

Acoustics — Determination of sound power levels of noise sources using sound pressure — Survey method using an enveloping measurement surface over a reflecting plane

The European Standard EN ISO 3746:1995 has the status of a British Standard

ICS 17.140.10

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The preparation of this British Standard was entrusted to Technical Committee EH/1, Acoustics, upon which the following bodies were represented:

- Association of Consulting Engineers
- British Broadcasting Corporation
- British Occupational Hygiene Society
- British Telecommunications plc
- Department of the Environment (Building Research Establishment)
- Department of Health
- Department of Trade and Industry (National Physical Laboratory)
- Health and Safety Executive
- Institute of Acoustics
- Institute of Occupational Hygienists
- Institute of Sound and Vibration Research
- Institution of Electrical Engineers
- Royal Institute of British Architects
- Society of Environmental Engineers

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

- Advanced Manufacturing Technology Research Institute
- Agricultural Engineers Association
- British Cement Association
- British Compressed Air Society
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- British Iron and Steel Producers Association
- Construction Industry Research and Information Association
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- Federation of Piling Specialists
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- Rotating Electrical Machines Association
- University of Liverpool
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Contents

	Page
Committees responsible	Inside front cover
National foreword	iii
Foreword	2
Introduction	3
1 Scope	5
2 Normative references	6
3 Definitions	7
4 Acoustic environment	8
5 Instrumentation	8
6 Installation and operation of source under test	9
7 Measurement of sound pressure levels	10
8 Calculation of A-weighted surface sound pressure level and A-weighted sound power level	14
9 Information to be recorded	15
10 Information to be reported	16
Annex A (normative) Qualification procedures for the acoustic environment	17
Annex B (normative) Microphone array on the hemispherical measurement surface	20
Annex C (normative) Microphone array on the parallelepiped measurement surface	23
Annex D (informative) Guidelines for the detection of impulsive noise	27
Annex E (informative) Bibliography	28
Figure 1 — Examples illustrating reference boxes and characteristic source dimensions d_0 with respect to the origin of the coordinate system Q	12
Figure A.1 — Environmental correction K_{2A} , in decibels	18
Figure B.1 — Microphone array on the hemisphere — Key microphone positions	20
Figure B.2 — Microphone array on the hemisphere	21
Figure B.3 — Plan view of a spherical measurement surface and microphone positions around a reference box adjacent to two reflecting planes	22
Figure C.1 — Procedure for fixing the specified microphone positions where a side of the measurement surface exceeds $3d$	23
Figure C.2 — Example of a measurement surface and microphone positions for a small machine	23
Figure C.3 — Example of a measurement surface and microphone positions for a tall machine with a small base area	24
Figure C.4 — Example of a measurement surface and microphone positions for a long machine	24
Figure C.5 — Example of a measurement surface and microphone positions for a medium-sized machine	25
Figure C.6 — Example of a measurement surface and microphone positions for a large machine	26
Figure C.7 — Measurement surface (parallelepiped) with four microphone positions for floor-standing appliances placed against a wall	26
Figure C.8 — Measurement surface (parallelepiped) with three microphone positions for floor-standing appliances placed against two walls	27

	Page
Table 0.1 — Overview of International Standards for determination of sound power levels of noise sources using enveloping surface methods over a reflecting plane and giving different grades of accuracy	4
Table 1 — Estimated upper values of the standard deviations of reproducibility of A-weighted sound power levels determined in accordance with this International Standard	5
Table A.1 — Approximate values of the mean sound absorption coefficient α	19
Table B.1 — Coordinates of key microphone positions (4, 5, 6, 10) and additional microphone positions (14, 15, 16, 20)	20
Table B.2 — Coordinates of microphone positions (4, 5, 6, 10) for sources emitting discrete tones	20
List of references	Inside back cover

National foreword

This British Standard has been prepared by Technical Committee EH/1 and is the English language version of EN ISO 3746:1995 *Acoustics — Determination of sound power levels of noise sources using sound pressure — Survey method using an enveloping measurement surface over a reflecting plane*, published by the European Committee for Standardization (CEN). It is identical with ISO 3746:1995 including Technical Corrigendum 1:1995 published by the International Organization for Standardization (ISO).

This British Standard supersedes BS 4196-6:1981 which is withdrawn.

Cross-references

Publication referred to	Corresponding British Standard
ISO 354:1985	BS EN 20354:1993 <i>Acoustics. Measurement of sound absorption in a reverberation room</i>
ISO 3744:1994	BS EN ISO 3744:1995 <i>Acoustics. Determination of sound power levels of noise sources using sound pressure. Engineering method in an essentially free field over a reflecting plane</i>
	BS 4196 <i>Sound power levels of noise sources</i>
ISO 3745:1977	Part 5:1981 <i>Precision methods for determination of sound power levels for sources in anechoic and semi-anechoic rooms</i>
ISO 3747:1987	Part 7:1988 <i>Survey method for determination of sound power levels of noise sources using a reference sound source</i>
ISO 6926:1990	Part 8:1991 <i>Specification for the performance and calibration of reference sound sources</i>
	BS 6805 <i>Statistical methods for determining and verifying stated noise emission values for machinery and equipment</i>
ISO 7574-1:1985	Part 1:1987 <i>Glossary of terms</i>
ISO 7574-4:1985	Part 4:1987 <i>Methods for determining and verifying stated values for batches of machines</i>
IEC 651:1979	BS EN 60651:1994 <i>Specification for sound level meters</i>
IEC 804:1985	BS EN 60804:1994 <i>Specification for integrating-averaging sound level meters</i>
IEC 942:1988	BS 7189:1989 <i>Specification for sound calibrators</i>

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Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, the EN title page, pages 2 to 28, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

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Descriptors: Acoustics, sound sources, noise (sound), engine noise, tests, acoustic tests, determination, sound pressure, sound power, acoustic measurements

English version

Acoustics — Determination of sound power levels of noise sources using sound pressure — Survey method using an enveloping measurement surface over a reflecting plane

(ISO 3746:1995)

Acoustique — Détermination des niveaux de puissance acoustique émis par les sources de bruit à partir de la pression acoustique — Méthode de contrôle employant une surface de mesure enveloppante au-dessus d'un plan réfléchissant
(ISO 3746:1995)

Akustik — Bestimmung der Schalleistungspegel von Geräuschquellen aus Schalldruckmessungen — Hüllflächenverfahren der Genauigkeitsklasse über einer reflektierenden Ebene
(ISO 3746:1995)

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Foreword

The text of the International Standard ISO 3746:1995 has been prepared by Technical Committee ISO/TC 43, Acoustics, in collaboration with CEN/TC 211, Acoustics.

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 February 1996, and conflicting national standards shall be withdrawn at the latest by February 1996.

This European Standard has been prepared under a Mandate given to CEN by the Commission of the European Commission and the European Free Trade Association, and supports essential requirements of EC Directive(s).

According to the CEN/CENELEC Internal Regulations, the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

0.1 This International Standard is one of the ISO 3740 series, which specifies various methods for determining the sound power levels of machines, equipment and their sub-assemblies. When selecting one of the methods of the ISO 3740 series, it is necessary to select the most appropriate for the conditions and purposes of the noise test. General guidelines to assist in the selection are provided in ISO 3740. The ISO 3740 series gives only general principles regarding the operating and mounting conditions of the machine or equipment under test. Reference should be made to the test code for a specific type of machine or equipment, if available, for specifications on mounting and operating conditions.

0.2 This International Standard specifies a method for measuring the sound pressure levels on a measurement surface enveloping the source and for calculating the sound power level produced by the source. The enveloping surface method can be used for any of three grades of accuracy (see Table 0.1), and is used in this International Standard for grade 3 accuracy.

The use of this International Standard requires certain qualification criteria to be fulfilled as described in Table 0.1. If the relevant qualification criteria cannot be met, it might be possible to use ISO 3747 or ISO 9614.

Noise test codes for specific families of machines or equipment should be based without any contradiction on the requirements of one or more of the basic documents of the ISO 3740 or ISO 9614 series.

If measurements are made in typical machine rooms, where sources are normally installed, corrections may be required to account for background noise or undesired reflections.

The methods specified in this International Standard permit the determination of sound power level as an A-weighted value directly from the A-weighted sound pressure level measurements.

0.3 In this International Standard, the computation of sound power level from sound pressure level measurements is based on the premise that the sound power output of the source is directly proportional to the mean-square sound pressure averaged in time and space.

Table 0.1 — Overview of International Standards for determination of sound power levels of noise sources using enveloping surface methods over a reflecting plane and giving different grades of accuracy

Parameter	ISO 3745 Precision method Grade 1	ISO 3744 Engineering method Grade 2	ISO 3746 Survey method Grade 3
Test environment	Hemi-anechoic room	Outdoors or indoors	Outdoors or indoors
Criterion for suitability of test environment ^a	$K_2 \leq 0,5$ dB	$K_2 \leq 2$ dB	$K_2 \leq 7$ dB
Volume of sound source	Preferably less than 0,5 % of test room volume	No restriction: limited only by available test environment	No restriction: limited only by available test environment
Character of noise	Any (broad-band, narrow-band, discrete-frequency, steady, non-steady, impulsive)		
Limitation for background noise ^a	$\Delta L \geq 10$ dB (if possible, exceeding 15 dB) $K_1 \leq 0,4$ dB	$\Delta L \geq 6$ dB (if possible, exceeding 15 dB) $K_1 \leq 1,3$ dB	$\Delta L \geq 3$ dB $K_1 \leq 3$ dB
Number of measurement points	≥ 10	$\geq 9^b$	$\geq 4^b$
Instrumentation:			
a) Sound level meter at least complying with	a) type 1 as specified in IEC 651	a) type 1 as specified in IEC 651	a) type 2 as specified in IEC 651
b) Integrating sound level meter at least complying with	b) type 1 as specified in IEC 804	b) type 1 as specified in IEC 804	b) type 2 as specified in IEC 804
c) Frequency band filter set at least complying with	c) class 1 as specified in IEC 1260	c) class 1 as specified in IEC 1260	—
Precision of method for determining L_{WA} expressed as standard deviation of reproducibility	$s_R \leq 1$ dB	$s_R \leq 1,5$ dB	$s_R \leq 3$ dB (if $K_2 < 5$ dB) $s_R \leq 4$ dB (if $5 \text{ dB} \leq K_2 \leq 7 \text{ dB}$) If discrete tones are predominant, the value of s_R is 1 dB greater
^a The values of K_1 and K_2 given shall be met in each frequency band within the frequency range of interest for determining the sound power spectrum. For determining A-weighted sound power levels, the same criteria apply to K_{1A} and K_{2A} . ^b Under given circumstances, it is permissible to use a reduced number of microphone positions.			

1 Scope

1.1 General

This International Standard specifies a method for measuring the sound pressure levels on a measurement surface enveloping the source in order to calculate the sound power level produced by the noise source. It gives requirements for the test environment and instrumentation as well as techniques for obtaining the surface sound pressure level from which the sound power level of the source is calculated, leading to results which have a grade 3 accuracy.

It is important that specific noise test codes for various types of equipment be established and used in accordance with this International Standard. For each type of equipment, such noise test codes will give detailed requirements on mounting, loading and operating conditions for the equipment under test as well as a selection of the measurement surface and the microphone array as specified in this International Standard.

NOTE 1 The noise test code for a particular type of equipment should give detailed information on the particular surface that is selected, as the use of differently shaped measurement surfaces may yield differing estimates of the sound power level of a source.

1.2 Types of noise and noise sources

The method specified in this International Standard is suitable for measurements of all types of noise.

NOTE 2 A classification of different types of noise (steady, non-steady, quasi-steady, impulsive, etc.) is given in ISO 12001.

This International Standard is applicable to noise sources of any type and size (e.g. device, machine, component, sub-assembly).

NOTE 3 Measurements according to this International Standard may be impracticable for very tall or very long sources such as chimneys, ducts, conveyors and multisource industrial plants.

1.3 Test environment

The test environment that is applicable for measurements made in accordance with this International Standard may be located indoors or outdoors, with one or more reflecting planes present, meeting specified requirements.

1.4 Measurement uncertainty

For sources which radiate steady broad-band noise, determinations made in accordance with this International Standard result, with few exceptions, in standard deviations of reproducibility of the A-weighted sound power level equal to or less than 3 dB (if K_{2A} determined in accordance with annex A is lower than 5 dB) or 4 dB (if K_{2A} is within the range of 5 dB to 7 dB). For discrete-tone sources, the standard deviation of reproducibility is normally 1 dB greater (see Table 1).

A single value of the sound power level of a noise source determined in accordance with the procedures given in this International Standard is likely to differ from the true value by an amount within the range of the measurement uncertainty. The uncertainty in determinations of the sound power level arises from several factors which affect the results, some associated with environmental conditions at the test site and others with experimental techniques.

If a particular noise source were to be transported to each of a number of different test sites, and if, at each test site, the sound power level of that source were to be determined in accordance with this International Standard, the results would show a scatter. The standard deviation of the measured levels could be calculated (see examples in ISO 7574-4:1985, annex B). With few exceptions, these standard deviations would not exceed those listed in Table 1. The values given in Table 1 are standard deviations of reproducibility, s_R , are defined in ISO 7574-1. The values of Table 1 take into account the cumulative effects of measurement uncertainty in applying the procedures of this International Standard, but exclude variations in the sound power output caused by changes in operating conditions (e.g. rotational speed, line voltage) or mounting conditions.

The measurement uncertainty depends on the standard deviation of reproducibility tabulated in Table 1 and on the degree of confidence that is desired. As examples, for a normal distribution of sound power levels, there is a 90 % confidence that the expected value of the sound power level of a source lies within the range $\pm 1,656s_R$ of the measured value and a 95 % confidence that it lies within the range $\pm 1,96s_R$ of the measured value. For further examples, reference should be made to the ISO 7574 series and ISO 9296.

Table 1 — Estimated upper values of the standard deviations of reproducibility of A-weighted sound power levels determined in accordance with this International Standard

Application	Highest standard deviation of reproducibility, s_R dB
For a source which emits noise with a relatively "flat" spectrum over the frequency range of interest	3
For a source which emits noise that contains predominant discrete tones	4