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BRITISH STANDARD

BS EN ISO 17201-5:2010

Acoustics — Noise from shooting ranges

Part 5: Noise management (ISO 17201-5:2010)

ICS 17.140.20; 95.020; 97.220.10

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British Standards

National foreword

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EUROPEAN STANDARD

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English Version

Acoustics - Noise from shooting ranges - Part 5: Noise management (ISO 17201-5:2010)

Acoustique - Bruit des stands de tir - Partie 5: Gestion du bruit (ISO 17201-5:2010)

Akustik - Geräusche von Schießplätzen - Teil 5: Lärmmanagement (ISO 17201-5:2010)

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Foreword

This document (EN ISO 17201-5:2010) 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of an identical text or by endorsement, at the latest by August 2010, and conflicting national standards shall be withdrawn at the latest by August 2010.

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Foreword

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ISO 17201-5 was prepared by Technical Committee ISO/TC 43, *Acoustics*, Subcommittee SC 1, *Noise*.

ISO 17201 consists of the following parts, under the general title *Acoustics — Noise from shooting ranges*:

— *Part 1: Determination of muzzle blast by measurement*

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

— *Part 3: Guidelines for sound propagation calculations*

— *Part 4: Prediction of projectile sound*

— *Part 5: Noise management*

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Introduction

The initiative to prepare a standard on impulse noise from shooting ranges was taken by the Association of European Manufacturers of Sporting Ammunition (AFEMS), in April 1996 by the submission of a formal proposal to CEN (see doc. CEN N 1085). After consultation in CEN in 1998, CEN/TC 211, *Acoustics*, asked ISO/TC 43, *Acoustics*, Subcommittee SC 1, *Noise* to prepare ISO 17201 (all parts).

This part of ISO 17201 provides guidance for noise management of shooting activity at shooting ranges. It deals with the control of the noise received outside shooting ranges at specified reception points based either on measured or calculated data.

In general, national or regional environmental authorities specify how sound from shooting ranges should comply with guidelines, rules or regulations made by the relevant authorities. In situations with no official regulations, the management of a shooting range may use the method specified in this part of ISO 17201.

NOTE Conflicting national guidelines, rules or regulations can prevent the application of methods described in this part of ISO 17201.

Looking through various regulations used worldwide, many different approaches for noise control are found. In some countries, the long-term equivalent continuous sound pressure level is used to limit sound levels from shooting. In other countries, noise control is managed by limiting the level of one shot or by the difference between the long-term rating level and background sound pressure level, etc. This part of ISO 17201 gives a method for noise management to control the equivalent continuous sound pressure level by managing the number of shots for each combination of weapon type, ammunition type, the locations of firing, and the firing direction that is used in a shooting range. The weighting of the number of shots is related to the sound exposure levels produced by each combination at the reception points. By directly relating the number of shots to the limiting values, management objectives such as minimizing the noise load in the neighbourhood can be met.

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Acoustics — Noise from shooting ranges —

Part 5:
Noise management

1 Scope

This part of ISO 17201 gives guidelines for noise management of shooting activity at shooting ranges. The control of the noise received outside shooting ranges at specified reception points based either on measured or calculated sound exposure levels is specified. This part of ISO 17201 can also be used in the planning of new or reconstruction of existing ranges. It is intended to comply with all relevant local rules and regulations which imply a conversion of sound exposure level to other indicators as given in ISO 17201-3.

This part of ISO 17201 applies to weapons with calibres of less than 20 mm or explosive charges of less than 50 g TNT equivalent and pressures of less than 1 kPa at the reception point.

NOTE National or other regulations, which could be more stringent, can 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 1996-2, *Acoustics — Description, measurement and assessment of environmental noise — Part 2: Determination of environmental noise levels*

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

ISO 17201-2, *Acoustics — Noise from shooting ranges — Part 2: Estimation of muzzle blast and projectile sound by calculation*

ISO 17201-3, *Acoustics — Noise from shooting ranges — Part 3: Guidelines for sound propagation calculations*

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

ISO/IEC Guide 98-3:2008, *Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in* measurement (*GUM:1995*)

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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
event duration
T
stated time interval, long enough to encompass all significant sound of a stated event at a **reception point** (3.22)

NOTE 1 The event duration is expressed in seconds.

NOTE 2 Adapted from ISO 17201-1:2005, 3.5.

3.2
sound exposure
E_T
integral of the square of the sound pressure, p, over a stated time interval or event of duration T (starting at t_1 and ending at t_2)

$$E_T = \int_{t_1}^{t_2} p^2(t)\, \mathrm{d}t \qquad (1)$$

NOTE 1 Sound exposure is expressed in square pascal seconds.

NOTE 2 Adapted from ISO 17201-1:2005, 3.6.

NOTE 3 Because of practical limitations of the measuring instruments, p^2 is always understood to denote the square of a frequency-weighted and frequency-band-limited sound pressure. If a specific frequency weighting as specified in IEC 61672-1 [6] is applied, this should be indicated by appropriate subscripts: e.g. $E_{\mathrm{A,1\,h}}$ denotes the A-weighted sound exposure over 1 h.

NOTE 4 When applied to a single event, the quantity is called "single event sound exposure" and the symbol E is used without subscript.

NOTE 5 This definition is technically in accordance with ISO 80000-8:2007 [5], 8-18.

3.3
sound exposure level
L_E
ten times the logarithm to the base 10 of the ratio of the **sound exposure** (3.2), E_T, to a reference value, E_0, expressed in decibels

$$L_E = 10 \lg \frac{E_T}{E_0}\ \mathrm{dB} \qquad (2)$$

where the reference value, E_0, is $(20\ \mu\mathrm{Pa})^2\mathrm{s} = 4 \times 10^{-10}\ \mathrm{Pa}^2\mathrm{s}$

NOTE 1 Adapted from ISO 17201-1:2005, 3.7.

NOTE 2 Application of specific frequency weightings as specified in IEC 61672-1 [6] is indicated by appropriate subscripts.

NOTE 3 When applied to a single event, the quantity is called "single event sound exposure level" and the symbol L_E is used without further subscript.

NOTE 4 This definition is technically in accordance with ISO 80000-8:2007 [5], 8-24.

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3.4
total sound
totally encompassing sound in a given situation at a given time, usually composed of sound from many sources near and far

[ISO 1996-1:2003 [1].3.4.1]

See Figure 1.

3.5
specific sound
component of the **total sound** (3.4) that can be specifically identified and which is associated with a specific source

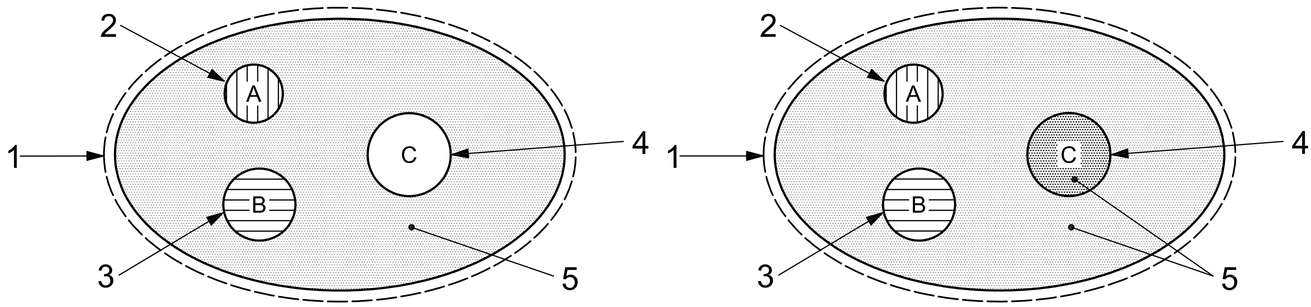
[ISO 1996-1:2003 [1].3.4.2]

See Figure 1.

3.6
residual sound
total sound (3.4) remaining at a given position and situation when the **specific sounds** (3.5) under consideration are suppressed

[ISO 1996-1:2003 [1], 3.4.3]

See Figure 1.



a) Three specific sounds (3.5) A, B and C under consideration — the residual sound (3.6) and the total sound (3.4) are also shown

b) Two specific sounds (3.5) A and B under consideration — the residual sound (3.6) and the total sound (3.4) are also shown

Key

1 total sound
2 specific sound A
3 specific sound B
4 specific sound C
5 residual sound

NOTE 1 The lowest residual sound level is obtained when all specific sounds are suppressed.

NOTE 2 In Figure 1 a), the dotted area indicates the residual sound when sounds A, B, and C are suppressed.

NOTE 3 In Figure 1 b), the residual sound includes the specific sound C since it is not under consideration.

Figure 1 — Total, specific and residual sound designation

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3.7
background sound pressure level
$L_{A,N}$
equivalent continuous sound pressure level of **residual sound** (3.6) for a specified period of time

NOTE 1 Background sound pressure level is expressed in decibels.

NOTE 2 The time should be chosen with respect to the rating time period.

NOTE 3 The background sound pressure level depends on many parameters (such as time of the day and of the year, wind speed, traffic, etc.) so that the level is expected to vary randomly.

3.8
background sound pressure spectrum
spectrum obtained by averaging over all spectra obtained during the specified time T without unusual events or during periods where the level is below a specified percentile level

3.9
source combination
k
combination of specified weapon, ammunition, firing location, and firing direction used in the shooting range

3.10
immission class
class, of width 3 dB, to which a **source combination** (3.9) is assigned on the basis of the A-weighted long-term sound exposure level $L_{E,A}$ at a specified **reception point** (3.22)

NOTE The long-term averaged sound exposure level is defined in ISO 1996-1:2003 [1], 3.2.2.

3.11
immission class 0
immission class (3.10) with the highest long-term sound exposure level $L_{E,A,max}$ at a specified **reception point** (3.22)

NOTE 1 To determine the upper limit of immission class 0, 1,5 dB is added to $L_{E,,A,max}$ and the result is rounded to the nearest integer:

$$L_{up}(0) = \text{round}\,(L_{E,A,max} + 1{,}5\ \text{dB})$$

The lower limit is obtained by subtracting 3 dB from $L_{up}(0)$:

$$L_{lo}(0) = L_{up}(0) - 3\ \text{dB}$$

NOTE 2 The immission class limits are usually different for differently situated reception points.

NOTE 3 If the range is used under all weather conditions, the maximum value refers to the long-term average of these conditions. If the use is linked to specific weather conditions, the maximum value refers to the long-term average for those conditions.

NOTE 4 The operator “round” is used to denote rounding to the nearest integer.

3.12
immission class i
immission class (3.10) with an upper limit that is 3i dB, where i is an integer, below the upper limit of **immission class 0** (3.11)

NOTE With an increasing immission class number, the upper limit of the immission class decreases according to the equation:

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$$L_{up}(i) = L_{up}(0) - 3i \text{ dB}$$

3.13
***N* % exceedance level**
$L_{N(T)}$
time-weighted and frequency-weighted sound pressure level that is exceeded for N % of the time interval T considered

EXAMPLE $L_{p,\text{AF},95,1\text{h}}$ is the A-frequency weighted, F-time-weighted sound pressure level exceeded for 95 % of 1 h.

NOTE 1 The N % exceedance level is expressed in decibels.

NOTE 2 Adapted from ISO 1996-1:2003, 3.1.3.

3.14
event index
number of shooting events of limited duration of which the time- and frequency-weighted level exceeds a given value for a given time period, such as time of day, day of the week or their combinations

NOTE The event index counts the number of events exceeding a specific level at the reception point.

3.15
event index limit
limit that should not be exceeded by the **event index** (3.14)

3.16
immission class factor
C_k
weighting factor of a **source combination** (3.9), k, of which the sound exposure level at a **reception point** (3.22) falls within **immission class** i (3.12):

$$C_k = 2^{-i} \quad (3)$$

EXAMPLE Shots in immission classes $i = 3$ and $i = 5$ have weights 1/8 and 1/32, respectively, with the result that four shots in immission class $i = 5$ are equivalent to one shot in immission class $i = 3$.

3.17
quota count
QC
n_{Q}
sound dose as sound energy/time at a **reception point** (3.22) resulting from all shots fired on a range during a specific time period expressed as an equivalent number of shots of **immission class 0** (3.11)

3.18
quota count limit
QCL
$n_{\text{Q, lim}}$
upper limit number of the **quota count** (3.17) which is related to the permissible or pursued limiting level

3.19
immission class level
$L_{E,\text{A},i}$
A-weighted sound exposure level of shots which represents an **immission class** (3.10), set to −1 dB of the upper limit of the immission class:

$$L_{E,\text{A},i} = L_{up}(i) - 1 \text{ dB} \quad (4)$$

NOTE The immission class level is expressed in decibels.

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3.20
equivalent continuous sound pressure level
$L_{p,\text{eq}T}$
ten times the logarithm to the base 10 of the ratio of the time-average of the square of the sound pressure, p, during a stated time interval of duration T (starting at t_1 and ending at t_2), to the square of a reference value, p_0, expressed in decibels

$$L_{p,T} = L_{p,\text{eq}T} = 10\ \lg \left[\frac{\frac{1}{T}\int_{t_1}^{t_2} p^2(t)\ \text{d}t}{p_0^2} \right] \text{dB}$$

where the reference value, p_0, is 20 µPa

[ISO/TR 25417:2007[4], 2.3]

NOTE The A-weighted equivalent continuous sound pressure level, $L_{\text{A,eq}}$, due to shots of the shooting range under evaluation, is calculated from the sound exposure level of all shots according to:

$$L_{\text{A,eq}} = 10 \lg \left(\frac{t_0}{T_\text{p}} \sum_{j=1}^{N} 10^{0,1 L_{E,\text{A},j}} \right) \text{dB} \tag{5}$$

where

t_0 is the reference time, 1 s;

$L_{E,\text{A},j}$ is the sound exposure level, in decibels, of shot j;

N is the total number of shots;

T_p is the evaluation period, in seconds.

3.21
sound emergence
E_m
increase from **background sound pressure level** $L_{\text{A},N}$ (3.7) to total A-weighted equivalent continuous sound pressure level, $L_{\text{A,eq}}$, due to shooting sound

NOTE 1 Adapted from ISO 1996-1:2003 [1], 3.4.7.

NOTE 2 $E_\text{m} = L_{\text{A,eq}} - L_{\text{A},N}$.

NOTE 3 The sound emergence is expressed in decibels.

3.22
reception point
point of interest within the context of noise management

3.23
evaluation period
T_p
time period to be assessed by the rating level

NOTE The evaluation period is expressed in seconds.

EXAMPLE For a daytime period of 16 h: "16 × 3 600 s daytime".

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3.24
source classification
classification for all weapon and ammunition combinations with respect to the weapon type

NOTE In the context of noise management procedures in this part of ISO 17201, the immission class quantities can replace the acoustical features of the specific weapon/ammunition combinations.

3.25
source energy class
classification for the muzzle blast of weapon and ammunition combinations with respect to the source strength in terms of source energy level

NOTE The sound energy level can be measured or estimated in accordance with ISO 17201-1 or ISO 17201-2, respectively. See also Annex B.

3.26
source direction class
classification of weapon/ammunition combinations with respect to the directivity in terms of the angular source energy distribution

NOTE The directivity pattern can be measured or estimated in accordance with ISO 17201-1 or ISO 17201-2, respectively. See also Annex B.

3.27
specified level
L_V
⟨shooting range noise⟩ upper limit for the long-term $L_{\mathrm{A,eq}}$ used for the management process

NOTE The specified level is expressed in decibels.

4 Management process

4.1 General

The following management scheme allows the sound impact of a shooting range on a neighbourhood to be estimated. The usage is expressed by the sum of the number of shots, n_k, of all source combinations, k, that contribute to immission class i. The contribution of one shot of source combination, k, is expressed by its long-term averaged sound exposure level $L_{E,\mathrm{A}}(k)$ at the reception point, which is used to assign immission class i to this combination. Using the number of shots within each immission class, the quota count (QC) for each reception point is calculated. The QC is directly related to the specified value set by the management, which is the equivalent continuous sound pressure level of all shots. This value is related to the rating level by possible additions. From the equivalent continuous sound pressure level the sound emergence can be obtained, if the background sound pressure levels are known. If an event index is used, the QC concept can be modified to take into account only those shots which are above a specified limit. For other evaluation schemes, the QC concept may not be applicable.

4.2 Basic quantities

4.2.1 Classification of weapon, ammunition, and location combinations

The highest weighted sound exposure level at a reception point, $L_{E,\mathrm{A,max}}$, of all m combinations is used to set the upper limit of immission class 0, $L_{\mathrm{up}}(0)$, as follows:

$$L_{\mathrm{up}}(0) = \mathrm{round}\,(L_{E,\mathrm{A,max}} - 0{,}5\ \mathrm{dB}) + 2\ \mathrm{dB} \qquad (6)$$

The upper limit of immission class 0 is obtained by truncating the value of $L_{E,\mathrm{A,max}}$ to an integer number and adding 2 dB.

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The immission class width is 3 dB, therefore immission class 0 has a lower limit $L_{\text{lo}}(0)$:

$$L_{\text{lo}}(0) = L_{\text{up}}(0) - 3\ \text{dB} \tag{7}$$

which is the upper limit $L_{\text{up}}(1)$ of immission class 1:

$$L_{\text{up}}(1) = L_{\text{lo}}(0) \tag{8}$$

Or for immission class i:

$$L_{\text{up}}(i) = L_{\text{lo}}(i-1) \tag{9}$$

The long-term sound exposure level, $L_{E,\text{A}}(k)$, at the reception point of each source combination, k, is used to identify its immission class number i using

$$i = \text{round}\left(\frac{L_{\text{up}}(0) - L_{E,\text{A}}(k)}{3\ \text{dB}} - 0{,}5\right) \tag{10}$$

If projectile sound is perceived at the reception point, this shall also be included. The sound exposure level, $L_{E,\text{A}}(k)$, can be determined using reliable procedures such as those specified in ISO 17201-2 and ISO 17201-4. Annex B contains a weapon and ammunition combination classification, which may be used to describe the sound emission.

From the immission class index i the weighting factor of source combination, k, is obtained by Equation (3) as follows: $C_k = 2^{-i}$

Small variations of the combination elements, such as weapon (e.g. barrel length), ammunition (e.g. characteristics or amount of propellant), firing location or firing direction can be classified in the same immission class as long as the long-term average sound exposure level $L_{\text{A},E}$ at the reception points resulting from those variations do not exceed the appropriate immission class limits.

NOTE The immission class width of 3 dB is chosen for each source combination as this classification leads to a doubling of a number of shots from one immission class to the next without changing the equivalent level, e.g. 8 shots which fall in immission class 3 produce the same rating level as one shot in immission class 0, because both produce the same amount of sound energy in the long term.

4.2.2 Number of shots

As the number of shots for each source combination, k, during the evaluation time is the key quantity for the determination of equivalent continuous sound pressure level $L_{\text{A,eq}}$ that allows management to estimate the sound load around the shooting range, it is required that the number of shots be registered for all m combinations.

4.2.3 Quota count

The QC, n_{Q}, is calculated as the sum of the number of shots n_k of source combination, k, weighted by immission class factor C_k

$$n_{\text{Q}} = \sum_{k=1}^{m} C_k \ n_k \tag{11}$$

where

- m is the number of source combinations;
- C_k is the weighting factor of source combination k;
- n_k is the number of shots of source combination, k, over the period of evaluation.

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NOTE 1 As the immission class width is 3 dB, one shot in class 0 is equivalent to two shots in immission class 1.

NOTE 2 If the evaluation period contains time periods during which an adjustment K_k of the sound exposure level has to be applied (e.g. an addition of a 5 dB or 6 dB adjustment), this can be taken into account by adjusting the number of shots in that period, according to

$$C'_k = C_k \times 10^{0,1 K_k}$$

where

C_k is the weighting factor of source combination, k;

K_k is an adjustment, in decibels, to account for the time of day or impulsiveness for the source combination in the kth class.

4.2.4 Background sound pressure level

The background sound pressure level can be evaluated by using a percentile level such as $L_{A,90}$ or $L_{A,95}$ for an appropriate time period. The time period should be specified and should not be less than half an hour. The value obtained shall be representative for the evaluation period of the shooting range and shall not contain unusual events.

NOTE Unusual events are, for example, the sound of a construction site which is assumed not to be there for a long period of time.

4.2.5 Sound exposure level

The sound exposure level of each shot at a reception point may vary considerably, independently of the sound emission, due to variations in short- and long-term sound propagation conditions. Standard deviations of up to 15 dB have been observed for the distribution of single event sound exposure levels within a time frame of less than 1 h. If the sound exposure levels of the source combinations are measured, the measuring time shall be chosen such that a long-term average is obtained. It should be noted that wind directions can have a tendency to prevail for up to 72 h. This means that statistical independence with respect to wind direction can only be assumed if the observation time is much longer.

4.3 Indicators

4.3.1 General

The goal of the management process is to control the emission to ensure that specific levels at reception points are not exceeded. To achieve this, these limiting levels are equivalently expressed as quota count limits (QCLs). The event index and/or sound emergence can also be used to control the immission.

4.3.2 Quota count limit

The QCL gives the number of shots with the immission class level, $L_{AE,0}$, of immission class 0 which could be fired without exceeding the specified level, L_V. The QCL, $n_{Q,\,lim}$, can be calculated as follows:

$$n_{Q,\,lim} = \left(\frac{T_p}{t_0}\right) \times 10^{0,1(L_V - L_{A,E,0})/\mathrm{dB}} \quad (12)$$

where

t_0 is the reference time, 1 s;

T_p is the evaluation period, in seconds;

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$L_{E,\mathrm{A},0}$ is the sound exposure level, in decibels, of immission class 0: the value is obtained by subtracting 1 dB from the $L_{\mathrm{up}}(0)$, i.e. $L_{E,\mathrm{A},0} = L_{\mathrm{up}}(0)$ –1 dB;

L_V is the specified level, in decibels.

NOTE L_V may be different for each reception point and even if that is not the case, different QCLs can be obtained for each reception point.

By definition (3.18), the QC should not be exceed the QCL.

4.3.3 Sound emergence

The sound emergence is expressed as the difference between the A-weighted equivalent continuous sound pressure level, $L_{\mathrm{A,eq}}$, of the shooting sound at the reception point and the background sound pressure level at the same location.

The equivalent level, $L_{\mathrm{A,eq}}$, due to shots of the shooting range under evaluation is calculated from the sound exposure level of all shots according to:

$$L_{\mathrm{A,eq}} = 10\lg\left(\frac{t_0}{T_\mathrm{p}}\sum_{j=1}^{N}10^{0,1L_{E,\mathrm{A},j}}\right)\mathrm{dB} = L_{E,\mathrm{A},0} + 10\lg\left(\frac{t_0}{T_\mathrm{p}}\sum_{k=1}^{m}C_k\ n_k\right)\mathrm{dB} \qquad (13)$$

where

t_0 is the reference time, 1 s;

$L_{E,\mathrm{A},j}$ is the sound exposure level, in decibels, of shot j;

N is the total number of shots;

m is the number of source combinations;

T_p is the evaluation period, in seconds;

n_k is the number of shots fired for the source combination, k, during the time period, T_p;

C_k is the immission class factor for source combinations, k, which fall in immission class i.

The sound emergence, E_m, is calculated by subtracting the background sound pressure level from $L_{\mathrm{A,eq}}$

$$E_\mathrm{m} = L_{\mathrm{A,eq}} - L_{\mathrm{A},N} \qquad (14)$$

where $L_{\mathrm{A},N}$ is the equivalent level of residual sound (3.6) without unusual events.

During field measurements, the pulses shall be clearly identified and it shall be certain that the shots taken into account come from the shooting range under evaluation and not from other sources (such as hunters outside the range or use of other neighbouring ranges). The $L_{\mathrm{A},N}$ should be representative for the reception point under consideration.

4.4 Specified levels

The QC in association with 3 dB immission classes allows an approximate calculation of the specified level, L_V, for each reception point and evaluation period using

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$$L_V = L_{E,A,0} + 10\lg\left(\frac{t_0}{T_p}\sum_{k=1}^{m} n_k \ C'_k\right) \text{dB} \qquad (15)$$

where

$L_{E,A,0}$ is the sound exposure level, in decibels, of the immission class 0;

m is the number of combinations k;

n_k is the number of shots with combination k within the evaluation period, T_p;

T_p is the evaluation period, in seconds;

C'_k is the immission class factor for combinations k at the point under consideration;

t_0 is the reference time, 1 s.

NOTE The specified level is obtained from the limiting value set by the local authority taking the impulsiveness into account as well as in consideration of relevant uncertainties.

4.5 Noise management procedure — flow chart

Figure 2 depicts the calculation of indicators that can be used in the management procedure for a specific period. It is assumed that the management knows the usage of the range in form of all n_k shooting numbers. The basic sound energy data are obtainable from ISO 17201-1, ISO 17201-2, and ISO 17201-4 or from measurements. The estimated excess attenuation for the different points is adjusted for this period judging wind speed and direction. Based on the specified level for each reception point, the weighting immission class factors are estimated and the QC to be expected for this period is calculated. If the result shows that at one reception point the QC is greater than the QCL, different usages have to be checked to find a combination for which the QCs for all reception points are below its limits. In cases where the concept of sound emergence is used and the background sound pressure levels depend on weather conditions, the QCL may be adjusted to account for this.

If percentage exceedance levels are used to limit the noise, the right hand side of the flow chart has to be used for additional limitation.

5 Management documentation

The management documentation shall contain at least the following information:

a) reference to this part of ISO 17201 (ISO 17201-5:2010);

b) methods used to obtain source data;

c) which indicator(s) is(are) used, and, as far as applicable, specified level and limits;

d) propagation model used;

e) a map showing the context of the facility (topographic context, firing locations, firing directions, lines of fire, reception points);

f) for each reception point, the calculation results for the indicator(s) used in the management scheme.

If relevant, the following information shall be added:

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1) maximum capacity for each shooting range within the facility;

2) the full measurement report concerning a specified background sound pressure level;

3) meteorological data;

4) uncertainty of the prediction or of the measurement.

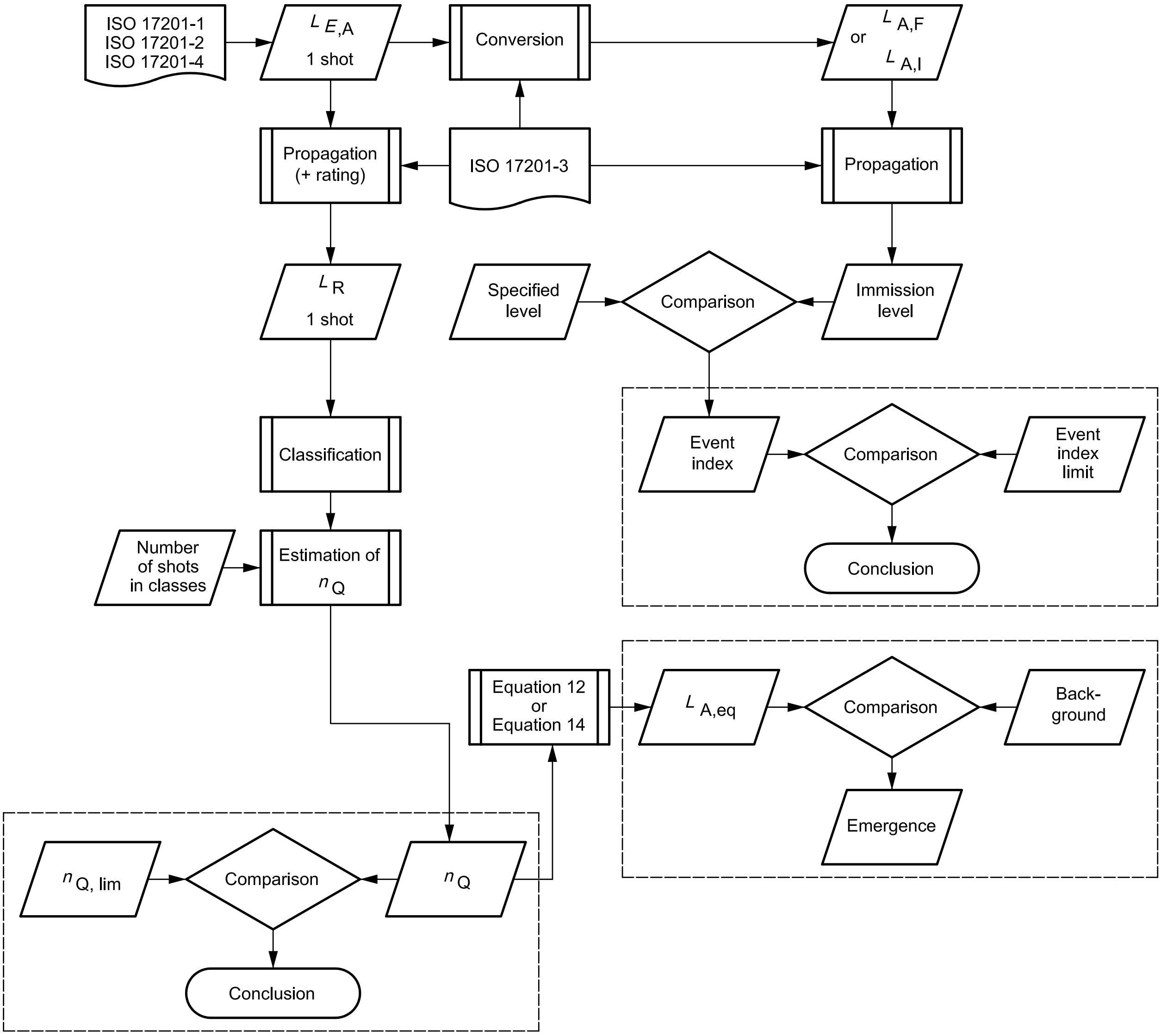

Figure 2 — Flow chart illustrating how to calculate the indicators in the management procedure

6 Uncertainties

Uncertainty of measurement shall be evaluated in accordance with ISO/IEC Guide 98-3.

Uncertainty from measurements performed in accordance with ISO 1996-2 shall be calculated in accordance with ISO 1996-2.

Uncertainty resulting from measurement of the source energy distribution level shall be taken into account in accordance with ISO 17201-1.

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Annex A
(informative)

Examples

A.1 General

Assume the following situation. The gun club 17201 in Isosburg has recently increased the number of shooting lanes and ranges to ensure that more shooting events can be held at its facility. The main change is the doubling of the number of shotgun ranges. A public hearing was held before a new certificate of approval was issued by the local government. During this hearing, the gun club announced that it would introduce a noise management scheme to minimize noise impact as far as possible.

A.2 Description of the facility

The rifle range consists of six 100 m lanes and six 50 m lanes, where the latter is used for short barrel weapons. Furthermore, there are two trap and two skeet ranges.

A.3 Shooting capacity

The shooting capacities listed in Table A.1 are assumed for the different ranges distinguishing between usage in relation to sport (s) or hunting (h) activities.

Table A.1 — Shooting capacities

Shooting capacity	Number of facilities or lines	Number of shots per hour and facility or line	
		Sport	Hunting
1 Long barrel weapon	6 lines each	40	80
2 Short barrel weapon	5 lines each	40	60
3 Moving target	1 line	35	70
4 Clay target shooting			
Trap	2 each 6 shooters	420	360
Skeet	2 each 6 shooters	320	270

A.4 Period of operation

The range operates from 09:00 to 18:00 during the week. On Sundays and public holidays a pause is observed between 12:00 to 14:00. The facility can be used for championships 10 times a year, when the range can be operated from 08:00 to 18:00.

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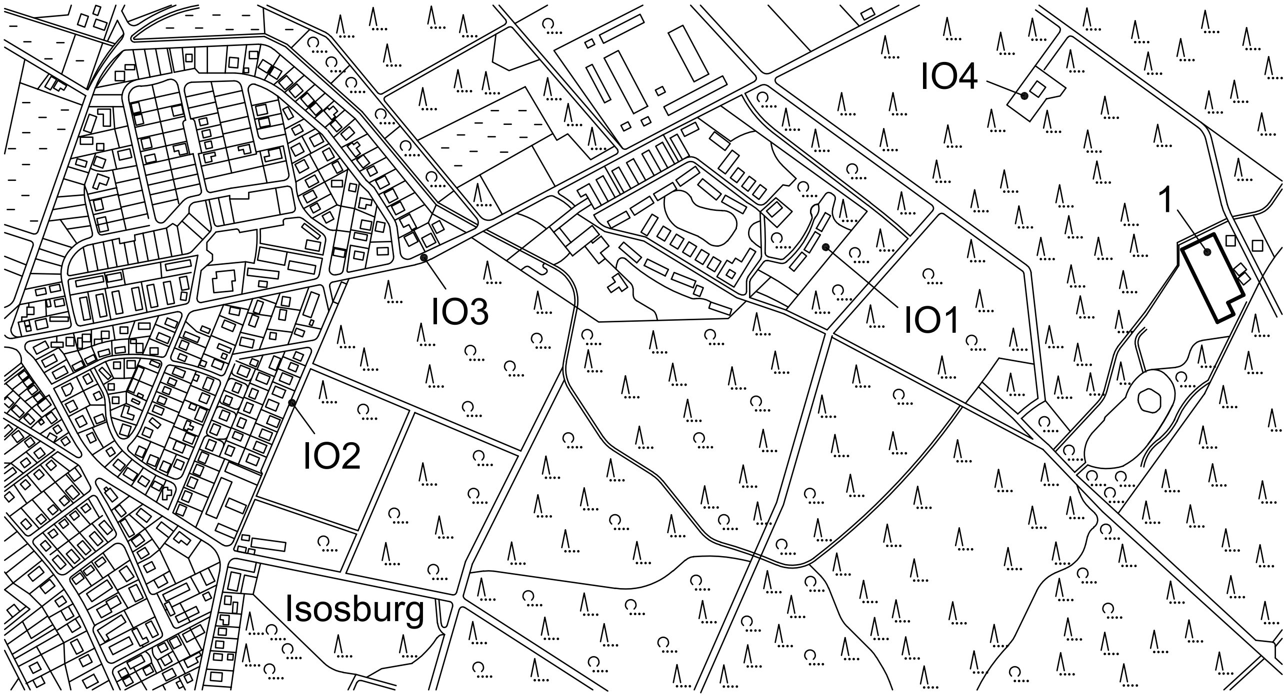
A.5 Topographic situation

The map in Figure A.1 shows the shooting range and its neighbourhood.



Key

1 shooting range

NOTE The whole area around the range is woodland with the exception of a small area north of reception point IO3 which is farmland.

Figure A.1 — The shooting range including reception points IO1, IO2, IO3, and IO4

A.6 Legal limits and background sound pressure levels

Figure A.1 shows the range, situated in the countryside in a wooded area. The area characterized by the reception point IO1 has commercial as well as residential use. Under the local by-law, the specified level L_V for daytime between 06:00 and 22:00 was set at 48 dB.

The usage of the areas in which reception points IO2 and IO3 are situated is predominantly residential with very few commercial activities. The specified levels L_V assigned for reception points IO2 and IO3 were 40 dB and 43 dB, respectively.

At reception point IO4 for an industrial site the specified level L_V is fixed at 58 dB.

For championships, the specified level L_V was set to 53 dB for reception points IO1, IO2 and IO3, and to 63 dB for reception point IO4.

When setting the specified level, a distance-dependent addition for impulsiveness has been taken into account. Furthermore, the local authority limited the number of shots that exceed a given A-weighted level of 70 dB at all four reception points. Sites were chosen according to the different land use in the neighbourhood.

Furthermore, it should be noted that the road passing reception point IO3, running east to north, is used by 20 000 vehicles per day at an average speed of 50 km/h. Trucks constitute 20 % of the vehicles. This results in a background sound pressure level of 58 dB in the neighbourhood around IO3 and 52 dB for the area near

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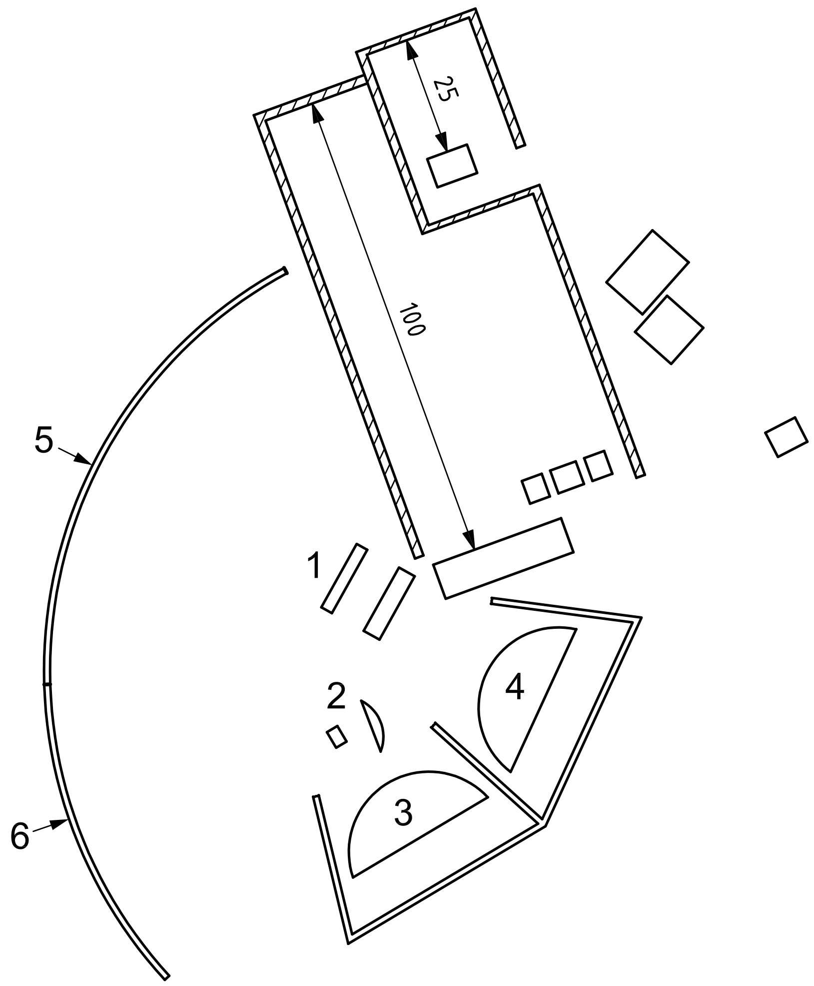
IO2. The background sound pressure level was obtained as the long-term equivalent level for the hourly L_{95} percentile between 08:00 and 18:00 for each hour separately. On Sundays and public holidays, these levels are reduced by 5 dB due to the fact that no trucks are allowed and the number of vehicles is reduced. Due to shielding by buildings and the forest, the background sound pressure level around reception point IO1 and IO4 is well below 50 dB.

At reception point IO3, the long-term A-weighted sound pressure level $L_{A,F,eq}$ resulting from the road traffic is 70 dB.

A.7 Sound exposure levels

In Figure A.2 the shooting range is depicted:

Dimensions in metres



Key

1 trap 1
2 trap 2
3 skeet 1
4 skeet 2
5 wall
6 net

NOTE The 25 m range is a closed shooting hall not to be included in the management scheme.

Figure A.2 — Shooting facility

Using source measurements (see ISO 17201-1), calculation methods (see ISO 17201-2 and ISO 17201-4), and propagation calculations (see ISO 17201-3), the sound exposure levels given in Table A.2 were obtained.

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The propagation calculation was done using the meteorological correction C_{met} based on $c_0 = 3$ (see ISO 9613-2:1996, Clause 8, Notes).

Table A.2 — A-weighted sound exposure levels $L_{E,A}$ for the major weapon, ammunition and location combinations

k	Range	Type		IO1 $L_{E,A}$ dB	IO2 $L_{E,A}$ dB	IO3 $L_{E,A}$ dB	IO4 $L_{E,A}$ dB
		Weapon	Ammunition				
1	100 m	long barrel	.30-06 [a]	53,6	49,7	50,3	56,6
2	100 m	long barrel	.22 lfB. [a]	45,2	42,3	42,3	48,2
3	50 m	short barrel	.44 Rem. Mag. [a]	56,2	45,8	46,1	59,2
4	50 m	long barrel	.22 Hornet [a]	46,4	34,2	36,9	49,4
5	Trap1	shotgun 720 mm	24 g	51,3	47,7	48,0	55,6
6	Trap1	shotgun 680 mm	24 g	51,8	48,3	48.9	56,2
7	Trap2	shotgun 720 mm	24 g	53,8	50,9	51,6	56,8
8	Trap2	shotgun 680 mm	36 g	55,2	**52,3** [b]	**52,7** [b]	60,3
9	Skeet 1	shotgun 680 mm	24 g	54,6	49,0	51,1	59,6
10	Skeet 2	shotgun 680 mm	24 g	60,7	50,2	50,6	66,4
11	Skeet 1	shotgun 680 mm	36 g	56,1	50,5	52,6	62,1
12	Skeet 2	shotgun 680 mm	36 g	**62,2** [b]	51,7	52,1	**67,8** [b]

[a] Product available commercially. This information is given for the benefit of users of this part of ISO 17201 and does not constitute an endorsement by ISO of this product.

[b] $L_{E,A,max}$ in column IO.

The classification is carried out in accordance with 4.2.1. The range of immission class 0 for reception point IO1 covers 64 dB to 61 dB. For reception points IO2 and IO3, immission class 0 covers 54 dB to 51 dB and for reception point IO4 it covers 69 dB to 66 dB. The A-weighted reference sound exposure class level, $L_{E,A,0}$, at immission class level 0 is determined by to Equation (4). Values of $L_{E,A,0}$ are: for IO1, 63 dB ($k = 12$); for IO2 and IO3, 53 dB ($k = 8$); and for IO4 68 dB ($k = 12$).

Using this classification for each combination, the immission class factors C_k listed in Table A.3 are obtained.

Table A.3 — Combination 1 to 12 with immission class factors C_k for four reception points

k	Immission class [a]				$1/C_k$ [b]			
	IO1	IO2	IO3	IO4	IO1	IO2	IO3	IO4
1	3	1	1	4	8	2	2	16
2	6	3	3	6	64	8	8	64
3	2	2	2	3	4	4	4	8
4	5	6	5	6	32	64	32	64
5	4	2	1	4	16	4	2	16
6	4	1	1	4	16	2	2	16
7	3	1	0	4	8	2	1	16
8	2	0	0	2	4	1	1	4
9	3	1	0	3	8	2	1	8
10	1	1	1	0	2	2	2	1
11	2	1	0	2	4	2	1	4
12	0	0	0	0	1	1	1	1

[a] Determined by Equation (10).

[b] Determined by Equation (3).

The A-weighted reference sound exposure class levels of class 0, $L_{E,A,0}$, are given in Table A.4.

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Table A.4 — $L_{E,\mathrm{A},0}$ for the four reception points

Reception point	$L_{E,\mathrm{A},0}$ [a] dB
IO1	63
IO2	53
IO3	53
IO4	68

[a] Determined by Equation (6).

QCLs obtained by Equation (12) are listed in Table A.5.

Table A.5 — Quota count limits for the four reception points

Reception point	Evaluation period T_p s	Specified level L_V dB	Quota count limit $n_{\mathrm{Q, lim}}$ shots per day
IO1	57 600	48	1 821
IO2	57 600	40	2 887
IO3	57 600	43	5 760
IO4	57 600	58	5 760

For championships, QCLs are also obtained by Equation (12), which gives the results listed in Table A.6.

Table A.6 — Quota count limits for the four reception points during championships

Reception point	Evaluation period T_p s	Specified levels L_V dB	Quota count limit $n_{\mathrm{Q, lim}}$ shots per day
IO1	57 600	53	5 760
IO2	57 600	53	57 600
IO3	57 600	53	57 600
IO4	57 600	63	18 215

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Values of the sound emergence, E_m, for the QCLs, determined by Equations (13) and (14), are listed in Table A.7.

Table A.7 — Sound emergence of the limiting values for the four reception points

Reception point	Sound emergence E_m dB
IO1	10
IO2	0
IO3	6
IO4	15

A.8 Management

A.8.1 Different scenarios

In the following different scenarios are given to explain the management approach.

A.8.2 Management on a day-to-day basis

The management expects, on a very busy day, over an 8 h operating period, a maximum of 6 000 pellet shots of which 4 000 shots are expected to be trap and 2 000 skeet. If trap 1 is used for 9 h, it can take 3 000 shots and trap 2 can take 1 000 shots. Skeet 1 can handle 2 000 shots. This leads to the QCs in Table A.8.

Table A.8 — Management on a day-to-day basis

k	$N_{k,\max}$	$1/C_k$				$N_{k,\max}/(1/C_k)$			
		IO1	IO2	IO3	IO4	$n_{Q,1}$	$n_{Q,2}$	$n_{Q,3}$	$n_{Q,4}$
5	3 000	16	4	2	16	188	750	1 500	188
7	1 000	8	2	1	16	125	500	1 000	62
9	2 000	8	2	1	8	250	1 000	2 000	250
Total QC [determined by Equation (11)]						563	2 250	4 500	500
QCL (from Table A.5)						1 821	2 887	5 760	5 760
ΔL [a]						–5,1 dB	–1,1 dB	–1,1 dB	–10,6 dB

[a] The difference between the actual rating level and the limiting value is obtained using the relationship:

$$\Delta L = 10 \lg \left(\frac{n_Q}{n_{Q,\lim}} \right) \text{dB} \qquad \text{(A.1)}$$

Comparing the QC to the QCL, it is obvious that the specified level for the noise management is not exceeded.

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A.8.3 Championships

For the championship, it is assumed that source combinations 2, 4, 5, 8, 11 and 12 are not used. For the 10 h of operation and the maximum number of shots possible, the QC numbers in Table A.9 are obtained.

Table A.9 — Description of the use and the quota count of the facility during championship

k	$N_{k,\max}$ [a]	$1/C_k$				$N_{k,\max}/(1/C_k)$			
		IO1	IO2	IO3	IO4	$n_{Q,1}$	$n_{Q,2}$	$n_{Q,3}$	$n_{Q,4}$
1	800	8	2	2	16	100	400	400	50
3	600	4	4	4	8	150	150	150	75
6	3 600	16	2	2	16	225	1 800	1 800	225
7	3 600	8	2	1	16	450	1 800	3 600	225
9	2 700	8	2	1	8	338	1 350	2 700	338
10	2 700	2	2	2	1	1 350	1 350	1 350	2 700
Total QC [determined by Equation (11)]						2 613	6 850	10 000	3 613
QCL (from Table A.6)						5 760	57 600	57 600	18 215

[a] Maximum shooting capacity.

Comparing the QC to the QCL it is obvious that the specified level for the noise management is not exceeded.

NOTE Reception point 1 has a QC of 2613 which represents half of the QCL. For the other reception points the ratio is larger. Therefore reception point 1 is most sensitive to change.

A.8.4 Long-term management

For more than 50 % of the operation time, the management expects the number of shots to be less than 50 % of those under maximum conditions. This means that, for those days, the louder facilities of type $k = 6$ to $k = 8$ as well as $k = 10$ to $k = 12$ are not needed. This leads to the QCs listed in Table A.10.

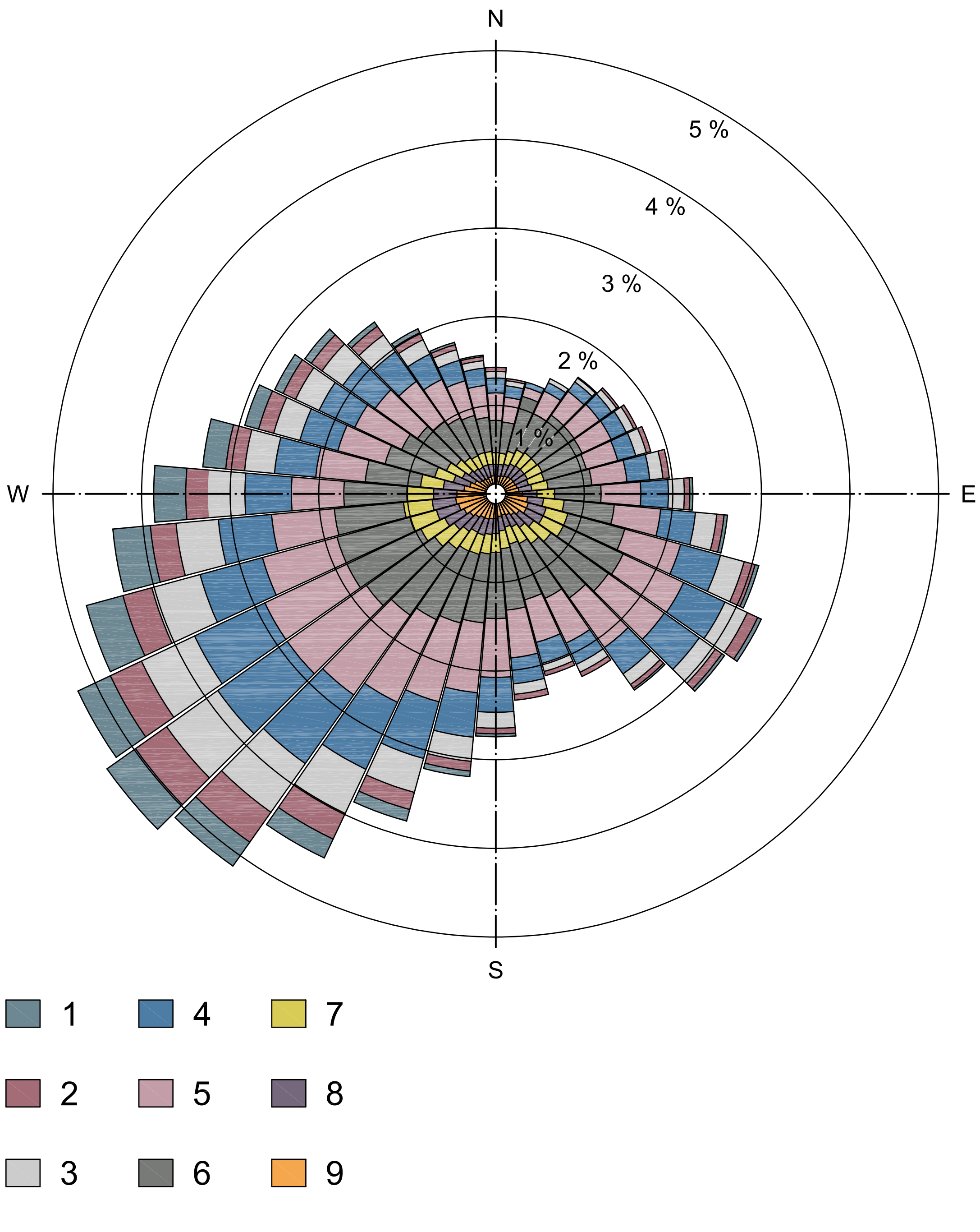
Table A.10 — Long-term management

k	$N_{k,\max}$	$1/C_k$				$N_{k,\max}/(1/C_k)$			
		IO1	IO2	IO3	IO4	$n_{Q,1}$	$n_{Q,2}$	$n_{Q,3}$	$n_{Q,4}$
1	400	8	2	2	16	50	200	200	25
3	300	4	4	4	8	75	75	75	37
5	2 000	16	4	2	16	125	500	1 000	125
9	1 000	8	2	1	8	125	500	1 000	125
QC [determined by Equation (11)]						375	1 275	2 275	312
QCL (from Table A.5)						1 821	2 887	5 760	5 760
ΔL [a]						–6,9 dB	–3,5 dB	–4,0 dB	–12,6dB

[a] See Equation (A.1).

This means that, by using the range in an optimal way, the rating level for 50 % of all days of operation is on average for all four reception points 5,6 dB below the limiting values. Based on the daily notes taken, it can be shown that only on very few days is the maximum usage reached. The records show that rating levels close to those of the maximum are reached in less than 20 % of the operation time and the rating level of the 50 % situation for less then 40 % of the operation time. Thus the long-term rating level can be held at least 4 dB below the limiting values, if meteorological conditions do not need to be taken into account.

Figure A.3 shows the long-term frequency distribution of wind direction and wind velocity.



Key

Wind speed, v, m/s

1	$v > 10$	4	$5{,}5 < v \leqslant 7{,}0$	7	$1{,}9 < v \leqslant 2{,}4$
2	$8{,}5 < v \leqslant 10{,}0$	5	$3{,}9 < v \leqslant 5{,}5$	8	$1{,}4 < v \leqslant 1{,}9$
3	$7{,}0 < v \leqslant 8{,}5$	6	$2{,}4 < v \leqslant 3{,}9$	9	$v \leqslant 1{,}4$

Figure A.3 — Frequency distribution of the wind direction and wind speed over 10 years

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It can be seen that the downwind situation occurs only for 20 % of the time during daytime. Also, for reception points IO2 and IO3, an upwind situation is observed more than 66 % of the time. The result is that the difference between the downwind levels (calculated using ISO 9613-2 in conjunction with ISO 17201-3) is 5 dB higher than the long-term L_{eq}. ISO 9613-2 uses air absorption alone, which represents the minimum possible as can be seen by comparing with the respective data given in ISO 9613-1 and observed during daytime at Isosburg. This means that the stated reduction for downwind to long-term L_{eq} is the minimum amount to be expected.

A.8.5 Sound emergence

For the shooting as described in A.8.2, the A-weighted equivalent levels $L_{A,eq}$ over the 16 h of daytime are given in Table A.11.

Table A.11 — Sound emergence

Reception point	IO1	IO2	IO3	IO4
$L_{A,eq}$ [a] dB	42,9	38,9	41,9	47,4
$L_{A,N,t}$ [b] dB	35,0	52,0	58,0	35,0
E_m [c] dB	7,9	–13,1	–16,1	12,4

a The A-weighted equivalent level $L_{A,eq}$ is determined by Equation (13).

b Background sound pressure level.

c The sound emergence E_m is determined by Equation (14).

The chosen background sound pressure levels represent the minimum values taken during the 16 h of daytime. Usually the range is only operated over 12 h, which reduces the emergence by 1,2 dB. Then the range considerably influences the ambient sound situation at reception points IO1 and IO4. This fact can also be used to operate the range in such a way that reception points IO1 and IO4 get a smaller load.

A.8.6 Event index

As can be seen from Table A.2, the highest A-weighted sound exposure level to be observed under downwind conditions is 67,8 dB at reception point IO4. However, it should be noted that in autumn under rarely occurring inversion conditions, A-weighted sound exposure levels may be observed being slightly above 70 dB. At the other three sites, the event index is zero as can be seen from Table A.2.

A.8.7 Changes in weapon-ammunition combination

As can be seen from Annex B or ISO 17201-2, the sound energy of a shot depends directly on the propellant mass. The same weapon may be used with a different propellant and remain in the same class even with a propellant whose mass deviates by up to 50 % from a known combination. If the barrel length varies by less than 10 %, the same assumption can reasonably be taken including no significant change in the directivity.

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Annex B
(informative)

Classification of muzzle blast (emission)

B.1 General

The following classification of muzzle blast and of demolition may be used to group weapon/ammunition combinations

The classification has two parts:

a) the classification for the total energy in accordance with ISO 17201-1:2005, Equation (10);

b) the classification for the directionality in accordance with ISO 17201-1:2005, Equation (12).

B.2 Sound energy — Classes of the total sound energy

ISO 17201-1:2005, Equation (10), defines the sound energy level for a rotational symmetry. For this sound energy level, Table B.1, column 8 gives the upper bound value of the classes indicated in column 9.

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Table B.1 — Classification of muzzle blast

Weber radius	a_0 unweighted	a_0 C-weighted	a_0 A-weighted	Propellant mass	Sample	Sound energy	Decibel value	Class name[c,d]
m	dB	dB	dB	g		J	dB	
0,25	135,3	135,0	134,3	0,2	—	32	135	7
0,32	138,6	138,3	137,0	0,5	Hornett .22[b]	80	139	8
0,40	141,5	141,3	139,4	1	Starter pistol	160	142	9
0,51	144,7	144,5	141,9	2	Pistol, rifle	320	145	A
0,69	148,6	148,4	144,9	5	Pistol, rifle, shotgun	800	149	B
0,87	151,7	151,4	147,1	10	Pistol, rifle, shotgun	1 600	152	C
1,10	154,7	154,4	149,3	20	Large calibre rifle	3 200	155	D
1,50	158,8	158,3	152,2	50 [a]	Demolition simulator	8 000	159	E
1,90	161,9	161,2	154,4	100 [a]	Cannon, 20 mm	16 000	162	F
2,40	164,9	164,0	156,4	200 [a]	Cannon, 25 mm	32 000	165	G
3,25	168,9	167,6	159,1	500 [a]	Cannon, 35 mm	80 000	169	H
4,05	171,7	170,1	161,1	1 000 [a]	Low demolition	160 000	172	I
5,10	174,7	172,6	163,1	2 000 [a]	Mine, grenade	320 000	175	J
7,00	178,9	176,0	165,9	5 000 [a]	Howitzer, 4WB[b]	800 000	179	K
8,70	181,7	178,2	167,8	10 000 [a]	Cannon, 120 mm	1 600 000	182	L
11,00	184,7	180,6	169,8	20 000 [a]	High demolition	3 200 000	185	M
14,90	188,7	183,5	172,5	50 000 [a]	—	8 000 000	189	N

Column	Description
1	Weber radius of an equivalent TNT explosion with mass of column 5
2	Unweighted sound energy level of an explosion with a Weber radius of column 1
3	C-weighted sound energy level of an explosion with a Weber radius of column 1
4	A-weighted sound energy level of an explosion with a Weber radius of column 1
5	Mass of an equivalent TNT explosion
6	Sample that falls into the class indicated by the symbol in column 9
7	Related sound energy of the class indicated by the symbol in column 9
8	Related sound energy level of the class indicated by the symbol in column 9
9	Symbol of the class

[a] The classification lies outside the scope of this part of ISO 17201.

[b] Product available commercially. This information is given for the convenience of users of this part of ISO 17201 and does not constitute an endorsement by ISO of this product.

[c] The classification and notation follows the definition of the so-called acoustical classes of explosions and muzzle blasts in the weapon database of the German military.

[d] If necessary, the classification can be expanded to lower or higher classes.

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B.3 Classification of a shot configuration

A shot configuration (weapon and ammunition combination) is a member of class C if the sound energy level is less than the decibel value of the class C and greater than or equal to the decibel value of previous class in terms of lower decibel value. The Weber radius or weighted levels may also be used to classify a shot configuration.

B.4 Directionality

Terms

ISO 17201-1:2005, Equation (12) gives the directionality of the muzzle blast by means of coefficients of a cosine series. For classification purposes, the coefficients a_1, a_2, and a_3 set up a scheme of directionality pattern, $R_{k,l,m}$.

The coefficient a_1 determines whether the directionality pattern is stretched to the front or to the rear of the weapon, k denotes the class index. See Table B.2.

Table B.2 — Classification for the directivity pattern

Parameter	To the rear					To the front			
	very strong	strong	moderate	weak	none	weak	moderate	strong	very strong
k	–4	–3	–2	–1	0	1	2	3	4
a_1 dB	–12	–9	–6	–3	0	3	6	9	12

The coefficient a_2 determines the lateral contraction or dilatation of the directivity pattern. See Table B.3.

Table B.3 — Contraction or dilatation of the directivity pattern

Parameter	Contraction		Dilatation
l	–1	0	1
a_2 dB	–3	0	3

The coefficient a_3 adds a delta-shaped distortion to the directivity pattern. See Table B.4.

Table B.4 — Distortion to the directivity pattern

Parameter	Contraction		Dilatation
m	–1	0	1
a_3 dB	–3	0	3

NOTE 1 If necessary, the classes can be expanded either by expanding the range of k, l, m or by adding a higher order coefficient.

NOTE 2 Most of the directivity pattern matches one the classes $R_{k,l,m}$ with angular maximum deviation of 3 dB.

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Bibliography

[1] ISO 1996-1:2003, *Acoustics — Description, measurement and assessment of environmental noise — Part 1: Basic quantities and assessment procedures*

[2] ISO 9613-1, *Acoustics — Attenuation of sound during propagation outdoors — Part 1: Calculation of the absorption of sound by the atmosphere*

[3] ISO 9613-2:1996, *Acoustics — Attenuation of sound during propagation outdoors — Part 2: General method of calculation*

[4] ISO/TR 25417:2007, *Acoustics — Definitions of basic quantities and terms*

[5] ISO 80000-8:2007, *Quantities and units — Part 8: Acoustics*

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

[7] NF S 31-010*, Acoustique — Caractérisation et mesurage des bruits de l'environnement — Méthodes particulières de mesurage* [Acoustics — Characterization and measurement of environmental noise — Special methods of measurement]

[8] NF S 31-110, *Acoustique — Caractérisation et mesurage des bruits de l'environnement — Grandeurs fondamentales et méthodes générales d'évaluation* [Acoustics — Characterization and measurement of environmental noise — Fundamental quantities and general methods of evaluation]

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