Noise measurement in buildings
ANC Guide

ANC ACOUSTICS & NOISE CONSULTANTS

Jack Harvie-Clark
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Overview

- Introduction, context, other guidance: Jack Harvie-Clark
- Example specification of sound level limits: Nigel Burton
- “ANC simple method”: Dan Saunders

Context

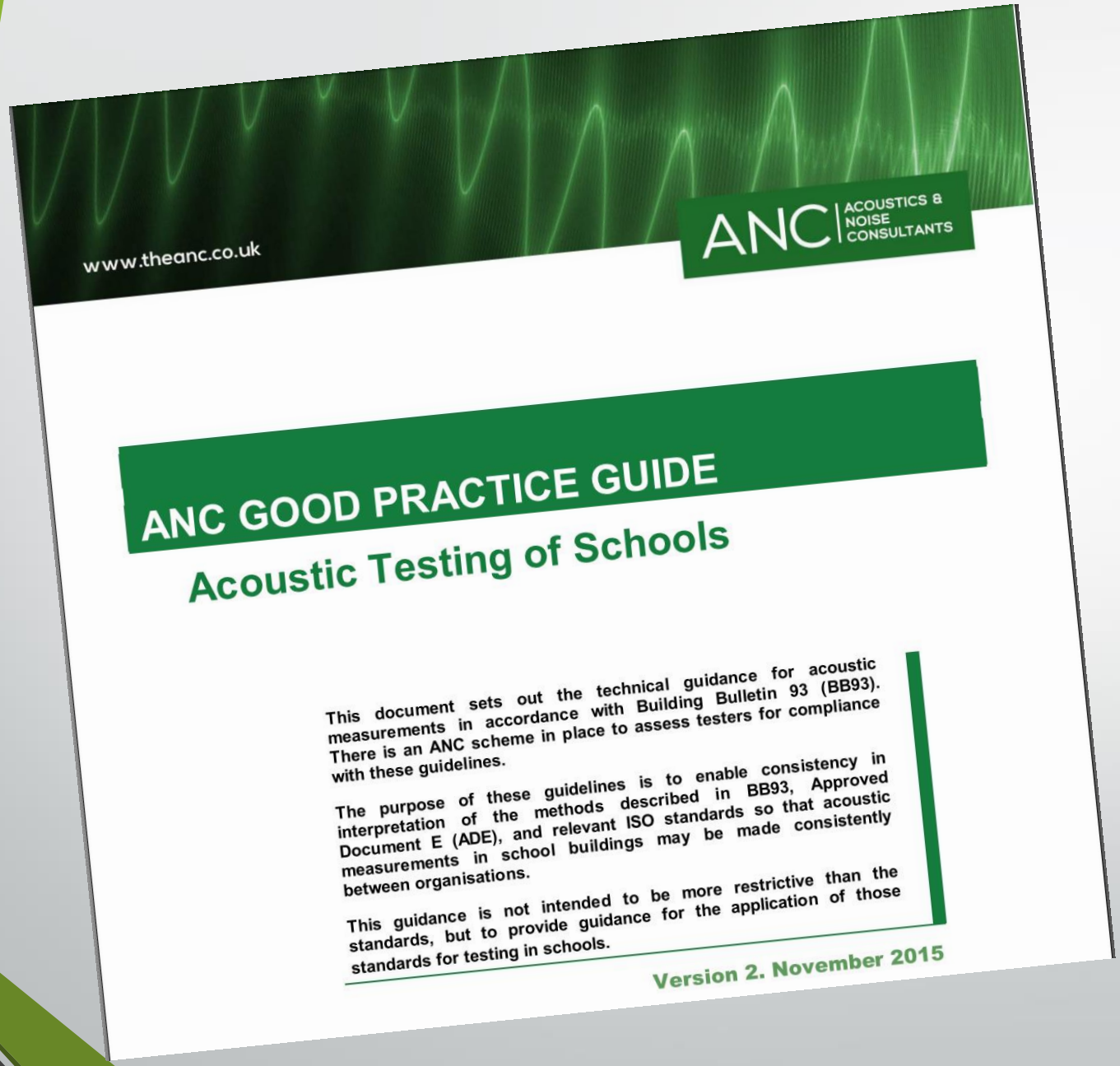
- Supersedes Part 1 & 2 of ANC Guidelines for measuring noise in buildings, 1997 and ‘98
- International Standards and other guidance have been published.
- General external sources has not received the same degree of attention.
- *suitable skills, knowledge and experience in sound level measurements and who are familiar with the appropriate equipment.*
- **Working Group**
- Nigel Burton, Temple Group
- Jack Harvie-Clark, Apex Acoustics
- Chris McNeillie, Cass Allen
- Dan Doherty, WSP
- Dan Saunders, Clarke Saunders

Scope

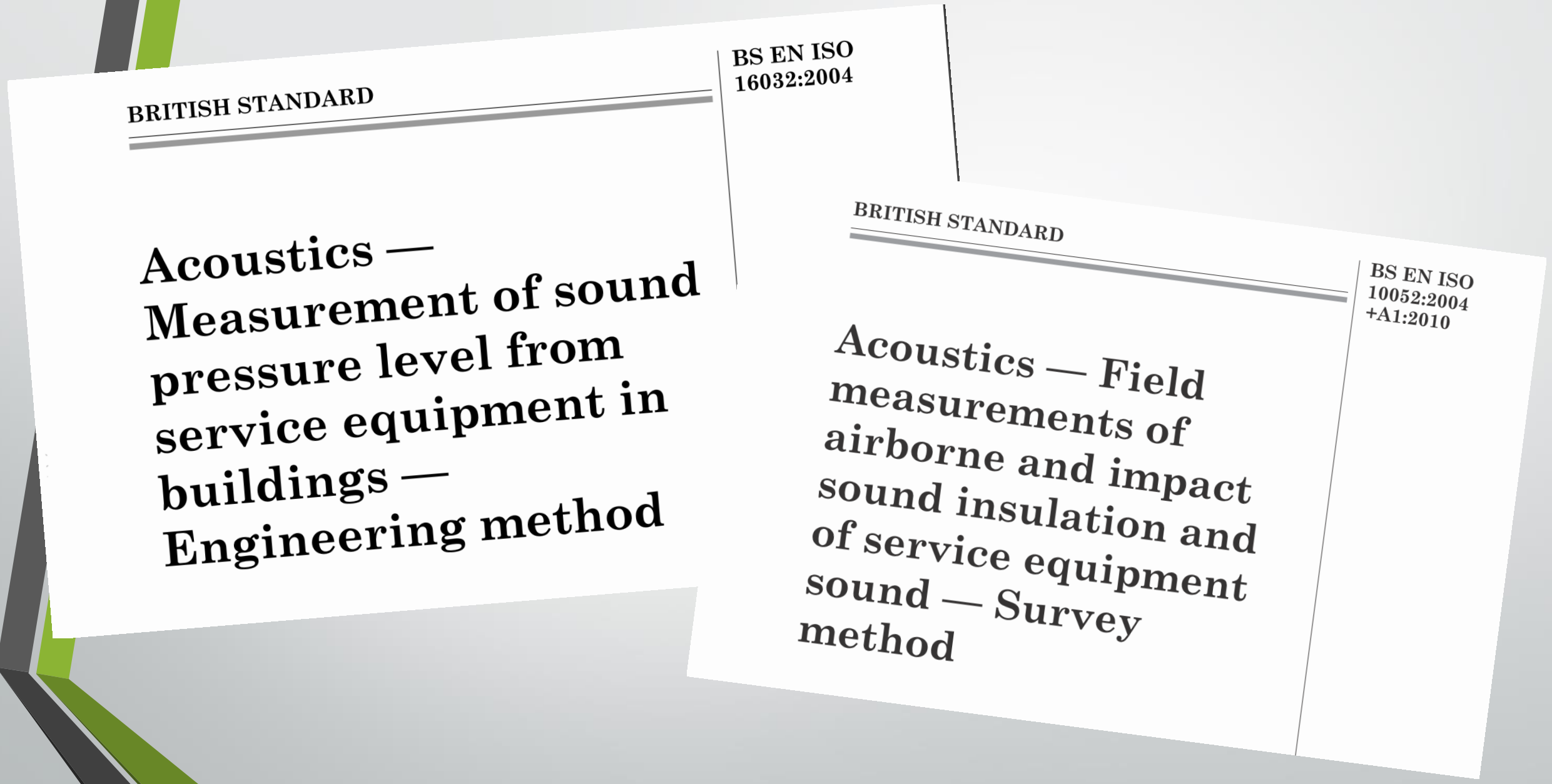
- …buildings where ambient sound levels are important, but not acoustically specialised places, for example:
- Offices
- Hospitals
- Dwellings
- Hotels
- Schools and other educational premises
- Commercial and industrial premises

Sign posting to other guidance

Reference	Year
ANC simple method for internal and/or external sources	2018
ANC GPG: Acoustics Testing of Schools	2015
BS EN ISO 10052	2004
BS EN ISO 16032	2004
Swedish guide to application of ISO 10052 & 16032	2015
Measurement of low frequency noise in rooms	2011
BS EN ISO 16283-3	2016



- Anyone concerned about ambiguities?


BRITISH STANDARD
BS EN ISO 16032:2004
Acoustics — Measurement of sound pressure level from service equipment in buildings — Engineering method
BRITISH STANDARD
BS EN ISO 10052:2004 +A1:2010
Acoustics — Field measurements of airborne and impact sound insulation and of service equipment sound — Survey method

Vägledning för mätning av ljudnivå i rum med stöd av SS-EN ISO 10052/16032

Simmons

Equivalent levels

Here is equivalent levels of marketers bands 31.5 Hz - 10,000 Hz

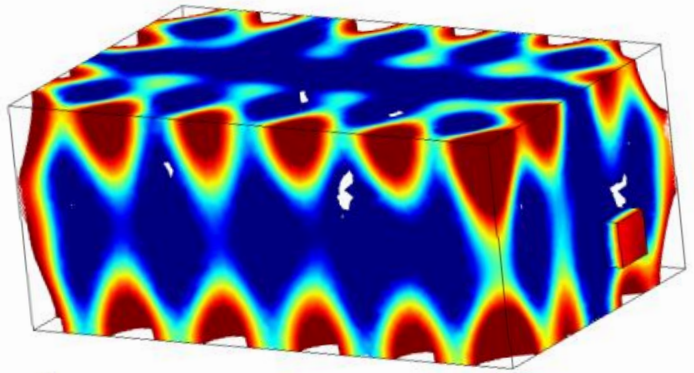
		L_{Aeq}	L_{Ceq}		$L_{31,5,eq}$	$L_{40,eq}$	$L_{50,eq}$	$L_{63,eq}$	$L_{80,eq}$	$L_{100,eq}$	$L_{125,eq}$	$L_{160,eq}$
Measurement 1	Corner measurement 1											
	Room measurement 1											
	Room measurement 2											
	Difference											
>3 dB?	More positions?											
Measurement 2	Corner measurement 2											
	Room measurement 3											
	Room measurement 4											
	Difference											
>6 dB?	More positions?											
Measurement 3												
	Corner measurement 3											
	Room measurement 6											
	Difference											
>9 dB?												
	Average											

A and C weighted equivalent levels calculated from the measured third octave band levels. Mean values above in italics and are included for

Finnish Institute of Occupational Health

Measurement of low frequency noise in rooms

David Oliva, Valtteri Hongisto, Jukka Keränen, Vesa Koskinen

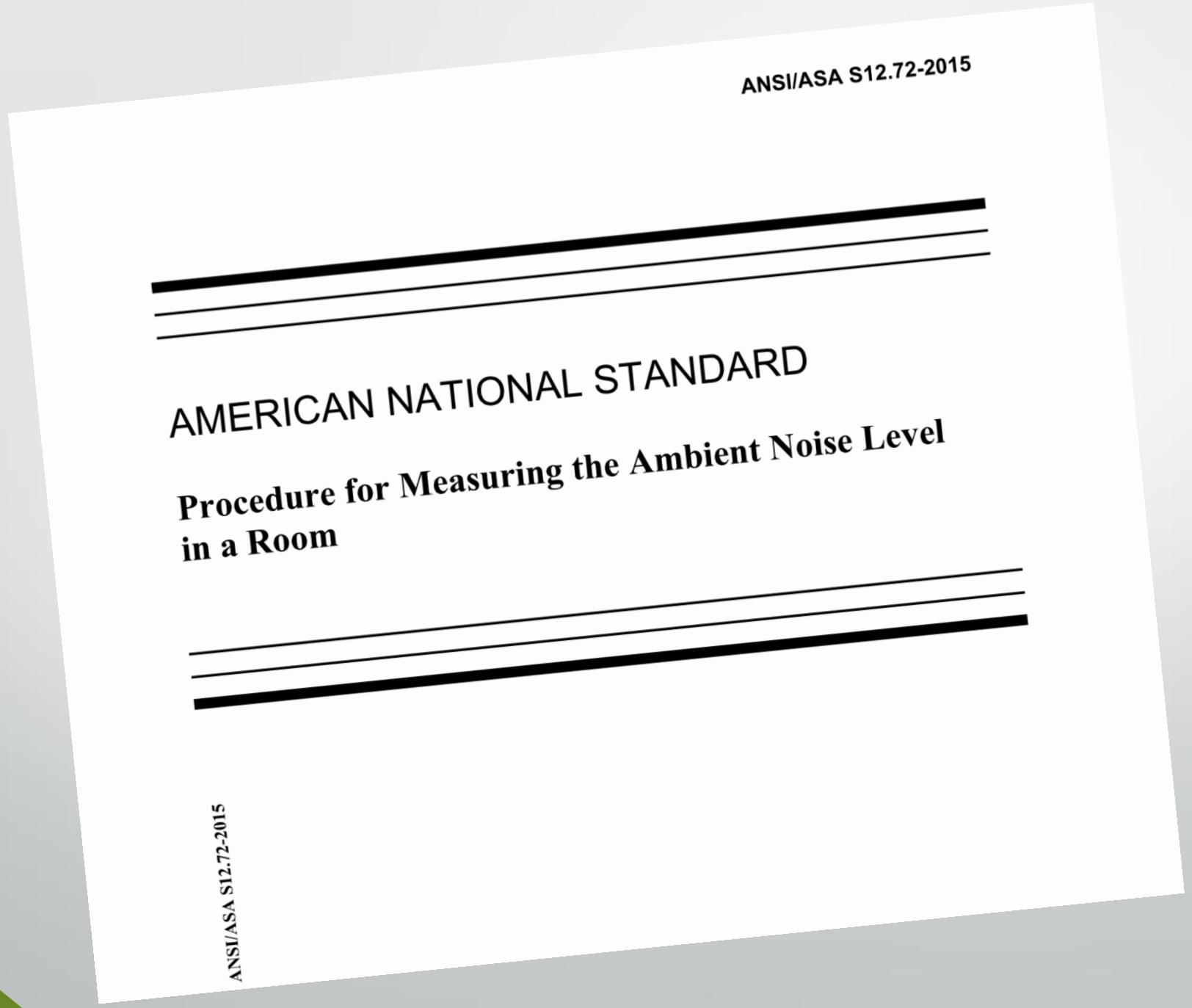


BS EN ISO 16283-3:2016

BSI Standards Publication

Acoustics — Field measurement of sound insulation in buildings and of building elements

Part 3: Façade sound insulation


ANSI/ASA S12.72-2015
AMERICAN NATIONAL STANDARD
Procedure for Measuring the Ambient Noise Level in a Room
ANSI/ASA S12.72-2015

Measurement of sound in buildings
ANC Guide

Appendix A: Specification of Sound Levels

Nigel Burton

Appendix A: Specification of Sound Level Limits and Application of Criteria

- Factors Affecting the Interpretation of the Sound Levels
- Physical Factors Affecting the Measured Sound Level
- Application of Criteria
- Example Sound Level Specifications

Factors Affecting the Interpretation of the Sound Levels

- Temporal variations, spatial variations, and variations across the frequency range of interest.
- The parameter(s) for sound level characterisation, such as NR, NC, RC MkII, L_{An}, L_{Aeq}, L_{max}, stating a maximum acceptable level and, if masking sound is required, a minimum acceptable level.
- The number of events or cycles to be measured and method of averaging or otherwise processing the data. This should include specification of a method for interpretation of all key indices. For example, if L_{Amax} were important it could be specified that maximum sound levels from events over a defined period would be recorded and an appropriate threshold be specified.
- The period of interest and the length of the measurement periods.
- The character of the measured sound, for example penalties to account for tonal components (from external sources such as transformers, from internal sources such as fan coil units), or impulsive components (crashes and bangs, etc.).[ref to QAI procedure]
- Correction for background noise
- Correction for reverberation time to account for differences in room conditions.
- The frequency range of measurements.
- Measurement equipment type, specification, tolerances, calibration and verification.

Physical Factors Affecting the Measured Sound Level

- The position in the room where the specification must be met (typically any “normally occupied” position or usable location).
- The type of room in which tests should be performed and the condition of the room (furnished or unfurnished).
- The mechanical services or plant operating conditions under which sound levels should be measured. Any automated control systems may need to be overridden during the period of measurement.
- Any control settings for natural ventilation systems.
- The sound source conditions under which the specified sound level should be measured.
- For external sound this should state the need to avoid atypical events which may affect the measured internal sound level (such as interrupted traffic flows on roads due to construction work or reduced maximum train sound levels due to speed restrictions on a railway.)
- For internal sound this should state the building services operating condition under which the requirements are to be met (such as “typical” duty or “maximum” duty).
- Weather or meteorological conditions which may influence the propagation of sound from external sources.

An appropriate specification will need to include requirements for the above factors.

Appendix A: Specification of Sound Level Limits and Application of Criteria

Application of Criteria

In applying the sound level specification, there are two methods that can be adopted:

- Specification of an upper and lower limit (for example where masking noise is required);
- Specification of an upper limit only.

Where the noise source is proposed to be used to provide sound masking, it may be appropriate to apply both an upper and lower sound level limit. Generally, this would only apply to noise from building services plant with broadband and continuous characteristics such as air handling units or masking sound systems.

For intrusive noise, particularly where the noise source is transient/ intermittent (e.g. aircraft, trains), it would usually be appropriate to apply an upper sound level limit only (since transient events would not provide effective sound masking).

Where noise sources are considered to contain features such as tones or impulses, reference shall be made to section 2 of this guide in determining the method of applying penalties to the measured sound levels. Details of the application of penalties would form part of the sound level specification.

Appendix A: Specification of Sound Level Limits and Application of Criteria

- Example Sound Level Specifications
  - Example 1: Building Services Noise within a New Office Development
  - Example 2: Sound Level Specification – Measurement of environmental and building services noise in a residential development
  - Others?

Example 1: Building Services Noise within a New Office Development

1. Measurement of building services noise

1. Measurements shall be carried out and reported by a suitably qualified person following the method in the ANC Guide Appendix B for measurement of sound levels in buildings, and meeting the requirements shown below.

2. Spaces of Interest

1. Sound pressure levels shall be measured in a representative number of spaces within the development, to be agreed with the Client before testing. A representative sample of each different room type and each performance requirement shall be tested.
2. In the absence of any specific Client or Employer requirements, the normal procedure shall be to test one in four spaces within the development.

3. Requirements

1. The source level due to building services shall be measured in accordance with the ANC Simple Measurement Method presented in the ANC Guidelines - Noise Measurements in Buildings.
2. Sound pressure levels shall be measured in each space of interest with equipment complying with the requirements shown in the ANC Simple Measurement Method.
3. Sound pressure levels shall be measured over a suitable measurement duration, depending on the character of the noise (i.e. whether it is steady and whether it is continuous).
4. Measurements shall be carried out at a suitable number of positions in each space of interest.
5. Measurements shall be carried out within finished and normally furnished but unoccupied rooms. Where this is not possible, corrections shall be applied to the measured level to account for the absence of normal furnishing. Corrections shall be applied to standardise the source level to the reverberation time that would be present within a finished and furnished room, as defined in the Project Acoustic Design Report.
6. A correction for background noise level shall be applied in accordance with the ANC Simple Measurement Method.
7. The presence of any tonal or impulsive features in noise from building services shall be noted via subjective observations.
8. Source levels shall be quantified in terms of the guidance level parameters referred to in the Employer's Requirements or the Project Acoustic Design Report.

4. Specific noise level targets

1. Where the average source level within each space, as measured in accordance with the requirements shown in Section 2, falls within the specific noise level range that is specified within the Employer's Requirements or the Project Acoustic Design Report, it is considered to comply with specification. Small deviations from the design criteria (for example up to 2 dB) at individual locations may be acceptable at the project acoustician's discretion.
2. In the absence of Employer's Requirements or a Project Acoustic Design Report., specific noise level targets shall be prescribed as defined within the British Council for Offices Guide to Specification in terms of the Noise Rating (NR) level.
3. Reporting:
    a. The information to be reported shall be as described in the ANC Simple Measurement Method.
    b. Where, in the subjective opinion of the the practitioner undertaking measurements, tonal or impulsive features are observed, these shall be highlighted to the Client.

Measurement of sound in buildings ANC Guide

Appendix B
ANC simple measurement method

Dan Saunders

Appendix B – ANC simple measurement method

- Measuring equipment, calibration and tolerance
- Terms, definitions & measurement parameters
- Measurement of internal & external noise sources
- Information to be reported

Appendix B – ANC simple measurement method

- Measuring equipment, calibration and tolerance
  - No fundamental changes
- Terms, definitions & measurement parameters
  - Not too dissimilar to before
  - Sampling time (non-steady intermittent) – key change

Appendix B – ANC simple measurement method

- Sampling time (non-steady intermittent) – key change

1997 – 5.4

The $L_{eq,T}$ over the entire period of interest should be obtained, either by measurement over the entire period or by a shortened measurement method similar to that described in 5.2 above.

For individual events, measurements of L_{AFmax}, and $L_{eq,T}$ may be appropriate and, in some circumstances, SEL may also be appropriate. The measured SEL of events may be used to calculate $L_{eq,T}$.

Measurements should be made over a survey period of sufficient duration to provide a representative sample of all events in order to quantify the spread of noise levels experienced throughout the reference period.

Appendix B – ANC simple measurement method

- Sampling time (non-steady intermittent) – key change

2018 proposal

The $L_{eq,T}$ over the entire reference period should be obtained, either by measurement over the entire period or by a shortened measurement method similar to that described in XXX above.

For individual events, measurements of L_{AFmax}, and $L_{eq,T}$ may be appropriate and, in some circumstances, SEL may also be appropriate. The measured SEL of events may be used to calculate $L_{eq,T}$.

Appropriate selection of sampling time is a key consideration in order to quantify the number of individual events which occur during the entire reference period e.g where maximum noise events are from road traffic passbys, it may be appropriate to measure using a 1-minute sampling time .

Measurements should be made over a survey period of sufficient duration to provide a representative sample of all events in order to quantify the spread of noise levels experienced throughout the reference period.

Appendix B – ANC simple measurement method

- Measurement positions (key change)
  - Using spatial average via a moving microphone
  - Larger rooms

Within larger rooms, measurements should be carried out at a suitable number of zones to sufficiently characterise each location separately. For example:

a. Rooms with floor area less than 25 m^2: One measurement.

b. Rooms with floor area between 25 m^2 and 99 m^2: Three measurements.

c. Rooms with floor area between 100 m^2 and 499 m^2: Six measurements.

d. Rooms with floor area of 500 m^2 or greater: Ten measurements.

When measurements are carried out in different zones within a larger room, each value should be reported separately.

Appendix B – ANC simple measurement method

- Correction for reverberation time
  - Relative vagary of the 1997 version remains
  - Revised to provide some additional guidance (BS EN 16032:2004)

Appendix B – ANC simple measurement method

- Correction for background sound
  - Fundamental change to bring in line with BS EN 16032:2004

Difference between Total and Background noise levels, $L_{Total} - L_{Residual}$ / dB	Correction for Background to determine the Specific noise level
$L_{Total} - L_{Residual} \geq 10$	None
$4 < L_{Total} - L_{Residual} < 10$	Logarithmic correction, i.e.: [Add equation]
$L_{Total} - L_{Residual} \leq 4$	Equivalent to a difference of 4 dB, i.e. $L_{Specific} = L_{Total} - 2.2$

Appendix B – ANC simple measurement method

- Information to be reported
  - No fundamental changes
  - Summarise method used (moving/fixed positions)

Thanks for listening.

Any comments?

Thank you for listening

- Any other relevant guidance to signpost?
- Any problems with ANC Simple method?
- Rating of noise / penalties for characteristics?
- Sufficient guidance / insufficiently prescriptive?
- How long to measure?