High air temperature	80 °C	90 °C	16 h	60068-2-2: B
c	Damp heat	30 °C, 93 %	30 °C, 93 %	96 h	60068-2-78: Cb
d	Rate of change of temperature	-50 °C to +23 °C 1 °C/min	-50 °C to +23 °C 1 °C/min	2 cycles	60068-2-14: Nb
e	Solar radiation	1 120 W/m ²	1 120 W/m ²	172 h/ 40 °C	60068-2-5: Sa
f	Condensation	40 °C 90 % to 100 % RH	40 °C 90 % to 100 % RH	96 h	60068-2-30: Db
g	Precipitation (rain, snow, hail, dust, etc.)	IP 54	IP 55	-	60529
h	Movement of the surrounding air	50 m/s	60 m/s	-	-
i	Formation of ice and frost	Yes	Yes	-	-
j	Ultraviolet degradation test	Yes	Yes	-	ISO 4892-2
NOTE – For comparable conditions the International Standard Air, in accordance to ISO 2533 (15 °C at 1 013, 25 hPa) shall be used.					

	Environmental parameters	Test severity		Duration	Method
		Class 1	Class 2		
a	Low air temperature	-40 °C	-50 °C	16 h	IEC 60068-2-1: A
b	High air temperature ¹	+85 °C	+85 °C	16 h	IEC 60068-2-2: B
c	Damp heat	+30 °C, 93 %	+30 °C, 93 %	96 h	IEC 60068-2-78: Cb
d	Change of temperature	-40 °C to +23 °C 1 °C/min	-40 °C to +85 °C 1 °C/min	2 cycles	IEC 60068-2-14: Nb
e	Condensation	90 % to 100 % RH	90 % to 100 % RH	144 h (6 cycles)	IEC 60068-2-30: Db
f	Precipitation (rain, snow, hail, etc.)	IPX4	IPX5	-	IEC 60529
g	Movement of the surrounding air	50 m/s	60 m/s	-	-
h	Formation of ice and frost	Minimum requirement: No mechanical deformation			-

i	Ultraviolet degradation	Minimum requirement: No reduction in mechanical properties (tensile strength and elongation at yield) by more than 20 %.	ISO 4892-2
For comparable conditions, the International Standard Air, in accordance to ISO 2533 (15 °C at 1 013, 25 hPa) shall be used.			
¹ This maximum temperature includes the effects of heat dissipation caused by active electronics and includes solar load.			

Following the test, compliance is checked by visual inspection of the internal and external parts; no rust, cracking or other deterioration shall be detected with impact to the required function; no ingress of water.

Hinges, locks and handles for example shall be in operating condition.

The test in accordance with Table 1, item **h**, shall prove that access to the internal equipment is possible without causing permanent degradation of protection levels.

6.3 Biological tests

Table 2 – Biological tests

	Environmental parameters	Test severity		Purpose	IEC-method
		Class 1	Class 2		
a	Flora: Presence of mould, fungus, etc.	Yes	Yes	To check the material for resistance	60068-2-10
b	Fauna: Presence of rodents and others harmful to the equipment	Yes, but without termites	Yes, but with termites		

	Environmental parameters	Test severity		Purpose	Method
		Class 1	Class 2		
a	Flora: Presence of mould, fungus, etc.	Minimum requirement: No reduction in mechanical properties (tensile strength and elongation at yield) by more than 20 %.		To check the material for resistance	IEC 60068-2-10: J
b	Fauna: Presence of rodents and others harmful to the equipment				

Following the test, compliance is checked by visual inspection.

6.4 Tests of resistance against chemically active substances

Table 3 – Tests of resistance against chemically active substances

(Similar to IEC 60721-3-4, Class 4C2)

	Environmental parameters	Test severity		Duration	IEC method
		Class 1 Mean value	Class 2 Maximum value		
a	Salts: Sea and road salt mist	Yes, at 35 °C, 5 % NaCl		4 days	60068-2-11; Ka
b	Sulphur dioxide ^a	0,3 mg/m ³ 0,11 cm ³ /m ³	1,0 mg/m ³ 0,37 cm ³ /m ³	10 days	60068-2-60; Ke
c	Hydrogen sulphide ^a	0,1 mg/m ³ 0,071 cm ³ /m ³	0,5 mg/m ³ 0,36 cm ³ /m ³		
d	Chlorine ^a	0,1 mg/m ³ 0,034 cm ³ /m	0,3 mg/m ³ 0,1 cm ³ /m ³		
e	Nitrogen oxides ^a	0,5 mg/m ³ 0,26 cm ³ /m ³	1,0 mg/m ³ 0,52 cm ³ /m ³		
^a —The tests may be performed by a four component mixture of these gases. Tests of Table 3 may be combined with tests of Table 1.					

	Environmental parameters	Test severity		Duration	Method
		Class 1 Mean value	Class 2 Maximum value		
a	Salts: Sea and road salt mist	+35 °C, 5 % NaCl		4 weeks (672 h)	IEC 60068-2-11: Ka
b	Sulphur dioxide ¹	0,3 mg/m ³ 0,11 cm ³ /m ³	1,0 mg/m ³ 0,37 cm ³ /m ³	10 days	IEC 60068-2-60: Ke
c	Hydrogen sulphide ¹	0,1 mg/m ³ 0,071 cm ³ /m ³	0,5 mg/m ³ 0,36 cm ³ /m ³		
d	Chlorine ¹	0,1 mg/m ³ 0,034 cm ³ /m	0,3 mg/m ³ 0,1 cm ³ /m ³		
e	Nitrogen oxides ¹	0,5 mg/m ³ 0,26 cm ³ /m ³	1,0 mg/m ³ 0,52 cm ³ /m ³		
¹ Tests of Table 3 may be combined with tests of Table 1.					

Following each of the tests of Table 3, compliance is checked by visual inspection of the outside of the used materials or coatings.

Surface corrosion of the protective enclosure is allowed.

The enclosure design shall provide protection for electromagnetic interference gaskets and for protective earthing contacts, where no corrosion is permitted.

6.5 Tests of resistance against mechanically active substances

Table 4 – Tests of resistance against mechanically active substances

	Environmental parameters	Test severity Classes 1 and 2	IEC method
a	Sand	IP-50 (see note)	60529
b	Dust (suspension)		
c	Dust (sedimentation)		
NOTE—No measurable dust shall have entered the enclosure (this assessment is more severe than IEC 60529).			

	Environmental parameters	Test severity Classes 1 and 2	Method
a	Sand	IP5X	IEC 60529
b	Dust (suspension)		
c	Dust (sedimentation)		

~~Following the test, compliance is checked by visual inspection.~~

Following the test, shall be executed according to the next assessment: no measurable dust shall have entered the enclosure (this is more severe than in IEC 60529 for IP5X, and IP6X may be applied for an intended requirement).

7 Mechanical tests

7.1 General

The purpose of these mechanical tests is to ensure that the outdoor enclosure will withstand handling, storage, transport and protect installed equipment from exposure to mechanical stress. For seismic compliance, see Clause 9. Installations in public areas typically require compliance to more severe local regulatory laws. These and any additional application specific requirements need to be observed. Should the outdoor enclosure be installed in a public place, the power input requirements may have to be in compliance with IEC 61439-5.

7.2 **Dynamic Transport tests**

The dynamic tests of an outdoor enclosure shall be conducted under the intended transport conditions. Since outdoor enclosure dynamic transport stress is considerably more severe than typical handling and storage stress, no further dynamic tests are required. For the purpose of this test, no transport packing material is used. The outdoor enclosure shall be mounted to the shock/vibration table by using the intended ground/floor mounting features. ~~For the purpose of the dynamic test the outdoor enclosure static load shall be agreed between the vendor and user.~~

~~The chosen severity classes are similar to IEC 60721-3-2, class 2M1.~~

Table 5 shows the chosen severity classes.

Table 5 – Vibration and shock test

	Environmental parameters	Test severity		IEC method/ ETSI EN
		Class 1 (controlled transport condition)	Class 2 (limited transport condition)	
a	Vibration, sinusoidal 3 axes, 10 cycles	2-9 Hz/3,5 mm displacement 9-200 Hz/10 m/s ² acceleration 200-500 Hz/15 m/s ² acceleration	5-9 Hz/3,5 mm displacement 9-200 Hz/10 m/s ² acceleration 200-500 Hz/15 m/s ² acceleration	60068-2-6: Fc
b ^{††}	Vibration, random	-	5-20 Hz: 1 m ² /s ⁴ /Hz 20-200 Hz: -3 dB/oct	ETSI EN 300019-2-2 Class 2.3
c	Shock, 1/2 sine wave vertical axes only No of shocks: 3	Peak acceleration 100 m/s ² Time: 11 ms	Peak acceleration 100 m/s ² Time: 11 ms	60068-2-27: Ea Shock response spectrum type I
d	Free fall: enclosure mass < 20 kg 20 kg to 100 kg > 100 kg	0,25 m 0,25 m 0,10 m	1,25 m 1,00 m 0,25 m	60068-2-32: Ed
^{††} Alternative test.				

	Environmental parameters	Test severity		Method
		Class 1 (controlled transport condition)	Class 2 (limited transport condition)	
a	Vibration, sinusoidal 3 axes, 10 cycles	5 Hz to 9 Hz/3,5 mm displacement 9 Hz-200 Hz/10 m/s ² acceleration 200 Hz to 500 Hz/15 m/s ² acceleration	5 Hz to 9 Hz/3,5 mm displacement 9 Hz to 200 Hz/10 m/s ² acceleration 200 Hz to 500 Hz/15 m/s ² acceleration	IEC 60068-2-6: Fc
b ¹	Vibration, random	-	5 Hz to 20 Hz: 11 m ² /s ³ 20 Hz to 200 Hz: -3 dB/oct.	ETSI EN 300 019-2-2 Class 2.3
c	Shock, 1/2 sine wave vertical axes only No of shocks: 3	Peak acceleration 100 m/s ² Time: 11 ms	Peak acceleration 100 m/s ² Time: 11 ms	IEC 60068-2-27: Ea Shock response spectrum type I
d ²	Free fall: enclosure mass < 20 kg 20 kg to 100 kg > 100 kg	0,25 m 0,25 m 0,10 m	1,25 m 1,00 m 0,25 m	IEC 60068-2-31: Ec
¹ Alternative test.				
² The test is excited in the packaging condition.				

Following the test, no deformation or damage of parts that affect form, fit and function shall be found.

7.3 Lifting and stiffness test

If lifting eyes are provided, the performance test as per IEC 61587-1 shall be applied.

Following the test, no deformation or damage of parts that affect form, fit and function shall be found.

8 Safety aspects

8.1 General

General safety requirements: The outdoor enclosure shall ~~consider adequate design considerations to be of~~ not present a danger ~~and~~ or hazard to people and shall prevent unauthorized access. To protect authorized personnel (during assembly, installation, test and maintenance phases), the outdoor enclosure shall be free of defects such as sharp edges, burrs, etc. Compliance to IEC 60950-1 and IEC 62368-1 is required, as applicable, for the electrical and electronic equipment that is installed inside the outdoor enclosure.

NOTE The above safety standards do not directly apply to an empty outdoor enclosure.

Regulatory safety requirements: The outdoor enclosure shall also comply with the local enforced regulatory safety requirements.

Table 6 – 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	Using IEC 60950 and IEC 61439-5 for equipped enclosure IEC 61010/60825
Lightning strike	To be observed in the total "Earth bonding" 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	General warning, caution, risk of danger Caution, risk of life Caution, risk of electric shock Caution, hot surface	ISO 3864, B.3.1 ISO 3864, B.3.2 ISO 3864, B.3.6 IEC 60417
Security, vandalism protection	Requirements for the resistance of the enclosure and the locking devices against unauthorised access	Tests may be part of the user specifications
Flammability	Material properties may be specified by user	IEC 60695-11-10

For requirements and relevant tests covering safety aspects, both general and of local regulatory (to be agreed between vendor and user), Table 2 of IEC 61969-1:2020 shall apply.

8.2 Locking devices

Outdoor enclosure access locking functions such as used on doors, covers, roofs, etc. are application and/or regulatory specific. The outdoor enclosure shall have the capability to be locked and unlocked only by authorized crafts people.

8.3 Vandalism resistance

Outdoor enclosure vandalism resistance required on any locking functions such as used with doors, covers, roofs, etc. are application and/or regulatory specific. The outdoor enclosure shall provide for heavy duty key locking and hinges hardware.

Compliance check: The outdoor enclosure shall be resistant to unauthorized access ~~by the use of typical tools such as screw drivers, pliers, hammers, etc.~~ Test method shall be agreed between vendor and user.

8.4 ~~Bullet~~ Firearms resistance (optional)

Outdoor enclosure ~~bullet~~ firearms resistance is application and/or regulatory specific.

The outdoor enclosure shall be designed for withstanding a 12 gauge shotgun blast of no. 7 ½ shot at a distance of 15 m without penetration of the enclosure wall by any pellets.

Test procedure:

The enclosure shall be positioned as in a typical installation and all unique vertical surfaces shall be subjected to a blast from a 12 gauge shotgun ~~with No. 7 ½ size shot~~ fired at a distance of 15 m. The load used shall be a ~~high brass~~ 70 mm shell ~~fired~~ loaded with 28 or 32 grams of no. 6 steel shot fired from ~~an improved~~ or a 28 inch modified choke barrel.

Assessment following the test:

The outer skin of the enclosure may be deformed but still maintaining protection, ~~and~~ without any ~~protrusions~~ penetration of the enclosure wall by any pellets.

9 Seismic requirements

Outdoor enclosure seismic compliance is application and/or regulatory specific. If seismic compliance is requested, tests shall be conducted in accordance with IEC 61587-2.

10 Electromagnetic shielding performance

This requirement is optional, dependent on the area where needed.

If electromagnetic shielding compliance is required, test should be conducted in accordance with IEC 61587-3 unless otherwise specified.

11 Thermal management

For the operation of electronic equipment housed in outdoor enclosures, passive and/or active thermal management devices are used. Since the active heat management devices typically include fans, noise emission may have to comply with local regulatory requirements. Preferably, outdoor enclosure heat management should be based on convection air cooling (passive). If

environmental compliance testing is required, tests should be conducted in accordance with IEC 62194 unless otherwise specified.

12 Noise emission

The final location of the installed outdoor enclosure will determine the noise limits tolerated. Typically, regional and location specific regulatory requirements are in place. Sound power noise tests shall be conducted in accordance with ISO 3744, unless otherwise specified. The noise may be generated by the installed equipment and/or by thermal management solutions.

To simplify the approval process it is always recommended to explore the possibilities of passive convection cooling first. This may be achieved by applying strategically placed heat sinks and/or double wall enclosure designs. Power emission, thermal management and noise limitations will have to be considered for the final application.

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Mechanical structures for electrical and electronic equipment – Outdoor enclosures –

Part 3: Environmental requirements, tests and safety aspects

Structures mécaniques pour équipement électrique et électronique – Enveloppes de plein air –

Partie 3: Exigences et essais d'environnement, et aspects liés à la sécurité

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**MECHANICAL STRUCTURES FOR ELECTRICAL AND
ELECTRONIC EQUIPMENT – OUTDOOR ENCLOSURES –****Part 3: Environmental requirements, tests and safety aspects****FOREWORD**

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International Standard IEC 61969-3 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.

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) alignment with the content of ETSI EN 300 019 and IEC 60721 series latest editions, particularly with the actualization of climate conditions;
- b) new requirements added to reflect market requirements on environmental issues;
- c) improvement on terminology and overall editorial improvement.

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

FDIS	Report on voting
48D/721/FDIS	48D/724/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

This International Standard is to be used in conjunction with IEC 61969-1:2020.

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.

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

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

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

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INTRODUCTION

The products covered by IEC 61969 (all parts) are empty enclosures for outdoor locations, to be equipped with application-specific combinations of electrical and electronic equipment, and to be used at non-weather protected locations above ground.

IEC 61969 (all parts) 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).

This document provides basic environmental requirements and tests, as well as safety aspects, to be used for outdoor enclosures in absence of local regulatory documents, or of application-specific environmental test requirements.

This document provides manufacturers and users of generic outdoor enclosures with minimum performance compliance criteria. The thermal management solution depends on the specific environment of the outdoor enclosure.

Since forced air heat dissipation and acoustic noise are closely related, noise limitations are typically defined by local regulatory documents.

It is responsibility of the outdoor enclosure vendor to provide a solution for thermal management within the local regulatory noise limitations.

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MECHANICAL STRUCTURES FOR ELECTRICAL AND ELECTRONIC EQUIPMENT – OUTDOOR ENCLOSURES –

Part 3: Environmental requirements, tests and safety aspects

1 Scope

This part of IEC 61969 specifies a set of basic environmental requirements and tests, as well as safety aspects for outdoor enclosures under conditions of non-weather protected locations above ground.

The purpose of this document is to define a minimum level of environmental performance in order to meet requirements of storage, transport and final installation. The intention is to establish basic environmental performance criteria for outdoor enclosure compliance.

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 60068-2-1, *Environmental testing – Part 2-1: Tests – Test A: Cold*

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

IEC 60068-2-6, *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*

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 60068-2-78, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

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

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

IEC 61587-1, *Mechanical structures for electronic equipment – Tests for IEC 60917 and IEC 60297 series – Part 1: Environmental requirements, test set-up 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 60297 – Part 2: Seismic tests for cabinets and racks*

IEC 61969-1:2020, *Mechanical structures for electrical and electronic equipment – Outdoor enclosures – Part 1: Design guidelines*

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

ISO 3744, *Acoustics – Determination of sound power levels and sound energy levels of noise sources using sound pressure – Engineering methods for an essentially free field over a reflecting plane*

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

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*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61969-1 apply.

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

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

4 Coordination dimensions

This clause of IEC 61969-1:2020 applies.

5 Environmental requirements, tests and safety aspects – Classification of environmental conditions

The environmental conditions are derived from IEC 60721-3-4, with the focus on empty outdoor enclosures relevant requirements.

Class 1: Non-weatherprotected location: Covers all regions with a moderate climate.

Class 2: Non-weatherprotected locations, extended: Covers all regions with severe climate.

The individual outdoor enclosure tested to these basic environmental test requirements may claim compliance to either class 1 or class 2 or a combination of class 1/class 2.

6 Test conditions

6.1 General

The basic test conditions shown in Table 1, Table 2, Table 3 and Table 4 reflect typical outdoor enclosure environments to be endured.

6.2 Climatic tests

Table 1 – Climatic conditions for environmental classes 1 and 2

	Environmental parameters	Test severity		Duration	Method
		Class 1	Class 2		
a	Low air temperature	−40 °C	−50 °C	16 h	IEC 60068-2-1: A
b	High air temperature ¹	+85 °C	+85 °C	16 h	IEC 60068-2-2: B
c	Damp heat	+30 °C, 93 %	+30 °C, 93 %	96 h	IEC 60068-2-78: Cb
d	Change of temperature	−40 °C to +23 °C 1 °C/min	−40 °C to + 85 °C 1 °C/min	2 cycles	IEC 60068-2-14: Nb
e	Condensation	90 % to 100 % RH	90 % to 100 % RH	144 h (6 cycles)	IEC 60068-2-30: Db
f	Precipitation (rain, snow, hail, etc.)	IPX4	IPX5	-	IEC 60529
g	Movement of the surrounding air	50 m/s	60 m/s	-	-
h	Formation of ice and frost	Minimum requirement: No mechanical deformation			-
i	Ultraviolet degradation	Minimum requirement: No reduction in mechanical properties (tensile strength and elongation at yield) by more than 20 %.			ISO 4892-2

For comparable conditions, the International Standard Air, in accordance to ISO 2533 (15 °C at 1 013, 25 hPa) shall be used.

¹ This maximum temperature includes the effects of heat dissipation caused by active electronics and includes solar load.

Following the test, compliance is checked by visual inspection of the internal and external parts; no rust, cracking or other deterioration shall be detected with impact to the required function; no ingress of water.

Hinges, locks and handles for example shall be in operating condition.

The test in accordance with Table 1, item h, shall prove that access to the internal equipment is possible without causing permanent degradation of protection levels.

6.3 Biological tests

Table 2 – Biological tests

	Environmental parameters	Test severity		Purpose	Method
		Class 1	Class 2		
a	Flora: Presence of mould, fungus, etc.	Minimum requirement: No reduction in mechanical properties (tensile strength and elongation at yield) by more than 20 %.		To check the material for resistance	IEC 60068-2-10: J
b	Fauna: Presence of rodents and others harmful to the equipment				

Following the test, compliance is checked by visual inspection.

6.4 Tests of resistance against chemically active substances

Table 3 – Tests of resistance against chemically active substances

	Environmental parameters	Test severity		Duration	Method
		Class 1 Mean value	Class 2 Maximum value		
a	Salts: Sea and road salt mist	+35 °C, 5 % NaCl		4 weeks (672 h)	IEC 60068-2-11: Ka
b	Sulphur dioxide ¹	0,3 mg/m ³ 0,11 cm ³ /m ³	1,0 mg/m ³ 0,37 cm ³ /m ³	10 days	IEC 60068-2-60: Ke
c	Hydrogen sulphide ¹	0,1 mg/m ³ 0,071 cm ³ /m ³	0,5 mg/m ³ 0,36 cm ³ /m ³		
d	Chlorine ¹	0,1 mg/m ³ 0,034 cm ³ /m	0,3 mg/m ³ 0,1 cm ³ /m ³		
e	Nitrogen oxides ¹	0,5 mg/m ³ 0,26 cm ³ /m ³	1,0 mg/m ³ 0,52 cm ³ /m ³		
¹ Tests of Table 3 may be combined with tests of Table 1.					

Following each of the tests of Table 3, compliance is checked by visual inspection of the outside of the used materials or coatings.

Surface corrosion of the protective enclosure is allowed.

The enclosure design shall provide protection for electromagnetic interference gaskets and for protective earthing contacts, where no corrosion is permitted.

6.5 Tests of resistance against mechanically active substances

Table 4 – Tests of resistance against mechanically active substances

	Environmental parameters	Test severity Classes 1 and 2	Method
a	Sand	IP5X	IEC 60529
b	Dust (suspension)		
c	Dust (sedimentation)		

Following the test, shall be executed according to the next assessment: no measurable dust shall have entered the enclosure (this is more severe than in IEC 60529 for IP5X, and IP6X may be applied for an intended requirement).

7 Mechanical tests

7.1 General

The purpose of these mechanical tests is to ensure that the outdoor enclosure will withstand handling, storage, transport and protect installed equipment from exposure to mechanical stress. For seismic compliance, see Clause 9. Installations in public areas typically require compliance to more severe local regulatory laws. These and any additional application specific requirements need to be observed. Should the outdoor enclosure be installed in a public place, the power input requirements may have to be in compliance with IEC 61439-5.

7.2 Transport tests

The dynamic tests of an outdoor enclosure shall be conducted under the intended transport conditions. Since outdoor enclosure dynamic transport stress is considerably more severe than typical handling and storage stress, no further dynamic tests are required. For the purpose of this test, no transport packing material is used. The outdoor enclosure shall be mounted to the shock/vibration table by using the intended ground/floor mounting features.

Table 5 shows the chosen severity classes.

Table 5 – Vibration and shock test

	Environmental parameters	Test severity		Method
		Class 1 (controlled transport condition)	Class 2 (limited transport condition)	
a	Vibration, sinusoidal 3 axes, 10 cycles	5 Hz to 9 Hz/3,5 mm displacement 9 Hz-200 Hz/10 m/s ² acceleration 200 Hz to 500 Hz/15 m/s ² acceleration	5 Hz to 9 Hz/3,5 mm displacement 9 Hz to 200 Hz/10 m/s ² acceleration 200 Hz to 500 Hz/15 m/s ² acceleration	IEC 60068-2-6: Fc
b ¹	Vibration, random	-	5 Hz to 20 Hz: 11 m ² /s ³ 20 Hz to 200 Hz: -3 dB/oct.	ETSI EN 300 019-2-2 Class 2.3
c	Shock, 1/2 sine wave vertical axes only No of shocks: 3	Peak acceleration 100 m/s ² Time: 11 ms	Peak acceleration 100 m/s ² Time: 11 ms	IEC 60068-2-27: Ea Shock response spectrum type I
d ²	Free fall: enclosure mass < 20 kg 20 kg to 100 kg > 100 kg	0,25 m 0,25 m 0,10 m	1,25 m 1,00 m 0,25 m	IEC 60068-2-31: Ec
¹ Alternative test. ² The test is excited in the packaging condition.				

Following the test, no deformation or damage of parts that affect form, fit and function shall be found.

7.3 Lifting and stiffness test

If lifting eyes are provided, the performance test as per IEC 61587-1 shall be applied.

Following the test, no deformation or damage of parts that affect form, fit and function shall be found.

8 Safety aspects

8.1 General

General safety requirements: The outdoor enclosure shall not present a danger or hazard to people and shall prevent unauthorized access. To protect authorized personnel (during assembly, installation, test and maintenance phases), the outdoor enclosure shall be free of defects such as sharp edges, burrs, etc. Compliance to IEC 60950-1 and IEC 62368-1 is required, as applicable, for the electrical and electronic equipment that is installed inside the outdoor enclosure.

NOTE The above safety standards do not directly apply to an empty outdoor enclosure.

Regulatory safety requirements: The outdoor enclosure shall also comply with the local enforced regulatory safety requirements.

For requirements and relevant tests covering safety aspects, both general and of local regulatory (to be agreed between vendor and user), Table 2 of IEC 61969-1:2020 shall apply.

8.2 Locking devices

Outdoor enclosure access locking functions such as used on doors, covers, roofs, etc. are application and/or regulatory specific. The outdoor enclosure shall have the capability to be locked and unlocked only by authorized crafts people.

8.3 Vandalism resistance

Outdoor enclosure vandalism resistance required on any locking functions such as used with doors, covers, roofs, etc. are application and/or regulatory specific. The outdoor enclosure shall provide for heavy duty key locking and hinges hardware.

Compliance check: The outdoor enclosure shall be resistant to unauthorized access. Test method shall be agreed between vendor and user.

8.4 Firearms resistance (optional)

Outdoor enclosure firearms resistance is application and/or regulatory specific.

The outdoor enclosure shall be designed for withstanding a 12 gauge shotgun blast of no. 7 ½ shot at a distance of 15 m without penetration of the enclosure wall by any pellets.

Test procedure:

The enclosure shall be positioned as in a typical installation and all unique vertical surfaces shall be subjected to a blast from a 12 gauge shotgun fired at a distance of 15 m. The load used shall be a 70 mm shell loaded with 28 or 32 grams of no. 6 steel shot fired from a 28 inch modified choke barrel.

Assessment following the test:

The outer skin of the enclosure may be deformed but still maintaining protection, and without any penetration of the enclosure wall by any pellets.

9 Seismic requirements

Outdoor enclosure seismic compliance is application and/or regulatory specific. If seismic compliance is requested, tests shall be conducted in accordance with IEC 61587-2.

10 Electromagnetic shielding performance

This requirement is optional, dependent on the area where needed.

If electromagnetic shielding compliance is required, test should be conducted in accordance with IEC 61587-3 unless otherwise specified.

11 Thermal management

For the operation of electronic equipment housed in outdoor enclosures, passive and/or active thermal management devices are used. Since the active heat management devices typically include fans, noise emission may have to comply with local regulatory requirements. Preferably, outdoor enclosure heat management should be based on convection air cooling (passive). If environmental compliance testing is required, tests should be conducted in accordance with IEC 62194 unless otherwise specified.

12 Noise emission

The final location of the installed outdoor enclosure will determine the noise limits tolerated. Typically, regional and location specific regulatory requirements are in place. Sound power noise tests shall be conducted in accordance with ISO 3744, unless otherwise specified. The noise may be generated by the installed equipment and/or by thermal management solutions.

To simplify the approval process it is always recommended to explore the possibilities of passive convection cooling first. This may be achieved by applying strategically placed heat sinks and/or double wall enclosure designs. Power emission, thermal management and noise limitations will have to be considered for the final application.

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

**STRUCTURES MÉCANIQUES POUR ÉQUIPEMENT ÉLECTRIQUE
ET ÉLECTRONIQUE – ENVELOPPES DE PLEIN AIR –****Partie 3: Exigences et essais d'environnement,
et aspects liés à la sécurité**

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La Norme internationale IEC 61969-3 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.

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) alignement avec le contenu des dernières éditions des séries ETSI EN 300 019 et IEC 60721, en particulier concernant l'actualisation des conditions climatiques;
- b) ajout de nouvelles exigences pour refléter celles du marché relatives aux questions environnementales;
- c) amélioration de la terminologie et modifications éditoriales générales.

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

FDIS	Rapport de vote
48D/721/FDIS	48D/724/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de la présente Norme internationale.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2.

Cette Norme Internationale doit être utilisée conjointement avec l'IEC 61969-1:2020.

Une liste de toutes les parties de la série IEC 61969, publiées sous le titre général *Structures mécaniques pour les équipements électriques et électroniques – Enveloppes de plein air*, peut être consultée sur le site web de l'IEC.

Les futures normes de cette série porteront dorénavant le nouveau titre général cité ci-dessus. Le titre des normes existant déjà dans cette série sera mis à jour lors de la prochaine édition.

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 "<http://webstore.iec.ch>" dans les données relatives au document recherché. A cette date, le document sera

- reconduit,
- supprimé,
- remplacé par une édition révisée, ou
- amendé.

INTRODUCTION

Les produits couverts par l'IEC 61969 (toutes les parties) 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.

L'IEC 61969 (all parts) comprend:

- une partie générale donnant les lignes directrices pour la conception (IEC 61969-1);
- une norme traitant des dimensions de coordination (IEC 61969-2);
- une norme détaillant les exigences et essais d'environnement, et les aspects liés à la sécurité (IEC 61969-3).

Le présent document fournit les exigences et les essais d'environnement de base, ainsi que les aspects liés à la sécurité, à utiliser pour les enveloppes de plein air en l'absence de documents réglementaires locaux ou d'exigences d'essais d'environnement spécifiques à l'application.

Il offre aux fabricants et aux utilisateurs d'enveloppes de plein air génériques des critères minimaux de conformité de performances. La solution de gestion thermique dépend de l'environnement de l'enveloppe de plein air.

Etant donné que la dissipation de chaleur par circulation d'air forcée et le bruit acoustique sont étroitement liés, les limites de bruit sont généralement définies par les documents réglementaires locaux.

Il incombe au fournisseur d'enveloppes de plein air de fournir une solution liée à la gestion thermique respectant les limites de bruit réglementaires locales.

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

Partie 3: Exigences et essais d'environnement, et aspects liés à la sécurité

1 Domaine d'application

La présente partie de l'IEC 61969 spécifie un ensemble d'exigences et d'essais d'environnement de base, ainsi que les aspects liés à la sécurité relatifs aux enveloppes de plein air placées dans les conditions suivantes: emplacement non protégé contre les intempéries, au-dessus du sol.

L'objet du présent document est de définir un niveau minimal de performances environnementales, afin de répondre aux exigences de stockage, de transport et d'installation finale. Il s'agit d'établir des critères de performances environnementales de base en vue de la conformité des enveloppes de plein air.

2 Références normatives

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

IEC 60068-2-1, *Essais d'environnement – Partie 2-1: Essais – Essais A: Froid*

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

IEC 60068-2-6, *Essais d'environnement – Partie 2-6: Essais – Essai Fc: Vibrations (sinusoïdales)*

IEC 60068-2-10, *Essais d'environnement – Partie 2-10: Essais – Essai J et guide: Moisissures*

IEC 60068-2-11, *Essais fondamentaux climatiques et de robustesse mécanique – Partie 2-11: Essais – Essai Ka: Brouillard salin*

IEC 60068-2-14, *Essais d'environnement – Partie 2-14: Essais – Essai N: Variation de température*

IEC 60068-2-27, *Essais d'environnement – Partie 2-27: Essais – Essai Ea et guide: Chocs*

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

IEC 60068-2-31, *Essais d'environnement – Partie 2-31: Essais – Essai Ec: Choc lié à des manutentions brutales, essai destiné en premier lieu aux matériels*

IEC 60068-2-60, *Essais d'environnement – Partie 2-60: Essais – Essai Ke: Essai de corrosion dans un flux de mélange de gaz*

IEC 60068-2-78, *Essais d'environnement – Partie 2-78: Essais – Essai Cab: Chaleur humide, essai continu*

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

IEC 60950-1, *Matériels de traitement de l'information – Sécurité – Partie 1: Exigences générales*

IEC 61587-1, *Structures mécaniques pour équipement électronique – Essais pour les séries IEC 60917 et IEC 60297 – Partie 1: Exigences environnementales, montage d'essai et aspects liés à la sécurité des baies, bâtis, bacs à cartes et châssis dans des conditions d'utilisation intérieure ou de transport*

IEC 61587-2, *Structures mécaniques pour équipements électroniques – Essais pour la CEI 60917 et la CEI 60297 – Partie 2: Essais sismiques pour baies et bâtis*

IEC 61969-1:2020, *Structures mécaniques pour équipement électrique et électronique – Enveloppes de plein air – Partie 1: Lignes directrices pour la conception*

IEC 62368-1, *Équipements des technologies de l'audio/vidéo, de l'information et de la communication – Partie 1: Exigences de sécurité*

ISO 3744, *Acoustique – Détermination des niveaux de puissance acoustique et des niveaux d'énergie acoustique émis par les sources de bruit à partir de la pression acoustique – Méthodes d'expertise pour des conditions approchant celles du champ libre sur plan réfléchissant*

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

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* (disponible en anglais seulement)

3 Termes et définitions

Pour les besoins du présent document, les termes et définitions de l'IEC 61969-1 s'appliquent.

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

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

4 Dimensions de coordination

L'article correspondant de l'IEC 61969-1:2020 s'applique.

5 Exigences et essais d'environnement, et aspects liés à la sécurité – Classification des conditions d'environnement

Les conditions d'environnement sont issues de l'IEC 60721-3-4, pour ce qui concerne en particulier les exigences applicables aux enveloppes de plein air vides.

Classe 1: emplacement non protégé contre les intempéries: couvre toutes les régions de climat tempéré.

Classe 2: emplacement non protégé contre les intempéries, étendu: couvre toutes les régions soumises à des climats extrêmes.

L'enveloppe de plein air individuelle soumise à essai selon ces exigences d'essais d'environnement de base peut prétendre à la conformité à la classe 1 ou à la classe 2, ou encore à une combinaison de classe 1/classe 2.

6 Conditions d'essai

6.1 Généralités

Les conditions d'essai de base indiquées dans le Tableau 1, le Tableau 2, le Tableau 3 et le Tableau 4 reflètent les environnements typiques auxquels sont soumises les enveloppes de plein air.

6.2 Essais climatiques

Tableau 1 – Conditions climatiques pour les classes d'environnement 1 et 2

	Paramètre d'environnement	Sévérité d'essai		Durée	Méthode
		Classe 1	Classe 2		
a	Basse température de l'air	−40 °C	−50 °C	16 h	IEC 60068-2-1: A
b	Haute température de l'air ¹	+85 °C	+85 °C	16 h	IEC 60068-2-2: B
c	Chaleur humide	+30 °C, 93 %	+30 °C, 93 %	96 h	IEC 60068-2-78: Cb
d	Variation de température	De −40 °C à +23 °C 1 °C/min	De −40 °C à +85 °C 1 °C/min	2 cycles	IEC 60068-2-14: Nb
e	Condensation	HR de 90 % à 100 %	HR de 90 % à 100 %	144 h (6 cycles)	IEC 60068-2-30: Db
f	Précipitations (pluie, neige, grêle, etc.)	IPX4	IPX5	-	IEC 60529
g	Mouvement de l'air ambiant	50 m/s	60 m/s	-	-
h	Formation de glace et de givre	Exigence minimale: absence de déformation mécanique			-
i	Dégradation aux ultraviolets	Exigence minimale: pas d'altération des propriétés mécaniques (résistance à la traction et allongement au seuil d'écoulement) supérieure à 20 %.			ISO 4892-2
Pour des conditions comparables, l'Atmosphère type doit être utilisée, conformément à l'ISO 2533 (15 °C à 1 013, 25 hPa).					
¹ Cette température maximale inclut les effets de la dissipation thermique, résultant des dispositifs électroniques actifs, et du rayonnement solaire.					

A l'issue de l'essai, la conformité est vérifiée par examen visuel sur les pièces internes et externes: aucune formation de rouille, fissure ou autres détériorations dont l'impact se répercute sur la fonction exigée, ni aucune pénétration d'eau, ne doivent être détectées.