

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

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EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

Käesolev Eesti standard EVS-ENV 12299:2002 sisaldab Euroopa standardi ENV 12299:1999 ingliskeelset teksti.

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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 European Prestandard (ENV) was approved by CEN on 29 August 1997 as a prospective standard for provisional application.

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This European Prestandard has been prepared by Technical Committee CEN/TC 256 "Railway applications", the secretariat of which is held by DIN.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to announce this European Prestandard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

This ENV takes into account the documents listed below for the following:

UIC 513	Evaluation of Mean Comfort indices and definition of filters
ISO 2631	Definitions
BRR TR DOS 018 5/86	Comfort on Curve Transitions
	Comfort on Discrete Events
UIC 518	Selected testing procedures and track characteristics
List of normative clauses and annexes	Clauses 1, 2, 3, 4
	Normative Annexes A, B, C, D
List of informative clauses and annexes	Foreword, Introduction, Clauses 5, 6
	Informative Annexes E, F, G, H, K, L, M, N, P, Q, R, S

Introduction

a) General

The comfort of passengers in a railway vehicle is influenced by a number of different factors (temperature, noise, vibration etc). This European Prestandard considers only that part of the comfort influenced by the dynamic behaviour of the vehicle. This is described as Ride Comfort or as Comfort.

This European Prestandard summarizes the relevant works on the matter:

- taking into account, in mandatory form, the effects on Ride comfort for passengers of vibration exposure measured on the carbody floor (the simplified method for Mean Comfort evaluation);
- taking into account, (as recommendation), the vibration exposure measured on the interfaces (the complete method for Mean Comfort evaluation);
- taking into account, (as recommendation), the effects on Ride comfort for passengers of:
 - discrete events (Comfort on Discrete Events);
 - running on curve transitions (Comfort on Curve Transitions).

The standard is published as European Prestandard (ENV), due to

- the lack of experience in the application of the Mean Comfort measurement and evaluation criteria, based on UIC-leaflet 513, up to now experimentally approved in UIC, both for the normative part (N_{mv}) and for the informative part (N_{va} , N_{vd});
- the lack of experience in the application of the recommended P_{DE} , P_{CT} comfort indexes, up to now based on the technical experience in studies and direct tests given mainly in Great Britain and in indirect tests performed by Italy, Germany and Switzerland.

Railway transport exposes passengers to vibrations related to the dynamic movements of the carbody.

The movements of the carbody transmit their effects to the human body through the following interfaces:

- in the standing position:
 - floor - feet
- in the seated position:
 - headrest - neck
 - arm rest - upper arms
 - seat - hip
 - seat - back
 - floor - feet

The type of transmission is whole-body transmission (see 3.4), which acts on the whole body through the interfaces (see 3.3).

The effect produced by the carbody movements considered in this ENV is:

- discomfort (effect on comfort, see 3.2), associated with relatively low levels of acceleration.

Other effects, not included in the standard, are associated with higher acceleration levels:

- health risk effect: physical damage and psychological deterioration.

This ENV applies to passengers in good health.

b) Inclusions and exclusions

The following table lists the items included or excluded from this ENV:

Table 1

Item	included	excluded
Effects of movements	- on comfort	- on health - on activities
Transmission	- on whole body through interfaces	- on single body part - on whole surface
Type of vehicles	- railway vehicles designed for carrying passengers	- other types of railway vehicles, e.g. locomotives, freight wagons
Test procedure	- definitions - reference system - requirements - measurement and evaluation rules - report rules	- notes or attributes related to service quality and/or passenger expectation - limiting values
Position of passenger	- standing - seated	- lying - performing specific actions
Type of measurement	- indirect measurements - simplified measurements of Mean Comfort - complete measurements of Mean Comfort¹⁾ - evaluation of Comfort on Discrete Events¹⁾ - evaluation of Comfort in Curve Transitions¹⁾	- direct measurements - combined measurements
¹⁾ informative		

c) Characteristics of railway vehicle movements

The basic typical characteristics, referred to the type of measurement and evaluation, are:

- range of frequencies from 0 to 2 Hz for Comfort on Curve Transitions and for Discrete Events, from 0,4 to 80 Hz for Mean Comfort evaluation. For the latter, with a large part in the sub-range:
 - 0,4 up to 3,0 Hz in the lateral direction,
 - 0,4 up to 20 Hz in the vertical direction;
- relatively low level of amplitude;
- different properties, depending on the type of evaluation: stationary (Mean Comfort), non-stationary (Discrete Events), quasi-static (mean lateral acceleration on Discrete Events), dynamic with relevant transient components (peak-to-peak on Discrete Events, Comfort on Transitions), highly non-linear (on Curves, on Discrete Events), linear (Mean Comfort).

d) Ride comfort for passengers

The Ride comfort for passengers is the complex sensation, produced on the passenger by the carbody movements of the railway vehicle, transmitted to the whole body through the interfaces.

This sensation is classified as:

- average sensation, based on the vibration applied on a long-time basis (at least some minutes),
- instantaneous sensation: a sudden modification of the average sensation, due to a short-basis event (change of mean lateral acceleration value, roll movement at significant speed, lateral jerk with possible oscillation).

Both the first and the second type of sensation are taken into account in the Mean Comfort evaluation.

The second type of sensation is taken into account in the Comfort on Curve Transitions and in Comfort on Discrete Events.

e) Direct and indirect measurements

The quantification of Ride comfort for passengers is performed through indirect measurements, i.e. measuring and post-processing the relevant parameters (see 3.5). Other types of tests and evaluation, such as direct tests based on the direct assessment of the perceptions of tested passengers, and combined tests, including both direct and indirect tests, are not quantified in this European Prestandard.

f) Simplified and complete measurements for Mean Comfort

The indirect measurements are classified as simplified or complete if the measurements are taken respectively on relevant points of the carbody floor or also on the interfaces.

g) Summary table of procedures

The evaluation of Ride comfort for passengers is taken into account in this European Prestandard by:

- normative procedure for the quantification of Mean Comfort through indirect simplified measurements, described in the normative part, see 4.1 to 4.2,
- informative procedure for the quantification of Mean Comfort through indirect complete measurements, described in the informative part, see Annex E,
- informative procedure for the quantification of Comfort on Curve Transitions through indirect simplified measurements, described in the informative part, see Annex K,
- informative procedure for the quantification of Comfort on Discrete Events through indirect simplified measurements, described in the informative part, see Annex M.

The use of an informative procedure in addition is appropriate in situations where these aspects are of particular interest, as for example for the evaluation of behaviour of tilting vehicles running in curves.

Table 2 presents an overview of different characteristics for measurement and evaluation procedures.

Table 2

Characteristics	Mean Comfort simplified	Mean Comfort complete	Comfort on Curve Transitions	Comfort on Discrete Events
Comfort index	N_{mv}	N_{vd}	P_{ct}	P_{de}
		N_{va}		
Procedure	normative	informative	informative	informative
Measuring parameter	accelerations	accelerations	lateral acceleration; roll speed	lateral acceleration
Measuring position	floor	floor	floor	floor
		floor and interfaces		

A table of possible applications, and the list of corresponding information needed, is given in 6.2.

1 Scope

This European Prestandard specifies a method for quantifying the effects of carbody movements on Ride comfort for passengers ("Comfort"¹⁾).

The scope of the standard is limited to public railway services; the standard includes railway vehicles designed for carrying passengers travelling on railway lines, including secondary and suburban lines; this document can be used as a guide for other railway vehicles, for example locomotives, metros, trams, etc.

The standard applies to passengers in good health.

2 Normative references

This European Prestandard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European prestandard only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies.

ISO 2631-1	Mechanical vibration and shock - Evaluation of human exposure to whole-body vibration - Part 1: General requirements
ISO 5348	Mechanical vibration and shock - Mechanical mounting of accelerometers
ISO 8002	Mechanical vibrations - Land vehicles - Method for reporting measured data
UIC 513 E ²⁾	Guidelines for evaluating passenger comfort in relation to vibration in railway vehicles - 1st edition 01-07-94
UIC 518 VE ²⁾	Testing and approval of railway vehicles from the point of view of their dynamic behaviour - Safety - Track fatigue - Ride quality - 1st edition 01-07-95
B 153 - Rp 10 ²⁾	Vibratory comfort: Drawing up weighting curves
B 153 - Rp 12 ²⁾	Influence of the low frequency components on the evaluation of comfort
B 153 - Rp 13 ²⁾	Tests on comfort in standing position
B 153 - Rp 17 ²⁾	Comfort in seated position
C 116 - Rp 3 and Rp 6 ²⁾	Geometry of the contact between wheelset and track - Part 1: Methods of measurement and analysis - Part 2: Equivalent conicity values for wheelsets in service

3 Definitions

For the purpose of this standard, the following definitions apply:

3.1 Passengers

People travelling in a railway vehicle, without specific activities related to the transport.

3.2 Comfort

This is the complex sensation produced during the application of oscillations and/or inertia forces, via whole-body transmission (see 3.4) caused by the railway vehicle's carbody movements.

It is defined and measured through Comfort indexes³⁾ as:

- Mean Comfort: a mean feeling, continuously adjusted, as evaluated through measurement following the procedures indicated in clause 4 and Annexes A, B, C, D for Comfort index N_{mv} and the procedure indicated in Annexes E, F, G, H for Comfort indices N_{va} , N_{vd} .

¹⁾ The quantification of Ride Quality and the corresponding evaluation rules will be covered by a separate European Standard.

²⁾ To be purchased from: UIC, Direction Générale, 16, rue Jean Rey, F - 75015 Paris

³⁾ The base of the derivation of the comfort indexes is experimental.