

---

**Železniške naprave - Akustika - Ugotavljanje dinamične togosti elastičnih tirničnih komponent v povezavi s hrupom in vibracijami - Sestavi tirničnih podlag in tirnih pritrdilnih elementov**

Railway Applications - Acoustics - Determination of the dynamic stiffness of elastic track components related to noise and vibration - Rail pads and track fastener assemblies

Bahnanwendungen - Akustik - Bestimmung der dynamischen Steifigkeit von elastischen Komponenten im Oberbau in Bezug auf Schall und Schwingungen - Zwischenlagen und Schienenbefestigungssysteme (standards.iteh.ai)

Applications ferroviaires - Acoustique - Détermination de la raideur dynamique des composants élastiques de la voie pour le bruit et les vibrations - Semelles sous rail et systèmes de fixation de la voie

**Ta slovenski standard je istoveten z: prEN 17495**

---

**ICS:**

17.140.30	Emisija hrupa transportnih sredstev	Noise emitted by means of transport
93.100	Gradnja železnic	Construction of railways

**oSIST prEN 17495:2020****en,fr,de**

## **iTeh STANDARD PREVIEW (standards.iteh.ai)**

[oSIST prEN 17495:2020](https://standards.iteh.ai/catalog/standards/sist/7478cc50-2130-486f-93fc-7962682636fb/osist-pren-17495-2020)

<https://standards.iteh.ai/catalog/standards/sist/7478cc50-2130-486f-93fc-7962682636fb/osist-pren-17495-2020>

EUROPEAN STANDARD  
NORME EUROPÉENNE  
EUROPÄISCHE NORM

**DRAFT**  
**prEN 17495**

April 2020

ICS 17.140.30; 93.100

English Version

## Railway Applications - Acoustics - Determination of the dynamic stiffness of elastic track components related to noise and vibration - Rail pads and track fastener assemblies

Applications ferroviaires - Acoustique - Détermination de la raideur dynamique des composants élastiques de la voie pour le bruit et les vibrations - Semelles sous rail et systèmes de fixation de la voie

Bahnanwendungen - Akustik - Bestimmung der dynamischen Steifigkeit von elastischen Komponenten im Oberbau in Bezug auf Schall und Schwingungen - Zwischenlagen und Schienenbefestigungssysteme

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

**iTeh STANDARD PREVIEW**

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.

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, Turkey and United Kingdom.

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.

**Warning** : This document is not a European Standard. It is distributed for review and comments. It is subject to change without notice and shall not be referred to as a European Standard.



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

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

## Contents

European foreword.....	3
Introduction .....	4
1 Scope .....	5
2 Normative references .....	5
3 Terms and definitions .....	6
4 Symbols and abbreviated terms .....	7
5 General Requirements .....	8
5.1 Introduction .....	8
5.2 Apparatus.....	8
6 Requirements for different application cases .....	9
6.1 Preloads.....	9
6.2 Excitation amplitudes.....	10
7 Test methods .....	10
7.1 General.....	10
7.2 Arrangements applying to both the direct and indirect methods.....	10
7.3 Direct method.....	11
7.4 Indirect method .....	15
8 Test report.....	18
Bibliography.....	19

## European foreword

This document (prEN 17495:2020) 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.

## iTeh STANDARD PREVIEW (standards.iteh.ai)

[oSIST prEN 17495:2020](https://standards.iteh.ai/catalog/standards/sist/7478cc50-2130-486f-93fc-7962682636fb/osist-pren-17495-2020)

<https://standards.iteh.ai/catalog/standards/sist/7478cc50-2130-486f-93fc-7962682636fb/osist-pren-17495-2020>

## Introduction

Airborne rolling noise and structure-borne noise that propagates through the ground, are excited during rolling wheel-rail interaction by the *acoustic roughness* (see EN 15610) of the wheel and rail surfaces. For this reason, models for railway noise and vibration use a measure of track-support stiffness determined at amplitudes of vibration caused by acoustic roughness and under the load of a train and/or the track fastener system.

This document sets out requirements for a laboratory measurement of the dynamic stiffness of rail pads and fasteners relevant to noise and vibration models.

An alternative technique to determine input data for rolling noise models is to measure track decay rates according to EN 15461 (see also Bibliography [1]).

**NOTE** In contrast to the test methods elaborated in this document, other methods exist that can deliver values for dynamic stiffness and loss factor of elastic components and fastening systems. They are not thought to attain the quality and comparability required for standardization and they are not within the scope or content of this standard. For more information on these methods, see Bibliography [2 – 6].

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

oSIST prEN 17495:2020

<https://standards.iteh.ai/catalog/standards/sist/7478cc50-2130-486f-93fc-7962682636fb/osist-pren-17495-2020>

## 1 Scope

This document specifies laboratory test procedures to determine a high-frequency dynamic stiffness, “acoustic stiffness”, of resilient components. The purpose is to provide data for assessment and specification of the acoustic performance of track components.

This document is applicable to complete track fastening assemblies and to pad components of fastening systems including both discrete and continuous fastening systems.

It is applicable to specimens of a single rail seat fastener.

It is applicable to the measurement of the dynamic transfer stiffness under a prescribed pre-load and the associated hysteretic damping loss factor.

It provides measurement methods and pre-load, excitation and frequency range conditions for application to ground borne and structure borne noise as well as for rolling noise.

It is not applicable to the measurement of the stiffness of pads and fastening assemblies under static or low frequency dynamic loading used for track mechanics and which is specified in EN 13146-9.

## 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 13481-1:2012, *Railway applications - Track - Performance requirements for fastening systems - Part 1: Definitions*

EN ISO 7500-1:2018, *Metallic materials - Calibration and verification of static uniaxial testing machines - Part 1: Tension/compression testing machines - Calibration and verification of the force-measuring system (ISO 7500-1:2018)*

EN ISO 10846-1:2008, *Acoustics and vibration - Laboratory measurement of vibro-acoustic transfer properties of resilient elements - Part 1: Principles and guidelines (ISO 10846-1:2008)*

EN ISO 10846-2:2008, *Acoustics and vibration - Laboratory measurement of vibro-acoustic transfer properties of resilient elements - Part 2: Direct method for determination of the dynamic stiffness of resilient supports for translatory motion (ISO 10846-2:2008)*

EN ISO 10846-3:2002, *Acoustics and vibration - Laboratory measurement of vibro-acoustic transfer properties of resilient elements - Part 3: Indirect method for determination of the dynamic stiffness of resilient supports for translatory motion (ISO 10846-3:2002)*

ISO 7626-1:2011, *Mechanical vibration and shock — Experimental determination of mechanical mobility — Part 1: Basic terms and definitions, and transducer specifications*

ISO 16063-21:2003+A1:2016, *Methods for the calibration of vibration and shock transducers — Part 21: Vibration calibration by comparison to a reference transducer*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 13481-1 and EN ISO 10846-1 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

#### 3.1

##### **acoustic stiffness**

dynamic stiffness of an elastic track support component or fastening assembly that is measured under a static preload and at small amplitudes of displacement or velocity applied in the frequency range relevant to noise or vibration perception. It is the measure of stiffness addressed by this document for use in noise and vibration models

#### 3.2

##### **acoustic damping**

loss factor associated with the acoustic stiffness

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[oSIST prEN 17495:2020](https://standards.iteh.ai/catalog/standards/sist/7478cc50-2130-486f-93fc-7962682636fb/osist-pren-17495-2020)

<https://standards.iteh.ai/catalog/standards/sist/7478cc50-2130-486f-93fc-7962682636fb/osist-pren-17495-2020>



## 4 Symbols and abbreviated terms

For the purposes of this document, the following symbols apply.

**Table 1 — Symbols**

Symbol	Meaning	Relevant subclause
$\eta_A$	acoustic loss factor, (dimensionless)	7.3.5
$\omega$	angular frequency in rad/s	7.3.2
$a_1$	acceleration of the upper mass (input), in $\text{m/s}^2$	7.3.2
$a_2$	acceleration of the force-measuring platform or lower mass (output), in $\text{m/s}^2$	7.3.2
$F_2$	force on the measuring platform (output) in the direct measurement method, in N	7.3.2
$j$	$\sqrt{-1}$	7.3.2
$k_A$	acoustic stiffness, in N/m	7.3.5
$k_D$	transfer stiffness measured by the direct method, in N/m	7.3.2
$k_I$	transfer stiffness measured by the indirect method, in N/m	7.4.2
$k_L$	lower isolators combined support stiffness in the indirect method, in N/m	7.4.2
$m_2$	mass of the measuring platform and any parts of the fastening assembly below the resilient element in the direct method, or the blocking mass in the indirect method, in kg	7.3.2 7.4.2
$u_1$	displacement of the upper mass $= -a_1 / \omega^2$ , in m	7.3.2
$u_2$	displacement of the lower mass in the indirect method $= -a_2 / \omega^2$ , in m	7.3.2
$v_1$	excitation velocity $= a_1 / j\omega$ , in m/s	7.3.2

NOTE The subscript 1 denotes a quantity at the input and subscript 2 denotes a quantity at the output side of the test specimen.

## 5 General Requirements

### 5.1 Introduction

Good quality measurements depend upon the: competence of the measurement team, control of the environmental conditions, estimation of measurement uncertainties, measurement traceability, control of data, handling of samples, and the reporting of results.

NOTE Guidance is provided in EN ISO/IEC 17025:2005.

### 5.2 Apparatus

The test equipment shall conform to the following requirements in order to produce repeatable results over the frequency range and applied loads specified in this document. In particular the following requirements shall be applied for the transducers used.

#### 5.2.1 Accelerometers

Accelerometers shall be calibrated at the laboratory temperature in the frequency range of interest and shall have a sensitivity level which is frequency independent to within 0,5 dB and the sensitivity to cross-axis accelerations shall be smaller than 5 % of the main axis of sensitivity. Calibration shall be carried out according to ISO 16063-21:2003+A1:2016.

All accelerometers used shall have an internal resonance frequency at least twice the upper limit of the working frequency range.

Where measurements are summed from multiple accelerometers, the measurement resulting from the whole transducer and signal acquisition system shall conform to the requirements stated above.

#### 5.2.2 Force transducers

Force transducers used for the measurement of the dynamic force shall be calibrated in the frequency range and temperature range of interest and have a sensitivity level which is frequency independent to within 0,5 dB and the sensitivity to cross-axis forces shall be smaller than 5 %. Calibration shall be carried out according to the mass-loading technique as described in ISO 7626-1:2011.

If the transducer has an associated sensitivity-level function to compensate for its variation of sensitivity with force amplitude the effective calibration of the system shall meet the 0,5 dB requirement.

All force transducers used for the measurement of dynamic force shall have an internal resonance frequency at least twice the upper limit of the working frequency range.

Where measurements are summed from multiple force transducers, the measurement resulting from the whole transducer and signal acquisition system shall conform to the requirements stated above.

Force transducers used for the measurement of the static preload shall be calibrated over the working range to Class 1 according to EN ISO 7500-1:2018.

#### 5.2.3 Signal acquisition and processing equipment

The spectral resolution shall provide at least one discrete frequency in each one-third-octave band in which the result is required.

#### 5.2.4 Load applying equipment

The equipment shall be capable of maintaining the required preload over the period of the test at the set value to within  $\pm 10$  %.

### 5.2.5 Temperature environment

Measurements shall be made within a tolerance of a particular temperature even if the measurement is only required at nominal room temperature. A controlled environment shall therefore be provided capable of maintaining a set temperature within the required tolerance and for sufficient time for specimens to acclimatize to that temperature stably and for the measurement procedure to be completed.

## 6 Requirements for different application cases

### 6.1 Preloads

Different preloads and frequency ranges are required according to whether the stiffness is to be used in the assessment of (1) rolling noise, (2) bridge noise or (3) ground borne vibration (low frequency vibration, and “groundborne noise”). Table 1 specifies the preloads that shall be used in cases (1) to (3). The frequency range for each case is stated as a minimum requirement and a preferred requirement.

**Table 2 — Preloads used for different application cases**

Case	Component	Minimum frequency range (one-third octave bands)	Preferred frequency range (one-third octave bands)	Preload values
Rolling noise (1)	Rail pad	80 to 400 Hz	50 Hz to 1,25 kHz	18 kN
	Assembly or baseplate pad			5 kN
Bridge noise (2)	Rail pad	80 to 400 Hz	25 Hz to 2 kHz	18, 35, 50, 68 kN
	Assembly or baseplate pad			5, 18, 35, 50 kN
Ground vibration/ground borne noise (3)	Rail pad	50 to 200 Hz	10 to 400 Hz	18, 35, 50, 68 kN
	Assembly or baseplate pad			5, 18, 35, 50 kN

The minimum frequency range requirement should be achievable in most cases with either the direct or indirect measurement methods set out below. The preferred frequency range reflects more closely the requirements of acoustic calculations.

**NOTE 1** The approach sets a range of values for the preload and it is up to the user of the results to select or interpolate from this to determine the appropriate stiffness value for the rail seat load of the noise or vibration assessment.

**NOTE 2** For fasteners or pads with complicated load-deflection behaviour it may be advisory to make extra measurements at intermediate preload values.

**NOTE 3** Higher preloads may be omitted in cases where a fastener or pad is not designed to take such high loads.