INTERNATIONAL STANDARD

ISO 17201-1

Second edition
2018-11

Acoustics — Noise from shooting ranges —

Part 1: Determination of muzzle blast by measurement

Acoustique — Bruit des stands de tir —

Partie 1: Mesurage de l´énergie sonore en sortie de bouche

Reference number
ISO 17201-1:2018(E)

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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 on 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 the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 43, *Acoustics*, Subcommittee SC 1, *Noise*.

This second edition cancels and replaces the first edition (ISO 17201-1:2005), which has been technically revised. It also incorporates the Technical Corrigendum ISO 17201-1:2005/Cor 1:2009.

The main changes compared to the previous edition are as follows:

— the complete document has been editorially revised;

— 5.1, especially Figure 3 and the attached formula have been technically revised;

— Annex A (informative) "Small arms glossary" has been revised editorially;

— Annex B (informative) has been technically revised;

— references have been updated.

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.

Introduction

The initiative to prepare a standard on impulse noise from shooting ranges was taken by AFEMS, the Association of European Manufacturers of Sporting Ammunition, in April 1996 by the submission of a formal proposal to CEN. After consultation in CEN in 1998, CEN/TC 211, *Acoustics* asked ISO/TC 43/SC 1, *Noise* to prepare the ISO 17201 series.

To obtain reliable data for the prediction of shooting sound levels at a reception point, the energy of sound emission produced by the muzzle blast is needed. The muzzle blast is produced by the propellant gas expelled from the barrel of a weapon; in most cases the gas has a supersonic fluid speed. Close to the muzzle, the sound pressure is very high and cannot be described with linear acoustics. For the purpose of this document, the non-linear region is defined by the observation of a peak sound pressure level of 154 dB or more. This document defines how the sound source energy and directivity of the muzzle blast can be obtained from the measurement of sound exposure levels and how these measurements are to be carried out. The source energy, its directivity and spectral structure can be used as input for sound propagation models for environmental noise assessment. This cannot be used for calculations of sound exposure levels close to the weapon, for instance to estimate injury to people or animals.

Acoustics — Noise from shooting ranges —

Part 1:
Determination of muzzle blast by measurement

1 Scope

This document specifies a method to determine the acoustic source energy of the muzzle blast for calibres of less than 20 mm or explosive charges of less than 50 g TNT equivalent. It is applicable at distances where peak pressures less than 1 kPa (equivalent to a peak sound pressure level of 154 dB) are observed. The source energy, directivity of the source and their spectral structure determined by this procedure can be used as input data to sound propagation programmes, enabling the prediction of shooting noise in the neighbourhood of shooting ranges. Additionally, the data can be used to compare sound emission from different types of guns or different types of ammunition used with the same gun.

This document is applicable to guns used in civil shooting ranges but it can also be applied to military guns. It is not applicable to the assessment of hearing damage or sound levels in the non-linear region.

Suppressors and silencers are not taken into consideration in this document.

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.

IEC 60942, *Electroacoustics — Sound calibrators*

IEC 61672-1, *Electroacoustics — Sound level meters — Part 1: Specifications*

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

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
sound pressure
p
difference between instantaneous total pressure and static pressure

Note 1 to entry: The sound pressure is expressed in pascals (Pa).

Note 2 to entry: Static pressure is the pressure that exists in the absence of sound waves.

Note 3 to entry: This definition applies to a medium allowing a non-zero mean flow in the atmosphere.

Note 4 to entry: This definition is technically in accordance with ISO 80000-8:—[1)], item 8-2.2.

Note 5 to entry: For the definition of "static pressure" see ISO 80000-8:—, item 8-2.1, with the difference of allowing non-zero mean flow.

3.2
sound pressure level
L_p
ten times the logarithm to the base 10 of the ratio of the square of the root-mean-squared sound pressure, p_{rms}, to the square of a reference value, p_0

$$L_p = 10 \lg \frac{p_{\mathrm{rms}}^2}{p_0^2} \text{ dB} \tag{1}$$

Note 1 to entry: The sound pressure level is expressed in decibels (dB).

Note 2 to entry: The sound pressure is expressed in pascals (Pa).

Note 3 to entry: For sound in air and other gases, the reference sound pressure is given by p_0 = 20 µPa.

Note 4 to entry: The sound pressure level can be frequency weighted and time weighted.

Note 5 to entry: This definition is technically in accordance with ISO 80000-8:—, item 8-15.

[SOURCE: ISO/TR 25417:2007, 2.2, modified — “the sound pressure, p” has been replaced with “the root-mean-squared sound pressure, p_{rms}”; the wording “where the reference value, p_0, is 20 µPa” has been removed; the original NOTE 1 and 2 have been removed; Note 1, 2, 3, 4 and 5 to entry have been added.]

3.3
peak sound pressure
p_{peak}
maximum absolute *sound pressure* (3.1) during a stated time interval

Note 1 to entry: The peak sound pressure is expressed in pascals (Pa).

[SOURCE: ISO/TR 25417:2007, 2.4, modified — The word “greatest” has been replaced with “maximum”; the word “certain” has been replaced with “stated”; NOTE 2 has been removed.]

3.4
peak sound pressure level
$L_{p,\mathrm{peak}}$
ten times the logarithm to the base of 10 of the ratio of the square of the *peak sound pressure*, p_{peak} (3.3) to the square of the reference value, p_0

$$L_{p,\mathrm{peak}} = 10 \lg \frac{p_{\mathrm{peak}}^2}{p_0^2} \text{ dB} \tag{2}$$

Note 1 to entry: The reference value is given by p_0 = 20 µPa.

Note 2 to entry: The peak sound pressure level is expressed in decibels (dB).

Note 3 to entry: Peak sound pressure should be determined with a detector as defined in IEC 61672-1; IEC 61672-2 only specifies the accuracy of a detector using C-weighting.

[SOURCE: ISO/TR 25417:2007, 2.5, modified — The wording “where the reference value, p_0, is 20 µPa” has been removed; the original NOTE has been removed; Note 1, 2 and 3 to entry have been added.]

1) Under preparation.

3.5
event duration
T
stated time interval, long enough to encompass all significant sound of a stated event

Note 1 to entry: The event duration is expressed in seconds (s).

3.6
sound exposure
E_T
integral of the square of the *sound pressure*, p (3.1), over a stated time interval or *event duration*, T (3.5), starting at t_1 and ending at t_2

$$E_T = \int_{t_1}^{t_2} p^2(t)\mathrm{d}t \tag{3}$$

Note 1 to entry: The sound exposure is expressed in pascal-squared seconds (Pa^2s).

[SOURCE: ISO/TR 25417:2007, 2.6, modified — The original NOTE 1 to 4 have been removed; Note 1 to entry has been added.]

3.7
sound exposure level
$L_{E,T}$
ten times the logarithm to the base 10 of the ratio of the sound exposure, E_T (3.6), to a reference value, E_0

$$L_{E,T} = 10\lg\frac{E_T}{E_0}\ \mathrm{dB} \tag{4}$$

Note 1 to entry: The sound exposure level is expressed in decibels (dB).

Note 2 to entry: For sound in air and other gases, the reference value is given by E_0 = 400 μPa^2s.

Note 3 to entry: This definition is technically in accordance with ISO 80000-8:—, item 8-17.

[SOURCE: ISO/TR 25417:2007, 2.7, modified — The original NOTE 1 to 3 have been removed; Note 1, 2 and 3 to entry have been added.]

3.8
source energy
Q
total sound source energy of the event

Note 1 to entry: The source energy is expressed in joules (J).

3.9
source energy level
L_Q
ten times the logarithm to the base 10 of the ratio of *source energy*, Q (3.8), to the reference source energy, Q_0

$$L_Q = 10\lg\left(\frac{Q}{Q_0}\right)\mathrm{dB} \tag{5}$$

Note 1 to entry: The source energy level is expressed in decibels (dB).

Note 2 to entry: The reference value is given by $Q_0 = 10^{-12}$ J.

3.10
angular source energy distribution
$S_q(\alpha)$
acoustic energy radiated from the muzzle blast into the far field, per unit solid angle

Note 1 to entry: The acoustic energy radiated by the muzzle blast within a narrow cone centred on the direction α (3.14) is:

$$S_q(\alpha) = \frac{\mathrm{d}Q}{\mathrm{d}\Omega} \tag{6}$$

where

Q is the *sound energy* (3.8);

Ω is the solid angle expressed in steradians.

Note 2 to entry: The angular source energy distribution, $S_q(\alpha)$, is expressed in joules per steradians (J sr^{-1}).

Note 3 to entry: Rotational symmetry is assumed around the line with $\alpha = 0$.

3.11
interpolated angular source energy distribution
$\overline{S}_q(\alpha)$
continuous function in α of the *source energy distribution* $S_q(\alpha)$ (3.10) derived by using a defined interpolation method

Note 1 to entry: The interpolated angular source energy distribution, $\overline{S}_q(\alpha)$, is expressed in joules per steradian (J sr^{-1}).

3.12
angular source energy distribution level
$L_q(\alpha)$
angular source energy distribution (3.10), given by ten times the logarithm to base 10 of the ratio of *angular source energy distribution*, $S_q(\alpha)$ (3.10) to the reference value, S_{q_0}

$$L_q(\alpha) = 10\,\lg\left[\frac{S_q(\alpha)}{S_{q_0}}\right]\mathrm{dB} \tag{7}$$

Note 1 to entry: The angular source energy distribution level, $L_q(\alpha)$, is expressed in decibels (dB).

Note 2 to entry: The reference value is given by $S_{q_0} = 10^{-12}$ J sr^{-1}.

3.13
interpolated angular source energy distribution level
$\overline{L}_q(\alpha)$
continuous function in α of the *angular source energy distribution level,* $L_q(\alpha)$ (3.12), derived by using a defined interpolation method

Note 1 to entry: The interpolated angular source energy distribution level is expressed in decibels (dB).

3.14
angle alpha
α
angle between the line of fire and the line from the muzzle to the receiver

Note 1 to entry: The angle alpha is expressed in radians in all formulae.

3.15
angle beta
β
angle describing the rotation around the line of fire, anticlockwise from the view of the shooter

Note 1 to entry: The angle beta is expressed in radians in all formulae.

3.16
angle gamma
γ
angle describing the inclination of the line of fire from the horizontal plane

Note 1 to entry: The angle gamma is expressed in radians in all formulae.

Note 2 to entry: See Figure 3.

3.17
angle delta
δ
angle constituted by the projection of angle α on the horizontal plane

Note 1 to entry: The angle delta is expressed in radians in all formulae.

Note 2 to entry: See Figure 3.

3.18
directivity
$D(\alpha)$
difference between the *angular source energy distribution level* (3.12) of the source under test and the source energy distribution level of a monopole source with the same acoustic source energy

Note 1 to entry: The directivity is expressed in decibels (dB).

3.19
muzzle distance
r_m
distance measured from the muzzle to the microphone point

Note 1 to entry: The muzzle distance is expressed in metres (m).

Note 2 to entry: See Figure 3.

4 Gun and ammunition

4.1 General

The information given in 4.2 to 4.6 is needed to unambiguously define the weapon plus ammunition combination for which the sound exposure level of the muzzle blast is estimated. All terms have the meanings given in Reference [14] and Annex A.

4.2 Gun

The following features shall be stated:

— description or brand name;

— type of gun (shot gun, rifle, revolver, pistol, etc.);

— calibre or gauge;

— barrel bore;

— barrel length.

The following feature should be stated:

— number, type and disposition of barrels (side-to-side, superposed, drilling, etc.).

If present, special features such as the following shall be mentioned:

— flame shield;

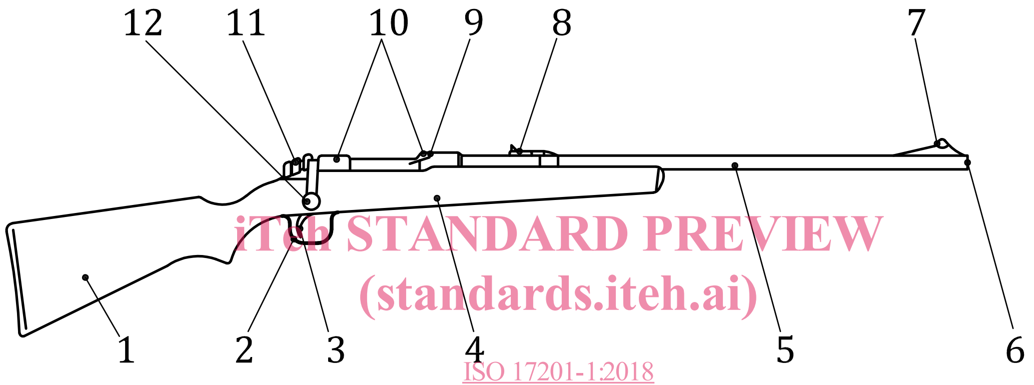
— muzzle brake.

Special features such as the following should be mentioned:

— choke;

— reload system.

Figure 1 is a schematic view and gives the main terms used to describe the gun.



Key

1 stock
2 trigger guard
3 trigger
4 magazine (inside)
5 barrel
6 muzzle
7 front sight
8 rear sight
9 bolt
10 receiver
11 safety lock
12 bolt handle

Figure 1 — Main terms used to describe the gun (schematic view)

The main parts of smooth-bore barrel and a rifled barrel are given in Annex A.

4.3 Ammunition

The following information is needed and shall be stated:

— description or brand name;

— projectile calibre;

— projectile mass.

The following additional information should be given:

— type and mass or chemical energy of propellant;

— type of projectile (ball, sabot, pellets or blank).

In case of shot guns (shot pellets), the following additional information shall be stated:

— type, number, size and weight or type-number of pellets.

In case of shot guns (shot pellets), the following additional information should be stated:

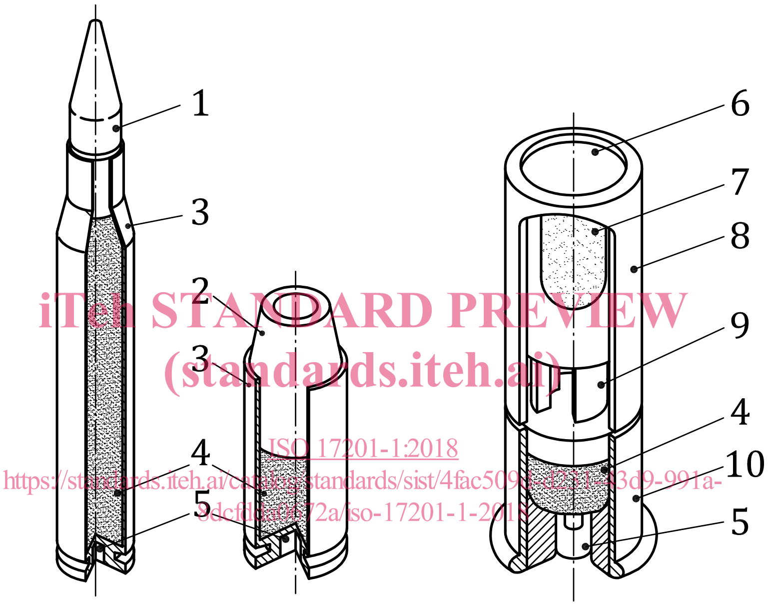
— total length of the cartridge and the gauge;

— type of tube;

— type of wad;

— type of crimping.

Schematic views of ammunition for rifles, pistols and shotguns are shown in Figure 2, with names of their main components.



Key

1	projectile (bullet) for rifle	6	tube
2	projectile (bullet) for pistol	7	shot pellets
3	case	8	plastic cylinder
4	propellant	9	wad
5	primer	10	case head

NOTE The measurements can be influenced by conditions such as the heating of the barrel during repetitive shooting, the temperature, the humidity and the age of the ammunition.

Figure 2 — Schematic view of ammunition

4.4 Ballistic parameters

The muzzle speed (speed of the projectile at the muzzle), as a result of a gun/ammunition combination as specified by the manufacturer, shall be stated.

Other available ballistic parameters should be stated.

NOTE Muzzle speed is a calculated value that corresponds to the speed of the projectile itself for rifles, or to the speed of the centre of gravity of the cloud of pellets close to the muzzle of a shot gun.

