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Packaging — Complete, filled transport packages — General rules for the compilation of performance test schedules

Emballages — Emballages d'expédition complets et pleins — Règles générales pour l'établissement de programmes d'essais d'aptitude à l'emploi

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 122, *Packaging*, Subcommittee SC 3, *Performance requirements and tests for means of packaging, packages and unit loads (as required by ISO/TC 122)*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

This second edition cancels and replaces the first edition (ISO 4180:2009) which has been technically revised. The main changes compared to the previous edition are as follows:

- the test item in the test schedule can now be selected by agreement of the stakeholders depending on the expected or existing transportation process and hazards;
- in 6.4, the test conditions have been reviewed and revised by the distance and condition of transportation;
- in 6.5, a new Level-4 has been added for well controlled handling;
- in 6.6, the test conditions have been reviewed and revised; they can be changed or selected depending on the storage conditions by the agreement of stakeholders.

Packaging — Complete, filled transport packages — General rules for the compilation of performance test schedules

1 Scope

This document establishes general rules for the compilation of performance test schedules for complete, filled transport packages intended for use within any distribution system except for the packages used for dangerous goods.

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.

ISO 2206, *Packaging — Complete, filled transport packages — Identification of parts when testing*

ISO 2233, *Packaging — Complete, filled transport packages and unit loads — Conditioning for testing*

ISO 2244, *Packaging — Complete, filled transport packages and unit loads — Horizontal impact tests*

ISO 2873, *Packaging — Complete, filled transport packages and unit loads — Low pressure test*

ISO 8318, *Packaging — Complete, filled transport packages and unit loads — Sinusoidal vibration tests using a variable frequency*

ISO 13355:2016, *Packaging — Complete, filled transport packages and unit loads — Vertical random vibration test*

ISO 21067-1, *Packaging — Vocabulary — Part 1: General terms*

IEC 60068-1:2013, *Environmental testing — Part 1: General and guidance*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 21067-1 and the following apply.

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

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

3.1 performance test schedule

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single laboratory test, or series of tests, intended to ascertain the performance, under working conditions, of the subject under test

3.2

hazard

factor which brings a possibility of damage or deterioration of the value to the packaged freight or product

3.3

power spectral density

acceleration power spectral density

PSD

degree of variation in energy for each frequency to the acceleration signal in a specific frequency range as a function of frequency

3.4

sweep cycle

scanning through the specified frequency band once in each direction, e.g. 10 Hz to 150 Hz to 10 Hz

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[SOURCE: IEC 60068-2-6:2008, 3.4, modified — The Note has been deleted.]

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4 Hazard

Typical hazards in the logistics process, and the related international standards, are shown in Table 1.

Table 1 — Expected hazard during logistics process, and related international standards

Basic factor in logistics	Hazard	Related international standards	
Transport	— Vibration during transportation — Repetitive impact by bouncing	Vertical random vibration test	ISO 13355
		Sinusoidal vibration tests using a variable frequency	ISO 8318
		Vibration tests at fixed low frequency	ISO 2247
	Horizontal impact by sudden stop or start	Horizontal impact test	ISO 2244
	Horizontal impact by linking work of railway freight car		
	Stacking stress during transportation	Random vibration test	ISO 13355
		Sinusoidal vibration tests using a variable frequency	ISO 8318
Low pressure by high altitude	Low pressure test	ISO 2873	
Handling	Drop impact by manual handling	Vertical impact test by dropping	ISO 2248

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	Drop impact by mechanical handling		EN 14149
	Horizontal impact during handling by forklift or crane as such	Horizontal impact test	ISO 2244
	Rough handling by rolling	Rolling test	ISO 2876
	Topple	Toppling test	ISO 8768
	Handling of unit load	Stability testing of unit loads	ISO 10531
Storage	Compression load in stacking storage in warehouse	Stacking tests using a static load	ISO 2234
		Compression and stacking tests using a compression tester	ISO 12048
Climate	Temperature and humidity	High temperature test	ISO 2233 IEC 60068-1
		High temperature/High humidity test	
		Low temperature test	
	Wet, dewing	Water-spray test	ISO 2875

5 Preparation of the test schedule

5.1 The test item shall be selected from Table 2 depending on the expected or existing hazard and considering logistics-related elements which affect the specimen.

The characteristics of the specimen, test equipment and past damage experience should be considered when selecting the test item.

Table 3 shows an example of hazards and corresponding test items.¹⁹

5.2 The test schedule shall be chosen by accumulation of selected hazards. Follow Clause 6 for the selection of test level.

However, the test level can be modified by agreement of the stakeholders.

Table 4 shows an example of performance test schedule based on the hazards listed in Table 3.

5.3 The test sequence should be decided by agreement of the stakeholders taking into consideration the logistics process. Where the logistics process is unknown, the following test sequence may be carried out:

- a) compression test;
- b) vibration test;
- c) free-fall test.

The test sequence may comprise one, two or three of the tests given in a), b) and c), in any order.

5.4 Refer to ISO 10531 for the handling and stability test of the unit load.

Table 2 — Selection guide for test item and correspondent test method

Basic factor in logistics	Test item	Type of hazard	Guide for selection of test	Test method
Transport	Vertical random vibration test in general transportation	Vertical vibration or stacking load in general transportation	Examples of the related product or failure	6.4.2
	Sinusoidal vibration test in general transportation	Repetitive shock by poor road		6.4.3
	Random vibration test in rough road transportation	Stacking stress during transportation	<ul style="list-style-type: none"> — Electric, electronics or mechanical products — High precision surfaced products — Powder or granular products 	6.4.4
	Sinusoidal vibration test in rough road transportation			6.4.5
	Vibration tests at fixed low frequency	Low pressure	<ul style="list-style-type: none"> — Burst, deformation — Leak of the contents 	ISO 2247
	Stacked vibration test			6.4.6
	Low pressure test	Manual handling	<ul style="list-style-type: none"> — Electronic component or product which has mechanical structure — Liquid or semi-liquid product 	6.8
	Free-fall test	Machinery handling		6.5.2
	Rotational drop test	Horizontal impact during handling or transportation	<ul style="list-style-type: none"> — Products which are weak to sharp item — Pressure sensitive product, powder or granular products 	6.5.3
	Horizontal impact test	Toppling during handling		6.5.4
Handling	Rolling test	Rough handling by rolling	Container for warehouse storage and products	ISO 8768
	Compression test	Stacking compression in warehouse		ISO 2786
Storage	Temperature and humidity environmental test	High temperature with low humidity	Deformation or cracking by the high temperature	6.6
		High temperature/high humidity		6.7
Climate	Water spray test	Low temperature	<ul style="list-style-type: none"> — Sensitive to corrosion — Hygroscopic product — Mold, spoil, degrade 	6.7
		Rain		Degradation by contraction or embrittlement
	Random vibration has priority.		Wet damage	ISO 2875 ^b

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Basic factor in logistics	Test item	Guide for selection of test		Test method
		Type of hazard	Examples of the related product or failure	
<p>Test condition may be specified by the agreement of the stakeholders.</p>				

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Table 3 — Example of hazard and correspondent test item

No.	Activity	Hazard	Test item	Test method
1	Unitization at factory	Mechanical handling	Rotational drop test	6.5.3
2	Container loading by forklift	Mechanical handling	Rotational drop test	6.5.3
			Horizontal impact test	6.5.4
3	Transport to port	150 km, paved road, by trailer	Vertical random vibration test	6.4.2
4	Storage at port	Maximum stack height: 2,4 m	Compression test	6.6
		Temperature/humidity	Temperature and humidity environmental test	6.7
5	Load to container ship	Mechanical handling	Rotational drop test	6.5.3
6	Transport by ship	Vibration	Horizontal impact test	6.5.4
			Vertical random vibration test	6.4.2
7	Unload from container ship	Maximum stack height: 2,4 m	Compression test	6.6
		Mechanical handling	Rotational drop test	6.5.3
8	Transport container to warehouse	3 000 km, paved road, by trailer	Vertical random vibration test	6.4.2
			Horizontal impact test	6.5.4
9	Storage operation by forklift Storage at warehouse	Mechanical handling	Rotational drop test	6.5.3
			Horizontal impact test	6.5.4
10	De-vanning at warehouse Reload to local distribution truck	Maximum stack height: 5 m	Compression test	6.6
		Temperature/humidity	Temperature and humidity environmental test	6.7
		Manual handling	Free-fall test	6.5.2

No.	Activity	Hazard	Test item	Test method
11	Transport to final destination	Partially rough road transport	Random vibration	6.4.2
		Partly air cargo	Random vibration test in rough road transportation	6.4.4
		Manual handling	Low pressure test	6.8
12	Unloading at final destination		Free-fall test	6.5.2

Table 4 — Example of performance test schedule based on Table 3

Test schedule	Example of test order			
	1	2	3	4
A: Sequential test using one specimen	Conditioning [6.3 Method B]	Compression test [6.6.2.2, Table 22, Classification level 2]	Vertical random vibration test [6.4.2 Table 6, Level 1]	Free-fall test [6.5.2 Table 17]
B: Parallel test using multiple specimens (in case of four specimens)	Conditioning [6.3 Method A]	Vertical random vibration test [6.4.2 Table 6, Level 1]	Random vibration test in rough road transportation [6.4.4 Table 12, Level 2]	Free-fall test [6.5.2 Table 17]
	Conditioning [6.3 Method B]	Compression test [6.6.2.2, Table 22, Classification level 2]		
	Conditioning [6.3 Method B]	Temperature and humidity environmental test [6.7, table 26, High temperature test]		
	Conditioning [6.3 Method B]	Low pressure test [6.8, Table 27, Level 2]		

NOTE Table 4 shows an example of a performance test schedule based on Table 3.

6 Test method

6.1 The laboratory atmosphere

The laboratory shall be in the standard atmospheric conditions specified in IEC 60068-1:2013, Table 2:

- temperature: 15 °C to 35 °C;
- relative humidity: 25 %RH to 75 %RH;
- air pressure: 86 kPa to 106 kPa.

NOTE IEC 60068-1 is referred in this situation due to the difference of environment between pre-conditioning and laboratory atmosphere.

6.2 Specimens

6.2.1 Content of specimens

Each test specimen shall be filled with its intended content. However, simulated or substituted content can be used, provided that the dimensions and physical properties of such content are as close as possible to those of the intended content. The specimen shall be packaged (closed, sealed, bundled as such) under shipment conditions.

6.2.2 Number of specimens

The preparation of several specimens is recommended for high reliability of test result. The number of specimens may be decided by the standard user or by agreement of the stakeholders.

6.2.3 Degradation of specimen

Unless the performance of aged specimen materials is known, the effects of aged specimen on transportation should be considered.

6.2.4 Identification of specimen

The identification of specimens shall be in accordance with ISO 2206.

6.3 Conditioning

Conditioning shall be applied in accordance with Table 5, depending on the characteristics of the packaged product. For the compression test, Method B should be applied, except when a user specifies, a specially controlled environment to be applied (Method C).