A review of AS/NZS 2107:2016 Acoustics – Recommended design sound levels & reverberation times for building interiors

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1. Introduction

Contemporary acoustic standards are essential to ensure standardization across government, private, and public sectors. In the case of *AS/NZS 2107:2016 Acoustics – Recommended design sound levels and reverberation times for building interiors*, this standard reflects the progress in acoustic science and technology and in building design since its predecessor, AS/NZS 2107:2000 was published some 16 years ago.

This paper provides comments and observations on the changes to the most recent version of the standard from the viewpoint of the authors, with oversight from our peer reviewer, who was on the Standards Australia Committee which drafted the 2016 standard. The aim of this paper is to provide the reader with a concise review of AS/NZS 2107:2016, focusing primarily on the key changes and updates between the 2000 and 2016 versions of the standard.

2. The purpose of updating AS/NZS 2107

The purpose of AS/NZS 2107:2016 is to provide guidance on recommended design sound levels and reverberation times for building interiors, including measurement for compliance assessment purposes. The objectives of the latest revision to AS/NZS 2107 were to update and expand guidance on design sound levels and recommended reverberation times. The basis for the required update was that the standard needed 'modernising', so as to include spaces relevant to the modern architecture and remove spaces that were no longer relevant. Minor but important changes to the text, layout and format have also been made.

3. Overview of national and international standards

Standards are documents setting out specifications, procedures and guidelines to ensure products, services and systems are reliable and consistent. There are generally three kinds of standards: international, regional, and national. In general, international standards are developed by the International Organization for Standardization (ISO) and its sister organisation, International Electrotechnical Commission (IEC). Individual countries can choose to adopt international standards directly for use as their countries national standard and through national standards organisations they have an opportunity to contribute the development of ISO/IEC standards.

Regional standards are generally prepared by a specific geographical region, such as the European Union, which develops European 'EN' standards. Similarly, in this part of the world, there are Joint Australian/New Zealand standards, with the designation AS/NZS that are regional standards for Australasia. AS/NZS 2107 is one of many Joint Australian/New Zealand standards.

The third type of standard is developed by a national standards body, which in the case of New Zealand is 'Standards New Zealand'. Standards developed under the brand of 'Standards New Zealand' are generally developed specifically for New Zealand conditions.

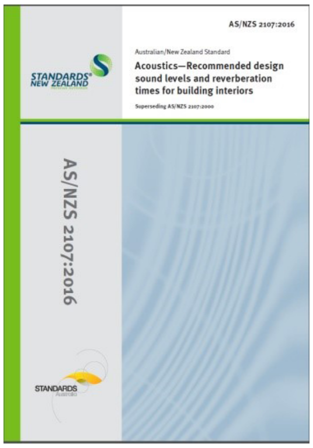
Standards are generally voluntary, but can become mandatory when cited in Acts, regulations, or other legislative instruments. Standards may also be referenced in regulations as one means of compliance or as an acceptable solution under those regulations, without being mandatory. Compliance with specific standards is often a requirement in specifications for buildings, plant and equipment.

4. New Zealand national standards organizations and management

The first national standards organisation was created in New Zealand in 1932 and was known as the 'Standards Association of New Zealand' (SANZ). Currently in New Zealand under the *Standards and Accreditation Act 2015*, the 'Ministry of Business, Innovation and Employment' (MBIE) has the primary responsibility to administer the *Standards and*

Accreditation Act and thus provide and manage standards. Standards are developed by MBIE through 'Standards New Zealand' (Paerewa Aotearoa), a business unit within MBIE. Standards New Zealand forms part of the Consumer Protection and Standards Branch in Market Services within MBIE.

5. A brief history of AS/NZS 2107



The '2107' standard originated some 40 years ago as Australian Standard AS 107-1977. The standard was updated 10 years later in 1987 as AS 2107-1987. In 2000 the standard was jointly revised and adopted by the standards organisations in both Australia and New Zealand as AS/NZ 2107:2000. The most recent 2016 edition is an update of AS/NZS 2017:2000 and was prepared by the Joint '*Technical Committee AV-004, Acoustics, and Architectural Acoustics*'. Twelve organisations are represented on this committee, including the Acoustical Society of New Zealand, the Acoustical Society of Australia, six Universities from Australia and New Zealand and government and industry bodies.

Under the current practices of the standards organisations the revision of a standard must specifically identify the scope for the revision and requires justification of the need for a range of stakeholders. Once that documentary evidence of the need has been collated the standards organisation prioritises the requests and decides if and when the revision process can be commenced by the relevant committee. The standard revision project involved the technical committee completing a revision and an updated draft of the standard in 2014. This was then issued for public comment as draft standard 'DR AS/NZS 2107:2014' in October of 2014. The public comment draft received almost 500 comments, a record for acoustics standards and demonstrating the extensive use and interest in this standard. After the close of the public submission period, and collation of the comments, a two-day meeting was held in March 2015 for the 'AV-004 Technical Committee' to go through the submissions, discuss and amend the draft standard as necessary. A number of comments related to extension of the scope of the standard to include aspects related to audio systems but that was outside the scope of the original versions and hence could not be introduced in the revision. The final updated version with the designation 'AS/NZS 2107:2016 Acoustics – Recommended Design Sound Level and Reverberation Time for Building Interiors', was approved on behalf of the Council of Standards Australia on 25^{th} August 2016 and on behalf of the Council of Standards New Zealand on 6^{th} September 2016. It was officially published in late 2016 (24^{th} October 2016).

6. Scope and application of AS/NZS 2107:2016

AS/NZS 2107:2016 recommends design criteria conditions within building interiors to ensure "healthy, comfortable and productive environments for the occupants and end users". The purpose of the standard is to provide guidance on acceptable acoustic environments within unoccupied spaces ready for occupancy. It specifies methods of measurement of 'background sound levels' and reverberation times, for unoccupied spaces. The use of the term 'background sound level' in this standard is different to the definition in the environmental noise standard NZS 6801:2008, where it is defined as $L_{A90(t)}$. In AS/NZS 2107, 'background sound level' is defined as the $L_{Aeq,t}$ value with the space unoccupied, but ready for occupancy. In general environmental sound measurement terminology, this would be considered to be the 'ambient sound level'.

AS/NZS 2107:2016 is intended for use by acousticians and professional designers of acoustic environments within new and existing buildings. The design sound levels in the standard are intended for stead-state and quasi-stead-state sounds (sounds whose average characteristic substantially represent the steady-state sound) and not transient or variable noises outside buildings such as, but not limited to, aircraft, railway, road or construction noise.

Two key designations in AS/NZS 2107:2016 are the 'design sound level' and 'design reverberation time'. Table 1 in the standard provides a detailed list of values of these two quantities for nine distinct areas of occupancy within buildings, which range from educational buildings through to studios and for the spaces within those general areas. The standard makes it clear, where acoustic performance is critical, a specialist acoustic design is required (for example, spaces for students with learning difficulties) and that this design is beyond the scope of the standard. As with any technical standard, the end user should be suitably qualified, experienced and educated in (building) acoustics to ensure they understand the applications and limitations of the standard.

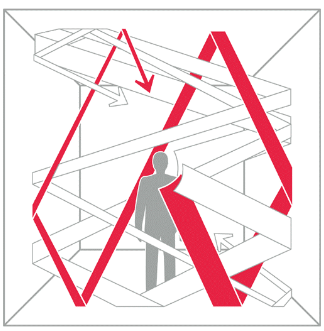
As well as specifying the recommended design values of background sound level and reverberation time, the standard provides detail on methods of measurement and reporting. It also contains four detailed informative appendices. Appendix A provides a guide for further information on reverberation times of selected spaces, such as music, speech, sports and lectures rooms. Appendix B provides information on building services evaluation, while Appendix C provides maximum recommended octave-band sound pressure levels for studios, drama theatres and cinemas. And lastly, Appendix D provides information for spectral imbalance and tonal components within spaces.

7. Changes between AS/NZS 2107:2000 and AS/NZS 2107:2016

7.1 Activity and occupancy

Table 1 of AS/NZS 2017:2016 set out each design sound level and design reverberation times in relation to a specific type of occupancy. The standard now includes the introduction of new spaces such as 'open plan office spaces' or 'post/pre-op recovery rooms' and has deleted specific types of historic occupancy and activities that no longer apply in modern buildings, such as an architect's 'draughting office'. The purpose of these changes was to reflect spaces used in modern architecture and delete those spaces that no longer exist in modern building practises.

7.2 Design sound levels



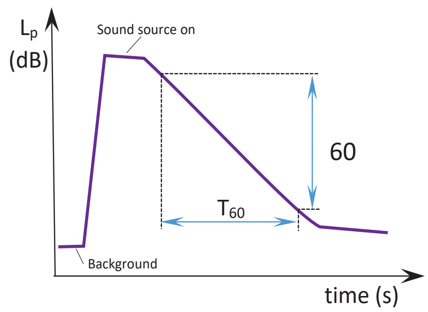
AS/NZS 2107:2016 defines the 'design sound level' as the 'background sound level' that is acceptable for most people for the space under consideration and uses the LAeq,t descriptor. As in the previous version of the standard, there is a section providing basic guidance on how to measure the background sound level.

The first noted change in AS/NZS 2107:2016 is that the detailed list of 'design sound levels', previously defined as 'satisfactory' or 'maximum', have been deleted and replaced with a range for the design sound level, thus providing an upper and lower range.

The historic standard AS/NZS 2017:2000, stated that a 'maximum design sound level' was the level of noise above which most people occupying a space start to become dissatisfied and a 'satisfactory design sound level' was defined as the level of noise that had been found to be 'acceptable' to most people for the environment not to be intrusive. Defining the sound levels in terms of a 'satisfactory' and 'maximum' level could be interpreted to suggest to the users of the standard that sound levels below 'satisfactory' were desirable, which in fact the opposite may be the case. Levels below those which were listed as 'satisfactory', could potentially lead to inadequate acoustic masking, resulting in loss of acoustic isolation and speech privacy. AS/NZS 2017:2016 specifically provides commentary on such implications, such as a sound level below the recommended range can have an unhelpful effect on acoustic masking and speech privacy. It is further understood that the use of 'satisfactory' and 'maximum' levels in AS/NZS 2107:2000 caused potential problems with meeting compliance for specifications, when one or the other may have become the mandatory compliance level. Thus, introducing the concept of a range in the 2016 standard, gives some flexibility and assistance to end users as one should be aware that there is no single or 'perfect' design noise level for a particular space.

A second update of note in AS/NZS 2017:2016 is that in some cases, the 'design sound levels' provides only a recommended maximum value. For example, the 2016 standard states a design sound level of "< 65 dB" for "uncovered car park areas". The reasoning for this approach was simply that for a space of this type there is no real justification for setting a lower level since speech privacy is not an issue.

7.3 Design reverberation times



AS/NZS 2017:2016 sets out 'design reverberation times' in terms of reverberation time (*T*) defined as the time required for the reverberantly decaying sound pressure level in the enclosure space to decrease by 60 decibels. The only guidance in the standard on the measurement of reverberation time is that "it shall comply with the relevant part of ISO 3382". This ISO standard titled 'Acoustics – Measurement of room acoustic parameters', has three parts: Part 1 (2009) is for performance spaces; Part 2 (2008) for ordinary rooms; and Part 3 (2012) for open plan offices. Only parts 1 and 2 include information on measuring reverberation time. In terms of notation, one of the notes in ISO 3382 Part 2 indicates that if the reverberation time (*T*) is evaluated based on a smaller dynamic range than 60 dB and extrapolated to a decay time of 60 dB, it should be labelled accordingly. For example, if it is derived from the time at which the decay curve first reaches 5 dB and 35 dB below the initial level, it is labelled T_{30}[1].

In the AS/NZS 2017:2016 standard there are more extensive recommendations regarding reverberation times. For many spaces a similar approach to that for the design sound levels is taken, by providing a range, such as

1 Using this notation means that: $T \equiv T_{60} \cong T_{30}$, which is confusing at first glance since mathematically, $T_{60} \approx 2x\ T_{30}$.

'0.3 to 0.6 seconds'. For other spaces only an upper level is given'. For a number of spaces, the comment is either that "reverberation time should be minimised for noise control" or reference is given to Appendix A reverberation time curves. This figure is based on German DIN 18041 standard ('Acoustic quality in rooms - Specifications and instructions for the room acoustic design') and the 'Mean Reverberation Times' curve has itself been updated as part of the AS/NZS 2107:2016 review.

7.4 Additional changes of note

There have been some practical changes to AS/NZS 2107:2016 which although relatively minor, are noticeable, and make the use and application of the standard easier. One such example is Table 1 where horizontal lines have been introduced, making it easier to read across rows. Another simple but affective change is the use of colour in 'Mean Reverberation Times' graph in Appendix A. Such changes are simple but make the standard clearer and easier to follow and apply.

8. Publications and reference documents

There are a host of technical documents on acoustics related websites which refer to AS/NZS 2107. As the latest standard is fairly new, the majority of these technical documents refer to AS/NZS 2107:2000 and have not yet been updated to refer to the 2016 version, including those of government agencies. It will take some time for these documents to be updated to reflect the changes in AS/NZS 2107:2016.

9. Conclusion

AS/NZS 2107:2016 is an important Joint Australian/New Zealand standard for the acoustic performance of internal building spaces. Changes made in 2016 revision improve its scope of application by including modern types of occupancy, and design values aligned with current international standards.

It is important that the work of the AS/NZS 2107:2016 standard committee and the standards organisations are acknowledged to ensure that this essential standard is updated and revised on a regular basis.

Qualifications and Copyright

This paper review is intended as a guide only; it is not intended to be surrogate for any expert advice from a professional acoustic consultant. The reader and users should further understand that the information within this review does not attempt to cover all areas and applications of the standards and therefore there are a host of omissions. While all care has been taken in the preparation of this work and the information

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We have a single decision to bring you this issue being the final decision concerning Windflow Technologies' application for the re-consent of the Gebbies Pass turbine, Banks Peninsula. Please see New Zealand Acoustics Volume 30, 2017 #1 for a summary of the substantive decision.

Following is a summary of the proceeding but a full copy of the decision and the final conditions of consent can be found on the RMA Net website at: www.rma.net

In the Environment Court

LUKE PICKERING – Appellant
CHRISTCHURCH CITY COUNCIL – Respondent
WINDFLOW TECHNOLOGY LTD – Applicant

[2017] NZEnvC 068, 16p, [25] paras, 10 May 2017

Summary of Facts

In Interim Decision [2016] NZEnvC 237 the Court granted consent to Windflow Technology Ltd for the re-consent of an existing wind turbine at Gebbies Pass, Banks Peninsula subject to confirmation of conditions. The residents of the neighbouring McQueen's Valley had experienced noise from the turbine which had intruded upon their general enjoyment of their properties and for some, disturbed and disrupted their sleep. The Court had been troubled that during the tenure of the original consent, Windflow did not undertake compliance monitoring within McQueen's Valley to confirm whether the turbine was operating within the conditions imposed on its consent. Instead, Windflow relied on predicted noise levels in the valley based on measurements undertaken at the turbine site. As such Windflow was met with strong opposition to the re-consent application.

The Court concluded that the noise from the turbine, including amplitude modulation, was a particular feature of the case due to the adverse effect on the amenity of the residents in the low background sound environment of McQueen's Valley. Overall the Court concluded restrictions on the hours of operation and ceasing operation of the turbine if verification measurements identified penalisable levels of amplitude modulation or tonality, were an appropriate response given Windflow's duty under s 16 RMA to avoid unreasonable noise.

The Court restructured and clarified the conditions and requested parties to responded. The Court confirmed conditions relating to the requirement and timing for an acoustic engineer to carry out measurement and monitoring. The Court also clarified that the fixed value of 35 dB in Condition 8 did not address the adverse effect of noise with amplitude modulation where the background sound was also low. The Court noted that the Advice Note to Condition 8 made it clear, mitigation was achieved through Condition 3 which restricted the hours of operation when wind speeds were less than 10 m/sec and Condition 7 where restrictions on the operation of the turbine were to apply if there was penalisable amplitude modulation at the turbine.

The Court also highlighted that if the predicted noise level of 25 dB at the representative receptor site in McQueen's Valley was erroneous and the measured noise was higher, that would be material inaccuracy for the purposes of s 128(c) RMA. Overall the Court was satisfied with the restrictions as proposed by the applicant and the City Council, with the greatest level of affect being on residential amenity during the evening.

Court held:

Appeal allowed to the extent that the application for resource consent granted subject to amended conditions of consent as attached to the decision.

Costs reserved.

Disclaimer - *This article has been provided to help raise an initial awareness of some recent cases involving acoustic issues. It does not purport to be a full listing of all decisions which have acoustic issues, nor does it replace proper professional advice.*

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Acknowledgements

The authors would like to specifically thank the contribution from our peer reviewer Mrs Marion Burgess, Editor of the Australian Acoustic Journal, 'Acoustics Australia', and staff member of the University of New South Wales, Australia. Marion is based in Sydney, Australia. The authors would also like to that this opportunity to thank those involved in the update of this important standard (including but not limited to) the Joint '*Technical Committee AV-004, Acoustics, and Architectural Acoustics*' as well as the Australia and New Zealand standards organisations and the Acoustical Society of New Zealand and the Acoustical Society of Australia.