INTERNATIONAL STANDARD

ISO 13355

Second edition
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Packaging — Complete, filled transport packages and unit loads — Vertical random vibration test

Emballages — Emballages d'expédition complets et pleins et charges unitaires — Essais de vibration verticale aléatoire

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Foreword

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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 on 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 the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 122, *Packaging*, Subcommittee SC 3, *Performance requirements and tests for means of packaging, packages and unit loads*.

This second edition cancels and replaces the first edition (ISO 13355:2003), which has been technically revised.

Some of the major modification points are listed as follows:

a) Annex A has been changed from Informative to Normative;

b) in Table A.1, 0,048 $(m/s^2)^2$ at 3 Hz, Slope between 3 Hz to 6 Hz, 1,154 $(m/s^2)^2$ at 6 Hz to 18 Hz has been changed to 0,048 $(m/s^2)^2$ at 2 Hz, Slope between 2 Hz to 4 Hz, 1,154 $(m/s^2)^2$ at 4 Hz to 18 Hz;

c) Annex B has been added.

Introduction

A random vibration test is a more realistic method in reproducing environmental vibration during transportation than sinusoidal vibration test. For this reason, if suitable laboratory facilities are available, a vibration test is more preferable than any fixed or swept frequency sinusoidal vibration tests similar to those given in ISO 2247 and ISO 8318.

Packaging — Complete, filled transport packages and unit loads — Vertical random vibration test

1 Scope

This International Standard specifies a method to carry out a vertical random vibration test on a complete, filled transport package(s) and unit loads using random excitation[1]. This document also provides methods for assessing the performance of a package in terms of its strength or the protection that it offers to its contents when it is subjected to vertical vibration. The test discussed in this document can be performed either as a single test to investigate the effects of vertical vibration, or as a part of a sequence of tests designed to measure the ability of a test specimen to withstand a distribution system that includes a vibration hazard.

NOTE In this International Standard, a package or unit load is referred to as test specimen.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 2234, *Packaging — Complete, filled transport packages and unit loads — Stacking tests using a static load*

3 Principle

The test specimen is placed on a vibration table and made to vibrate using random excitation with an effective frequency range for the test specimen. Atmospheric conditions, test duration, acceleration power spectral density, attitude of the test specimen and method of restraint are predetermined.

Specific requirements for mounting a test specimen on the vibrating platform are given in ISO 4180:2009, 10.7.1.

NOTE When required, a load is superimposed on the test specimen to simulate the conditions at the bottom of a stack.

4 Apparatus

4.1 Vibration table

A table of sufficient size and performance (in terms of power, displacement, frequency range) capable of being stiff (its lower resonant frequency shall be higher than the higher test frequency) and remaining horizontal during the test.

1) Random vibration theory is discussed in IEC 60068-2-64.

The frequency range shall be 2 Hz to 200 Hz, with a resolution of at least 1 Hz. By considering the resonance frequency of the seismic-base of the test equipment, the frequency range at the low end may be modified based on the agreement between the involved stakeholders or on the technical instruction of the test equipment.

The table may be equipped with the following components:

— Low fences restricting sideways and endways movements during testing;

— High fences or other means of maintaining a superimposed load in position on the test specimen during testing.

Furthermore, the apparatus shall meet the requirements and tolerances of Clause 6.

4.2 Vibration measurement, data storage and control system

A system comprising accelerometers, signal conditioners and a computer, capable of:

— generating vibration with the required power spectral density;

— controlling the motion of the vibration table by feeding back the signal from the control accelerometer which monitors the table acceleration;

— performing the analysis with at least 120 statistical degrees of freedom; and

— having data acquisition and control channels with a response accurate to 5 % over the frequency range specified for the test.

5 Sampling

5.1 Test specimen preparation

The test specimen shall normally be filled with its intended contents. However, simulated or substituted contents may be used, provided that the dimensions and physical properties of such contents are as close as possible to those of the intended contents.

Ensure that the test specimen is closed normally, as if ready for distribution. If simulated or substituted contents are used, ensure that the normal method of closure is still employed.

5.2 Conditioning

Condition the test specimen in accordance with ISO 2233.

6 Procedure

Carry out the test in the same atmospheric conditions as used for conditioning where this is critical to the performance of the test specimen.

In other circumstances, the test shall be carried out in atmospheric conditions which are as near as practicable to those used for conditioning.

Place the test specimen in the predetermined attitude on the vibration table (see 4.1), with the centre of gravity placed as near as practicable to the centre of the table; if the test specimen is not secured to the table it may be fenced. If a superimposed load is required, the loading procedure shall comply with ISO 2234.

Measure the imposed acceleration of the vibration table as closely as possible to the test specimen.

Ensure the horizontal components of the acceleration are no greater than 20 % of the value of the vertical component.

Start the test at 6 dB below the test level to allow the system to equalize the power spectral density profile, then carefully adjust the level to reach full test level and continue the test for the predetermined duration.

The test duration and the power spectral density of the vibration table, in absence of experimental data concerning the effects of transportation to be reproduced, should be chosen as indicated in Annex A.

When distribution system and intensity of vibration acceleration are partly known, the test duration and the power spectral density of the vibration table may be chosen from B.1 or B.2, as indicated.

NOTE Vibration spectra depend very much on the transport conditions such as road conditions or vehicle type which selected. Therefore, whenever possible, perform tests with spectra obtained from measured data of the particular transportation conditions.

The test schedule may be changed as agreed by the involved stakeholders. In this case, the change and the reason should be added to the test report.

The tolerance on root mean square acceleration shall not exceed 15 %; the obtained acceleration power spectral density of the test control signal shall not deviate by more than ± 3 dB over the entire test frequency range.

Tests may be interrupted at any time to allow visual inspection of the test specimen, or for any other purpose.

7 Test report

The test report shall include the following information:

— reference to this International Standard, i.e. ISO 13355;

— name and address of the testing laboratory and of the customer;

— unique identification of the report;

— date of receipt of the test specimens and the date(s) of performance of test;

— name, title and signature of the person(s) accepting responsibility for the test report;

— note stating that test results relate only to the specimens tested;

— note stating that the report shall not be reproduced, except in full, without the written approval of the testing laboratory;

— number of test specimens tested;

— full description, including dimensions, mass, structural and material specifications of the test specimen and its fittings, cushioning, blocking, closure or reinforcing arrangements, in accordance with ISO 2206;

— description of the contents, i.e. if simulated or substituted contents were used, full details shall be given;

— gross mass of the test specimen;

— relative humidity, temperature and time of conditioning, as well as the temperature and relative humidity of the test area at the time of test, noting whether these values conform to the requirements of ISO 2233;

— duration of the test, frequency range, applied acceleration power spectral density and obtained root mean square acceleration value;

— whether a superimposed load was used; if so, the mass, in kilograms, of the superimposed load and the period of time during which the test specimen was under load;

— method of restraint, and whether low or high fences were used;

— any deviations from the test method specified in this International Standard;

— test results and any observations which may assist in correct interpretation;

— attitude(s) in which the test specimen was tested, using the method of identification as given in ISO 2206;

— a list of equipment and their respective serial numbers (include calibration data, if required).

Annex A
(normative)

Power spectral density in generic transportation

Table A.1 and Figure A.1 give the power spectral density levels that can be used to simulate generic (mainly road) transportation when experimental recordings are not available.

Table A.1 — Spectral density

Frequency, f (Hz)	**Level** $(m/s^2)^2/Hz$	**Level** g^2/Hz	**Slope** dB/oct
$f = 2$	0,048	0,000 5	—
$2 < f < 4$	—	—	+13,75
$4 \leq f \leq 18$	1,154	0,012	—
$18 < f < 40$	—	—	–9,34
$f = 40$	0,096	0,001	—
$40 < f < 200$	—	—	–1,29
$f = 200$	0,048	0,000 5	—

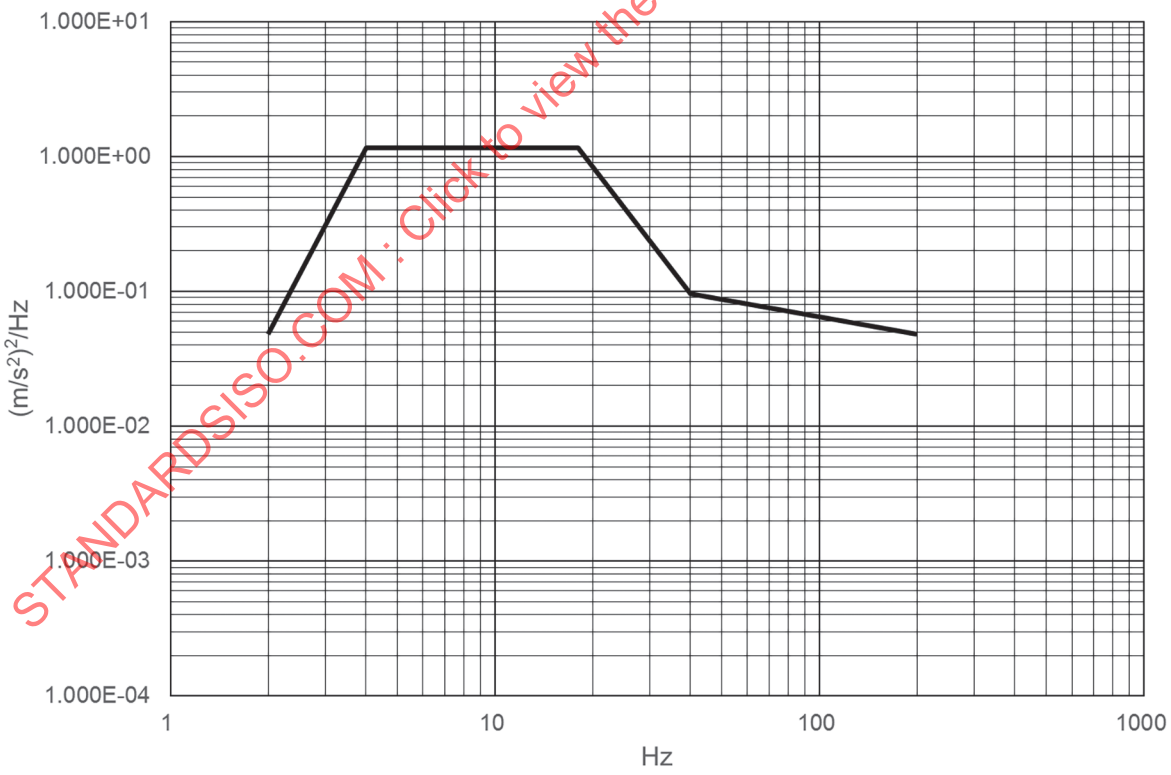

Figure A.1 — PSD profile

The total root mean square acceleration value of the frequency range is 5,926 m/s^2 rms (0,604 g rms).

The minimum recommended test duration is 30 min for each test specimen attitude to be tested. The correlation between transport distance and test duration is not addressed in this International Standard.

Annex B
(informative)

Power spectral densities derived from recorded data

B.1 PSD derived from recorded data (Europe)

The test data in Table B.1 and Figure B.1 simulate 12 h of transportation on the road. This is a multilevel test where all three levels are performed in sequence and in any order. To reduce testing time, the levels can be increased by multiplying the values of all power spectral densities with the factors given in Table B.2.

The three test levels may also be used independently, when suitable. See Reference [5].

Table B.1 — Vibration spectrum for road transportation

Frequency Hz	Power spectral density $(m/s^2)^2/Hz$			Power spectral density g^2/Hz		
	Level 1 $(m/s^2)^2/Hz$	**Level 2** $(m/s^2)^2/Hz$	**Level 3** $(m/s^2)^2/Hz$	**Level 1** g^2/Hz	**Level 2** g^2/Hz	**Level 3** g^2/Hz
3	0,185	0,364	0,577	0,001 920	0,003 780	0,006 000
5	0,308	0,606	0,962	0,003 200	0,006 300	0,010 000
11	—	—	0,962	—	—	0,010 000
24	0,048	0,092	—	0,000 500	0,000 960	—
38	0,005	0,010	—	0,000 052	0,000 100	—
48	—	—	0,029	—	—	0,000 300
61	0,004	0,008	—	0,000 044	0,000 087	—
71	—	—	0,029	—	—	0,000 300
80	—	—	0,014	—	—	0,000 150
98	0,001	0,003	—	0,000 014	0,000 028	—
200	0,001	0,003	0,014	0,000 014	0,000 028	0,000 150
Test duration (h:min:s)	07:12:00	03:36:00	01:12:00	07:12:00	03:36:00	01:12:00
Percentage of test duration	**60**	**30**	**10**	**60**	**30**	**10**
3 to 200 Hz m/s^2 rms (g rms)	1,775	2,481	4,070	(0,181)	(0,253)	(0,415)
5 to 200 Hz m/s^2 rms (g rms)	1,638	2,285	3,874	(0,167)	(0,233)	(0,395)

NOTE 1 Peak to peak displacement may exceed 25,4 mm by testing with low frequencies.

NOTE 2 A frequency range from 5 Hz to 200 Hz may be sufficient for the testing of small specimens.