SLOVENSKI STANDARD
oSIST prEN IEC 61373:2024

01-februar-2024

Železniške naprave - Oprema voznih sredstev - Preskusi na udarce in vibracije

Railway applications - Rolling stock equipment - Shock and vibration tests

Bahnanwendungen – Betriebsmittel von Bahnfahrzeugen – Prüfungen für Schwingen und Schocken

Applications ferroviaires - Matériel roulant - Essais de chocs et vibrations

Ta slovenski standard je istoveten z: **prEN IEC 61373:2023**

ICS:

17.160	Vibracije, meritve udarcev in vibracij	Vibrations, shock and vibration measurements
45.060.01	Železniška vozila na splošno	Railway rolling stock in general

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9/3019/CDV

COMMITTEE DRAFT FOR VOTE (CDV)

PROJECT NUMBER: **IEC 61373 ED3**	
DATE OF CIRCULATION: **2023-12-01**	CLOSING DATE FOR VOTING: **2024-02-23**
SUPERSEDES DOCUMENTS: **9/2862/CD, 9/2896A/CC**	

IEC TC 9 : ELECTRICAL EQUIPMENT AND SYSTEMS FOR RAILWAYS	
SECRETARIAT: France	SECRETARY: Mr Denis MIGLIANICO
OF INTEREST TO THE FOLLOWING COMMITTEES:	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.
FUNCTIONS CONCERNED: ☐ EMC ☐ ENVIRONMENT ☐ QUALITY ASSURANCE ☐ SAFETY	
☒ SUBMITTED FOR CENELEC PARALLEL VOTING **Attention IEC-CENELEC parallel voting** The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this Committee Draft for Vote (CDV) is submitted for parallel voting. The CENELEC members are invited to vote through the CENELEC online voting system.	☐ NOT SUBMITTED FOR CENELEC PARALLEL VOTING

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TITLE:

Railway applications – Rolling stock equipment – Shock and vibration tests

PROPOSED STABILITY DATE: 2027

NOTE FROM TC/SC OFFICERS:

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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RAILWAY APPLICATIONS – ROLLING STOCK EQUIPMENT – SHOCK AND VIBRATION TESTS

FOREWORD

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International Standard IEC 61373 has been prepared by IEC technical committee 9: Electrical equipment and systems for railways.

This third edition cancels and replaces the second edition, issued in 2010 and constitutes a technical revision.

The main technical changes with regard to the previous edition are as follows:

- consideration of specific ASD spectra from onboard measurements and certification limited to the specific case;
- exclusion from the scope of applicability of traction motors and any substructure not equipped with electrical/electronic/pneumatic device;
- clarification for order of testing and typical test sequence, taking into account the possibility of simultaneous multi-axis testing;
- recommendation and guidance for removing resilient mounts of the equipment (if located between the equipment and the main structure) during the long-life test;
- qualification of the fixture device used to attach the equipment to the test bench;
- guidance for using a measuring point as a possibility to assess mechanical integrity;
- change of the method to calculate the acceleration ratio which has to be applied to the functional ASD value to obtain the simulated long-life ASD value;
- duration of long-life test can be set from 5 hours to 100 hours per axis, with corresponding acceleration ratio (default value) indicated in a table;
- clarification of the concept of structural integrity;
- description of test exemption cases, subassembly tests, and finite element analysis for structural parts of equipment (new Annex E);
- the lowest frequency f_1 of ASD spectra is fixed at 5 Hz whatever the mass of the equipment for Categories 1 and 2;
- update of ASD spectra for functional random vibration test: Table 1, Table 2, Table 3, Table 4, Table A.2 and Figure 5, Figure 6, Figure 7, Figure 9;

The text of this document is based on the following documents:

FDIS	Report on voting

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

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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

INTRODUCTION

This document covers the requirements for random vibration and shock testing items of pneumatic, electrical and electronic equipment/components (hereinafter only referred to as equipment) to be fitted on to railway vehicles. Random vibration and shock (as test method or as numerical simulation) is the only method to be used for equipment/component approval.

The tests contained within this document are specifically aimed at demonstrating the ability of the equipment under test to withstand the type of environmental vibration conditions normally expected for railway vehicles. In order to achieve the best representation possible, the values quoted in this document have been derived from actual service measurements submitted by various bodies from around the world.

This document is not intended to cover self-induced vibrations as these will be specific to particular applications.

Engineering judgement and experience are required in the execution and interpretation of this document.

This document is suitable for design and validation purposes; however, it does not exclude the use of other development tools (such as sine sweep), which may be used to ensure a predetermined degree of mechanical and operational confidence. The test levels to be applied to the equipment under test are dictated only by its location on the train (i.e. axle, bogie or body-mounted).

It should be noted that these tests may be performed on prototypes in order to gain design information about the product performance under random vibration. However, for test certification purposes the tests have to be carried out on equipment taken from normal production.

The procedures and requirements defined in this document do not substitute or overrule any structural assessment required from other structural requirement standards. This document is not intended to be used as a proof of fatigue strength.

NOTE European Standards EN 12663 and EN 13749 are examples of such structural requirement standards.

RAILWAY APPLICATIONS – ROLLING STOCK EQUIPMENT – SHOCK AND VIBRATION TESTS

1 Scope

This International Standard specifies the requirements for testing items of equipment intended for use on railway vehicles which are subsequently subjected to vibrations and shock owing to the nature of railway operational environment. To gain assurance that the quality of the equipment is acceptable, it has to withstand tests of reasonable duration that simulate the service conditions seen throughout its expected life.

Simulated long-life testing can be achieved in a number of ways each having their associated advantages and disadvantages, the following being the most common:

a) amplification: where the amplitudes are increased and the time base decreased;

b) time compression: where the amplitude history is retained and the time base is decreased (increase of the frequency);

c) decimation: where time slices of the historical data are removed when the amplitudes are below a specified threshold value.

The amplification method as stated in a) above, is used in this document and together with the publications referred to in Clause 2; it defines the default test procedure to be followed when vibration testing items for use on railway vehicles. However, other standards exist and may be used with prior agreement between the manufacturer and the customer. In such cases test certification against this document will not apply. Where service information is available, tests can be performed using the method outlined in Annex A. If the levels are lower than those quoted in this document, equipment is partially certified against this document (only for service conditions giving functional test values lower than or equal to those specified in the test report).

Whilst this document is primarily concerned with railway vehicles on fixed rail systems, its wider use is not precluded. For systems operating on pneumatic tyres, or other transportation systems such as trolleybuses, where the level of shock and vibration clearly differ from those obtained on fixed rail systems, the supplier and customer can agree on the test levels at the tender stage. It is recommended that the frequency spectra and the shock duration/amplitude be determined using the guidelines in Annex A.

Equipment tested at levels lower than those quoted in this document shall be resulting from an agreement between supplier and customer, based on customized spectra resulting from onboard measurements. Certification according to this document is reached but limited to the specific case.

An example of this is trolleybuses, whereby body-mounted trolleybus equipment could be tested in accordance with category 1 equipment referred to in the standard.

This document applies to single axis testing. However, multi-axis testing may be used with prior agreement between the manufacturer and the customer.

The test values quoted in this document have been divided into three categories dependent only upon the equipment's location within the vehicle.

Category 1 Body mounted

Class A Cubicles, subassemblies, equipment and components mounted directly on or under the car body.

Class B Anything mounted inside an equipment case which is in turn mounted directly on or under the car body.

Class B should be used when it is not clear where the equipment is to be located.

Category 2 Bogie mounted

Cubicles, subassemblies, equipment and components which are to be mounted on the bogie of a railway vehicle.

Category 3 Axle mounted

Subassemblies, equipment and components or assemblies which are to be mounted on the wheelset assembly of a railway vehicle.

In the case of equipment mounted on vehicles with one level of suspension such as wagons and trucks, unless otherwise agreed at the tender stage, axle mounted equipment are tested as category 3, and all other equipment are tested as category 2.

The cost of testing is influenced by the weight, shape and complexity of the equipment under test. Consequently, the supplier may at the tender stage propose a more cost-effective method of demonstrating compliance with the requirements of this document. Where alternative methods are agreed, it will be the responsibility of the supplier to demonstrate to the customer or its representative that the objective of this document has been met. If an alternative method of evaluation is agreed, then the equipment tested cannot be certified against the requirements of this document.

This document is intended to evaluate equipment which is attached to the main structure of the vehicle (and/or components mounted thereon). It is not intended to test equipment which forms part of the main structure. Main structure in the sense of this document means car body, bogie and axle.

The following items are out of scope of this document:

- Traction motors for railway vehicles;
- Any mechanical substructure not equipped with electrical/electronic/pneumatic component.

There are a number of cases where additional or special vibration tests may be requested by the customer, cases where additional or special vibration tests may be requested by the customer, which are not specified in this document, for example:

a) equipment mounted on, or linked to, items which are known to produce defined frequency excitation;

b) equipment such as traction motors, pantographs, shoegear, or suspension components which may be subjected to tests in accordance with their special requirements, applicable to their use on railway vehicles. In all such cases the tests carried out should be dealt with by separate agreement at the tender stage;

c) equipment intended for use in special operational environments as specified by the customer;

d) transportation and handling tests.

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 60068-2-27:2008, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60068-2-47:2005, *Environmental testing – Part 2-47: Tests – Mounting of specimens for vibration, impact and similar dynamic tests*

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

ISO 3534-1:2006, *Statistics – Vocabulary and symbols – Part 1: Probability and general statistical terms*

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EC 60068-2-64, ISO 3534-1 and the following apply. ISO and IEC maintain terminology 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/

3.1.1 random vibration

vibration the instantaneous value of which cannot be precisely predicted for any given instant of time

3.1.2 Gaussian distribution

Gaussian, or normal, distribution has a probability density function equal to (see Figure 1):

$$P_X(x) = \frac{1}{\sigma\sqrt{2.\pi}} \cdot e^{\frac{-(x-\bar{x})^2}{2.\sigma^2}}$$

where:

σ is the RMS value;

x is the instantaneous value;

$\bar{x}$ is the mean value of x.

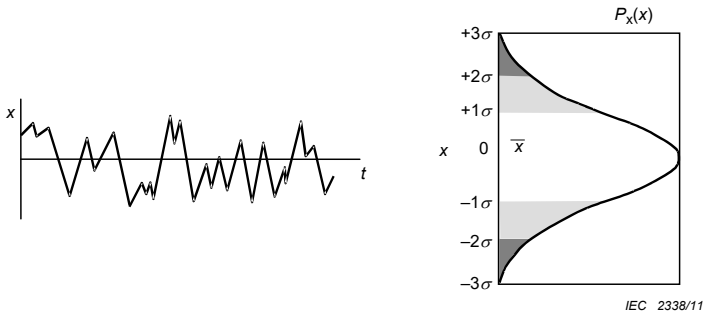

Figure 1 – Gaussian distribution

NOTE According to Figure 1, the probability that the instantaneous acceleration value is between ±a is equal to the zone under the probability density curve $P_x(x)$. This means that the instantaneous acceleration value between:

- 0 and 1σ represents 68,26 % of the time,
- 1σ and 2σ represents 27,18 % of the time,
- 2σ and 3σ represents 4,30 % of the time.

3.1.3 acceleration spectral density (ASD)

mean-square value of that part of an acceleration signal passed by a narrow-band filter of a centre frequency, per unit bandwidth, in the limit as the bandwidth approaches zero and the averaging time approaches infinity

3.1.4 component

<in a cubicle> pneumatic, electrical, or electronic part located inside a cubicle.

3.1.5 cubicle

self-contained item of equipment, comprising structure, mechanical parts and mounted components.

Note 1 to entry examples include converter, inverter, battery box.

3.1.6 acceleration ratio

coefficient applied to the functional ASD value to obtain the simulated long-life ASD value.

3.1.7 weakest point

structural area which provides the lowest margin of safety under fatigue loads.

3.2 Symbols and abbreviated terms

PCM Pulse Code Modulation

DAT Digital Audio Tape

FM Frequency Modulation

DR Digital Recorder

ADC Analog to Digital Converter

FEA Finite Element Analysis

PDF Probability Density Function