PUBLICLY AVAILABLE SPECIFICATION

ISO/PAS 1996-3

First edition
2022-07

Acoustics — Description, measurement and assessment of environmental noise —

Part 3: Objective method for the measurement of prominence of impulsive sounds and for adjustment of L_{Aeq}

Acoustique — Description, mesurage et évaluation du bruit de l'environnement —

Partie 3: Méthode objective pour le mesurage de l'émergence des bruits impulsifs et pour l'ajustement du L_{Aeq}

Reference number
ISO/PAS 1996-3:2022(E)

Contents

Page

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).

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.

This document was prepared by Technical Committee ISO/TC 43, *Acoustics*, Subcommittee SC 1, *Noise*.

A list of all parts in the ISO 1996 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.

Introduction

Noise with prominent impulsive sound is more annoying than continuous types of noise (without impulses or tones) with the same equivalent sound pressure level. Therefore, an adjustment is commonly added to the measured L_{Aeq}, if prominent impulsive sound is present.

In ISO 1996, three categories of impulsive sound have been found to correlate best with community response, and adjustments are given for each. Sources of impulsive sound are listed for each category. However, the list is not exhaustive.

This method objectively categorises sources by determining the prominence of impulsive sound at the receiver point, with the aim of correlating to human response. The resulting adjustments can be used to categorise the sources or be applied directly. It describes specific methodology for this purpose and provides guidance to cognizant authorities for categorising sources and their adjustments. It is intended to complement the ISO 1996-2 measurement method for general purpose environmental noise assessment.

Acoustics — Description, measurement and assessment of environmental noise —

Part 3: Objective method for the measurement of prominence of impulsive sounds and for adjustment of L_{Aeq}

1 Scope

This method objectively categorises sources by determination of the prominence of impulsive sound, with the aim of correlating to community response. This method for measuring the prominence of impulsive sounds is intended for sources not identified as gunfire or high-energy impulsive sound. It typically produces adjustments in the range 0,0 dB to 9,0 dB. These adjustments are intended to be used to categorise the sources as either regular impulsive or highly impulsive sound sources and apply the penalty indicated in ISO 1996-1. However, the adjustments may be applied directly, as is done in NT ACOU 112[2], and BS 4142[3]. ISO 1996-2 provides additional guidance for performing these measurements.

The method is intended for use on sources with impulsive characteristics that are not already categorised in ISO 1996-1. A non-exhaustive list of examples includes compressed air release, scrap handling, goods delivery, fork lifts with rattling forks, skateboard ramps, industrial shearing, gas discharges, percussive tools in demolition, powered riveting, etc.

The method is not intended for use on sounds from firearms. Although the measurements of prominence may give relevant results, research has shown the response to these sources is influenced by factors outside of the scope of this document. In addition, the method is not intended to use for high-energy impulsive sound sources as specified in ISO 1996-1.

NOTE This method is not intended for occupational hearing loss, which is outside the scope of this document.

See Annex A for recommended additional research.

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 1996-1, *Acoustics — Description, measurement and assessment of environmental noise — Part 1: Basic quantities and assessment procedures*

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

3 Terms and definitions

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

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
sound pressure level
L_{pAF}
A frequency-weighted and F time-weighted sound pressure level

Note 1 to entry: The sound pressure level is as defined in ISO 1996-1.

3.2
impulsive sound
sound with a sudden onset

Note 1 to entry: The definition includes only the onset of a sound, not the sound as a whole. ”Sudden” is based on an auditive judgement, which is expressed in terms of physical measurements in this method.

Note 2 to entry: The perceived characteristics and prominence of an impulsive sound at the immission point depends on the character of the emitted sound, the distance and propagation path from the sound source and the residual sound. Therefore, the onset parameters characterize the impulse independent of the category of the sound source.

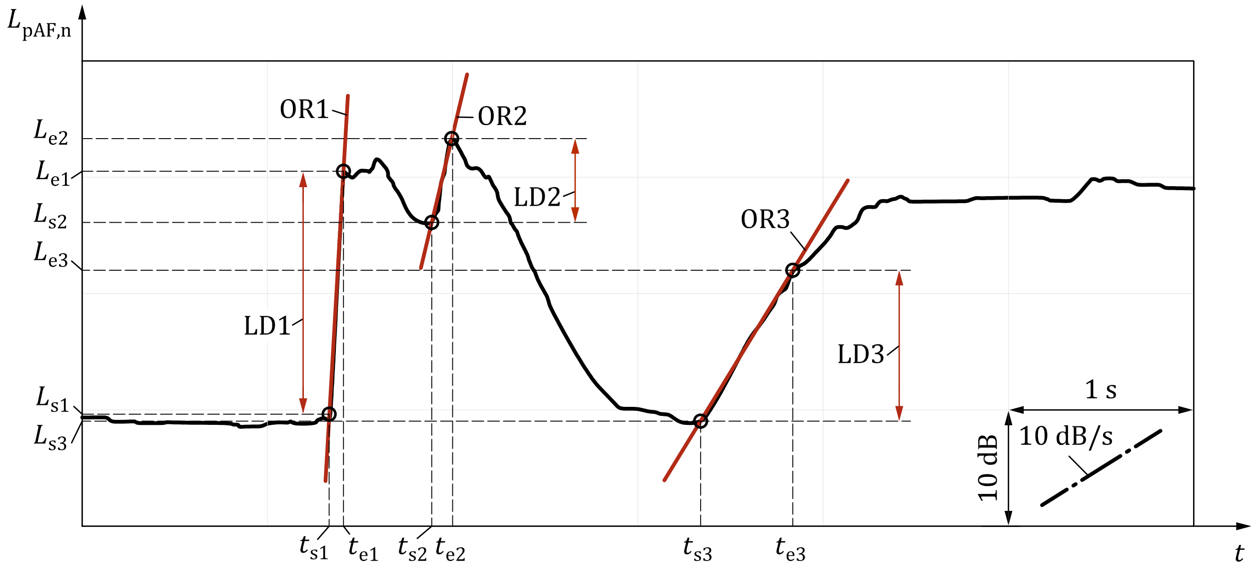
3.3
onset
contiguous part of the positive slope of the time history of L_{pAF} where the gradient exceeds 10 dB/s

Note 1 to entry: The starting point of an onset is the point where the gradient first exceeds 10 dB/s. The end point of an onset is the first point after the starting point where the gradient decreases to less than 10 dB/s. Irregularities (on the onset) shorter than 50 ms are excluded.

3.4
level difference
LD
difference in decibels of L_{pAF} between the level of the end point L_e and the level of the starting point L_s of the *onset* (3.3)

3.5
onset rate
OR
slope in decibels per second of the straight line that gives the best approximation to the *onset* (3.3) between the starting point and the end point

Note 1 to entry: For pass-bys of, e.g. road vehicles, trains or aircraft the onset rates shall be found from the level range $L_e - (L_e - L_s)/2$ to L_e, i.e. over the upper half of the slope, see Figure 1 illustrating the onset rate (OR) and the level difference (LD) based on the time history of the A frequency-weighted and F time-weighted sound pressure levels.



Key

LD level difference, in decibels

L_s level at the starting point, in decibels

L_e level at the end point, in decibels

OR onset rate, in decibels per second

t_s starting point, in seconds

t_e end point, in seconds

NOTE Gradients of 10 dB/s or more are indicated with short line segments.

Figure 1 — Analysis of the time history of the A frequency-weighted and F time-weighted sound pressure levels

3.6
assessment time interval
time interval in which any adjustment is applied

Note 1 to entry: This is typically different than the reference time interval, the measurement time interval and the observation time interval.

4 Measurements

Measurements shall be made with instruments conforming with Class 1 as specified in IEC 61672-1 with the additional logging of L_{pAF}, the A frequency-weighted and F time-weighted sound pressure level, at the intervals identified below.

The A frequency-weighted and F time-weighted sound pressure level shall be sampled with time intervals in the range 10-25 ms (incl.). Alternatively, measurements made on the basis of short-term L_{Aeq} values (e.g. 10 ms) may be used and, if so, shall (e.g. by computation) be approximated to time weighting F before the readings are taken.

NOTE 1 Direct measurements of L_{pAF} are preferred to those based on short-term L_{Aeq} values.

NOTE 2 Measurements based on a series of short-term L_{Aeq} values can be converted to a series of L_{pAF} values by the following Formula (1):

$$L_{pAF,n} = 10 \cdot \lg \left[\left(\left(\frac{\tau}{\Delta t} - 1 \right) \cdot 10^{\frac{L_{pAF,n-1}}{10}} + 10^{\frac{L_{Aeq,n}}{10}} \right) \Big/ \left(\frac{\tau}{\Delta t} \right) \right] \text{dB} \quad (1)$$

where

$L_{Aeq,n}$ — n'th short-term L_{Aeq} value, in decibels;

$L_{pAF,n}$ — A frequency-weighted and F time-weighted sound pressure level at the time of the n'th L_{Aeq} value, $L_{Aeq,n}$; $L_{pAF,0} = L_{Aeq,0}$, in decibels;

τ — time constant for the time weighting, in ms. For F: τ = 125 ms;

Δt — time between the L_{Aeq} values (and the integration time), in ms.

Measurements based on samples with time intervals of 100 ms may be used for surveys and screening, as many modern sound level meters can do this while recording the audio in sufficient detail for later analysis. Using this method, a higher uncertainty is associated to the results.

NOTE 3 Using time intervals of 100 ms means that it is not possible to observe two impulsive sound events occurring within 50 ms.

The measurement is to be made where possible at such times that impulses from sources of residual sound are not present as these can impact the assessment of the source of specific sound under investigation. Where not possible, the influence of the sources of residual sound on the measurement is to be reported. When unattended measurements are used, ancillary data such as audio recording or other methods of source identification are recommended. It is recommended that impulses that are suspected of being caused by sources of residual sound are excluded from analysis.

From a successive series of A frequency-weighted and F time-weighted sound pressure levels, $L_{pAF,n}$, the starting point s and the end point e of an onset are defined from the procedures a) to d). The symbols used are defined below. Points a) to c) refer to Figure 1. Point d) refers to Figure 2.

a) The starting point, s1, is the first point where the slope is larger than 10 dB/s: $\frac{(L_{s1+1} - L_{s1})}{(t_{s1+1} - t_{s1})} > 10$ dB/s.

b) The end point, e1, is the first point after the starting point where the slope is less than 10 dB/s: $\frac{(L_{e1+1} - L_{e1})}{(t_{e1+1} - t_{e1})} < 10$ dB/s.

c) A new starting point, s2, in Figure 1, occurs when condition a) is met again.

d) If a new starting point, s2, occurs within a period of 50 ms after the end point, e1, see Figure 2, then end point, e1, and starting point, s2, become unnamed intermediate points if the following conditions are met:

$$\frac{(L_{e2} - L_{e1})}{(t_{e2} - t_{e1})} > 10 \text{ dB/s and } \frac{(L_{s2} - L_{s1})}{(t_{s2} - t_{s1})} > 10 \text{ dB/s}$$

e2 is the end point after the new starting point, s2. If point, e1 and s2, become unnamed, point e2 takes over the name e1 (illustrated in grey in Figure 2).

s_{1+1} denotes the point one sample after point s_1. L_{s1} is the level of point s_1, and t_{s1} is the time of sampling: L_{e1} is the level of point e_1, and t_{e1} is the time of sampling, and so on.