

Australian/New Zealand Standard™

**Acoustics—Recommended design
sound levels and reverberation times for
building interiors**



AS/NZS 2107:2016

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Association of Australian Acoustical Consultants
Australian Acoustical Society
Australian Building Codes Board
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Australian/New Zealand Standard™

Acoustics—Recommended design sound levels and reverberation times for building interiors

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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/NZS 2107:2000.

The objective of this Standard is to provide methods for the measurement of compliance in terms of background noise and reverberation times. It recommends design criteria for conditions affecting the acoustic environment within occupied spaces.

This revision updates and expands guidance on design sound levels and provides more extensive recommendations regarding reverberation times.

In this Standard, the recommended design sound levels are provided as a range with a recommended lower level and upper level. In previous editions of this Standard the design sound levels were established in terms of a 'satisfactory' and 'maximum' level. This could be interpreted to suggest that sound levels below 'satisfactory' were desirable. But in fact the opposite may be the case and levels below those which were listed as 'satisfactory' can lead to inadequate acoustic masking resulting in loss of acoustic isolation and speech privacy.

In this edition the use of the L_{Aeq} level is maintained as it is considered the most appropriate descriptor for establishing a criterion for background noise and for compliance measurements. However, where the background noise appears to be unbalanced, this Standard provides direction in terms of suitable diagnostic tools that can be used to assess the spectrum distribution of the background noise.

In this edition, the list of occupancy/activity spaces has been increased to include spaces used in modern buildings and to delete those no longer used.

For the purposes of this Standard, the word 'shall' refers to practices which are mandatory for compliance with this Standard. The word 'should' refers to practices which are advised or recommended.

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

Similarly, the notes in this Standard are of an advisory nature only to give explanation or guidance on recommended design considerations or technical procedures, or to provide an informative cross-reference to other documents or publications. Notes to clauses in this Standard do not form a mandatory part for compliance with this Standard.

Where the number of an IEC, ISO or New Zealand Standard is provided in brackets after an Australian Standard number, the IEC, ISO or New Zealand Standard applies to New Zealand only and the Australian Standard applies to Australia only.

CONTENTS

	<i>Page</i>
1 SCOPE	4
2 APPLICATION AND LIMITATION	4
3 REFERENCED DOCUMENTS	5
4 DEFINITIONS	6
5 RECOMMENDED DESIGN SOUND LEVELS AND REVERBERATION TIMES	7
6 METHOD OF MEASUREMENT	15
7 REPORT	16
 APPENDICES	
A REVERBERATION TIMES FOR SELECTED SPACES	17
B BUILDING SERVICES EVALUATION	18
C MAXIMUM RECOMMENDED OCTAVE BAND SOUND PRESSURE LEVELS FOR STUDIO BUILDINGS, DRAMA THEATRES AND CINEMAS	19
D SPECTRAL IMBALANCE AND TONAL COMPONENTS	20

STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

Australian/New Zealand Standard**Acoustics—Recommended design sound levels and reverberation times
for building interiors**

1 SCOPE

This Standard recommends design criteria for conditions affecting the acoustic environment within building interiors to ensure a healthy, comfortable and productive environment for the occupants and the users. The background sound levels recommended take into account the function of the area(s) and apply to the sound level measured within the space unoccupied but ready for occupancy (see Note 1 below). The Standard is applicable to steady-state or quasi-steady-state sounds. The reverberation times recommended are for the occupied state of the space.

This Standard also specifies methods of measuring the background sound level in unoccupied spaces and the reverberation time in un-occupied spaces in buildings.

NOTES:

- 1 The sound level during occupancy will usually be increased owing to the activities of the occupants.
- 2 Reverberation times for selected spaces are given in Appendix A. See also Clause 5.4.
- 3 Specialist acoustic advice should be sought for auditoriums or studios.

2 APPLICATION AND LIMITATION**2.1 Application**

This Standard is intended for use by designers of environments within occupied spaces in new and existing buildings. Design considerations include the selection and assessment of—

- (a) building materials and services used in these spaces;
- (b) building components that exclude noise external to the building (e.g. traffic noise, industrial noise); and
- (c) building components that exclude noise generated within the building (e.g. building services noise).

2.2 Limitation

This Standard is not intended for—

- (a) use in evaluating occupancy noise, or noise due to specialist equipment associated with specific user requirements including fume cupboards (see AS 2243.8), dust extractors, and similar items of equipment;
- (b) application to sounds which are not categorized as steady-state or quasi-steady-state;
- (c) either the assessment or prescription of acceptable recommended noise levels from transient or variable noises outside the building such as—
 - (i) aircraft noise (see AS 2021 or NZS 6805);
 - (ii) construction noise such as jackhammers and pile-drivers (see AS 2436 or NZS 6803);
 - (iii) railway noise;

NOTE: AS 2377 gives methods of measurement for railway noise.

- (iv) road traffic noise (see AS 3671 or NZ 6806);
 - (v) crowd noise, e.g. from parades and sporting events;
 - (vi) emergency vehicle audible warning devices; and
 - (vii) industrial and commercial noise.
- (d) spaces in which acoustic performance is critical and needs specialist design;
 - (e) spaces where high performance specifications are a user choice, e.g. luxury hotels and apartments;
 - (f) design of building systems or services noise control measures including acoustic masking;
 - (g) spaces for building services which are not intended for occupation;
 - (h) spaces inside buildings used for sleeping during daylight hours;
 - (i) spaces inside buildings with essential features enabling ventilation, cooling or heating that when operated, compromise design sound levels and reverberation control, e.g. opening windows and/or doors for natural ventilation;
 - (j) spaces where the composition and surface of materials used to achieve design sound level or reverberation control may have critical implications for infection control, hygiene, or sterility requirements of users; and
 - (k) spaces with high levels of low frequency noise and/or vibration.

NOTE: See Appendix B for guidance regarding sound level measurements to determine the compliance with specifications of noise levels of plant and equipment that are used in occupied spaces.

3 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

- 1055 Acoustics—Description and measurement of environmental noise (series)
- 2021 Acoustics—Aircraft noise intrusion—Building siting and construction
- 2243 Safety in laboratories
- 2243.8 Part 8: Fume cupboards
- 2377 Acoustics—Methods for the measurement of railbound vehicle noise
- 2436 Guide to noise and vibration control on construction, demolition and maintenance sites
- 3671 Acoustics—Road traffic noise intrusion—Building siting and construction

AS IEC

- 60942 Electroacoustics—Sound calibrators
- 61672 Electroacoustics—Sound level meters
- 61672.1 Part 1: Specifications

AS ISO

- 8253 Acoustics—Audiometric test methods (series)

AS/NZS

- 1269 Occupational noise management
- 1269.2 Part 2: Noise control management
- 1269.4 Part 4: Auditory assessment

ISO	
1996	Acoustics—Description, measurement and assessment of environmental noise
1996-2	Part 2: Determination of environmental noise levels
3382	Acoustics—Measurement of rooms acoustic parameters (series)
IEC	
60050	International Electrotechnical Vocabulary
60050-801	Chapter 801: Acoustics and electroacoustics
60942	Electroacoustics—Sound calibrators
NZS	
6801	Acoustics—Measurement of environmental sound
6803	Acoustics—Construction noise
6805	Airport noise management and land use planning
6806	Acoustics—Road-traffic noise—New and altered roads
ANSI/ASA	
S12.2	Criteria for Evaluating Room Noise
DIN	
18041	Acoustical quality in small to medium-sized rooms

4 DEFINITIONS

For the purpose of this Standard, the definitions in IEC 60050-801 and those below apply.

4.1 A-weighted sound pressure level (L_A)

The level of the frequency A-weighted sound pressure, as determined by an integrating-averaging sound level meter complying with AS IEC 61672.1.

4.2 Background sound level

The background sound level is defined as the $L_{Aeq,t}$ level with the space unoccupied but ready for occupancy.

NOTE: Australian users of this Standard should note the term ‘background A-weighted sound pressure level’ has a different defined meaning for environmental purposes under the AS 1055 series. New Zealand users should note ‘background sound level’ has a different defined meaning in NZS 6801 and other Standards related to environmental noise.

4.3 Equivalent continuous A-weighted sound pressure level ($L_{Aeq,t}$)

The value of the A-weighted sound pressure level of a continuous steady sound that, within the measurement time interval, t , has the same mean square sound pressure as a sound under consideration whose level varies with time.

4.4 Design sound level

The sound levels given in this Standard are for the design of spaces in buildings.

NOTE: Sound levels within the given ranges have been found to be acceptable by most people for the space under consideration. When the sound level is greater than the upper level of the range most people occupying the space will become dissatisfied with the level of sound. When the sound level is below the lower level of the range, the inadequacy of background sound to provide masking sound can become problematic, for example, by allowing other intermittent noise sources to cause distraction, annoyance, or lack of privacy (see Clause 5.3).

4.5 Quasi-steady-state sounds

Sounds whose average characteristics substantially represent a steady-state sound.

4.6 Reverberation time (T)

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

4.7 Steady-state sounds

Sounds whose average characteristics remain relatively constant in time.

5 RECOMMENDED DESIGN SOUND LEVELS AND REVERBERATION TIMES

5.1 Design sound levels for different areas of occupancy in buildings

The recommended ranges for design sound levels are given in Table 1. The levels are given as equivalent continuous A-weighted sound pressure levels measured in decibels.

NOTES:

- 1 For air-conditioning or plant noise with excessive low frequency energy (< 200 Hz) due to turbulence (rumble), significant annoyance can arise even when the A-weighted sound pressure level is below the recommended range. See Clause 6.1.7.
- 2 The level of background sound may affect speech communication, recording, and in extreme conditions, the effectiveness of a public address system. Control of the background sound level is required to achieve good communications.
- 3 Spaces such as open plan and closed cell offices benefit from some continuous background sound or acoustic masking, which assists in providing acoustic separation, speech privacy, and reducing speech distraction.

5.2 Design sound levels and expectations of quality

The design sound levels given in Table 1 are not necessarily appropriate in all circumstances. In particular, lower sound levels may be appropriate in quiet environments or where expectations of quality are high. For example, lower design sound levels than those given in Table 1 may be preferred for luxury hotels and apartments. However, additional costs will be incurred in achieving sufficient sound attenuation between spaces for acoustic privacy requirements. For each 5 dB reduction in the background sound level, 5 dB shall be added to the overall sound isolation performance of the dividing elements to maintain the same level of privacy. There could also be additional costs associated with the provision of quieter building services.

5.3 Acoustic masking

In spaces where acoustic isolation and speech privacy are important and the sound levels are below the lower level of the recommended design range, there is increased risk of inadequate acoustic masking. Where this occurs, loss of acoustic and speech privacy can be a significant concern. In these situations acoustic masking can be introduced into the space to raise the sound level to within the recommended design sound range level in Table 1.

5.4 Design reverberation times for different areas of occupancy in buildings

The optimum reverberation time for a particular space is dependent on the room volume. Where the room shape for a particular occupancy or activity is relatively standard, the recommended reverberation times are given in Table 1. These recommended times are for the middle frequencies (arithmetic average of the reverberation times in the octave bands at 500 Hz and 1000 Hz). It is generally considered acceptable in large volumes to have some increase in reverberation time towards the low frequencies. For small volumes, it may be more suitable to have the same reverberation time across the frequency range.

NOTE: Where the room volume for the particular occupancy/activity can vary greatly, reference should be made to Appendix A.