AKUSTIKA
Heli sumbumine välistingimustes leviku korral
Osa 2: Üldine arvutusmeetod

Acoustics
Attenuation of sound during propagation outdoors
Part 2: General method of calculation
(ISO 9613-2:1996, identical)

EESTI STANDARDIKESKUS EVS
ESTONIAN CENTRE FOR STANDARDISATION

EESTI STANDARDI EESSÕNA

See Eesti standard EVS-ISO 9613-2:2006 „Akustika. Heli sumbumine välistingimustes leviku korral. Osa 2: Üldine arvutusmeetod“ sisaldab rahvusvahelise standardi ISO 9613-2:1996 „Acoustics. Attenuation of sound during propagation outdoors. Part 2: General method of calculation“ identset ingliskeelset teksti.

Ettepaneku rahvusvahelise standardi ümbertrüki meetodil ülevõtuks on esitanud EVS/TK 61, standardi avaldamist on korraldanud Eesti Standardikeskus.

Standard EVS-ISO 9613-2:2006 on jõustunud sellekohase teate avaldamisega EVS Teatajas.

Standard on kättesaadav Eesti Standardikeskusest.

NATIONAL FOREWORD

This Estonian Standard EVS-ISO 9613-2:2006 consists of the identical English text of the International Standard ISO 9613-2:1996 „Acoustics. Attenuation of sound during propagation outdoors. Part 2: General method of calculation“.

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.

Standard EVS-ISO 9613-2:2006 has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation.

This standard is available from the Estonian Centre for Standardisation.

Käsitlusala

Standardisarja ISO 9613 see osa 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 standardisarja ISO 1996 osades 1 kuni 3) meteotingimustes, mis soodustavad helide levimist teadaolevatest allikatest.

Need tingimused on ette nähtud kasutamiseks heli allatuult levimisel, nagu on täpsustatud standardi ISO 1996-2:1987 jaotises 5.4.3.3, või samaväärseks levimiseks hariliku mõõduka temperatuuri inversiooni korral maapinnal, nagu tavaliselt on öösel. Inversiooni tingimused veepindade kohal ei ole kaetud ja võivad põhjustada kõrgema helirõhutaseme, kui on eeldatud standardisarja ISO 9613 selles osas.

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.

Standardisarja ISO 9613 selles osas 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 hoonete, taimestiku ja tööstusalade kaudu levimise kohta on esitatud lisas A.

Seda 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.

Standardisarja ISO 9613 selle osa meetodi rakendamiseks allika oktaavriba helivõimsustaseme leviku kohta olulistes suundades on vaja teada mitut parameetrit, nagu müraallika ja keskkonna geomeetria ja maapinna omadused.

MÄRKUS 1 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.

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile standardiosakond@evs.ee.

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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.

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.

International Standard ISO 9613-2 was prepared by Technical Committee ISO/TC 43, *Acoustics*, Subcommittee SC 1, *Noise*.

ISO 9613 consists of the following parts, under the general title *Acoustics — Attenuation of sound during propagation outdoors:*

— *Part 1: Calculation of the absorption of sound by the atmosphere*

— *Part 2: General method of calculation*

Part 1 is a detailed treatment restricted to the attenuation by atmospheric absorption processes. Part 2 is a more approximate and empirical treatment of a wider subject — the attenuation by all physical mechanisms.

Annexes A and B of this part of ISO 9613 are for information only.

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Introduction

The ISO 1996 series of standards specifies methods for the description of noise outdoors in community environments. Other standards, on the other hand, specify methods for determining the sound power levels emitted by various noise sources, such as machinery and specified equipment (ISO 3740 series), or industrial plants (ISO 8297). This part of ISO 9613 is intended to bridge the gap between these two types of standard, to enable noise levels in the community to be predicted from sources of known sound emission. The method described in this part of ISO 9613 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 of standards.

Acoustics — Attenuation of sound during propagation outdoors —

Part 2:
General method of calculation

1 Scope

This part of ISO 9613 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 parts 1 to 3 of ISO 1996) under meteorological conditions favourable to propagation from sources of known sound emission.

These conditions are for downwind propagation, as specified in 5.4.3.3 of ISO 1996-2:1987 or, equivalently, propagation under a well-developed moderate ground-based temperature inversion, such as commonly occurs at night. Inversion conditions over water surfaces are not covered and may result in higher sound pressure levels than predicted from this part of ISO 9613.

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.

The method specified in this part of ISO 9613 consists specifically of octave-band algorithms (with nominal midband 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 housing, foliage and industrial sites is given in annex A.

This 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 part of ISO 9613, 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.

NOTE 1 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 standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 9613. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 9613 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 1996-1:1982, *Acoustics — Description and measurement of environmental noise — Part 1: Basic quantities and procedures.*

ISO 1996-2:1987, *Acoustics — Description and measurement of environmental noise — Part 2: Acquisition of data pertinent to land use.*

ISO 1996-3:1987, *Acoustics — Description and measurement of environmental noise — Part 3: Application to noise limits.*

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

IEC 651:1979, *Sound level meters,* and Amendment 1:1993.

3 Definitions

For the purposes of this part of ISO 9613, the definitions given in ISO 1996-1 and the following definitions apply. (See table 1 for symbols and units.)

3.1 equivalent continuous A-weighted sound pressure level, L_{AT}: Sound pressure level, in decibels, defined by equation (1):

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

where

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

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

T is a specified time interval, in seconds.

The A-frequency weighting is that specified for sound level meters in IEC 651.

NOTE 2 The time interval T should be long enough to average the effects of varying meteorological parameters. Two different situations are considered in this part of ISO 9613, namely short-term downwind and long-term overall averages.

Table 1 — Symbols and units

Symbol	Definition	Unit
A	octave-band attenuation	dB
C_{met}	meteorological correction	dB
d	distance from point source to receiver (see figure 3)	m
d_p	distance from point source to receiver projected onto the ground plane (see figure 1)	m
$d_{s,o}$	distance between source and point of reflection on the reflecting obstacle (see figure 8)	m
$d_{o,r}$	distance between point of reflection on the reflecting obstacle and receiver (see figure 8)	m
d_{ss}	distance from source to (first) diffraction edge (see figures 6 and 7)	m
d_{sr}	distance from (second) diffraction edge to receiver (see figures 6 and 7)	m
D_I	directivity index of the point sound source	—
D_z	screening attenuation	—
e	distance between the first and second diffraction edge (see figure 7)	m
G	ground factor	—
h	mean height of source and receiver	m
h_s	height of point source above ground (see figure 1)	m
h_r	height of receiver above ground (see figure 1)	m
h_m	mean height of the propagation path above the ground (see figure 3)	m
H_{max}	largest dimension of the sources	m
l_{min}	minimum dimension (length or height) of the reflecting plane (see figure 8)	m
L	sound pressure level	dB
α	atmospheric attenuation coefficient	dB/km
β	angle of incidence	rad
ρ	sound reflection coefficient	—