TECHNICAL SPECIFICATION

ISO/TS 13475-2

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Acoustics — Stationary audible warning devices used outdoors —

Part 2: Precision methods for determination of sound emission quantities

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Acoustique — Dispositifs d'alarme sonore fixes utilisés à l'extérieur — Partie 2: Méthodes de laboratoire pour le mesurage des grandeurs d'émission acoustique

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of normative document:

— an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;

— an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote.

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An ISO/PAS or ISO/TS is reviewed every three years with a view to deciding whether it can be transformed into an International Standard.

Attention is drawn to the possibility that some of the elements of this part of ISO 13475 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 13475 consists of the following parts, under the general title *Acoustics — Stationary audible warning devices used outdoors*:

— *Part 1: Field measurements for determination of sound emission quantities*

— *Part 2: Precision methods for determination of sound emission quantities*

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Introduction

ISO 13475-1 describes field measurements. The test methods are intended to produce field test values of the sound emission level of the siren as it is installed in an outdoor situation. These field test values may, within the uncertainties, be used to control the specifications of delivered sirens, or to compare the performance of different sirens under the same conditions emitting the same signals.

ISO/TS 13475-2 describes precision measurements. This method is intended to produce generally valid specification of sirens for type tests, acceptance test or for use in the design of outdoor warning systems, etc.

In this part of ISO 13475, two types of precision measurements are discussed. They are:

a) **free-field measurements**, which are applicable to measurements in an anechoic chamber or outdoors at large height;

b) **measurements in a free field over a reflecting plane**, which are applicable to measurements in semi-anechoic rooms or outdoors using a flat plate with perpendicular sound incidence (free field with one reflecting plane).

In addition to the tests described in this part of ISO 13475, further tests may be relevant (e.g. tests for the influence of and resistance to cold, heat, humidity, electromagnetic fields, shock and vibration and long-term performance tests). Test methods for phenomena other than acoustic performance are not included in this part of ISO 13475.

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Measurements made under optimal conditions in conformity with ISO 13475 should result in the expanded uncertainties given in Table 1.

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Table 1 — Uncertainty in the determination of immission-relevant C-weighted sound power levels for stationary audible warning devices

Reference	Measurement method	Expected expanded uncertainty
Part 1: Field measurements	Flat plate	2 dB
	Horizontal	4 dB
Part 2: Precision measurements	—	1 dB

The expanded uncertainty for actual measurement conditions, taking into account the cumulative effect of all causes of measurement uncertainty, can be found in annex B.

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Acoustics — Stationary audible warning devices used outdoors —

Part 2:
Precision methods for determination of sound emission quantities

1 Scope

This part of ISO 13475 specifies the test conditions under which the acoustic emission levels of stationary audible warning devices may be obtained. It is applicable to sirens for use in outdoor public warning systems and sound signalling devices for use outdoors.

The purpose of this test code is to be able to produce reliable sound emission level measurements for stationary sirens to be used outdoors.

This part of ISO 13475 does not cover spoken messages and contains no recommendations for specific warning signals.

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2 Normative references

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The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 13475. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 13475 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 3745, *Acoustics — Determination of sound power levels of noise sources using sound pressure — Precision methods for anechoic and semi-anechoic rooms.*

IEC 60942:1997, *Electroacoustics — Sound calibrators*.

IEC 61260:1995, *Electroacoustics — Octave-band and fractional-octave-band filters.*

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

3 Terms and definitions

For the purposes of this part of ISO 13475, the following terms and definitions apply.

3.1
siren
audible warning device for use outdoors

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1) To be published. (Revision of IEC 60651 and IEC 60804)

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3.2
electronic siren
siren that produces tonal sounds by amplifying the output of an electronic signal generator and broadcasting the amplified signal from one or more electrodynamic loudspeakers

NOTE Such sirens may also be used for giving voice messages.

3.3
electromechanical siren
siren that produces tonal sounds by flow interruptions generated in a rotating wheel

NOTE Electromechanical sirens are mechanical sirens driven by an electric motor.

3.4
pneumatic siren
siren that produces sound by periodically interrupting or modulating a flow of compressed air

NOTE The air compressor may be integrated with or separate from the flow interrupter.

3.5
horizontally omnidirectional siren
siren that radiates sound approximately uniformly (within a specified tolerance) in all horizontal directions from the siren at the specified frequency of the sound

3.6
directional siren
siren that radiates most of its sound in one or more specific directions

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3.7
rotating or oscillating siren
directional siren that contains a mechanism which slowly rotates its beam of sound about a vertical axis

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3.8
immission-relevant sound power level
sound power level from a monopole source that would give the same sound pressure level in the far field as the actual source

NOTE 1 It is expressed in decibels (ref. 1 pW).

NOTE 2 No information concerning the total radiated power can be drawn from $L_{W,\mathrm{imm}}$.

3.9
near field
that part of the sound field with significant interaction between different parts of the siren source

NOTE The sound pressure decay with distance does not follow the inverse square law in the acoustic near field.

3.10
far field
that part of the sound field with insignificant interaction between parts of the siren

NOTE The sound pressure decay with distance follows the inverse square under acoustic free-field conditions.

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4 Symbols

L_{pC} C-weighted sound pressure level (ref. 20 µPa), in decibels

L_p sound pressure level, in decibels

$L_{pCeq,T}$ equivalent C-weighted sound pressure level, in decibels, over a time period T

$L_{pCmax,F}$ maximum C-weighted sound pressure level, in decibels, measured with time weighting F

$L_{W,imm}$ immission-relevant sound power level (ref. 1 pW), in decibels

$L_{WC,imm}$ C-weighted immission-relevant sound power level (ref. 1 pW), in decibels

5 Measurement methods

5.1 General

Two methods for the performance of measurements are described: the free-field method and the flat-plate method. Both methods may be used indoors or outdoors. In all cases the measuring distance shall be chosen in accordance with 5.2.

Measurements of the sound pressure levels produced from outdoor sirens in far-field areas, i.e. at distances larger than 200 m, similar to that defined in this part of ISO 13475, vary widely instant by instant. These variations are due to varying ground cover, localized and regional thermal effects and gradients, phase coherence of the siren, wind conditions, ground surface effects, etc. If applying the results gained from this precision method to an actual planning of a warning system, the large variations due to the above-mentioned effects shall be taken into account.

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5.2 Microphone positions

Microphone positions shall be chosen on the qualified measurement line, in accordance with the procedure given in annex C. Windshields shall be used for all outdoor measurements. When choosing the measuring distance, d, the influence of the near-field effects shall be taken into account. A measuring position outside the near field is preferred. This can be fulfilled through relationship (1):

$$d \geqslant (l^2 f)/c \quad (1)$$

where

l is the largest vertical dimension of the sound opening (according to 7.3.2.2 and Figure 6);

f is the highest frequency of interest;

c is the speed of sound.

If the microphone cannot be located outside of the near field, the location shall fulfil the requirement of relationship (2):

$$d > (l^2 f)/4{,}5\, c \quad (2)$$

Corrections to the signal output shall then be applied according to 7.3.2.2.

The maximum distance between the siren and the microphone shall not exceed 50 m.

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5.3 Free-field method

5.3.1 General

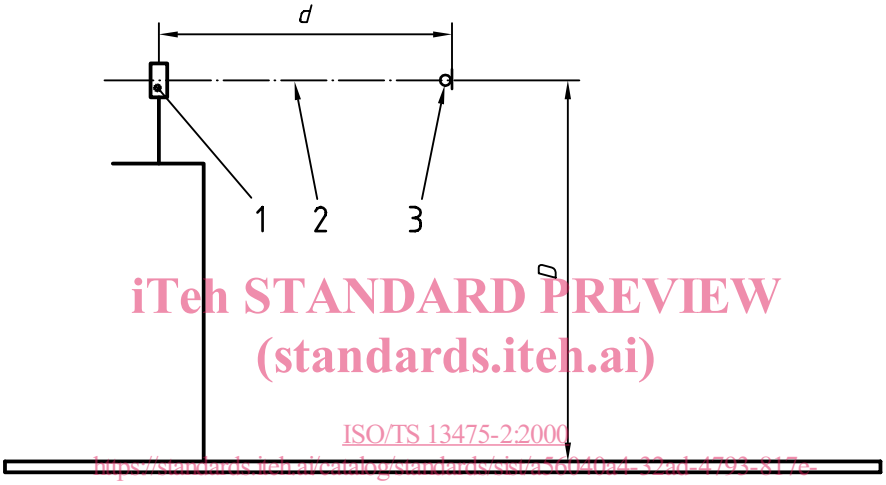
The free-field method may be performed either in an anechoic chamber or outdoors under conditions giving practically no influence from reflecting surfaces (see Figure 1 and annex C).

5.3.2 Anechoic chamber

The test room shall be large enough to comply with the requirements given in 5.2.

5.3.3 Free-field measurement at large height

A typical set-up for a free-field test at large height is shown in Figure 1.



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Key

1 Siren
2 Measurement line
3 Microphone

D is the distance from the reflecting surface
d is the measurement distance

Figure 1 — Outdoor test site

For an outdoor test site to qualify for measurements conforming to this part of ISO 13475, the relevant measuring line shall be in accordance with the requirements given in 5.2.

NOTE Distance $D > 5\,d$ to the nearest reflecting surface is usually sufficient.

5.4 Measurements in a free field over a reflecting plane

5.4.1 General

The flat-plate method may be performed either in a semi-anechoic room or outdoors as shown in Figure 2. The absorption coefficient of the hard surface shall be less than 0,06 over the frequency range of interest.

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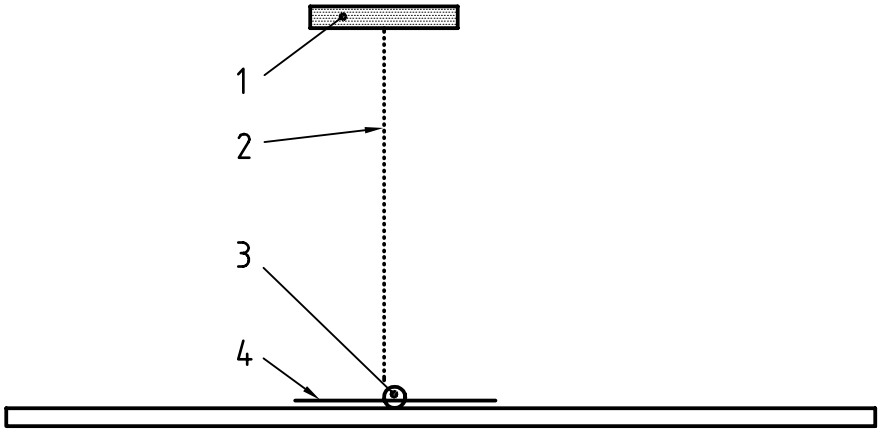

Key

1 Siren
2 Measurement line
3 Microphone
4 Flat plate or hard surface in semi-anechoic room

Figure 2 — Flat-plate method

The microphone shall be placed on a hard surface as shown in Figures 3, 4 and 5.

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A metal plate of 2,5 mm thickness fulfils the requirement for an absorption coefficient of less than 0,06. Although this plate is shown in Figures 3 to 5, it is optional if the surface beneath fulfils the requirements.

Since this measurement method doubles the sound pressures relative to free-field measurements due to reflections from the flat plate, it is necessary to subtract 6 dB from the sound pressure level measured ($L_{p,\mathrm{meas}}$) on the flat plate (see 7.3.2.1).

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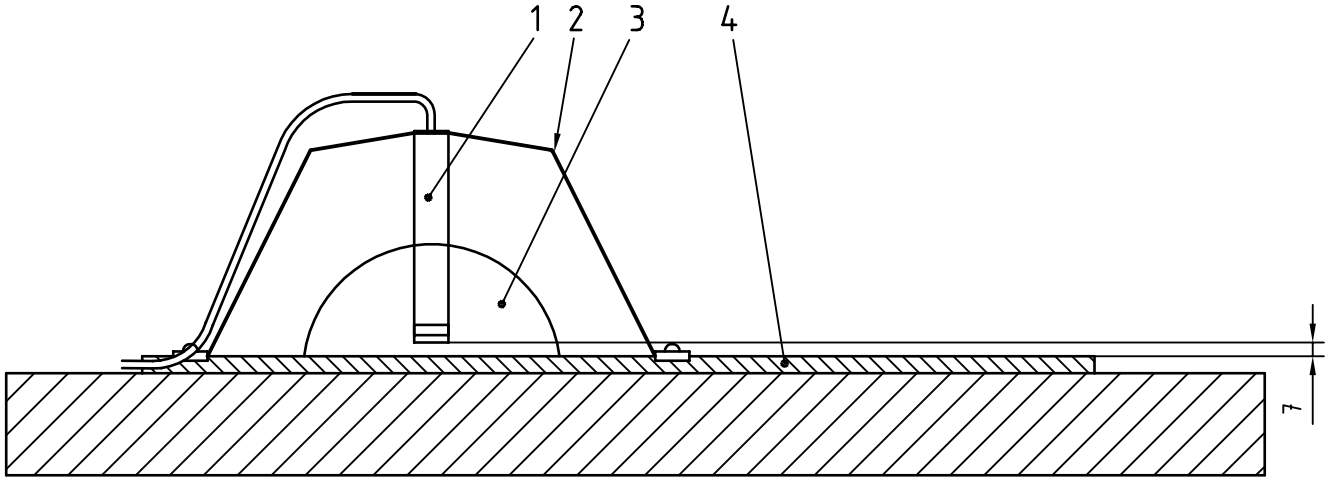
Dimension in millimetres



Key

1 Microphone
2 Steel wire of 3-mm diameter, e.g. 3 pieces
3 Windshield
4 Hard plate

Figure 3 — Inverted microphone (in accordance with reference [3])

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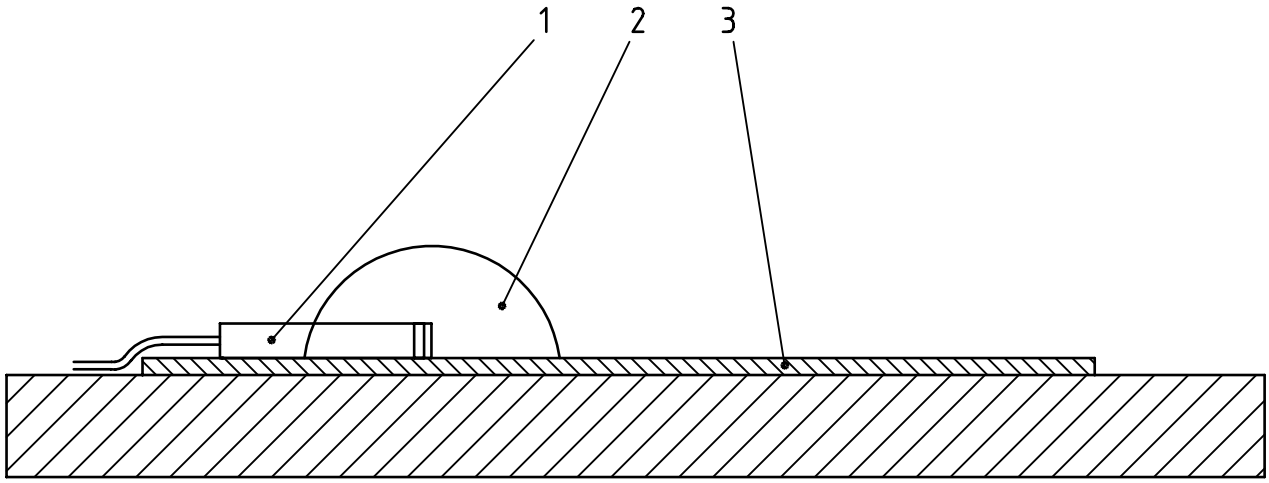

Key

1 Microphone
2 Windshield
3 Hard plate

Figure 4 — Microphone on its side

Dimension in metres

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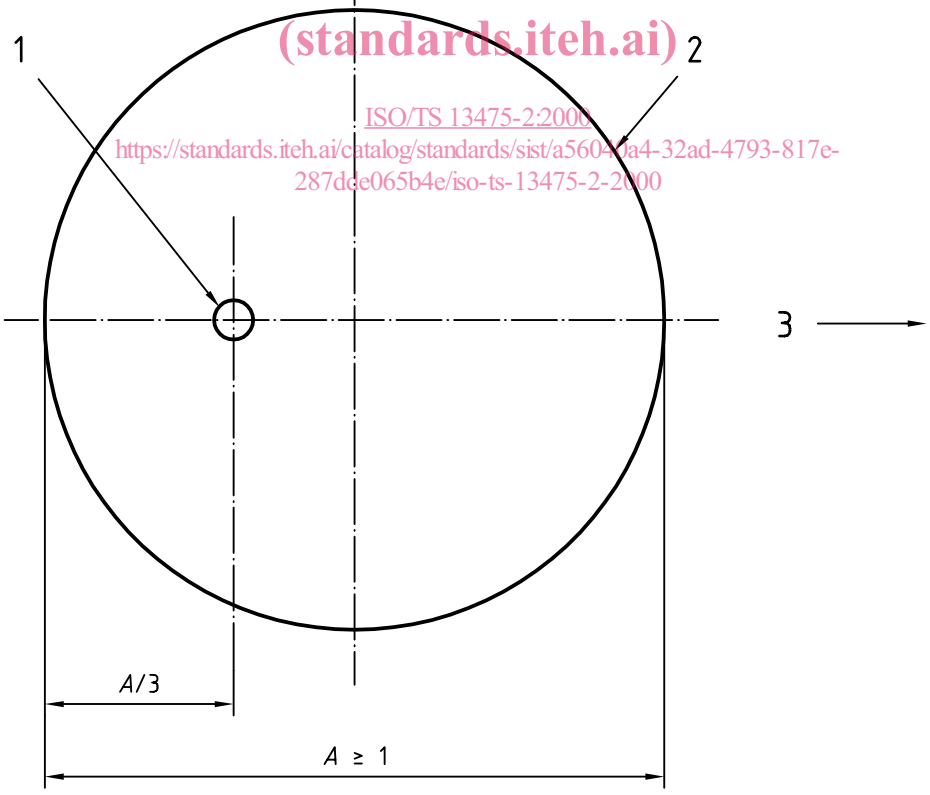

Key

1 Microphone location
2 Hard plate
3 Warning device

Figure 5 — Microphone location: Plan view of plate to be used outdoors

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