SWEDISH STANDARDS INSTITUTE

SVENSK STANDARD
SS-EN ISO 17201-2:2006

Fastställd 2006-07-21

Utgåva 1

Akustik – Buller från skjutbanor –
Del 2: Bestämning av mynningsljud och bogvågsknall medelst beräkning
(ISO 17201-2:2006)

Acoustics – Noise from shooting ranges –
Part 2: Estimation of muzzle blast and projectile sound by calculation (ISO/FDIS 17201-2:2006)
(ISO 17201-2:2006)

ICS 17.140.20; 95.020; 97.220.10

Språk: engelska

Publicerad: september 2006

Europastandarden EN ISO 17201-2:2006 gäller som svensk standard. Detta dokument innehåller den officiella engelska versionen av EN ISO 17201-2:2006.

The European Standard EN ISO 17201-2:2006 has the status of a Swedish Standard. This document contains the official English version of EN ISO 17201-2:2006.

Upplysningar om **sakinnehållet** i standarden lämnas av SIS, Swedish Standards Institute,
telefon 08 - 555 520 00.

Standarder kan beställas hos SIS Förlag AB som även lämnar **allmänna upplysningar** om svensk och utländsk standard.
Postadress: SIS Förlag AB, 118 80 STOCKHOLM
Telefon: 08 - 555 523 10. *Telefax*: 08 - 555 523 11
E-post: sis.sales@sis.se. *Internet*: www.sis.se

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN ISO 17201-2

July 2006

ICS 97.220.10; 95.020; 17.140.20

English Version

Acoustics - Noise from shooting ranges - Part 2: Estimation of muzzle blast and projectile sound by calculation (ISO 17201-2:2006)

Acoustique - Bruit des stands de tir - Partie 2: Estimation de la détonation à la bouche et du bruit du projectile par calcul (ISO 17201-2:2006)

Akustik - Geräusche von Schießplätzen - Teil 2: Bestimmung des Mündungsknalls und des Geschossgeräusches durch Berechnung (ISO 17201-2:2006)

This European Standard was approved by CEN on 5 June 2006.

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. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

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

Management Centre: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN ISO 17201-2:2006: E

Contents

Page

Foreword

This document (EN ISO 17201-2:2006) 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 European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by January 2007, and conflicting national standards shall be withdrawn at the latest by January 2007.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Endorsement notice

The text of ISO 17201-2:2006 has been approved by CEN as EN ISO 17201-2:2006 without any modifications.

Introduction

Two basic sources dominate the shooting sound from firearms: the muzzle blast and the projectile sound. These two sources are basically different. The explosion blast from devices can be treated as muzzle blast.

The muzzle blast is caused by the expanding gases of the propellant at the muzzle. The muzzle blast can be modelled based on essentially less spherical volume of these gases at that moment when the expansion speed becomes subsonic.

The projectile sound is caused by the supersonic flight of the projectile along the trajectory from the muzzle to the target or to a point on the trajectory where the projectile speed becomes subsonic. The projectile sound stems from a section of the trajectory that coherently radiates a shock wave into a certain direction.

In general, the procedures for estimating the source energy depends on the estimation of energies that are involved in related processes. The procedures give estimates for the fraction of these energies that transforms into acoustic energy. The result of the estimation is a set of acoustical source data with respect to energy, direction and frequency content.

Acoustics — Noise from shooting ranges —

Part 2:
Estimation of muzzle blast and projectile sound by calculation

1 Scope

This part of ISO 17201 specifies methods for estimating the acoustic source data of muzzle blast and explosions and the source data of projectile sound on the basis of non-acoustic data for firearms with calibres less than 20 mm and explosions less than 50 g TNT equivalent.

This part of ISO 17201 addresses those cases where no source measurements exist or where the data necessary to calculate projectile sound according to ISO 17201-4 are unknown. An example of this situation would be measuring projectile sound from shot guns pellets. This part of ISO 17201 can also be used as an interpolation method between measurements of muzzle blast.

Source data are given in terms of spectral angular source energy covering the frequency range from 12,5 Hz to 10 kHz and can be used as data input for sound propagation calculation.

This part of ISO 17201 is not applicable to the prediction of sound levels for the assessment of hearing damage and cannot be used to predict sound pressure levels or sound exposure levels below a specific distance where linear acoustics does not apply.

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 17201-1:2005, *Acoustics — Noise from shooting ranges — Part 1: Determination of muzzle blast by measurement*

ISO 17201-4, *Acoustics — Noise from shooting ranges — Part 4: Prediction of projectile sound*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 17201-1 and the following apply.

3.1 General

3.1.1
air density
ρ
density of air for the estimation conditions

NOTE The air density is expressed in kilograms per cubic metre (kg/m^3).

3.1.2
angular frequency
ω
frequency multiplied by 2π

NOTE The angular frequency is expressed in radians per second (rad/s) in all formulae.

3.1.3
coordinate system (x, y)
plane coordinate system describing geometry, where the x-axis denotes the line of fire with x = 0 at the muzzle, and the y-axis measures the perpendicular distance from the line of fire in any plane around the line of fire

NOTE 1 The sound field of projectile sound is rotational symmetric around the line of fire.

NOTE 2 The coordinates are given in metres (m).

3.1.4
cosine-coefficients
$c_{1,2\ldots N}$
coefficients of the cosine-transform used to describe the directivity of the angular source energy

3.1.5
deceleration angle
ε
difference between the radiation angle at the beginning and end of a part of the trajectory

NOTE The deceleration angle is expressed in radians (rad) in all formulae.

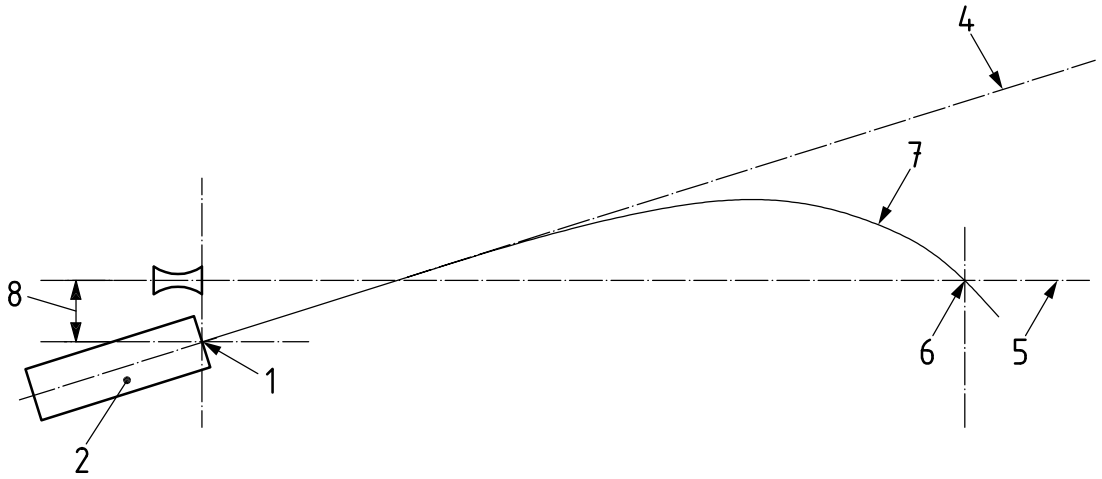
3.1.6
specific chemical energy
u
specific chemical energy content of the propellant

NOTE The specific chemical energy is usually expressed in joules per kilogram (J/kg)

3.1.7
line of fire
continuation of the axis of the barrel

See Figure 1.

NOTE Ballistic trajectories can be described as a sequence of straight lines. Then the methods apply to each segment. Corrections of the aiming device are ignored.



a) Side or elevation view

b) Top or plan view

Key

1 muzzle
2 barrel
3 sight
4 line of fire
5 line of sight
6 target
7 trajectory
8 height of sight

Figure 1 — Line of fire and line of sight

3.1.8
projectile sound source energy
Q_p
acoustic energy from a trajectory length of one metre

NOTE 1 The projectile sound source energy is expressed in joules (J).

NOTE 2 See also 3.3.6.

3.1.9
propellant mass
m_c
mass of the propellant

NOTE The propellant mass is expressed in kilograms (kg).

3.1.10
radiation angle
ξ
angle between the line of fire and the wave number vector describing the local direction of the propagation of the projectile sound

NOTE 1 The radiation angle is expressed in radians (rad) in all formulae.

NOTE 2 ξ is the 90° complement of the Mach angle.

3.1.11
angle alpha
α
angle between the line of fire and a line from the muzzle to the receiver

NOTE 1 See ISO 17201-1:2005, Figure 3.

NOTE 2 The angle alpha is expressed in radians (rad) in all formulae.

3.1.12
sound exposure
E
time integral of frequency-weighted squared instantaneous sound pressure over the event duration time

$$E = \int_T p^2(t)\ \mathrm{d}t$$

NOTE The sound exposure is expressed in pascal-squared seconds ($Pa^2 \cdot s$).

3.1.13
sound exposure level
L_E
ten times the logarithm to the base 10 of the ratio of the sound exposure to a reference value

NOTE 1 The sound exposure level is expressed in decibels.

NOTE 2 See also ISO 1996-1.

NOTE 3 The sound exposure level of a single burst of sound or transient sound with duration time is given by the formula

$$L_E = 10 \lg \left[\int_T \frac{p^2(t)}{p_0^2 T_0} \mathrm{d}t \right] \mathrm{dB}$$

where

$p(t)$ is the instantaneous sound pressure as a function of time;

$p_0^2 T_0$ is the reference value [(20 μPa)^2 × 1 s].

3.1.14
speed of sound in air
c
speed of sound for the estimation condition

NOTE The speed of sound in air is expressed in metres per second (m/s).