Laboratory measurement of airborne insulation of a wall system

Test report ID: T1830-2

Report prepared by:

Dr Andrew Hall

Mr Gian Schmid

AUCKLAND UNISERVICES LIMITED

a wholly owned company of

THE UNIVERSITY OF AUCKLAND

Reports from Auckland UniServices Limited should only be used for the purposes for which they were commissioned. If it is proposed to use a report prepared by Auckland UniServices Limited for a different purpose or in a different context from that intended at the time of commissioning the work, then UniServices should be consulted to verify whether the report is being correctly interpreted. In particular it is requested that, where quoted, conclusions given in UniServices reports should be stated in full.

LABORATORY MEASUREMENT OF AIRBORNE AND IMPACT INSULATION OF BUILDING ELEMENTS ACCORDING TO ISO-10140

Report prepared for:

Olsson Fire and Risk
Level 1, 60 Cashel Street
Christchurch, 8013, New Zealand

Report prepared by:

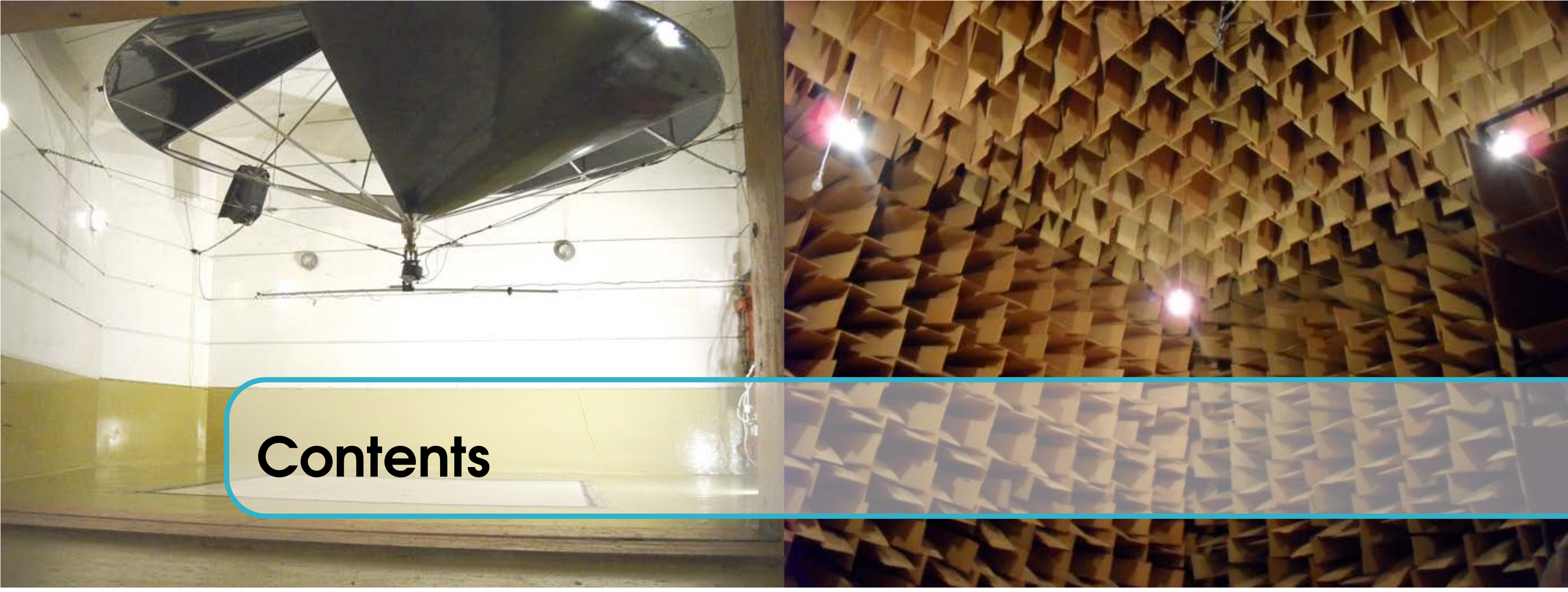
Acoustics Testing Services
Dept. of Mechanical Engineering
The University of Auckland

AUCKLAND UNISERVICES LTD
THE UNIVERSITY OF AUCKLAND,
PRIVATE BAG 92019 AUCKLAND

Mr. Gian Schmid

Dr. Andrew Hall

Dr. Michael Kingan



Contents

1. Test Report

1.1 Photos of test specimen

Figure 1.1: 90x45mm studs and nogs

Figure 1.2: Wall panels

Acoustics Testing Service

Figure 1.3: Panels fastened to studs

Figure 1.4: Panels installed over the wall

Figure 1.5: Thermal insulation material installed

Figure 1.6: Plasterboard applied to wall

Sound reduction index, R, in accordance with ISO 10140-2
Laboratory measurements of airborne sound insulation of building elements

Description and identification of the test specimen and test arrangement: Date of test: 8-Aug-18

Airborne sound insulation of a wall system Client: Resene Construction Systems

Wall System:

Source room:

Linings: 1 layer *10 mm GIB® Standard®*
Insulation: *Pink Batts* R2.2
Framing: 90 mm x 45 mm timber frame with studs set at 600 mm centres and nogs set at 800 mm centres
20 mm gap with rubber isolated L-brackets joining timber framing to Integra panels at 0.6 m vertical & 1.2 m horizontal centres
50 mm thick *Integra* panels adhered together at the joints
20 mm gap with rubber isolated L-brackets joining timber framintg to Integra panels at 0.6 m vertical & 1.2 m horizontal centres

Receiving room:

Framing: 90 mm x 45 mm timber frame with studs set at 600 mm centres and nogs set at 800 mm centres
Insulation: *Pink Batts* R2.2
Linings: 1 layer *10 mm GIB® Standard®*

Perimeter Sealant: *GIB® Soundseal*
Total thickness: 240 mm

Source chamber: Chamber C, Receiving chamber: Chamber A . Test specimen installed by client. Curing time: 14hrs

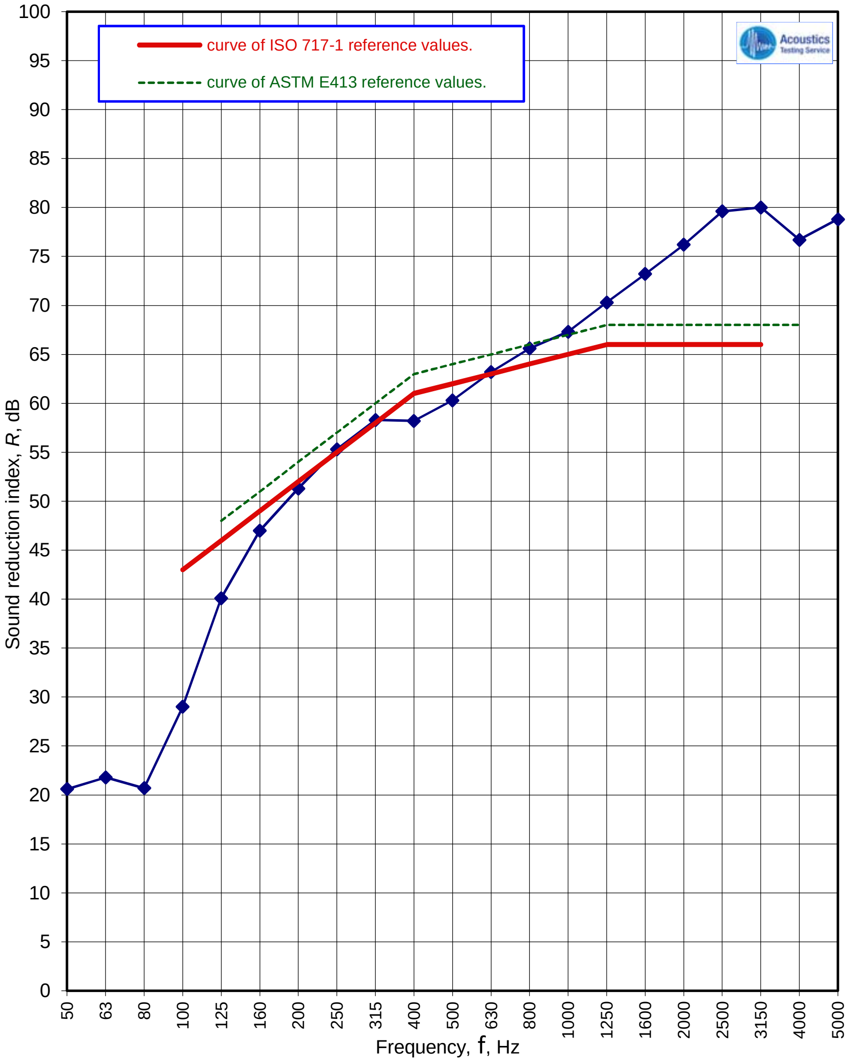
Computer files: T1830-2.pls Emmited noise: T1830-2 TL.pls / Source Received noise: T1830-2 TL.pls / Receiving Reverberation time: T1830-2 RT.pls

Area *S* of test specimen: 11.95 m^2

Air temp in the test rooms: 23 °C
Air humidity in test rooms: 65 %
Source room volume: 208 m^3
Receiving room volume: 202 m^3

Frequency *f* Hz	*R* One-third octave dB
50	20.6
63	21.8
80	20.7
100	**29.0**
125	**40.1**
160	**47.0**
200	**51.3**
250	**55.3**
315	**58.3**
400	**58.2**
500	**60.3**
630	**63.2**
800	**65.6**
1000	**67.3**
1250	**70.3**
1600	**73.2**
2000	**76.2**
2500	**79.6**
3150	**80.0**
4000	76.7
5000	78.8

Notes:1. #N/A = Value not available.
2. **Bold** values are used to calculate STC and R_w.
3. Words in ***Blue Italic*** in the description are manufacturers brand names.



Rating according to ISO 717-1 R_w (C;C_{tr}) = 62 (-5 ; -14) dB

$C_{50\text{-}3150}$ = -12 dB $C_{tr,\ 50\text{-}3150}$ = -23 dB
$C_{50\text{-}5000}$ = -11 dB $C_{tr,\ 50\text{-}5000}$ = -23 dB
$C_{100\text{-}5000}$ = -4 dB $C_{tr,100\text{-}5000}$ = -14 dB

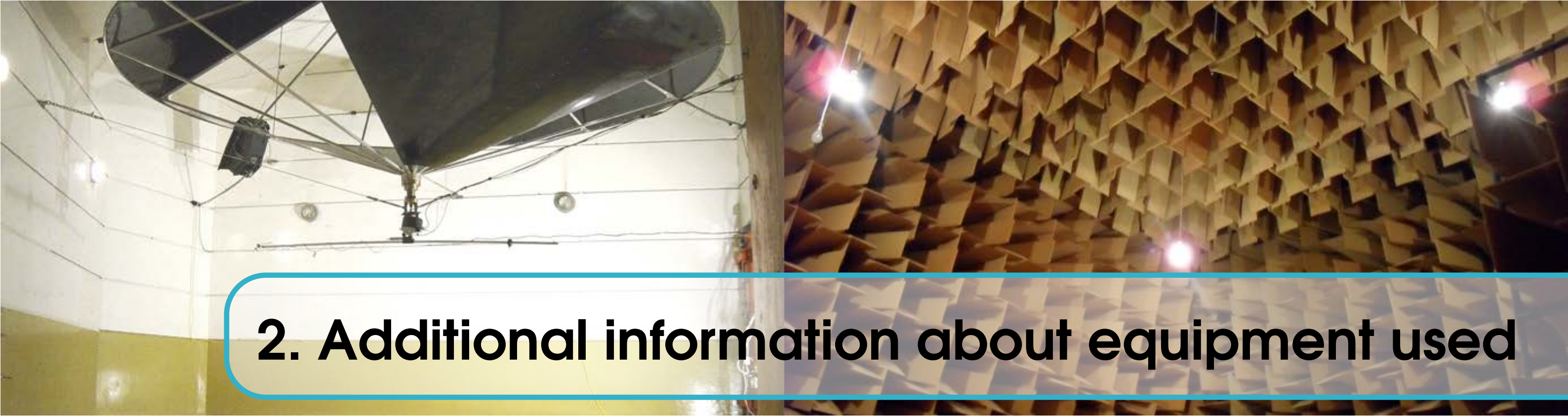
Rating according to ASTM E413 -87

Sound Transmission Class = 64 dB

No. of test report: **T1830-2**

Name of test institute: University of Auckland Acoustics Testing Service.

Signature: Date: 25/09/2018



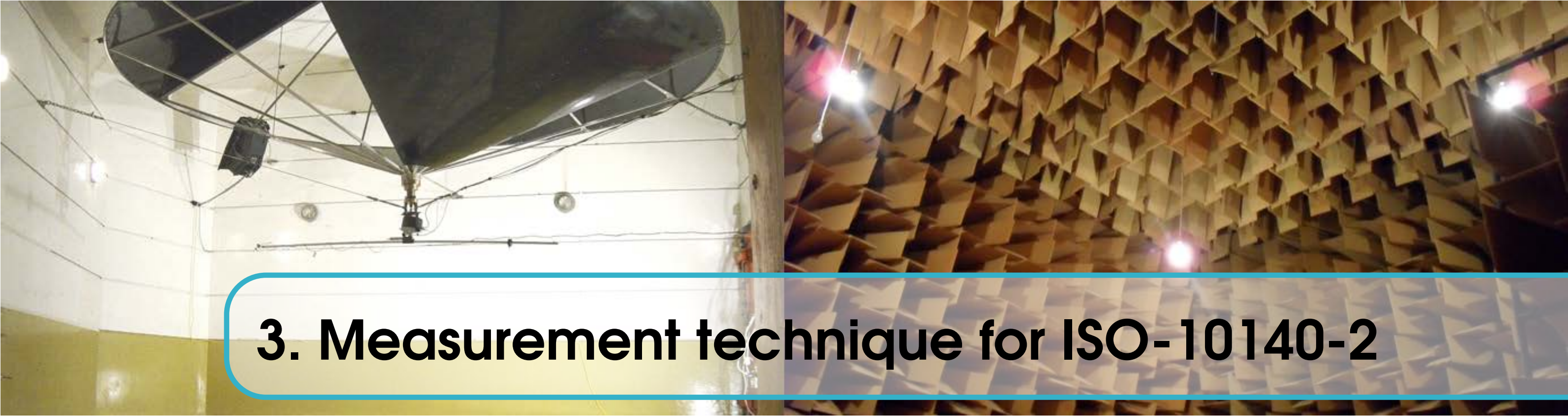
2. Additional information about equipment used

BRÜEL & KJÆR		
EQUIPMENT	TYPE	SERIAL No.
1/2" Microphone	4190	2150379
1/2" Microphone	4165	1622303
Preamplifier	2619	945952
Preamplifier	2660	1055704
Calibrator	4231	2241899
Analyzer	3160	106456

GRAS		
EQUIPMENT	TYPE	SERIAL No.
1/2" Microphone	46AE	259995
1/2" Microphone	46AE	259988
1/2" Microphone	46AE	259987
1/2" Microphone	46AE	319878

LOOK LINE		
EQUIPMENT	TYPE	SERIAL No.
Tapping Machine	EM50	F3.090142

Calibration of the above equipment was conducted by Electroacoustic Calibration Services (ECS), an IANZ registered laboratory.



3. Measurement technique for ISO-10140-2

3.1 Installation of sample

The wall under test is installed in the opening between two reverberation chambers – chambers C and A for a wall, chambers A and B for a floor. These chambers are vibration isolated from each other which results in a structural discontinuity at the middle of the test opening. This gap is covered over by a collar, which seals the gap and provides for ease of fixing of samples. The wall sample is constructed by the client following the techniques normally used in practice for that type of wall or floor/ceiling, and is sealed into the test opening with perimeter seals of acoustic sealant. For ease of removal, the surfaces of the test opening are covered with an adhesive, heavy fabric tape prior to the construction of the building element.

3.2 Method

The measured transmission loss values are obtained in accordance with the recommendations of ISO standard 10140-2:2010(E) "Laboratory measurement of sound insulation of building elements- Part 2: Measurement of airborne sound insulation"

Essentially the transmission loss of a building element is measured by generating sound on one side of the building element (the source chamber) and measuring how much sound is transmitted into the receiving chamber. In the source chamber pink noise is radiated from a loudspeaker. Time and space averaged sound pressure levels in both the source and receiving chambers are measured by using a rotating boom microphone, and the average sound pressure levels are obtained by sampling the sound pressure levels as the boom rotates through one cycle (taking 64 seconds). This is repeated for a different loudspeaker position in the source chamber.

Measurements of the background noise levels in the receiving chamber are also made. Then, should it prove necessary, the transmitted noise levels are corrected for the influence of background noise as prescribed in the standard. The sound absorption of the receiving chamber is also determined by measuring the reverberation times (ISO-354:2003(E) "Measurement of Sound Absorption in a Reverberation Room").

3.3 Presentation of results

The third octave band sound reduction indices R are presented in both table and graph formats. Sometimes a highly reflective test sample means that the lower frequency sound pressure levels cannot be reliably measured; this is indicated by # N/A in the table of results. Additionally, if the specimen is highly insulating, sometimes the background noise affects the measurements, resulting in only an upper threshold being found; this is indicated by a > sign preceding the tabulated results.

Single figure ratings are also presented. The weighted sound reduction index Rw, determined according to ISO 717-1, is presented along with spectrum adaptation terms C_{tr} and C. Rw is determined by fitting a reference curve to the third octave band sound reduction indices R from 100Hz to 3150Hz, and gives a single figure rating of the sound reduction through the building element (higher is better). The spectrum adaptation terms are added to Rw and are used to take into account the characteristics of particular sound spectra. C is used for living activity noise, children playing, railway traffic at medium and high speed, highway (>80km/h) road traffic, and jet aircraft at short distances. C_{tr} is used for lower frequency noise such as urban road traffic, low speed railway traffic, aircraft at large distances, pop music, and factories which emit low to medium frequency noise. C and C_{tr} without further subscripts are applied to a frequency range of 100Hz to 3150Hz. Other spectrum adaptation terms are provided with enlarged frequency ranges (if measured), e.g. $C_{tr,50-5000}$ is applied to urban traffic noise with a frequency range of 50Hz to 5000Hz. For light timber constructions Ctr will be negative, indicating the poor sound insulation abilities of such constructions at low frequencies.

The sound transmission class (STC) determined according ASTM E413 is also presented. This is determined by fitting a reference curve to the third octave band sound reduction indices R from 125Hz to 4000Hz, but in a slightly different way to ISO 717-2. The sound transmission class gives a single figure rating of the sound reduction through the building element so that higher is better.

4. Acoustics Research Centre Facilities

There are three large interconnected reverberation chambers at the Acoustics Research Centre, two at ground level (Chambers C and A) and the third (Chamber B) below A.

All three reverberation chambers may be described as hexagonal prisms; each having 6 vertical sided walls, perpendicular to the floor. The roofs of chamber A and C are plane, but inclined at 12 degrees from horizontal. Chamber B has a plane, horizontal roof which is the floor of chamber A above it. The floor of chamber B is also horizontal, but has two angled sections at its north west and south east ends. The centre section is horizontal because a floor jack is installed there. The floor jack may be raised hydraulically to the ceiling of chamber B, the centre of which consists of a floor plug between the two chambers. This plug may be disconnected from chamber A and lowered down into chamber B, leaving a 3.2m x 3.2 m opening between the two chambers. This allows for the measurement of airborne and impact insulation of floor and roof elements.

The wall of chamber C adjacent to chamber A is left open, and the corresponding wall of chamber A consists of a pair of iron doors that are clamped against the chamber. The clamps may be removed and the iron doors pulled back, leaving the entire wall area (4.6m wide x 2.74m high) between the chambers open. This allows for the measurement of airborne sound insulation of wall elements. The gaps between chamber C and the wall of chamber A are covered with MDF boards when testing is carried out in chamber C.

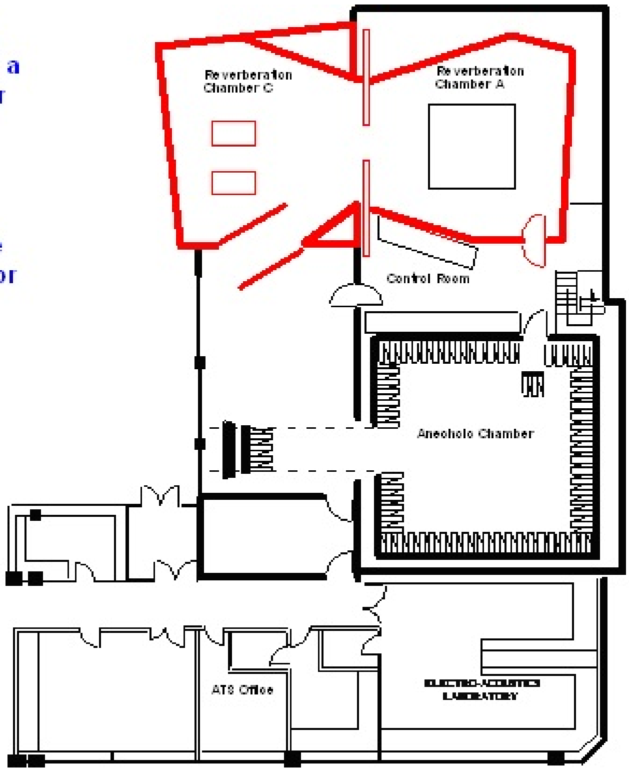
Chamber A has a rotating vane diffuser in a central position with an area (both sides) of about 53 m2. It has the shape of two cones with their bases joined, with the two opposite quadrants of one cone open and the complementary quadrants in the other cone open. Chamber C has a similar rotating vane diffuser but it is smaller, having a total area of about 27 m2.

In addition, up to ten static diffusers may be employed if needed. These are constructed of two laminated layers of dense Formica, of dimensions 2m x 2m. The Formica elements are riveted to a frame constructed of aluminium T section. Four aluminium arms may be bolted onto the frame to allow the diffusers to be mounted as desired. Currently four of these are used in chamber C, and three are used in chamber B.

The volumes and surface areas of the reverberation chambers are as follows:

Acoustics Testing Service Chambers		
	VOLUME (m^3)	SURFACE AREA (m^2)
Chamber A	202 ± 3	203.6 ± 0.9
Chamber B	153 ± 2	173 ± 1
Chamber C	209 ± 4	214 ± 0.9

The three Reverberation Chambers are linked by heavy steel doors and a removable Standard Industrial Floor Section which is removed and repositioned by a hydraulic hoist. The three chambers are vibration isolated from one another so that sound can only pass from one to the other via the intervening Test Wall or Test Floor/Ceiling Section.



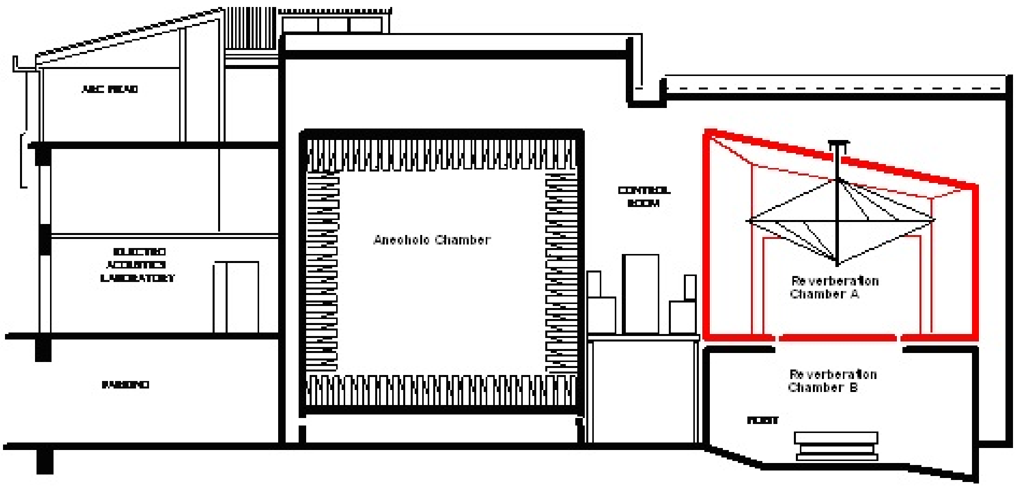


Figure 4.1: Acoutic Testing Service, The red lines show chambers used in measurements