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Acoustics — Determination of sound power levels of noise sources using sound intensity —

Part 1:

Measurement at discrete points

*Acoustique — Détermination par intensimétrie des niveaux de puissance
acoustique émis par les sources de bruit —*

Partie 1: Mesurages par points



Reference number
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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.

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.

International Standard ISO 9614-1 was prepared by Technical Committee ISO/TC 43, *Acoustics*, Sub-Committee SC 1, *Noise*.

ISO 9614 consists of the following parts, under the general title *Acoustics — Determination of sound power levels of noise sources using sound intensity*.

- *Part 1: Measurement at discrete points*
- *Part 2: Measurement by scanning*

Annexes A and B form an integral part of this part of ISO 9614. Annexes C, D and E are for information only.

Introduction

0.1 The sound power radiated by a source is equal in value to the integral of the scalar product of the sound intensity vector and the associated elemental area vector over any surface totally enclosing the source. Previous International Standards which describe methods of determination of sound power levels of noise sources, principally ISO 3740 to ISO 3747, without exception specify sound pressure level as the primary acoustic quantity to be measured. The relationship between sound intensity level and sound pressure level at any point depends on the characteristics of the source, the characteristics of the measurement environment, and the disposition of the measurement positions with respect to the source. Therefore ISO 3740 to ISO 3747 necessarily specify the source characteristics, the test environment characteristics and qualification procedures, together with measurement methods which are expected to restrict the uncertainty of the sound power level determination to within acceptable limits.

The procedures specified in ISO 3740 to ISO 3747 are not always appropriate, for the following reasons.

- a) Costly facilities are necessary if high precision is required. It is frequently not possible to install and operate large pieces of equipment in such facilities.
- b) They cannot be used in the presence of high levels of extraneous noise generated by sources other than that under investigation.

The purpose of ISO 9614 is to specify methods whereby the sound power levels of sources may be determined, within specific ranges of uncertainty, under test conditions which are less restricted than those required by the series ISO 3740 to ISO 3747. The sound power is the *in situ* sound power as determined by the procedure of this part of ISO 9614; it is physically a function of the environment, and may in some cases differ from the sound power of the same source determined under other conditions.

0.2 This part of ISO 9614 complements the series ISO 3740 to ISO 3747 which specify various methods for the determination of sound power levels of machines and equipment. It differs from these International Standards principally in three aspects.

- a) Measurements are made of sound intensity as well as of sound pressure.
- b) The uncertainty of the sound power level determined by the method specified in this part of ISO 9614 is classified according to the results of specified ancillary tests and calculations performed in association with the test measurements.

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c) Current limitations of intensity measurement equipment restrict measurements to the one-third-octave range 50 Hz to 6,3 kHz. Band-limited A-weighted values are determined from the constituent one-octave or one-third-octave band values and not by direct A-weighted measurements.

0.3 This part of ISO 9614 gives a method for determining the sound power level of a source of stationary noise from measurements of sound intensity on a surface enclosing the source. In principle, the integral over any surface totally enclosing the source of the scalar product of the sound intensity vector and the associated elemental area vector provides a measure of the sound power radiated directly into the air by all sources located within the enclosing surface, and excludes sound radiated by sources located outside this surface. In the presence of sound sources operating outside the measurement surface, any system lying within the surface may absorb a proportion of energy incident upon it. The total sound power absorbed within the measurement surface will appear as a negative contribution to source power, and may produce an error in the sound power determination; in order to minimize the associated error, it is therefore necessary to remove any sound-absorbing material lying within the measurement surface which is not normally present during the operation of the source under test.

This part of ISO 9614 is based on discrete-point sampling of the intensity field normal to the measurement surface. The resulting sampling error is a function of the spatial variation of the normal intensity component over the measurement surface, which depends on the directivity of the source, the chosen sampling surface, the distribution of sample positions, and the proximity of extraneous sources outside the measurement surface.

The precision of measurement of the normal component of sound intensity at a position is sensitive to the difference between the local sound pressure level and the local normal sound intensity level. A large difference may occur when the intensity vector at a measurement position is directed at a large angle (approaching 90°) to the local normal to the measurement surface. Alternatively, the local sound pressure level may contain strong contributions from sources outside the measurement surface, but may be associated with little net sound energy flow, as in a reverberant field in an enclosure; or the field may be strongly reactive because of the presence of the near-field and/or standing waves.

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Acoustics — Determination of sound power levels of noise sources using sound intensity —

Part 1: Measurement at discrete points

1 Scope

1.1 This part of ISO 9614 specifies a method for measuring the component of sound intensity normal to a measurement surface which is chosen so as to enclose the noise source(s) of which the sound power level is to be determined. The one-octave, one-third-octave or band-limited weighted sound power level is calculated from the measured values. The method is applicable to any source for which a physically stationary measurement surface can be defined, and on which the noise generated by the source is stationary in time (as defined in 3.13). The source is defined by the choice of measurement surface. The method is applicable *in situ*, or in special purpose test environments.

1.2 This part of ISO 9614 is applicable to sources situated in any environment which is neither so variable in time as to reduce the accuracy of the measurement of sound intensity to an unacceptable degree, nor subjects the intensity measurement probe to gas flows of unacceptable speed or unsteadiness (see 5.3 and 5.4).

In some cases, it will be found that the test conditions are too adverse to allow the requirements of this part of ISO 9614 to be met. In particular, extraneous noise levels may vary to an excessive degree during the test. In such cases, the method given in this part of ISO 9614 is not suitable for the determination of the sound power level of the source.

NOTE 1 Other methods, e.g. determination of sound power levels from surface vibration levels as described in ISO/TR 7849, may be more suitable.

1.3 This part of ISO 9614 specifies certain ancillary procedures, described in annex B, to be followed in conjunction with the sound power determination. The results are used to indicate the quality of the deter-

mination, and hence the grade of accuracy. If the indicated quality of the determination does not meet the requirements of this part of ISO 9614, the test procedure should be modified in the manner indicated.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 9614. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 9614 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 5725:1986, *Precision of test methods — Determination of repeatability and reproducibility for a standard test method by inter-laboratory tests*.

IEC 942:1988, *Sound calibrators*.

IEC 1043:—,¹⁾ *Instruments for the measurement of sound intensity*.

3 Definitions

For the purposes of this part of ISO 9614, the following definitions apply.

3.1 sound pressure level, L_p : Ten times the logarithm to the base 10 of the ratio of the mean-square sound pressure to the square of the reference sound pressure. The reference sound pressure is 20 μPa .

Sound pressure level is measured in decibels.

1) To be published.