

## **Railway applications - Rolling stock equipment - Shock and vibration tests**

This document is a preview generated by EVS

## EESTI STANDARDI EESSÕNA

## NATIONAL FOREWORD

Käesolev Eesti standard EVS-EN 61373:2010 sisaldab Euroopa standardi EN 61373:2010 ingliskeelset teksti.

Standard on kinnitatud Eesti Standardikeskuse 31.10.2010 käskkirjaga ja jõustub sellekohase teate avaldamisel EVS Teatajas.

Euroopa standardimisorganisatsioonide poolt rahvuslikele liikmetele Euroopa standardi teksti kättesaadavaks tegemise kuupäev on 17.09.2010.

Standard on kättesaadav Eesti standardiorganisatsioonist.

This Estonian standard EVS-EN 61373:2010 consists of the English text of the European standard EN 61373:2010.

This standard is ratified with the order of Estonian Centre for Standardisation dated 31.10.2010 and is endorsed with the notification published in the official bulletin of the Estonian national standardisation organisation.

Date of Availability of the European standard text 17.09.2010.

The standard is available from Estonian standardisation organisation.

ICS 45.060

### Standardite reprodutseerimis- ja levitamiseõigus kuulub Eesti Standardikeskusele

Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonilisse süsteemi või edastamine ükskõik millises vormis või millisel teel on keelatud ilma Eesti Standardikeskuse poolt antud kirjaliku loata.

Kui Teil on küsimusi standardite autorikaitse kohta, palun võtke ühendust Eesti Standardikeskusega:  
Aru 10 Tallinn 10317 Eesti; [www.evs.ee](http://www.evs.ee); Telefon: 605 5050; E-post: [info@evs.ee](mailto:info@evs.ee)

### Right to reproduce and distribute belongs to the Estonian Centre for Standardisation

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, without permission in writing from Estonian Centre for Standardisation.

If you have any questions about standards copyright, please contact Estonian Centre for Standardisation:  
Aru str 10 Tallinn 10317 Estonia; [www.evs.ee](http://www.evs.ee); Phone: 605 5050; E-mail: [info@evs.ee](mailto:info@evs.ee)

English version

**Railway applications -  
Rolling stock equipment -  
Shock and vibration tests  
(IEC 61373:2010)**

Applications ferroviaires -  
Matériel roulant -  
Essais de chocs et vibrations  
(CEI 61373:2010)

Bahnanwendungen –  
Betriebsmittel von Bahnfahrzeugen –  
Prüfungen für Schwingen und Schocken  
(IEC 61373:2010)

This European Standard was approved by CENELEC on 2010-09-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

**CENELEC**

European Committee for Electrotechnical Standardization  
Comité Européen de Normalisation Electrotechnique  
Europäisches Komitee für Elektrotechnische Normung

**Management Centre: Avenue Marnix 17, B - 1000 Brussels**

## Foreword

The text of document 9/1386/FDIS, future edition 2 of IEC 61373, prepared by IEC TC 9, Electrical equipment and systems for railways, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61373 on 2010-09-01.

This European Standard supersedes EN 61373:1999.

The main technical changes with regard to the EN 61373:1999 are as follows:

- 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;
- addition of the notion of partially certified against this standard;
- suppression of Annex B of the EN 61373:1999 due to the new method to calculate the acceleration ratio;
- addition of guidance for calculating the functional RMS value from service data or the RMS value from ASD levels of Figures 2 to 5.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN and CENELEC shall not be held responsible for identifying any or all such patent rights.

The following dates were fixed:

- |  |       |            |
|--|-------|------------|
| – latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement | (dop) | 2011-06-01 |
| – latest date by which the national standards conflicting with the EN have to be withdrawn   | (dow) | 2013-09-01 |

Annex ZA has been added by CENELEC.

---

## Endorsement notice

The text of the International Standard IEC 61373:2010 was approved by CENELEC as a European Standard without any modification.

---

## 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.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60068-2-27	2008	Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock	EN 60068-2-27	2009
IEC 60068-2-47	2005	Environmental testing - Part 2-47: Tests - Mounting of specimens for vibration, impact and similar dynamic tests	EN 60068-2-47	2005
IEC 60068-2-64	2008	Environmental testing - Part 2-64: Tests - Test Fh: Vibration, broadband random and guidance	EN 60068-2-64	2008
ISO 3534-1	2006	Statistics - Vocabulary and symbols - Part 1: General statistical terms and terms used in probability	-	-

## CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	7
2 Normative references.....	8
3 Terms and definitions .....	9
4 General .....	10
5 Order of testing.....	11
6 Reference information required by the test house.....	11
6.1 Method of mounting and orientation of equipment under test.....	11
6.2 Reference and check points.....	11
6.2.1 Fixing point.....	11
6.2.2 Check point .....	12
6.2.3 Reference point .....	12
6.2.4 Measuring point.....	12
6.3 Mechanical state and functioning during test .....	12
6.3.1 Mechanical state.....	12
6.3.2 Functional tests .....	13
6.3.3 Performance tests.....	13
6.4 Reproducibility for random vibration tests.....	13
6.4.1 Acceleration spectral density (ASD) .....	13
6.4.2 Root mean square value (r.m.s.) .....	13
6.4.3 Probability density function (PDF) .....	13
6.4.4 Duration.....	13
6.5 Measuring tolerances.....	14
6.6 Recovery .....	14
7 Initial measurements and preconditioning.....	14
8 Functional random vibration test conditions .....	14
8.1 Test severity and frequency range .....	14
8.2 Duration of functional vibration tests .....	15
8.3 Functioning during test .....	15
9 Simulated long-life testing at increased random vibration levels.....	15
9.1 Test severity and frequency range .....	15
9.2 Duration of accelerated vibration tests .....	15
10 Shock testing conditions .....	16
10.1 Pulse shape and tolerance.....	16
10.2 Velocity changes .....	16
10.3 Mounting .....	16
10.4 Repetition rate .....	16
10.5 Test severity, pulse shape and direction.....	16
10.6 Number of shocks.....	17
10.7 Functioning during test .....	17
11 Transportation and handling.....	17
12 Final measurements .....	17
13 Acceptance criteria .....	17
14 Report .....	17

15	Test certificate .....	18
16	Disposal .....	18
	Annex A (informative) Explanation of service measurements, measuring positions, methods of recording service data, summary of service data, and method used to obtain random test levels from acquired service data .....	25
	Annex B (informative) Figure identifying general location of equipment on railway vehicles and their resulting test category .....	32
	Annex C (informative) Example of a type test certificate .....	33
	Annex D (informative) Guidance for calculating RMS values from ASD values or levels.....	34
	Figure 1 – Gaussian distribution .....	9
	Figure 2 – Category 1 – Class A – Body-mounted – ASD spectrum .....	19
	Figure 3 – Category 1 – Class B – Body-mounted – ASD spectrum .....	20
	Figure 4 – Category 2 – Bogie mounted – ASD spectrum .....	21
	Figure 5 – Category 3 – Axle mounted – ASD spectrum .....	22
	Figure 6 – Cumulative PDF tolerance bands .....	23
	Figure 7 – Shock test tolerance – Bands half sine pulse .....	24
	Figure A.1 – Standard measuring positions used for axle, bogie (frame) and body .....	25
	Figure A.2 – Typical fatigue strength curve .....	29
	Figure B.1 – General location of equipment on vehicles .....	32
	Figure D.1 – ASD spectrum .....	35
	Table 1 – Test severity and frequency range for functional random vibration tests.....	14
	Table 2 – Test severity and frequency range.....	15
	Table 3 – Test severity, pulse shape and direction.....	16
	Table A.1 – Environment data acquisition summary of the test parameters/conditions .....	26
	Table A.2 – Summary of the r.m.s. acceleration levels obtained from the questionnaire .....	28
	Table A.3 – Test levels obtained from service data using the method shown in Clause A.4 ....	31

## INTRODUCTION

This standard 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 is the only method to be used for equipment/component approval.

The tests contained within this standard 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 standard have been derived from actual service measurements submitted by various bodies from around the world.

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

Engineering judgement and experience is required in the execution and interpretation of this standard.

This standard 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.



# 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 standard 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 standard 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 standard, equipment is partially certified against this standard (only for service conditions giving functional test values lower than or equal to those specified in the test report).

Whilst this standard 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 standard cannot be fully certified against the requirements of this standard.

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 standard 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 standard 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.

NOTE 1 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.

NOTE 2 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 will be tested as category 3, and all other equipment will be tested as category 2.

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

This standard 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 standard means car body, bogie and axle. There are a number of cases where additional or special vibration tests may be requested by the customer, for example:

- a) equipment mounted on, or linked to, items which are known to produce fixed frequency excitation;
- b) equipment such as traction motors, pantographs, shoe gear, 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.

## 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 60068-2-27:2008, *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*