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Acoustics — Noise from shooting ranges —

Part 4: Calculation of projectile sound

Acoustique — Bruit des stands de tir —

Partie 4: Calcul du bruit du projectile

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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 document 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).

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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 17201-4:2006), which has been technically revised.

The main changes are as follows:

— restructure of the document into new clauses: Projectile sound, Source description, Sound exposure level at the receiver, and Uncertainty;

— separation of source and propagation terms;

— inclusion (from ISO 17201-2) and update of the source level for non-streamlined projectiles;

— expansion of the Clause on uncertainty;

— addition of Annex B on ballistic trajectories;

— addition of Annex C on projectile velocity change;

— addition of Annex D with informative examples.

A list of all parts in the ISO 17201 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.

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Introduction

Shooting sound registered around shooting ranges consists in general of three components: muzzle blast sound, impact sound and projectile sound. This document deals solely with the projectile sound from supersonic projectiles. It specifies a method for calculating the source sound exposure level of projectile sound. It also provides a method for calculating the propagation of projectile sound, accounting for its distinct characteristics that set it apart from the propagation of sound originating from other sources.

This document is intended for calibres of less than 20 mm but can also be used for larger calibres.

Projectile sound is described as originating from a specific point on the projectile trajectory, the "source point."

The source sound exposure level is calculated from the geometric properties and the speed of the projectile along its trajectory. Methods are given on how the sound exposure level at a receiver location is to be calculated from this source sound exposure level, taking into account geometrical attenuation, atmospheric absorption and attenuation and frequency shift due to non-linear effects. In addition, the effects on the sound exposure level due to the decrease of the projectile speed and atmospheric turbulence are taken into account.

In a restricted region, the Mach region (region II – see 4.2), the projectile sound exposure level is significant compared to the muzzle blast sound exposure level. Outside this region only diffracted or scattered projectile sound is received, with considerably lower levels than in this Mach region. Projectile sound behind the Mach region (region I) is negligible compared to muzzle sound, except for contributions due to reflections from other regions. In this document, a computational scheme for the levels in regions II and III is provided. The levels in region III are typically 10 dB to 15 dB lower than those in region II.

Two computational methods are given to be able to calculate the projectile sound for streamlined and non-streamlined projectiles such as pellets. Default values of parameters used in this document are given for a temperature of 10 °C, 80 % relative humidity, and a pressure of 1 013 hPa. Annex A can be used for calculations for other atmospheric conditions. For calibres < 20 mm, the source spectrum is dominated by high frequency components. As air absorption is rather high for these frequency components, calculations are performed in one-third octave bands, in order to obtain more accurate results.

For projectiles with a speed just above the speed of sound the computational methods are less accurate. Guidance is given how to deal with this increased uncertainty.

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Acoustics — Noise from shooting ranges —

Part 4: Calculation of projectile sound

1 Scope

This document specifies computational methods for determining the acoustical source level of projectile sound and its one-third octave band spectrum, expressed as the sound exposure level for nominal mid-band frequencies from 12,5 Hz to 10 kHz. It also specifies a method on how to use this source level to calculate the sound exposure level at a receiver position.

Results obtained with this document can be used as a basis for assessment of projectile sound from shooting ranges. Additionally, the data can be used to determine sound emission or immission from different types of ammunition and weapons. The prediction methods are applicable to outdoor conditions and straight projectile trajectories. Two computational methods are given to determine the acoustical source level: one for streamlined projectile shapes and one for non-streamlined shapes, such as pellets.

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.

ISO 80000-8, *Quantities and units — Part 8: Acoustics*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 80000-8 and the following apply.

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

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

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

3.1
streamlined projectile
projectile that has a shape that can be described as a body of revolution of which the first derivative of the cross-sectional area $A(x)$ at a distance x behind the nose of the body is continuous for $0 < x < l_p$

Note 1 to entry: For the definition of effective projectile length, l_p, see 3.3.

3.2
non-streamlined projectile
projectiles that have a body different from *streamlined projectiles* (3.1)

Note 1 to entry: These can be multi part projectiles, such as shotgun pellets, or single part projectiles with a non-streamlined form, such as shotguns slugs (see Figure 1).

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