SLOVENSKI PREDSTANDARD

oSIST prEN ISO 3741:2006

april 2006

Akustika – Določanje ravni zvočnih moči in ravni zvočne energije virov hrupa z zvočnim tlakom - Precizijska metoda z merjenjem v odmevnici (ISO/DIS 3741:2006)

Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Precision methods for reverberation test rooms (ISO/DIS 3741:2006)

ICS 17.140.01

Referenčna številka
oSIST prEN ISO 3741:2006(en)

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
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February 2006

ICS

Will supersede EN ISO 3741:1999

English Version

Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Precision methods for reverberation test rooms (ISO/DIS 3741:2006)

Acoustique - Détermination des niveaux de puissance acoustique et des niveaux d'énergie acoustique émis par les sources de bruit à partir de la pression acoustique - Méthodes de laboratoire en salles d'essais réverbérantes (ISO/DIS 3741:2006)

This draft European Standard is submitted to CEN members for parallel enquiry. It has been drawn up by the Technical Committee CEN/TC 211.

If this draft becomes a European Standard, 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.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This document (prEN ISO 3741:2006) has been prepared by Technical Committee ISO/TC 43 "Acoustics" in collaboration with Technical Committee CEN/TC 211 "Acoustics", the secretariat of which is held by DS.

This document is currently submitted to the parallel Enquiry.

This document will supersede EN ISO 3741:1999.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

Endorsement notice

The text of ISO 3741:2006 has been approved by CEN as prEN ISO 3741:2006 without any modifications.

DRAFT INTERNATIONAL STANDARD ISO/DIS 3741

ISO/TC **43**/SC **1** Secretariat: **DS**

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Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Precision methods for reverberation test rooms

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[Revision of third edition (ISO 3741:1999) and ISO 3741:1999/Cor1:2001]

ICS 17.140.01

ISO/CEN PARALLEL ENQUIRY

The CEN Secretary-General has advised the ISO Secretary-General that this ISO/DIS covers a subject of interest to European standardization. **In accordance with the ISO-lead mode of collaboration as defined in the Vienna Agreement, consultation on this ISO/DIS has the same effect for CEN members as would a CEN enquiry on a draft European Standard.** Should this draft be accepted, a final draft, established on the basis of comments received, will be submitted to a parallel two-month FDIS vote in ISO and formal vote in CEN.

In accordance with the provisions of Council Resolution 15/1993 this document is circulated in the English language only.

Conformément aux dispositions de la Résolution du Conseil 15/1993, ce document est distribué en version anglaise seulement.

To expedite distribution, this document is circulated as received from the committee secretariat. ISO Central Secretariat work of editing and text composition will be undertaken at publication stage.

Pour accélérer la distribution, le présent document est distribué tel qu'il est parvenu du secrétariat du comité. Le travail de rédaction et de composition de texte sera effectué au Secrétariat central de l'ISO au stade de publication.

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

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.

ISO 3741 was prepared by Technical Committee ISO/TC 43, *Acoustics*, Subcommittee SC 1, *Noise*.

This fourth edition cancels and replaces the third edition (ISO 3741:1999), which has been technically revised.

Introduction

0.1 This International Standard is one of the series ISO 3740 to ISO 3747, which specify various methods for determining the sound power levels and sound energy levels of noise sources including machinery, equipment and their sub-assemblies. The selection of one of the methods from the series for use in a particular application will depend on the purpose of the test to determine the sound power level or sound energy level and on the facilities available. General guidelines to assist in the selection are provided in ISO 3740[1)]. The series of standards of which this International Standard is a part gives only general principles regarding the operating and mounting conditions of the machinery or equipment for the purposes of the test. It is important that test codes be established for individual kinds of noise source, in order to give detailed requirements on mounting, loading and operating conditions under which the sound power levels or sound energy levels are to be obtained.

0.2 The methods given in this International Standard require the source to be mounted in a reverberation test room having specified acoustical characteristics. The methods are then based on the premise that the sound power or sound energy of the source is directly proportional to the mean square sound pressure averaged in space and time and otherwise depends only on the acoustical and geometric properties of the room and on the physical constants of air.

For a source emitting sound in narrow bands of frequency or at discrete frequencies, a precise determination of the radiated sound power level or sound energy level in a reverberation test room requires greater effort than for a source emitting sound more evenly over a wide range of frequencies, because:

— the space/time averaged sound pressure along a short microphone path, or as determined with an array of a small number of microphones, is not always a good estimate of the space/time averaged mean-square pressure throughout the room;

— the sound power or sound energy radiated by the source is more strongly influenced by the normal modes of the room and by the position of the source within the room.

The increased measurement effort in the case of a source emitting narrow bands of sound or discrete tones consists of either the optimization and qualification of the test room and set-up or the use of a greater number of source locations and microphone positions (or increased path length for a moving microphone). The addition of low-frequency absorbers or the installation of rotating diffusers in the test room can help to reduce the measurement effort.

0.3 The methods given in this International Standard permit the determination of the sound power level and the sound energy level in one-third-octave frequency bands, from which octave band data and data with frequency weighting 'A' can be computed.

0.4 This International Standard describes methods giving a precision grade of accuracy (grade 1) as defined in ISO 12001. The resulting sound power levels and sound energy levels include corrections to allow for any differences that might exist between the meteorological conditions under which the tests are conducted and reference meteorological conditions. For applications in reverberant environments where reduced accuracy is acceptable, reference can be made to ISO 3743-1, ISO 3743-2 or ISO 3747.

0.5 This International Standard cancels and replaces ISO 3741:1999.

1) Under revision

Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Precision methods for reverberation test rooms

1 Scope

1.1 General

This International Standard specifies methods for determining the sound power level or sound energy level of a noise source from sound pressure levels measured in a reverberation test room, the requirements for which are stated, from that noise source (machinery or equipment) located in the room. The sound power level (or, in the case of noise bursts or transient noise emission, the sound energy level) produced by the noise source, in frequency bands of width one-third-octave, is calculated using those measurements, including corrections to allow for any differences between the meteorological conditions at the time and place of the test and those corresponding to a reference characteristic impedance. Measurement and calculation procedures are given for both a direct method and a comparison method of determining the sound power level and the sound energy level.

In general, the frequency range of interest includes the one-third-octave bands with midband frequencies from 100 Hz to 10 000 Hz. Guidelines for the application of the specified methods over an extended frequency range in respect to lower frequencies are given in Annex E. This international Standard is not applicable to frequency ranges above the 10 000 Hz one-third-octave band. For higher frequencies, the use of methods given in ISO 9295 is recommended.

1.2 Types of noise and noise sources

The methods specified in this International Standard are suitable for all types of noise (steady, non-steady, fluctuating, isolated bursts of sound energy, etc.) defined in ISO 12001.

The noise source under test may be a device, machine, component or sub-assembly. This International Standard is applicable to noise sources with a volume not greater than 2 % of the volume of the reverberation test room. For a source with a volume greater than 2 % of the volume of the test room, it might not be possible to achieve accuracy grade 1 in the results.

1.3 Reverberation test room

The test rooms that are applicable for measurements made in accordance with this International Standard are reverberation test rooms meeting specified requirements (see clause 5).

1.4 Measurement uncertainty

Information is given on the uncertainty of the sound power levels and sound energy levels determined in accordance with this International Standard, for measurements made in limited bands of frequency and for calculations from those measurements with frequency weighting A applied. The uncertainty conforms with that of the precision grade of accuracy (grade 1) defined in ISO 12001.

2 Normative references

The following referenced documents are indispensable for the application 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 3382, *Acoustics – Measurement of the reverberation time of rooms with reference to other acoustical parameters*

ISO 6926, *Acoustics – Requirements for the performance and calibration of reference sound sources for the determination of sound power levels*

ISO 7574-1, *Acoustics – Statistical methods for determining and verifying stated noise emission values of machinery and equipment – Part 1: General considerations and definitions*

ISO 12001, *Acoustics – Noise emitted by machinery and equipment – Rules for the drafting and presentation of a noise test code*

IEC 60942:2003, *Electroacoustics – Sound calibrators*

IEC 61183, *Electroacoustics – Random incidence and diffuse field calibration of sound level meters*

IEC 61260:1995, *Electroacoustics – Octave-band and fractional-octave-band filters*

IEC 61672-1:2002*, Electroacoustics – Sound level meters – Part 1: Specifications*

Guide to the expression of uncertainty in measurement (GUM). International Organization for Standardization, Geneva, Switzerland. ISBN 92-67-10188-9, First Edition 1993, corrected and reprinted 1995

3 Terms and definitions

For the purposes of this International Standard, the following definitions apply:

3.1
sound pressure
p
fluctuating pressure superimposed on the static pressure by the presence of sound, expressed in pascals

3.2
sound pressure level
L_p
ten times the logarithm to the base 10 of the ratio of the square of the sound pressure, p, to the square of a reference value, p_0, expressed in decibels

$$L_p = 10 \lg \frac{p^2}{p_0^2} \text{ dB} \qquad (1)$$

The reference value, p_0, is 20 μPa (2 x 10^{-5} Pa).

3.3
time-averaged sound pressure level
$L_{p,T}$
level of the time-averaged square of the sound pressure over the measurement time interval $T = t_2 - t_1$, expressed in decibels

$$L_{p,T} = 10\lg\left[\frac{1}{T}\int_{t_1}^{t_2}\frac{p^2(t)}{p_0^2}\mathrm{d}t\right] \quad (2)$$

NOTE 1 In general, the subscript "T" is omitted since time-averaged sound pressure levels are necessarily determined over a certain measurement time interval.

NOTE 2 Time-averaged sound pressure levels are often A-weighted, in which case they are denoted by $L_{pA,T}$, which is usually abbreviated to L_{pA}.

3.4
single-event sound pressure level
L_E
level of the time-integrated square of the sound pressure of an isolated single sound event (burst of sound or transient sound) of specified duration T (or specified measurement time interval $T = t_2 - t_1$ covering the single event) normalized to reference time interval T_0 = 1 s, expressed in decibels

$$L_E = 10\lg\left[\frac{1}{T_0}\int_{t_1}^{t_2}\frac{p^2(t)}{p_0^2}\mathrm{d}t\right]\mathrm{dB} = L_{p,T} + 10\lg\frac{T}{T_0}\ \mathrm{dB} \quad (3)$$

3.5
measurement time interval
T
portion or a multiple of an operational period or operational cycle of the noise source under test for which the time-averaged sound pressure level is determined, expressed in seconds

3.6
reverberation test room
test room meeting the requirements of this International Standard

3.7
reverberant sound field
that portion of the sound field in the test room over which the influence of sound received directly from the source is negligible

3.8
reverberation time
T_{rev}
time that would be required for the sound pressure level to decrease by 60 dB after a sound source in space has stopped instantaneously, expressed in seconds

NOTE The reverberation time is frequency dependent.

3.9
sound absorption coefficient
α
at a given frequency and for specified conditions, the relative fraction of sound power incident upon a surface which is not reflected

NOTE For use in this International Standard, sound absorption coefficients are calculated in accordance with ISO 354.

3.10
equivalent sound absorption area
A
product of the area and sound absorption coefficient of a surface, expressed in square metres

3.11
reference sound source
sound source meeting the requirements of ISO 6926

3.12
frequency range of interest
for general purposes, the range of one-third-octave bands with nominal midband frequencies from 100 Hz to 10 000 Hz

NOTE For special purposes, the range may be extended or reduced, provided that the test environment and instrumentation otherwise meet all requirements of this International Standard. The range may be extended downwards in frequency as far as the 50 Hz one-third-octave band (see Annex E), but may not be extended upwards beyond the 10 000 Hz band. For reduced frequency ranges, the report shall clearly state the reduced range and shall indicate that the reported results are in conformance with this International Standard over the reduced frequency range.

3.13
background noise
noise from all sources other than the noise source under test

NOTE Background noise may include contributions from airborne sound, noise from structure-borne vibration, and electrical noise in the instrumentation.

3.14
background noise correction
K_1
correction applied to the measured sound pressure levels in the reverberation test room to account for the influence of background noise, expressed in decibels

NOTE The background noise correction is frequency dependent; the correction in the case of a frequency band is denoted K_{1f}, where f denotes the relevant midband frequency.

3.15
sound power
W
rate per unit time at which airborne sound energy is radiated by a source, expressed in watts

3.16
sound power level
L_W
ten times the logarithm to the base 10 of the ratio of the sound power of a source W, to a reference value, W_0, expressed in decibels

$$L_W = 10 \lg \frac{W}{W_0} \text{ dB} \quad (4)$$

The reference value, W_0, is 1 pW (10^{-12} W).

NOTE The frequency weighting, or the midband frequency of the frequency band used, is indicated in the symbol. For example, the A-weighted sound power level is L_{WA}.

3.17
sound energy
J
energy of a single burst of sound or transient sound emitted by a source, expressed in joules

3.18
sound energy level
L_J
ten times the logarithm to the base 10 of the ratio of the sound energy of a source, J, to a reference value, J_0, expressed in decibels

$$L_J = 10 \lg \frac{J}{J_0} \text{ dB} \quad (5)$$

The reference value, J_0, is 1 pJ (10^{-12} J).

NOTE The frequency weighting, or the midband frequency of the frequency band used, is indicated in the symbol. For example, the A-weighted sound energy level is $L_{J\text{A}}$.

4 Reference meteorological conditions

Reference meteorological conditions for the purpose of calculating the sound power level and sound energy level, corresponding to a reference characteristic impedance of ρc = 411,5 Nsm^{-3} (where ρ is the density of air and c is the speed of sound) are:

— air temperature: 23,0 °C;

— barometric pressure: 1,01325 × 10^5 Pa;

— relative humidity: 50 %.

5 Reverberation test room

5.1 General

The reverberation test room shall be large enough and have a low enough total sound absorption to provide an adequate reverberant sound field for all frequency bands within the frequency range of interest. Guidelines for the design of rooms suitable for use in determining sound power levels and sound energy levels in accordance with this International Standard are given in Annex A. Guidelines for the design of rotating diffusing vanes in the room are given in Annex B.

5.2 Volume and shape of test room

The minimum volume of the room shall be as specified in Table 1. All test rooms should be qualified using Annex C. For test rooms with volumes less than the values shown in Table 1 for the frequency range of interest, or with a volume exceeding 300 m^3, the adequacy of the room for broadband measurements shall be demonstrated using the procedure of Annex C. A room qualification procedure for the measurement of discrete-frequency components is given in Annex D. Information is given in Annex E to assist in testing at frequencies below 100 Hz.

Table 1 — Minimum volume of the reverberation test room as a function of the lowest frequency band of interest

Lowest one-third-octave band frequency of interest Hz	Minimum volume of the reverberation test room m^3
100	200
125	150
160	100
200 and higher	70