INTERNATIONAL STANDARD

ISO 1680

Second edition
2013-12-15

Acoustics — Test code for the measurement of airborne noise emitted by rotating electrical machines

Acoustique — Code d'essai pour le mesurage du bruit aérien émis par les machines électriques tournantes

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2, www.iso.org/directives.

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Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

The committee responsible for this document is ISO/TC 43, *Acoustics*, Subcommittee SC 1, *Noise*.

This second edition cancels and replaces the first edition (ISO 1680:1999), which has been technically revised.

Acoustics — Test code for the measurement of airborne noise emitted by rotating electrical machines

1 Scope

This International Standard specifies all the information necessary to carry out efficiently and under standardized conditions the determination, declaration, and verification of the noise emission characteristics of rotating electrical machines. It specifies noise measurement methods that can be used, and specifies the operating and mounting conditions required for the test.

Noise emission characteristics include the sound power level and emission sound pressure level. The determination of these quantities is necessary:

— for comparing the noise emitted by machines;

— to enable manufacturers to declare the noise emitted; and

— for the purposes of noise control.

The use of this International Standard as a noise test code ensures the reproducibility of the determination of the noise emission characteristics within specified limits determined by the grade of accuracy of the basic noise measurement method used. Noise measurement methods allowed by this International Standard are precision methods (grade 1), engineering methods (grade 2) and survey methods (grade 3). Methods of engineering grade (grade 2) are to be preferred.

This International Standard is applicable to rotating electrical machines of any length, width or height.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3741, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Precision methods for reverberation test rooms*

ISO 3743-1, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering methods for small movable sources in reverberant fields — Part 1: Comparison method for a hard-walled test room*

ISO 3743-2, *Acoustics — Determination of sound power levels of noise sources using sound pressure — Engineering methods for small, movable sources in reverberant fields — Part 2: Methods for special reverberation test rooms*

ISO 3744:2010, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering methods for an essentially free field over a reflecting plane*

ISO 3745:2012, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Precision methods for anechoic rooms and hemi-anechoic rooms*

ISO 3746, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Survey method using an enveloping measurement surface over a reflecting plane*

ISO 3747, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering/survey methods for use in situ in a reverberant environment*

ISO 4871:1996, *Acoustics — Declaration and verification of noise emission values of machinery and equipment*

ISO 7574-4, *Acoustics — Statistical methods for determining and verifying stated noise emission values of machinery and equipment — Part 4: Methods for stated values for batches of machines*

ISO 9614-1, *Acoustics — Determination of sound power levels of noise sources using sound intensity — Part 1: Measurement at discrete points*

ISO 9614-2, *Acoustics — Determination of sound power levels of noise sources using sound intensity — Part 2: Measurement by scanning*

ISO 9614-3, *Acoustics — Determination of sound power levels of noise sources using sound intensity — Part 3: Precision method for measurement by scanning*

ISO 11203, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions from the sound power level*

IEC 60034-1, *Rotating electrical machines — Part 1: Rating and performance*

IEC 61672-1, *Electroacoustics — Sound level meters — Part 1: Specifications*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
time averaged sound pressure level
$L_{p,T}$
ten times the logarithm to the base 10 of the ratio of the time average of the square of the sound pressure, p, during a stated time interval of duration, T (starting at t_1 and ending at t_2), to the square of a reference value, p_0, expressed in decibels

$$L_{p,T} = L_{p,\mathrm{eq}T} = 10 \lg \left[\frac{\dfrac{1}{T} \displaystyle\int_{t_1}^{t_2} p^2(t)\,\mathrm{d}t}{p_0^2} \right] \mathrm{dB}$$

where the reference value, p_0, is 20 µPa

Note 1 to entry: Because of practical limitations of the measuring instruments, p^2 is always understood to denote the square of a frequency-weighted and frequency-band-limited sound pressure. If a specific frequency weighting as specified in IEC 61672-1 and/or specific frequency bands are applied, this should be indicated by appropriate subscripts; e.g. $L_{p,A,10\,\mathrm{s}}$ denotes the A-weighted time-averaged sound pressure level over 10 s.

3.2
measurement surface
hypothetical surface of area S, enveloping the source on which the measurement points are located

Note 1 to entry: The measurement surface terminates on one or more reflecting planes.

3.3
surface sound pressure level
$\overline{L_p}$
energy average of the time-averaged sound pressure levels at all the microphone positions on the measurement surface, with the background noise correction K_1 and the environmental correction K_2 applied

Note 1 to entry: It is expressed in decibels.

3.4
sound intensity
$\vec{I}$
time-averaged value of the product of the instantaneous sound pressure and the associated sound velocity at a point in a temporally stationary sound field

3.5
normal sound intensity level
L_{I_n}
ten times the logarithm to the base 10 of the ratio of the unsigned value of the normal component of the sound intensity (which is radiated by the sound source under test and determined in a direction perpendicular to the measurement surface) to the reference sound intensity

Note 1 to entry: It is expressed in decibels.

Note 2 to entry: The reference sound intensity is 10^{-12} Wm^{-2}.

3.6
sound power level
L_W
ten times the logarithm to the base 10 of the ratio of the sound power, P, to a reference value, P_0, expressed in decibels

$$L_W = 10 \lg \frac{P}{P_0} \, \text{dB}$$

where the reference value, P_0, is 1 pW

Note 1 to entry: If a specific frequency weighting as specified in IEC 61672-1 and/or specific frequency bands are applied, this should be indicated by appropriate subscripts; e.g. $L_{W,A}$ denotes the A-weighted sound power level.

Note 2 to entry: This definition is technically in accordance with ISO 80000-8:2007, 8-23[15].

3.7
emission sound pressure
p
time-averaged sound pressure, at a specified position near a noise source, when the source is in operation under specified operating and mounting conditions on a reflecting plane surface, excluding the effects of background noise as well as the effects of reflections from room surfaces other than the plane or planes permitted for the purpose of the test

Note 1 to entry: It is expressed in pascals.

3.8
emission sound pressure level
L_p
ten times the logarithm to the base 10 of the ratio of the square of the emission sound pressure, $p^2(t)$, to the square of the reference sound pressure, p_0^2, measured with a particular time weighting and a particular frequency weighting, selected from those defined in IEC 61672-1

Note 1 to entry: It is expressed in decibels. The reference sound pressure is 20 µPa.

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EXAMPLE   The A-weighted emission sound pressure level with time weighting F is denoted L_{pAF}. The C-weighted peak emission sound pressure level is denoted $L_{pC,peak}$.

3.9
noise emission declaration
information on the noise emitted by the machine, given by the manufacturer or supplier in technical documents or other literature concerning noise emission values

Note 1 to entry: The noise emission declaration may take the form of either the declared single-number noise emission value or the declared dual-number noise emission value.

3.10
measured noise emission value
L
A-weighted sound power level, or the A-weighted time-averaged emission sound pressure level, or the C-weighted peak emission sound pressure level, as determined from measurements

Note 1 to entry: Measured values may be determined either from a single machine or from the average of a number of machines, and are not rounded.

3.11
declared single-number noise emission value
L_d
sum, rounded to the nearest whole decibel, of the measured noise emission value, L, and the associated uncertainty, U:

$$L_d = L + U$$

3.12
declared dual-number noise emission value
L **and** U
measured noise emission value L, and its associated uncertainty U, both rounded to the nearest decibel

4   Description of machinery family

This International Standard is applicable to self-standing rotating electrical machines, i.e. motors and generators (d.c. and a.c machines), without any limitation on the output or voltage, and with any linear dimensions.

Families of devices covered by this International Standard include rotating electrical machines to be fed by the following possibilities:

— a network (sinusoidal supply) whenever specially designed for that purpose;

— an associated converter.

In the case of supply by a converter, the noise radiated by the converter is excluded from the scope of this International Standard; only the effect of non-sinusoidal voltage and current within the machine is to be taken into account.

Auxiliary components required for the operation of the machine (e.g. oil pumps or cooling ventilators) should be included when integrated with the machine. When these components are separately mounted, they shall not be included as part of the machine under test.

5 Sound power determination

5.1 General

The sound power radiated by rotating electrical machines shall be determined on the basis of one of the following basic standards:

— accuracy grade 1: ISO 3741, ISO 3745, ISO 9614-1, ISO 9614-3;

— accuracy grade 2: ISO 3743-1, ISO 3743-2, ISO 3744, ISO 3747, ISO 9614-1, ISO 9614-2.

Methods of engineering grade (grade 2) are to be preferred.

Furthermore, survey methods may also be used if it has been proved that no method with better accuracy is practical:

— accuracy grade 3: ISO 3746, ISO 9614-1, ISO 9614-2.

5.2 Guidelines for the selection of the most appropriate basic standard

The usable basic standards are mainly distinguished by the following:

— different environmental conditions;

— different requirements with respect to the background noise levels related to the noise level of the machine under test;

— different grades of accuracy;

— different quantities to be measured: sound pressure or sound intensity.

NOTE 1   Detailed guidelines for the selection of the most appropriate basic standards are given in ISO 3740.

The sound intensity measurement method has the following advantages as compared to the sound pressure measurement method.

a) Determination of the correct sound power is possible regardless of whether the measurement surface lies within or outside the near field.

b) Determination of the correct sound power is possible in the presence of noise fields where the sound pressure method gives results which are so wrong that they would no longer conform to sound pressure measurement standards.

c) It allows a better grade of accuracy for the sound power determination especially under the worst environmental conditions (and therefore allows determination of the sound power level of machines in the presence of noisy loading machines).

NOTE 2   Methods described in ISO/TS 7849[4] allow that part of the radiated airborne sound power caused by the vibrating outer surface of the machine to be determined separately.

A description of the fields of application of the main basic standards is given in Table 1, supplemented by Figure 1. A more precise distinction of these standards is shown in Annex A.

5.3 Additional requirements

Each of the basic standards gives detailed and precise requirements for all acoustical aspects of the relevant measurement procedure, such as definition of the measurement surface, if any, microphone array, environmental adequacy, determination of environmental and background noise corrections, if relevant, together with requirements for instrumentation. These standards leave open precise definitions of mounting and operating conditions which shall be stated in the machinery-specific noise test code. These requirements are given in Clause 6.

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When applying ISO 3744 or ISO 3746 which use sound pressure measurements under more or less free-field conditions, a parallelepiped measurement surface shall be used to facilitate the location of the microphone positions.

Supplementing the general rules for rotating electrical machines, the following simplifications may be used.

a) The arrangement of the measurement positions may, especially for large machines, be simplified if, for a specific type of machine, it can be shown, with the help of preliminary investigations on machines of that specific type, that the sound field is adequately uniform and that measurements lead to values of sound power level deviating by no more than 0,5 dB for grade 2 methods and 1 dB (A-weighted) for grade 3 methods from those determined with a complete arrangement of measurement positions.

b) For sources that produce a symmetrical radiation pattern, it may be sufficient to distribute the measurement positions over only a portion of the measurement surface. This is acceptable only if, for a specific type of machine, it can be shown, with the help of preliminary investigations on machines of that specific type, that the measurements lead to values of sound power level deviating by no more than 0,5 dB for grade 2 methods and 1 dB (A-weighted) for grade 3 methods from those determined with a complete arrangement of measurement positions.

c) If required to check the presence of prominent discrete tone(s), the so called "magnetic noise", being typical of rotating electrical machines, should be taken into consideration with preference. Under no-load operating conditions, this noise component is weak and do not disturb in general, but may increase significantly under loading conditions.

Consequently the following alternative tonality tests are useful for rotating electrical machines:

1) measuring the A-weighted sound power level, $L_{W,A}$, caused by changing the operating conditions from no-load to rated load to determine the relevant difference $\Delta L_{W,A}$, in decibels; or

NOTE   This test is used by IEC 60034-9[9] where limit values for $\Delta L_{W,A}$ are given.

2) measuring the one-third-octave band pressure spectrum under rated load conditions at the measurement position with the highest value of $L_{p,A,T}$, and calculation of the difference between each protruding level and its two adjacent band levels.

Differences larger than 6 dB can be characterized as prominent for the frequency range from 500 Hz to 10 000 Hz; or

3) determining the tonality under rated load conditions according to ISO 7779:2010,[3] Annex D.

Table 1 — Sound power determination procedures and relations to their fields of application

International Standard	Environment	Background noise levels	Grade of accuracy	Quantity to be measured
ISO 3741	Special measurement room, "reverberant room"	Very low background noise levels	Grade 1	Sound pressure
ISO 3743-1	High reverberant ordinary room	Low background noise level	Grade 2	Sound pressure
ISO 3743-2	Special measurement room	Low background noise level	Grade 2	Sound pressure
ISO 3744	*In situ*, but with limited environmental reflections	Low background noise levels	Grade 2	Sound pressure
ISO 3745	Special measurement room, "anechoic, hemi-anechoic room"	Very low back-ground noise levels	Grade 1	Sound pressure
ISO 3746	*In situ*, less limited environ-mental reflections	Less limited back-ground noise levels	Grade 3	Sound pressure
ISO 3747	*In situ*, approximately reverberant conditions	Low background noise levels	Grade 2	Sound pressure
ISO 9614-1	*In situ*, practically no limi-tations	Practically no limitation for stationary background noise levels	Grades 1, 2, and 3	Normal component of sound intensity
ISO 9614-2	*In situ*, practically no limi-tations	Practically no limitation for stationary background noise levels	Grade 2 and 3	Normal component of sound intensity
ISO 9614-3	*In situ*, practically no limi-tations	Practically no limitation for stationary background noise levels	Grade 1	Normal component of sound intensity
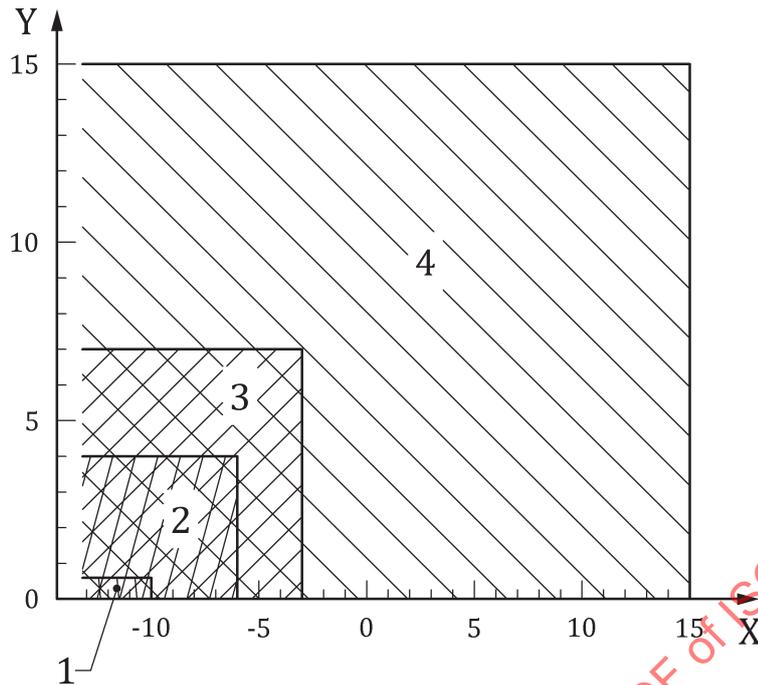
Key

Y   environmental correction, K_2, dB

X   background noise excessive rise, $\Delta L = \overline{L_{p(B)}} - \overline{L_{p(ST)}}$ dB, dB

1   p^2-Method, grade 1 (e.g. see ISO 3745).

2   p^2-Method, grade 2 (e.g. see ISO 3744).

3   p^2-Method, grade 3 (e.g. see ISO 3746).

4   Intensity method, grade 2 (e.g. see ISO 9614-1).

$\overline{L_{p(B)}}$ is the mean time-averaged sound pressure level of the background noise (B) from the array of microphone positions over the measurement surface, in decibels

$\overline{L_{p(ST)}}$ is the mean time-averaged sound pressure level from the array of microphone positions over the measurement surface, with the noise source under test (ST) in operation, in decibels

Figure 1 — Fields of application for sound power determination methods using an enveloping measurement surface

6 Installation and mounting conditions

6.1 Mounting of the machine

6.1.1 General

If practicable, the machine shall be mounted in the same way as for normal usage. Care shall be taken to minimize the transmission and the radiation of structure-borne noise from all mounting elements including the foundation. This minimizing can be achieved by resilient mounting for smaller machines. Larger machines can usually only be tested under rigid mounting conditions. A detailed description of the mounting conditions used shall be given [see 11 a)].

Machines tested under loaded conditions shall have rigid mounting. It is likely that the higher load ratings may be available only *in situ*. In this respect, precautions shall be taken according to 6.2 in order to discriminate between the supplementary noise due to the loading (to be measured) and the noise

emitted by the load itself (for a motor) or by the driving machine itself (for a generator) which is not to be measured.

In all cases, measurements shall be processed in accordance with Clauses 5 and 10, if relevant.

The installation and mounting conditions shall be identical for the determination of both sound power levels and emission sound pressure levels at specified positions, if relevant, and for declaration purposes.

6.1.2 Resilient mounting

The highest natural frequency of the system consisting of the support device and the machine under test shall be lower than a quarter of the frequency corresponding to the lowest rotational speed of the machine.

The effective mass of the resilient support shall not be greater than 1/10 of that of the machine under test.

6.1.3 Rigid mounting

The machines shall be rigidly mounted to a surface with dimensions adequate for the machine type (for example by foot or flange fixed in accordance with the manufacturer's instructions). The machine shall not be subject to additional mounting stresses from incorrect shimming.

The mass of the support shall be at least twice that of the machine under test.

6.2 Auxiliary equipment and loaded machines

All auxiliary equipment (loading machines, gears, transformer, converters, external cooling systems) and coupled machines which are necessary for the operation of the machine under test, but which do not form an integral part of the machine, shall not significantly affect the noise measurement. If they do, they should be shielded acoustically, located outside the test environment or the test should be carried out in accordance with ISO 9614.

7 Operating conditions

7.1 General

The machine shall operate at rated voltage(s) and speed(s), and with the corresponding excitation(s) (see IEC 60034-1).

For a.c. machines, the sinusoidality of the supply voltage and the degree of unbalance of the supply voltage system shall comply with the same limits that are specified in IEC 60034-1. For converter-fed machines, the harmonics of voltage or current are given by the properties of the relevant converter.

Synchronous machines shall be run with the field current which permits the rated voltage.

Other conditions may be agreed between the manufacturer and the customer.

The operating conditions used shall be recorded and reported in detail [see 11 a) and Clause 12].

The operating conditions shall be identical for the determination of both sound power level and emission sound pressure level at the specified position, if relevant.

7.2 Load

The testing shall be performed under no-load conditions, unless otherwise specified.

NOTE 1   Rated load conditions are very useful in practice although not mandatory according to this noise test code because of the variety of possible loads. Noise emission values under specified load conditions may be established by agreement between the manufacturer and the customer.

NOTE 2   In some cases, the difference in noise levels between load and no-load conditions may be required. The use of ISO 9614 or ISO/TS 7849[4] is recommended.

7.3 Variable speed devices

The machine under test shall be monitored over the whole range of operating speeds to determine the speed(s) generating the maximum noise level. To find this level, a low speed variation shall be applied. This condition shall be used for the noise test and the speed reported in the results.

NOTE 1   The variation in noise levels results mainly from the following two causes which cannot be accurately predicted in general:

a)   frequency coincidence between the rotational speed or its harmonics, and a natural frequency of the equipment;

b)   the possible existence of higher harmonic components in the supply producing structure mechanical excitations and noise emission.

NOTE 2   The purpose of the test is to determine:

a)   the noise characteristics at full speed conditions;

b)   the noise characteristics at the worst noise conditions over the whole specified speed range.

8 Measurement uncertainty

A single value of the sound power level of a noise source determined according to the procedures of 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 result, some associated with environmental conditions in the measurement laboratory and others with experimental technique.

If, at different laboratories, the sound power level of one certain source were to be determined in accordance with the provisions of this International Standard, the results would show a scatter. The uncertainties of sound power levels determined in accordance with this International Standard are estimated by the total standard deviation, σ_{tot}, in decibels.

In this context, this standard deviation is expressed by the standard deviation of reproducibility of the method, σ_{R0}, in decibels, and the standard deviation, σ_{omc}, in decibels, describing the uncertainty due to the instability of the operating and mounting conditions of the source under test in accordance with:

$$\sigma_{tot} = \sqrt{\sigma_{R0}^2 + \sigma_{omc}^2} \qquad (1)$$

Equation (1) shows that variations of operating and mounting conditions expressed by σ_{omc} should be taken into account before a measurement procedure with a certain grade of accuracy (characterized by σ_{R0}) is selected for a specific machine family.

NOTE 1   If different measurement procedures offered by the ISO 3740 to ISO 3747 series and ISO 9614 are used, systematic numerical deviations (biases) may additionally occur.

Derived from σ_{tot}, the expanded measurement uncertainty, U, in decibels, shall be calculated from

$$U = k\sigma_{\text{tot}} \tag{2}$$

The expanded measurement uncertainty depends on the degree of confidence that is desired. For a normal distribution of measured values, there is 95 % confidence that the true value lies within the range $(L_W - U)$ to $(L_W + U)$. This corresponds to a coverage factor of $k = 2$.

If the purpose of determining the sound power level is to compare the result with a limit value, it can be more appropriate to apply the coverage factor for a one-sided normal distribution. In that case, the coverage factor $k = 1,6$ corresponds to a 95 % confidence level.

Table 2 shows typical upper bound values of the standard deviation σ_{R0} for accuracy grades 1, 2 and 3 that may cover most of the applications of this International Standard (ISO 5725,[2] References [13] [14]). In special cases or if certain requirements of this International Standard are not met for a machine family or if it is anticipated that actual values of σ_{R0} for a given family of machines are smaller than those given in Table 2, a round robin test (see e. g. ISO 3744:2010, 9.3.2) is recommended to obtain machine-specific values of σ_{R0}.

Table 2 — Typical upper bound values of the standard deviation of reproducibility of the method, σ_{R0}, for A-weighted sound power levels determined in accordance with this International Standard

Grade of accuracy	Standard deviation of reproducibility, σ_{R0} dB
Grade 1	1,0
Grade 2	1,5
Grade 3	3,0
NOTE Information on values of σ_{R0} for octave or one-third octave band sound power levels are to be found in the relevant basic standards.	

The standard deviation σ_{omc} which describes the uncertainty associated with the instability of the operating and mounting conditions for the particular source under test shall be taken into account when determining the measurement uncertainty. It can be determined separately from repeated measurements carried out on the same source at the same location by the same persons, using the same measuring instruments and the same measurement position(s). For each of these measurements, the mounting of the machine and its operating conditions shall be readjusted. For N repetitions ($N \geq 3$), σ_{omc} is calculated by

$$\sigma_{\text{omc}} = \sqrt{\frac{1}{N-1} \sum_{j=1}^{N} \left(L'_{p,j} - L_{p,\text{av}} \right)^2} \text{ dB} \tag{3}$$

where

$L'_{p,j}$ is the sound pressure level measured for the jth repetition at the microphone position with the highest level or averaged over the entire measurement surface and determined without any correction;

$L_{p,\text{av}}$ is the (energy corresponding) average of the N values.

NOTE 2   For further details see e. g. 9.2 and ISO 3744:2010, Annex H.

9 Determination of the emission sound pressure level

9.1 General

The determination of emission sound pressure levels is not a requirement of this International Standard. If requested, they shall be determined according to this International Standard.

9.2 Selection of the relevant work station

For rotating electrical machines, this International Standard defines the work station as the enveloping measurement surface at a distance of 1 m from the reference box.

NOTE   If the position of an operator or bystander near the machine is well defined, the emission sound pressure level can be determined by using ISO 11202,[5] ISO 11204[6] or ISO 11205[7].

9.3 Selection of basic standard to be used

In this International Standard, the emission sound pressure level L_p is determined in accordance with ISO 11203.

No additional measurements are necessary for the determination. As defined by ISO 11203, L_p is calculated directly from the sound power level L_W determined according to Clauses 5 and 6:

$$L_p = L_W - 10 \lg\left(\frac{S}{S_0}\right) \text{ dB} \tag{4}$$

where

S is the area, in square metres, of the surface enveloping the machine with respect to the reference box at 1 m distance — this means L_p is the surface sound pressure level at 1 m distance;

S_0 $= 1 \text{ m}^2$.

9.4 Measurement uncertainty

Based on Equation (4), the emission sound pressure level is determined with the same accuracy as L_W (see Clause 8).

NOTE   Measurement uncertainties of emission sound pressure levels determined for operator or bystander positions can be found in the relevant standards used.

10 Indication of noise emission quantities determined according to this International Standard

Noise emission quantities determined according to the requirements of this International Standard shall be indicated by a double number describing both the basic standard used and this International Standard establishing all machinery-specific parameters applied for the emission measurement.

EXAMPLE 1   ISO 1680/ISO 3744 (rotating electrical machines)/(grade 2 determination of sound power levels; sound pressure enveloping surface method)

EXAMPLE 2   If determination of the emission sound pressure level is requested, see:

ISO 1680/ISO 9614-2/ISO 11203 (rotating electrical machines)/(grade 2 determination of sound power levels; sound intensity method)/(determination of emission sound pressure levels from the sound power level)

11 Information to be recorded

The following information shall be compiled and recorded for all measurements carried out in accordance with the requirements of this International Standard. Any deviations from the requirements of this International Standard shall be indicated.

a) Machine under test:

— description of the machine under test (i.e. type, size and auxiliary equipment, if any);

— operating conditions (especially voltage; type of converter, if any; load);

— mounting conditions.

b) Acoustic environment

— see relevant clause of the appropriate basic standard used.

c) Instrumentation

— see relevant clause of the appropriate basic standard used.

d) Acoustical data

— see relevant clause of the appropriate basic standard used.

12 Information to be reported

The test report shall contain the statement that the sound power levels have been obtained in full conformity with the procedures of this International Standard. If not, any deviations shall be indicated. The following information shall be reported:

a) a description of the machine under test;

b) the operating conditions;

c) the A-weighted sound power level, $L_{W,A}$, in decibels, and, if requested, unweighted sound power levels in frequency bands — reference: 1 pW;

d) the A-weighted emission sound pressure level, L_{pA}, in decibels, if requested — reference: 20 µPa;

e) the uncertainty of the results, in decibels;

f) if relevant, information on the presence of discrete tones determined in accordance with 5.3 c), indicating the method used;

g) the date when the measurements were carried out.

13 Declaration and verification of noise emission values (if required)

Declaration and verification of the noise emission values determined in accordance with this International Standard shall follow the procedures of ISO 4871 using the dual-number presentation (measured noise emission value L and uncertainty U).

In applying this International Standard, it is recommended that values for the uncertainty U for single machines according to Equation (2) (confidence: 95 %) be used. For the determination of U for batches, see ISO 4871 or ISO 7574-4.

NOTE   According to ISO 4871, the sum of L and U includes a greater part of the measurement uncertainty and, if relevant, also includes a certain portion of the spread caused by deviations in production, if using the same declaration for a whole batch.

The declaration shall give at least the following information:

— an indication of the measurement method used (see Clause 10);

— whether the declaration is related to one single machine or to a well-defined batch of machines; and

— the operating conditions used.

An example of a noise emission declaration is given in Annex B.

For the verification, it is recommended that a procedure of the same or a higher grade of accuracy as compared to the method used for determining the declared values be applied.

Annex A
(informative)

Overview of standards for the determination of sound power levels of machines and equipment