Akustika. Müraallikate helivõimsustaseme määramine helitugevuse abil. Osa 2: Mõõtmine skaneerimisega

Acoustics - Determination of sound power levels of noise sources using sound intensity - Part 2: Measurement by scanning

EESTI STANDARDI EESSÕNA **NATIONAL FOREWORD**

Käesolev Eesti standard EVS-EN ISO 9614-2:1999 sisaldab Euroopa standardi EN ISO 9614-2:1996 ingliskeelset teksti. Käesolev dokument on jõustatud 12.12.1999 ja selle kohta on avaldatud teade Eesti standardiorganisatsiooni ametlikus väljaandes. Standard on kättesaadav Eesti standardiorganisatsioonist.	This Estonian standard EVS-EN ISO 9614-2:1999 consists of the English text of the European standard EN ISO 9614-2:1996. This document is endorsed on 12.12.1999 with the notification being published in the official publication of the Estonian national standardisation organisation. The standard is available from Estonian standardisation organisation.

Käsitlusala: Standard määrab kindlaks meetodi mõõtepinnaga risti oleva helitugevuskomponendi määramiseks. Valitud mõõtepind ümbritseb müraallikat(id), mille helivõimsustaset määratakse.	**Scope:**

ICS 17.140.01

Võtmesõnad: akustika, akustilised katsed, akustilised mõõtmised, heliallikad, helitugevus, helivõimsus, katsed, kindlaksmääramine, müra (heli)

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN ISO 9614-2

August 1996

ICS 17.140.10

Descriptors: Acoustics, noise source, sound intensity, testing.

English version

Acoustics

Determination of sound power levels of noise sources using sound intensity

Part 2: Measurement by scanning
(ISO 9614-2:1996)

Acoustique – Détermination par intensimétrie des niveaux de puissance acoustique émis par les sources de bruit – Partie 2: Mesurages par balayage
(ISO 9614-2:1996)

Akustik – Bestimmung der Schalleistungspegel von Geräuschquellen aus Schallintensitätsmessungen – Teil 2: Messung mit kontinuierlicher Abtastung
(ISO 9614-2:1996)

This European Standard was approved by CEN on 1996-05-19 and is identical to the ISO Standard as referred to.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom.

CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Foreword

International Standard

ISO 9614-2:1996 Acoustics – Determination of sound power levels of noise sources using sound intensity – Measurement by scanning,

which was prepared by ISO/TC 43 'Acoustics' of the International Organization for Standardization, has been adopted by Technical Committee CEN/TC 211 'Acoustics' as a European Standard.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, and conflicting national standards withdrawn, by February 1997 at the latest.

In accordance with the CEN/CENELEC Internal Regulations, the following countries are bound to implement this European Standard:

Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom.

Endorsement notice

The text of the International Standard ISO 9614-2:1996 was approved by CEN as a European Standard without any modification.

Introduction

0.1 The sound power radiated by a source is equal in value to the integral of the scalar product of the sound intensity vector and the associated elemental area vector over any surface totally enclosing the source. Previous International Standards which describe methods of determination of sound power levels of noise sources, principally ISO 3740 to ISO 3747, without exception specify sound pressure level as the primary acoustic quantity to be measured. The relationship between sound intensity level and sound pressure level at any point depends on the characteristics of the source, the characteristics of the measurement environment, and the disposition of the measurement positions with respect to the source. Therefore ISO 3740 to ISO 3747 necessarily specify the source characteristics, the test environment characteristics and qualification procedures, together with measurement methods which are expected to restrict the uncertainty of the sound power level determination to within acceptable limits.

The procedures specified ISO 3740 to ISO 3747 are not always appropriate, for the following reasons:

a) Costly facilities are necessary if high precision is required. It is frequently not possible to install and operate large pieces of equipment in such facilities.

b) They cannot be used in the presence of high levels of extraneous noise generated by sources other than that under investigation.

0.2 This part of ISO 9614 specifies methods of determining the sound power levels of sources, within specific ranges of uncertainty, under test conditions which are less restricted than those required by ISO 3740 to ISO 3747. The sound power level is the *in situ* sound power level as determined by the procedure of this part of ISO 9614; it is physically a function of the environment, and may in some cases differ from the sound power level of the same source determined under other conditions.

It is recommended that personnel performing sound intensity measurements according to this part of ISO 9614 are appropriately trained and experienced.

0.3 This part of ISO 9614 complements ISO 9614-1 and the series ISO 3740 to ISO 3747 which specify various methods for the determination of sound power levels of machines and equipment. It differs from the ISO 3740 to ISO 3747 series principally in three aspects:

a) measurements are made of sound intensity as well as of sound pressure;

b) the uncertainty of the sound power level determined by the method specified in this part of ISO 9614 is classified according to the results of specified ancillary tests and calculations performed in association with the test measurements;

c) current limitations of intensity measurement equipment which conforms to IEC 1043 restricts measurements to the one-third-octave range 50 Hz to 6,3 kHz; band-limited A-weighted values are determined from the constituent one-octave or one-third-octave band values and not by direct A-weighted measurement.

0.4 The integral over any surface totally enclosing the source of the scalar product of the sound intensity vector and the associated elemental area vector provides a measure of the sound power radiated directly into the air by all sources located within the enclosing surface and excludes sound radiated by sources located outside this surface. In practice, this exclusion is effective only if the source under test and other sources of extraneous intensity on the measurement surface are stationary in time. In the presence of sound sources operating outside the measurement surface, any system lying within the surface may absorb a proportion of energy incident upon it. The total sound power absorbed within the measurement surface will appear as a negative contribution to source power, and may produce an error in the sound power determination. In order to minimize the associated error, it is therefore necessary to remove any sound-absorbing material lying within the measurement surface which is not normally present during the operation of the source under test.

This method is based on sampling of the intensity field normal to the measurement surface by moving an intensity probe continuously along one or more specified paths. The resulting sampling error is a function of the spatial variation of the normal intensity component over the measurement surface, which depends upon the directivity of the source, the chosen sampling surface, the pattern and speed of the probe scanning, and the proximity of extraneous sources outside the measurement surface.

The accuracy of measurement of the normal component of sound intensity at a position is sensitive to the difference between the local sound pressure level and the local normal sound intensity level. A large difference may occur when the intensity vector at a measurement position is directed at a large angle (approaching 90°) to the local normal to the measurement surface. Alternatively, the local sound pressure level may contain strong contributions from sources outside the measurement surface, but may be associated with little net sound energy flow, as in a reverberant field in an enclosure; or the field may be strongly reactive because of the presence of the near field and/or standing waves.

The accuracy of determination of sound power level is adversely affected by a flow of sound energy into the volume enclosed by the measurement surface through a portion of that surface, even though it is, in principle, compensated by increased flow out of the volume through the remaining portion of the surface. This condition is caused by the presence of a strong extraneous source close to, but outside, the measurement surface.

1 Scope

1.1 This part of ISO 9614 specifies a method for measuring the component of sound intensity normal to a measurement surface which is chosen so as to enclose the noise source(s) of which the sound power level is to be determined.

Surface integration of the intensity component normal to the measurement surface is approximated by subdividing the measurement surface into contiguous segments, and scanning the intensity probe over each segment along a continuous path which covers the extent of the segment. The measurement instrument determines the average normal intensity component and averaged squared sound pressure over the duration of each scan. The scanning operation may be performed either manually or by means of a mechanical system.

Band-limited weighted sound power level is calculated from the measured octave or one-third-octave band values. The method is applicable to any source for which a physically stationary measurement surface can be defined, and on which the noises generated by the source under test and by other significant extraneous sources are stationary in time, as defined in 3.13. The source is defined by the choice of measurement surface. The method is applicable *in situ*, or in special-purpose test environments.

This part of ISO 9614 specifies certain ancillary procedures, described in annex B, to be followed in conjunction with the sound power determination. The results are used to indicate the quality of the determination, and hence the grade of accuracy. If the indicated quality of the determination does not meet the requirements of this part of ISO 9614, the test procedure is to be modified in the manner indicated.

This part of ISO 9614 does not apply in any frequency band in which the sound power of the source is found to be negative on measurement.

1.2 This part of ISO 9614 is applicable to sources situated in any environment which is neither so variable in time as to reduce the accuracy of the measurement of sound intensity to an unacceptable degree, nor subjects the intensity measurement probe to gas flows of unacceptable speed or unsteadiness (see 5.2.2, 5.3 and 5.4).

In some cases it will be found that the test conditions are too adverse to allow the requirements of this part of ISO 9614 to be met. Extraneous noise levels may exceed the dynamic capability of the measuring instrument or may vary to an excessive degree during the test. In such cases the method given in this part of ISO 9614 is not suitable for the determination of the sound power level of the source.

NOTE 1 Other methods (e.g. determination of sound power levels from surface vibration levels as described in ISO/TR 7849) may be more suitable.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 9614. 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 9614 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.

IEC 942:1988, *Sound calibrators.*

IEC 1043:1993, *Electroacoustics — Instruments for the measurement of sound intensity — Measurements with pairs of pressure sensing microphones.*

3 Definitions

For the purposes of this part of ISO 9614, the following definitions apply.

3.1 Sound pressure levels

3.1.1 sound pressure level, L_p: Ten times the logarithm to the base 10 of the ratio of the mean-square sound pressure to the square of the reference sound pressure. The reference sound pressure is 20 µPa.

Sound pressure level is expressed in decibels.

3.1.2 segment-average sound pressure level, L_{pi}: Ten times the logarithm to the base 10 of the ratio of the spatial-average mean-square pressure on segment i to the square of the reference sound pressure.

It is expressed in decibels.

3.2 instantaneous sound intensity, $\vec{I}(t)$: Instantaneous rate of flow of sound energy per unit of surface area in the direction of the local instantaneous acoustic particle velocity.

This is a vectorial quantity which is equal to the product of the instantaneous sound pressure at a point and the associated particle velocity:

$$\vec{I}(t) = p(t)\cdot\vec{u}(t) \qquad \ldots (1)$$

where

$p(t)$ is the instantaneous sound pressure at a point;

$\vec{u}(t)$ is the associated instantaneous particle velocity at the same point;

t is the time.

3.3 sound intensity, $\vec{I}$: Time-average value of $\vec{I}(t)$ in a temporally stationary sound field:

$$\vec{I} = \lim_{T\to\infty} \frac{1}{T}\int_0^T \vec{I}(t)\ \mathrm{d}t \qquad \ldots (2)$$

where T is the integration period.

Also

I is the signed magnitude of $\vec{I}$; the sign is an indication of directional sense, and is dictated by the choice of positive direction of energy flow;

$|I|$ is the unsigned magnitude of $\vec{I}$.

3.4 normal sound intensity, I_n: Component of the sound intensity in the direction normal to a measurement surface defined by the unit normal vector $\vec{n}$:

$$I_n = \vec{I}\cdot\vec{n} \qquad \ldots (3)$$

where $\vec{n}$ is the unit normal vector directed out of the volume enclosed by the measurement surface.

3.5 normal sound intensity level, L_{I_n}: Logarithmic measure of the unsigned value of the normal sound intensity, $|I_n|$, given by:

$$L_{I_n} = 10\ \lg[|I_n|/I_0]\ \mathrm{dB} \qquad \ldots (4)$$

where I_0 is the reference sound intensity ($= 10^{-12}\ \mathrm{Wm}^{-2}$).

It is expressed in decibels.

When I_n is negative, the level is expressed as (–) XX dB, except when used in the evaluation of δ_{pI_0} (see 3.11).

3.6 Sound powers

3.6.1 partial sound power, P_i: Time-averaged rate of flow of sound energy through an element (segment) of a measurement surface, given by:

$$P_i = \langle I_{ni}\rangle S_i \qquad \ldots (5)$$

where

$\langle I_{ni}\rangle$ is the signed magnitude of the segment-average normal sound intensity measured on the segment i of the measurement surface;

S_i is the area of the segment i.

Also $|P_i|$ is the magnitude of P_i.