BS EN 61587-2:2011

BSI Standards Publication

Mechanical structures for electronic equipment Tests for IEC 60917 and IEC 60297

Part 2: Seismic tests for cabinets and racks

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National foreword

This British Standard is the UK implementation of EN 61587-2:2011. It is identical to IEC 61587-2:2011. It supersedes BS EN 61587-2:2001 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee EPL/48, Electromechanical components and mechanical structures for electronic equipment.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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English version

Mechanical structures for electronic equipment - Tests for IEC 60917 and IEC 60297 - Part 2: Seismic tests for cabinets and racks

(IEC 61587-2:2011)

Structures mécaniques pour équipements électroniques -
Essais pour la CEI 60917
et la CEI 60297 -
Partie 2: Essais sismiques pour baies et bâtis
(CEI 61587-2:2011)

Mechanische Bauweisen für elektronische Einrichtungen -
Prüfungen für IEC 60917 und IEC 60297 -
Teil 2: Seismische Prüfungen für Schränke und Gestelle
(IEC 61587-2:2011)

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Foreword

The text of document 48D/471/FDIS, future edition 2 of IEC 61587-2, prepared by SC 48D, "Mechanical structures for electronic equipment", of IEC/TC 48, "Electromechanical components and mechanical structures for electronic equipment" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61587-2:2011.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2012-06-29
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2014-09-29

This document supersedes EN 61587-2:2001.

EN 61587-2:2011 includes the following significant technical changes with respect to EN 61587-2:2001:

EN 61587-2:2001 specified the test condition with one size of the cabinet, and one load distribution. The specified acceleration condition for the test specimen was single-axis and one of the RRS (required response spectra) specified in the standard was selected. The test was aimed to obtain the reference for the structural strength of the enclosure against the specified seismic intensity. Earthquakes are actually random phenomena that are much more carefully simulated by tri-axial simultaneous operation. The demand of tri-axial excitation has emerged as a more accurate representation of an earthquake.

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Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following referenced documents are indispensable for the application 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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60068-2-6	-	Environmental testing - Part 2-6: Tests - Test Fc: Vibration (sinusoidal)	EN 60068-2-6	-
IEC 60068-2-47	-	Environmental testing - Part 2-47: Tests - Mounting of specimens for vibration, impact and similar dynamic tests	EN 60068-2-47	-
IEC 60068-2-57	-	Environmental testing - Part 2-57: Tests - Test Ff: Vibration - Time-history method	EN 60068-2-57	-
IEC 60068-3-3	-	Environmental testing - Part 3: Guidance - Seismic test methods for equipments	EN 60068-3-3	-
IEC 60297	Series	Dimensions of mechanical structures of the 482,6 mm (19 in) series	EN 60297	Series
IEC 60917	Series	Modular order for the development of mechanical structures for electronic equipment practices	EN 60917	Series

CONTENTS

INTRODUCTION

Edition 1.0 of this standard specified the seismic test for the cabinets or racks according to IEC 60297 and IEC 60917. The specified test applied to the structure of the enclosure and did not apply to the whole system.

Edition 1.0 specified the test condition with one size of the cabinet, and one load distribution. The specified acceleration condition for the test specimen was single-axis and one of the RRS (required response spectra) specified in the standard was selected. The test was aimed to obtain the reference for the structural strength of the enclosure against the specified seismic intensity.

The electronic system consists of two or more subracks. Two or more plug-in units that perform signal processing are installed in each subrack. The size, i.e.: height, width and depth, and the weight of each subrack may vary for each electronic system. So, various types of cabinets or racks to equip the electronic system are currently demanded. Therefore, many types of cabinets or racks are required to install the equipment.

Earthquakes are actually random phenomena that are much more carefully simulated by tri-axial simultaneous operation. The demand of tri-axial excitation has emerged as a more accurate representation of an earthquake.

Edition 2.0 of this standard has been reviewed in consideration of these demanded conditions. However, it is impossible to perform the seismic test under all of the cabinet or rack conditions. The aim of this standard is then to evaluate the reference of the cabinet or rack structure with a common examination method. The seismic test is therefore assumed to be performed on one set of cabinet dimensional conditions (i.e. height, width and depth) and one set of load distribution conditions in the cabinet. The input acceleration for the test specimen is assumed to be selected and applied either single-axial or tri-axial. Single-axis acceleration was already specified in Edition 1.0 of this standard. Therefore, the RRS (required response spectra) for tri-axial acceleration have been added. According to this standard, the examination should be performed in the same manner, so as to obtain a reference for the evaluation of the structural strength of the tested cabinet or rack.

The user who requests an individual structural cabinet or rack condition, such as a different cabinet size or a different load distribution in the cabinet, and requests different seismic acceleration intensity, can perform the test by changing the corresponding condition specified in this standard. In this case, the test result is treated as an individual evaluation, not to be taken as a reference.

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

Part 2: Seismic tests for cabinets and racks

1 Scope

This part of IEC 61587 specifies seismic tests for cabinets and racks accommodated with IEC 60917 and 60297 series. It applies, in whole or in part, only to the mechanical structures of cabinets and racks for electronic equipment according to the above cited series of standards, while it does not apply to the electronic equipment or systems deemed to be installed within these mechanical structures. This standard does not apply either to a cabinet or a rack having an anti-seismic isolation structure, either external or internal.

This standard aims to provide test conditions and criteria that constitute a reference to evaluate the ability of the mechanical structure of the cabinets or racks to acceptably withstand specified seismic intensities. For this purpose, this standard specifies test specimen conditions, such as dimensions (i.e. height, width and depth) of the cabinet and the rack, load distribution, structural test condition and the RRS (required response spectra) of single-axis or tri-axis acceleration as the seismic test wave condition. The single-axis or tri-axis acceleration is selectable.

2 Normative references

The following referenced documents are indispensable for the application 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 60068-2-6: *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-47: *Environmental testing – Part 2-47: Tests – Mounting of specimens for vibration, impact and similar dynamic tests*

IEC 60068-2-57: *Environmental testing – Part 2-57: Tests – Test Ff: Vibration – Time-history method*

IEC 60068-3-3: *Environmental testing – Part 3: Guidance – Seismic test methods for equipments*

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

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60068-2-6, IEC 60068-3-3, IEC 60068-2-47 and IEC 60068-2-57 apply.

4 Set up of test specimen and measurement items

4.1 Introductory remarks

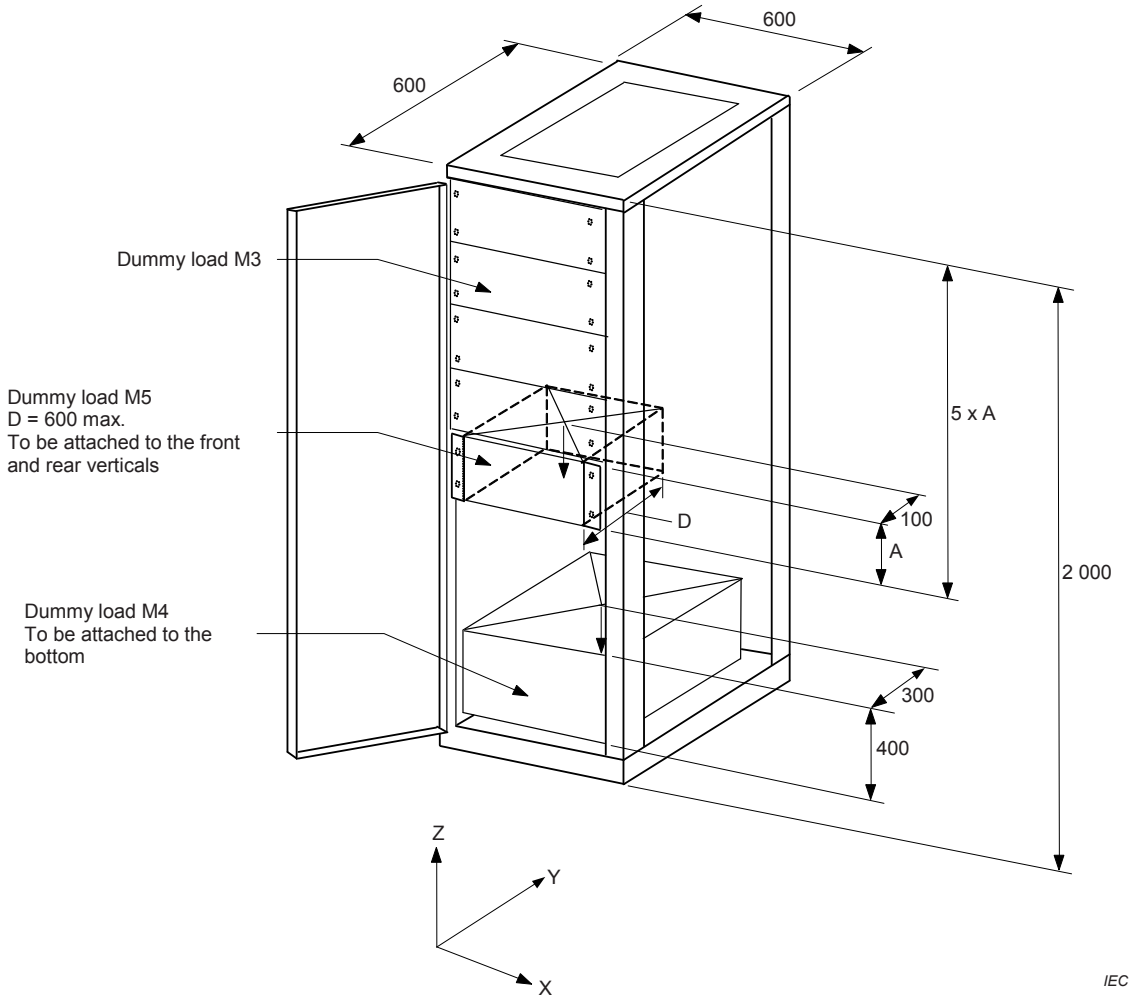
The seismic test of the cabinets or the racks shall be performed under loaded condition.

4.2 General

The cabinets or racks under the test shall be loaded in a distributed manner throughout the height of the cabinets or racks with dummy plug-in units similar to a practical subrack application.

The cabinets or racks to be tested shall be loaded as shown in Figure 1 and Table 1. This is the condition to be taken as reference.

Cabinets or racks equipped with front/rear doors, and/or side panels may gain structural contribution from their installation. The test report shall state whether the tested cabinets or racks were tested with or without doors and panels. Cabinets or racks to be deployed in the field by the user without doors and/or side panels will require cabinets or racks to be tested without doors and/or side panels.



Dimensions in millimetres

Figure 1 – Cabinets or racks configuration for test set up

Table 1 – Load distribution within the cabinet

Cabinets according	A (mm)	M3 (kg)	M4 (kg)	M5 (kg)	Total load (kg)
IEC 60297-3-100	265,9	25 × 4 positions	90	60	250
IEC 60917-2-1	250	25 × 4 positions	90	60	250

4.3 Set up of the cabinets or racks to the vibration table

Mounting condition is referred to IEC 60068-2-6, in which there is reference to IEC 60068-2-47.

The loaded cabinets or racks for the test may be mounted to the vibration table without using interfaces such as concrete anchors, however the securing of the cabinet/rack to vibration table shall use similar size and number of hold-down devices in accordance with the intended bolt-down positions of field installed units. If a specific cabinet mounting condition is required, the test should be performed with agreement between user and manufacture. If there are several bolt-down patterns for fixing the cabinets or racks to the vibration table, the test shall be performed under the worst bolt-down condition, that is, the largest stress works to the bolts. For the block diagram of the test set-up configuration, see Figure 2.

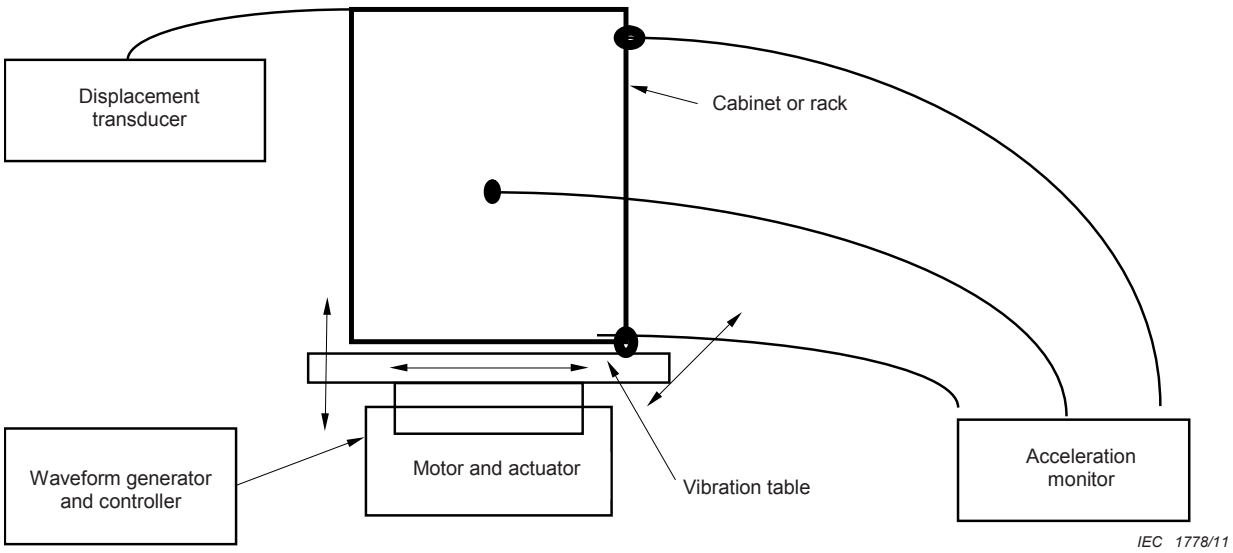


Figure 2 – Block diagram of test set up configuration

4.4 Measurement items

These items shall be measured and reported.

a) Measure the critical frequency and the damping ratio of the loaded cabinets or racks for test with the sweeping sinusoidal or the random wave before and after the seismic test.

b) Measure the acceleration of the vibration table during the test.

c) Measure the accelerations of horizontal and vertical directions at the top, bottom, and center of the cabinets or racks.

d) Measure the horizontal displacement of the top of the cabinet or rack at the attachment point to the vibration table.

5 Test waveform and acceleration condition

5.1 Introductory remarks

The parameters such as time history, zero period acceleration, damping ratio and severities (frequency range, required response spectrum, acceleration axis) are referred to IEC 60068-3-3 and 60068-2-57.

5.2 General

The test shall be performed as follows.

a) The test wave for the seismic test shall be a synthesized waveform.

b) The test shall be implemented with single-axis or tri-axial condition defined below, and which method actually applied shall be recorded.

c) The duration of the strong part of the time history is defined as from the time when the plot first reaches 25 % of the maximum value to the time when it falls for the last time to the 25 % level.

d) The test response spectrum (TRS) shall equal or exceed the required response spectrum (RRS) as shown in Figure 3 (for single axis) and Figure 5 (for tri-axes). The damping ratio of 3 % or 2 % is applied to evaluate the TRS and RRS, and is not applied to the frequency range less than 0,5 Hz and more than 50 Hz. The value of g, i.e., standard acceleration due to the earth, is rounded up to the nearest whole number, that is 10 m/s^2.

e) The test waveform shall be made to satisfy the RRS.

f) It is acceptable that the TRS is lower than RRS partially at the frequency range of lower than half or larger than two-times of the 1st natural frequency, but shall not exceed 20 % of RRS.

g) If TRS does not satisfy the RRS with the limitation of the displacement of the vibration table, TRS shall equal or exceed the frequency range equal or larger than 1Hz.

5.3 Single-axis acceleration

a) Accelerate each axis of the vibration table independently.

b) The acceleration of the vibration table is measured during the test as shown 4.3 b).

c) The duration of the strong part of the time history shall be equal or more than 18 s.

d) The zero period acceleration of input test wave shall be 16 m/s^2.

e) The time-history of the test wave is shown in Figure 4.

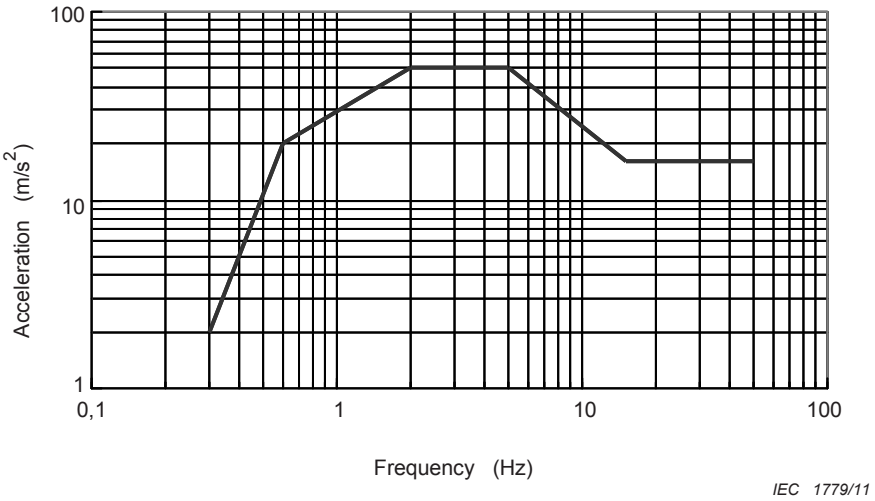


Figure 3 – The RRS for test wave (damping ratio 2 %)

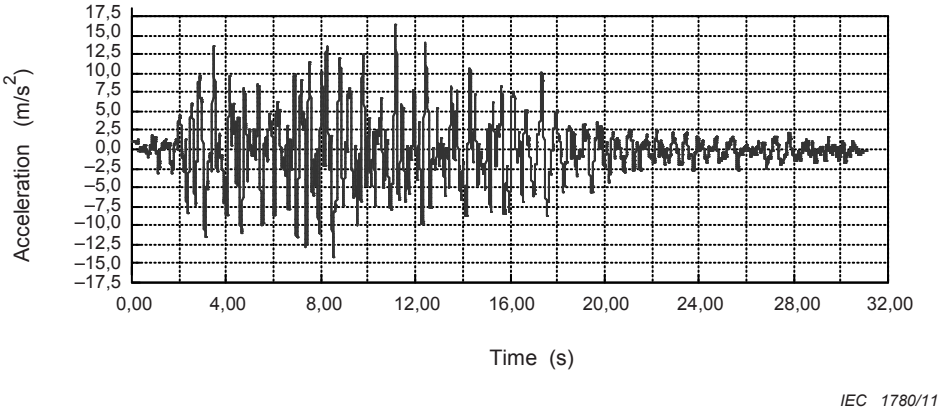


Figure 4 – Time-history of the test wave

5.4 Triaxial acceleration

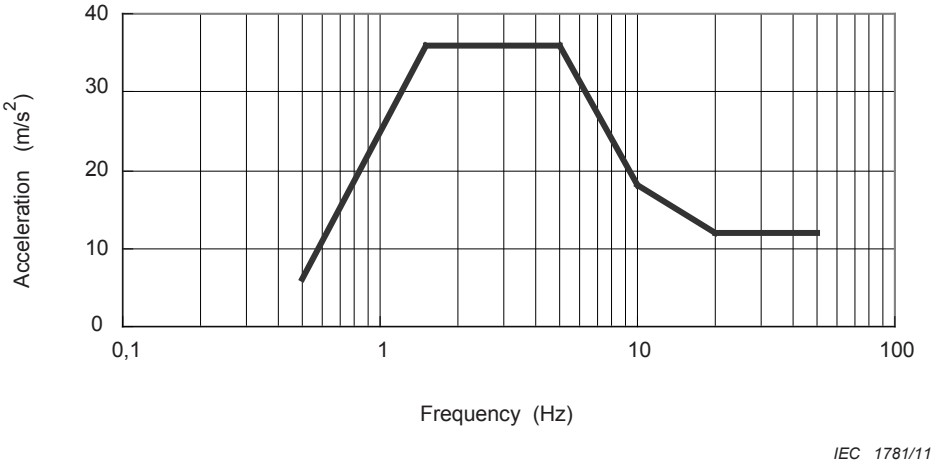
a) Accelerate the vibration table to three axes, i.e., width, depth, and up and down directions of the cabinets or racks, simultaneously.

b) Acceleration of individual axis is different from each other. The acceleration of the vibration table is measured during the test as indicated in 4.3 b).

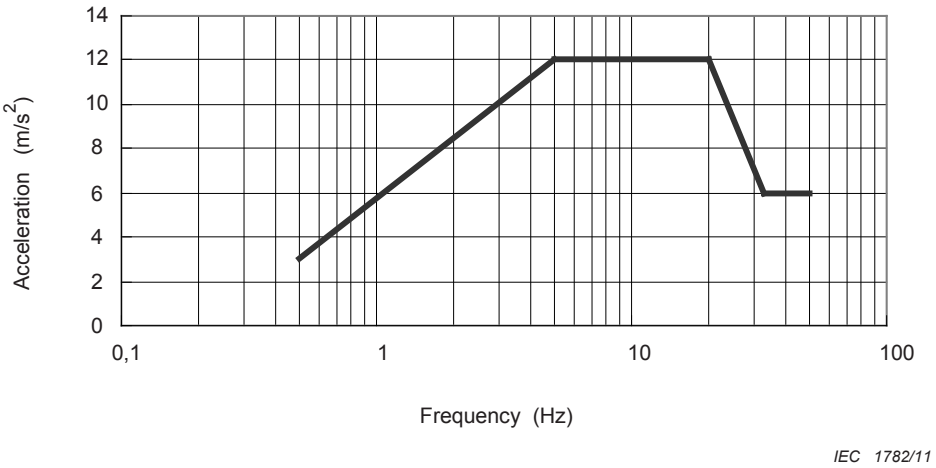
c) The duration of the strong part of the time-history shall be equal or more than 30 s.

d) The required maximum acceleration (zero period acceleration) for input test wave shall be 12 m/s^2 for horizontal and 6 m/s^2 for up-and-down. The RRS is shown in Figure 5.

e) Examples of time-histories for each axis are shown in Figure 6.

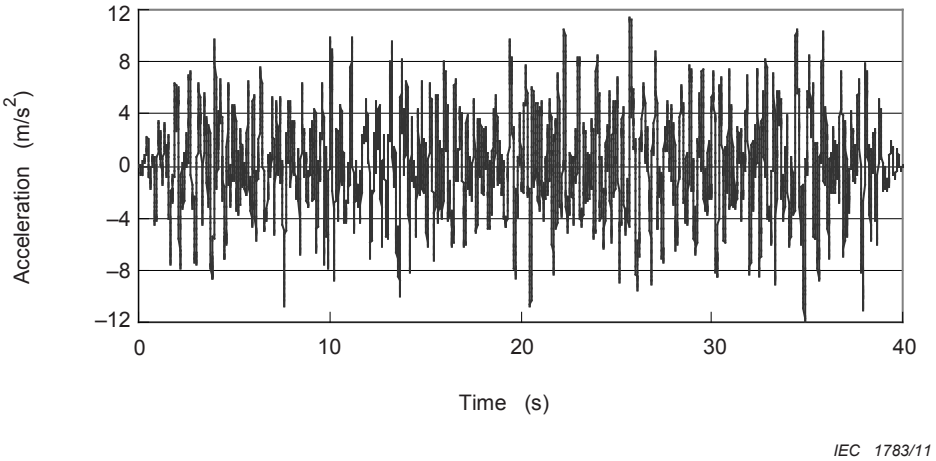


a) Horizontal

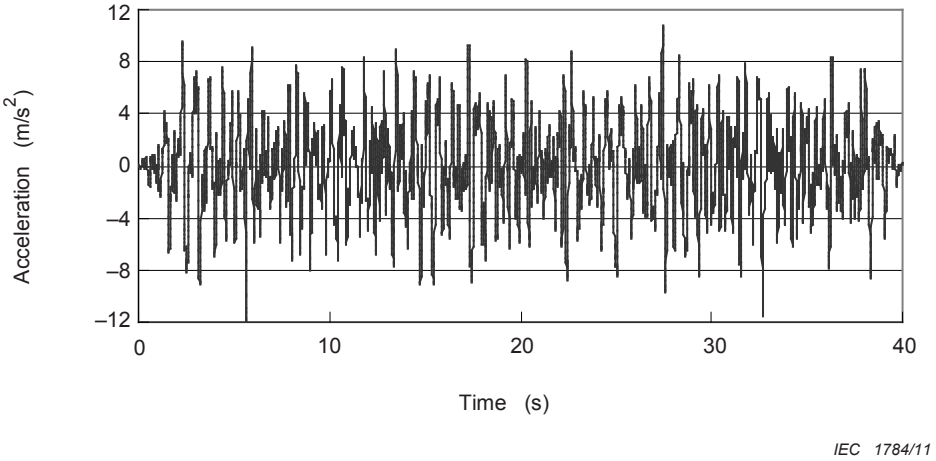


b) Up-and-down

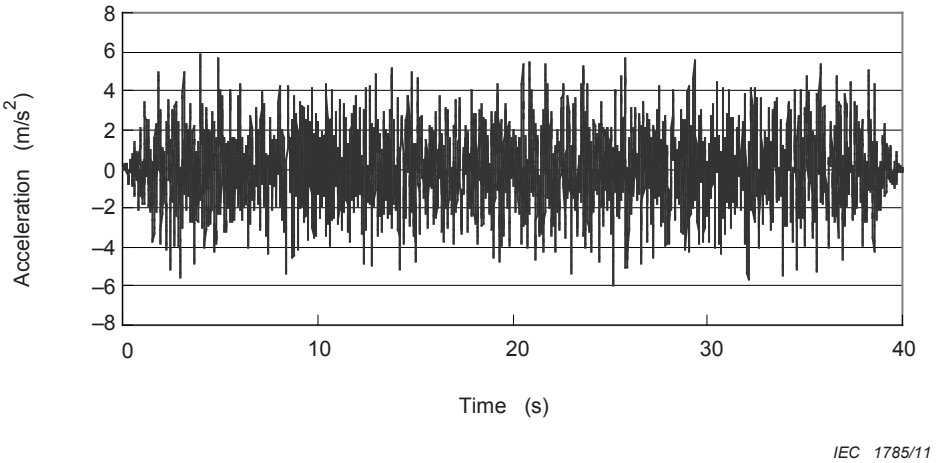
Figure 5 – The RRS for test wave (damping ratio 3 %)



a) longitude



b) latitude



c) vertical

Figure 6 – Time-history of test wave for each axis

6 Assessment following the test

a) There is no permanent deformation to the cabinets or racks exceeding 6 mm or buckling of any component.

b) There is no crack or break to the structural parts by visual inspection.

c) The displacement of the upper part of the cabinets or racks while the test shall not exceed 75 mm.

d) Subracks or plug-in units installed in the cabinets or racks remain in their installed position.

e) Doors shall operate as intended after the test.

f) The covers are not disengaged from the cabinets or racks structures.

g) If the test is done with doors and/or side panels, doors and/or side panels shall not open and/or fall off during the test.

Annex A
(informative)

Vibration generators and information

A.1 Vibration generator types

There are mainly two types of vibration generators, such as a hydraulic servo actuated generator and an electro-dynamic vibration generator. How to apply either of these is determined by the test conditions, such as frequency and displacement condition.

The hydraulic servo actuated vibration generator is suitable for vibration with big displacement (several hundreds of mm) of a low frequency region (several Hz to dozens of Hz). Therefore, it is possible to reproduce seismic vibration. This vibration generator size, in almost all cases, is medium to large. On the other hand, the electro-dynamic vibration generator is suitable for vibration with small displacement (several dozens of mm) of a higher frequency region (several Hz to several kHz).

A.2 Contact information for waveform data

The contact information regarding waveform data for Figure 4 is as follows:
Telcordia Technologies, Inc.
Information Delivery Organization

The contact information regarding waveform data for Figure 6 is as follows:
NIPPON TELEGRAPH AND TELEPHONE CORPORATION or NTT Facilities, Inc.,
Vibration test waveform data

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