## ISO/FDIS-9612:2023(E)

ISO-<u>/TC-43/SC-1<del>/WG 67</del></u> Secretariat:-<u>DIN</u>

Date: 2023-10-31x

## Acoustics — Determination of occupational noise exposure\_\_\_ Methodology

<u> Acoustique — Détermination de l'exposition au bruit en milieu de travail — Méthodologie</u>

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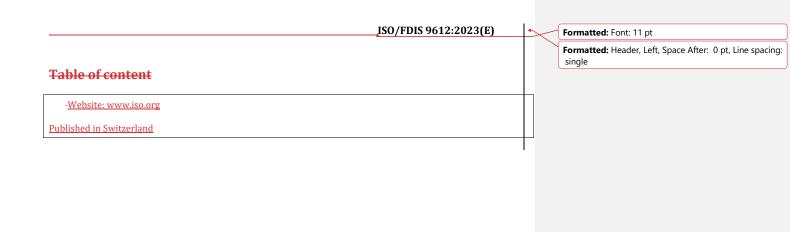
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Collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 211, <i>Acoustics</i> , in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement). This second edition cancels and replaces the first edition (ISO 9612;2009), which has been technically revised.	Formatted: Default Paragraph Font Formatted: Default Paragraph Font
The main changes are as follows:	Formatted: Default Paragraph Font
<ul> <li>— A reshaping of the guidance on measurement of L<sub>p,A,eqTm</sub> L<sub>p,A,eqTm</sub> for the task based strategy</li></ul>	<b>Formatted:</b> Adjust space between Latin and Asian text, 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 + 6.3 cm + 7 cm
<ul> <li>— The addition of Homogenous noise Exposure Groups (HEG) sampling requirements for the full day measurement strategy and the addition of criteria to validate sampling (11.3). (11.3).</li> </ul>	
<ul> <li>— Some precisions and clarifications on the instrumentation section.</li> </ul>	
— Some additions to the test report section: number of peak events, $L_{EX,Bh,95\%}$ , $L_{EX,Bh,95\%}$ .	
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— — The addition of <u>C.7C.7</u> in <u>Annex C, Annex C</u> , which gives the formulae to calculate the measurement uncertainty when multiple nominal days are used. <u>An Annex H</u> An <u>Annex H</u> is also introduced to clarify uncertainty of peak measurements. Formatted: Header, Left, Space After: 0 pt, Line spacing: single
<ul> <li>— — The introduction of a new informative Annex G: Example calculation of daily noise exposure level for flexible workers. Annex G.</li> </ul>
— — The introduction of a new informative Annex H: Uncertainty calculation for peak levels. Annex H.
— A full revision of the Excel calculation file attached to this document.
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.

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## Introduction

This document provides a stepwise approach to the determination of occupational noise exposure from noise level measurements. The procedure contains the following major steps: work analysis, selection of measurement strategy, measurements, error handling and uncertainty evaluations, calculations, and presentation of results. This document specifies three different measurement strategies: task-based measurement; job-based measurement; and full-day measurement. This document gives guidance on selecting an appropriate measurement strategy for a particular work situation and purpose of investigation. This document also provides an informative spreadsheet to allow calculation of measurement results and uncertainties. ISO is not responsible for errors that shall arise or occur with the use of this spreadsheet.

This document recognizes the use of hand-held sound level meters as well as personal sound exposure meters. The methods specified optimize the effort required for obtaining a given accuracy.

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## Acoustics — Determination of occupational noise exposuremethodology — Methodology

#### 1 Scope

This document specifies a method for measuring workers' exposure to noise in a working environment and calculating the noise exposure level. This document deals with A-weighted levels but is applicable also to C-weighted levels. Three different strategies for measurement are specified. The method is applicable for detailed noise exposure studies or epidemiological studies of hearing damage or other adverse effects.

The measuring process requires observation and analysis of the noise exposure conditions so that the quality of the measurements can be controlled. This document provides methods for estimating the uncertainty of the results.

This document is not intended for assessment of masking of oral communication or assessment df infrasound, ultrasound and non-auditory effects of noise. It does not apply to the measurement of the noise exposure of the ear when hearing protectors are worn.

Results of the measurements performed in accordance with this document can provide useful information when defining priorities for noise control measures.

#### 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.

<std>ISO 1999, Acoustics Estimation of noise-induced hearing loss</std>

<std>ISO/IEC Guide 98-ISO 1999, Acoustics — Estimation of noise-induced hearing loss

ISO/IEC Guide 98-3, Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)-</

<std>IEC 60942, *Electroacoustics — Sound calibrators*</std>

<std>IEC 60942, Electroacoustics — Sound calibrators

IEC 61252, Electroacoustics — Specifications for personal sound exposure meters </std>

<std>IEC\_61672-\_1, Electroacoustics — Sound level meters — Part 1: Specifications</std>

#### 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminologicalterminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at <u>https://www.iso.org/obp</u>https://www.iso.org/obp

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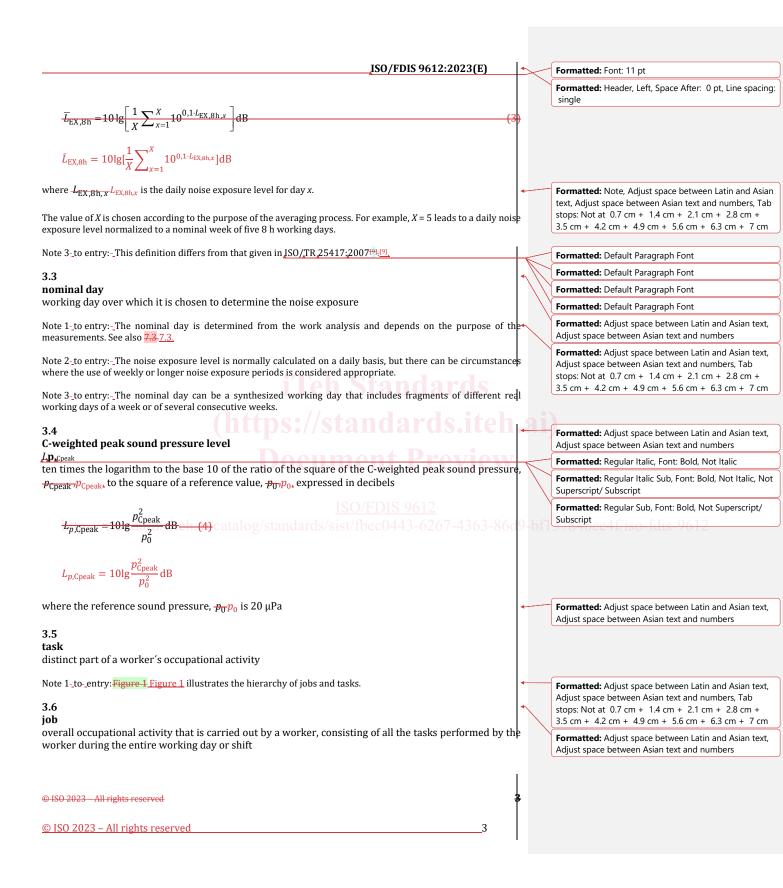
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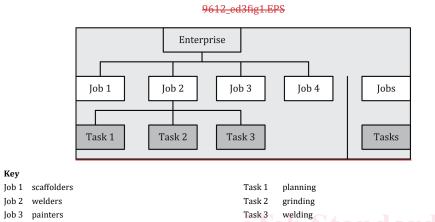
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## ISO/FDIS 9612:2023(E)

Note 1-to entry:-A worker often has a job title that describes his or her job, sometimes complemented with anadditional description to ensure clear identification, e.g. "welder - process line A".

Note 2-to entry: Figure 1 Figure 1 illustrates the hierarchy of jobs and tasks.



Job 4 store keepers

Key

Figure 1- — An example illustrating the hierarchy of jobs and tasks (nups://stanuards

### 4 Symbols

Symbol	Description	Unit	
Ci	sensitivity coefficient related to each input quantity		
C1_	sensitivity coefficient associated with job noise level sampling DIS 9612		
C1a,m	sensitivity coefficient associated with noise level sampling of task $m$ 43-6267-436	3-860	1
<b>C</b> 1b,m	sensitivity coefficient associated with estimation of duration of task m		
C2	sensitivity coefficient associated with measurement instrumentation		
C3	sensitivity coefficient associated with microphone position		
i	task sample number		
I	total number of task samples		
j,	number of observations of task duration		
J	total number of observations of task duration		
k	coverage factor related to a confidence interval		
K <sub>N</sub>	denominator as given in <del>C.3.3, C.3.3,</del> Note 2		
L <sub>EX,8h</sub>	A-weighted noise exposure level normalized to a nominal 8 h working day	dB	
$\overline{L}_{\rm EX,8h}$ $\overline{L}_{\rm EX,8h}$	A-weighted noise exposure level normalized to a nominal 8 h working day averaged over a number of days	dB	

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ISO/FDIS 9612:2023(E)       Formatted         Symbol       Description       Unit         Lax,8h,95 %       A-weighted noise exposure level including its associated uncertainty - 95 % level of confidence       dB       Formatted          NOTE       Statistically, assuming a normal distribution of the noise exposure, 95 % of the workers are exposed at or below this level       G       Formatted          Lex,8h,m       A-weighted equivalent continuous sound pressure level of task <i>m</i> contributing to the daily noise exposure       dB       Formatted          Lp,A.eqT_m       A-weighted equivalent continuous sound pressure level of task <i>m</i> dB       Formatted					ſ		
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The formation of the working day     h     Formatted	T	time period over which an average is taken	h	1/		Formatted	
$F_e T_{e_a}$ enective duration of the working day       n       n $T_m T_m$ duration of task m       h       Formatted $T_m T_m$ duration of sample <i>j</i> of task m       h       Formatted $T_m T_n$ duration of sample <i>n</i> (job or full-day approaches)       h       Formatted $U_{a}$ expanded uncertainty       dB       Formatted          U       expanded uncertainty       dB       Formatted          ISO 2023 - All rights reserved       5       Formatted          Formatted        Formatted<	$-T_0 T_0$	reference duration; $T_{0}T_{0} = 8 \text{ h}$	h	- 1	X		
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Symbol	Description	Unit	
u,	combined standard uncertainty	dB	•>
<del>u<sub>i</sub></del> u <sub>i</sub>	standard uncertainty of each input quantity	dB	
<u><i>u</i></u> <sub>T</sub> <i>u</i> <sub>1</sub>	standard uncertainty of the energy average of a number of measurements of A- weighted equivalent continuous sound pressure level	dB	
$-u_{1a,m}u_{1a,m}$	standard uncertainty due to noise level sampling of task <i>m</i>	dB	
$u_{1b,m}u_{1b,m}$	standard uncertainty due to the estimation of duration of task $m_{\rm A}$	h	
$\frac{u_2}{u_2}u_2$	standard uncertainty due to the instrumentation	dB	5
$u_{2,m}u_{2,m}$	standard uncertainty due to the instrumentation in the task method	dB	
<del>-u<sub>3</sub>-u<sub>3</sub></del>	standard uncertainty due to microphone position	dB	
ŪŪ	expanded uncertainty for multiple nominal days	dB	
X	day number for multiple nominal days		FW
X	total number of days for multiple nominal days		H

### **5** Instrumentation

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## 5.1 Sound level meters and personal sound exposure meters

Measurements can be made by using either integrating-averaging sound level meters or personal sound exposure meters.

Sound level meters, including the microphone and associated cables, shall meet the requirements for JEC 61672-1, class 1 or class 2 instrumentation. Class 1 instrumentation is preferred and should be used when measuring at very low temperatures or when the noise is dominated by high frequencies (see also NOTES 2 and 4).

Personal sound exposure meters, including the microphone and cable, shall meet the requirements specified in IEC 61252 Personal sound exposure meters also fulfilling the requirements of IEC 61672-1, class 1, are recommended when measuring at very low temperatures or when the noise is dominated by high frequencies (see also NOTES 2 and 4).

NOTE 1 Personal sound exposure meter is often referred to as "noise dose meter" or "noise dosimeter".

NOTE 2 For JEC 61672-1, class 1 instruments, the specified tolerance limits are applied for the temperature range from -10 °C to +50 °C. For instrumentation in accordance with JEC 61672-1, class 2, and for personal sound exposure meters in accordance with JEC 61252, the influence of variations in the air temperature on the measured signal level is specified over the range from 0 °C to +40 °C. In order to maintain accuracy when performing measurements outside this temperature range, it can be necessary to use an instrument for which the manufacturer specifies compliance for a wider temperature range. Alternatively, a sound level meter in accordance with JEC 61672-1 class 1, can be selected. In cold conditions, the measuring instrument can be kept warm, e.g. under clothing, such that only the microphone is exposed to low temperatures.

NOTE 3 The choice of the instrumentation influences the uncertainty of the measurements.

NOTE 4 For personal sound exposure meters, IEC 61252 allows wide tolerances in the frequency characteristics above 4 000 Hz, which can lead to incorrect measurement of high frequency sound such as that from air nozzles. In order to reduce the uncertainty when measuring noise dominated by high frequencies, it can be necessary to use a measuring instrument for which the manufacturer specifies high frequency characteristics within a narrower tolerance range. Alternatively, a sound level meter specified in accordance with JEC 61672-1 class 1 or 2, can be

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