
**Mechanical vibration — Ground-borne
noise and vibration arising from rail
systems —**

**Part 31:
Guideline on field measurements for
the evaluation of human exposure in
buildings**

*Vibrations mécaniques — Vibrations et bruits initiés au sol dus à des
lignes ferroviaires —*

*Partie 31: Lignes directrices de mesurages in situ pour l'évaluation de
l'exposition des individus dans les bâtiments*



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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 108, *Mechanical vibration, shock and condition monitoring*, Subcommittee SC 2, *Measurement and evaluation of mechanical vibration and shock as applied to machines, vehicles and structures*.

A list of all parts in the ISO 14837 series can be found on the ISO website.

Mechanical vibration — Ground-borne noise and vibration arising from rail systems —

Part 31:

Guideline on field measurements for the evaluation of human exposure in buildings

1 Scope

This document gives guidelines to encourage reporting of field measurements of ground-borne noise and vibration in a metric that allows international comparison and future development of empirical models. It also sets out the basic minimum requirements and good practice when taking measurements for the evaluation of human exposure in residential buildings to ensure they are reliable. While national standards or requirements based upon project-specific purposes would normally take priority, this guidance can be used where there are no particular requirements or to provide supplementary guidance. Thereby, this document provides a means of improving general quality and reporting of field measurements in a preferred format.

There are a number of reasons for carrying out field measurements of ground-borne noise and vibration arising from rail operations, from complaint investigations to validation of prediction models, diagnostics and research as detailed in ISO 14837-1:2005, 7.2. In the present document, two levels of evaluation are considered.

- Scope 1 corresponds to basic measurements of floor vibration and noise in rooms in buildings to evaluate the human exposure to ground-borne vibration and ground-borne noise. Requirements are presented under two levels of accuracy:
 - a) basic measurements with minimum accuracy;
 - b) measurements with reduced uncertainty, also more reproducible and more appropriate for prediction.

Ground-borne noise is noise generated by vibrating building elements (e.g. floors, walls and ceilings) in the room of interest and is therefore best expressed by both an acoustic and a vibrational quantity. Its identification as ground-borne noise (as opposed to airborne noise, potentially also present) requires simultaneous noise and vibration measurements. Nevertheless, there are also cases of very low frequency vibration (below 10 Hz to 16 Hz) where only vibration measurements are relevant. Rattle can also arise from vibration, which can be from building components or furniture. This document does not set out to characterize this phenomenon, but to note its presence when it occurs.

NOTE In some cases, Scope 1 can relate to measurements on the ground outside a building (to resolve access issues or to comply with national regulations), although measurements at the building are generally preferred.

- Scope 2 corresponds to measurements extended to evaluate the vibration immission to buildings, which includes vibration measurements at or near the building foundations and vibration measurements on ground next to the building so that the building coupling loss and building transmissibility can be estimated.

Vibration measurements near the tracks (on ground surface or in tunnels) for a proper characterization of the source are outside the scope of this document.

Certain requirements are specified in the interest of achieving a consistent minimum data set for each investigation, allowing data comparison between sites.

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.

ISO 1996-2:2017, *Acoustics — Description, measurement and assessment of environmental noise — Part 2: Determination of sound pressure levels*

ISO 14837-1:2005, *Mechanical vibration — Ground-borne noise and vibration arising from rail systems — Part 1: General guidance*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 14837-1 and the following 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 <https://www.iso.org/obp>

3.1 building coupling loss

frequency-dependent vibration level difference (typically in the vertical axis and sometimes also in the horizontal plane), in decibels, between the ground surface (free field) and the building foundation (which can be a measurement at or near this foundation), which is influenced by the building as a whole

Note 1 to entry: Care is required to interpret this quantity, which can be approximated in situations where measurements of the ground are performed close to the building such that it is not an ideal free field (see [4.5](#) and [Annex B](#)).

3.2 building transmissibility

frequency-dependent vibration level difference, in decibels, between the building foundation and the building floors

Note 1 to entry: The building transmissibility can be applicable to both the vertical and the horizontal directions. It can be based on either metric, velocity, acceleration, etc. (see [Annex B](#)).

3.3 room corner

3D ceiling corner (3D cc) or 3D floor corner (3D fc), which refers to noise measurements in a corner with a vertex formed from three surfaces (two walls and a ceiling, or two walls and a floor), with eight such 3D corners in a rectangular room

Note 1 to entry: A measurement in accordance with this document is usually equidistant from all the surfaces.

Note 2 to entry: A 2D corner is formed from two surfaces, typically two walls of a room (2D ww). In practice, a 2D corner measurement is at a given height from a floor (usually 1,2 m to 1,5 m), whereas the distance from the wall is usually 1 m, but not less than 0,5 m and needs to be measured and stated. A 2D corner could also arise from a floor and a wall (2D fw), or wall and a ceiling (2D wc), but is not used in this document.

3.4 category of rail events

set of rail events corresponding to the same train types passing at a typical speed, within which mean values (and standard deviations) of the exposure descriptors measured for each pass-by can be estimated and used to characterize the category considered

EXAMPLE Train types can be freight, local commuter, intercity, high speed.