New Zealand Standard

Acoustics – Measurement of environmental sound

Superseding NZS 6801:1999
COMMITTEE REPRESENTATION

This Standard was prepared under the supervision of the P 6801 Committee the Standards Council established under the Standards Act 1988.

The committee consisted of representatives of the following nominating organisations:

ECS Ltd
Local Government New Zealand
Massey University
Ministry of Health
New Zealand Acoustical Society
New Zealand Institute of Environmental Health
University of Auckland

ACKNOWLEDGEMENT

Standards New Zealand gratefully acknowledges the contribution of time and expertise from all those involved in developing this Standard.

We acknowledge Transit New Zealand's input into the early stages of this document.

We also acknowledge use of figure C1 – Ray paths showing upward and downward refraction of sound waves reprinted from ANSI S1.18-1994 (R2004) Procedures for Outdoor Measurement of Sound Pressure Level, © 1994 with the permission of the Acoustical Society of America, 35 Pinelawn Road, Suite 114E, Melville, NY 11747.

COPYRIGHT

The copyright of this document is the property of the Standards Council. No part of it may be reproduced by photocopying or by any other means without the prior written approval of the Chief Executive of Standards New Zealand unless the circumstances are covered by Part III of the Copyright Act 1994.

Standards New Zealand will vigorously defend the copyright in this Standard. Every person who breaches Standards New Zealand's copyright may be liable to a fine not exceeding $50,000 or to imprisonment for a term not to exceed three months. If there has been a flagrant breach of copyright, Standards New Zealand may also seek additional damages from the infringing party, in addition to obtaining injunctive relief and an account of profits.

Published by Standards New Zealand, the trading arm of the Standards Council, Private Bag 2439, Wellington 6140. Telephone (04) 498 5990, Fax (04) 498 5994, Website www.standards.co.nz.

AMENDMENTS
New Zealand Standard

Acoustics – Measurement of environmental sound

ISBN 1-86975-088-8
CONTENTS

Committee representation............................................................................................................ IFC
Acknowledgement ............................................................................................................................ IFC
Copyright ........................................................................................................................................ IFC
Referenced documents...................................................................................................................... 5
Related documents............................................................................................................................. 6
Latest revisions...................................................................................................................................... 7
Foreword ............................................................................................................................................... 8
Review of Standards............................................................................................................................ 8

Section

1 SCOPE........................................................................................................................................... 9

2 INTERPRETATION............................................................................................................................ 9
   2.1 Terminology ................................................................................................................................ 9
   2.2 Time interval ............................................................................................................................... 9

3 DEFINITIONS ................................................................................................................................ 9

4 SYMBOLS ...................................................................................................................................... 15
   4.1 Quantities .................................................................................................................................. 15
   4.2 Notation .................................................................................................................................... 15

5 INSTRUMENTATION ....................................................................................................................... 16
   5.1 Sound level meters ................................................................................................................... 16
   5.2 Calibration ............................................................................................................................... 16
   5.3 Field checks ............................................................................................................................. 16
   5.4 Accessory equipment ............................................................................................................... 17

6 MEASUREMENTS .......................................................................................................................... 17
   6.1 Measurement positions ............................................................................................................. 17
   6.2 Measurements inside buildings ............................................................................................... 18
   6.3 When and how long to measure ............................................................................................... 18

7 METEOROLOGICAL EFFECTS .................................................................................................... 19
   7.1 Introduction .............................................................................................................................. 19
   7.2 Meteorological window ............................................................................................................ 20

8 DETERMINATION OF SOUND DESCRIPTORS ........................................................................... 21
   8.1 General .................................................................................................................................... 21
   8.2 Steady sound ............................................................................................................................. 21
   8.3 Steady sound with stepped variations of level .......................................................................... 21
   8.4 Cyclic sound and separate sound events ............................................................................... 22
   8.5 Fluctuating sound .................................................................................................................... 22
   8.6 Impulsive sound ....................................................................................................................... 22
   8.7 Background sound level .......................................................................................................... 23
9 INFORMATION TO BE INCLUDED IN REPORTS ........................................... 23
  9.1 Introduction ......................................................................................... 23
  9.2 Instrumentation and data processing .................................................. 23
  9.3 Measurement technique .................................................................... 24
  9.4 Conditions prevailing during measurement ........................................ 24
  9.5 Acoustic data and description ............................................................. 25
  9.6 Uncertainty .......................................................................................... 26

Appendix
A Uncertainty (Informative) ........................................................................ 27
B Prediction of sound (Informative) ............................................................ 28
C Propagation of sound outdoors (Informative) .......................................... 32

Table
1 Symbols for sound quantities ................................................................. 15
B1 Incoming solar radiation ....................................................................... 29
B2 Sun altitude prediction .......................................................................... 30
B3 Definition of Pasquill stability categories .......................................... 30
B4 Determination of meteorological category ........................................ 31

Figure
1 Total sound, specific sounds and residual sound ............................... 12
C1 Ray paths showing upward and downward refraction of sound waves... 33
REFERENCED DOCUMENTS

Reference is made in this Standard to the following:

NEW ZEALAND STANDARDS

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NZS 6802:2008</td>
<td>Acoustics – Environmental noise</td>
</tr>
<tr>
<td>NZS 6805:1992</td>
<td>Airport noise management and land use planning</td>
</tr>
<tr>
<td>NZS 6807:1994</td>
<td>Noise management and land use planning for helicopter landing areas</td>
</tr>
<tr>
<td>NZS 6808:1998</td>
<td>Acoustics – The assessment and measurement of sound from wind turbine generators</td>
</tr>
</tbody>
</table>

PREVIOUS EDITIONS OF NEW ZEALAND STANDARDS

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NZS 6801:1999</td>
<td>Acoustics – Measurement of sound</td>
</tr>
<tr>
<td>NZS 6801:1991</td>
<td>Measurement of sound</td>
</tr>
</tbody>
</table>

INTERNATIONAL STANDARDS

IEC STANDARDS

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 60942:2003</td>
<td>Electroacoustics – Sound calibrators</td>
</tr>
<tr>
<td>IEC 61672: - - -</td>
<td>Sound level meters</td>
</tr>
<tr>
<td>Part 1:2002</td>
<td>Specifications</td>
</tr>
<tr>
<td>Part 2:2003</td>
<td>Pattern evaluation tests</td>
</tr>
<tr>
<td>Part 3:2006</td>
<td>Periodic tests</td>
</tr>
</tbody>
</table>

PREVIOUS EDITIONS OF IEC STANDARDS

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 60651:1979</td>
<td>Sound level meters (and Amendment No. 1, 1993)</td>
</tr>
<tr>
<td>IEC 60804:1985</td>
<td>Integrating-averaging sound level meters (and Amendment No. 1, 2000)</td>
</tr>
</tbody>
</table>

ISO STANDARDS

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO 140: - - -</td>
<td>Acoustics – Measurement of sound insulation in buildings and of building elements</td>
</tr>
<tr>
<td>Part 4:1998</td>
<td>Field measurements of airborne sound insulation between rooms</td>
</tr>
<tr>
<td>ISO 1996: - - -</td>
<td>Acoustics – Description, measurement and assessment of environmental noise</td>
</tr>
<tr>
<td>Part 2:2007</td>
<td>Determination of environmental noise levels</td>
</tr>
<tr>
<td>ISO 9613: - - -</td>
<td>Acoustics – Attenuation of sound during propagation outdoors</td>
</tr>
<tr>
<td>Part 1:1993</td>
<td>Calculation of the absorption of sound by the atmosphere</td>
</tr>
<tr>
<td>Part 2:1996</td>
<td>General method of calculation</td>
</tr>
</tbody>
</table>

AMERICAN STANDARDS

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANSI S12.18-1994 (R2004)</td>
<td>Procedures for outdoor measurement of sound pressure level</td>
</tr>
</tbody>
</table>
NEW ZEALAND LEGISLATION
Resource Management Act 1991
Standards Act 1988

OTHER PUBLICATIONS

NSW Environment Protection Authority (from April 2007 New South Wales Department of Climate Change), NSW industrial noise policy, January 2000.


RELATED DOCUMENTS

NEW ZEALAND STANDARDS
NZS 6803:1999 Acoustics – Construction noise
NZS 6806:xxxx Acoustics – Road traffic noise – New and altered roads (in preparation)
NZS 6809:1999 Acoustics – Port noise management and land use planning

INTERNATIONAL STANDARDS
IEC STANDARDS
IEC 60050-801:Ed.2.0 (1994) International electrotechnical vocabulary
IEC 60942 Ed. 3.0 (2003) Electroacoustics – Sound calibrators (incorporating Amendment No. 1, 2000)

ISO STANDARDS
ISO 80000:- - - - Quantities and units
Part 8:2007 Acoustics
ISO 1996:- - - - Acoustics – Description, measurement and assessment of environmental noise
Part 1:2003 Basic quantities and assessment procedures

AMERICAN STANDARDS
ANSI S1.26-1995 Method for the calculation of absorption of sound by the atmosphere (R2004)

NEW ZEALAND LEGISLATION
Building Act 2004
Building Regulations 1992 (Schedule 1)
LATEST REVISIONS

The users of this Standard should ensure that their copies of the above-mentioned Standards are the latest revisions. Amendments to referenced New Zealand and Joint Australian/New Zealand Standards can be found on www.standards.co.nz.

The Standards Act 1988 states that a reference made to a Standard in any Act, regulation or bylaw refers to the latest edition of that Standard. However section 23 of the Act also makes an exception where the context otherwise requires. The Environment Court has held that where a New Zealand Standard has been incorporated by reference or cited in a district plan or a condition of consent, its version (and that of any included documents such as another New Zealand, ISO or foreign Standard), is the version current at the date of publication of the plan or condition.

**Commentary**

*If this were not the case, the district plan or resource consent condition could be altered, not by the appropriate planning authority and processes under the Resource Management Act, but by the Standards Council and its processes under the Standards Act.*

*Where a Standard is not incorporated by reference in consent conditions, a rule or national environmental standard, but is being referred to for guidance, then references to other Standards without identification of the version can be taken to refer to the latest versions of those other Standards as provided by s.23 of the Standards Act.*
FOREWORD

This Standard is a revision of NZS 6801:1999 Acoustics – Measurement of environmental sound.

In December 2005 a scoping workshop was held by Standards New Zealand, which identified a number of key areas requiring revision in both NZS 6801 and NZS 6802. A committee comprising acoustic specialists and representatives of key stakeholders in environmental noise was appointed by Standards New Zealand in January 2007 to revise both Standards.

The majority of issues addressed by this revision of NZS 6801 are relatively minor corrections, clarifications, and updates. In addition there is discussion of uncertainty in Appendix A and the adoption of new terminology for consistency with international Standards. The committee was aware that formalised consideration of uncertainty would be a new issue for many users. Therefore this revision of NZS 6801 does not require the documentation of uncertainty for all environmental sound measurements, but simply encourages users to familiarise themselves with this topic through reference to a good practice guide.

The procedures described are intended to enable consistent measurement of environmental sound for all conditions within the scope of the Standard. These procedures are referenced by other Standards in the acoustics series (NZS 680...). Users of this Standard are assumed to have a basic understanding of the science of acoustics and experience in sound measurement.

The Standard may be cited in local authority rules, plans, and consent conditions or in national environmental standards to avoid the need for inclusion of technical information while ensuring national consistency in sound measurement methods.

REVIEW OF STANDARDS

Suggestions for improvement of this Standard will be welcomed. They should be sent to the Chief Executive, Standards New Zealand, Private Bag 2439, Wellington 6140.
1 SCOPE

This Standard defines basic quantities to be used for the description of sound in community environments and describes procedures for the measurement of these quantities.

This Standard forms the basis for others in the environmental sound series listed in referenced documents.

2 INTERPRETATION

2.1 TERMINOLOGY

For the purposes of this Standard, the word ‘shall’ refers to requirements that are mandatory for compliance with the Standard, while the word ‘should’ refers to practices that are advised or recommended.

The term ‘Informative’ has been used in this Standard to define the application of the Appendix to which it applies. An ‘Informative’ Appendix provides additional information, and is only for guidance.

Clauses prefixed by ‘C’ are comments on the corresponding clauses and are intended only as helpful guidance. The Standard can be complied with if the comment is ignored.

2.2 TIME INTERVAL

For consistency with international Standards, the term ‘time interval’ in this Standard has a specific meaning as the period between the start and finish of a measurement (or reference period). In this Standard ‘interval’ does not refer to the gap between two separate measurements.

3 DEFINITIONS

In this Standard the following definitions shall apply:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient sound</td>
<td>See Total sound</td>
</tr>
<tr>
<td>Averaging</td>
<td>The process of finding the mean of a data set. Normally this is by summing the data and dividing by the number in the data set (arithmetic averaging). However, where the average of a set of LEQ or SEL levels is required then an ‘energy averaging’ method is used. The expression for this is given by Equation 1.</td>
</tr>
</tbody>
</table>

\[ L = 10 \log \left[ \frac{1}{N} \left( 10^{0.1L_1} + 10^{0.1L_2} + \ldots + 10^{0.1L_N} \right) \right] \text{ dB} \]  

\text{Equation 1}

where:

\( N \) is the number of sample levels

\( L_i \) is the \( i \)th sample level

\( L \) is the energy average level