



SLOVENSKI STANDARD
oSIST prEN 12299:2023
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Železniške naprave - Udobnost vožnje potnikov - Meritve in vrednotenje

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: prEN 12299

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Bahnanwendungen - Fahrkomfort für Fahrgäste -
Messung und Auswertung

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 256.

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COMITÉ EUROPÉEN DE NORMALISATION
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CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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prEN 12299:2022(E)**European foreword**

This document (prEN 12299:2022) has been prepared by Technical Committee CEN/TC 256 "Railway applications", the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 12299:2009.

prEN 12299:2022 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 has 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) New Annex H, I, J and K have been added to the document.

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 may also be used as a guide for example on urban rail systems, but their operational routes/environments may make it difficult to comply with the requirements of the test methods.

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 14363:2016+A2:2022, *Railway applications — Testing and Simulation for the acceptance of running characteristics of railway vehicles — Running behaviour and stationary tests*

ISO 5348, *Mechanical vibration and shock — Mechanical mounting of accelerometers*

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

passengers

people 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)

prEN 12299:2022(E)**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 their weight 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 transition**

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

3.7**comfort on discrete event**

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 (geometry, irregularities, turnout, bridges, etc.) and operation condition (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 is defined through:

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, right hand system is used with vertical direction defined upwards

A more detailed definition of the reference system is given in Annex A

4 Symbols, units and abbreviations

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

Table 1 — Symbols, units and abbreviation

General parameters			
Parameter	Symbol	Unit	
Time	t	[s]	
Time period	T	[s]	
Integration variable	τ	[s]	
Vehicle speed	V	[km/h]	
Frequency	f	[Hz]	
Interface, the floor (Plancher in French)	P	[-]	
Interface, the seat pan (Assise in French)	A	[-]	
Interface, the seat back (Dossier in French)	D	[-]	
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	[-]	

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General parameters			
Parameter	Symbol	Unit	
n-tile	k	[-]	
Percentile	n	[%]	
Number of samples	N	[-]	
Imaginary unit	i	[-]	
Root mean square	rms	[-]	
Parameter	Longitudinal axis	Lateral Axis	Vertical Axis
Translational accelerations on running gear [m/s ²]			
Wheelset i	-	\ddot{y}_i	-
Translational accelerations in vehicle body [m/s ²]			
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/s ²]			
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, weighted W_c, W_d, W_b , rms	a_{XD}^{Wc}	a_{YA}^{Wd}	a_{ZA}^{Wb}
Floor, weighted W_d, W_b , rms	a_{XP}^{Wd}	a_{YP}^{Wd}	a_{ZP}^{Wb}
Floor, Weighted W_d, W_b , rms, 50th percentile	a_{XP50}^{Wd}	a_{YP50}^{Wd}	a_{ZP50}^{Wb}
Seat, weighted W_c, W_d, W_b , rms, 95th percentile	a_{XD95}^{Wc}	a_{YA95}^{Wd}	a_{ZA95}^{Wb}
Floor, weighted W_d, W_b , rms, 95th percentile	a_{XP95}^{Wd}	a_{YP95}^{Wd}	a_{ZP95}^{Wb}

General parameters			
Parameter	Symbol	Unit	
One-second average	-	$\ddot{y}_{1s}(t)$	-
Two-second average	-	$\ddot{y}_{2s}(t)$	-
Peak to peak	-	$\ddot{y}_{pp}(t)$	-
One-second average, maximum absolute value	-	$\left \ddot{y}_{1s} \right _{\max}$	-
Two-second average, absolute value	-	$\left \ddot{y}_{2s} \right (t)$	-
Translational jerk in vehicle body [m/s³]			
One-second average	-	$\ddot{\ddot{y}}_{1s}(t)$	-
One-second average, maximum absolute value	-	$\left \ddot{\ddot{y}}_{1s} \right _{\max}$	-
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	$\left \dot{\phi}_{1s} \right _{\max}$	-	-
Parameter	Longitudinal axis	Lateral Axis	Vertical Axis
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_3sec}		-
	P_{CT_Rol}	P_{CT_Lat}	-

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General parameters		
Parameter	Symbol	Unit
Comfort on discrete events	-	P_{DE} -
Constants for passenger comfort on curve transitions and discrete events		
Parameter	Symbol	Unit
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		
Parameter	Symbol	Unit
Corner 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	$H_s(f)$	[-]
Corner frequencies, n = 1,2,3,4,5,6	f_n	[Hz]
Resonant quality factors, n = 1,2,3,4	Q_n	[-]

5 General description

5.1 General

The comfort of passengers in a rail vehicle is influenced by a number of different factors (temperature, noise, vibration, etc.). This document considers only that part of the comfort influenced by the vibrations and motions of the vehicle. This is described as ride comfort or as passenger comfort. The document can also be used for vehicle assessment with respect to ride comfort.

This document defines as the standard method:

- a) The standard method for mean comfort evaluation, taking into account the effects of vibration exposure measured on the floor of the vehicle body.

This document also defines several methods for special applications:

- b) taking into account the short time effects of vibration exposure measured on the floor of the vehicle body as continuous comfort for the longitudinal, lateral, and vertical direction
- c) taking into account the vibration exposure measured on the seat or other interfaces on ride comfort as the complete method for mean comfort evaluation
- d) taking into account the effects of:
 - 1) discrete events (comfort on discrete events) and
 - 2) running on curve transitions (comfort on curve transitions) on ride comfort.
- e) taking into account the vibration exposure measured on the floor of the vehicle body for the purpose of vehicle assessment with respect to ride comfort.

5.2 Passenger exposure to vibrations

Rail transport exposes passengers to vibrations related to the dynamic motions of the vehicle body.

The motions of the vehicle body transmit their effects to the human body through the following interfaces:

- a) in the standing position:
 - 1) floor – feet
- b) in the seated position:
 - 1) headrest – head
 - 2) arm rest – arms
 - 3) seat – hips
 - 4) backrest – back
 - 5) floor – feet

The type of transmission is whole-body transmission which acts on the whole body through the interfaces.