



**SLOVENSKI STANDARD**  
**oSIST prEN IEC 61373:2024**  
**01-februar-2024**

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**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**

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**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

**oSIST prEN IEC 61373:2024**

**en**





# 9/3019/CDV

## COMMITTEE DRAFT FOR VOTE (CDV)

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

IEC TC 9 : ELECTRICAL EQUIPMENT AND SYSTEMS FOR RAILWAYS	
SECRETARIAT: France	SECRETARY: Mr Denis MIGLIANICO
OF INTEREST TO THE FOLLOWING COMMITTEES:	PROPOSED HORIZONTAL STANDARD: <input type="checkbox"/> Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.
FUNCTIONS CONCERNED: <input type="checkbox"/> EMC <input type="checkbox"/> ENVIRONMENT <input type="checkbox"/> QUALITY ASSURANCE <input type="checkbox"/> SAFETY	
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TITLE: <b>Railway applications – Rolling stock equipment – Shock and vibration tests</b>
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PROPOSED STABILITY DATE: 2027

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## CONTENTS

CONTENTS .....	2
FOREWORD .....	5
INTRODUCTION .....	8
1 Scope .....	9
2 Normative references .....	11
3 Terms, definitions, symbols and abbreviated terms .....	11
3.1 Terms and definitions .....	11
3.1.1 random vibration .....	11
3.1.2 Gaussian distribution .....	11
3.1.3 acceleration spectral density (ASD) .....	12
3.1.4 component .....	12
3.1.5 cubicle .....	12
3.1.6 acceleration ratio .....	12
3.1.7 weakest point .....	12
3.2 Symbols and abbreviated terms .....	12
4 General .....	13
5 Order of testing .....	13
6 Reference information required by the test house .....	14
6.1 General .....	14
6.2 Method of mounting and orientation of equipment under test .....	14
6.3 Reference and check points .....	16
6.3.1 General .....	16
6.3.2 Fixing point .....	17
6.3.3 Check point .....	17
6.3.4 Reference point .....	17
6.3.5 Measuring point .....	17
6.4 Mechanical state and functioning during test .....	18
6.4.1 Mechanical state .....	18
6.4.2 Functional tests .....	18
6.4.3 Performance tests .....	18
6.5 Reproducibility for random vibration tests .....	18
6.5.1 General .....	18
6.5.2 Acceleration spectral density (ASD) .....	18
6.5.3 Root mean square value (RMS) .....	18
6.5.4 Probability density function (PDF) .....	19
6.5.5 Duration .....	19
6.6 Measuring tolerances .....	19
6.7 Recovery .....	19
7 Initial measurements and preconditioning .....	19
8 Functional random vibration test conditions .....	20
8.1 Test severity and frequency range .....	20
8.1.1 Body mounted – Category 1 Class A .....	21
8.1.2 Body mounted – Category 1 Class B .....	24
8.1.3 Bogie mounted – Category 2 .....	27
8.1.4 Axle mounted – Category 3 .....	30
8.2 Duration of functional vibration tests .....	32

8.3	Functioning during test .....	32
9	Simulated long-life testing at increased random vibration levels .....	32
9.1	Test severity and frequency range .....	32
9.1.1	Body mounted – Category 1 Class A .....	33
9.1.2	Body mounted – Category 1 Class B .....	34
9.1.3	Bogie mounted – Category 2 .....	35
9.1.4	Axle mounted – Category 3 .....	36
9.2	Duration and acceleration ratio of long-life vibration tests .....	36
10	Shock testing conditions .....	38
10.1	Pulse shape and tolerance .....	38
10.2	Velocity changes .....	38
10.3	Mounting .....	38
10.4	Repetition rate .....	38
10.5	Test severity, pulse shape and direction .....	38
10.6	Number of shocks .....	39
10.7	Functioning during test .....	40
11	Transportation and handling .....	40
12	Final measurements and acceptance criteria .....	40
12.2	Acceptance criteria .....	40
13	Test exemption .....	41
14	Report .....	41
15	Test certificate .....	41
16	Disposal .....	42
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 .....	44
Annex B (informative)	Figure identifying general location of equipment on railway vehicles and their resulting test category .....	56
Annex C (informative)	Example of a type test certificate .....	57
Annex D (informative)	Guidance for calculating RMS values from ASD values or levels .....	58
Annex E (informative)	Guidance for numerical validation of structural parts of cubicles .....	60
Figure A.1	– Standard measuring positions used for axle, bogie (frame) and body .....	44
Figure A.2	– Typical fatigue strength curve .....	49
Figure A.3	– Acceleration ratio as function as number of cycles during long life test $N_T$ .....	51
Figure A.4	– Default acceleration ratio as function as long-life test duration $d_{LLT}$ for categories 1 and 2 .....	52
Figure A.4	– Default acceleration ratio as function as long-life test duration $d_{LLT}$ for category 3 .....	52
Figure B.1	– General location of equipment on vehicles .....	56
Figure D.1	– ASD spectrum .....	59
Figure E.1	– Stress value on element, Frequency Response Analysis .....	65
Figure E.2	– Power Spectral Density, acceleration and stress $\sigma_{PSD}(f)$ .....	65
Table 1	– Test severity and frequency range for functional random vibration tests of Category 1 Class A .....	23

Table 2 – Test severity and frequency range for functional random vibration tests of Category 1 Class B .....	26
Table 3 – Test severity and frequency range for functional random vibration tests of Category 2 .....	28
Table 4 – Test severity and frequency range for functional random vibration tests of Category 3 .....	31
Table 5 – Test severity and frequency range for 5 hours simulated long-life random vibration tests of Category 1 Class A .....	33
Table 6 – Test severity and frequency range for 100 hours simulated long-life random vibration tests of Category 1 Class A .....	33
Table 7 – Test severity and frequency range for 5 hours simulated long-life random vibration tests of Category 1 Class B .....	34
Table 8 – Test severity and frequency range for 100 hours simulated long-life random vibration tests of Category 1 Class B .....	34
Table 9 – Test severity and frequency range for 5 hours simulated long-life random vibration tests of Category 2 .....	35
Table 10 – Test severity and frequency range for 100 hours simulated long-life random vibration tests of Category 2 .....	35
Table 11 – Test severity and frequency range for 5 hours simulated long-life random vibration tests of Category 3 .....	36
Table 12 – Test severity and frequency range for 100 hours simulated long-life random vibration tests of Category 3 .....	36
Table 13 – Acceleration ratio and long-life test duration table (default values) .....	37
Table 4 – Test severity, pulse shape and direction .....	39
Table A.1 – Environment data acquisition summary of the test parameters/conditions .....	45
Table A.2 – Summary of the additional RMS acceleration levels obtained from the questionnaire .....	47
Table A.3 – Fatigue curves parameters considered for default acceleration ratio computation .....	50
Table A.4 – Acceleration ratio and long-life test duration table (default values) .....	53
Table A.5 – Parameters for specific acceleration ratio computation (Example 1) .....	54
Table A.6 – Parameters for specific acceleration ratio computation (Example 2) .....	55

## 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;

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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
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## 1 INTRODUCTION

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

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

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

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

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

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

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

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

28

29  
30  
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32

# RAILWAY APPLICATIONS – ROLLING STOCK EQUIPMENT – SHOCK AND VIBRATION TESTS

## 33 1 Scope

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

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

- 41 a) amplification: where the amplitudes are increased and the time base decreased;  
42 b) time compression: where the amplitude history is retained and the time base is decreased  
43 (increase of the frequency);  
44 c) decimation: where time slices of the historical data are removed when the amplitudes are  
45 below a specified threshold value.

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

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

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

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

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

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

### 70 **Category 1** Body mounted

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

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

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

76 **Category 2** Bogie mounted

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

79 **Category 3** Axle mounted

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

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

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

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

96 The following items are out of scope of this document:

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

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

- 102 a) equipment mounted on, or linked to, items which are known to produce defined frequency  
103 excitation;
- 104 b) equipment such as traction motors, pantographs, shoe gear, or suspension components  
105 which may be subjected to tests in accordance with their special requirements, applicable  
106 to their use on railway vehicles. In all such cases the tests carried out should be dealt with  
107 by separate agreement at the tender stage;
- 108 c) equipment intended for use in special operational environments as specified by the  
109 customer;
- 110 d) transportation and handling tests.

111

## 112 2 Normative references

113 The following documents are referred to in the text in such a way that some or all of their content  
114 constitutes requirements of this document. For dated references, only the edition cited applies.  
115 For undated references, the latest edition of the referenced document (including any  
116 amendments) applies.

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

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

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

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

## 124 3 Terms, definitions, symbols and abbreviated terms

### 125 3.1 Terms and definitions

126 For the purposes of this document, the terms and definitions given in EC 60068-2-64, ISO 3534-  
127 1 and the following apply. ISO and IEC maintain terminology databases for use in  
128 standardization at the following addresses:

129 • ISO Online browsing platform: available at <https://www.iso.org/obp>

130 • IEC Electropedia: available at <http://www.electropedia.org/>

#### 131 3.1.1 random vibration

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

#### 134 3.1.2 Gaussian distribution

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

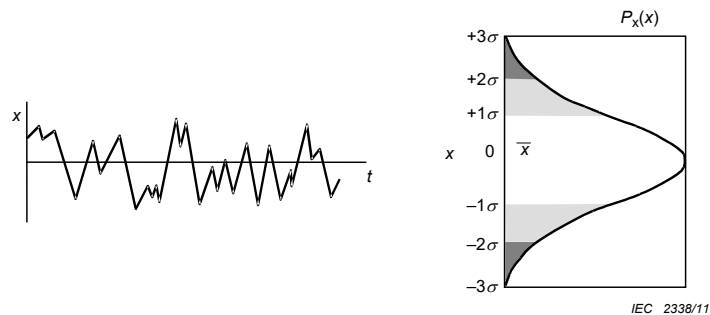
$$136 \quad P_x(x) = \frac{1}{\sigma \sqrt{2 \cdot \pi}} \cdot e^{-\frac{(x-\bar{x})^2}{2 \cdot \sigma^2}}$$

137 where:

138  $\sigma$  is the RMS value;

139  $x$  is the instantaneous value;

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



141

142

**Figure 1 – Gaussian distribution**

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

- 145 • 0 and  $1\sigma$  represents 68,26 % of the time,
- 146 •  $1\sigma$  and  $2\sigma$  represents 27,18 % of the time,
- 147 •  $2\sigma$  and  $3\sigma$  represents 4,30 % of the time.

### 148 3.1.3 acceleration spectral density (ASD)

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

### 152 3.1.4 component

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

### 154 3.1.5 cubicle

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

157 Note 1 to entry examples include converter, inverter, battery box.  
 158 <https://standards.iteh.ai/catalog/standards/sist/2338-11-2024/iec-61373-2024>

### 159 3.1.6 acceleration ratio

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

### 161 3.1.7 weakest point

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

## 163 3.2 Symbols and abbreviated terms

164 PCM Pulse Code Modulation

165 DAT Digital Audio Tape

166 FM Frequency Modulation

167 DR Digital Recorder

168 ADC Analog to Digital Converter

169 FEA Finite Element Analysis

170 PDF Probability Density Function