

Australian Standard™

Electroacoustics—Sound level meters

Part 1: Specifications



This Australian Standard was prepared by Committee AV-002, Acoustics—Instrumentation and Measurement Techniques. It was approved on behalf of the Council of Standards Australia on 3 February 2004 and published on 7 April 2004.

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Electroacoustics—Sound level meters

Part 1: Specifications

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PREFACE

This Standard was prepared by the Australian members of the Joint Standards Australia/Standards New Zealand Committee AV-002, Acoustics—Instrumentation and Measurement Techniques. After consultation with stakeholders in both countries, Standards Australia and Standards New Zealand decided to develop this Standard as an Australian Standard, rather than an Australian/New Zealand Standard.

This Standard supersedes in part AS 1259.1—1990, *Sound level meters, Part 1: Non-integrating* and AS 1259.2—1990, *Acoustics—Sound level meters, Part 2: Integrating—Averaging*

This Standard is identical with and has been reproduced from IEC 61672.1, *Electroacoustics—Sound level meters, Part 1: Specifications*.

The objective of this Standard is to give electroacoustical performance specifications of sound level meters.

As this Standard is reproduced from an International Standard, the following applies:

- (a) Its number does not appear on each page of text and its identity is shown only on the cover title page.
- (b) A full point substitutes for a comma when referring to a decimal marker.

This Standard provides for the use of the following Australian and Australian/New Zealand Standards as equivalent to particular International Standards reference herein:

<i>Reference to International Standard</i>		<i>Australian Standard</i>	
IEC		AS IEC	
60942	Electroacoustics—Sound calibrators	60942	Electroacoustics—Sound calibrators
61000	Electromagnetic compatibility (EMC)	61000	Electromagnetic compatibility (EMC)
61000-4-2	Part 4-2: Testing and measuring techniques—Electrostatic discharges immunity tests	61000.4.2	Part 4.2: Testing and measuring techniques—Electrostatic discharges immunity tests
61000-6-2	Part 6-2: Generic standards—Immunity for industrial equipment	61000.6.2	Part 6.2: Generic standards—Immunity for industrial equipment

Any International Standard not listed has not been adopted as an Australian Standard.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the annex to which they apply. A ‘normative’ annex is an integral part of a Standard, whereas an ‘informative’ annex is only for information and guidance.

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AUSTRALIAN STANDARD

Electroacoustics—Sound level meters

Part 1:

Specifications

1 Scope

1.1 This standard gives electroacoustical performance specifications for three kinds of sound measuring instruments:

- a conventional sound level meter that measures exponential time-weighted sound level;
- an integrating-averaging sound level meter that measures time-average sound level; and
- an integrating sound level meter that measures sound exposure level.

A single instrument may make any, or all, of the three kinds of measurements. Additional performance specifications are given for the measurement of maximum time-weighted sound level and peak C sound level. Frequency-weighting A is mandatory for all sound level meters specified in this standard.

1.2 Sound level meters conforming to the requirements of this standard have a specified frequency response for sound incident on the microphone from one principal direction in an acoustic free field or from random directions.

1.3 Sound level meters specified in this standard are intended to measure sounds generally in the range of human hearing.

NOTE For measurement of audible sound in the presence of ultrasound, the AU weighting, specified in IEC 61012 [1], may be applied.¹

1.4 Two performance categories, class 1 and class 2, are specified in this standard. In general, specifications for class 1 and class 2 sound level meters have the same design goals and differ mainly in the tolerance limits and the range of operational temperatures. Tolerance limits for class 2 specifications are greater than, or equal to, those for class 1 specifications.

1.5 This standard is applicable to a range of designs for sound level meters. A sound level meter may be a self-contained hand-held instrument with an attached microphone and a built-in display device. A sound level meter may be comprised of separate components in one or more enclosures and may be capable of displaying a variety of acoustical signal levels. Sound level meters may include extensive analogue or digital signal processing, separately or in combination, with multiple analogue and digital outputs. Sound level meters may include general-purpose computers, recorders, printers, and other devices that form a necessary part of the complete instrument.

¹ Numbers in square brackets refer to the bibliography.

1.6 Sound level meters may be designed for use with an operator present or for automatic and continuous measurements of sound level without an operator present. Specifications in this standard for the response to sound waves apply without an operator present in the sound field.

2 Normative references

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

CISPR² 16-1:1999, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1: Radio disturbance and immunity measuring apparatus*

IEC 60050(801), *International Electrotechnical Vocabulary – Chapter 801: Acoustics and electroacoustics*

IEC 60942, *Electroacoustics – Sound calibrators*

IEC 61000-4-2, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 2: Electrostatic discharge immunity test*. Basic EMC Publication

IEC 61000-6-2:1999, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity for industrial environments*

ISO/IEC GUIDE EXPRES:1995, *Guide to the expression of uncertainty in measurement*

ISO Publication, ISBN 92-67-01075-1, *International vocabulary of basic and general terms in metrology*

3 Terms and definitions

For the purposes of this standard, the terms and definitions given in IEC 60050(801), the *International vocabulary of basic and general terms in metrology*, the *Guide to the expression of uncertainty in measurement*, and IEC 61000-6-2:1999, as well as the following apply. All quantities are expressed in SI units.

3.1

reference sound pressure

reference quantity conventionally chosen equal to 20 μPa for airborne sound

3.2

sound pressure level

twenty times the logarithm to the base ten of the ratio of the root-mean-square of a given sound pressure to the reference sound pressure

NOTE Sound pressure level is expressed in decibels (dB); symbol L_p .

² In English, CISPR stands for International Special Committee on Radio Interference.

3.3

frequency weighting

for a sound level meter, the difference between the level of the signal indicated on the display device and the corresponding level of a constant-amplitude steady-state sinusoidal input signal, specified in this standard as a function of frequency

NOTE The difference in level is expressed in decibels (dB).

3.4

time weighting

exponential function of time, of a specified time constant, that weights the square of the instantaneous sound pressure

3.5

time-weighted sound level

twenty times the logarithm to the base ten of the ratio of a given root-mean-square sound pressure to the reference sound pressure, root-mean-square sound pressure being obtained with a standard frequency weighting and standard time weighting

NOTE 1 Time-weighted sound level is expressed in decibels (dB).

NOTE 2 For time-weighted sound level, example letter symbols are L_{AF} , L_{AS} , L_{CF} , and L_{CS} for frequency weightings A and C and time weightings F and S.

NOTE 3 In symbols, A-weighted and time-weighted sound level, $L_{At}(t)$, at any instant of time t is represented by

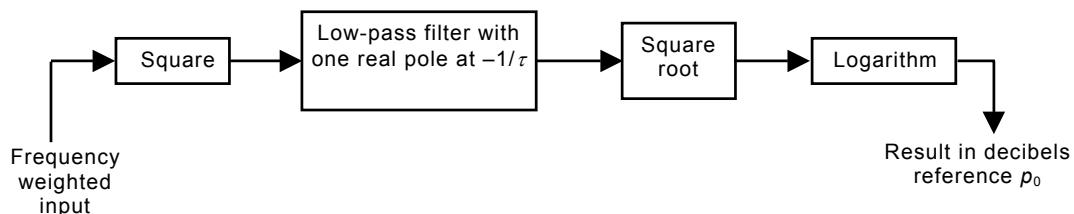
$$L_{At}(t) = 20 \lg \left\{ \left[\left(1/\tau \right) \int_{-\infty}^t p_A^2(\xi) e^{-(t-\xi)/\tau} d\xi \right]^{1/2} / p_0 \right\} \quad (1)$$

where

- τ is the exponential time constant in seconds for time weighting F or S;
- ξ is a dummy variable of time integration from some time in the past, as indicated by $-\infty$ for the lower limit of the integral, to the time of observation t ;
- $p_A(\xi)$ is the A-weighted instantaneous sound pressure; and
- p_0 is the reference sound pressure.

In equation (1), the numerator of the argument of the logarithm is the exponential-time-weighted, root-mean-square, frequency-weighted sound pressure at observation time t .

NOTE 4 The sketch in figure 1 illustrates the process indicated by equation (1).



IEC 1082/02

Figure 1 – Principal steps involved in forming an exponential-time-weighted sound level

3.6

maximum time-weighted sound level

greatest time-weighted sound level within a stated time interval

NOTE 1 Maximum time-weighted sound level is expressed in decibels (dB).

NOTE 2 For maximum time-weighted sound level, example letter symbols are L_{AFmax} , L_{ASmax} , L_{CFmax} , and L_{CSmax} for frequency weightings A and C and time weightings F and S.

3.7

peak sound pressure

greatest absolute instantaneous sound pressure during a stated time interval

3.8

peak sound level

twenty times the logarithm to the base ten of the ratio of a peak sound pressure to the reference sound pressure, peak sound pressure being obtained with a standard frequency weighting

NOTE 1 Peak sound level is expressed in decibels (dB).

NOTE 2 This standard provides specifications for measurement of peak C sound level; symbol L_{Cpeak} .

3.9

time-average sound level

equivalent continuous sound level

twenty times the logarithm to the base ten of the ratio of a root-mean-square sound pressure during a stated time interval to the reference sound pressure, sound pressure being obtained with a standard frequency weighting

NOTE 1 Time-average or equivalent continuous sound level is expressed in decibels (dB).

NOTE 2 In symbols, time-average, A-weighted sound level, L_{AT} or L_{AeqT} , is given by

$$L_{AT} = L_{AeqT} = 20 \lg \left\{ \left[(1/T) \int_{t-T}^t p_A^2(\xi) d\xi \right]^{1/2} / p_0 \right\} \quad (2)$$

where

- ξ is a dummy variable of time integration over the averaging time interval ending at the time of observation t ;
- T is the averaging time interval;
- $p_A(\xi)$ is the A-weighted instantaneous sound pressure; and
- p_0 is the reference sound pressure.

In equation (2), the numerator of the argument of the logarithm is the root-mean-square, frequency-weighted sound pressure over averaging time interval T .

NOTE 3 In principle, time weighting is not involved in a determination of time-average sound level.

3.10

sound exposure

time integral of the square of sound pressure over a stated time interval or event

NOTE 1 Duration of integration is included implicitly in the time integral and need not be reported explicitly, although the nature of the event should be stated. For measurements of sound exposure over a specified time interval such as 1 h, duration of integration should be reported.

NOTE 2 In symbols, A-weighted sound exposure E_A of a specified event is represented by

$$E_A = \int_{t_1}^{t_2} p_A^2(t) dt \quad (3)$$

where $p_A^2(t)$ is the square of the A-weighted instantaneous sound pressure during an integration time starting at t_1 and ending at t_2 .

The unit of A-weighted sound exposure is pascal-squared seconds if A-weighted sound pressure is in pascals and running time is in seconds.

NOTE 3 Sound exposure in pascal-squared hours is more convenient for applications such as measurement of exposure to noise in the workplace; see IEC 61252 [2].

3.11 sound exposure level

ten times the logarithm to the base ten of the ratio of a sound exposure to the reference sound exposure, reference sound exposure being the product of the square of the reference sound pressure and the reference time interval of 1 s

NOTE 1 Sound exposure level is expressed in decibels (dB).

NOTE 2 In symbols, A-weighted sound exposure level, L_{AE} , is related to a corresponding measurement of time-average, A-weighted sound level, L_{AT} or L_{AeqT} , by

$$L_{AE} = 10 \lg \left\{ \left[\int_{t_1}^{t_2} p_A^2(t) dt \right] / (p_0^2 T_0) \right\} = 10 \lg(E_A / E_0) = L_{AT} + 10 \lg(T / T_0) \quad (4)$$

where

- E_A is the A-weighted sound exposure in pascal-squared seconds (see equation (3));
- E_0 is the reference sound exposure of $(20 \mu\text{Pa})^2 \times (1 \text{ s}) = 400 \times 10^{-12} \text{ Pa}^2\text{s}$;
- $T_0 = 1 \text{ s}$; and
- $T = t_2 - t_1$ is the time interval for measurement, in seconds, for sound exposure level and time-average sound level.

NOTE 3 Time-average, A-weighted sound level L_{AT} or L_{AeqT} during time interval T is related to the total A-weighted sound exposure E_A occurring within that interval by

$$E_A = (p_0^2 T) (10^{0,1 L_{AT}}) \quad (5a)$$

or

$$L_{AT} = 10 \lg [E_A / (p_0^2 T)] = L_{AE} - 10 \lg(T / T_0) \quad (5b)$$

3.12 microphone reference point

point specified on, or close to, the microphone to describe the position of the microphone

NOTE The microphone reference point may be at the centre of the diaphragm of the microphone.

3.13 reference direction

inward direction toward the microphone reference point and specified for determining the acoustical response, directional response, and frequency weighting of a sound level meter

NOTE The reference direction may be specified with respect to an axis of symmetry.

3.14 sound-incidence angle

angle between the reference direction and a line between the acoustic centre of a sound source and the microphone reference point

NOTE Sound-incidence angle is expressed in degrees.

3.15 level range

range of nominal sound levels measured with a particular setting of the controls of a sound level meter

NOTE Level range is expressed in decibels (dB).

3.16**reference sound pressure level**

sound pressure level specified for testing the electroacoustical performance of a sound level meter

NOTE Reference sound pressure level is expressed in decibels (dB).

3.17**reference level range**

level range specified for testing the electroacoustical characteristics of a sound level meter and containing the reference sound pressure level

NOTE Reference level range is expressed in decibels (dB).

3.18**calibration check frequency**

nominal frequency, in the range from 160 Hz to 1 250 Hz, of the sinusoidal sound pressure produced by a sound calibrator that is used in checking and adjusting a sound level meter

3.19**level linearity error**

at a stated frequency, an indicated signal level minus the anticipated signal level

NOTE Level linearity error is expressed in decibels (dB).

3.20**linear operating range**

on any level range and at a stated frequency, the range of sound levels over which level linearity errors are within the tolerance limits specified in this standard

NOTE Linear operating range is expressed in decibels (dB).

3.21**total range**

range of A-weighted sound levels, in response to sinusoidal signals, from the smallest sound level, on the most-sensitive level range, to the highest sound level, on the least-sensitive level range, that can be measured without indication of overload or under-range and within the tolerance limits specified in this standard for level linearity error

NOTE Total range is expressed in decibels (dB).

3.22**toneburst**

one or more complete cycles of a sinusoidal signal starting and stopping at a zero crossing of the waveform

3.23**toneburst response**

maximum time-weighted sound level, time-average sound level, or sound exposure level, measured in response to a sinusoidal electrical toneburst minus the corresponding measured sound level of the steady sinusoidal input signal from which the toneburst was extracted

NOTE Toneburst response is expressed in decibels (dB).

3.24

reference orientation

orientation of a sound level meter for tests to demonstrate conformance to the specifications of this standard for emissions of, and susceptibility to, radio frequency fields

4 Reference environmental conditions

Reference environmental conditions for specifying the performance of a sound level meter are:

- air temperature 23 °C;
- static pressure 101,325 kPa;
- relative humidity 50 %.

5 Performance specifications

5.1 General

5.1.1 Generally, a sound level meter is a combination of a microphone, a signal processor, and a display device.

The signal processor includes the combined functions of an amplifier with a specified and controlled frequency response, a device to form the square of the frequency-weighted time-varying sound pressure, and a time integrator or time averager. Signal processing that is necessary to conform to the specifications of this standard is an integral part of a sound level meter.

In this standard, a display device provides either a physical and visible display, or storage, of measurement results. Any stored measurement result shall be available for display by means of a manufacturer-specified device, for instance a computer with associated software.

5.1.2 The performance specifications of this clause apply under the reference environmental conditions of clause 4.

5.1.3 For specifying the emission of, and susceptibility to, radio frequency fields, sound level meters are classified into three groups as follows:

- group X sound level meters: self-contained instruments that include sound level measurement facilities according to this standard and which specify internal battery power for the normal mode of operation, requiring no external connections to other apparatus to measure sound levels;
- group Y sound level meters: self-contained instruments that include sound level measurement facilities according to this standard and which specify connection to a public supply of electric power for the normal mode of operation, requiring no external connections to other apparatus to measure sound levels; and
- group Z sound level meters: instruments that include sound level measurement facilities according to this standard and which require two or more items of equipment, which are essential constituent parts of the sound level meter, to be connected together by some means for the normal mode of operation. The separate items may be operated from internal batteries or from a public supply of electric power.

5.1.4 The configuration of the complete sound level meter and its normal mode of operation shall be stated in the instruction manual. If appropriate, the configuration of the complete sound level meter includes a windscreen and other devices that are installed around the microphone as integral components for the normal mode of operation.

5.1.5 A sound level meter that is stated in the instruction manual to be a class 1 or class 2 sound level meter shall conform to all mandatory class 1 or class 2 specifications, respectively, that are provided in this standard. A class 2 sound level meter may provide some class 1 capabilities, but if any capability conforms only to the class 2 specifications, the instrument is a class 2 sound level meter. A sound level meter may be specified as a class 1 instrument in one configuration and a class 2 instrument in another configuration (for example, with a different microphone or preamplifier).

5.1.6 The instruction manual shall state the models of microphones with which the complete sound level meter conforms to the specifications for class 1 or class 2 performance for sound waves incident on the microphone from the reference direction in a free field, or with random incidence, or both, as appropriate. The instruction manual shall describe appropriate procedures for use of the sound level meter.

5.1.7 The instruction manual shall state how the microphone is to be mounted, if applicable, to conform to the specifications for directional response and frequency weightings. A microphone extension device or cable may be required to conform to the specifications. In this event, the sound level meter shall be stated in the instruction manual as conforming to the applicable specifications for directional response and frequency weighting only when the specified devices are installed.

5.1.8 Computer software may be an integral part of the sound level meter. The instruction manual shall provide unique identification for all such software.

5.1.9 As a minimum, a conventional sound level meter shall provide a means to indicate A-frequency-weighted and F-time-weighted sound level. As a minimum, an integrating-averaging sound level meter shall provide a means to indicate A-weighted time-average sound level. As a minimum, an integrating sound level meter shall provide a means to indicate A-weighted sound exposure level. Sound level meters may contain any or all of the design features for which performance specifications are given in this standard. A sound level meter shall conform to the applicable performance specifications for those design features that are provided.

5.1.10 A sound level meter shall have frequency-weighting A. Sound level meters conforming to class 1 tolerance limits also shall have frequency weighting C, at least for pattern evaluation tests. Sound level meters that measure peak C sound levels for non-steady sounds shall also measure C-weighted sound levels for steady sounds, at least for pattern evaluation tests. The ZERO frequency weighting (Z-weighting) is optional. The instruction manual shall describe all frequency weightings that are provided.

5.1.11 A sound level meter may have more than one display device.

NOTE An a.c., d.c., or digital output connection alone is not a display device.

5.1.12 A sound level meter may have more than one level range with a suitable level range control. The instruction manual shall describe the level range(s) by the nominal A-weighted sound level at 1 kHz. The instruction manual shall describe the operation of the level range controls and provide recommendations for selecting the optimum level range to display the results of a measurement of sound level or sound exposure level.

5.1.13 The reference sound pressure level, reference level range, and reference orientation shall be stated in the instruction manual. The instruction manual shall state the reference direction for each model of microphone intended for use with the sound level meter; the position of the microphone reference point shall also be stated.

NOTE A reference sound pressure level of 94 dB is preferred. Alternatively, a reference sound pressure level of 74 dB, 84 dB, 104 dB, 114 dB, or 124 dB may be specified. A sound pressure level of 94 dB corresponds closely to a root-mean-square sound pressure of 1 Pa.

5.1.14 A hold feature shall be provided, for measurements of maximum time-weighted sound level and peak C sound level if the sound level meter is capable of measuring these quantities. The instruction manual shall describe the operation of the hold facility and the means for clearing a display that is held.

5.1.15 Determination of conformance to many specifications of this standard requires the application of electrical signals. The electrical signals are to be equivalent to signals from the microphone. As appropriate for each specified model of microphone, the design goal and applicable tolerance limits shall be stated in the instruction manual for the electrical characteristics of the device, or the means, to insert signals into the electrical input facility. Electrical characteristics include the resistive and reactive components of the electrical impedance at the output of the device. The design goal for the impedance shall be specified for a frequency of 1 kHz.

5.1.16 The instruction manual shall state the highest sound pressure level at the microphone and the greatest peak-to-peak voltage that can be applied at the electrical input facility without causing damage to the sound level meter.

5.1.17 Performance specifications in this standard apply, as appropriate, to any time or frequency weightings operated in parallel and to each independent channel of a multi-channel sound level meter. The instruction manual shall describe the characteristics and operation of each independent channel.

NOTE A multi-channel sound level meter may have two or more microphone inputs.

5.1.18 Specifications for the electroacoustical response of a sound level meter apply after an initial time interval following switching on the power. The initial time interval, stated in the instruction manual, shall not exceed 2 min. The sound level meter shall be allowed to reach equilibrium with the prevailing ambient environment before switching on the power.

5.1.19 Tolerance limits in this standard include allowances for design and manufacturing and for the maximum expanded uncertainties of measurement for the tests to demonstrate conformance to the specifications (see annex A).

NOTE In some cases, the tolerance limits in this standard are larger than the tolerance limits for corresponding characteristics in IEC 60651 and IEC 60804. Tolerance limits in IEC 60651 [3] and in IEC 60804 [4] did not include allowances for uncertainties of measurement.