

Sound power levels of noise sources

Part 3. Engineering methods for determination of sound power levels for sources in special reverberation test rooms

Niveaux de puissance acoustique émis par les
sources de bruit
Partie 3. Méthodes d'expertise pour la
détermination des niveaux de puissance
acoustique des sources en salles d'essai
réverbérantes spéciales

Schalleistungspegel von Schallquellen
Teil 3. Technische Verfahren zur Bestimmung
der Schalleistungspegel von Quellen in
speziellen Nachhallprüfräumen

Committees responsible for this British Standard

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British Broadcasting Corporation
British Occupational Hygiene Society
British Telecommunications plc
Department of Health
Department of the Environment (Building Research Establishment)
Department of Trade and Industry (Air Division)
Department of Trade and Industry (National Physical Laboratory)
Engineering Equipment and Materials Users' Association
Health and Safety Executive
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Institute of Acoustics
Institute of Occupational Hygienists
Institute of Physics
Institute of Sound and Vibration Research
Institution of Civil Engineers
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AFRC Institute of Engineering Research
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National foreword

This revision of this Part of BS 4196 has been prepared under the direction of the Environment and Pollution Standards Policy Committee and is identical with ISO 3743 : 1988 'Acoustics - Determination of sound power levels of noise sources - Engineering methods for special reverberation test rooms', prepared by subcommittee 1, Noise, of ISO technical committee 43, Acoustics, and published by the International Organization for Standardization (ISO).

This Part of BS 4196 supersedes BS 4196 : Part 3 : 1981, which is now withdrawn.

This edition of BS 4196 : Part 3 differs from the previous edition in the following principal respect: an annex giving requirements for the characteristics and calibration of the reference sound source has been added and further information notes on measurement uncertainty have been added to **1.3**. Minor editorial changes have also been made.

BS 4196 at present comprises the following Parts which have been published:

- Part 0 Guide for the use of basic standards and for the preparation of noise test codes
- Part 1 Precision methods for determination of sound power levels for broad-band sources in reverberation rooms
- Part 2 Precision methods for determination of sound power levels for discrete-frequency and narrow-band sources in reverberation rooms
- Part 3 Engineering methods for determination of sound power levels for sources in special reverberation test rooms
- Part 4 Engineering methods for determination of sound power levels for sources in free-field conditions over a reflecting plane
- Part 5 Precision methods for determination of sound power levels for sources in anechoic and semi-anechoic rooms
- Part 6 Survey method for determination of sound power levels of noise sources
- Part 7 Survey method for determination of sound power levels of noise sources using a reference sound source
- Part 8 Specification for the performance and calibration of reference sound sources

Cross-references

International standard	Corresponding British Standard
ISO 266 : 1975	BS 3593 : 1963 Recommendation on preferred frequencies for acoustical measurement (Technically equivalent)
ISO 354 : 1985	BS 3638 : 1987 Method for measurement of sound absorption in a reverberation room (Identical)
ISO 3740 : 1980	BS 4196 Sound power levels of noise sources Part 0 : 1981 Guide for the use of basic standards and for the preparation of noise test codes (Identical)
ISO 3741 : 1988	Part 1 : 1991 Precision methods for determination of sound power levels for broad-band sources in reverberation rooms (Identical)
ISO 3742 : 1988	Part 2 : 1991 Precision methods for determination of sound power levels for discrete-frequency and narrow-band sources in reverberation rooms (Identical)

ISO 3744 : 1981	Part 4 : 1981 Engineering methods for determination of sound power levels for sources in free-field conditions over a reflecting plane (Identical)
ISO 3745 : 1977	Part 5 : 1981 Precision methods for determination of sound power levels for sources in anechoic and semi-anechoic rooms (Identical)
ISO 3746 : 1979	Part 6 : 1981 Survey method for determination of sound power levels of noise sources (Identical)
ISO 3747 : 1987	Part 7 : 1988 Survey method for determination of sound power levels of noise sources using a reference sound source (Identical)
ISO 6926 : 1990 ¹⁾	Part 8 : 1991 Specification for the performance and calibration of reference sound sources (Identical)
IEC 225 : 1966	BS 2475 : 1964 Specification for octave and one-third octave band-pass filters (Technically equivalent)
IEC 651 : 1979	BS 5969 : 1981 Specification for sound level meters (Identical)

The Technical Committee has reviewed the provisions of ISO 2204, to which reference is made in the text, and has decided that they are acceptable for use in conjunction with this standard.

IEC Publication 50(08) is referred to in clause 2 for information only.
IEC Publication 50(08) has been superseded by IEC Publication 50(801) : 1984, to which BS 4727 'Glossary of electrotechnical, power, telecommunication, electronics, lighting and colour terms' Part 3 'Terms particular to telecommunications and electronics' Group 08 : 1985 'Acoustics and electroacoustics terminology' is technically equivalent.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

¹⁾ Now published.

Acoustics — Determination of sound power levels of noise sources — Engineering methods for special reverberation test rooms

0.1 Related International Standards

This International Standard is one of a series specifying various methods for determining the sound power levels of machines and equipment. These basic documents specify only the acoustical requirements for measurements appropriate for different test environments as shown in table 1.

When applying these basic documents, it is necessary to decide which one is most appropriate for the conditions and purposes of the test. The operating and mounting conditions of the machine or equipment to be tested are given as general principles stated in each of the basic documents. Guidelines for making these decisions are provided in ISO 3740. If no noise test code is specified for a particular machine, the mounting and operating conditions shall be fully described in the test report.

0.2 Synopsis of ISO 3743

0.2.1 Applicability

0.2.1.1 Test environment

Reverberation room with specified volume and absorption. Guidelines for the design of reverberation rooms are given in annex B.

0.2.1.2 Type of noise source

Device, machine, component, sub-assembly.

0.2.1.3 Size of noise source

Volume of the source preferably not greater than 1 % of the volume of the test room.

0.2.1.4 Character of noise radiated by the source

Steady (as defined in ISO 2204).

0.2.2 Precision

Measurements made in conformity with this International Standard will, with very few exceptions, result in standard deviations equal to or less than 2 dB from 500 Hz to 4 000 Hz, 3 dB for 250 Hz and 8 000 Hz, and 5 dB for 125 Hz (see 1.3 and table 2).

0.2.3 Quantities to be measured

Sound pressure levels with A-weighting and in octave bands on specified paths or at several fixed positions.

0.2.4 Quantities to be determined

A-weighted sound power levels or sound power levels with other weighting; sound power levels in octave bands.

0.2.5 Quantities which cannot be obtained

Directivity characteristics of the source; temporal pattern of radiated noise for sources emitting non-steady noise.

0.3 Introduction

This International Standard specifies relatively simple engineering methods for determining the weighted and octave-band sound power levels of small noise sources. These methods are applicable to small machines, devices and components which are sources of steady noise and can be installed for the purposes of the measurements in a special test room with specified acoustical characteristics. These methods are particularly suitable when the cost and labour involved in carrying out the measurements should be minimized and high precision is not necessary.

These methods are based on the premise that the mean-square sound pressure averaged in space and time in the test room can be used to determine the sound power emitted by the source. The properties of the test room are chosen so that the influence of the test room on the sound power output of the source under test is reasonably small. A simple method is given to determine the number of microphone positions and source locations required in the test room.

1 Scope and field of application

1.1 General

This International Standard specifies relatively simple engineering methods for determining the approximate sound power levels of small noise sources. The measurements are carried out when the source is installed in a specially designed room having a specified reverberation time over the frequency range of interest. The results of the measurements are given in terms of the A-weighted and/or octave-band power levels of the source.

Table 1 — International Standards specifying various methods for determining the sound power levels of machines and equipment

Inter-national Standard No.*	Classification of method**	Test environment	Volume of source	Character of noise	Sound power levels obtainable	Optional information available
3741	Precision (grade 1)	Reverberation room meeting specified requirements	Preferably less than 1 % of test room volume	Steady, broad-band	In one-third octave or octave bands	A-weighted sound power level
3742				Steady, discrete-frequency or narrow-band		
3743	Engineering (grade 2)	Special reverberation test room		Steady, broad-band, narrow-band, or discrete-frequency	A-weighted and in octave bands	Other weighted sound power levels
3744	Engineering (grade 2)	Outdoors or in large room	Greatest dimension less than 15 m	Any	A-weighted and in one-third octave or octave bands	Directivity information and sound pressure levels as a function of time; other weighted sound power levels
3745	Precision (grade 1)	Anechoic or semi-anechoic room	Preferably less than 0,5 % of test room volume	Any		
3746	Survey (grade 3)	No special test environment	No restrictions: limited only by available test environment	Any	A-weighted	Sound pressure levels as a function of time; other weighted sound power levels
3747	Survey (grade 3)	No special test environment; source under test not movable	No restrictions	Steady, broad-band, narrow-band, or discrete-frequency	A-weighted	Sound power levels in octave bands

* See clause 2.

** See ISO 2204.

NOTE — Precision methods for the determination of octave-band and one-third octave-band power levels of small noise sources are specified in ISO 3741, ISO 3742 and ISO 3745.

1.2 Field of application

1.2.1 Types of noise

The methods specified in this International Standard are not suitable for measurements of noise sources which emit impulsive noise consisting of single noise bursts. The results obtained for sources of quasi-steady impulsive noise may be of limited value. For sources of impulsive noise, the free-field methods specified in ISO 3744 and ISO 3745 should be used. A classification of different types of noise (steady, impulsive, etc.) is given in ISO 2204.

1.2.2 Size of source

This International Standard applies to small noise sources producing steady noise within a specified frequency range. The maximum size of the source under test and the lower limit of the frequency range for which the methods are applicable depend on the test room used. The volume of the noise source should not exceed 1 % of the volume of the test room. For the minimum test room volume of 70 m³, the recommended maximum size of the source is 0,7 m³. Measurements on sources emitting discrete-frequency components below 200 Hz are frequently difficult to make in such small rooms.

1.3 Measurement uncertainty

Measurements made in conformity with this International Standard tend to result in standard deviations which are equal to or less than those given in table 2. The standard deviations given in table 2 take into account the cumulative effects of all causes of measurement uncertainty. For a source which emits noise with a relatively "flat" spectrum in the 100 to 10 000 Hz frequency range, the A-weighted sound power level is determined with a standard deviation of mean value of approximately 2 dB.

Table 2 — Uncertainty in determining sound power levels in special reverberation test rooms

Octave-band centre frequency	Standard deviation of mean value
Hz	dB
125	5
250	3
500 to 4 000	2
8 000	3

NOTES

1 The methods specified in ISO 3741 and ISO 3742 yield sound power levels with smaller standard deviations than those given in table 2.

2 The standard deviations given in table 2 are measures of the uncertainties associated with the test methods defined in this International Standard. If a stable source of steady noise were transported to each of a large number of laboratories, and if, at each laboratory, the sound power level of that source were measured in accordance with the provisions of this International Standard, the standard deviation, as a function of frequency, of these many sound power level calculations could be calculated. If a similar inter-laboratory series of measurements were carried out on each of a large number of different specimens of the same type of stable sources of steady noise, it would be possible to calculate overall standard deviations that would correspond to the random selection of a noise source and the random selection of a laboratory. It is these standard deviations which have been estimated and given in table 2.

3 If two laboratories use similar facilities and instrumentation, the results of sound power level determinations on a given source in these laboratories may be in better agreement than would be inferred from the standard deviations in table 2.

4 For a particular family of noise sources, of similar size and with similar sound spectra, the standard deviations of sound power level determinations in different laboratories may be significantly smaller than the values given in table 2. Thus, a test code for a particular type of machinery may state standard deviations smaller than those given in table 2 if the results of inter-laboratory tests are available to substantiate the smaller values.

2 References

ISO 266, *Acoustics — Preferred frequencies for measurements.*

ISO 354, *Acoustics — Measurement of sound absorption in a reverberation room.*

ISO 2204, *Acoustics — Guide to International Standards on the measurement of airborne acoustical noise and evaluation of its effects on human beings.*

ISO 3740, *Acoustics — Determination of sound power levels of noise sources — Guidelines for the use of basic standards and for the preparation of noise test codes.*

ISO 3741, *Acoustics — Determination of sound power levels of noise sources — Precision methods for broad-band sources in reverberation rooms.*

ISO 3742, *Acoustics — Determination of sound power levels of noise sources — Precision methods for discrete-frequency and narrow-band sources in reverberation rooms.*

ISO 3744, *Acoustics — Determination of sound power levels of noise sources — Engineering methods for free-field conditions over a reflecting plane.*

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

ISO 3746, *Acoustics — Determination of sound power levels of noise sources — Survey method.*

ISO 3747, *Acoustics — Determination of sound power levels of noise sources — Survey method using a reference sound source.*