IEC 61587-1

Edition 5.0 2022-01

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

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 61587-1:2022-01 (en-fr)

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MECHANICAL STRUCTURES FOR ELECTRICAL AND ELECTRONIC EQUIPMENT – TESTS FOR IEC 60917 AND IEC 60297 SERIES –

Part 1: Environmental requirements, test setups and safety aspects

FOREWORD

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IEC 61587-1 has been prepared by sub-committee 48D: Mechanical structures for electrical and electronic equipment, of IEC technical committee 48: Electrical connectors and mechanical structures for electrical and electronic equipment.

This fifth edition cancels and replaces the fourth edition published in 2016. This edition constitutes a technical revision.

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

a) Modification of title.
b) Revision of Clauses 6, 7 and 8 including new defined test setups.
c) Compatibility with IEC 61587-2, IEC 61587-3 and IEC 61587-5.

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

FDIS	Report on voting
48D/743/FDIS	48D/748/RVD

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

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

This document was drafted in accordance with the 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/standardsdev/publications.

A list of all parts of the IEC 61587 series, under the general title *Mechanical structures for electrical and electronic equipment – Tests for IEC 60917 and IEC 60297 series*, can be found on the IEC website.

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

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- withdrawn,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

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INTRODUCTION

This document provides a common methodology to perform and report conformance tests of IEC 60917 or IEC 60297 compliant cabinets, racks, subracks, chassis, chassis integrated subracks and associated plug-in units under indoor condition use and transportation conditions.

Manufacturers can show the performance and characteristics of products in their catalogues by using the classifications in accordance with this document.

Users get comparative figures to compare products of different producers and can choose products for their targeted system from their catalogues. With the information of different classification levels, they get important indices for the possible maximum loads of the enclosure, which are important for their individual and safe applicability.

Designers of new products can define the performance requirements of these new products for their targeted systems by referencing this document. This allows a cost optimized design in accordance with the intended application.

This edition 5 constitutes a revision of the previous edition, with the following changes:

a) Subracks, chassis with integrated subracks and associated plug-in units
   - The static mechanical tests of subracks as described in edition 4 were based on the inspection of load bearing structural parts (single point load). On the other hand, the dynamic mechanical load test in edition 4 described not only subracks but also various types of chassis with integrated subracks, based on the load categories. In addition, the dynamic mechanical test for plug-in units with mass load was defined. There was no mention of mechanical tests for chassis.
   - This edition 5 provides test methods for static load tests for subracks and chassis integrated subracks, which are categorized based on subracks' associated mass loaded plug-in units. The static load test for chassis is similarly categorized by applying with dummy loads for chassis. These load categories for subracks, chassis with integrated subracks and chassis are applied for the dynamic load tests. These test methods solve previous edition lack of requirements on the static/dynamic tests for subracks and associated plug-in units, chassis with integrated subrack and chassis.
   - Furthermore, a test setup is defined in a test fixture with optional recessed assembly fixtures at subracks in a housing or rack.
   - In the dynamic load tests, the random vibration test is added.
   - Specification of individual mechanical tests for plug-in units, which were defined in edition 4, are required for applications of single board computing system or embedded systems in relation with applied connector reliability test. The test specification is introduced as Annex A (normative).
b) Cabinets and racks
   - Test setups for the cabinet for different applications, e.g. using a mounting plate, are added.
   - The cabinet/rack samples with different dummy loads have been extended by a test sample with dummy loads mounted on a mounting plate for industrial electrical installations.
   - The vertical structure test is supplemented instead of the lifting test (LT) of edition 4.
   - In the dynamic load tests, the random vibration test is added.

In the revised Clause 9, stability, installation conditions of racks and cabinets are added.

MECHANICAL STRUCTURES FOR ELECTRICAL AND ELECTRONIC EQUIPMENT – TESTS FOR IEC 60917 AND IEC 60297 SERIES –

Part 1: Environmental requirements, test setups and safety aspects

1 Scope

This part of IEC 61587 specifies environmental requirements, test set-ups, as well as safety aspects for empty enclosures, i.e. cabinets, racks, subracks, chassis, chassis integrated subracks and associated plug-in units under indoor condition use and transportation. It defines classifications (product performance levels) for these products, regarding and simulating the usually arising loads during their use. For mechanical static and dynamic load tests typical examples with dummy loads are used.

The purpose of this document is to establish defined levels of physical performance in order to meet certain requirements of manufacture, storage, transport and final location conditions.

This document applies in general only to the above cited mechanical structures.

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 60068-1, *Environmental testing – Part 1: General and guidance*

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 60068-2-11, *Environmental testing – Part 2-11: Tests – Test Ka: Salt mist*

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 60068-2-42, *Environmental testing – Part 2-42: Tests – Test Kc: Sulphur dioxide test for contacts and connections*

IEC 60068-2-43, *Environmental testing – Part 2-43: Tests – Test Kd: Hydrogen sulphide test for contacts and connections*

IEC 60068-2-49, *Environmental testing – Part 2-49: Tests – Guidance to test Kc: Sulphur dioxide test for contacts and connections*

IEC 60068-2-52, *Environmental testing – Part 2-52: Tests – Test Kb: Salt mist, cyclic (sodium, chloride solution)*

IEC 60068-2-64:2008, *Environmental testing – Part 2-64: Tests – Test Fh: Vibration, broadband random and guidance*
IEC 60068-2-64:2008/AMD1:2019

IEC 60297 (all parts), M*echanical structures for electronic equipment – Dimensions of mechanical structures of the 482,6 mm (19 in) series*

IEC 60297-3-100, *Mechanical structures for electronic equipment – Dimensions of mechanical structures of the 482,6 mm (19 in) series – Part 3-100: Basic dimensions of front panels, subracks, chassis, racks and cabinets*

IEC 60297-3-101, *Mechanical structures for electronic equipment – Dimensions of mechanical structures of the 482,6 mm (19 in) series – Part 3-101: Subracks and associated plug-in units*

IEC 60297-3-105, *Mechanical structures for electronic equipment – Dimensions of mechanical structures of the 482,6 mm (19 in) series – Part 3-105: Dimensions and design aspects for 1U high chassis*

IEC 60297-3-107, *Mechanical structures for electronic equipment – Dimensions of mechanical structures of the 482,6 mm (19 in) series – Part 3-107: Dimensions of subracks and plug-in units, small form factor*

IEC 60297-3-108, *Mechanical structures for electronic equipment – Dimensions of mechanical structures of the 482,6 mm (19 in) series – Part 3-108: Dimensions of R-types subracks and plug-in units*

IEC 60512-1-1, *Connectors for electronic equipment – Tests and measurements – Part 1-1: General examination – Test 1a: Visual examination*

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

IEC 60654-4, *Operating conditions for industrial-process measurement and control equipment – Part 4: Corrosive and erosive influences*

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

IEC 60917 (all parts), *Modular order for the development of mechanical structures for electronic equipment practices*

IEC 60917-2-1, *Modular order for the development of mechanical structures for electronic equipment practices – Part 2: Sectional specification – Interface co-ordination dimensions for the 25 mm equipment practice – Section 1: Detail specification – Dimensions for cabinets and racks*

IEC 60917-2-2, *Modular order for the development of mechanical structures for electronic equipment practices – Part 2: Sectional specification – Interface co-ordination dimensions for the 25 mm equipment practice – Section 2: Detail specification – Dimensions for subracks, chassis, backplanes, front panels and plug-in units*

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

IEC 61076-4-116, *Connectors for electronic equipment – Product requirements – Part 4-116: Printed board connectors – Detail specification for a high-speed two-part connector with integrated shielding function*

IEC 61373, *Railway applications – Rolling stock equipment – Shock and vibration tests*

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

IEC 61587-3:2013, *Mechanical structures for electronic equipment – Tests for IEC 60917 and IEC 60297 – Electromagnetic shielding performance tests for cabinets and subracks*

IEC 61587-5, *Mechanical structures for electronic equipment – Tests for IEC 60917 and IEC 60297 – Seismic tests for chassis, subracks, and associated plug-in units*

IEC 62208:2011, *Empty enclosures for low-voltage switchgear and control gear assemblies – General requirements*

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 22878, *Castors and wheels – Test methods and apparatus*

ISO 22883, *Castors and wheels – Requirements for applications up to 1,1 m/s (4 km/h)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

3.1
indoor condition
location at which the product is protected from weather influence

3.2
test sample
unit under test, dummy loaded where necessary in order to achieve repeatable results

4 Classification of environmental conditions

The climatic conditions are derived from IEC 60721-3-2, IEC 60721-3-3 and IEC 60654-4.

The mechanical conditions, which relate to the levels of vibration and shock, are derived from IEC 60721-3-2, and IEC 60721-3-3.

5 General

These climatic and mechanical tests ensure that the mechanical structure of cabinets, racks, subracks, chassis integrated subracks, associated plug-in units and chassis will survive the normal handling during manufacture, storage, transport and final location conditions.

In order to have some safety margin built into the enclosures and related mechanical parts, all classification parameters are higher than parameters for the overall application itself. This should ensure proper working of a complete unit in an application.

Unless otherwise specified all tests shall be done at an ambient (room) temperature range of nominal +20 °C to +25 °C.

The specified classifications of performance and kinds of tests of this document can be combined as required. Compliance to individual subclauses and levels is permissible. Individual tests and severities are referred to by letters and numbers (see Table 1 for examples which show a selection of representative values from each subclause and relevant table).

The various tests should be performed using the same sample wherever it is possible. Experience has shown that the sequence of tests listed in this document (see also IEC 60068-1) enables the test sequence to be performed using the same test sample except where the individual test results preclude further testing of the same sample, i.e., the test damages (destroys) the sample.

Table 1 – Examples showing references to tests

Test	Subracks and associated plug-in units, chassis with integrated subracks, and chassis IEC 60297 or IEC 60917 series	Cabinet or rack IEC 60297 or IEC 60917series
Climatic	C1 C2 C3 (Table 2)	
Industrial atmosphere	A1 A2 A3 (Table 3)	
Static load	SLC01 SLC02 SLC03 SLC04 SLC05 SLC06 SLC07 SLC08 (Table 4a for subracks and associated plug-in units, chassis with integrated subracks) SLC11, SLC12, SLC13 SLC14, SLC15 (Table 4b for chassis)	Test combination: SL04 SL05 SL06 SL11 SL12 (Table 15) NL01 until NL05 (Table 7, Table 8) NL11 until NL15 (Table 9)
Vertical structure (VT)	--	VT1 until VT5 (Table 11)
Stiffness (ST)	--	ST1 until ST5 (Table 13)
Dynamic load (vibration)	DL01V DL02V DL03V DL11V DL12V (Table 6)	DL04V DL05V DL06V DL07V (Table 17)
Dynamic load (shock)	DL01S DL02S DL03S DL11S (Table 6)	DL04S DL05S DL06S DL07S (Table 17)
Impact (IK code)	Ref. IEC 62262	
Protection (IP code)	Ref. IEC 60529	
Seismic	Ref. IEC 61587-5	Ref. IEC 61587-2
Electromagnetic shielding	Ref. IEC 61587-3	

Application example:

A subrack in accordance with IEC 60297-3-101 complies with the following test requirements:

- Climatic: C2 (see Table 2)
- Industrial atmosphere: A1 (see Table 3)
- Static load: SLC02 (see Table 4a)
- Vibration: DL01V (see Table 6)
- Shock: DL01S (see Table 6)
- Safety aspects: Clause 9
- Protection class: IP20 (according to IEC 60529)

6 Climatic tests

6.1 General

Climatic tests ensure that cabinets, racks, subracks, chassis with integrated subracks, associated plug-in units and chassis will survive the particular environment in which they will normally operate without degradation or creating a hazard.

Climatic tests shall be selected by reference to the application examples given in Table 2 for cabinets, racks, subracks, chassis integrated subracks, associated plug-in units and chassis.

In order to claim compliance at a given level, all test criteria for that requirement level shall be met.

6.2 Cold, dry heat and damp heat (cyclic)

Table 2 – Classifications for cold, dry heat and damp heat

Classification	Application examples	Cold according to IEC 60068-2-1		Dry heat according to IEC 60068-2-2		Damp heat according to IEC 60068-2-30 cyclic (12h + 12h cycle), upper limit
		Temper-ature °C	Duration[a] h	Temper-ature °C	Duration[a] h	°C
C1	Enclosed spaces without particular stresses (for example office, laboratory) with temperatures between –10 °C and +55 °C, 20 % to 80 % RH: non-condensing	–10	16	+55	16	+55
C2	Enclosed spaces subject to climatic stress (for example production halls) with temperatures between –25 °C and +70 °C, 20 % to 80 % RH: non-condensing	–25	16	+70	16	+55
C3	Extreme climatic stresses (for example open air, tropical climate) with temperatures between –40 °C and +85 °C, 20 % to 95 % RH: non-condensing	–40	16	+85	16	+55

[a] The duration shall be measured from the moment temperature stability of the test sample is reached.

Assessment following the tests:

a) Visual examination (see IEC 60512-1-1, test 1a).

b) Earth bond continuity check to be carried out in accordance with 9.4.

c) For electromagnetic shielding performance examination see IEC 61587-3:2013 (Table 1).

6.3 Industrial atmosphere

Table 3 – Classifications for industrial atmosphere

Classification	Application examples	Test conditions			Assessment following the test
		Sulphur dioxide test and hydrogen sulphide test, at 25 °C and 75 % RH (extended range at 40 °C and 80 % RH) according to IEC 60068-2-42, IEC 60068-2-43 and IEC 60068-2-49		Salt mist test Ka according to IEC 60068-2-11 at 35 °C (extended range as IEC 60068-2-52)	
		SO_2	H_2S	NaCl	
A1	Moderate concentration of harmful substances, general industrial use with low chemical emissions (for example enclosed spaces) and concentrations according to IEC 60654-4, namely; SO_2: mean 0,1 cm^3/m^3 maximum 0,5 cm^3/m^3	10 cm^3/m^3 4 days	1 cm^3/m^3 4 days	–	Visual examination (for example alteration in surface finish, traces of corrosion, colour, degree of lustre) For electromagnetic shielding gasket performance examination see IEC 61587-3.
A2	Heavy concentration of harmful substances, with considerable chemical emissions (for example chemical industry, field work) and concentrations according to IEC 60654-4 namely: SO_2: mean 5 cm^3/m^3 maximum 15 cm^3/m^3 H_2S: mean 10 cm^3/m^3 maximum 50 cm^3/m^3	25 cm^3/m^3 4 days	10 cm^3/m^3 to 15 cm^3/m^3 4 days	–	Visual examination (for example alteration in surface finish, traces of corrosion, colour, degree of lustre). Variation in resistance of earthing conductor junctions, see 9.4. For electromagnetic shielding gasket performance examination see IEC 61587-3.
A3	Heavy concentration of harmful substances combined with stress due to maritime climate (for example seaborne chemical processing technology, drilling rigs) and concentrations according to IEC 60654-4, namely: SO_2: mean 5 cm^3/m^3 maximum 15 cm^3/m^3 H_2S: mean 10 cm^3/m^3 maximum 50 cm^3/m^3	25 cm^3/m^3 4 days	10 cm^3/m^3 to 15 cm^3/m^3 4 days	5 % 96 h at 35 °C Extended range: 5 % 1 cycle: 146 h at 35 °C	Visual examination (for example alteration in surface finish, traces of corrosion, colour, degree of lustre) Variation in resistance of earthing conductor junctions, see 9.4. For electromagnetic shielding gasket performance examination see IEC 61587-3.
NOTE The tests may be performed on individual components and sample units or component assemblies instead of the original units (cabinets, racks and subracks, chassis) if the replacement items and the original sample share the same materials and surface treatments.					