



SLOVENSKI STANDARD
SIST EN ISO 3095:2005
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Železniške naprave – Akustika – Merjenje hrupa, ki ga oddajajo tirna vozila (ISO 3095:2005)

Railway applications - Acoustics - Measurement of noise emitted by railbound vehicles (ISO 3095:2005)

Bahnanwendungen - Akustik - Messung der Geräuschemission von spurgebundenen Fahrzeugen (ISO 3095:2005)

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Applications ferroviaires - Acoustique - Mesurage du bruit émis par les véhicules circulant sur rails (ISO/FDIS 3095:2005)

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ICS 17.140.30; 45.060.01

English Version

Railway applications - Acoustics - Measurement of noise emitted
by railbound vehicles (ISO 3095:2005)

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Geräuschemission von spurgebundenen Fahrzeugen (ISO
3095:2005)

This European Standard was approved by CEN on 19 May 2005.

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 Central Secretariat 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 Central Secretariat has the same status as the official versions.

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

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EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This European Standard (EN ISO 3095:2005) has been prepared by Technical Committee CEN/TC 256 "Railway applications", the secretariat of which is held by DIN, in collaboration with Technical Committee ISO/TC 43 "Acoustics".

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 February 2006, and conflicting national standards shall be withdrawn at the latest by February 2006.

This document has been prepared under a mandate given to CEN/CENELEC/ETSI by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive 96/48.

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

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

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1 Scope

This European Standard specifies the conditions for obtaining reproducible and comparable measurement results of levels and spectra of noise emitted by all kinds of vehicles operating on rails or other types of fixed track, hereinafter conventionally called "train", except for track maintenance vehicles in operation.

This standard is applicable for:

- type testing;
- periodic monitoring testing.

The results may be used, for example:

- to characterise the noise emitted by these trains;
- to compare the noise emission of various vehicles on a particular track section;
- to collect basic source data for trains.

The test procedures specified in this European Standard are of engineering grade (grade 2, with a precision of ± 2 dB), that is the preferred one for noise declaration purposes, as defined in EN ISO 12001.

The procedures specified for accelerating and decelerating tests are of survey grade.

NOTE 1 Although this standard is for characterising noise emission for vehicles, the wheel-rail rolling noise often contains a significant and sometimes dominant noise contribution from the track.

NOTE 2 This Standard aims to specify the conditions for obtaining reproducible and comparable measurement results of noise emitted by railbound vehicles and the method described may also be used to monitor the noise emissions in ordinary traffic. In the latter case it is not necessary that track and vehicle conditions fulfil the requirements described in the standard. Therefore the results of such tests are only representative of a "particular" situation.

2 Normative references

The following referenced documents are indispensable for the application 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 60942, *Electroacoustics — Sound calibrators (IEC 60942:2003)*

EN 61260, *Electroacoustics — Octave-band and fractional-octave-band filters (IEC 61260:1995)*

EN 61672-1, *Electroacoustics — Sound level meters — Part 1: Specifications (IEC 61672-1:2002)*

EN 61672-2, *Electroacoustics — Sound level meters — Part 2: Pattern evaluation tests (IEC 61672-2:2003)*

EN ISO 266, *Acoustics — Preferred frequencies (ISO 266:1997)*

3 Terms and definitions

NOTE Definitions from 3.7 to 3.14 apply to values measured either as a frequency spectrum or in a particular frequency band of centre f (expressed in Hz).

For the purposes of this European Standard, the following terms and definitions apply.

3.1 train

single vehicle or a number of coupled vehicles/units operating on a guided ground transport system

[EN 13452-1]

3.2 type test for noise emission of railbound vehicles

type test

measurement performed to prove that, or to check if, a vehicle delivered by the manufacturer complies with the noise specifications

3.3 monitoring test for noise emission of railbound vehicles

monitoring test

measurement performed to check if the noise of a vehicle has changed since initial delivery or after modification

3.4 environmental assessment test

measurement performed for collecting data to be utilised in prediction method for environmental assessment

3.5 roughness

r

root mean square (RMS) value of the amplitude variation of the running surface of a rail in the direction of motion (longitudinal level) measured over a rail length, expressed in μm

3.6 roughness level

L_r

level given by the equation:

$$L_r = 10 \lg (r/r_0)^2 \text{ dB} \quad (1)$$

where

L_r is the roughness level in dB;

r is the RMS roughness in μm ;

r_0 the reference roughness; $r_0 = 1 \mu\text{m}$.

This definition applies to values measured either as a wavelength spectrum or in a particular wavelength band centred at λ (expressed in m)

3.7 sound pressure

$p(t)$

root mean square (RMS) value of a fluctuating pressure superimposed on the static atmospheric pressure measured over a certain time period, expressed in Pa

3.8 sound pressure level

L_p

level given by the equation:

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$$L_p = 10 \lg (p(t)/p_0)^2 \text{ dB} \quad (2)$$

where

- L_p is the sound pressure level in dB;
- $p(t)$ is the RMS sound pressure in Pa;
- p_0 the reference sound pressure; $p_0 = 20 \mu\text{Pa}$

NOTE Adapted from ISO 1996-1:2003.

3.9

A-weighted sound pressure level

L_{pA}

sound pressure level obtained by using the frequency weighting A (see EN 61672 –1 and EN 61672-2), given by the following equation:

$$L_{pA} = 10 \lg (p_A(t)/p_0)^2 \text{ dB} \quad (3)$$

where

- L_{pA} is the A-weighted sound pressure level in dB;
- $p_A(t)$ is the RMS A-weighted sound pressure in Pa;
- p_0 the reference sound pressure; $p_0 = 20 \mu\text{Pa}$.

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3.10

AF-weighted maximum sound pressure level

L_{pAFmax}

maximum value of the A-weighted sound pressure level determined during the measurement time interval T by using time weighting F (fast)

[EN 61672-1]

3.11

A-weighted equivalent continuous sound pressure level

$L_{pAeq,T}$

A-weighted sound pressure level given by the following equation:

$$L_{pAeq,T} = 10 \lg \left(\frac{1}{T} \int_0^T \frac{p_A^2(t)}{p_0^2} dt \right) \text{ dB} \quad (4)$$

where

- $L_{pAeq,T}$ is the A-weighted equivalent continuous sound pressure level in dB;
- T is the measurement time interval in s;
- $p_A(t)$ is the A-weighted instantaneous sound pressure in Pa;
- p_0 the reference sound pressure; $p_0 = 20 \mu\text{Pa}$.

NOTE Adapted from ISO 1996-1:2003.

3.12

A-weighted equivalent continuous sound pressure level on the pass-by time

$L_{pAeq,Tp}$

A-weighted sound pressure level given by the following equation:

$$L_{pAeq,Tp} = 10 \lg \left(\frac{1}{T_2 - T_1} \int_{T_1}^{T_2} \frac{p_A^2(t)}{p_0^2} dt \right) \text{ dB} \quad (5)$$

where

$L_{pAeq,Tp}$ is the A-weighted equivalent continuous sound pressure level on the pass-by time in dB;

$T_p = T_2 - T_1$ is the measurement pass-by time interval beginning at T_1 and ending at T_2 in s, see Figure 1;

$p_A(t)$ is the A-weighted instantaneous sound pressure in Pa;

p_0 the reference sound pressure; $p_0 = 20 \mu\text{Pa}$.

3.13

single event level

SEL

A-weighted sound level of a single event measured for a time interval T and normalised to $T_0 = 1$ s. The time interval T will be long enough to include all the acoustic energy related to the event, considering at least the points at - 10 dB below the lower L_{pA} during T . SEL is given by the following equation:

$$\text{SEL} = 10 \lg \left(\frac{1}{T_0} \int_0^T \frac{p_A^2(t)}{p_0^2} dt \right) \text{ dB} \quad (6)$$

where

SEL is the A-weighted sound exposure level in dB;

$T_0 = 1$ s is the reference time interval;

T is the measurement time interval in s;

$p_A(t)$ is the A-weighted instantaneous sound pressure in Pa;

p_0 the reference sound pressure; $p_0 = 20 \mu\text{Pa}$.

single event level, SEL, is related to the A-weighted equivalent continuous sound pressure level, $L_{pAeq,T}$, by the following equation:

$$\text{SEL} = L_{pAeq,T} + 10 \lg (T/T_0) \text{ dB} \quad (7)$$

3.14

transit exposure level

TEL

A-weighted sound level of a train passage, measured for a time interval T and normalised to the pass-by time T_p . The time interval T will be long enough to include all the acoustic energy related to the event, considering at least the points at - 10 dB below the lower L_{pA} during T_p . TEL is given by the following equation:

$$TEL = 10 \lg \left(\frac{1}{T_p} \int_0^T \frac{p_A^2(t)}{p_0^2} dt \right) \text{dB} \quad (8)$$

where

TEL is the A-weighted transit exposure level in dB;

T is the measurement time interval in s;

T_p is the pass-by time of the train in seconds which is the overall length of the train divided by the train speed;

$p_A(t)$ is the A-weighted instantaneous sound pressure in Pa;

p_0 the reference sound pressure; $p_0 = 20 \mu\text{Pa}$.

transit exposure level, TEL, is related to single event level, SEL, and to the A-weighted equivalent continuous sound pressure level, $L_{pAeq,T}$ by the following equations:

$$TEL = SEL + 10 \lg (T_0/T_p) \quad (9)$$

and

$$TEL = L_{pAeq,T} + 10 \lg (T/T_p) \quad (10)$$

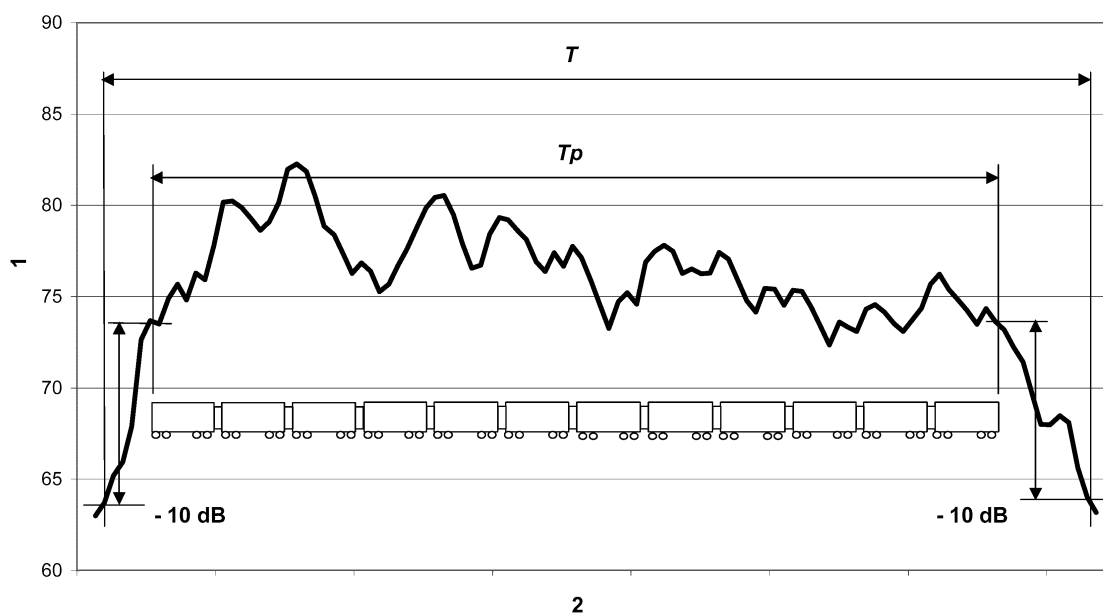
where $T_0 = 1\text{s}$ is the reference time interval (standards.iteh.ai)

3.15

measurement time interval T , and train pass-by time

T_p

measurement time interval, T , is chosen, so the measurement starts when the A-weighted sound pressure level is 10 dB lower than found when the front of the train is opposite the microphone position. The measurement is stopped when the A-weighted sound pressure level is 10 dB lower than found when the rear of the train is opposite the microphone position.

**Key**

- 1 A-weighted sound pressure level, dB
- 2 Time

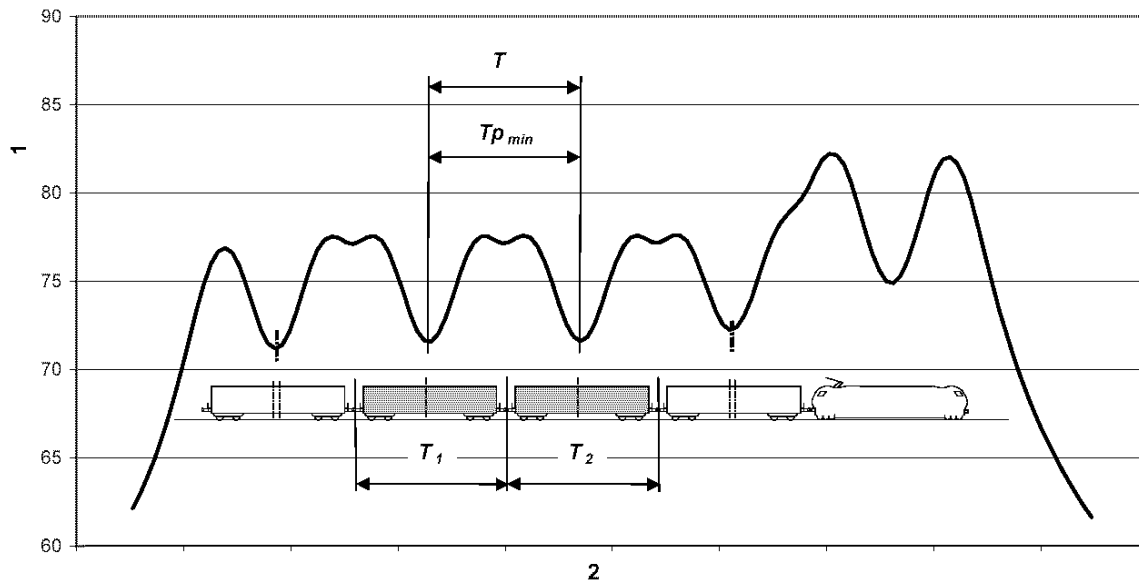
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Figure 1 — Example of selection of measuring time interval, T , for a whole train

NOTE The example illustrates the need for an independent device for measuring the train passage time, as the time cannot be deduced from the sound pressure level versus time.

For measurement of vehicle(s), which form part of a train, the measurement time interval T is the passing time T_p of the vehicle(s) under test.

For the measurement of un-powered vehicles, the measurement time interval T begins when the centre of the first vehicle under test passes in front of the microphone position and ends when the centre of the last vehicle under test passes in front of the microphone position. Figure 2 shows the required measurement time interval T or the measurement of a single un-powered vehicle. Furthermore, it shows an example of the A-weighted sound pressure level, L_{pA} , time history for the passage of a train.



Key

- 1 A-weighted sound pressure level, dB
- 2 Time

Figure 2 — Example of selection of measuring time interval, T , for parts of a train

3.16

noise with impulsive character

noise which contains an isolated event or a series of such events. The impulsive character is conventionally confirmed if the difference between $L_{pAeq,T}$ and $L_{pAeq,T}$ is greater than 3 dB

[EN ISO 12001]

3.17

noise with tonal character

noise which contains audible tones