

AS 1081.1—1990

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Australian Standard[®]

**Acoustics—Measurement of
airborne noise emitted by rotating
electrical machinery**

**Part 1: Engineering method for
free-field conditions over a
reflective plane**

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PREFACE

This Standard was prepared by the Standards Australia Committee on Acoustics—Machinery Noise to supersede, in part, AS 1081—1975, *Measurement of airborne noise emitted by rotating electrical machinery*. It is identical with and has been reproduced from ISO 1680/1—1986, *Acoustics—Test code for the measurement of airborne noise emitted by rotating electrical machinery—Part 1: Engineering method for free-field conditions over a reflective plane*.

This Standard is one of the series which deals with rotating electrical machinery noise, the series being arranged as follows:

Part 1: Engineering method for free-field conditions over a reflective plane (this Standard).

Part 2: Survey method.

For the purpose of this Australian Standard, the ISO text should be modified as follows:

(a) *Clause 3:* The terms which have their equivalents in AS 1633, *Acoustics—Glossary of terms and related symbols* should follow the definitions of the Australian Standard. The terms which do not have equivalents in the AS 1633 should be as in this Standard.

(b) *References:* The reference to other publications should be modified as follows:

ISO 266	Acoustics—Preferred frequencies for measurements	AS 2533	Acoustics—Preferred frequencies for measurements
354	Acoustics—Measurement of sound absorption in a reverberation room	1045	Acoustics—Measurement of sound absorption in a reverberation room
1680/2	Acoustics—Test code for the measurement of airborne noise emitted by rotating electrical machinery—Part 2: Survey method	1081.2	Acoustics—Measurement of airborne noise emitted by rotating electrical machinery Part 2: Survey method
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	1271.1	Determination of sound power levels of noise sources, Part 1: Guidelines for the use of basic standards for the preparation of noise test codes
3741	Acoustics—Determination of sound power levels of noise sources—Precision methods for broad-band sources in reverberation rooms	1217.2	Acoustics—Determination of sound power levels of noise sources, Part 2: Precision methods for broad-band sources in reverberation rooms
3742	Acoustics—Determination of sound power levels of noise sources—Precision methods for discrete-frequency and narrow-band sources in reverberation room	1217.3	Acoustics—Determination of sound power levels of noise sources, Part 3: Precision methods for discrete-frequency and narrow-band sources in reverberation room
3744	Acoustics—Determination of sound power levels of noise sources—Engineering methods for free-field conditions over a reflecting plane	1217.5	Acoustics—Determination of sound power levels of noise sources, Part 5: Engineering methods for free-field conditions over a reflecting plane
3745	Acoustics—Determination of sound power levels of noise sources—Precision methods for anechoic and semi-anechoic rooms	1217.6	Acoustics—Determination of sound power levels of noise sources, Part 6: Precision methods for anechoic and semi-anechoic rooms
IEC 34/1	Rotating electrical machines Part 1: Rating and performance	1359	Rotating electrical machines — General requirements
225	Octave, half-octave and third-octave band filters intended for the analysis of sounds and vibrations	Z41	Octave, half-octave and one-third octave band pass filters intended for analysis of sound and vibrations
651	Sound level meters	1259	Sound level meters

CONTENTS

	<i>Page</i>
0 INTRODUCTION	4
1 SCOPE	4
2 REFERENCES	4
3 DEFINITIONS	5
4 ACOUSTIC ENVIRONMENT	6
5 INSTRUMENTATION	6
6 INSTALLATION AND OPERATION OF THE MACHINE	7
7 SOUND PRESSURE LEVELS ON THE MEASUREMENT SURFACE	7
8 CALCULATION OF SURFACE SOUND PRESSURE LEVEL AND SOUND POWER LEVEL	11
9 INFORMATION TO BE RECORDED	11
10 INFORMATION TO BE REPORTED	12
 ANNEXES	
A QUALIFICATION PROCEDURES FOR THE ACOUSTIC ENVIRONMENT	13
B COMPUTATIONAL PROCEDURES FOR CALCULATING A-WEIGHTED SOUND POWER LEVEL FROM OCTAVE OR ONE-THIRD OCTAVE BAND POWER LEVELS	16
C METHOD FOR ESTIMATING THE DIFFERENCE IN NOISE LEVEL BETWEEN NO-LOAD AND ON-LOAD OPERATIONS	17

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Acoustics—Measurement of airborne noise emitted by rotating electrical machinery—
Part 1: Engineering method for free-field conditions over a reflecting plane

0 Introduction

This part of ISO 1680 is based on ISO 3744 and has been drafted in accordance with ISO 3740.

The main purpose of this part of ISO 1680 is to specify a clearly defined measurement method for rotating electrical machines operating under steady-state conditions, the results of which can be expressed in sound power levels so that all machines tested using this code can be directly compared. Other methods, such as the precision methods of ISO 3741, 3742 and 3745, may also be used for determining sound power levels if the installation and operating conditions of this part of ISO 1680 are used.

1 Scope and field of application

1.1 General

This part of ISO 1680 specifies, in accordance with ISO 2204, an engineering method (grade 2) for measuring the sound pressure levels on a rectangular parallelepiped surface enveloping the machine and for calculating the sound power level produced by the machine. It outlines the procedures which may be used to evaluate the test environment and specifies the characteristics of suitable measuring instruments. A method is given for determining the A-weighted sound power level and, if required, octave or one-third octave band sound power levels of the machine from the mean of the sound pressure levels measured on the rectangular parallelepiped surface.

This part of ISO 1680 applies to the measurement of airborne noise from rotating electrical machines, such as motors and generators (d.c. and a.c. machines) without any limitation on the output or voltage, when fitted with their normal auxiliaries. It applies to rotating electrical machines with any linear dimension (length, width or height) not exceeding 15 m.

This part of ISO 1680 applies to measurements carried out in environmental conditions that meet the criteria given in clause 4 and annex A (environmental correction $K \leq 2$ dB, correction for background noise ≤ 1 dB). If these criteria are not met, standard deviations of the test results may be greater than those given in table 1, i.e. the engineering grade of accuracy may not be achieved. The method given in ISO 1680/2 shall then be used, which will result in A-weighted sound power levels of

lower accuracy. In this case, no reference shall be made to this part of ISO 1680.

1.2 Measurement uncertainty

Measurements carried out in conformity with this part of ISO 1680 usually result in standard deviations which are equal to or less than those given in table 1. The standard deviations given in table 1 reflect the cumulative effects of all causes of measurement uncertainty, excluding variations in the sound power level of the machine from test to test. For a machine 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 approximately 2 dB. For outdoor measurements, the standard deviation in the octave band centred on 63 Hz will be approximately 5 dB.

NOTE— The standard deviations in table 1 include the effects of allowable variations in the positioning of the measurement positions and in the selection of the stipulated measurement surface.

Table 1 — Uncertainty in determining sound power levels for engineering measurements indoors or outdoors

Octave band centre frequencies	One-third octave band centre frequencies	Standard deviation of mean value
Hz	Hz	dB
125	100 to 160	3,0
250 to 500	200 to 630	2,0
1 000 to 4 000	800 to 5 000	1,5
8 000	6 300 to 10 000	2,5

2 References

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

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

ISO 1680/2, *Acoustics— Test code for the measurement of airborne noise emitted by rotating electrical machinery— Part 2: Survey method*.

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 6926, *Acoustics—Determination of sound power levels of noise sources—Characterization and calibration of reference sound sources*.¹⁾

IEC Publication 34-1, *Rotating electrical machines—Part 1: Rating and performance*.

IEC Publication 225, *Octave, half-octave and third-octave band filters intended for the analysis of sounds and vibrations*.

IEC Publication 651, *Sound level meters*.

3 Definitions

For the purposes of this part of ISO 1680, the following definitions apply.

3.1 free field: A sound field in a homogeneous, isotropic medium free of boundaries. In practice, it is a field in which the effects of the boundaries are negligible over the frequency range of interest.

3.2 free field over a reflecting plane: A sound field in the presence of a reflecting plane on which the source is located.

3.3 anechoic room: A test room the surfaces of which absorb essentially all the incident sound energy over the frequency range of interest, thereby affording free-field conditions over the measurement surface.

3.4 semi-anechoic room: A test room with a hard reflecting floor the other surfaces of which absorb essentially all the incident sound energy over the frequency range of interest, thereby affording free-field conditions above a reflecting plane.

3.5 sound pressure level, L_p , in decibels: Twenty times the logarithm to the base 10 of the ratio of the sound

pressure to the reference sound pressure. The weighting network or the width of the frequency band and its centre frequency used shall be indicated: for example, A-weighted sound pressure level, L_{pA} , octave band sound pressure level, one-third octave band sound pressure level, etc. The reference sound pressure is 20 μPa .

3.6 surface sound pressure: The sound pressure averaged in time on a mean-square basis and also averaged over the measurement surface using the averaging procedures specified in 8.1 and corrected for the effects of background noise and the influence of reflected sound at the measurement surface.

3.7 surface sound pressure level, $\overline{L}_{pt}$, in decibels: Ten times the logarithm to the base 10 of the ratio of the square of the surface sound pressure to the square of the reference sound pressure.

3.8 sound power level, L_W , in decibels: Ten times the logarithm to the base 10 of the ratio of a given sound power to the reference sound power. The weighting network or the width of the frequency band used shall be indicated: for example, A-weighted sound power level, L_{WA} , octave band sound power level, one-third octave band sound power level, etc. The reference sound power is 1 pW ($= 10^{-12}$ W).

NOTE—The surface sound pressure level is numerically different from the sound power level and its use in lieu of the sound power level is not correct because the size of the measurement surface is not covered by this quantity.

3.9 frequency range of interest: For general purposes, the frequency range of interest includes the octave bands with centre frequencies between 125 and 8 000 Hz or the one-third octave bands with centre frequencies between 100 and 10 000 Hz. Any band may be excluded in which the level is more than 40 dB below the highest band pressure level. For special purposes, the frequency range of interest may be extended at either end, provided that the test environment and instrument accuracy are satisfactory for use over the extended frequency range. For sources which radiate predominantly high (or low) frequency sound, the frequency range of interest may be limited in order to optimize the test facility and procedures.

3.10 measurement surface: A hypothetical surface of area S enveloping the source on which the measurement positions are located and which terminates on the reflecting plane.

3.11 reference box: A hypothetical surface which is the smallest rectangular parallelepiped that just encloses the source and terminates on the reflecting plane.

3.12 measurement distance: The minimum distance from the reference box to the measurement surface.

3.13 background noise: The sound pressure level at each microphone position with the source inoperative.

1) At present at the stage of draft.