

AS 1259.1—1990

Australian Standard[®]

Sound level meters

Part 1: Non-integrating

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Australian Acoustical Society
Australian and New Zealand Environment Council
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Sound level meters

Part 1: Non-integrating

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PREFACE

This Standard was prepared by the Standards Australia Committee on Acoustics—Instrumentation and Measurement Techniques to supersede AS 1259–1982, *Sound level meters* and is one of a series of two which deals with sound level meters, the series being arranged as follows:

Part 1: Non–integrating (this Standard)

Part 2: Integrating–averaging

This Standard is devoted to the non–integrating sound level meters and is technically equivalent to IEC 651, *Sound level meters*, with which it corresponds in all essential details, and includes the requirements of D–weighting specified in IEC 537, *Frequency weighting for the measurement of aircraft noise (D–weighting)*. An Annex giving brief details of important deviations of this Standard from IEC 651 is provided.

Part 2 of the Standard is devoted to the integrating–averaging sound level meters and is technically identical to IEC 804, *Integrating–averaging sound level meters* and incorporates *IEC Amendment No 1 of September 1989 to the IEC 804*.

The Standard provides for four types of sound level meters, viz. Types 0 and 1 intended for laboratory and precision use; Type 2, intended for general field applications; and Type 3, primarily intended for field noise survey applications.

The sound level meters have one or more frequency–weighting characteristics designated A, B, and C, and one or more time–weighting characteristics designated S, F and I and P.

Owing to the complexity of operation of the human ear, it is not possible at present to design an objective noise measuring apparatus for all types of noise, to give results which are absolutely comparable in respect of some characteristic of the noise such as loudness or annoyance which can be obtained by subjective assessment.

However, it is considered essential that an apparatus by which sounds can be measured under closely defined conditions be standardized so that results obtained by users of such apparatus are always reproducible within stated tolerances.

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STANDARDS AUSTRALIA

Australian Standard
Acoustics—Sound level meters

Part 1: Non-integrating

1 SCOPE. This Standard specifies requirements for sound level meters for the measurement of certain frequency-weighted and time-weighted sound pressure levels.

This Standard specifies the following characteristics of sound level meters:

- (a) Directional characteristics.
- (b) Frequency-weighting characteristics.
- (c) Time-weighting, detector and indicator characteristics.
- (d) Sensitivity to various environments.

It also sets out electrical and acoustical procedures to verify compliance with the characteristics specified and describes the method for absolute sensitivity calibration.

2 REFERENCED DOCUMENTS. The following documents are referred to in this Standard:

AS

1099 Basic environmental testing procedures for electrotechnology

1633 Acoustics—Glossary of terms and related symbols

2533 Acoustics—Preferred frequencies for measurements

2659 Guide to the use of sound measuring equipment

2659.1 Part 1: Portable sound level meters

IEC

537 Frequency weighting for the measurement of aircraft noise (D-weighting)

3 DEFINITIONS. For the purpose of this standard, the definitions in AS 1633 and the following apply:

3.1 Weighted sound pressure level (in decibels (dB))—20 times the logarithm to the base 10 of the ratio of a weighted sound pressure to the reference sound pressure. The sound pressure is weighted in accordance with one of the frequency weightings A, B, C or D and is time-weighted in accordance with characteristic S, F, I or P, the frequency weightings and time weightings being as specified in this Standard. The reference sound pressure is 20 μ Pa and does not depend on the frequency weighting or the time weighting.

3.2 Crest factor (of a signal)—the ratio of the peak value to the r.m.s. value measured over a specified time interval, the instantaneous values of the signal being measured with respect to the arithmetic mean value.

3.3 Primary indicator range (of a sound level meter)—a specified range of the indicator for which the sound level meter readings are within particularly close tolerances on level linearity as specified in Clause 8.9 and Clause 8.10.

3.4 Level linearity—the relationship when the reading of the sound level meter is a linear function of the level of the input signal, within stated tolerances.

3.5 Reference direction—the direction of sound incidence specified by the manufacturer to be used for determination of the absolute sensitivity, the directional characteristics and the frequency weighting of a sound level meter.

3.6 Reference frequency—a frequency, specified by the manufacturer, in the range 200 Hz to 1000 Hz to be used for calibration of the absolute sensitivity of a sound level meter.

3.7 Reference sound pressure level—a sound pressure level, specified by the manufacturer, to be used for calibration of the absolute sensitivity of the sound level meter.

3.8 Reference range (of a sound level meter)—a range, specified by the manufacturer, for calibration purposes.

3.9 Tone burst—an integral number of cycles of a sine wave starting and ending at a zero crossing.

4 DESIGNATION.

4.1 Types. This Standard specifies sound level meters of four degrees of precision, designated Types 0, 1, 2 and 3.

The Type 0 sound level meter is intended as a laboratory reference Standard. Type 1 is intended for laboratory use, and for field use where the acoustical environment can be closely specified or controlled or both. The measurement accuracy possible with Type 0 and 1 instruments may not be realized under ordinary conditions. The Type 2 sound level meter is suitable for general field applications. Type 3 is intended primarily for field noise survey applications such as to determine whether an established noise limit has been significantly violated.

NOTES:

1. Sound level meters intended for field use have to comply with rigorous environmental specifications. Other sound level meters are used only in laboratories where the environment is controlled, and it is not justifiable to require such instruments to meet the design constraints imposed on field instruments. The distinction is provided for in Clauses 9.6 and 9.7 which specify additional requirements for instruments intended for field use.
2. It is recognized that sound level meters are used to measure many types of sound under different conditions and for a variety of reasons. For each application, the measurement technique should be chosen and controlled carefully to obtain valid and consistent results. It is important to note that the method of use has at least as much effect on a measurement as the quality of the instrument itself, and errors will often result if the effect of the environment and (especially for portable instruments) the presence of the observer are ignored. See also AS 2659.1.

4.2 Tolerances. The specifications for Types 0, 1, 2 and 3 sound level meters have the same centre values and differ only in the tolerances allowed. Tolerances generally broaden as the type number increases and differ for the various types to a degree which affects manufacturing costs significantly.

4.3 Weighting characteristics.

4.3.1 Frequency weighting. A sound level meter shall have one or more frequency-weighting characteristics designated A, B and C. Optional weighting characteristics, which may be included, are as follows:

- (a) A characteristic designated Lin for which the response is constant over a wide frequency range.
- (b) A frequency-weighting characteristic designated D-weighting.

NOTES:

1. The term 'weighted sound pressure level', used throughout this Standard, has often been abbreviated to 'weighted sound level' or 'sound level' and such use is deprecated.
2. The weighted sound pressure levels obtained by the use of the weighting networks A, B, C, D, Lin, etc are customarily stated with corresponding suffixes beside the unit decibel, e.g. dB(A), dB(B), dB(D), dB(Lin). Such suffixes are not part of the unit, but serve as reminders of the type of quantity being stated.
3. The D-weighting complies with the requirements specified in IEC 537.

4.3.2 Time weighting. A sound level meter shall have one or both time-weighting characteristics designated S and F. An I or P characteristic may also be included. Where provided, P characteristic allows the sound level meter to indicate the level of the peak of the acoustical signal (see also Clause 5.5).

NOTES:

1. The time-weighting symbols 'S', 'F', 'I' and 'P' have been derived respectively from the words 'Slow', 'Fast', 'Impulse', and 'Peak' based on older instruments. However, those instruments may not comply with the time-weighting characteristics specified in this Standard.
2. In the past, frequency weighting and time weighting have been associated with certain characteristics of the ear. However, recent work has not substantiated these historical associations, so that frequency-weighting and time-weighting characteristics of sound level meters may be considered to be conventional. The A-weighting characteristic is now frequently specified for rating sounds irrespective of level and is no longer restricted to low level sounds. Furthermore, standardization of the I-weighting characteristic does not imply that the relationship between loudness or hearing damage risk of impulsive sounds and the physical characteristics of sounds is thereby precisely presented.

4.4 Optional features. This Standard is intended to allow special features in a sound level meter such as wide indicator range, digital display, recording display and automatic range change.

5 GENERAL CHARACTERISTICS OF SOUND LEVEL METERS.

5.1 General. A sound level meter is generally a combination of a microphone, an amplifier with controlled frequency weighting, and a detector-indicator device with controlled time-weighting characteristics. In Clauses 6, 7 and 8, specifications are given for these parts of the sound level meter, and tolerances are given for four types of sound level meters. Any additional items necessary to comply with any of the requirements (such as extension rods or cables and random-incidence correctors) are regarded as integral parts of the sound level meter.

5.2 Accuracy and calibration. The reading of the sound level meter under the reference conditions, as defined in Clause 10.1 and Clause 10.2.1(a), shall be accurate to within ± 0.4 dB, ± 0.7 dB, ± 1.0 dB, ± 1.5 dB for Types 0, 1, 2 and 3 instruments respectively, after any warm-up period specified by the manufacturer. A means shall be available to check and maintain calibration at the reference frequency and reference sound pressure level.

NOTES

1. A reference frequency of 1000 Hz is preferred.
2. A reference sound pressure level of 94 dB is preferred or, if this level is not within the measuring range of the instrument, 84 dB or 74 dB.

5.3 Directional characteristics. Ideally, a sound level meter is equally responsive to sounds arriving at any angle of incidence. The microphone and instrument case shall comply with Clause 6 for directional characteristics.

5.4 Frequency weighting. The output signal of the microphone is frequency-weighted to produce one or more of the three characteristics designated A, B and C. Weighting and amplifier circuits shall comply with Clause 7.

The D-weighting, where provided, shall also comply with Clause 7.

The Lin response, where provided, allows the sound level meter to measure sound pressure level (unweighted) or to function as a preamplifier for an auxiliary device. Where the Lin response is provided, the manufacturer shall specify its frequency range and tolerances. The tolerances shall not be greater than those for the frequency-weighting characteristics (see Table 5).

NOTE: Where weighted sound pressure level is quoted, the frequency weighting and the time weighting are to be indicated.

5.5 Time weighting. The frequency-weighted signal is detected and indicated in accordance with one or more of the characteristics designated S, F, I and P specified in Clause 8 and Clause 10.4.

5.6 Sensitivity to various environments. Although the frequency-weighting characteristic and detector-indicator characteristic are usually associated with particular circuits within the sound level meter, the tests to determine compliance with Clause 10 shall be made on the complete instrument. In this way, any interaction between the various elements of the instrument will be taken into account.

5.7 Means for substitution of electrical signal. The manufacturer shall provide the means to substitute an electrical signal for the microphone for the purpose of performing tests on the complete instrument without the microphone.

5.8 Means for checking battery voltage. If the sound level meter is battery operated, suitable means shall be provided to check that a battery voltage, adequate to operate the instrument according to the specifications, is maintained.

5.9 Maximum change of reading during operation. After a warm-up period, to be specified by the manufacturer, but less than 10 min in duration, the reading shall not change within 1 h of continuous operation under constant test conditions by more than the values shown in Table 1.

6 DIRECTIONAL CHARACTERISTICS OF THE MICROPHONE AND INSTRUMENT CASE. The manufacturer shall specify a reference direction of incidence for which the frequency-weighting characteristics given in Clause 7 apply. The total spread of the change in sensitivity of the equipment within an angle of ± 30 degrees from the reference direction shall not exceed the values given in Table 2. The total spread of the change in sensitivity within an angle of ± 90 degrees from the reference direction shall not exceed the values given in Table 3. The tables shall apply when the microphone is mounted, as specified by the manufacturer, for normal use and with the observer not disturbing the sound field at the microphone. The values in both tables shall be checked using the same microphone configuration.

7 FREQUENCY-WEIGHTING AND AMPLIFIER CHARACTERISTICS.

7.1 General. The complete instrument comprising the microphone, amplifier, weighting network, and detector-indicator shall have one or more of the frequency-weighting characteristics with tolerance given in Tables 4 and 5, when measured in the reference direction. For sound level meters of a given type, the tolerances are identical for A, B and C characteristics.

Where D-weighting is provided, its tolerances shall comply with those given in Table 5 for Type 0 or Type 1 meters.

Where a level range control is included, it shall introduce errors less than those given in Table 6 for all settings with reference to a range setting specified by the manufacturer as the reference range. The reference range shall include the reference sound pressure level (defined in Clause 3.7) and the test shall be performed on the basis of this level.

NOTE: A reference sound pressure level of 94 dB is preferred or, if this level is not within the measuring range of the instrument, 84 dB or 74 dB.

7.2 Manual level range control. Where a manual level range control is included in a sound level meter, ranges shall overlap by at least —

- (a) 5 dB if the step of the level range control is 10 dB; or
- (b) 10 dB if the step is greater than 10 dB.

7.3 Crest factor capacity. The amplifier shall have a crest factor capacity sufficient to comply with Clause 8.2. For Type 0 instruments, overload detectors shall be placed in the amplifier chain and shall indicate when the crest factor capacity has been exceeded.

Where the I or P characteristic is included in any instrument, overload detectors shall be provided.

NOTES:

1. It is recommended that overload detectors should also be used in Type 1 and Type 2 instruments.
2. The relation between crest factor and pulse duty factor for sequences of rectangular pulses and for tone bursts is given in Appendix A.

TABLE 1
MAXIMUM CHANGE OF READING, IN DECIBELS, DURING 1 h OF OPERATION

Type 0	Type 1	Type 2	Type 3
0.2	0.3	0.5	0.5

TABLE 2
**MAXIMUM CHANGE IN SENSITIVITY WITHIN AN ANGLE OF ± 30 DEGREES
 FROM THE REFERENCE DIRECTION**

Frequency Hz	Maximum change in sensitivity, dB			
	Meter type			
	Type 0	Type 1	Type 2	Type 3
$\geq 31.5 \leq 1\ 000$	0.5	1	2	4
$> 1\ 000 \leq 2\ 000$	0.5	1	2	4
$> 2\ 000 \leq 4\ 000$	1	1.5	4	8
$> 4\ 000 \leq 8\ 000$	2	2.5	8	12
$> 8\ 000 \leq 12\ 500$	2.5	4	—	—

TABLE 3
**MAXIMUM CHANGE IN SENSITIVITY WITHIN AN ANGLE OF ± 90 DEGREES
 FROM THE REFERENCE DIRECTION**

Frequency Hz	Maximum change in sensitivity, dB			
	Meter type			
	Type 0	Type 1	Type 2	Type 3
$\geq 31.5 \leq 1\ 000$	1	1.5	3	8
$> 1\ 000 \leq 2\ 000$	1.5	2	5	10
$> 2\ 000 \leq 4\ 000$	2	4	8	16
$> 4\ 000 \leq 8\ 000$	5	8	14	30
$> 8\ 000 \leq 12\ 500$	7	16	—	—