

INTERNATIONAL STANDARD



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

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

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

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INTERNATIONAL STANDARD



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

INTERNATIONAL
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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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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 61969-3:2020. 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 61969-3 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. 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) alignment with the content of ETSI EN 300 019 and IEC 60721 series latest editions, particularly with the actualization of climate conditions;
- b) rationale for the selected operating conditions from IEC 60721-3-4 are added;
- c) tests are grouped according to the classification of conditions in IEC 60721-3-4;
- d) test severities for vibration and shock tests are aligned with ETSI EN 300 019-2-4;
- e) addition of pass/fail criteria for each test.

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

Draft	Report on voting
48D/765/FDIS	48D/766/RVD

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

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

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

This International Standard is to be used in conjunction with IEC 61969-1:2023.

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, or
- revised.

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INTRODUCTION

The products covered by 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.

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.

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 for electrical and electronic equipment under conditions of non-weatherprotected 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 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 60794-1-21, *Optical fibre cables – Part 1-21: Generic specification – Basic optical cable test procedures – Mechanical tests methods*

IEC 61300-2-10, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-10: Tests – Crush and load resistance*

IEC 61300-2-56:2020, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-56: Tests – Wind resistance of mounted housing*

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 61969-1:2020/2023, *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 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 4892-2, *Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc lamps*

ISO 4892-3, *Plastics – Methods of exposure to laboratory light sources – Part 3: Fluorescent UV 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*

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*

3 Terms and definitions

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

No terms and definitions are listed in this document.

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>

~~4 Coordination dimensions~~

~~This clause of IEC 61969-1:2020 applies.~~

~~4 Environmental requirements, tests and safety aspects~~ – Classification of environmental conditions

The environmental operating conditions are derived from IEC 60721-3-4, with the focus on empty outdoor enclosures relevant requirements. Two classes of environmental performance are described:

- class 1: Non-weatherprotected locations, standard performance: Covers all regions with a moderate climate;
- class 2: Non-weatherprotected locations, extended performance: Covers ~~all~~ regions with ~~severe~~ an extremely cold or extremely warm 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.

5 Environmental test conditions

5.1 General

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

The minimum tests and test severities for the non-weatherprotected conditions as defined in IEC 60721-3-4 can be found as:

- climatic conditions (K) given in Table 2;
- biological conditions (B) given in Table 3;
- chemical active substance (C) given in Table 4;
- mechanical active substance (S) given as pass/fail criterion PF2 in Table 1;
- mechanical conditions during operation (M) given in Table 5;

Two classes of test severities for the operating conditions are defined, each corresponding to the relevant class of environmental performance defined in Clause 4:

- class 1 for operating conditions in temperate climatic environments. The reference for this environment in IEC 60721-3-4 is 4K26/4Z4/4B2/4C2/4S12/4M11;
- class 2 for operating conditions with more extreme tropical and polar conditions 4K25/4Z5/4B2/4C2/4S12/4M11 and 4K27/4Z5/4B2/4C2/4S12/4M11 from IEC 60721-3-4.

5.2 Pass/fail criteria tests

Table 1 contains the pass/fail criteria tests that shall be performed after the climatic tests (Table 2), the biological tests (Table 3), the resistance against chemically active substances tests (Table 4) and the mechanical tests (Table 5). When the same test sample is used for several tests, it is allowed to perform the relevant pass/fail tests at the end of the test sequence.

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Table 1 – Pass/fail criteria tests

Test	Environmental parameters and test methods	Test severity		Acceptance conditions
		Class 1	Class 2	
PF1	Visual examination	Examination of the internal and external parts. Inspection with the naked eye for flaws, deformation, surface changes, rust, cracks or other deteriorations that could impair functionality.		No defects which would adversely affect product performance.
PF2 ^a	Protection against ingress of dust IEC 60529	IP5X		The protection is satisfactory if talcum powder has not accumulated in a quantity or location such that, as with any other kind of dust, it could interfere with the correct operation of the equipment or impair safety. No dust shall deposit where it could lead to tracking along the creepage distance.
PF3	Protection against ingress of water IEC 60529	IPX4		If any water has entered, it shall not: <ul style="list-style-type: none"> – be sufficient to interfere with the correct operation of the equipment or impair safety; – deposit on insulation parts where it could lead to tracking along the creepage distance; – reach live parts or windings not designed to operate when wet; – accumulate near the cable end or enter the cable if any. If the enclosure is provided with drain-holes, it should be proved by inspection that any water which enters does not accumulate and that it drains away without doing any harm to the equipment. For enclosures without drain-holes, the relevant product standard shall specify the acceptance conditions if water can accumulate to reach live parts.
			IPX5	No ingress of water

^a The IP5X pass/fail criterion for protection against ingress of dust is used to cover the mechanical active substance condition 4S12 of IEC 60721-3-4.

5.3 Climatic tests

The climatic tests from Table 2 shall be performed on test samples with hinges, locks and handles in operating condition.

Table 2 – 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 ⁴	+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.					
⁴ This maximum temperature includes the effects of heat dissipation caused by active electronics and includes solar load.					

Test	Environmental parameters and test methods	Test severity		Pass/fail criteria to be checked
		Class 1	Class 2	
K1	Cold ^a IEC 60068-2-1: Test A	-40 °C for 16 h	-50 °C for 16 h	Visual examination (PF1) Protection against ingress of dust (PF2) and water (PF3) after test.
K2	Dry heat ^b IEC 60068-2-2: Test B	+85 °C for 16 h		Visual examination (PF1) Protection against ingress of dust (PF2) and water (PF3) after test.
K3	Change of temperature IEC 60068-2-14: Test Nb	Temperature range: -40 °C to + 85 °C Dwell time at extreme temperatures: 4 h Rate of change of temperature: 1 °C/min Number of cycles: 2 (12 h/cycle)		Visual examination (PF1) Protection against ingress of dust (PF2) and water (PF3) after test.
K4	Damp heat, cyclic ^c IEC 60068-2-30: Test Db	Temperature range: +25 °C to +55 °C Humidity: >90 % RH Number of cycles: 6 (24 h/cycle)		Visual examination (PF1) Protection against ingress of dust (PF2) and water (PF3) after test.
K5	Ultraviolet light resistance ISO 4892-2 (for painted or polymer coated metal)	Xenon lamp (340 nm) Exposure cycle: Cycle 1 Exposure time: 1 000 h		Visual examination (PF1) No reduction in mechanical properties after test (for example: average tensile strength and elongation at yield) by more than 20 %.
	Ultraviolet light resistance ISO 4892-3 (for full polymer outer enclosures)	Fluorescent lamp type 1A (340 nm) Exposure cycle: Cycle 1 with alternating UV and condensation cycles: – UV cycle: 8 h at (+60 ± 3) °C – Condensation cycle: 4 h at (+50 ± 3) °C Exposure time: 2 160 h Test are performed on moulded dumbbells		
For comparable conditions, the International Standard Air, in accordance with ISO 2533 (15 °C at 1 013, 25 hPa) shall be used.				
^a This minimum temperature includes the effects of heat radiation during the night with open sky.				
^b This maximum temperature includes the effects of heat dissipation caused by active electronics and includes solar load.				
^c The damp heat, cyclic test replaces the less severe IEC 60068-2-78 damp heat, steady state test.				

~~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.~~

5.4 Biological tests

Table 3 – 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				

Test	Environmental parameters and test method	Test severities for class 1 and 2	Pass/fail criteria to be checked
B1	Flora: Presence of mould, fungus, etc. IEC 60068-2-10: Test J	Test samples: moulded dumbbells Test variant 1 Inoculation conditions: – Temperature: (29 ± 1) °C – Relative humidity: ≥ 90 % RH Duration: 28 days	Visual grading ≤2 In case visual rating is 0, no further tests are required. In case of visual grading 1 or 2 the degradation of material properties will be checked. No reduction in mechanical properties (for example average tensile strength and elongation at yield) by more than 20 %.
B2	Fauna: Presence of rodents and others harmful to the equipment	None	None

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

5.5 Tests of resistance against chemically active substances

The resistance tests to corrosion by chemically active substances are listed in Table 4. The test severities were taken from ETSI EN 300 019-2-2 and ETSI EN 300 019-2-4.

Large housings (like street cabinets) can be tested by using representative samples of used materials.

Table 4 – 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 ³	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.					

Test	Environmental parameters and test method	Test severity		Pass/fail criteria to be checked
		Class 1	Class 2	
C1	Salt mist IEC 60068-2-11: Test Ka	Temperature: +35 °C Solution: 5 % NaCl Duration: 5 days	Temperature: +35 °C Solution: 5 % NaCl Duration: 28 days	Visual examination (PF1) Contact materials for the electromagnetic shielding and grounding shall remain free of corrosion. Class 1: No signs of surface corrosion of protective enclosure. A colour change due to passivation is allowed. Class 2: Surface corrosion of the protective enclosure is allowed. It shall remain possible to open and close the door(s).
C2	Flowing mixed gas corrosion test IEC 60068-2-60: Test Ke method 4 with severities from ETSI EN 300 019-2-4	Temperature: (25 ± 1) °C Relative humidity: (75 ± 3) % RH Duration: 10 days		Visual examination (PF1) Surface corrosion of the protective enclosure is allowed. It shall remain possible to open and close the door(s).
	Sulphur dioxide SO ₂	1,0 mg/m ³ 0,37 cm ³ /m ³		Contact materials for the electromagnetic shielding and grounding shall remain free of corrosion.
	Hydrogen sulphide H ₂ S	0,5 mg/m ³ 0,36 cm ³ /m ³		
	Chlorine Cl	0,3 mg/m ³ 0,1 cm ³ /m ³		
	Nitrogen oxides NO ₂	1,0 mg/m ³ 0,52 cm ³ /m ³		

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.~~

5.6 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).~~

The resistance against mechanical active substances like sand and dust is covered by the test PF2 in Table 1.

6 Mechanical tests

6.1 ~~General~~ Operational related mechanical tests

~~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.~~

The purpose of the mechanical tests in Table 5 is to ensure that the outdoor enclosure will withstand handling and give protection of installed equipment from exposure to mechanical stress during operation. The test severities of tests M1, M2 and M3 were taken from ETSI EN 300 019-2-4, T 4.1E. For seismic compliance, see Clause 8.

Table 5 – Mechanical tests (operational)

Test	Environmental parameters and test methods	Test severities		Pass/fail criteria to be checked
		Class 1	Class 2	
M1	Wind resistance IEC 61300-2-56:2020	30 m/s (110 km/h) The applied force shall be calculated according to the method described in Annex B of IEC 61300-2-56:2020	50 m/s (180 km/h) The applied force shall be calculated according to the method described in Annex B of IEC 61300-2-56:2020	Visual inspection (PF1). No deformation or damage of parts that affect form, fit and function shall be observed.
M2	Vibration, sinusoidal ^a IEC 60068-2-6: Test Fc	5 Hz to 9 Hz: 1,2 mm displacement 9 Hz to 500 Hz: 4 m/s ² acceleration Axes: 3 mutually perpendicular 10 sweeps per axis		Visual inspection (PF1). No deformation or damage of parts that affect form, fit and function shall be observed. Protection against ingress of dust (PF2) and water (PF3) after test.
M3	Shock (operational) ^a IEC 60068-2-27: Test Ea	Half sine pulse Duration: 11 ms Acceleration: 50 m/s ² Axes 3 Number of shocks: 3 shocks in each direction per axis (= 18 shocks in total)		Visual inspection (PF1). No deformation or damage of parts that affect form, fit and function shall be found. Protection against ingress of dust (PF2) and water (PF3) after test.
M4	Crush IEC 61300-2-10	Load (N): 1 750 (Pa) × Width (m) × Depth (m) Load evenly distributed on top surface of the housing. Duration: 10 min		Visual inspection (PF1). No deformation or damage of parts that affect form, fit and function shall be found. Protection against ingress of dust (PF2) and water (PF3) after test.
M5	Impact IEC 62262	IK09 (10 J)	IK10 (20 J)	Visual inspection (PF1). No deformation or damage of parts that affect form, fit and function shall be found. Protection against ingress of dust (PF2) and water (PF3) after test.
^a The outdoor enclosure shall be mounted to the shock/vibration table by using the intended ground/floor mounting features.				

6.2 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: Fe
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: Ee
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.

Two classes for the test severities for the transport tests are defined:

- class 1: Conditions according to classification 2K12/2B2/2C2/2S2/2M4 of IEC 60721-3-2. This applies to handling, transport by rail, river, sea, air (jet aircraft only) and road transport using good vehicles on good roads. This category includes transport of goods within ISO containers;
- class 2: Conditions according to classification 2K12/2B2/2C2/2S2/2M5 of IEC 60721-3-2. This includes the conditions of class 1 plus road transport using poor vehicles and/or on poor roads as well as handling using trolleys with no suspension.

The requirements and relevant tests covering transport and handling of the packaged product can be agreed between vendor and user.

6.3 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.

7 Safety aspects

7.1 General

~~General safety requirements:~~ The outdoor enclosure, once fully equipped and installed, 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.

Provisions shall be made for providing electrical safety measures according to the relevant requirements in IEC 62368-1, for the electrical and electronic equipment that can be installed inside the outdoor enclosure.

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.

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.

7.2 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.

7.3 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~~ provide resistance against unauthorized access. Test method shall be agreed between vendor and user.

7.4 Firearms resistance (optional for outdoor metal enclosures)

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

The outdoor metal 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 (IEC 60794-1-21 method E13A):

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

8 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.

9 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.

10 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.

11 Acoustic noise emission

The final location of the installed outdoor enclosure will determine the acoustic 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.

Bibliography

IEC 60068-2-5, *Environmental testing – Part 2-5: Tests – Test SaS: Simulated solar radiation at ground level and guidance for solar radiation testing and weathering*

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

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

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

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

~~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*

~~ISO 2533, *Standard atmosphere*~~

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

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

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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

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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IEC 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. 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) alignment with the content of ETSI EN 300 019 and IEC 60721 series latest editions, particularly with the actualization of climate conditions;
- b) rationale for the selected operating conditions from IEC 60721-3-4 are added;

- c) tests are grouped according to the classification of conditions in IEC 60721-3-4;
- d) test severities for vibration and shock tests are aligned with ETSI EN 300 019-2-4;
- e) addition of pass/fail criteria for each test.

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

Draft	Report on voting
48D/765/FDIS	48D/766/RVD

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

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

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

This International Standard is to be used in conjunction with IEC 61969-1:2023.

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, or
- revised.

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INTRODUCTION

The products covered by 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.

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.

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 for electrical and electronic equipment under conditions of non-weatherprotected 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, *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 60068-2-60, *Environmental testing – Part 2-60: Tests – Test Ke: Flowing mixed gas corrosion test*

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

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 60794-1-21, *Optical fibre cables – Part 1-21: Generic specification – Basic optical cable test procedures – Mechanical tests methods*

IEC 61300-2-10, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-10: Tests – Crush and load resistance*

IEC 61300-2-56:2020, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-56: Tests – Wind resistance of mounted housing*

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 61969-1:2023, *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 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 4892-2, *Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc lamps*

ISO 4892-3, *Plastics – Methods of exposure to laboratory light sources – Part 3: Fluorescent UV 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*

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*

3 Terms and definitions

No terms and definitions are listed in this document.

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>

4 Classification of environmental conditions

The environmental operating conditions are derived from IEC 60721-3-4, with the focus on empty outdoor enclosures relevant requirements. Two classes of environmental performance are described:

- class 1: Non-weatherprotected locations, standard performance: Covers all regions with a moderate climate;
- class 2: Non-weatherprotected locations, extended performance: Covers regions with an extremely cold or extremely warm 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.

5 Environmental test conditions

5.1 General

The minimum tests and test severities for the non-weatherprotected conditions as defined in IEC 60721-3-4 can be found as:

- climatic conditions (K) given in Table 2;
- biological conditions (B) given in Table 3;
- chemical active substance (C) given in Table 4;
- mechanical active substance (S) given as pass/fail criterion PF2 in Table 1;
- mechanical conditions during operation (M) given in Table 5;

Two classes of test severities for the operating conditions are defined, each corresponding to the relevant class of environmental performance defined in Clause 4:

- class 1 for operating conditions in temperate climatic environments. The reference for this environment in IEC 60721-3-4 is 4K26/4Z4/4B2/4C2/4S12/4M11;
- class 2 for operating conditions with more extreme tropical and polar conditions 4K25/4Z5/4B2/4C2/4S12/4M11 and 4K27/4Z5/4B2/4C2/4S12/4M11 from IEC 60721-3-4.

5.2 Pass/fail criteria tests

Table 1 contains the pass/fail criteria tests that shall be performed after the climatic tests (Table 2), the biological tests (Table 3), the resistance against chemically active substances tests (Table 4) and the mechanical tests (Table 5). When the same test sample is used for several tests, it is allowed to perform the relevant pass/fail tests at the end of the test sequence.

Table 1 – Pass/fail criteria tests

Test	Environmental parameters and test methods	Test severity		Acceptance conditions
		Class 1	Class 2	
PF1	Visual examination	Examination of the internal and external parts. Inspection with the naked eye for flaws, deformation, surface changes, rust, cracks or other deteriorations that could impair functionality.		No defects which would adversely affect product performance.
PF2 ^a	Protection against ingress of dust IEC 60529	IP5X		The protection is satisfactory if talcum powder has not accumulated in a quantity or location such that, as with any other kind of dust, it could interfere with the correct operation of the equipment or impair safety. No dust shall deposit where it could lead to tracking along the creepage distance.
PF3	Protection against ingress of water IEC 60529	IPX4		If any water has entered, it shall not: <ul style="list-style-type: none"> – be sufficient to interfere with the correct operation of the equipment or impair safety; – deposit on insulation parts where it could lead to tracking along the creepage distance; – reach live parts or windings not designed to operate when wet; – accumulate near the cable end or enter the cable if any. If the enclosure is provided with drain-holes, it should be proved by inspection that any water which enters does not accumulate and that it drains away without doing any harm to the equipment. For enclosures without drain-holes, the relevant product standard shall specify the acceptance conditions if water can accumulate to reach live parts.
			IPX5	No ingress of water

^a The IP5X pass/fail criterion for protection against ingress of dust is used to cover the mechanical active substance condition 4S12 of IEC 60721-3-4.

5.3 Climatic tests

The climatic tests from Table 2 shall be performed on test samples with hinges, locks and handles in operating condition.

Table 2 – Climatic conditions for environmental classes 1 and 2

Test	Environmental parameters and test methods	Test severity		Pass/fail criteria to be checked
		Class 1	Class 2	
K1	Cold ^a IEC 60068-2-1: Test A	-40 °C for 16 h	-50 °C for 16 h	Visual examination (PF1) Protection against ingress of dust (PF2) and water (PF3) after test.
K2	Dry heat ^b IEC 60068-2-2: Test B	+85 °C for 16 h		Visual examination (PF1) Protection against ingress of dust (PF2) and water (PF3) after test.
K3	Change of temperature IEC 60068-2-14: Test Nb	Temperature range: -40 °C to + 85 °C Dwell time at extreme temperatures: 4 h Rate of change of temperature: 1 °C/min Number of cycles: 2 (12 h/cycle)		Visual examination (PF1) Protection against ingress of dust (PF2) and water (PF3) after test.
K4	Damp heat, cyclic ^c IEC 60068-2-30: Test Db	Temperature range: +25 °C to +55 °C Humidity: >90 % RH Number of cycles: 6 (24 h/cycle)		Visual examination (PF1) Protection against ingress of dust (PF2) and water (PF3) after test.
K5	Ultraviolet light resistance ISO 4892-2 (for painted or polymer coated metal)	Xenon lamp (340 nm) Exposure cycle: Cycle 1 Exposure time: 1 000 h		Visual examination (PF1) No reduction in mechanical properties after test (for example: average tensile strength and elongation at yield) by more than 20 %.
	Ultraviolet light resistance ISO 4892-3 (for full polymer outer enclosures)	Fluorescent lamp type 1A (340 nm) Exposure cycle: Cycle 1 with alternating UV and condensation cycles: – UV cycle: 8 h at (+60 ± 3) °C – Condensation cycle: 4 h at (+50 ± 3) °C Exposure time: 2 160 h Test are performed on moulded dumbbells		
For comparable conditions, the International Standard Air, in accordance with ISO 2533 (15 °C at 1 013, 25 hPa) shall be used.				
^a This minimum temperature includes the effects of heat radiation during the night with open sky.				
^b This maximum temperature includes the effects of heat dissipation caused by active electronics and includes solar load.				
^c The damp heat, cyclic test replaces the less severe IEC 60068-2-78 damp heat, steady state test.				

5.4 Biological tests

Table 3 – Biological tests

Test	Environmental parameters and test method	Test severities for class 1 and 2	Pass/fail criteria to be checked
B1	Flora: Presence of mould, fungus, etc. IEC 60068-2-10: Test J	Test samples: moulded dumbbells Test variant 1 Inoculation conditions: – Temperature: $(29 \pm 1) ^\circ\text{C}$ – Relative humidity: $\geq 90\% \text{ RH}$ Duration: 28 days	Visual grading ≤ 2 In case visual rating is 0, no further tests are required. In case of visual grading 1 or 2 the degradation of material properties will be checked. No reduction in mechanical properties (for example average tensile strength and elongation at yield) by more than 20 %.
B2	Fauna: Presence of rodents and others harmful to the equipment	None	None

5.5 Tests of resistance against chemically active substances

The resistance tests to corrosion by chemically active substances are listed in Table 4. The test severities were taken from ETSI EN 300 019-2-2 and ETSI EN 300 019-2-4.

Large housings (like street cabinets) can be tested by using representative samples of used materials.

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Table 4 – Tests of resistance against chemically active substances

Test	Environmental parameters and test method	Test severity		Pass/fail criteria to be checked
		Class 1	Class 2	
C1	Salt mist IEC 60068-2-11: Test Ka	Temperature: +35 °C Solution: 5 % NaCl Duration: 5 days	Temperature: +35 °C Solution: 5 % NaCl Duration: 28 days	Visual examination (PF1) Contact materials for the electromagnetic shielding and grounding shall remain free of corrosion. Class 1: No signs of surface corrosion of protective enclosure. A colour change due to passivation is allowed. Class 2: Surface corrosion of the protective enclosure is allowed. It shall remain possible to open and close the door(s).
C2	Flowing mixed gas corrosion test IEC 60068-2-60: Test Ke method 4 with severities from ETSI EN 300 019-2-4	Temperature: (25 ± 1) °C Relative humidity: (75 ± 3) % RH Duration: 10 days		Visual examination (PF1) Surface corrosion of the protective enclosure is allowed. It shall remain possible to open and close the door(s). Contact materials for the electromagnetic shielding and grounding shall remain free of corrosion.
	Sulphur dioxide SO ₂	1,0 mg/m ³ 0,37 cm ³ /m ³		
	Hydrogen sulphide H ₂ S	0,5 mg/m ³ 0,36 cm ³ /m ³		
	Chlorine Cl	0,3 mg/m ³ 0,1 cm ³ /m ³		
	Nitrogen oxides NO ₂	1,0 mg/m ³ 0,52 cm ³ /m ³		

5.6 Tests of resistance against mechanically active substances

The resistance against mechanical active substances like sand and dust is covered by the test PF2 in Table 1.

6 Mechanical tests

6.1 Operational related mechanical tests

The purpose of the mechanical tests in Table 5 is to ensure that the outdoor enclosure will withstand handling and give protection of installed equipment from exposure to mechanical stress during operation. The test severities of tests M1, M2 and M3 were taken from ETSI EN 300 019-2-4, T 4.1E. For seismic compliance, see Clause 8.

Table 5 – Mechanical tests (operational)

Test	Environmental parameters and test methods	Test severities		Pass/fail criteria to be checked
		Class 1	Class 2	
M1	Wind resistance IEC 61300-2-56:2020	30 m/s (110 km/h) The applied force shall be calculated according to the method described in Annex B of IEC 61300-2-56:2020	50 m/s (180 km/h) The applied force shall be calculated according to the method described in Annex B of IEC 61300-2-56:2020	Visual inspection (PF1). No deformation or damage of parts that affect form, fit and function shall be observed.
M2	Vibration, sinusoidal ^a IEC 60068-2-6: Test Fc	5 Hz to 9 Hz: 1,2 mm displacement 9 Hz to 500 Hz: 4 m/s ² acceleration Axes: 3 mutually perpendicular 10 sweeps per axis		Visual inspection (PF1). No deformation or damage of parts that affect form, fit and function shall be observed. Protection against ingress of dust (PF2) and water (PF3) after test.
M3	Shock (operational) ^a IEC 60068-2-27: Test Ea	Half sine pulse Duration: 11 ms Acceleration: 50 m/s ² Axes 3 Number of shocks: 3 shocks in each direction per axis (= 18 shocks in total)		Visual inspection (PF1). No deformation or damage of parts that affect form, fit and function shall be found. Protection against ingress of dust (PF2) and water (PF3) after test.
M4	Crush IEC 61300-2-10	Load (N): 1 750 (Pa) × Width (m) × Depth (m) Load evenly distributed on top surface of the housing. Duration: 10 min		Visual inspection (PF1). No deformation or damage of parts that affect form, fit and function shall be found. Protection against ingress of dust (PF2) and water (PF3) after test.
M5	Impact IEC 62262	IK09 (10 J)	IK10 (20 J)	Visual inspection (PF1). No deformation or damage of parts that affect form, fit and function shall be found. Protection against ingress of dust (PF2) and water (PF3) after test.
^a The outdoor enclosure shall be mounted to the shock/vibration table by using the intended ground/floor mounting features.				

6.2 Transport tests

Two classes for the test severities for the transport tests are defined:

- class 1: Conditions according to classification 2K12/2B2/2C2/2S2/2M4 of IEC 60721-3-2. This applies to handling, transport by rail, river, sea, air (jet aircraft only) and road transport using good vehicles on good roads. This category includes transport of goods within ISO containers;
- class 2: Conditions according to classification 2K12/2B2/2C2/2S2/2M5 of IEC 60721-3-2. This includes the conditions of class 1 plus road transport using poor vehicles and/or on poor roads as well as handling using trolleys with no suspension.

The requirements and relevant tests covering transport and handling of the packaged product can be agreed between vendor and user.

6.3 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.

7 Safety aspects

7.1 General

The outdoor enclosure, once fully equipped and installed, 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.

Provisions shall be made for providing electrical safety measures according to the relevant requirements in IEC 62368-1, for the electrical and electronic equipment that can be installed inside the outdoor enclosure.

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.

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 61969-1:2023 shall apply.

7.2 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.

7.3 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 provide resistance against unauthorized access. Test method shall be agreed between vendor and user.

7.4 Firearms resistance (optional for outdoor metal enclosures)

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

The outdoor metal 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 (IEC 60794-1-21 method E13A):

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

8 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.

9 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.

10 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.

11 Acoustic noise emission

The final location of the installed outdoor enclosure will determine the acoustic 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.

Bibliography

IEC 60068-2-5, *Environmental testing – Part 2-5: Tests – Test S: Simulated solar radiation at ground level and guidance for solar radiation testing and weathering*

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

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

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

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

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

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

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

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*

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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**

AVANT-PROPOS

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L'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. 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) alignement sur le contenu de l'édition la plus récente des séries ETSI EN 300 019 et IEC 60721, en particulier concernant l'actualisation des conditions climatiques;
- b) ajout de justifications pour les conditions de fonctionnement sélectionnées de l'IEC 60721-3-4.
- c) regroupement des essais conformément à la classification des conditions de l'IEC 60721-3-4.
- d) alignement des sévérités des essais de vibrations et de chocs sur l'ETSI EN 300 019-2-4;
- e) ajout de critères d'acceptation/de rejet pour chaque essai.

Le texte de la présente Norme internationale est issu des documents suivants:

FDIS	Rapport de vote
48D/765/FDIS	48D/766/RVD

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

La langue employée pour l'élaboration de la présente Norme internationale est l'anglais.

Le présent document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/standardsdev/publications.

La présente Norme internationale est destinée à être utilisée conjointement avec l'IEC 61969-1:2023.

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*, peut être consultée 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:

- reconduit,
- supprimé, ou
- révisée.

INTRODUCTION

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 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.

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

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

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

IEC 60068-2-14, *Essais d'environnement – Partie 2-14: Essais – Essai N: Variations 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 60068-2-60, *Essais d'environnement – Partie 2-60: Essais – Essai Ke: Essai de corrosion dans un flux de mélange de gaz*

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

IEC 60721-3-2, *Classification des conditions d'environnement – Partie 3-2: Classification des groupements des agents d'environnement et de leurs sévérités – Transport et manutention*

IEC 60721-3-4, *Classification des conditions d'environnement – Partie 3-4: Classification des groupements des agents d'environnement et de leurs sévérités – Utilisation à poste fixe, non protégé contre les intempéries*

IEC 60794-1-21, *Câbles à fibres optiques – Partie 1-21: Spécification générique – Procédures fondamentales d'essais des câbles optiques – Méthodes d'essai mécanique*

IEC 61300-2-10, *Dispositifs d'interconnexion et composants passifs fibroniques – Procédures fondamentales d'essais et de mesures – Partie 2-10: Essais – Résistance à la compression et à la charge*

IEC 61300-2-56:2020, *Dispositifs d'interconnexion et composants passifs fibroniques – Procédures fondamentales d'essais et de mesures – Partie 2-56: Essais – Résistance au vent des boîtiers installés*

IEC 61439-5, *Ensembles d'appareillage à basse tension – Partie 5: Ensembles pour réseaux de distribution publique*

IEC 61587-1, *Structures mécaniques pour les équipements électriques et électroniques – Essais pour les séries IEC 60917 et IEC 60297 – Partie 1: Exigences environnementales, montages d'essai et aspects liés à la sécurité*

IEC 61587-2, *Structures mécaniques pour équipement électronique – Essais pour l'IEC 60917 et l'IEC 60297 – Partie 2: Essais sismiques pour baies et bâtis*

IEC 61587-3, *Structures mécaniques pour équipement électronique – Essais pour l'IEC 60917 et l'IEC 60297 – Partie 3: Essais de performance du blindage électromagnétique pour les baies et les bacs à cartes*

IEC 61969-1:2023, *Structures mécaniques pour équipement électrique et électronique – Enveloppes de plein air – Partie 1: Lignes directrices pour la conception*

IEC 62194, *Méthode d'évaluation de la performance thermique des enveloppes*

IEC 62262, *Degrés de protection procurés par les enveloppes de matériels électriques contre les impacts mécaniques externes (code IK)*

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

ISO 2533, *Atmosphère type*

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*

ISO 4892-3, *Plastiques – Méthodes d'exposition à des sources lumineuses de laboratoire – Partie 3: Lampes fluorescentes UV*

ETSI EN 300 019-2-2, *Ingénierie de l'environnement (EE) – Conditions d'environnement et essais d'environnement des équipements de télécommunication – Partie 2-2: Spécification des essais d'environnement – Transport*

ETSI EN 300 019-2-4, *Ingénierie de l'environnement (EE) – Conditions et essais d'environnement des équipements de télécommunications – Partie 2-4: Spécifications des essais environnementaux – Utilisation à poste fixe sur des sites non protégés contre les intempéries*

3 Termes et définitions

Aucun terme n'est défini dans le présent document.

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

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

4 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. Deux classes de performances environnementales sont décrites:

- classe 1: emplacements non protégés contre les intempéries, performances normales: couvre toutes les régions de climat tempéré;
- classe 2: emplacements non protégés contre les intempéries, performances étendues: couvre toutes les régions de climat extrêmement froid ou extrêmement chaud.

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.

5 Conditions d'environnement d'essai

5.1 Généralités

Les essais et les sévérités d'essai minimaux pour les conditions non protégées contre les intempéries, tels que définis dans l'IEC 60721-3-4 sont les suivants:

- les conditions climatiques (K) données dans le Tableau 2;
- les conditions biologiques (B) données dans le Tableau 3;
- les substances chimiquement actives (C) données dans le Tableau 4;
- les substances mécaniquement actives (S) et le critère d'acceptation et de rejet PF2 donnés dans le Tableau 1;
- les conditions mécaniques pendant le fonctionnement (M) données dans le Tableau 5.

Deux classes de sévérités des essais pour les conditions de fonctionnement sont définies, chacune correspondant à la classe de performances environnementales pertinente définie à l'Article 4:

- la classe 1 pour les conditions de fonctionnement en environnements climatiques tempérés. La référence pour cet environnement dans l'IEC 60721-3-4 est 4K26/4Z4/4B2/4C2/4S12/4M11;
- la classe 2 pour les conditions de fonctionnement en environnements climatiques tropicaux ou polaires extrêmes 4K25/4Z5/4B2/4C2/4S12/4M11 et 4K27/4Z5/4B2/4C2/4S12/4M11 dans l'IEC 60721-3-4.