

Australian/New Zealand Standard™

**Acoustics—Measurement of the
reverberation time in rooms**



standards Australia



AS/NZS 2460:2002

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RECONFIRMATION

OF

AS/NZS 2460:2002

Acoustics—Measurement of the reverberation time in rooms

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NOTES

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee, AV-004, Acoustics, Architectural, to supersede AS 2460—1981, *Acoustics—Measurement of reverberation time in enclosures*.

The objective of this Standard is to specify methods for the measurement of reverberation time in rooms. This Standard applies to any room in which reverberation time is an important factor affecting the quality of sound in the room, or where reverberation control is used for noise control purposes.

During preparation of this Standard, cognizance was taken of ISO 3382:1997, *Acoustics—Measurement of the reverberation time of rooms with reference to other acoustical parameters*. This Standard incorporates a number of technical changes from ISO 3382:1997, most notably the specification for the nature of the sound source. Conventional loudspeakers, properly located and oriented, may be used as the test sound source in lieu of omnidirectional loudspeakers, where appropriate. An installed sound system may be used to excite the room under certain circumstances.

This Standard should be read by a person who has acquired through training, qualifications or experience, or a combination of these, the knowledge and skills enabling that person to perform the task required.

Appendix B, *Auditorium measures derived from impulse responses*, is technically equivalent to Annex A of ISO 3382:1997. It presents several quantities that can be obtained from measured impulse responses, namely, a further measure of reverberation (early decay time) and measures of relative sound levels, early/late energy fractions and lateral energy fractions. Subjective studies of the acoustical characteristics of auditoria have shown that these quantities are correlated with particular subjective aspects of the acoustical character of an auditorium. However, there is still work to be done in determining which measures are the most suitable as bases for standardization.

The term ‘informative’ has been used in this Standard to define the application of the appendix to which it applies. An ‘informative’ appendix is only for information and guidance.

CONTENTS

	<i>Page</i>
1 SCOPE	4
2 APPLICATION.....	4
3 REFERENCED DOCUMENTS	4
4 DEFINITIONS	5
5 EQUIPMENT.....	6
6 MEASUREMENT CONDITIONS	8
7 MEASUREMENT PROCEDURES	9
8 EVALUATION.....	11
9 STATEMENT OF RESULTS	11

APPENDICES

A	GUIDANCE ON THE CHOICE OF MEASUREMENT POSITIONS	13
B	AUDITORIUM MEASURES DERIVED FROM IMPULSE RESPONSES	15
C	BIBLIOGRAPHY	23

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Australian/New Zealand Standard
Acoustics—Measurement of the reverberation time in rooms

1 SCOPE

This Standard specifies methods for the measurement of reverberation time in rooms. It describes the measurement procedure, the apparatus needed, the coverage required, and the method of evaluating the data and presenting the test report.

2 APPLICATION

This Standard is applicable to any room in which reverberation time is important or where noise control by means of reverberation control is a consideration. Its application is not restricted to auditoria and concert halls. It is relevant to assessment of the suitability and quality of a wide variety of rooms for speech and music, including—

- (a) industrial halls and factories;
- (b) restaurants and coffee lounges;
- (c) studios for listening to and recording music and speech;
- (d) gymnasiums, swimming pools and school halls;
- (e) lecture rooms and classrooms; and
- (f) concert halls and opera houses.

This Standard does not apply to laboratory measurements in test facilities or reverberation rooms. Laboratory measurements require other specifications for averaging single measurements at prescribed source and microphone positions.

3 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

1259 Acoustics—Sound level meters

1259.1 Part 1: Non-integrating

1633 Acoustics—Glossary of terms and related symbols

AS/NZS

4476 Acoustics—Octave-band and fractional-octave-band filters

ISO

3382 Acoustics—Measurement of the reverberation time of rooms with reference to other acoustical parameters

3741 Acoustics—Determination of sound power levels of noise sources using sound pressure—Precision methods for reverberation rooms

ITU

Rec. P.58 Head and torso simulator for telephonometry

4 DEFINITIONS

For the purposes of this Standard, the definitions in AS 1633 and those below apply.

4.1 Decay curve

The decay, as a function of time, at one point and in one frequency band, of sound pressure level in the room after the source of sound has ceased.

NOTES:

- 1 The decay may either be measured directly (direct decay curve) or derived by reverse integration (see Clause 4.6).
- 2 When measured directly, the decay curve is normally viewed by printing with a level recorder, or being displayed on the screen of a real-time analyser or similar.

4.2 Impulse noise source

A noise source provided by a starting pistol, balloon burst, cannon shot or other source of very short duration (impulse) noise which provides adequate signal-to-noise ratio over the frequency range under investigation.

4.3 Interrupted continuous source

A noise source provided by loudspeakers radiating broadband or band limited random noise into the room with the provision of a switch to turn off, that is interrupt the noise without the switch itself generating transient noise. Other noise sources, such as an organ, may be used provided the decay rate of the noise source itself is much faster than the reverberant decay of sound in the room.

4.4 Level interval

The difference between the final and initial level of the reverberant decay over which the reverberation time is assessed.

4.5 Reverberation time, T

Of an enclosure, for a sound of given frequency or frequency band, the time that would be required for the reverberantly decaying sound pressure level in the enclosure to decrease by 60 decibels.

4.6 Reverse integration

Procedure for preparing a decay curve by successively or continuously plotting ten times the logarithm of the integral of the sound pressure squared, with the integration starting at a selected instant in time near the end of the room decay, and ending at a selected instant in time near the start of the room decay.

NOTES:

- 1 The starting point for the reverse integration needs to be selected appropriately to avoid bias in the result.
- 2 The resulting curve from reverse integration has the same slope or decay rate as the direct decay curve. However, it is significantly less affected by perturbations such as flutter echo, and hence allows easier and more accurate determination of the reverberation time.
- 3 Study of the direct decay curve has the advantage of showing clearly perturbations such as flutter echoes and double curvature of the sound in the space.

4.7 States of occupancy

NOTE: Reverberation times measured are influenced by the number of people present. The following states of occupancy are defined for measurement purposes.

4.7.1 *Unoccupied state*

State of the room prepared for use and ready for speakers or performers and audience, but without these persons present.

NOTE: For concert halls and opera houses the presence of chairs for performers, music stands and percussion instruments, etc. is taken into account.

4.7.2 *Studio state (only for rooms for speech and music)*

State of the room occupied by the performers or speakers only (without audience), for example at rehearsals or during sound recordings. The number of performers and other persons, such as technicians, corresponds to the usual number.

4.7.3 *Occupied state*

State of the room when some of the audience is present.

NOTE: Reports relating to the occupied state include an estimate of the percentage of the design capacity which is occupied.

5 EQUIPMENT

5.1 Sound source

5.1.1 *Location and directivity*

Where it is desired to characterize the reverberation of the space, the test sound source should be as omnidirectional as possible and located on the stage or other place or places where the sound sources are located in normal use of the space. Where it is desired to characterize the reverberation of the sound heard by an audience when an in-house sound reinforcement system is used, then the in-house system shall be used as the test source.

5.1.2 *Signal-to-noise ratio*

The test sound source shall produce a sound pressure level sufficient to provide decay curves with the required minimum dynamic range without contamination by background noise.

Under normal circumstances the reverberation time is evaluated from the averaged slope of the decay curve beginning from a sound pressure level of 1 dB to 5 dB below the start of the reverberant decay, or beginning 0.1 seconds to 0.2 seconds after the sound source has been switched off, for a level interval of not less than 30 dB.

In the event that insufficient signal is available, it may be necessary to evaluate the reverberation time over a smaller range of the decay of sound pressure level. It is permissible to evaluate the reverberation time for a level interval of less than 30 dB, but not less than 20 dB. However, in such cases the report shall note the level interval over which the reverberation time was determined.

In the case of measurements of impulse responses using pseudo-random sequences, the required sound pressure level may be quite low because a strong improvement of the signal-to-noise ratio by means of correlated averaging is possible. In the case of other measurements which do not use a synchronous averaging (or other) technique to augment the decay range, then a source level is required that gives at least 40 dB above the background level in the corresponding frequency band for a 30 dB decay curve evaluation. In the limit, it is sufficient to create a level of just 30 dB above the background level for qualified results obtained from evaluating only 20 dB of the decay curve. In such cases the report shall note the level interval over which the reverberation time was determined.