

# Railway applications — Acoustics — Measurement of noise emitted by railbound vehicles

The European Standard EN ISO 3095:2005 has the status of a British Standard

ICS 17.140.30; 45.060.01

# National foreword

This British Standard is the official English language version of EN ISO 3095:2005. It is identical with ISO 3095:2005.

The UK participation in its preparation was entrusted by Technical Committee EH/1, Acoustics, to Subcommittee EH/1/2, Transport noise, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

## Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the *BSI Catalogue* under the section entitled “International Standards Correspondence Index”, or by using the “Search” facility of the *BSI Electronic Catalogue* or of British Standards Online.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

**Compliance with a British Standard does not of itself confer immunity from legal obligations.**

## Summary of pages

This document comprises a front cover, an inside front cover, the EN ISO title page, the EN ISO foreword page, the ISO title page, pages ii to iv, pages 1 to 31 and a back cover.

The BSI copyright notice displayed in this document indicates when the document was last issued.

## Amendments issued since publication

| Amd. No. | Date | Comments |
|----------|------|----------|
|          |      |          |
|          |      |          |
|          |      |          |
|          |      |          |

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 January 2006

© BSI 31 January 2006

English Version

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

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

Bahnanwendungen - Akustik - Messung der  
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.



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

Management Centre: rue de Stassart, 36 B-1050 Brussels

## 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.

# INTERNATIONAL STANDARD

# ISO 3095

Second edition  
2005-08-15

---

---

## **Railway applications — Acoustics — Measurement of noise emitted by railbound vehicles**

*Applications ferroviaires — Acoustique — Mesurage du bruit émis par  
les véhicules circulant sur rails*



Reference number  
ISO 3095:2005(E)

**AVA** Documents  
Document Sharing Hub



## Contents

|                                                                                                       | page      |
|-------------------------------------------------------------------------------------------------------|-----------|
| <b>Foreword</b> .....                                                                                 | <b>iv</b> |
| <b>1 Scope</b> .....                                                                                  | <b>1</b>  |
| <b>2 Normative references</b> .....                                                                   | <b>1</b>  |
| <b>3 Terms and definitions</b> .....                                                                  | <b>1</b>  |
| <b>4 Measurement quantities</b> .....                                                                 | <b>8</b>  |
| <b>5 Instrumentation</b> .....                                                                        | <b>8</b>  |
| <b>6 Test conditions</b> .....                                                                        | <b>9</b>  |
| <b>7 Test procedure</b> .....                                                                         | <b>12</b> |
| <b>8 Test report</b> .....                                                                            | <b>14</b> |
| <b>Annex A (normative) Rail roughness measurement specifications</b> .....                            | <b>16</b> |
| <b>Annex B (normative) Additional measurements</b> .....                                              | <b>22</b> |
| <b>Annex C (informative) Procedure for determining the rail roughness limit spectrum</b> .....        | <b>25</b> |
| <b>Annex D (informative) Major influence parameters on track noise including track dynamics</b> ..... | <b>30</b> |
| <b>Bibliography</b> .....                                                                             | <b>31</b> |

## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 3095 was prepared by the European Committee for Standardization (CEN) in collaboration with Technical Committee ISO/TC 43, *Acoustics*, Subcommittee SC 1, *Noise*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Throughout the text of this document, read “...this European Standard...” to mean “...this International Standard...”.

This second edition cancels and replaces the first edition (ISO 3095:1975), which has been technically revised.

For the purposes of this International Standard, the CEN annex regarding fulfilment of European Council Directives has been removed.

## 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  $\pm 2$  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  $\mu\text{m}$

## 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  $\mu\text{m}$ ;

$r_0$  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  $\lambda$  (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:

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

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:

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

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;  $p_0 = 20 \mu\text{Pa}$ .

### 3.10

#### AF-weighted maximum sound pressure level

$L_{pAF\max}$

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:

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

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

$L_{pAeq,T_p}$

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

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

where

$L_{pAeq,T_p}$  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:

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

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:

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

### 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: