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**

ICS:

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

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

If this draft becomes a European Standard, 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.

This draft European Standard was established by CEN 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.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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

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

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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)

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	[-]

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/s2]			
Wheelset *i*	–	$\ddot{y}_i$	–
Translational accelerations in vehicle body [m/s2]			
Leading end of passenger compartment	–	$\ddot{y}^*_{\mathrm{EI}}$	$\ddot{z}^*_{\mathrm{EI}}$
Over leading bogie	–	$\ddot{y}^*_{I}$	$\ddot{z}^*_{I}$
Body centre	$\ddot{x}^*_{M}$	$\ddot{y}^*_{M}$	$\ddot{z}^*_{M}$
Over trailing bogie	–	$\ddot{y}^*_{\mathrm{II}}$	$\ddot{y}^*_{\mathrm{II}}$
Trailing end of passenger compartment	–	$\ddot{y}^*_{EII}$	$\ddot{z}^*_{EII}$
Translational weighted accelerations [m/s2]			
Seat, weighted W_c , W_b	$\ddot{x}^*_{\mathrm{D,Wc}}$	–	$\ddot{z}^*_{\mathrm{A,Wb}}$
Vehicle body, weighted W_d , W_b	$\ddot{x}^*_{\mathrm{P,Wd}}$	$\ddot{y}^*_{\mathrm{P,Wd}}$	$\ddot{z}^*_{\mathrm{P,Wb}}$
Vehicle body, weighted W_p	–	$\ddot{y}^*_{\mathrm{P,Wp}}$	–
Seat, weighted W_c , W_d , W_b , rms	$a^{w_c}_{\mathrm{XD}}$	$a^{w_d}_{\mathrm{YA}}$	$a^{w_b}_{\mathrm{ZA}}$
Floor, weighted W_d , W_b , rms	$a^{w_d}_{\mathrm{XP}}$	$a^{w_d}_{\mathrm{YP}}$	$a^{w_b}_{\mathrm{ZP}}$
Floor, Weighted W_d , W_b , rms, 50th percentile	$a^{w_d}_{\mathrm{XP50}}$	$a^{w_d}_{\mathrm{YP50}}$	$a^{w_b}_{\mathrm{ZP50}}$
Seat, weighted W_c , W_d , W_b , rms, 95th percentile	$a^{w_c}_{\mathrm{XD95}}$	$a^{w_d}_{\mathrm{YA95}}$	$a^{w_b}_{\mathrm{ZA95}}$
Floor, weighted W_d , W_b , rms, 95th percentile	$a^{w_d}_{\mathrm{XP95}}$	$a^{w_d}_{\mathrm{YP95}}$	$a^{w_b}_{\mathrm{ZP95}}$

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	–	$\dddot{y}_{1s}(t)$	–
One-second average, maximum absolute value	–	$\left\|\dddot{y}_{1s}\right\|_{max}$	–
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}	–

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	[s²/m]	
Constant in acceleration component in curve transitions	B	[s³/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	[s²/m]	
Constant in acceleration component in discrete events	b	[s²/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.