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Acoustics — Recommended practice for the design of low-noise workplaces containing machinery —

Part 1:
Noise control strategies

Acoustique — Pratique recommandée pour la conception de lieux de travail à bruit réduit contenant des machines —

Partie 1: Stratégies de réduction du bruit

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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

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. 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 www.iso.org/iso/foreword.html.

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 second edition cancels and replaces the first edition (ISO 11690-1:1996), of which it constitutes a minor revision. The changes compared to the previous edition are editorial.

A list of all parts in the ISO 11690 series can be found on the ISO website.

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.

Introduction

Several standards specify methods for measurement and/or evaluation of noise. The final objective of the ISO 11690 series is noise reduction.

A number of noise control measures are offered. However, in order to be effective, the most appropriate noise control measure(s) should be chosen for a given situation.

It is important when non-acoustic engineers are involved in noise control practice for these engineers to have a basic knowledge of noise emission and propagation characteristics and to understand the basic principles of noise control.

To assist in the development of noise control in the workplace, it is essential that the information contained in these recommended practices is disseminated through International Standards.

In order to reduce noise as a hazard in the workplace, individual countries have produced national legislation. Generally, such national legislation requires noise control measures to be carried out in order to achieve the lowest reasonable levels of noise emission, noise immission and noise exposure, taking into account:

— known available measures;

— the state of the art regarding technical progress;

— the treatment of noise at source;

— appropriate planning, procurement and installation of machines and equipment.

This part of ISO 11690, together with the two other parts in the series, outlines procedures to be considered when dealing with noise control at workplaces, within workrooms and in the open. These recommended practices give in relatively simple terms the basic information necessary for all parties involved in noise control in workplaces and in the design of low-noise workplaces to promote the understanding of the desired noise control requirements.

The purpose of the ISO 11690 series is to bridge the gap between existing literature on noise control and the practical implementation of noise control measures. In principle, the series applies to all workplaces and its main function is:

— to provide simple, brief information on some aspects of noise control in workplaces;

— to act as a guide to help in the understanding of requirements in standards, directives, text books, manuals, reports and other specialized technical documents;

— to provide assistance in decision making when assessing the various measures available.

The ISO 11690 series should be useful to persons such as plant personnel, health and safety officers, engineers, managers, staff in planning and purchasing departments, architects and suppliers of plants, machines and equipment. However, the above-mentioned parties should keep in mind that adherence to the recommendations of the ISO 11690 series is not all that is necessary to create a safe workplace.

The effects of noise on health, well-being and human activity are many. By giving guidelines for noise control strategies and measures, the ISO 11690 series aims at a reduction of the impact of noise on human beings at workplaces. Assessment of the impact of noise on human beings is dealt with in other documents.

Acoustics — Recommended practice for the design of low-noise workplaces containing machinery —

Part 1:
Noise control strategies

1 Scope

This document outlines strategies to be used in dealing with noise problems in existing and planned workplaces by describing basic concepts in noise control (noise reduction, noise emission, noise immission and noise exposure). It is applicable to all types of workplaces and all types of sources of sound which are met in workplaces, including human activities.

It includes those important strategies to adopt when buying a new machine or equipment.

This document deals only with audible sound.

2 Normative references

The following documents are referred to in the text in such 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.

ISO 4871, *Acoustics — Declaration and verification of noise emission values of machinery and equipment*

3 Terms and definitions

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

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

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

— IEC Electropedia: available at http://www.electropedia.org/

3.1 General noise descriptors

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 p, in pascals, to the square of a reference value, p_0

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

where the reference value, p_0, is 20 µPa

Note 1 to entry: The sound pressure level is the main quantity to describe the noise at a given point. It is expressed in decibels and shoud be measured with a standardized sound level meter (see IEC 61672-1).

Note 2 to entry: The frequency weighting (A or C) or the width of the frequency band and the time weighting (S [slow], F [fast], I [impulse] or peak) used should be indicated.

Note 3 to entry: For example, the C-weighted sound pressure level with time weighting peak is $L_{pC,peak}$.

Note 4 to entry: The notation L_p is used whether the sound pressure level refers to emission (see 3.2), immission or exposure (see 3.3).

3.1.2
equivalent continuous sound pressure level
$L_{peq,T}$
sound pressure level of a continuous steady sound that within a measurement time interval, T, has the same mean square sound pressure as a sound under consideration which varies with time, and is the level of the mean square sound pressure over a time interval

$$L_{peq,T} = 10 \lg \left[\frac{1}{T} \int_0^T 10^{0,1 L_p(t)} \, dt \right] \quad \text{dB}$$

Note 1 to entry: Equivalent continuous sound pressure level is expressed in decibels.

Note 2 to entry: The equivalent continuous sound pressure level is the main quantity to assess the immission at work stations and the exposure of persons.

Note 3 to entry: When immission or exposure is considered, impulse and tone adjustments, DL_I and DL_T, in decibels, may be used to take into account the influence of impulsive and tonal components ($L_{pA,eq,T}$ + DL_I + DL_T) (see ISO 1996-1, ISO 1996-2 and ISO 1999).

Note 4 to entry: Subscript "eq,T" is often omitted because in all cases considered in this document the sound pressure is determined over a certain measurement time interval (see IEC 61672-1).

3.1.3
work station
position, in the vicinity of a machine, which can be occupied by the operator or a position where a task is carried out

3.2 Noise emission descriptors

3.2.1
noise emission
airborne sound radiated into the environment from a defined source (machine or equipment) [see Figure 1 a)]

3.2.2
sound power level
L_W
ten times the logarithm to the base 10 of the ratio of the sound power P, in watts, radiated by the sound source under test to the reference sound power P_0 = 1 pW

Note 1 to entry: Sound power level is expressed in decibels and is a descriptor of the emission of a sound source (see the ISO 3740 and ISO 9614 series). The frequency weighting or the width of the frequency band used should be indicated.

Note 2 to entry: For example, the A-weighted sound power level is L_{WA}.

3.2.3
emission sound pressure level
L_p
sound pressure level caused by a sound source under test at its work station or at any other specified position

Note 1 to entry: Emission sound pressure level is expressed in decibels (dB) and is an additional descriptor of the emission of a sound source (see ISO 11200 to ISO 11204).

Note 2 to entry: The frequency weighting and/or the time weighting or the width of the frequency band used shall be indicated.

Note 3 to entry: For example, the C-weighted peak emission sound pressure level is $L_{pC,peak}$.

Note 4 to entry: The A-weighted emission sound pressure level is often averaged over an operational period of a sound source; it is denoted L_{pA}.

3.2.4
surface sound pressure level
$L_{pA,d}$
A-weighted sound pressure level averaged on an energy basis over a measurement surface at a distance *d* from the sound source

Note 1 to entry: When $d = 1$ m, it is usually noted $L_{pA,1m}$.

3.2.5
measured noise emission value
L
any of the A-weighted sound power level, the A-weighted time-averaged emission sound pressure level, or the C-weighted peak emission sound pressure level, determined from measurements

Note 1 to entry: Measured values may be determined either for a single machine or from the average of a number of machines.

Note 2 to entry: Measured noise emission value is expressed in decibels and is not rounded.

3.2.6
noise emission declaration
information on the noise emitted by the machine, given by the manufacturer or the supplier in technical documents or other literature, concerning noise emission values

Note 1 to entry: The noise emission declaration may take the form of either the declared single-number noise emission value or the declared dual-number noise emission value.

3.2.7
uncertainty
K
value of the measurement uncertainty associated with a measured noise emission value

Note 1 to entry: Uncertainty is expressed in decibels and is not rounded.

3.2.8
declared single-number noise emission value
L_d
sum of a measured noise emission value, *L*, and the associated uncertainty, *K*, rounded to the nearest decibel (dB)

$$L_d = L + K$$

3.2.9
declared dual-number noise emission value
L and *K*
measured noise emission value, *L*, and its associated uncertainty, *K*, both rounded to the nearest decibel

3.3 Noise immission and noise exposure

3.3.1
noise immission at a work station
all noises that arrive, whether or not a worker is present, over a specific time period *T*, at a measuring point (work station) in the actual situation; i.e. noise coming from the machine, noise coming from the other sound sources and noise reflected by the ceiling, the walls and any fittings [see Figure 1 b)]

Note 1 to entry: *T* can be the duration of a measurement, an operating cycle of a machine, a process, the duration a worker is usually present at or near the measurement point, or the duration of the workshift.

3.3.2
noise exposure of a person
all noises that arrive, over a specific time period *T*, at a person's ear in the actual situation [see Figure 1 c) and Figure 2]

3.3.3
noise immission and noise exposure descriptors
equivalent continuous A-weighted sound pressure level normalized to a nominal working day, L_{pA,eq,T_0} in decibels

$$L_{pA,eq,T_0} = L_{pA,eq,T_e} + 10\lg\left(T_e / T_0\right) \quad \text{dB}$$

where T_0 is the reference duration (e.g. 8 h) and T_e is the duration of the workshift

Note 1 to entry: Immission is measured at the work station. Exposure is measured at the ear of the person.

Note 2 to entry: L_{pA,eq,T_0} can result from the energetic summation of immission or exposure values, L_{pA,eq,T_i}, measured over individual time periods T_i, with $\sum T_i = T_e$.

Note 3 to entry: In some countries, a rating level $L_{pA,r}$ is used:

$$L_{pA,r} = L_{pA,eq,T_0} + \mathrm{DL_I} + \mathrm{DL_T} \ \text{dB}$$

where $\mathrm{DL_I}$ and $\mathrm{DL_T}$ describe impulsive and tonal components.

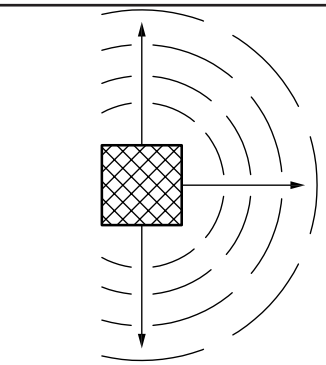
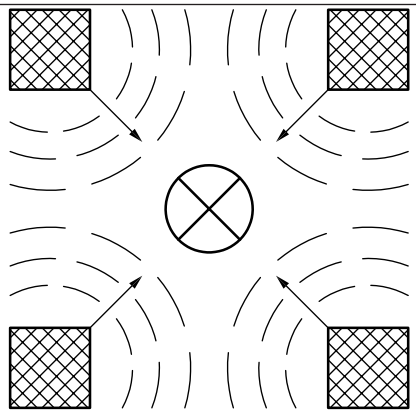
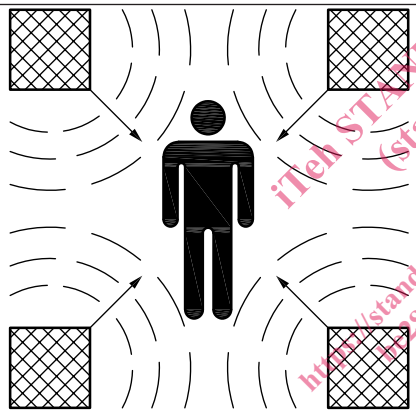
	a) Noise emission; sound radiation of a machine: — machine related — specified operating conditions — independent of environment
	b) Noise immission: sound impact at the work station: — work station related — real operation — dependendent on immission time — contribution from all sound sources
	c) Noise exposure; sound impact on human beings: — person related [at one or several work stations or for a person moving around (see Figure 2)] — real operation — dependent on exposure time — contribution from all sound sources

Figure 1 — Illustration of the difference between noise emission, noise immission and noise exposure (see also Figure 2)

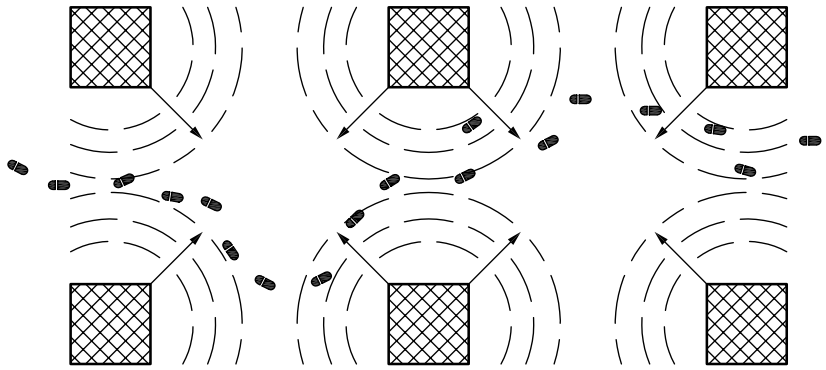


Figure 2 — Illustration of noise exposure for a person moving around