

SLOVENSKI STANDARD

SIST EN 12299:2024+A1:2026

01-december-2026

Nadomešča:
SIST EN 12299:2024

Železniške naprave - Udobnost vožnje potnikov - Meritve in vrednotenje (vključno z dopolnilom A1)

Railway applications - Ride comfort for passengers - Measurement and evaluation

Bahnanwendungen - Fahrkomfort für Fahrgäste - Messung und Auswertung

Applications ferroviaires - Confort de marche des voyageurs - Mesurage et évaluation

Ta slovenski standard je istoveten z: EN 12299:2024+A1:2026

ICS:

13.160	Vpliv vibracij in udarcev na ljudi	Vibration and shock with respect to human beings
45.060.20	Železniški vagoni	Trailing stock

SIST EN 12299:2024+A1:2026 **en**

Sample Document

get full document from standards.iteh.ai

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 12299:2024+A1

October 2026

ICS 45.060.20

Supersedes EN 12299:2024

English Version

**Railway applications - Ride comfort for passengers -
Measurement and evaluation**

Applications ferroviaires - Confort de marche des
voyageurs - Mesurage et évaluation

Bahnanwendungen - Fahrkomfort für Fahrgäste -
Messung und Auswertung

This European Standard was approved by CEN on 17 October 2026.

CEN 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 CEN-CENELEC Management Centre or to any CEN 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 CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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

get full document from standards.iteh.ai



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

© 2026 CEN All rights of exploitation in any form and by any means reserved
worldwide for CEN national Members.

Ref. No. EN 12299:2024+A1:2026 E

Contents	Page
European foreword	6
1 Scope.....	8
2 Normative references.....	8
3 Terms and definitions	8
4 Symbols, units and abbreviations.....	10
5 General description.....	14
5.1 General.....	14
5.2 Passenger exposure to vibrations	14
5.3 Application	15
5.4 Characteristics of rail vehicle motions.....	15
5.5 Ride comfort	16
5.6 Direct and indirect measurements.....	16
5.7 Summary table of procedures	16
5.8 Application of comfort indices	17
6 Mean comfort and continuous comfort.....	18
6.1 General.....	18
6.2 Basis of the method	19
6.3 Methodology	19
6.4 Test conditions	20
6.4.1 General.....	20
6.4.2 Selection of test sections	20
6.4.3 Test speed.....	20
6.4.4 Wheel-rail contact geometry	20
6.4.5 Vehicle condition	20
6.5 Parameters to be measured.....	20
6.5.1 General.....	20
6.5.2 Location of measuring points	21
6.5.3 Filtering.....	21
6.6 Definition of intermediate quantities	21
6.7 Definition of comfort indexes.....	23
6.7.1 Continuous comfort.....	23
6.7.2 Mean comfort standard method.....	23
6.7.3 Mean comfort complete method	24
6.8 Test report.....	24
7 Comfort on curve transitions.....	24
7.1 General.....	24
7.2 Basis of the method	24
7.3 Methodology	25
7.4 Test conditions	25
7.4.1 General.....	25
7.4.2 Selection of test sections	25
7.4.3 Test speed.....	25
7.4.4 Wheel-rail contact geometry	25
7.4.5 Vehicle condition	25
7.5 Parameters to be measured.....	26

7.5.1	General	26
7.5.2	Location of measuring points.....	26
7.5.3	Filtering.....	26
7.6	Definition of intermediate quantities	26
7.6.1	Symbols and indices	26
7.6.2	Averaging procedure.....	27
7.6.3	Identification of transition periods.....	27
7.6.4	Intermediate quantities	28
7.7	Definition of comfort index P_{CT}	30
7.8	Alternative comfort index 'sliding P_{CT} over 3 s'	30
7.9	Test report	33
8	Comfort on discrete events	33
8.1	General	33
8.2	Basis of the method.....	34
8.3	Methodology	34
8.4	Test conditions	34
8.4.1	General	34
8.4.2	Selection of test sections	34
8.4.3	Test speed.....	35
8.4.4	Wheel-rail contact geometry	35
8.4.5	Vehicle condition	35
8.5	Parameters to be measured.....	35
8.5.1	General	35
8.5.2	Location of measuring points.....	35
8.5.3	Filtering.....	35
8.6	Definition of quantities.....	35
8.6.1	Symbols and indices	35
8.6.2	Averaging procedure to obtain the mean value	36
8.6.3	Maximum peak to peak value.....	36
8.7	Definition of comfort index P_{DE}	37
8.8	Test report	37
9	Guide for the interpretation of results	37
9.1	General	37
9.2	Mean comfort	37
9.3	Continuous comfort	38
9.4	Comfort on curve transitions	38
9.5	Comfort on discrete events	39
Annex A (normative)	Reference system.....	40
Annex B (normative)	Measurement techniques.....	42
B.1	General	42
B.2	Measuring equipment.....	42
B.2.1	General	42
B.2.2	Transducers and signal amplifiers.....	42
B.2.3	Recording equipment.....	43
B.2.4	Fixing transducers to the floor	43
B.3	Seat measuring devices and their applications	43
Annex C (normative)	Weighting curves.....	46

EN 12299:2024+A1:2026 (E)

C.1	General.....	46
C.2	Filter functions.....	47
C.2.1	General.....	47
C.2.2	Band-limiting filter.....	47
C.2.3	Acceleration to velocity transition	48
C.2.4	Upward gradient	48
C.2.5	Overall frequency weighting.....	48
C.2.6	Reduction of the upper limit of the frequency range in vertical direction	48
C.3	Tolerances	48
C.4	Diagrams	50
Annex D (informative)	Specifying the vehicle performance with regard to ride comfort.....	54
D.1	General.....	54
D.2	Knowledge of route for comfort assessment	54
D.3	Track condition	54
D.4	Specification of vehicle conditions	55
D.5	General specification	55
Annex E (normative)	Vehicle assessment with respect to ride comfort.....	56
E.1	General.....	56
E.2	Track geometric quality	56
E.3	Test conditions	57
E.3.1	Selection of test sections and test zones.....	57
E.3.2	Test speed.....	57
E.3.3	Wheel-rail contact geometry	57
E.3.4	Vehicle condition	57
E.4	Acceptable modifications of the methods for the continuous or mean comfort evaluation	58
E.5	Test report.....	60
Annex F (informative)	Presentation of test report.....	61
F.1	General.....	61
F.2	Aim of test.....	61
F.3	Test performer.....	61
F.4	References	61
F.5	Test conditions	61
F.5.1	General information	61
F.5.2	Vehicle.....	62
F.5.3	Seat (for mean comfort complete method)	62
F.5.4	Seat occupant (for mean comfort complete method)	62

F.5.5	Track	62
F.5.6	Speed profile	63
F.5.7	Test configurations	63
F.6	Measurements and processing	63
F.6.1	Measurements	63
F.6.2	Processing	63
F.6.3	Deviations	63
F.7	Report on mean comfort and continuous comfort	63
F.7.1	General	63
F.7.2	Time series	63
F.7.3	Statistical results	66
F.7.4	Comfort evaluation	68
F.7.5	Spectral analyses	68
F.8	Report on comfort in curve transitions	70
F.9	Reporting on comfort on discrete events	70
Annex G (informative)	Guideline for the application of direct tests	73
Annex H (informative)	Workflow for calculation of RMS from measured (or simulated) time series of accelerations	74
Annex I (informative)	Determining quantities	75
Annex J (informative)	Guidance for the application of simulation	77
J.1	General	77
J.2	Benefits	77
J.3	Applications	77
J.4	Accuracy and limitations	78
J.5	State of the art for railway ENs	78
Annex K (informative)	$\langle A_1 \rangle$ Unit value for the mean comfort index $\langle A_1 \rangle$	80
K.1	Unit value definition	80
K.2	Simple example	80
K.3	Maximum simplification	81
K.4	Vehicle orientated simplification	82
K.5	Test zone orientated simplification	82
K.6	Ride comfort distribution	83
K.7	Combination of simplifications	83
K.8	Full analysis	83
K.9	Applying the $\langle A_1 \rangle N_{MV} \langle A_1 \rangle$ comfort index scale	83
Bibliography		84

EN 12299:2024+A1:2026 (E)**European foreword**

This document (EN 12299:2024+A1:2026) has been prepared by Technical Committee CEN/TC 256 "Railway applications", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2027, and conflicting national standards shall be withdrawn at the latest by April 2027.

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

This document supersedes A1 EN 12299:2024 A1.

This European Standard was approved by CEN on 5 August 2024 and includes Amendment 1 approved by CEN on 17 August 2026.

The start and finish of text introduced or altered by amendment is indicated in the text by tags A1 A1.

EN 12299:2024 includes the following significant technical changes with respect to EN 12299:2009:

- a) the Scope has been revised;
- b) Normative references have been updated;
- c) Clause 3, Terms and definitions has been updated;
- d) Clause 4, Symbols, units and abbreviations has been revised;
- e) Clause 5, General description has been revised;
- f) Clause 6, Mean comfort and continuous comfort have been revised;
- g) Clause 7, Comfort on curve transitions has been updated;
- h) Clause 8, Comfort on discrete events has been revised;
- i) Clause 9, Guide for the interpretation of the results has been updated;
- j) Annex B, Measurement techniques has been updated;
- k) Annex C, Weighting curves has been updated;
- l) new Annex D has been added;
- m) (previous) Annex D has been revised and renamed in Annex F;
- n) Annex E has been revised;
- o) (previous) Annex F has been revised and renamed in Annex G;
- p) Annex H has been renamed Annex I. New Annexes H, J and K added.

Any feedback and questions on this document should be directed to the users' national standards body. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

Sample Document

get full document from standards.iteh.ai

1 Scope

The purpose of this document is to provide methods for quantifying the ride comfort of a passenger in a rail vehicle in response to the track sections it is operated over.

The methods aim to quantify the effects of vehicle body motions on ride comfort and to make the assessment of passenger comfort predictable, repeatable, objective and meaningful.

The methods and comfort scales are validated for people of good health.

This document applies to passengers in rail vehicles operating on heavy rail networks.

This document applies to measurements of motions. It also applies to simulated motions. Guidance is provided on:

- which method described within the document should be used for different scenarios;
- typical values for different comfort levels;
- the application of simulation.

This document excludes health and safety issues, non-passenger carrying vehicles, vehicle homologation and safety, limit values, motion sickness, discomfort caused by accelerating and braking, design guidelines and measurement technology.

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.

EN 15663, *Railway applications — Vehicle reference masses*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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 <https://www.electropedia.org/>

3.1

passenger

person travelling in a rail vehicle, without specific activities related to the transport

3.2

ride comfort

complex sensation experienced by a passenger due to motions (vibrations, roll velocities and inertia forces etc.) transmitted through the rail vehicle body whilst running over track (see also 5.5)

3.3

interfaces

contact parts between the vehicle body or seat and the passenger with the function of sustaining and guiding the passenger and of transmitting the weight of the passenger to the vehicle body itself, e.g. floor-feet

3.4**mean comfort**

perceived comfort level, continuously adjusted, as evaluated through measurement on a long-time basis (at least some minutes)

3.5**continuous comfort**

level of accelerations, frequency weighted continuously evaluated as a set of RMS (root mean square) values in vertical, lateral and longitudinal direction over a short time period (typical 5 s)

3.6**comfort on curve transitions**

comfort evaluation, due to a perceived curve transition, expressed as percentage of passengers feeling uncomfortable

3.7**comfort on discrete events**

comfort evaluation, due to a perceived transient acceleration, expressed as percentage of passengers feeling uncomfortable

3.8**whole-body transmission**

motion transmitted to the whole body through the interfaces between vehicle body and passenger

3.9**indirect measurement**

measurement of motion environment by different motion quantities, such as acceleration or roll velocity

3.10**direct measurement**

measurement of actual passenger reactions, for example by asking passengers to fill in a questionnaire

3.11**vehicle assessment with respect to ride comfort**

identifying the vehicle's contribution to the ride comfort by relating the measured ride comfort to the condition of the track and operation condition

Note 1 to entry: conditions of track includes geometry, irregularities, turnout, bridges, etc.

Note 2 to entry: operation condition includes speed, cant deficiency, etc.

3.12**test section**

part of a rail line used for the passenger comfort test

3.13**test zone**

five-minute period, which is used for mean comfort evaluation

3.14**reference system**

local reference system for a vehicle body defined by:

EN 12299:2024+A1:2026 (E)

Origin: on the floor of the vehicle body, in the central position between the two body-bogie centre pivots (existing or ideally defined)

Axis:

- x-axis: longitudinal
- y-axis: lateral
- z-axis: vertical

Roll motions (φ) are defined as rotation around the x-axis

For human body reference system, a right hand system is used with vertical direction defined upwards

Note 1 to entry: A more detailed definition of the reference system is given in Annex A.

3.15**heavy rail network**

conventional rail network intended for intra- and interregional and/or international transportation

3.16**unit**

generic term used to name the rolling stock. It may be composed of either one vehicle or several vehicles in a fixed formation

4 Symbols, units and abbreviations

Table 1 and Table 2 define the symbols, units and abbreviations used in this document.

Table 1 — Symbols and units – Part 1

Parameter	Symbol	Unit
General parameters		
Time	t	[s]
Time period	T	[s]
Integration variable	τ	[s]
Vehicle speed	V	[km/h]
Frequency	f	[Hz]
Frequency weighting curve for vertical direction	W_b	[-]
Frequency weighting curve for longitudinal direction (backrest)	W_c	[-]
Frequency weighting curve for lateral/longitudinal direction	W_d	[-]
Low-pass filter	W_p	[-]
n-tile	k	[-]

Parameter	Symbol	Unit
Percentile	n	[%]
Number of samples	N	[-]
Imaginary unit	i	[-]
Root mean square	RMS	[-]
Constants for passenger comfort on curve transitions and discrete events		
Constant in acceleration component in curve transitions	A	$[s^2/m]$
Constant in acceleration component in curve transitions	B	$[s^3/m]$
Constant in acceleration component in curve transitions	C	[-]
Constant in roll velocity component in curve transitions	D	$[s/rad]$
Constant in roll velocity component in curve transitions	E	[-]
Constant in acceleration component in discrete events	a	$[s^2/m]$
Constant in acceleration component in discrete events	b	$[s^2/m]$
Constant in acceleration component in discrete events	c	[-]
Transfer functions		
Cut-off frequencies, $n = 1,2,3,4,5,6$	f_n	[Hz]
Resonant quality factors, $n = 1,2,3,4$	Q_n	[-]
Gain	K	[-]
High pass transfer function	$H_h(f)$	[-]
Low pass transfer function	$H_l(f)$	[-]
Acceleration to velocity transfer function	$H_t(f)$	[-]
Upward gradient transfer function	$H_s(f)$	[-]

Table 2 — Symbols and units – Part 2

Parameter	Longitudinal axis	Lateral axis	Vertical axis
Translational accelerations in vehicle body [m/s²]			
Leading end of passenger compartment	–	$\ddot{y}_{EI}^*$	$\ddot{z}_{EI}^*$
Over leading bogie	–	$\ddot{y}_I^*$	$\ddot{z}_I^*$
Body centre	$\ddot{x}_M^*$	$\ddot{y}_M^*$	$\ddot{z}_M^*$
Over trailing bogie	–	$\ddot{y}_{II}^*$	$\ddot{z}_{II}^*$
Trailing end of passenger compartment	–	$\ddot{y}_{EII}^*$	$\ddot{z}_{EII}^*$
Translational weighted accelerations [m/s²]			
Seat, weighted W_c, W_b	$\ddot{x}_{D,Wc}^*$	–	$\ddot{z}_{A,Wb}^*$
Vehicle body, weighted W_d, W_b	$\ddot{x}_{P,Wd}^*$	$\ddot{y}_{P,Wd}^*$	$\ddot{z}_{P,Wb}^*$
Vehicle body, weighted W_p	–	$\ddot{y}_{P,Wp}^*$	–
Seat (Dossier, seat back in French, and Assise, seat pan in French), weighted W_c, W_d, W_b , RMS	$a_{XD}^{w_c}$	$a_{YA}^{w_d}$	$a_{ZA}^{w_b}$
Floor (Plancher in French), weighted W_d, W_b , RMS	$a_{XP}^{w_d}$	$a_{YP}^{w_d}$	$a_{ZP}^{w_b}$
Floor, weighted W_d, W_b , RMS, 50 th percentile	$a_{XP50}^{w_d}$	$a_{YP50}^{w_d}$	$a_{ZP50}^{w_b}$
Seat, weighted W_c, W_d, W_b , RMS, 95 th percentile	$a_{XD95}^{w_c}$	$a_{YA95}^{w_d}$	$a_{ZA95}^{w_b}$
Floor, weighted W_d, W_b , RMS, 95 th percentile	$a_{XP95}^{w_d}$	$a_{YP95}^{w_d}$	$a_{ZP95}^{w_b}$
One-second average	–	$\ddot{y}_{ls}(t)$	–
Two-second average	–	$\ddot{y}_{2s}(t)$	–
Peak to peak	–	$\ddot{y}_{pp}(t)$	–
One-second average, maximum absolute value	–	$ \ddot{y}_{ls} _{\max}$	–
Two-second average, absolute value	–	$ \ddot{y}_{2s} (t)$	–

Parameter	Longitudinal axis	Lateral axis	Vertical axis
Translational jerk in vehicle body [m/s³]			
One-second average	–	$\ddot{y}_{1s}(t)$	–
One-second average, maximum absolute value	–	$ \ddot{y}_{1s} _{\max}$	–
Angular velocity in vehicle body [rad/s]			
Body	$\dot{\phi}^*(t)$	–	–
Weighted w_p	$\dot{\phi}_{wp}^*(t)$	–	–
One-second average	$\dot{\phi}_{1s}(t)$	–	–
One-second average, maximum absolute value	$ \dot{\phi}_{1s} _{\max}$	–	–
Comfort indexes [-]			
Mean comfort standard method	N_{MV}		
Mean comfort standard method, partial index	N_{MVx}	N_{MVy}	N_{MVz}
Mean comfort complete method, seated passenger (in French: VA = voyageur assis)	N_{VA}		
Mean comfort complete method, standing passenger (in French: VD = voyageur debout)	N_{VD}		
Continuous comfort	C_{Cx}	C_{Cy}	C_{Cz}
Comfort on curve transitions	P_{CT}, P_{CT-3s}		–
	P_{CT_Rol}	P_{CT_Lat}	–
Comfort on discrete events	–	P_{DE}	–