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# Sound power levels of noise sources

## Part 0. Guide for the use of basic standards and for the preparation of noise test codes

[ISO title : Acoustics—Determination of sound power levels of noise sources—  
Guidelines for the use of basic standards and for the preparation of noise test codes

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Niveaux de puissance acoustique émis par les sources de bruit  
Partie 0. Guide pour l'utilisation des normes fondamentales et pour la  
préparation des codes d'essais relatifs au bruit

Schalleistungspegel von Schallquellen  
Teil 0. Anleitung zur Anwendung von Grundnormen und Vorbereitung von Schallprüfungs-codes

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## National foreword

This Part of this British Standard has been prepared under the direction of the Environment and Pollution Standards Committee and is identical with 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', prepared by sub-committee 1, Noise, of ISO technical committee 43, Acoustics, and published in 1980 by the International Organization for Standardization (ISO).

This Part of this standard, together with the other Parts listed below, supersedes BS 4196 : 1967, which is therefore now withdrawn.

**Terminology and conventions.** The text of the international standard has been approved as suitable for publication, without deviation, as a British Standard. Some terminology and certain conventions are not identical with those used in British Standards; attention is especially drawn to the following.

The comma has been used throughout as a decimal marker. In British Standards it is current practice to use a full point on the baseline as the decimal marker.

Wherever the words 'International Standard' appear, referring to this standard, they should be read as 'British Standard'.

## Cross-references

| International Standard | Corresponding British Standard                                                                                                                               |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                        | BS 4196 Sound power levels of noise sources                                                                                                                  |
| ISO 3741-1975          | Part 1 : 1981 Precision methods for determination of sound power levels for broad-band sources in reverberation rooms<br>(Identical)                         |
| ISO 3742-1975          | Part 2 : 1981 Precision methods for determination of sound power levels for discrete-frequency and narrow-band sources in reverberation rooms<br>(Identical) |
| ISO 3743-1976          | Part 3 : 1981 Engineering methods for determination of sound power levels for sources in special reverberation rooms<br>(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<br>(Identical)       |
| ISO 3745-1979          | Part 5 : 1981 Precision methods for determination of sound power levels for sources in anechoic and semi-anechoic rooms<br>(Identical)                       |
| ISO 3746-1979*         | Part 6 : 1981* Survey method for determination of sound power levels of noise sources<br>(Identical)                                                         |

The technical committee has reviewed the provisions of ISO 2204-1979, to which reference is made in clause 2, 3.2 and annex A, and IEC 263 : 1975, to which reference is made in clause 2 and 4.3, and has decided that they are acceptable for use in conjunction with this standard.

\*In course of preparation.

British Standard

# Sound power levels of noise sources

Part 0. Guide for the use of basic standards and for the preparation of test codes

## Foreword

The most important factor in the selection of a noise measurement method is the ultimate use of the data that are to be obtained. This International Standard introduces a series of six International Standards describing various methods for determining the sound power levels of machines and equipment. Sound power level data are useful for :

- a) calculating the approximate sound pressure level at a given distance from a machine operating in a specified environment;
- b) comparing the noise radiated by machines of the same type and size;
- c) comparing the noise radiated by machines of different types and sizes;
- d) determining whether a machine complies with a specified upper limit of sound emission;
- e) planning in order to determine the amount of transmission loss or noise control required under certain circumstances;
- f) engineering work to assist in developing quiet machinery and equipment.

The sound power level data determined according to one of the basic International Standards are essentially independent of the environment in which the data are obtained. This is one of the reasons for using sound power level to characterize the noise emitted by various types of machines and equipment.

These basic standards specify the acoustical requirements for measurements appropriate for different test environments and accuracies.

When applying these basic standards to sound measurements on specific machines, it is necessary to decide which one of the basic standards is most appropriate for the particular class of machine or equipment and for the purpose of the test. It is also necessary to decide on specific details for mounting and operating the machine to be tested within the general principles stated in the basic documents.

Guidelines for making these decisions are provided in this International Standard. These guidelines are essential for the proper application of the basic acoustical measurement standards and for the preparation of specific sound test codes for various types of machines and equipment.

If no specific sound test code exists for a particular type of machine, the most suitable of the basic documents should be followed and the mounting and operating conditions used should be described in the test report. These conditions should be in accordance with the general principles given in the basic documents.

## 0 Introduction

Control of noise from machines or equipment requires effective exchange of acoustical information among the several parties concerned. These include the manufacturer, specifier, installer and user of the machine or equipment. This acoustical information is obtained from measurements. These measurements are useful only if they are carried out under specified conditions to obtain defined acoustical quantities using standardized instruments.

The set of basic International Standards for which this International Standard serves as the introduction is :

ISO 3741 — Precision methods for broad-band sources in reverberation rooms.

ISO 3742 — Precision methods for discrete-frequency and narrow-band sources in reverberation rooms.

ISO 3743 — Engineering methods for special reverberation test rooms.

ISO 3744 — Engineering methods for free-field conditions over a reflecting plane.

ISO 3745 — Precision methods for anechoic and semi-anechoic rooms.

ISO 3746 — Survey method.

Additional International Standards may be added to the series in the future.

In principle, the methods of measurement described in ISO 3741 to ISO 3746 cover all types of machines and equipment. For noise measurements on a particular kind and size of machine or equipment, or when only certain kinds of facilities are available for the measurements, only one of these International Standards may be applicable. For type testing, only one method should be prescribed.

The basic International Standards prescribe the acoustical conditions for the noise measurements and the instruments to be

used. Only general information is given on the installation and operation of the sound source during the measurements. Different types of machines and equipment require more detailed instructions concerning the installation and operation of the equipment during the noise tests.

## 1 Scope and field of application

### 1.1 Scope

This International Standard provides guidelines comprising :

- a) brief explanations of the principles underlying the set of basic International Standards for measuring the noise emitted by machines and equipment;
- b) assistance in the selection of the appropriate basic International Standard;
- c) general information on supplementing the basic International Standards with instructions concerning the installation and operating conditions for the particular type of machines or equipment; such instructions are usually incorporated in test codes.

### 1.2 Field of application

These guidelines are applicable to the preparation of all noise test codes for any type of machine or equipment, with the exception of moving vehicles or other non-stationary equipment. These guidelines apply only to airborne sound and are applicable only to test codes requiring the determination of sound power levels of noise sources.

## 2 References

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

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 3743, *Acoustics — Determination of sound power levels of noise sources — Engineering methods for reverberation rooms.*

ISO 3744, *Acoustics — Determination of sound power levels of*

*noise sources — Engineering methods for free-field conditions over a reflecting plane.*<sup>1)</sup>

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.*

IEC Publication 263, *Scales and sizes for plotting frequency characteristics and polar diagrams.*

## 3 Selection of appropriate International Standard for determination of sound power level

### 3.1 Quantities to be measured and determined

Methods are prescribed for measuring the sound pressure levels, either A-weighted or in frequency bands, in a specified acoustical environment. From these data, the sound power level of the source is calculated either as an A-weighted value or in frequency bands.

#### NOTES

1 Other weightings such as C-weighting may give additional information concerning low-frequency components.

2 Other meter characteristics such as "impulse" may give additional information concerning impulsive components.

The sound power levels are mean values obtained by time and space averaging. For certain kinds of noise and under certain measurement conditions, it is useful to supplement the sound power level data with information concerning fluctuations of the values is both space and time.

### 3.2 Considerations affecting choice of measurement method

The applicability of individual parts of this set of International Standards is determined by

- a) the size of the noise source which, for laboratory measurements, is given in terms of the percentage of test room volume;
- b) the test environment available for the measurements;
- c) the character of the noise produced by the source (for example : broad-band, narrow-band, discrete-frequency; steady, non-steady, impulsive);

<sup>1)</sup> At present at the stage of draft.

- d) frequency range of interest;
- e) the highest grade of accuracy required as classified according to ISO 2204;
- f) the acoustical data required including the sound power level data and other acoustical information (for example : directivity of source, temporal pattern).

### 3.3 Synopses

Synopses of ISO 3741 to ISO 3746 are to be found in annex A.

### 3.4 Test environments

For descriptions of the several test environments described in ISO 3741 to ISO 3746, reference should be made to annex C.

### 3.5 Procedure for selection

Table 1 summarizes the applicability of each of the series of six basic International Standards. Table 2 gives the uncertainties involved in the determinations of the sound power levels according to the six documents in the series.

Measurements made in conformity with this series of International Standards tend to result in standard deviations which are equal to or less than those given in table 2. The standard deviations of table 2 reflect the cumulative effects of all causes of measurement uncertainty, excluding those variations in the sound power level from test to test which may be caused, for example, by changes in the mounting or operating conditions of the source. The inter-laboratory reproducibility and repeatability of the test results may be considerably better (i.e., smaller standard deviations) than the uncertainties given in table 2 would indicate.

The purpose for which the noise measurements are to be made determines the grade of accuracy required. The several factors influencing the selection of an appropriate test method are shown in table 3. This table gives guidance for the selection of the appropriate International Standard. The left side of the table lists the selection criteria. In the right-hand column, bars along the vertical lines combine the appropriate test conditions according to each of the individual International Standards.

After defining the requirements of the test, the appropriate International Standard can be selected by following the bars along the appropriate vertical line. A solid bar indicates that the corresponding International Standard is fully applicable to the test condition and the sound power levels are within their given ranges of uncertainty. An open bar means that the data obtained are optional.

If the source can be moved and the test environments are available, one of the methods described in ISO 3741 to ISO 3746 should be selected. If the machine or equipment to be tested cannot be moved, only the methods described in ISO 3744 and ISO 3746 are applicable. The method selected will depend upon the factors discussed in 3.2.

Additional information concerning the topics covered in table 1 and 3 is given in annex B.

## 4 Preparation of noise test codes

### 4.1 General

Each noise test code requiring the determination of the sound power level of a particular kind of machine or equipment should preferably be based on

- a) one of the precision methods (ISO 3741, ISO 3742 or ISO 3745);
- b) one of the engineering methods (ISO 3743 or ISO 3744);
- c) the survey method (ISO 3746).

For the establishment of noise test codes for particular types of machines and equipment, the most appropriate method of measurement shall be selected from the basic International Standards listed in clause 0 of this International Standard. The decision shall then be made concerning the need for preparing supplementary requirements giving detailed specifications on :

- a) operating conditions;
- b) installation and mounting conditions;
- c) microphone array, microphone traverses and measurement surface.

The decision may be made that supplementary requirements are not necessary and that the basic International Standard is sufficient for the purposes of the noise test code.

If the basic International Standard is to be used in preparing the noise test code for a particular class of machine or equipment, the code should cover the subjects listed in 4.2.

### 4.2 Use of basic International Standards

**4.2.1** Under "Scope", the test code should carefully define the types of machines or equipment for which the test code is applicable. For large machines with many components and sub-assemblies, a clear definition should be made of the noise sources that are to be considered part of the machine under test.

**4.2.2** Under "Purpose", the test code should define the specific purpose(s) for which the data are to be obtained (see Foreword). The test code should state whether the noise emission is to be expressed in terms of a weighted sound power level or in terms of the sound power level spectrum (in octave or one-third octave bands).

**4.2.3** A "General Statement" should refer specifically to the basic International Standard which is to be used in applying the test code.

**4.2.4** The text of the basic International Standard should not be included verbatim in the test code.

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

| International Standard No.* | Classification of method | Test environment                                  | Volume of source                                             | Character of noise                                  | Sound power levels obtainable                      | Optional information available                                                                             |
|-----------------------------|--------------------------|---------------------------------------------------|--------------------------------------------------------------|-----------------------------------------------------|----------------------------------------------------|------------------------------------------------------------------------------------------------------------|
| 3741                        | Precision                | 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              | Special reverberation test room                   |                                                              | Steady, broad-band, narrow-band, discrete-frequency | A-weighted and in octave bands                     | Other weighted sound power levels                                                                          |
| 3744                        | Engineering              | 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                | Anechoic or semi-anechoic room                    | Preferably less than 0,5 % of test room volume               | Any                                                 |                                                    |                                                                                                            |
| 3746                        | Survey                   | 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                             |

**Table 2 — Uncertainty in determining sound power levels, expressed at the largest value of the standard deviation of decibels**

| International Standard No.* | Octave bands (Hz)     | 125        | 250        | 500        | 1 000 to 4 000 | 8 000           | A-weighting |
|-----------------------------|-----------------------|------------|------------|------------|----------------|-----------------|-------------|
|                             | 1/3 Octave bands (Hz) | 100 to 160 | 200 to 315 | 400 to 630 | 800 to 5 000   | 6 300 to 10 000 |             |
| 3741<br>3742                | 3                     | 3          | 2          | 1,5        | 3              | —               | —           |
| 3743                        | 5                     | 3          | 2          | 3          | 2              | —               | 2           |
| 3744                        | 3                     | 2          | 1,5        | 2,5        | 2              | —               | 2           |
| 3745                        | (Anechoic room)       | 1          | 1          | 0,5        | 1              | —               | —           |
|                             | (Semi-anechoic room)  | 1,5        | 1,5        | 1          | 1,5            | —               | —           |
| 3746                        | —                     | —          | —          | —          | —              | 5               | —           |

\* See clause 2.