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**Escalators and moving walks —  
Part 9:  
Measurement of ride quality**

*Escaliers mécaniques et trottoirs roulants —*

*Partie 9: Mesure de la qualité de leur déplacement*

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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](http://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](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of 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 [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 178, *Lifts, escalators and moving walks*.

This first edition of ISO 8103-9 cancels and replaces ISO 18738-2:2012, of which it constitutes a minor revision.

A list of all parts in the ISO 8103 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

## Introduction

The objective of this document is to encourage industry-wide uniformity in the definition, measurement, processing and expression of vibration and noise signals that comprise ride quality of escalators and moving walks.

The aim of such uniformity is to benefit industry clients by reducing variability in the results of ride quality measurements caused by differences in the methods of acquiring and quantifying the signals.

This document is intended to be referred to by those parties interested in:

- a) developing manufacturing specifications and calibration methods for instrumentation;
- b) defining the scope of the specifications for ride quality in contracts; and
- c) measuring ride quality of escalators and moving walks in accordance with an International Standard.

This document is intended to produce ride quality measurement methods and results which:

- a) are simple to understand without specialized knowledge of noise and vibration analysis;
- b) correlate well with human response to ensure plausibility; and
- c) are accountable via calibration procedures, which are traceable to national standards.

Experience in the escalator and moving walk industry has shown that passenger perception and sound pressure levels measured while travelling on an escalator or moving walk can be influenced by the presence of extraneous noise sources and by the acoustic characteristics of the environment in which the unit is installed. Additionally, the proximity of the escalator or moving walk to strong reflecting surfaces such as walls, ceilings or diagonally opposite units can also influence the sound pressure level measured. These influences can cause a sound pressure level measurement to significantly overestimate the sound level emitted exclusively by the unit.

In order to address this issue, this document defines the methodology for measuring sound pressure level that corresponds to passenger perception and additionally defines the methods that should be used if further understanding of the result is required in order to quantify the noise emitted by the unit as compared to the background or environmental contributions.



# Escalators and moving walks —

## Part 9: Measurement of ride quality

### 1 Scope

This document specifies requirements and methodology for the measurement and reporting of escalator and moving walk ride quality. This document does not specify acceptable or unacceptable ride quality values.

### 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 2041, *Mechanical vibration, shock and condition monitoring — Vocabulary*

ISO 8041, *Human response to vibration — Measuring instrumentation*

ISO 11201, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions in an essentially free field over a reflecting plane with negligible environmental corrections*

ISO 11205, *Acoustics — Noise emitted by machinery and equipment — Engineering method for the determination of emission sound pressure levels in situ at the work station and at other specified positions using sound intensity*

IEC 61043:1993, *Electroacoustics — Instruments for the measurement of sound intensity — Measurements with pairs of pressure sensing microphones*

IEC 61672-1:2013, *Electroacoustics — Sound level meters — Part 1: Specifications*

IEC 61672-2:2017, *Electroacoustics — sound level meters — Part 2: Pattern evaluation tests*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 2041, ISO 11201, ISO 11205 and the following apply.

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

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

#### 3.1

##### **load carrying unit**

part of an escalator or moving walk designed to carry persons for the purpose of transportation

EXAMPLE Step, pallet or belt.

**3.2**  
**ride quality**

*sound pressure levels* (3.6) at defined locations, and *vibration* (3.4) of *load carrying unit* (3.1) and handrail relevant to passenger perception, associated with escalator or moving walk operation

**3.3**  
**acceleration**

rate of change of *velocity* (3.5)

Note 1 to entry: The direction is according to [Figures 1](#) to [4](#).

Note 2 to entry: It is expressed in metres per second squared ( $\text{m/s}^2$ ) or Galileo (Gal).  $1 \text{ Gal} = 0,01 \text{ m/s}^2$   $1 \text{ m/s}^2 = 100 \text{ Gal}$ .

**3.4**  
**vibration**

variation with time of the magnitude of *acceleration* (3.3)

Note 1 to entry: It is expressed in metres per second squared ( $\text{m/s}^2$ ) or Galileo (Gal).  $1 \text{ Gal} = 0,01 \text{ m/s}^2$   $1 \text{ m/s}^2 = 100 \text{ Gal}$ .

**3.5**  
**velocity**

rate of change of displacement

Note 1 to entry: The direction is according to [Figures 1](#) to [4](#).

Note 2 to entry: Velocity is reported as speed in direction of travel. It is given in metres per second (m/s).

**3.6**  
**sound pressure level**

$L_p$   
ten times the logarithm to the base 10 of the ratio of the square of the sound pressure to the square of the reference sound pressure

Note 1 to entry: The reference sound pressure level is  $20 \mu\text{Pa}$  ( $2 \times 10^{-5} \text{ Pa}$ ).

**3.7**  
**equivalent sound pressure level**

$L_{Aeq}$   
average A-weighted *sound pressure level* (3.6)

**3.8**  
**emission sound pressure level**

$L_{pA}$   
A-weighted *sound pressure level* (3.6) at the specified positions, excluding the effects of background noise and contribution due to the room characteristics (reverberation) of the in-situ environment

Note 1 to entry: It is expressed in decibels.

**3.9**  
**background noise correction**

$K_{1A}$   
correction term to account for the influence of background noise on the *emission sound pressure level* (3.8) at the specified positions of the machine under test

Note 1 to entry: The correction in the case of A-weighting is to be determined from A-weighted measured values.



### 3.10 environmental indicator

$K_{2A}$

correction term to account for the influence of reflected sound on the *emission sound pressure level* (3.8) due to the characteristic of the test room

### 3.11 measured speed

speed of the escalator or moving walk with no load measured at the time of testing after the starting sequence has been completed

### 3.12 nominal speed

speed of the escalator or moving walk under no load stated by the manufacturer for which the escalator or moving walk has been designed

## 4 Measuring instrumentation

### 4.1 General

The measuring instrumentation shall consist of:

- a) a transducer to measure acceleration in each of the three orthogonal axes combined with a data acquisition system;
- b) a transducer to measure sound pressure level and/or sound intensity level.

### 4.2 Characteristics

The characteristics of the vibration measuring instrumentation shall be as described in [Table 1](#).

**Table 1 — Characteristics of vibration measuring instrumentation**

Characteristic	Vibration load carrying unit	Vibration handrail
Frequency weighting	Whole body combined (see ISO 8041)	Hand-arm (see ISO 8041)
Band limiting	See ISO 8041	See ISO 8041
Accuracy <sup>a</sup>	Type 1 (see ISO 8041)	Type 1 (see ISO 8041)
Time weighting	1 sec rms (see ISO 8041)	1 sec rms (see ISO 8041)
Environmental	See ISO 8041	See ISO 8041
Resolution	0,005 m/s <sup>2</sup>	0,005 m/s <sup>2</sup>
Measurement range	20 % above max. instantaneous acceleration to 20 % below min. instantaneous acceleration <sup>b</sup>	20 % above max. instantaneous acceleration to 20 % below min. instantaneous acceleration <sup>b</sup>

<sup>a</sup> The signals shall be filtered to exclude aliasing.

<sup>b</sup> A range of -1,5 m/s<sup>2</sup> to +1,5 m/s<sup>2</sup> should meet the above requirement.

The characteristics of the sound measuring instrumentation shall be as described in [Table 2](#).

**Table 2 — Characteristics of sound measuring instrumentation**

Measurement	Ride quality sound pressure level	Emission sound pressure level	Emission sound pressure
Characteristic		ISO 11201	ISO 11205
Method	Sound pressure	Sound pressure	Sound intensity (see ISO 11205)
Frequency weighting	A-weighting (see IEC 61672)	A-weighting (see IEC 61672)	A-weighting (see IEC 61043)
Frequency range	Not required	Not required	Octave 63 – 8 000 Hz Third 50 – 6 300 Hz
Accuracy <sup>a</sup>	Class 2 (see IEC 61672)	Class 1 (see IEC 61672)	Type 1 (see IEC 61043)
Measurement time interval	≥ 15 s, fast	≥ 15 s, fast	≥ 15 s
Environmental	See IEC 61672	See IEC 61672	See IEC 61043
Resolution	0,7 dB	0,7 dB	0,7 dB
Measurement range	35 dB to 90 dB A-weighted	30 dB to 90 dB A-weighted	See IEC 61043

<sup>a</sup> The signals shall be filtered to exclude aliasing.

### 4.3 Processing of vibration data

Vibration data shall be weighted in accordance with ISO 8041 to simulate the human body's response to vibration.

The acceleration signals in the  $x$ -,  $y$ - and  $z$ -axes, measured on the running load carrying unit, shall be frequency weighted using whole body combined filter and band limiting as defined in ISO 8041. The weighted signals, expressed as rms levels with a time constant of 1 s, shall be evaluated as a vector sum.

The acceleration signals in the  $x_h$ -axes, measured on the running handrail, shall be frequency weighted using "hand-arm" filter and band limiting as defined in ISO 8041 and expressed as rms levels with a time constant of 1 s.

The sample rate of the digital measuring system shall be sufficient to enable the measuring range in accordance with ISO 8041.

### 4.4 Environmental effects

The instrumentation shall be in accordance with the criteria for mechanical vibration, temperature range and humidity range, specified in ISO 8041.

### 4.5 Sound measurement requirements

The sound measuring system shall conform with the following.

- For ride quality sound pressure: the requirements of IEC 61672-1:2013, Class 2, sound level meters.
- For emission sound pressure: the requirements of IEC 61672-1:2013, Class 1, sound level meters or with the requirements of IEC 61043, Type 1, sound intensity meter.

The output shall be expressed in A-weighted decibels with respect to a reference sound pressure level (SPL) of 20  $\mu$ Pa.

## 4.6 Calibration requirements

### 4.6.1 General

All instrumentation calibrations shall be traceable to a metrological national standard.

### 4.6.2 Vibration measuring system

The vibration measuring system shall be calibrated in accordance with ISO 8041.

### 4.6.3 Sound measuring system

Calibration of the sound measuring system shall be carried out in accordance with IEC 61672-2:2017, Class 2 sound level meters, for ride quality sound pressure measurements.

Calibration of the sound measuring system shall be carried out in accordance with IEC 61672-2:2017, Class 1 sound level meters or IEC 61043, Type 1, sound intensity meter, for emission pressure.

## 5 Measuring and reporting

### 5.1 General measuring conditions

The escalator or moving walk should be measured in both running directions except where the unit is designed to operate in one direction only. In this case, it is sufficient to measure the unit only in this direction.

The measurement shall be carried out under the following conditions.

The unit shall:

- be assembled completely, adjusted and operating in accordance with the operating manual;
- have reached normal operating temperature;
- be measured in an unloaded condition;
- be measured after the starting sequence has been completed. If the unit operates at different speeds, all speeds shall be measured. This refers only to speeds for passenger transportation;
- have finished star/delta change over, if used, before starting the measurement. This is in order to avoid faulty measuring values.

### 5.2 General procedure

Collection of the specific data of the escalator or moving walk shall be according to [5.5](#).

The measurements should be taken at a time of day agreed by the parties involved, in order to prevent disputes over the possible effects of ambient noise.

### 5.3 Vibration measurement

#### 5.3.1 Special measuring conditions

Vibrations outside the escalator or moving walk might not falsify measurement.

Generators of disturbances shall be shut down. If not possible, reference measurement on the load carrying unit and on the handrail of a stopped escalator or moving walk shall be carried out and reported.