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

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CONTENTS

FOREWORD.....	3
INTRODUCTION.....	5
1 Scope.....	6
2 Normative references	6
3 Terms and definitions	8
4 Coordination dimensions	8
4 Environmental requirements, tests and safety aspects —Classification of environmental conditions	8
5 Environmental test conditions	8
5.1 General.....	8
5.2 Pass/fail criteria tests.....	9
5.3 Climatic tests	11
5.4 Biological tests	13
5.5 Tests of resistance against chemically active substances	13
5.6 Tests of resistance against mechanically active substances.....	15
6 Mechanical tests.....	15
6.1 General Operational related mechanical tests.....	15
6.2 Transport tests.....	16
6.3 Lifting and stiffness test	17
7 Safety aspects.....	18
7.1 General.....	18
7.2 Locking devices	18
7.3 Vandalism resistance.....	18
7.4 Firearms resistance (optional for outdoor metal enclosures)	18
8 Seismic requirements	19
9 Electromagnetic shielding performance	19
10 Thermal management.....	19
11 Acoustic noise emission	19
Bibliography.....	20
Table 1 – Pass/fail criteria tests	10
Table 2 – Climatic conditions for environmental classes 1 and 2	11
Table 3 – Biological tests	13
Table 4 – Tests of resistance against mechanically active substances	14
Table 4 – Tests of resistance against chemically active substances.....	14
Table 5 – Mechanical tests (operational).....	16
Table 5 – Vibration and shock test	16

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.
			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
<p>For comparable conditions, the International Standard Air, in accordance to ISO 2533 (15 °C at 1 013, 25 hPa) shall be used.</p> <p>⁴ This maximum temperature includes the effects of heat dissipation caused by active electronics and includes solar load.</p>					

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		
<p>For comparable conditions, the International Standard Air, in accordance with ISO 2533 (15 °C at 1 013, 25 hPa) shall be used.</p> <p>^a This minimum temperature includes the effects of heat radiation during the night with open sky.</p> <p>^b This maximum temperature includes the effects of heat dissipation caused by active electronics and includes solar load.</p> <p>^c The damp heat, cyclic test replaces the less severe IEC 60068-2-78 damp heat, steady state test.</p>				

~~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.~~