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Acoustics -- Description and measurement of environmental noise -- Part 2: Acquisition of data pertinent to land use

Acoustique -- Caractérisation et mesurage du bruit de l'environnement -- Partie 2: Saisie des données pertinentes pour l'utilisation des sols

Ta slovenski standard je istoveten z: ISO 1996-2:1987

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13.140	Vpliv hrupa na ljudi	Noise with respect to human beings
17.140.01	Akustična merjenja in blaženje hrupa na splošno	Acoustic measurements and noise abatement in general

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INTERNATIONAL STANDARD

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INTERNATIONAL ORGANIZATION FOR STANDARDIZATION
ORGANISATION INTERNATIONALE DE NORMALISATION
МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ

Acoustics — Description and measurement of environmental noise —

Part 2 : Acquisition of data pertinent to land use

Acoustique — Caractérisation et mesurage du bruit de l'environnement —

Partie 2 : Saisie des données pertinentes pour l'utilisation des sols

Reference number
ISO 1996-2 : 1987 (E)

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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 1996-2 was prepared by Technical Committee ISO/TC 43, *Acoustics*.

ISO 1996-2 together with ISO 1996-1 : 1982 and ISO 1996-3 : 1987 cancel and replace ISO Recommendation R 1996 : 1971, of which they constitute a technical revision.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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Acoustics — Description and measurement of environmental noise —

Part 2 :
Acquisition of data pertinent to land use

0 Introduction

0.1 ISO 1996 comprises the following three parts :

Part 1 : Basic quantities and procedures.

Part 2 : Acquisition of data pertinent to land use.

Part 3 : Application to noise limits.

0.2 This part of ISO 1996 describes methods to be used for measuring and describing environmental noise relevant to general land use.

The use of different measuring methods, such as continuous integration, sampling techniques and measurements under selected meteorological conditions, is considered. Calculation methods or scale model investigations may also be used.

This part of ISO 1996 does not deal in detail with calculation methods. If, however, such methods are used to obtain data pertinent to land use, it is important that the noise be described in a way that is consistent with the requirements of this part of ISO 1996.

The purpose of this part of ISO 1996 is to provide methods for the acquisition of data for describing environmental noise. Using these data as a basis, authorities may establish a system for selecting the appropriate land use, as far as levels of noise are concerned, for a specified area, or the sources of noise — existing or planned — which are acceptable with respect to land use, existing or planned.

This part of ISO 1996 does not give guidance on the estimation of the overall uncertainty of the results, but this should be considered in each specific case, if possible.

It does not specify noise limits.

1 Scope and field of application

This part of ISO 1996 describes methods for the acquisition of data which provide descriptors that enable

a) a description of the environmental noise in a specified area of land to be made in a uniform way;

b) the compatibility of any land use activity or projected activity to be assessed with respect to existing or predicted noise.

2 References

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

IEC Publication 651, *Sound level meters.*

IEC Publication 804, *Integrating-averaging sound level meters.*

3 Definitions

For the purposes of this part of ISO 1996, the definitions given in ISO 1996-1 together with the following definitions apply.

3.1 land use : An existing or intended use of a delineated area of land.

3.2 noise zone : Region where the long-term average rating level lies between two specified levels such as, for example, between 65 and 70 dB. The noise zone number for this example is 65-70 dB.

3.3 receiver : Person or group of persons who are or who are expected to be exposed to environmental noise.

4 Acquisition of data

For the purpose of acquisition of data relevant to land use, the following basic information is required :

a) geographical description of the area under consideration;

1) Cross-references to specific clauses, sub-clauses, etc. in ISO 1996-1 apply to the first edition published in 1982.

b) description of the main characteristics of the sources of noise pertinent to this area;

c) description of the situation of the receiver, such as location, occupation, use and features of the immediate surroundings.

NOTE — If possible, information on prevailing meteorological conditions in the area under consideration should be given, preferably as statistical information on wind speed and direction, on precipitation and temperature (including the occurrence of temperature inversions) for a typical time interval, such as a year or any other suitable time interval.

4.1 Acoustical data

4.1.1 General

Basic acoustical data are equivalent continuous A-weighted sound pressure levels determined over the reference time intervals and rating levels for the same reference time intervals with additional information on the characteristics of the noise, if required.

4.1.2 Rating level

The rating level shall be determined over reference time intervals related to the characteristics of the source(s) and receiver(s).

The rating level, $(L_{Ar,T})_i$, for each reference time interval, is given by the formula

$$(L_{Ar,T})_i = (L_{Aeq,T})_i + K_{1i} + K_{2i}$$

where

$(L_{Aeq,T})_i$ is the equivalent continuous A-weighted sound pressure level during the ith reference time interval;

K_{1i} is a tone adjustment applicable to the ith reference time interval;

K_{2i} is an impulse adjustment applicable to the ith reference time interval.

NOTE — If the tone or impulse characteristics are present for only a part of the reference time interval, the values of K_1 and K_2 may be adjusted to take account of the duration.

4.1.3 Tone adjustment, K_1

If tonal components are essential characteristics of the sound within a specified time interval, an adjustment may be applied, for that time interval, to the measured equivalent continuous A-weighted sound pressure level. The value of this adjustment shall be stated.

NOTE — In some practical cases, a prominent tonal component may be detected in one-third octave spectra if the level of a one-third octave band exceeds the level of the adjacent bands by 5 dB or more, but a narrow-band frequency analysis may be required in order to detect precisely the occurrence of one or more tonal components in a noise signal. If tonal components are clearly audible and their presence can be detected by a one-third octave analysis, the adjustment may be 5 to 6 dB. If the components are only just detectable by the observer and demonstrated by narrow-band analysis, an adjustment of 2 to 3 dB may be appropriate.

4.1.4 Impulse adjustment, K_2

If impulse is an essential characteristic of the sound within a specified time interval, an adjustment may be applied, for this time interval, to the measured equivalent continuous A-weighted sound pressure level. The value of this adjustment shall be stated.

NOTES

1 A method of describing the impulse characteristic of the sound within the specified time interval is to measure the difference between the A-weighted sound pressure level, determined with time-weighting characteristic I averaged over the same time interval, and $L_{Aeq,T}$. The sound pressure levels should be determined simultaneously. The character of the noise may be further illustrated by determining the peak level and the number of impulses during a specified time interval.

2 For large-amplitude noise, such as the noise generated by sonic booms, mining or quarry blasts, measurements with C-weighting are used in some countries to determine the rating level.

4.2 Meteorological adjustment

To extrapolate from a value of the equivalent continuous A-weighted sound pressure level measured under selected meteorological conditions to a long-term value, a meteorological adjustment may be used (see 5.3 in ISO 1996-1).

4.3 Long-term average sound level

The long-term average sound level, $L_{Aeq,LT}$, in decibels, for a given reference time interval, is given by the following formula :

$$L_{Aeq,LT} = 10 \lg \left[\frac{1}{N} \sum_{i=1}^{N} 10^{0,1\,(L_{Aeq,T})_i} \right]$$

where

N is the number of samples of the reference time interval;

$(L_{Aeq,T})_i$ is the equivalent continuous A-weighted sound pressure level in the ith sample, in decibels.

4.4 Long-term average rating level

The long-term average rating level, $L_{Ar,LT}$, in decibels, for a given reference time interval, is given by the following formula :

$$L_{Ar,LT} = 10 \lg \left[\frac{1}{N} \sum_{i=1}^{N} 10^{0,1\,(L_{Ar,T})_i} \right]$$

where

N is the number of samples of the reference time interval;

$(L_{Ar,T})_i$ is the rating level in the ith sample, in decibels.

4.5 Percentile level

In some cases, it may be desirable to describe a noise situation by the use of both the equivalent continuous A-weighted sound pressure level and the distribution of A-weighted sound pressure levels. For this purpose, percentile levels such as L_{95}, L_{50} and L_5 may be determined.

5 Determination of long-term average sound level and long-term average rating level

5.1 General

In general, these quantities are determined from measurements and/or calculations. The results shall be representative of the sound pressure level at a specified location. The measurement technique used, for example the instrumentation, the number of microphone positions, the number and duration of measurement time intervals, depends on the nature of the sound sources and the receivers, and on the significance of the results for land use.

Results that include contributions from exceptional sounds that are not typical for the noise received at a specified location shall be stated separately, if necessary.

5.2 Instrumentation

See clause 4 in ISO 1996-1.

The instrument used shall comply with the specifications for sound level meters, preferably of type 1, but at least of type 2, given in IEC Publication 651. Integrating-averaging sound level meters shall be as specified in IEC Publication 804.

If a recording device (e.g. a tape recorder, digital recorder, etc.) is used, its effect on the accuracy of the measurements shall be taken into account.

5.3 Location and number of measurement positions

5.3.1 General

The measurement of equivalent continuous A-weighted sound pressure levels shall be carried out at those outdoor locations that are appropriate for the acoustical description of the environment under consideration. The measurement positions shall be indicated on a map.

The location and number of measurement positions will depend on the required spatial resolution for the environment under consideration.

The measurement positions may be

a) chosen at approximately equally spaced positions over the area under consideration (e.g. at the intersections of grid lines on the map) — contours of equal levels of noise can be drawn by interpolation between the points;

b) representative of the average level of a specified zone or area (e.g. taking into account local shielding effects, topographical features, etc.);

c) at locations which characterize the noise which results from emissions by various sources that can be identified in the area under consideration; this allows noise to be determined at other locations in the area by means of calculations based on the propagation of sound.

5.3.2 Microphone position

The height of the microphone shall be chosen according to the actual or expected height of the receiver. In potentially built-up areas, the preferred measurement height shall be 3 to 11 m. In all other cases, see 5.2.1 in ISO 1996-1.

NOTE — By choosing the greater measurement height, the influence of ground effects and low barriers is reduced and the reproducibility is improved, but the measured level will generally be higher than that measured close to the ground.

In the case of outdoor measurements near buildings, measurements shall be carried out at locations where the noise to which a building is exposed is of interest. Unless otherwise specified, the preferred measurement positions are 1 to 2 m from the façade, and 1,2 to 1,5 m above each floor level of interest.

If it is desired to minimize the influence of reflections, measurements should, whenever possible, be made at least 3,5 m away from any reflecting structure or 0,5 m in front of an open window.

NOTE — If measurements are made 1 to 2 m in front of the façade of a building and the noise spectrum is of broad-band type with no dominating narrow band or pure tone, an approximation to the incident sound pressure level may be obtained by subtracting 3 dB from the measured value. If measurements are made in the plane of the façade at least 3,5 m from the edge of the façade, no corrections need be made. To characterize the effects of the walls of a proposed building, the addition of 3 dB to the free-field values may be useful in order to determine the sound pressure level near the walls.

The heights of the microphones shall be stated in the test report.

The microphone should be orientated to be most uniformly sensitive to the incident sound.

5.3.3 Location of grid points in an area

The density of grid points in an area depends on the spatial resolution required for the study concerned and the spatial variation of sound pressure levels of the noise. This variation is strongest in the vicinity of sources and large obstacles. The density of grid points should, therefore, be higher in these places. In general, the difference in sound pressure levels between adjacent grid points should not be greater than 5 dB. If significantly higher differences are encountered, intermediate grid points shall be used.

5.3.4 Location(s) representative of an area

If spatial variations of the sound pressure level are small, or only a small area is under consideration, location(s) may be selected

such that measurements will be representative for the whole area. A preliminary survey may be useful to identify such location(s).

5.3.5 Locations used for the description of sources

If it is desired to evaluate the contributions of various sound sources individually or as a class, measurement positions should usually be chosen in the vicinity of each of the sources in order to reduce the influence of the others.

The sound pressure level of the noise at the other positions can be estimated by interpolation and extrapolation, taking due account of attenuation as a result of the geometrical spreading of the sound, atmospheric absorption, ground effects, screening effects, etc.

NOTE — The number of measurement positions can be reduced when interpolation is possible by means of a suitable propagation model which permits the calculation of sound pressure levels at intermediate positions.

5.4 Selection of time intervals

5.4.1 Reference time interval

For the selection of appropriate reference and measurement time intervals, it may be necessary to investigate the noise situation over relatively long time periods during which survey measurements may be taken.

Reference time intervals shall be specified to cover typical human activities and variations in the operation of the source, e.g. density of traffic and working hours for industrial plants.

In relation to human activities, one reference time interval may be chosen for the day and another for the night. Reference time intervals for evenings, for weekends and for holidays may also be established.

When different human activities take place in a single reference time interval, an adjustment to the levels, as a function of the time at which these activities take place, may be introduced when determining the rating level for that reference time interval. Any such adjustments and the time intervals to which they were applied shall be recorded in the test report.

5.4.2 Long-term time interval

For the purpose of land use, it is the responsibility of the cognizant authority also to specify the long-term time interval. The choice of the long-term time interval is related to the noise control objective, the nature and activity of the receiver, the operation of the sources and variations in propagation conditions.

NOTE — The long-term time interval should be chosen so that long-term variations in noise emission are covered. It will frequently be of the order of several months. If the noise situation considered is restricted to a well defined part of the year, for example summertime with special activities, the long-term time interval may be restricted to that part of the year.

5.4.3 Measurement time intervals

5.4.3.1 Measurement time intervals shall be chosen so that all significant variations of noise emission and transmission are covered. Furthermore, the choice of the measurement time intervals shall be such that the long-term average sound level or rating level is determined with the desired accuracy.

5.4.3.2 If the noise displays a clear periodicity, the measurement time intervals shall cover at least one period. If continuous measurements over this period cannot be made, measurement time intervals shall be chosen so that each represents a part of the cycle and so that, together, they represent the complete cycle.

If the sound pressure level varies stepwise, the measurement time intervals shall be selected so that each represents a period within which the noise level may be considered to be approximately steady.

If the noise varies at random, measurement time intervals shall be chosen so as to give sufficient independent samples to give a significant estimation of the long-term average sound level.

If the noise is of the fly-over or pass-by type (i.e. the noise varies during the fly-over and is absent during a considerable portion of the reference time interval), measurement time intervals shall be chosen so that the sound exposure level, L_{AE}, of the fly-over or pass-by can be determined.

5.4.3.3 To facilitate the comparison of results, it may be convenient to carry out measurements under selected meteorological conditions which are reproducible and correspond to quite stable sound propagation conditions. In particular, when there is one dominant source, it may be convenient to choose meteorological conditions which correspond to enhanced propagation from the source to the receiver and/or to the specified area and to adopt measurement time intervals corresponding to the following conditions :

— wind direction within an angle of $\pm$ 45° of the direction connecting the centre of the dominant sound source and the centre of the specified area, with the wind blowing from the source to the receiver;

— wind speed between 1 and 5 m/s, measured at a height of 3 to 11 m above the ground;

— no strong temperature inversions near the ground;

— no heavy precipitation.

NOTES

1 It should always be ascertained that the wind noise at the microphone does not interfere with the measurements.

2 There will be systematic differences between the results of measurements under selected meteorological conditions and those obtained under random meteorological conditions. Compensation can be made for these systematic differences by the use of a meteorological adjustment of the rating level.

5.5 Acquisition of acoustical data

5.5.1 General

The acoustical data are acquired during the measurement time interval. Two methods can be used to acquire the data (see 5.5.2 and 5.5.3).

5.5.2 Continuous integration

In this method, the measurement time interval covers the whole reference time interval except for time intervals where the measurement conditions could lead to erroneous results, e.g. in periods of strong wind, heavy rain, or contributions of non-typical noise.

NOTE — This method gives the maximum accuracy, but the gain in accuracy compared with that obtained with sampling techniques cannot always be justified in relation to the increase in the overall measurement efforts.

5.5.3 Sampling techniques

The long-term values of the equivalent continuous A-weighted sound pressure level and the rating level are calculated from samples of measurement time intervals within the reference time interval.

In this case, the total measurement time interval will only be a fraction of the reference time interval and will consist of a number of distinct time intervals separated by intervals where no measurement is performed.

5.6 Long-term average sound level and long-term average rating level

From the results obtained according to 5.2 to 5.5, the long-term average sound level can be calculated as specified in 4.3 and the long-term average rating level can be calculated as specified in 4.4.

6 Prediction of noise levels

In many cases, the purpose of describing environmental noise is to predict the noise arising from planned, but non-existent, installations, such as industrial plants, and facilities for road, air and rail traffic.

In such situations, the problems should be approached through the use of suitable methods of calculation or by scale model investigations.

As universally agreed prediction models do not exist, the method adopted should be carefully described in each case.

NOTE — When available, prediction models accepted by relevant authorities should be used.

7 Noise zones, representation of results

In addition to reporting the results of measurements of existing environmental noise and the results of calculations of noise from projected activities, a presentation in terms of noise zones may be useful. It is recommended that contours indicating boundaries between zones in multiples of 5 dB be used. Reference to zones should be made by quoting the upper and lower noise limits, in decibels.

If the different zones are identified on a map of the area under consideration by means of colours or hatching, it is recommended that the combination of colours (or hatching) and classes specified in table 1 be used.

NOTE — In some cases, it may be sufficient to use a zone width of 10 dB; in such cases, colours (or hatching) as specified in table 2 should be used.

Table 1

Noise zone dB	Colour	Hatching
Below 35	Light green	Small points, low density
35 to 40	Green	Medium points, medium density
40 to 45	Dark green	Big points, high density
45 to 50	Yellow	Vertical lines, low density
50 to 55	Ochre	Vertical lines, medium density
55 to 60	Orange	Vertical lines, high density
60 to 65	Cinnabar	Cross-hatching, low density
65 to 70	Carmine	Cross-hatching, medium density
70 to 75	Lilac red	Cross-hatching, high density
75 to 80	Blue	Broad vertical stripes
80 to 85	Dark blue	Completely black

Table 2

Noise zone dB	Colour	Hatching
Below 45	Green	Medium points, medium density
45 to 55	Yellow	Vertical lines, low density
55 to 65	Orange	Vertical lines, high density
65 to 75	Red	Cross-hatching, medium density
75 to 85	Blue	Broad vertical stripes