AS 1055: 2018 Revision

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ABSTRACT

Australian Standard “AS 1055-2018 Acoustics – description and measurement of environmental noise” was published in late 2018 as the latest revision to the long-running series of standards of the same name, with the previous revision being dated 1997. This revision has followed the Standards Australia project approval and development system and was approved as a project in 2015 for completion by Standards Technical Committee EV-010 Acoustics, Community Noise. This revision consolidated the previous three-part and three volume standard into one single volume. The Standard applies primarily to noise emitted from industrial, commercial and residential premises. It excludes the setting of environmental noise criteria. Such levels are set by regulations or organizational policy. A number of changes were made to the standard to bring it into line with the latest relevant international standards and instrumentation and measurement techniques. This paper provides a brief explanation of how Australian Standards are currently developed or revised, as well as a review of the contents of the Standard for users and some of the reasoning behind the changes to the previous versions. New methods of how to allow for façade reflections and the informative appendix on assessment of impulsive noise are also discussed.

1 INTRODUCTION and BACKGROUND

Australian Standard AS1055 description and measurement of environmental noise was first published in 1973. It has been regularly revised at intervals since then, namely 1978, 1984 (when it was split into three-volumes), 1989 and 1997 (the most recent previous version). The author has had involvement with each of the revisions since preparations for the 1984 version and is current chair of the Standards Australia technical committee responsible for the Standard, EV-010 Community noise.

Each revision has been to keep up to date with developments in the technology of instrumentation, particularly digitalisation and the easier ability to measure time averaged equivalent sound levels ($L_{eq,T}$) and percent exceedance sound levels ($L_{n,T}$). Revisions have also been to keep up with developments in international standards for instruments and methods of measurement of environmental sound levels, as well as measurement experience and developments, such as adjustments for measurements in close to a reflecting surface such as a building façade. Finally the revisions have also attempted to keep pace with the introduction of and changes to regulatory authority documents such as policies and codes of practice and the different methods that State governments have to measure some environmental sound level parameters.

This paper describes briefly the revision process for Australian Standards, the major differences between the 1997 and 2018 revisions, reasons for some of the changes and how the new appendices can be used.

2 AUSTRALIAN STANDARDS DEVELOPMENT PROCESS

Standards Australia (SA) has a requirement to review existing standards at regular intervals and revise those which are considered to be in need of changes. While this requirement is in place, any revision still has to go through a process of an application proposal to SA to undertake the revision, as would occur for a new Standard. The recent 2018 revision was required to follow this SA Project application approach.

All proposals need to be submitted by an individual, preferably supported by a national organization – for a committee driven revision this would be the nominating organisation of the proposer. In this case the author was the proponent as the chair of the technical committee. The proposal has to outline the need for, and Net Benefit impact of, the proposed work on the Australian community, state the desired development pathway and who will fund the proposed work. Details of relevant stakeholders across interest groups have to be identified, the consultation process undertaken and whether they support the proposal. The proposal document also needs to include known risks and any dependencies that may impact successful completion of the proposed project/program and list existing related documents and alignment of proposed work to these documents – in other words providing a scope to the work involved in the revision so that it can be controlled.

This process is to ensure SA's resources are allocated where they can deliver greatest benefit to the community and in a manner that allows SA to operate on a sustainable basis.

So even before the work on the revision starts there is a lot of preparation work. The technical committee had agreed in 2007, 10 years after the previous revision, to implement another revision project. Revisions depend on availability of committee members and others to support the preparation, rates of change of technology and the time to go through the revision process, so a 10 year gap between revisions is more typical for acoustical standards.

A project proposal for the revision was made in about 2013 but was unsuccessful because of the high number of other standards being revised or developed. A second application was made in 2015 and that was successful out of the 79 proposals for 148 Standards Development Projects across all sectors of the economy. Justifications for the revision included:

- It was 1997 vintage and there are changed methods and parameters, as well as references;
- It is still the main reference for measurement of environmental noise in Australia;
- ISO 1996 is considered inappropriate as a replacement because some consider it too complex – this was also being revised at that time;
- Regulatory authorities set criteria based on methods of measurement described in AS1055 so they may value it being up to date;
- There could be an annex describing setting an environmental noise specification;
- Costs of modifications would be expected to not significantly affect the community
- Tonality assessment could be included but there would need to be agreement about which method to use – a simpler method was to be preferred.
- Meteorology measurements may need amendment in light of changes in computer noise models calculation methods from lapse rates to stability classes, and agreement on how to measure lapse rates for an inversion condition.

Other items to be included in the revision were facade correction, measurement intervals, percentile descriptors, background noise, extraneous noise influences on the background noise measurement, and measurement and prediction of uncertainty.

Once a draft is prepared it then goes through the committee members for review and amendment. After that it is provided for public comment where any person can provide input to the Standard. Comments are reviewed by the committee and addressed where it is within the scope of the work approved. The 2018 revision was finally approved for publication in late 2018.

3 BASIC PURPOSE OF AS1055 – MEASUREMENT METHODS, NOT PLANNING

As noted in the Preface to the Standard, its objective is "for use in the evaluation of environmental noise in order to meet the needs of public bodies and persons interested in its management. It applies primarily to noise emitted from industrial, commercial and residential premises, and is intended for use in the evaluation of existing problems, as well as for planning purposes. It may be used for noise that includes impulsive components, but it is not suitable for noise that consists solely of discrete impulses (e.g. shooting, blasting)". The intent for the Standard at its core is for it to be a document describing how to measure and what to measure to describe environmental noise as it is most commonly received at residential receiver locations. It is not a regulatory document and users are directed to identify the relevant requirements of the regulatory authorities. The Standard does not apply to noise from transportation sources, shooting and blasting or noise from wind farms – each of these types of noise has Standards to guide their measurement and assessment.

The Standard is also not intended to be used as a planning document to identify what sound levels are acceptable in different types of receiver areas. In previous revisions of the Standard there had been an informative appendix which provided a guideline table of estimated background sound levels for different areas containing residences if measurements were not able to be taken. Users of the Standard were advised that this Appendix may only be used as a guideline. Whenever possible values of $L_{A90,T}$ shall be measured and where the measured values are obtainable, this Appendix shall not be used. Such measurements of background sound levels are used in setting noise objectives in the planning process for new developments.

This table had always been a difficulty for regulatory authority members of the technical committee, as they rightly saw it as their role to set levels of acceptable sound levels for their constituents; having estimated sound levels in a Standard was considered by them to be an intrusion on their turf and caused delay to the completion of the 1987 and 1997 revisions. It had resulted in Council officers with less knowledge of environmental sound level measurement accepting the Standard estimated sound levels in place of measured sound levels.

Technical committee members also had personal experience of the Standard estimated background sound level table being wrongly applied by some consultants to set objective sound levels based on the estimated values rather than what they had measured. Such applications had been used to set objectives both above and below those which would apply from measured values.

The use of estimated background sound levels had originated in a time in the 1970s and 1980s when sound level meters were harder to obtain, identification of percent exceedance sound levels was even more difficult to obtain and measure accurately and before most regulatory authorities had set their own guidelines for acceptable sound levels. In the current revision, the availability of instruments to accurately measure environmental sound level parameters over long periods is widespread and regulatory authorities have set guidelines for noise measurement and planning purposes. In light of this and the evidence of misapplication of the estimated background sound level table, as well as the objective of the Standard to be a method for measurement and description but not planning for environmental noise, the committee agreed to remove that informative appendix. IF any organisation would like to propose a standard for planning for environmental noise they will be welcome to go through SA's project application and approval process.

4 DIFFERENCES TO PREVIOUS VERSIONS

The revisions from 1984 to 1997 had been three volumes, with Part 1 being General Procedures, Part 2 as Application to specific situations and Part 3 for acquisition of data pertinent to land use. The content of part 3 was had some references back to Part 1 and minor comments on prediction. The committee agreed to make the revision a single document which covered instrumentation, methods of measurement, parameters to be measured, information recording requirements, setting specifications for noise limits, checking compliance with noise limits, prediction of noise levels and uncertainty.

In all cases of sound level measurement, the Standard requires the user to check with the requirements of the relevant regulatory authority. This is to ensure that the correct parameters, locations, times of measurement intervals and other relevant details are included.

A key phrase in the measurement methods given for investigation of specific environmental noise situations is "The noise shall be measured at the relevant time and place. This is an important requirement which had been emphasised by Louis Challis, a technical committee member for the first 40 years of the Standard. He had related cases where a sound level measured at a quiet or high sound level time of the day, typically for use in assessing compliance, had been used to compare with objectives for a high sound level or quiet time of the day. The Standard requires that if the measurements are performed at other than the relevant time and place, justification should be provided. Relevant time implies at the same time of day in similar conditions and similar locations.

Guidance is provided in 'Section 6 Measurements' on making measurements near the facades of buildings where reflections may influence the measured sound level. Corrections to sound levels measured 1m in front of a façade to provide an approximation of the free-field sound level are provided for parameters other than $L_{A90,T}$. Ideally use of reflection corrections should be justified by measurements where possible.

As in previous revisions, Appendix A provided reasonably detailed guidance on how to use and apply the Standard. The Standard also provides guidance on how to make adjustments to measured sound levels when it includes potentially annoying characteristics such as tonality or impulsiveness. If adjustments are made to the measured value of the time average A-weighted sound pressure level $L_{Aeq,T}$, it is termed the *rating level* $L_{Ar,T}$. Guidance is provided in the standard for tonality and impulsiveness.

5 TONALITY ASSESSMENT

Objective assessment of tonality in measured noise are made using either of the two methods commonly used in Australia by regulatory authorities and are provided in the normative Appendix D of the Standard – normative means the Appendix is to be used; most acousticians will be familiar with at least one of them. The user is advised to use the relevant method applicable to the location of the measurements. Both methods use time-average one-third octave band sound levels over the frequency range 25 Hz to 16 kHz. Examples are given for an assessment using both methods. Figure 1 shows method 2 adjustment. Figure 2 a typical one-third octave band spectrum given as an example in the Appendix, with the band difference shown also. Figure 3 shows the adjusted band difference for method 2 and the criteria for method 1. The adjusted difference in total sound level would be 5 dB for method 1 and is 4 dB for method 2.

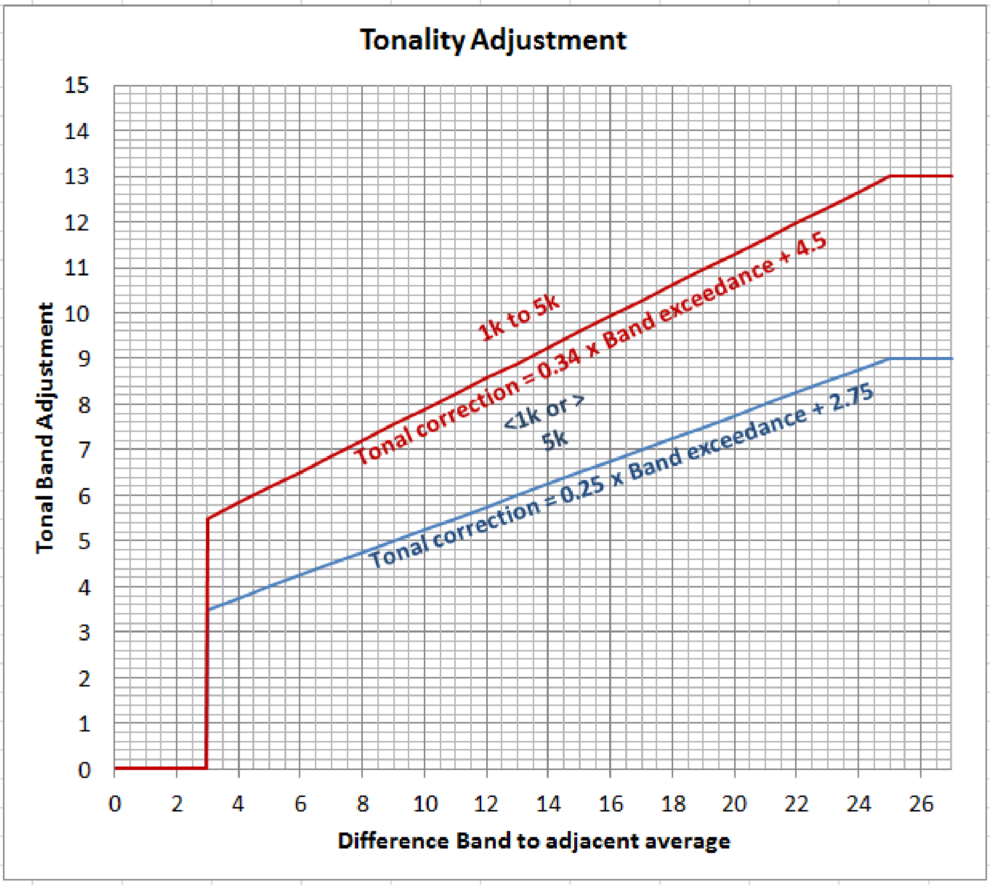


Figure 1: Tonal correction adjustment using Method 2, from Appendix D

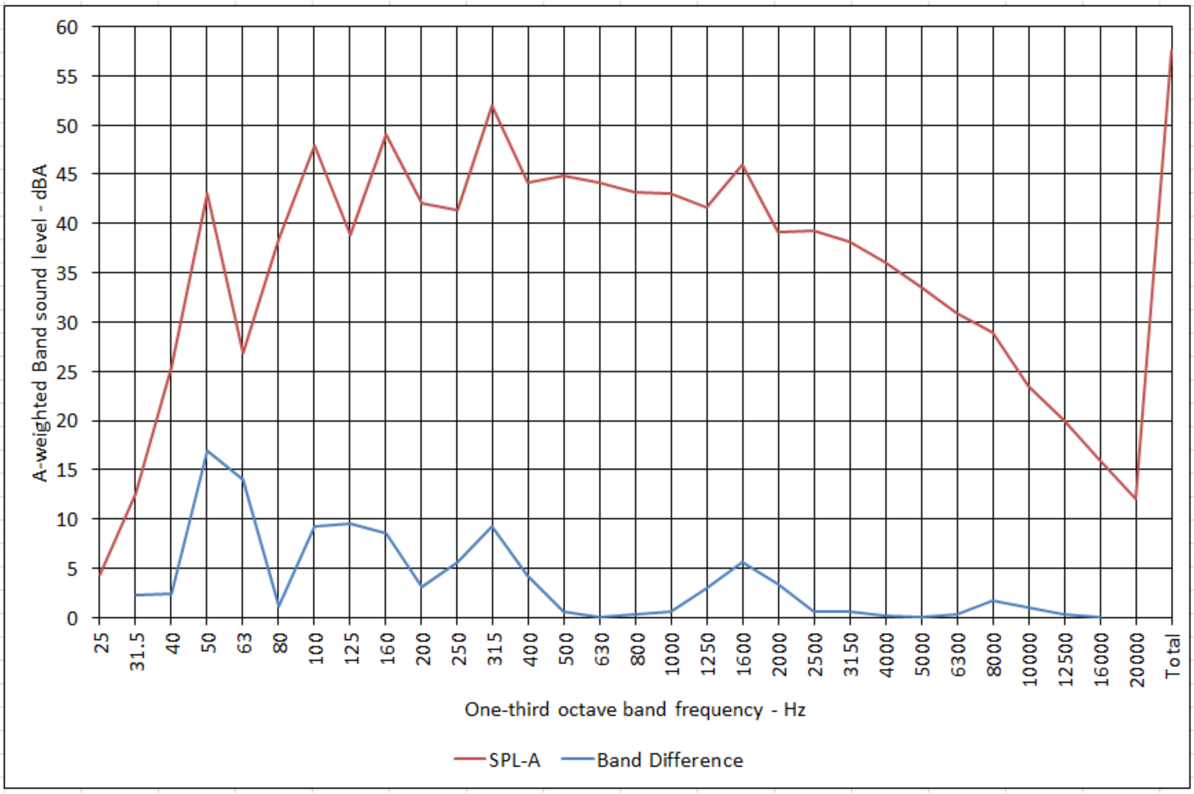


Figure 2: Example Spectrum with tonality and band difference shown, from Appendix D

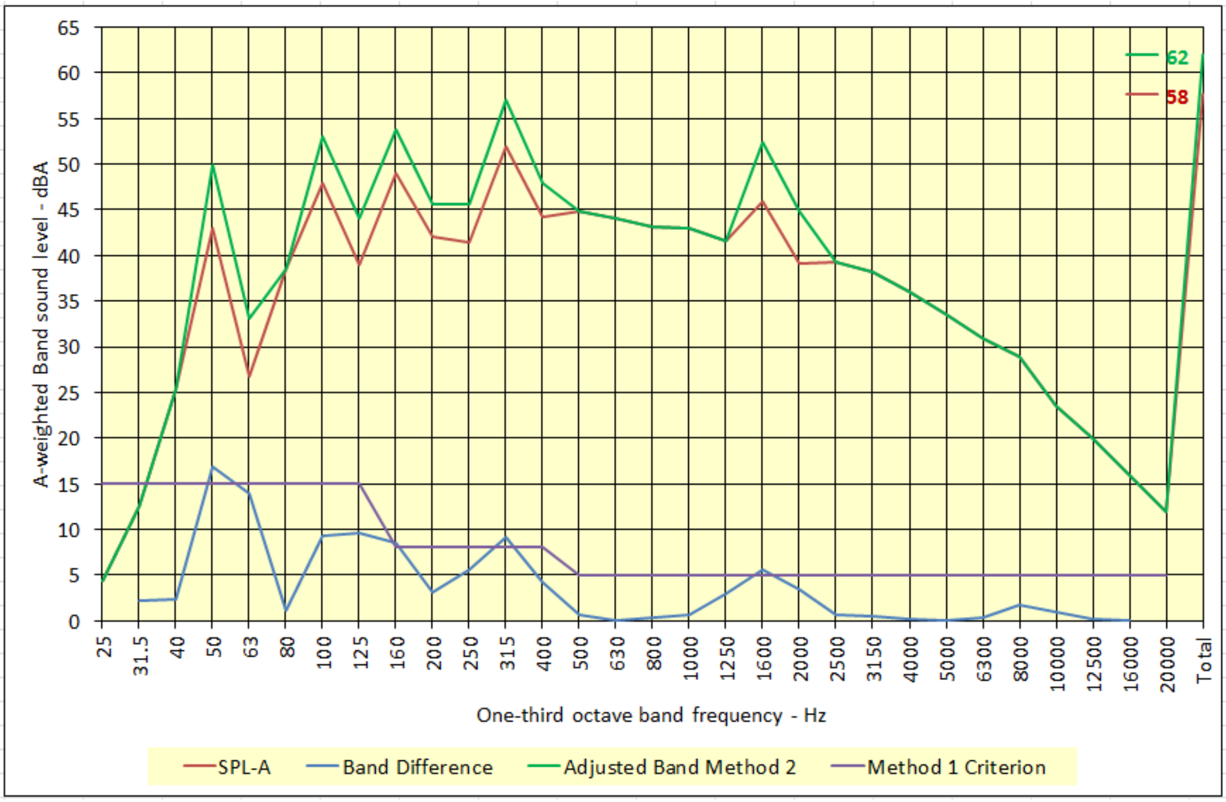


Figure 3: Example spectrum adjusted with method 2 and criteria for method 1 shown, from Appendix D

6 IMPULSIVITY ASSESSMENT

A method for objective assessment of measured sound for impulsive characteristics is provided as informative Appendix E in the Standard. The method used is taken from the Nordtest Method NT Acou 112 approved in 2002 for Nordic countries, and as also proposed for ISO 1996:3 (currently in development). The method is based on work reported at Inter-Noise 2000 by Tor Pedersen from Delta.

The need for a method was considered relevant because there is no current method given in an Australian Standard despite adjustments being required by regulatory authorities if the sound has significant impulsive characteristics. At least one state (Queensland) has a method using an ‘Impulsive’ time weighting for measurement of sound levels. However this was considered by the committee to be unsuitable because there is no international (IEC) or Australian standard for sound level meters with such a time constant – therefore it is not possible to provide a method without a suitable standard. The proposed method also uses A-weighted sound levels measured using Fast time weighting. As the method is new to Australia and not yet implemented in an ISO standard, it was agreed by the committee to make the Appendix ‘Informative’ only at this stage

The method aims at predicting the “prominence” of the impulsive sounds above the continuous sound level, with the adjustment corresponding to average subjective judgements. While the assessment of the prominence is objective, the adjustment applicable which is applied to the measured $L_{Aeq,T}$, may in time become a matter for regulatory authorities.

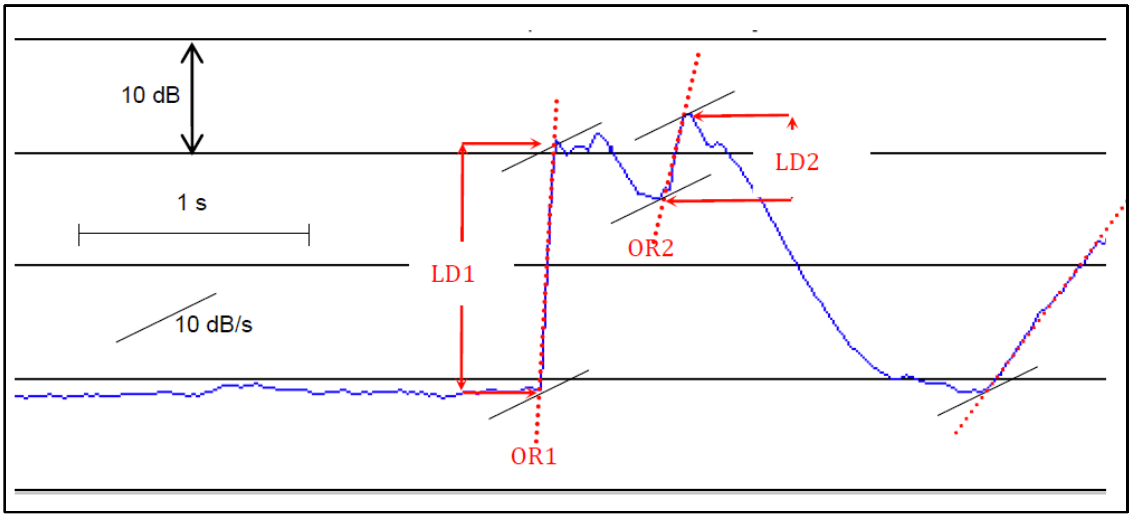
An example of how the method is applied is provided in the Appendix. The method comprises recording the A-weighted sound level measured with Fast time weighting L_{pAf} and then sampling it at intervals of 10 to 25 ms. Increases in sound levels between intervals of more than 10 dB/s have their ‘onset rate’ (OR) (the increase in sound level in dB/s) calculated from the level difference (LD) and the Prominence P determined by calculation. A graphical review of the periods with high onset rates is recommended. From the Prominence, the impulse adjustment can be calculated.

$$\text{Prominence } P = 3\log_{10}(OR) + 2\log_{10}(LD) \qquad (1)$$

where

OR = onset rate decibels/second;
LD = level difference in decibels.

Figure 4 shows an example time history with the OR and LD shown.



Note: Gradients of 10 dBA/s are shown with short line segments

Figure 4: An example time-history with Onset Rate and Level Difference shown, from Appendix E

The adjustments K_i to the $L_{Aeq,T}$ are made depending on the value of P as follows:

(a) For P > 5, $K_I = 1.8 \times (P - 5)$.
(b) For $P < 5$, $K_I = 0$.

All of these values are calculated on a spreadsheet basis using the sampled values for sound level. It is recommended that as an initial screening test, the 100 ms or 125 ms (Fast) sampled sound levels from a data-logging sound level meter be used with the method to assess periods of high Prominence and impulsivity. Then those periods could be assessed at the shorter time intervals recommended. At present (mid-year 2019), the ISO technical committee responsible for the environmental noise standard ISO 1996 series, TC43 SC1, is assessing whether the selection of sample interval makes a significant difference to the assessment. Obviously sampling at 10ms intervals involves a lot more data than at intervals of 25ms, and periods of 30ms, 50ms and 100ms are being considered in the comparison, to which the author is contributing.

In the example shown in Appendix E, the impulsive events are identified by listening as bird noise. Figure 5 shows the example 15-minute time-history at 100 millisecond intervals. Figure 6 shows the differences between successive intervals and figure 7 the prominence P. Figure 8 shows the adjustment K. The warning is provided in the Appendix to not blindly assume that when a recorded sound is analysed and shows impulsive characteristics, that it is not caused by an industrial source. The sources need to be assessed by a pair of ears.

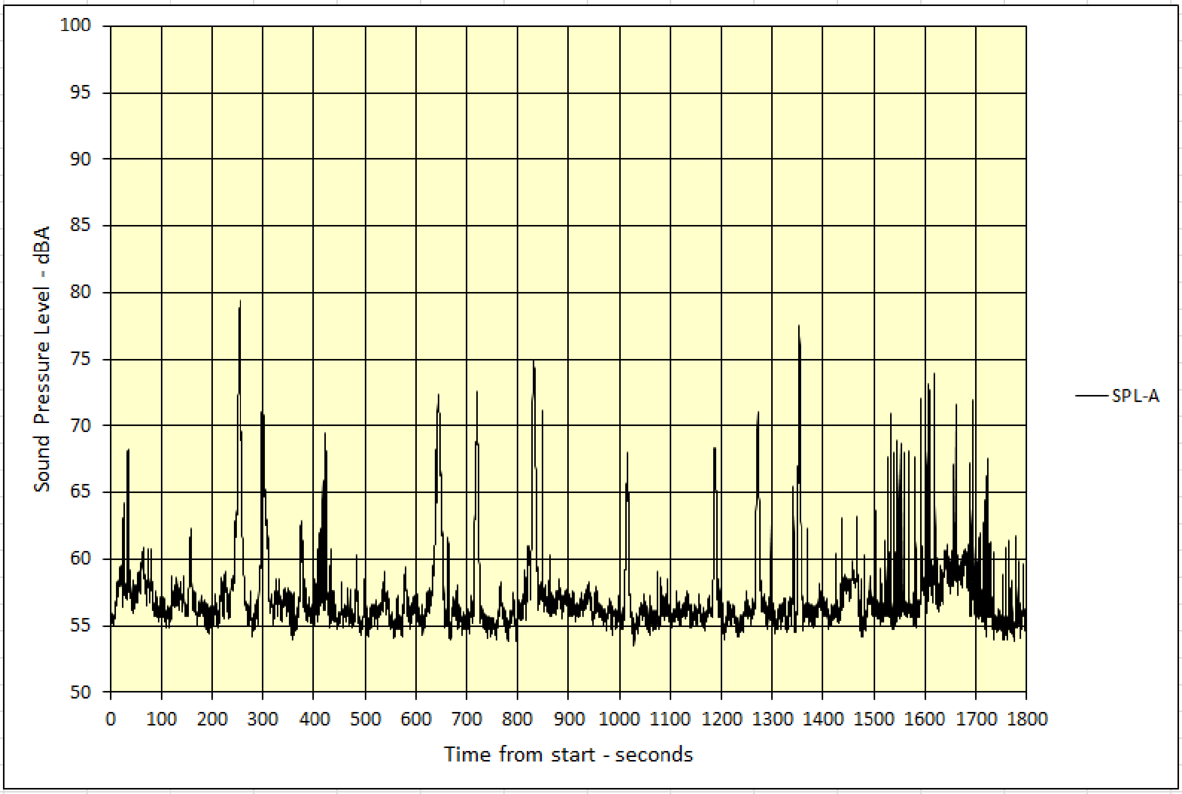


Figure 5: Example from Appendix E, time history at Fast response over 30 minutes with 1-s intervals shown

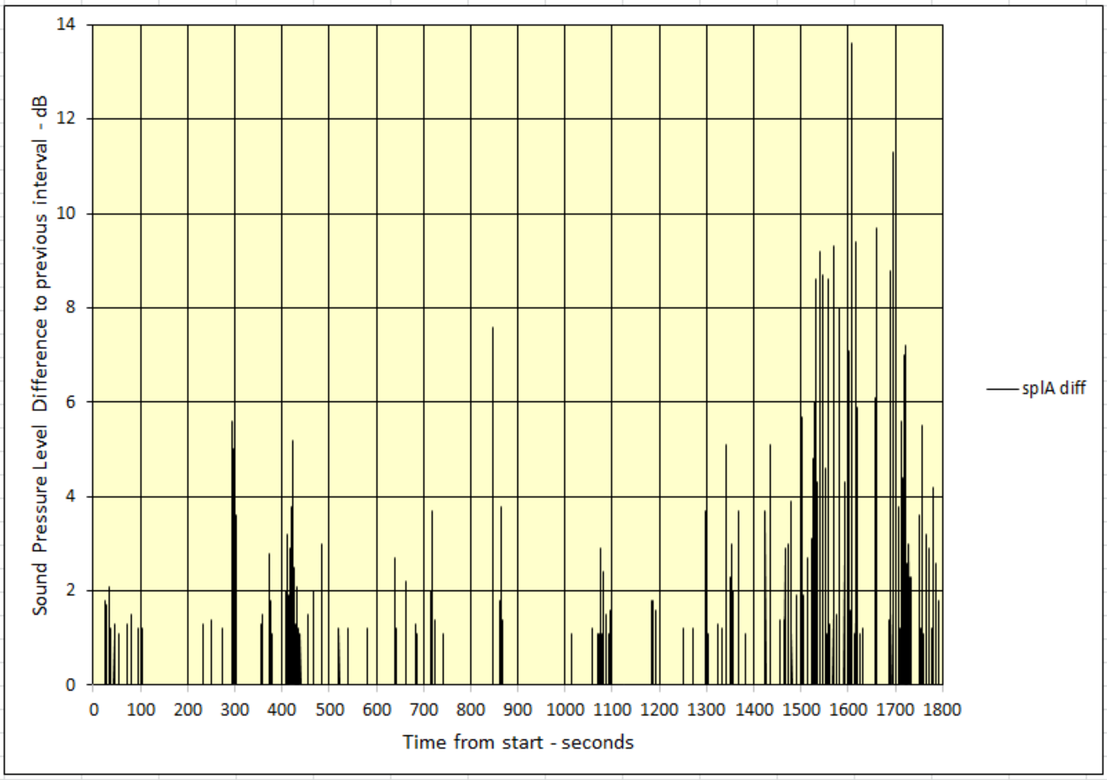


Figure 6: Example time-history showing the differences between subsequent intervals, from Appendix E

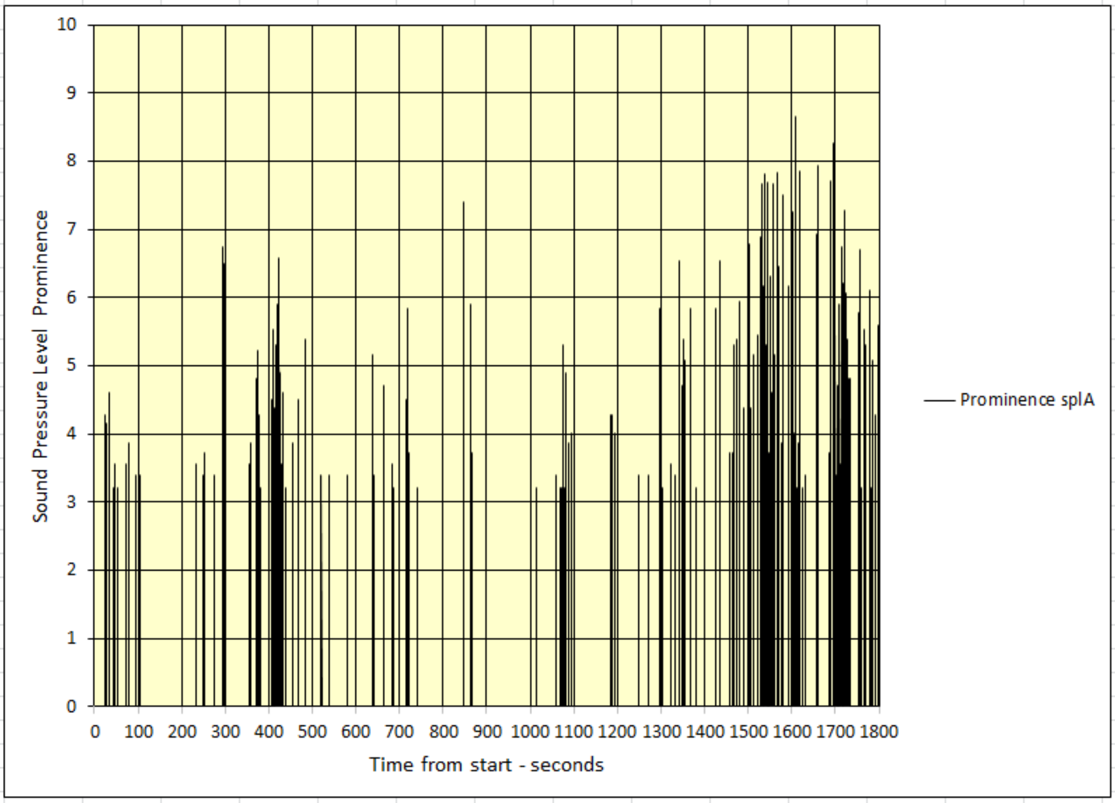


Figure 7: Example time-history showing Prominence P, from Appendix E

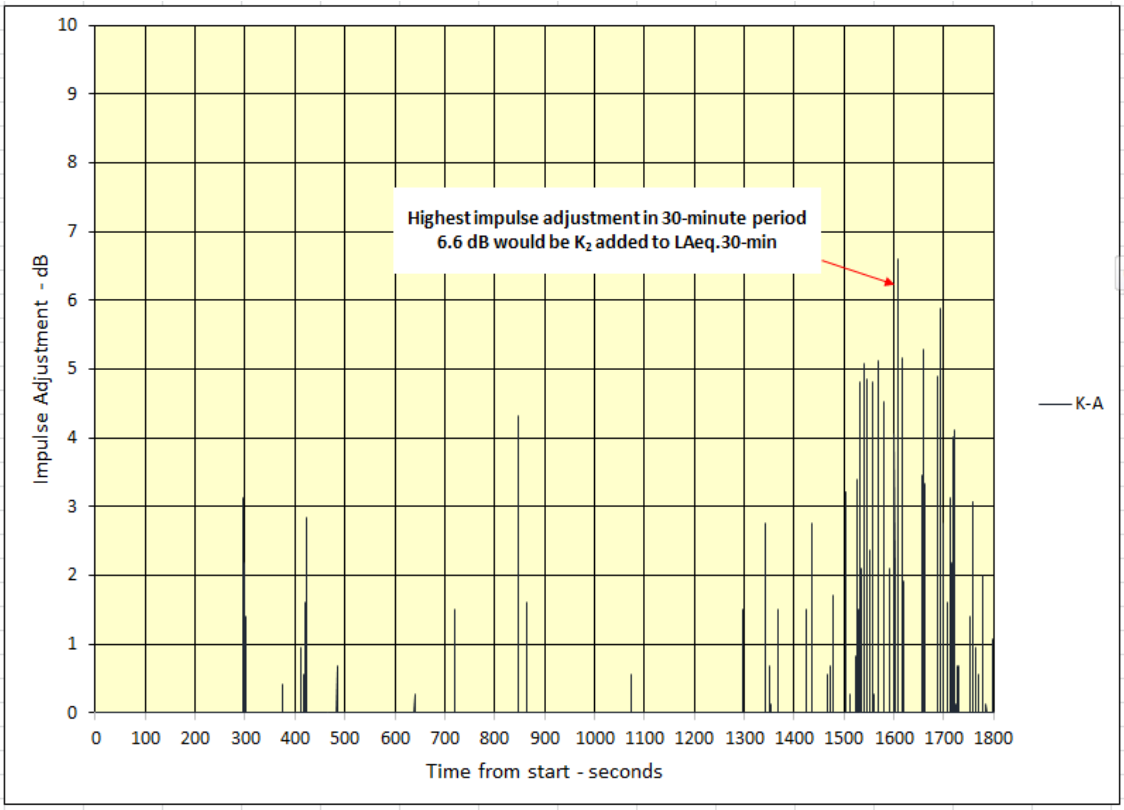


Figure 8: Sample SPL-A Impulse adjustment Ki for each interval over a 30-minute period, from Appendix E

7 REPORTING ON PREDICTION MODELLING AND UNCERTAINTY

There is a brief section dealing with prediction of noise levels in Section 11. This is because computer noise prediction models are used widely in the preparation of environmental noise assessments for new projects or in solving noise control problems. Guidance is not given on which methods to use but rather provides information on what to report on for cases where predictions have been used. The method adopted and assumptions used in each case need to be fully described.

Finally there is Section 12 which deals with uncertainty. It is not intended to be a detailed method but it is provided so that users of the Standard consider and report on the uncertainty and variability in the results obtained. As all those involved in measurement of environmental sound know from experience, there will be an uncertainty in a statistical sound level parameter caused by the variability of the sound over the measurement interval. These variabilities are caused by factors such as instrumentation performance, location of the measurements, different times of the day, source operating conditions, meteorological conditions and residual sound level variations. The methods presented in the standard are designed to minimise the measurement error in the process by requiring they be correctly performed. Typical ranges of uncertainty from different components of uncertainty are provided. In all cases it is necessary to report on the conditions occurring during the measurements.

As a final comment related to uncertainty, variability in environmental sound levels comes from many sources and causes and ranges typically from 0.5 dB or higher, depending on the variability of the component. Because of this variability and uncertainty it is considered inappropriate to report environmental sound level parameters to a greater accuracy of more than 1 dB. It is the author's experience in reviewing reports from very experienced consultants, that some show measured sound levels given with 1 or even 2 decimal points of accuracy. It is recommended that all sound levels are reported in integer format. Many years ago Professor Phillip Dickinson made the same observation and appeal at an AAS conference, which I repeat.

8 Summary

AS 1055: 2018 is the latest in a series of Australian standards dealing with environmental noise measurement, spanning 45 years since its first appearance. As in the past, it will continue to be reviewed and revised from time to time with the intent that it remains relevant to methods used in Australia for Australian conditions. The 2018 revision provides amendments intended to bring it up to date with local and international methods for measurement, assessment and description of environmental noise. Reference is regularly made in the Standard to the need to incorporate the requirements of the relevant regulatory authorities and their methods for assessment.

New methods provided for objective assessment of tonality and impulsiveness in measured environmental noise are also provided to adopt the latest in international practice.

9 References

Australian Standard *AS1055: 2018 Acoustics – Description and measurement of environmental noise*, Standards Australia

ISO 1996 - 1 : 2016 Acoustics - Description, measurement and assessment of environmental noise – Part 1: Basic quantities and assessment procedures, International Organization for Standardization

ISO 1996 – 2 : 2017 Acoustics -- Description, measurement and assessment of environmental noise -- Part 2: Determination of sound pressure levels, International Organization for Standardization

Nordtest Method ACOU 112 Acoustics: Prominence of Impulsive sounds and for adjustment of L_{Aeq}, Nordtest Finland 2002, ISSN 0283 7145

Pedersen, T.H. *Audibility of impulsive sounds in environmental noise*. Inter-Noise 2000.

10 Acknowledgements

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