

**AKUSTIKA. HELI SUMBUMINE VÄLISTINGIMUSTES
LEVIKU KORRAL**

**Osa 2: Tehniline meetod helirõhutasemete hindamiseks
välistingimustes**

**Acoustics. Attenuation of sound during propagation
outdoors**

**Part 2: Engineering method for the prediction of sound
pressure levels outdoors
(ISO 9613-2:2024, identical)**

EESTI STANDARDI EESSÕNA**NATIONAL FOREWORD**

See Eesti standard EVS-ISO 9613-2:2024 sisaldab rahvusvahelise standardi ISO 9613-2:2024 „Acoustics — Attenuation of sound during propagation outdoors — Part 2: Engineering method for the prediction of sound pressure levels outdoors“ identset ingliskeelset teksti.

Ettepaneku rahvusvahelise standardi ümbertrüki meetodil ülevõtuks on esitanud EVS/TK 61, standardi avaldamist on korraldanud Eesti Standardimis- ja Akrediteerimiskeskus.

Standard EVS-ISO 9613-2:2024 on jõustunud sellekohase teate avaldamisega EVS Teatajas.

Standard on kättesaadav Eesti Standardimis- ja Akrediteerimiskeskusest.

This Estonian Standard EVS-ISO 9613-2:2024 consists of the identical English text of the International Standard ISO 9613-2:2024 „Acoustics — Attenuation of sound during propagation outdoors — Part 2: Engineering method for the prediction of sound pressure levels outdoors“.

Proposal to adopt the International Standard by reprint method has been presented by EVS/TK 61, the Estonian Standard has been published by the Estonian Centre for Standardisation and Accreditation.

Standard EVS-ISO 9613-2:2024 has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation and Accreditation.

This standard is available from the Estonian Centre for Standardisation and Accreditation.

Käsitlusala

See dokument täpsustab tehnilist meetodit heli sumbumise arvutamiseks müra levimisel välistingimustes, et määrata keskkonnamüra taset müraallikatest eri kaugustel. Meetod võimaldab määrata samaväärse pideva A-korrigeeritud helirõhu taset (nagu on kirjeldatud ISO 1996 standardisarjas) meteotingimustes, mis soodustavad helide levimist teadaolevatest allikatest.

Need tingimused on ette nähtud kasutamiseks heli allatuult levimisel või samaväärseks levimiseks hariliku mõõduka temperatuuri inversiooni korral maapinnal, nagu tavaliselt on selgetel ja vaiksetel öödel. Inversiooni tingimused laialdaste veepindade kohal ei ole kaetud ja võivad põhjustada kõrgema helirõhutase, kui on eeldatud selles dokumendis (vt nt viited [11] ja [12]).

Meetod võimaldab määrata ka pikaajalist keskmist A-korrigeeritud helirõhutaset, nagu on täpsustatud standardites ISO 1996-1 ja ISO 1996-2. Pikaajaline keskmine A-korrigeeritud helirõhutase hõlmab hindamise võimalusi mitmesuguste meteotingimuste jaoks.

Antud on juhised meteoroloogilise korrektsiooni tuletamiseks, mis põhinevad tuule nurkjaotusel, mis on asjakohased võrdlus- või pikaajalise ajavahemiku jaoks, nagu on määratletud standardis ISO 1996-1:2016, jaotistes 3.2.1 ja 3.2.2. Võrdlusajavahemike näideteks on päev, öö või öötund, mille helirõhutase väärtus on suurim. Pikaajalised ajavahemikud, mille jooksul keskmistatakse või hinnatakse võrdlusajavahemike heli, moodustavad olulise osa aastast (nt 3 kuud, 6 kuud või 1 aasta).

Selles dokumendis täpsustatud meetod koosneb konkreetselt oktaavribade algoritmidest (nominaalsagedusega 63 Hz kuni 8 kHz) punktallikast või punktallikate kogumist pärit heli sumbumise arvutamiseks. Allikas (või allikad) võivad olla liikuvad või paiksed. Järgmistele füüsikalistele mõjudele kasutatakse algoritmides spetsiifilisi termineid:

- geomeetriline erinevus,
- atmosfääris neeldumine,

- maapinna mõju,
- peegeldus pindadelt,
- takistuste hindamine.

Lisateave taimestiku, tööstusalade ja hoonete kaudu levimise kohta on esitatud lisas A. Korstnapitside suunatavus tööstusobjektide heliproгноoside toetamiseks on lisatud lissasse B. Näide, kuidas saab kohaliku tuuleklimatoloogia põhjal määrata kaugmaa meteoroloogilist korrektsiooni C_0 , on toodud lissas C. Viimaste aastakümnete kogemused, kuidas tuuleturbiinide tekitatud helirõhutasemeid ennustada, on kokku võetud lissas D.

Meetodit saab praktikas kasutada väga paljude müraallikate ja keskkondade jaoks. See on otseselt või kaudselt rakendatav enamikus olukordades, mis on seotud maantee- või raudteeliikluse, tööstusliku müra allikate, ehitustegevuse ja paljude muude maapinnal asuvate müraallikatega. Seda ei kohaldata lennu ajal õhusõidukite tekitatava heli ega kaevanduse, militaar- või muude samalaadsete toimingute tekitatud lööklainete suhtes.

Selles dokumendis kirjeldatud meetodi rakendamiseks allika oktaavriba helivõimsustaseme leviku kohta olulistest suundades on vaja teada mitut parameetrit, nagu müraallika ja keskkonna geomeetria ja maapinna omadused.

Kui on teada ainult allikate A-korrigeeritud helivõimsustasemed, võib kasutada hindamisel sumbumise tingimustena 500 hertsile vastavat sumbumist.

Meetodi täpsust ja selle praktikas kasutamise piiranguid kirjeldatakse peatükis 9.

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ICS 17.140.01

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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 document 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).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

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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*.

This second edition cancels and replaces the first edition (ISO 9613-2:1996), which has been technically revised.

The main changes are as follows:

- subdivision of extended sources improved (more detailed to decrease uncertainty with software implementations);
- improved classification of the source-directivity;
- improved and more detail specified in the determination of the ground factor G (projection to horizontal plane);
- integration of a correction for A_{gr} to account for the decreasing ground effect for small values of distance/height – harmonizing the General method [7.3.1](#) and the Simplified method [7.3.2](#);
- modified definition of the mean height h_m for the application of the Simplified method [7.3.2](#);
- integration of the strategy to calculate screening as it was developed with ISO/TR 17534-3;

- modified specification of the barrier attenuation D_z and the correction for meteorological effects K_{met} to eliminate well known shortcomings with low barriers and large source-to-receiver distances;
- inclusion of clear specifications on how to combine vertical and lateral diffraction (from ISO/TR 17534-3);
- improved specification of the minimal extension (width or height) of a reflecting surface;
- multi-reflections up to higher orders (in accordance with ISO/TR 17534-3);
- reflections at vertical cylindrical surfaces;
- additional to the simple method for the attenuation of foliage without any parameter dependencies of the old version ISO 9613-2:1996, A.2.2, a new and more detailed method including the influence of forestal parameters (see A.2.3);
- the directivity correction D_c for chimney stacks (see [Annex B](#));
- proposal for a meteorological correction derived from the local wind-climatology (see [Annex C](#));
- calculation of sound pressure levels caused by wind turbines (see [Annex D](#)).

A list of all parts in the ISO 9613 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

The ISO 1996 series^{[1][2][3]} of standards specifies methods for the description of noise outdoors in community environments. Other standards specify methods for determining the sound power levels emitted by various noise sources, such as machinery and specified equipment (ISO 3740 series^[4]), or industrial plants (ISO 8297^[5]). This document is intended to bridge the gap between these two types of standards, to enable noise levels in the community to be predicted from sources of known sound emission. The method described in this document is general in the sense that it may be applied to a wide variety of noise sources and covers most of the major mechanisms of attenuation. There are, however, constraints on its use, which arise principally from the description of environmental noise in the ISO 1996 series.

This version includes the modifications developed for reasons of quality assurance if the method is implemented in software as described in ISO 17534-1^[6] and ISO/TR 17534-3^[7] and some improvements to make the applied strategy fit for broad software-based application.

Acoustics — Attenuation of sound during propagation outdoors —

Part 2:

Engineering method for the prediction of sound pressure levels outdoors

1 Scope

This document specifies an engineering method for calculating the attenuation of sound during propagation outdoors in order to predict the levels of environmental noise at a distance from a variety of sources. The method predicts the equivalent continuous A-weighted sound pressure level (as described in ISO 1996-series) under meteorological conditions favourable to propagation from sources of known sound emission.

These conditions are for downwind propagation or, equivalently, propagation under a well-developed moderate ground-based temperature inversion, such as commonly occurs in clear, calm nights. Inversion conditions over extended water surfaces are not covered and may result in higher sound pressure levels than predicted from this document (see e.g. References [11] and [12]).

The method also predicts a long-term average A-weighted sound pressure level as specified in ISO 1996-1 and ISO 1996-2. The long-term average A-weighted sound pressure level encompasses levels for a wide variety of meteorological conditions.

Guidance has been provided to derive a meteorological correction based on the angular wind distribution relevant for the reference or long-term time interval as specified in ISO 1996-1:2016, 3.2.1 and 3.2.2. Examples for reference time intervals are day, night, or the hour of the night with the largest value of the sound pressure level. Long-term time intervals over which the sound of a series of reference time intervals is averaged or assessed representing a significant fraction of a year (e.g. 3 months, 6 months or 1 year).

The method specified in this document consists specifically of octave band algorithms (with nominal mid-band frequencies from 63 Hz to 8 kHz) for calculating the attenuation of sound which originates from a point sound source, or an assembly of point sources. The source (or sources) may be moving or stationary. Specific terms are provided in the algorithms for the following physical effects:

- geometrical divergence;
- atmospheric absorption;
- ground effect;
- reflection from surfaces;
- screening by obstacles.

Additional information concerning propagation through foliage, industrial sites and housing is given in [Annex A](#). The directivity of chimney-stacks to support the sound predictions for industrial sites has been included with [Annex B](#). An example how the far-distance meteorological correction C_0 can be determined from the local wind-climatology is given in [Annex C](#). Experiences of the last decades how to predict the sound pressure levels caused by wind turbines is summarized in [Annex D](#).

The method is applicable in practice to a great variety of noise sources and environments. It is applicable, directly, or indirectly, to most situations concerning road or rail traffic, industrial noise sources, construction activities, and many other ground-based noise sources. It does not apply to sound from aircraft in flight, or to blast waves from mining, military, or similar operations.

To apply the method of this document, several parameters need to be known with respect to the geometry of the source and of the environment, the ground surface characteristics, and the source strength in terms of octave band sound power levels for directions relevant to the propagation.

If only A-weighted sound power levels of the sources are known, the attenuation terms for 500 Hz may be used to estimate the resulting attenuation.

The accuracy of the method and the limitations to its use in practice are described in [Clause 9](#).

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 9613-1:1993, *Acoustics — Attenuation of sound during propagation outdoors — Part 1: Calculation of the absorption of sound by the atmosphere*

3 Terms, definitions, symbols and units

3.1 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/>

3.1.1

A-weighted equivalent continuous sound pressure level

L_{AT}

sound pressure level defined by [Formula \(1\)](#):

$$L_{AT} = 10 \lg\left\{\left[\frac{1}{T}\right] \int_0^T p_A^2(t) dt / p_0^2\right\} \text{ dB} \quad (1)$$

where

$p_A(t)$ is the instantaneous A-weighted sound pressure, expressed in pascals;

p_0 is the reference sound pressure (= 20×10^{-6} Pa);

T is a specified time interval, expressed in seconds

Note 1 to entry: The A-frequency weighting is that specified for sound level meters in IEC 61672-1^[10].

Note 2 to entry: The time interval T should be long enough to average the effects of varying meteorological parameters. Two different situations are considered in this document, namely short-term downwind and long-term overall averages.