Waipapa Taumata Rau University of Auckland | ENGINEERING AND DESIGN

LABORATORY MEASUREMENT OF THE REDUCTION OF TRANSMITTED IMPACT SOUND OF A FLOOR COVERING

Test Report ID. T2605-1:

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Checked by- Dr Andrew Hall

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Acoustics Testing Service

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LABORATORY MEASUREMENT OF THE REDUCTION OF TRANSMITTED IMPACT SOUND BY FLOOR COVERINGS ON A STANDARD FLOOR

Report prepared for:

Belgotex NZ Limited
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Riccarton, Christchurch 8011

Report prepared by:

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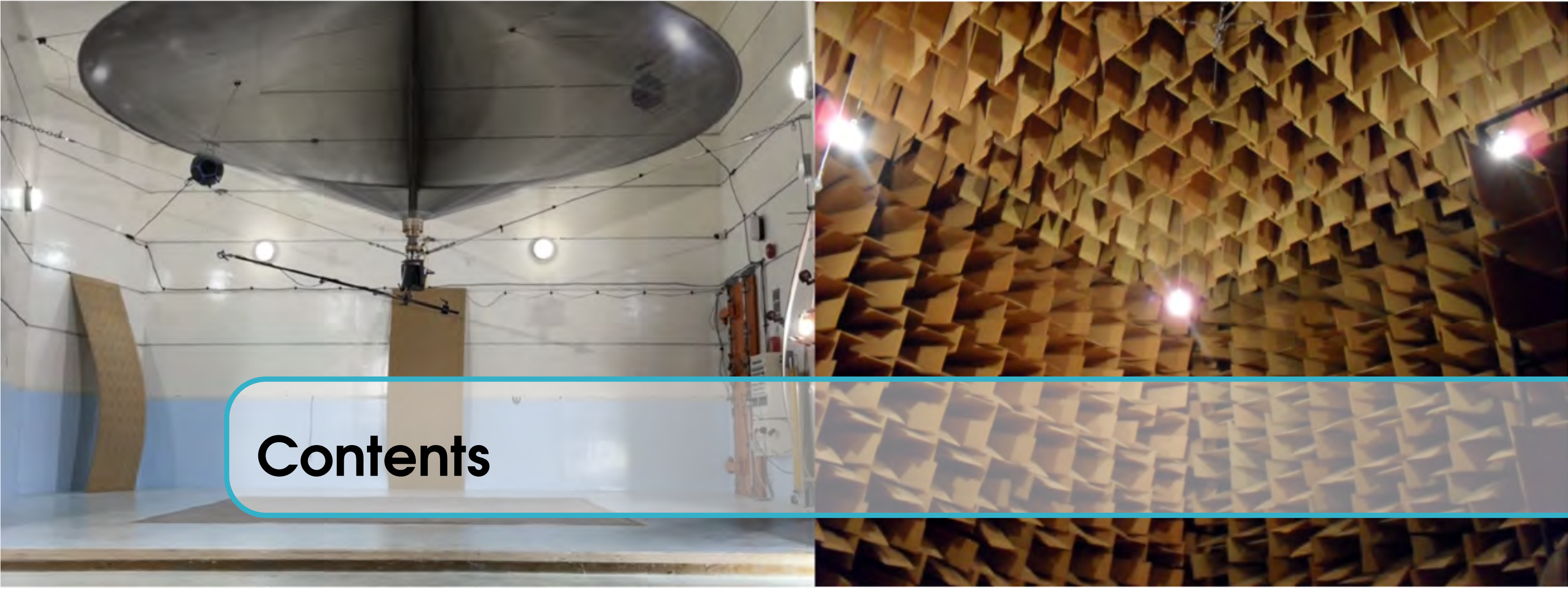


Contents

Reduction of impact sound pressure level according to ISO 10140-3

Laboratory measurements of the reduction of transmitted impact sound by floor coverings on a heavyweight reference floor

Client: *Belgotex NZ Ltd.*

Date of test: 4 March 2026

Test rooms: Reverberation Chambers A and B

Description and identification of the test specimen and test arrangement:

Flooring covering comprising:

Sample: *Finsa 8mm* Laminate flooring (standard plank size: 1.331 m(L) x 0.194 m(W) x 0.012 m thickness) planks assembled together and cut to cover the reference floor slab. Laminate flooring loose laid on 2.5 mm *Belgotex Aqua Elite* floating floor underlay butted together and adhered to each other with proprietary taping system. *Belgotex Aqua Elite* loose laid on concrete reference floor

Note: see photos in full test report for sample installation and layout details

Source chamber: Chamber A, receiving chamber: Chamber B . Test specimen curing times: N/A

Deviation from standard: The bare test floor used is of uniform thickness for an area of 2.6m x 2.6m. The description of bare test floor given in the full report. Wording in the description in *Blue Italics* indicate company product brand names.

Test Data Files: Bare Floor Data:T2605-Bare_Slab.pls (pos 1-6) Sample Data:T2605-All_Samples.pls\T2605-1 (pos 1-6)

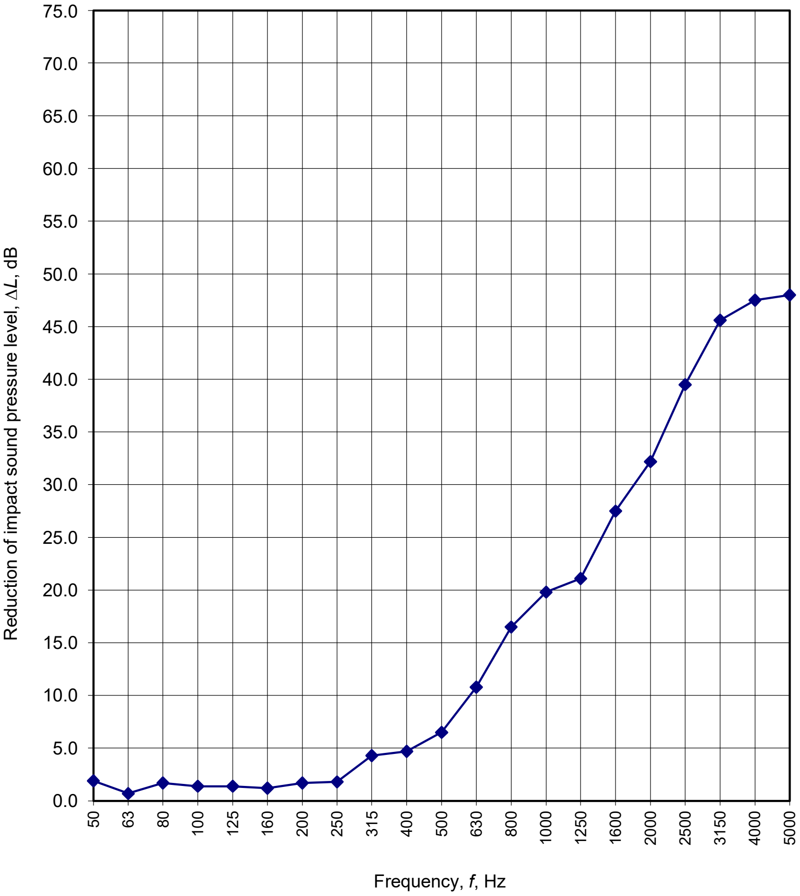
Mass of floor covering: 7.1 kg/m^2

Air temp in the test rooms: 23.9 ^oC

Air humidity in test rooms: 55 %

Receiving room volume: 153 m^3

Frequency f Hz	$L_{n,0}$ One-third octave dB	ΔL One-third octave dB
50	55.9	1.9
63	50.1	0.7
80	58.8	1.7
100	**63.9**	**1.4**
125	**66.1**	**1.4**
160	**66.8**	**1.2**
200	**68.5**	**1.7**
250	**70.2**	**1.8**
315	**72.6**	**4.3**
400	**70.3**	**4.7**
500	**74.4**	**6.5**
630	**72.6**	**10.8**
800	**71.3**	**16.5**
1000	**71.3**	**19.8**
1250	**72.2**	**21.1**
1600	**72.1**	**27.5**
2000	**72.9**	**32.2**
2500	**72.9**	**39.5**
3150	**72.6**	**45.6**
4000	70.8	47.5
5000	67.3	48.0



Notes: #N/A = Value not available. **Bold** values are used to calculate ΔL_w.

< indicates that the true value is lower.

$L_{n,0}$ are the bare floor impact sound levels.

Rating according to ISO 717-2:

ΔL_w = 17 dB $C_{I,\Delta}$ = 10 dB $C_{I,r}$ = -1 dB $C_{I,50-2500}$ = -1 dB

These results are based on a test made with an artificial source under laboratory conditions (engineering Method) with the specified reference floor.

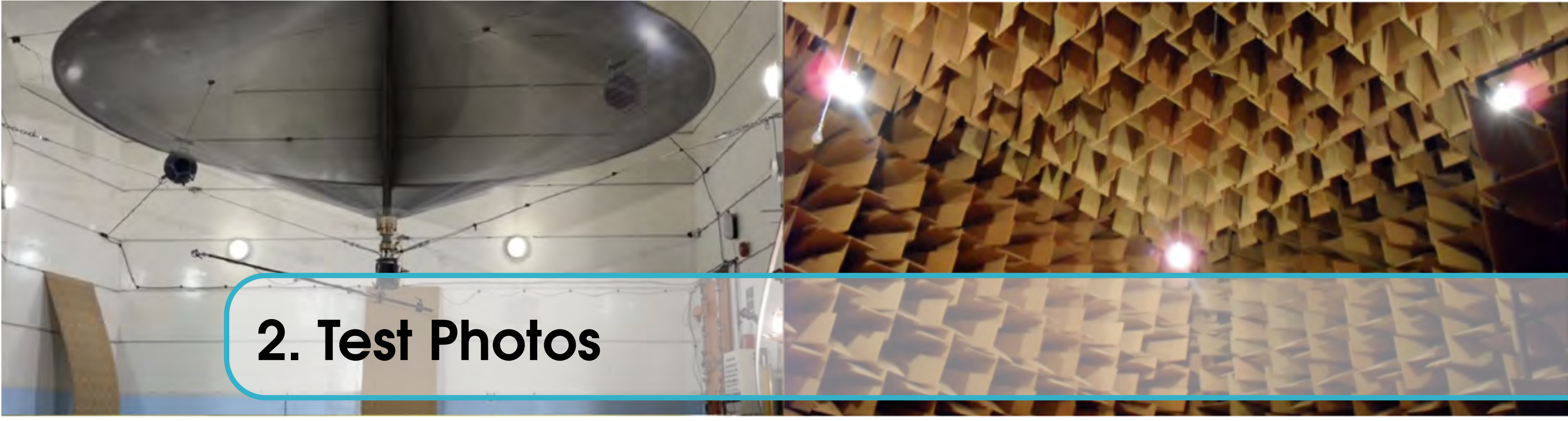
No. of test report: **T2605-1**

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

Date: 05-March-2026

Signature:

Acoustics Testing Service



2. Test Photos

Figure 2.1: *Belgotex Aqua Elite* underlay showing self adhesive tape system

Figure 2.2: *Finsa 8mm* finished floor system under test

Figure 2.3: Flooring and underlay section detail

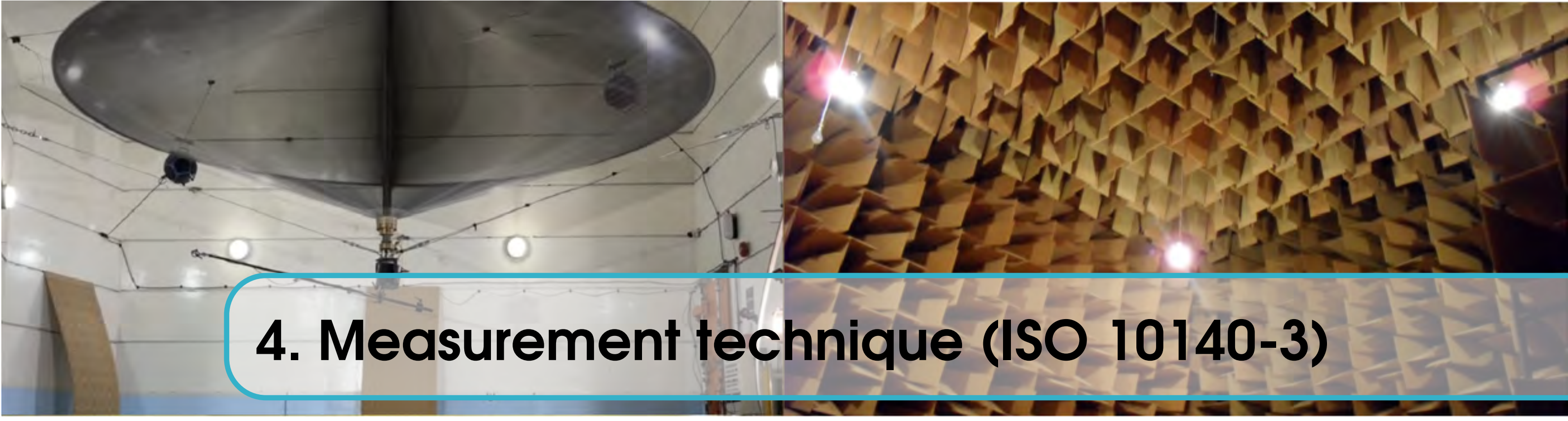
3. Additional information about equipment used

BRÜEL & KJÆR		
EQUIPMENT	TYPE	SERIAL No.
Calibrator	4231	2241899
Analyzer	3160	106456

G.R.A.S.		
EQUIPMENT	TYPE	SERIAL No.
1/2" Microphone	46AE	319875
1/2" Microphone	46AE	319877
1/2" Microphone	46AE	319878
1/2" Microphone	47HC	348370

NORSONIC		
EQUIPMENT	TYPE	SERIAL No.
Tapping Machine	Nor277	2776451
Rotating Boom	Nor265	29457
Rotating Boom	Nor265	29514

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



4. Measurement technique (ISO 10140-3)

4.1 Installation of sample

The floor covering is installed on a concrete floor plug that is positioned in the opening between two large reverberation chambers – chambers A and B. These chambers are vibration isolated from each other, which results in a structural discontinuity at the middle of the test opening. The concrete floor plug is made of concrete reinforced with steel and is covered with a layer of hard resin. The dimensions of the floor plug are given in the following elevation diagram. If the floor covering is flexible, a minium of three samples to be tested are laid by the client following the techniques normally used in practice for that type of floor covering, with the constraint that the concrete floor plug be protected by a layer of thin self adhesive plastic tape if necessary.

4.2 Method

The normalized impact sound pressure levels are obtained in accordance with the recommendations of ISO standard 10140-3 "Measurements of impact sound insulation." The NOR277 tapping machine is placed sequentially in four different positions on the floor. The impact sound pressure level is measured in the room below the floor, using a rotating microphone, in third octave frequency bands. The impact sound pressure levels are normalized against the room absorption. The room absorption is calculated from the reverberation time and room volume. The reverberation time is measured from the decay of a steady state sound field and tested according to ISO 354. Corrections are applied, where necessary, for airborne sound transmission and background noise. The airborne sound transmission is determined using a loudspeaker and the microphone.

4.3 Presentation of results

The third octave band normalized impact sound pressure levels L_n are presented in both table and graph formats. Sometimes a highly reflective test sample means that the lower frequency normalized impact sound pressure levels cannot be reliably measured; this is indicated by # N/A in

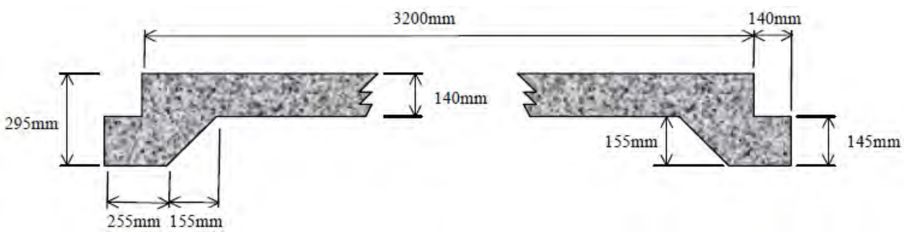


Figure 4.1: Floor/ceiling system

the table of results. Additionally, sometimes the airborne transmission of sound through the floor or loud 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 normalized impact sound pressure level $L_{n,w}$, determined according to ISO 717-2, is presented along with a spectrum adaptation term C_l . $L_{n,w}$ is determined by fitting a reference curve to the third octave band normalized impact sound pressure levels Ln from 100Hz to 3150Hz, and gives a single figure determination of the sound levels which are transmitted through the floor from impacts (higher is worse). The spectrum adaptation term C_l is used to suggest the presence of high level peaks in the results over the frequency range 100Hz to 2500Hz, and may be added to Ln,w . For massive floors with effective coverings C_l will be about zero, for light timber floors C_l will be slightly positive, and for concrete floors with less effective covering C_l will range from –15 dB to 0dB. Another spectrum adaptation term $C_{l,50-2500}$, which covers the frequency range from 50Hz to 2500Hz, may also be presented if the low frequency levels are available. The impact insulation class (IIC) determined according ASTM E989 is also presented. This is determined by fitting a reference curve to the third octave band normalized impact sound pressure levels L_n from 100Hz to 3150Hz, but in a slightly different way to ISO 717-2. The impact insulation class measures the insulating abilities of the floor so that higher is better (contrary to $L_{n,w}$).

5. Acoustics & Vibration Research Centre Facilities

There are three large interconnected reverberation chambers at the Acoustics & Vibration Research Centre (AVRC), 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 3.2m 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 m^2. 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 m^2.

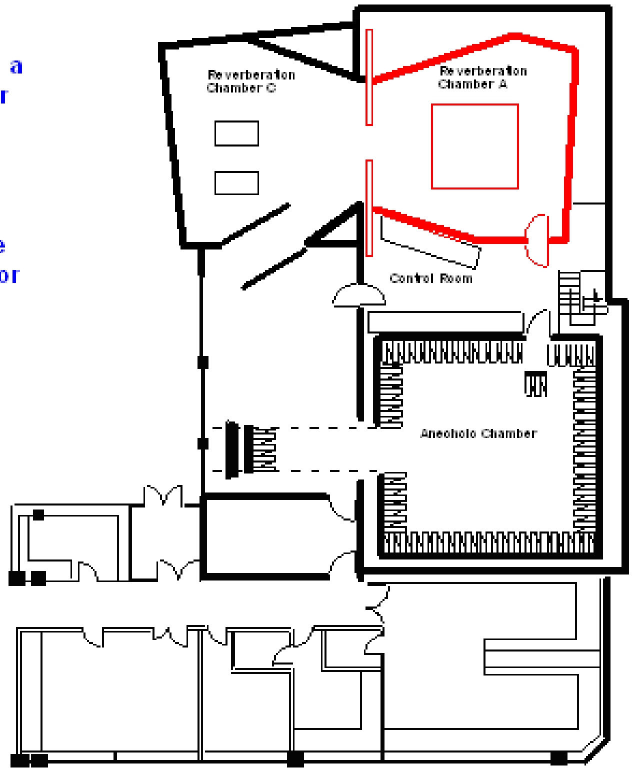
In addition, up to ten static diffusers may be employed if needed. These are constructed of two laminated layers of dense Formica, of dimensions 2m x 2m. The Formica elements are riveted to a frame constructed of aluminium T section. Four aluminium arms may be bolted onto the frame to allow the diffusers 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	203 ± 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.



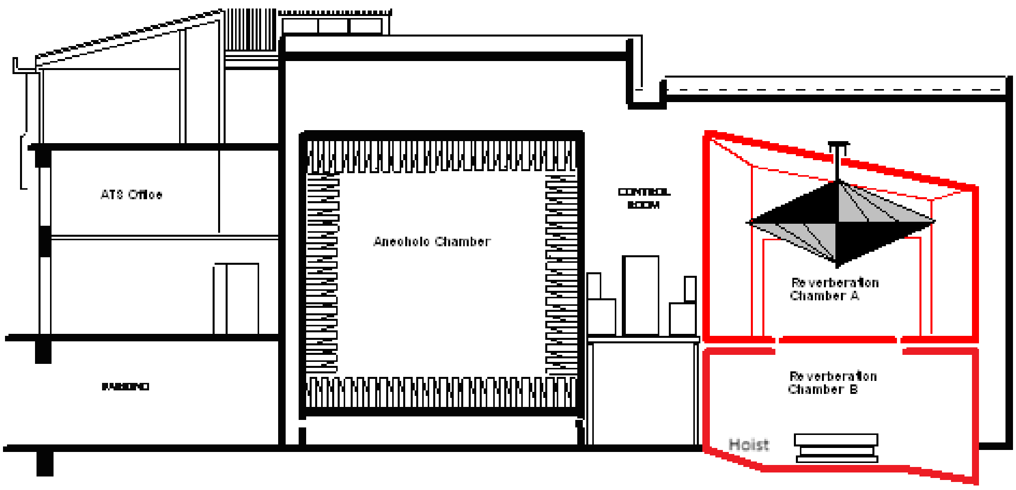


Figure 5.1: Acoustics Testing Service, The red lines show chambers used in measurements