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Acoustics-_— Determination of sound power levels of noise sources using sound pressure — Engineering methods for an essentially free field over a reflecting plane

<u>Acoustique — Détermination des niveaux de puissance acoustique émis par les sources de bruit à partir de la pression acoustique — Méthodes d'expertise pour des conditions approchant celles du champ libre sur plan réfléchissant</u>

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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 **specifieddescribed** in the ISO/IEC Directives, Part-1. In particular, the different approval criteria needed for the different types of ISO **documentsdocument** should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part-2 (see <u>www.iso.org/directives</u>).

Attention is drawnISO draws attention to the possibility that <u>some of</u> the <u>elementsimplementation</u> of this document may <u>beinvolve</u> the <u>subjectuse of (a) patent(s)</u>. 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. 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 <u>www.iso.org/iso/foreword.html</u>.

This document was prepared by Technical Committee ISO/TC 43, *Acoustics*, Subcommittee SC 1, *Noise*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 211, *Acoustics*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This fourth edition of <u>ISO 3744</u> cancels and replaces the third edition (<u>ISO 3744</u>;2010), which has been technically revised.

The main changes are as follows:

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- removed sound energy level determination due to lack of use and because it was highly duplicative of other text in the method,
- moved many of the special case measurement conditions and measurement parameters into Annexes to simplify the main body of the standard to focus on the basic sound power level determination method for typical sources and test environments,
- — removed absolute background noise criteria and replaced with new criteria for conformity with background noise requirements,

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 — removed the calculation estimation methods for K2, 		
 — instrumentation requirements revised to accommodate modern modular computerize instrumentation systems, 	l	
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removed and moved to JSO-26101-2,		Commented [eXtyles3]: ISO 26101-2: current stage is 50.00
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Introduction

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This document is one of the series ISO 3741 to ISO 3747^[2]-[2]to^[6][6] which specify various methods for determining the sound power levels of noise sources including machinery, equipment and their sub-assemblies. General guidelines to assist in the selection are provided in ISO 3740^[4]. The selection depends on the available test environment and on the precision of the sound power level values required. A noise test code can be established (see ISO 12001) for the individual noise source in order to select the appropriate sound measurement surface and microphone array from among those allowed in each member of the ISO 3741^[2] to ISO 3747^[6] to ISO 3747^[6] series, and to give requirements on test unit mounting, loading and operating conditions under which the sound power levels are to be obtained. The sound power emitted by a given source into the test environment is calculated from the mean square sound pressure that is measured over a hypothetical measurement surface enclosing the source, and the area of that surface.

The methods specified in this document permit the determination of the A-weighted sound power level and optionally the sound power level in octave or 1/3-octave frequency bands.

The main body of this document specifies test environment qualification criteria, testing procedures and the associated measurement uncertainties for basic compliance with the method. <u>Annex J Annex J</u> specifies additional requirements that may be applied by testing laboratories to reduce measurement uncertainty. For applications where even greater accuracy is required, reference can be made to <u>JSO 3745</u>, <u>JSO 3741</u>^[2]-or <u>ISO 9614</u>^{[9][10][11]}, If the relevant criteria for the measurement environment specified in this document are not met, it might be possible to refer to another standard from this series, or to <u>JSO 9614</u>^{[9][10][11]}, <u>JSO 9614</u>^{[10][11]}, <u>JSO 9614</u>^{[10][11]}, <u>JSO 9614</u>^{[10][11]}, <u>JSO </u>

This document specifies methods of accuracy grade 2 (engineering grade) as defined in <u>ISO 12001</u>, when the measurements are performed in a space that approximates an acoustically free field over a reflecting plane. Such an environment can be found in a specially designed room, or within industrial buildings or outdoors. Ideally, the test source should be mounted on a sound-reflecting plane located in a large open space. For sources normally installed on the floor of machine rooms, corrections are specified to account for undesired reflections from nearby objects, walls and ceiling, and for background noises.

This test method was originally issued as ISO 4872 in 1978. It was first released as ISO 3744 in 1994. A brief history of the technical requirements associated with the revisions of this test method follows.

ISO 3744:1994 required a test environment with a $K_{2f} \leq 2 \text{dB} K_{2f} \leq 2 \text{dB}$ in all frequency bands of interest and required measurements to be conducted in octave or one-third octave bands, with A-weighted levels being calculated from the band level data over the frequency range of interest.

ISO 3744:2010 relaxed the requirements on the test environment to require $K_{ZA} \le 4 \text{dB} K_{2A} \le 4 \text{dB}$ and allowed A-weighted levels to be determined either by calculation from frequency band level measurements or by direct measurement using an A-weighted filter. These changes to the requirements for the test environment and instrumentation were made to facilitate in-situ and field sound power level determinations using equipment without proportional octave band filtering for evaluation of compliance with regulatory requirements. Round robin studies were conducted to verify that the stated measurement uncertainties associated with the method could be maintained using these requirements^{[10],[10]}.

In addition, the 2010 revision added methods for sound energy level determination of short duration transient events, several special case sound power level determination conditions to the main body of the standard and several new measurement parameters.

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Acoustics-_— Determination of sound power levels of noise sourcesusing sound pressure-_— Engineering methods for an essentially free field over a reflecting plane

1 Scope

1.1 General

This document specifies methods for determining the sound power level of a noise source from sound pressure levels measured on a surface enveloping the noise source (machinery or equipment) in an environment that approximates to an acoustic free field near one or more reflecting planes. The sound power level produced by the noise source, in frequency bands or with A-weighting applied, is calculated using those measurements.

NOTE Differently shaped measurement surfaces can yield differing estimates of the sound power level of a givennoise source which are accounted for in the uncertainty associated with this test method, or a noise test code that refers to this method. An appropriately drafted noise test code (see <u>ISO 12001</u>) gives detailed information on the selection df the surface.

1.2 Types of noise and noise sources

The methods specified in this document are suitable for all types of noise (steady, non-steady, and fluctuating) as defined in ISO 12001, except for short duration, impulsive events.

This document is applicable to all types and sizes of noise source (e.g. stationary or slowly moving component or sub-assembly), provided that the conditions for the measurements can be met.

NOTE It is possible that the conditions for measurements given in this document are impracticable for very tall or very long sources such as chimneys, ducts, conveyors and multi-source industrial plants. A noise test code for the determination of noise emission of specific sources can provide alternative methods in such cases.

1.3 Test environment ds.iteh.ai/catalog/standards/iso/b59df3af-3d3c-4c76-a62

The test environments that are applicable for measurements made in accordance with this document can be located indoors or outdoors, with one or more sound-reflecting planes present on or near which the noise source under test is mounted. The ideal environment is a completely open space with no bounding or reflecting surfaces other than the reflecting plane(s) (such as that provided by a qualified hemi-anechoic chamber), but procedures are given for applying corrections (within limits that are specified) in the case of environments that are less than ideal. <u>Annex A Annex A or ISO 26101-21</u> specifies methods for determining the adequacy of the test environment and for determination of corrections to be applied to account for the effect of the test environment.

1.4 Measurement uncertainty

Information is given on the uncertainty of the sound power levels determined in accordance with this document, for measurements made in limited bands of frequency and with frequency A-weighting applied. Annex Annex I specifies procedures for testing laboratories that can be used to reduce measurement uncertainty. The uncertainty conforms to ISO 12001, accuracy grade 2 (engineering grade). General

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sound pressure		Adjust space between Asian text and numbers, Tab stops: Not at $0.7 \text{ cm} + 1.4 \text{ cm} + 2.1 \text{ cm} + 2.8 \text{ cm} +$
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difference between instantaneous total pressure and static pressure		Formatted
Note 1-to-entry:-Sound pressure is expressed in pascals.	•	Formatted: Regular Italic, Font: Bold, Not Italic
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where $\frac{p_{rms}}{p_{rms}}$ is the root-mean-square sound pressure $\frac{(3.1)(3.1)}{(3.1)}$ in the time domain and p_0 is the reference		Formatted
value for sound pressure		
t_2		Formatted
$\frac{p_{\rm rms}^2}{r} = \frac{1}{r} \int p^2(t) dt \qquad $		Commented [eXtyles21]: Not found: "IEC 61672-1"
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t_2		Formatted: Default Paragraph Font
$n^2 = \frac{1}{2} \int n^2(t) dt$		Formatted: Default Paragraph Font
$P_{\rm rms} = T \int_{L_{\star}} P(t) dt$		Formatted
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and $\frac{p_0 = 20 \mu Pa}{p_0} = 20 \mu Pa$ is the reference value of sound pressure $\frac{(3.1)}{(3.1)}$	- //	Formatted: Default Paragraph Font
Note 1- to-entry If specific frequency and time weightings as specified in IEC 616721 and/or specific frequency hand		Formatted: Default Paragraph Font
are applied, this is indicated by appropriate subscripts; e.g. $L_{pA}L_{pA}$ denotes the A-weighted sound pressure level.		Formatted: Default Paragraph Font
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[SOURCE: ISO 80000-8:2020, Table 1, 8-14, modified: deleted remarks and added instead Note		Formatted
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measurement time interval		
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Note 1-to-entry:- Measurement time interval is expressed in seconds.		Formatted: Font: 11 pt, Bold
3.4		Formatted: HeaderCentered, Space After: 0 pt, Line spacing: single
acoustic free field	$\langle \rangle$	Formatted: Adjust space between Latin and Asian text,
sound field in a homogeneous, isotropic medium free of boundaries Note 1- to- entry:- In practice, an acoustic free field is a field in which the influence of reflections at the boundaries or		Adjust space between Asian text and numbers, Tab stops: Not at 0.7 cm + 1.4 cm + 2.1 cm + 2.8 cm + 3.5 cm + 4.2 cm + 4.9 cm + 5.6 cm + 6.2 cm + 7 cm
other disturbing objects is negligible over the frequency range of interest.	\backslash	Formatted: Adjust space between Latin and Asian text,
3.5		
acoustic free field over a reflecting plane essentially <i>acoustic free field</i> (3.4)(3.4) over a reflecting plane in the absence of any other obstacles		Formattee: Adjust space between Latin and Asian text, Adjust space between Asian text and numbers, Tab stops: Not at $0.7 \text{ cm} + 1.4 \text{ cm} + 2.1 \text{ cm} + 2.8 \text{ cm} + 3.5 \text{ cm} + 4.2 \text{ cm} + 4.9 \text{ cm} + 5.6 \text{ cm} + 6.3 \text{ cm} + 7 \text{ cm}$
reflecting plane	```	Formatted: Adjust space between Latin and Asian text
sound reflecting planar surface on which the noise source under test is located		Adjust space between Asian text and numbers
3.7		
frequency range of interest		
<general purposes=""> frequency range of octave bands with nominal mid-band frequencies from 125 HZ to 8 000 Hz (including one-third octave bands with mid-band frequencies from 100 Hz to 10 000 Hz)</general>		Formatted: Adjust space between Latin and Asian text,
		Adjust space between Asian text and numbers, Tab
Note 1-to-entry:-For special purposes, the frequency range may be extended or reduced, provided that the test	/	stops: Not at 0.7 cm + 1.4 cm + 2.1 cm + 2.8 cm +
environment and instrument specifications are satisfactory for use over the modified frequency range. Changes to the frequency range of interest shall be included in the test report		
(https://standards.itah	/	Adjust space between Asian text and numbers
		Formatted: Line spacing: At least 11 pt. Adjust space
reference box hypothetical right narallelenined terminating on the <i>reflecting plane(s)</i> (2.6)(3.6) on which the poise source	1	between Latin and Asian text, Adjust space between
under test is located, that just encloses the source including all the significant sound radiating components		Asian text and numbers, Tab stops: Not at 0.7 cm +
and any test table on which the source is mounted		1.4 cm + 2.1 cm + 2.8 cm + 3.5 cm + 4.2 cm + 4.9 cm + 5.6 cm + 6.3 cm + 7 cm
Note 1 to entry. If required the smallest possible test table may be used for compatibility with emission sound pressure		Formatted: Default Paragraph Font
measurements at bystander positions in accordance with, for example, JSO 11201 [42].		Formatted: Default Paragraph Font
https://standards.iteh.ai/catalog/standards/iso/b59df3af-3d3c-4c76-a62f-	fda(Formatted: Adjust space between Latin and Asian text
3.9 characteristic source dimension	-	Adjust space between Asian text and numbers
d_{ρ}		Formatted: Regular Italic, Font: Bold, Not Italic
distance from the origin of the co-ordinate coordinate system to the farthest corner of the reference box		Formatted: Regular Sub, Font: Bold, Not Superscript/
(3.8) (3.8)		Subscript
Note 1-to-entry:-Characteristic source dimension is expressed in metres.	-	Formatted: Adjust space between Latin and Asian text,
		Adjust space between Asian text and numbers, lab stops: Not at $0.7 \text{ cm} + 1.4 \text{ cm} + 2.1 \text{ cm} + 2.8 \text{ cm} +$
3.10 maacurament distance		3.5 cm + 4.2 cm + 4.9 cm + 5.6 cm + 6.3 cm + 7 cm
d		Formatted
distance from the reference box (3.8)(3.8) to a parallelepiped measurement surface or to a cylindrical	-	Formatted: Regular Italic, Font: Bold, Not Italic
measurement surface		Formatted
Note 1-to-entry- Measurement distance is expressed in metres.		Formatted
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