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LABORATORY MEASUREMENT OF THE SOUND ABORPTION COEFFICIENT OF WALL TILES

Test ID: T1842-2

Report prepared by:
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Dr Andrew Hall

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Acoustics
Testing Service

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MEASUREMENT OF SOUND ABSORPTION IN A REVERBERATION ROOM

Report prepared for:

CSR Martini Pty Ltd
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Ingleburn Sydney 1890, Australia

Report prepared by:

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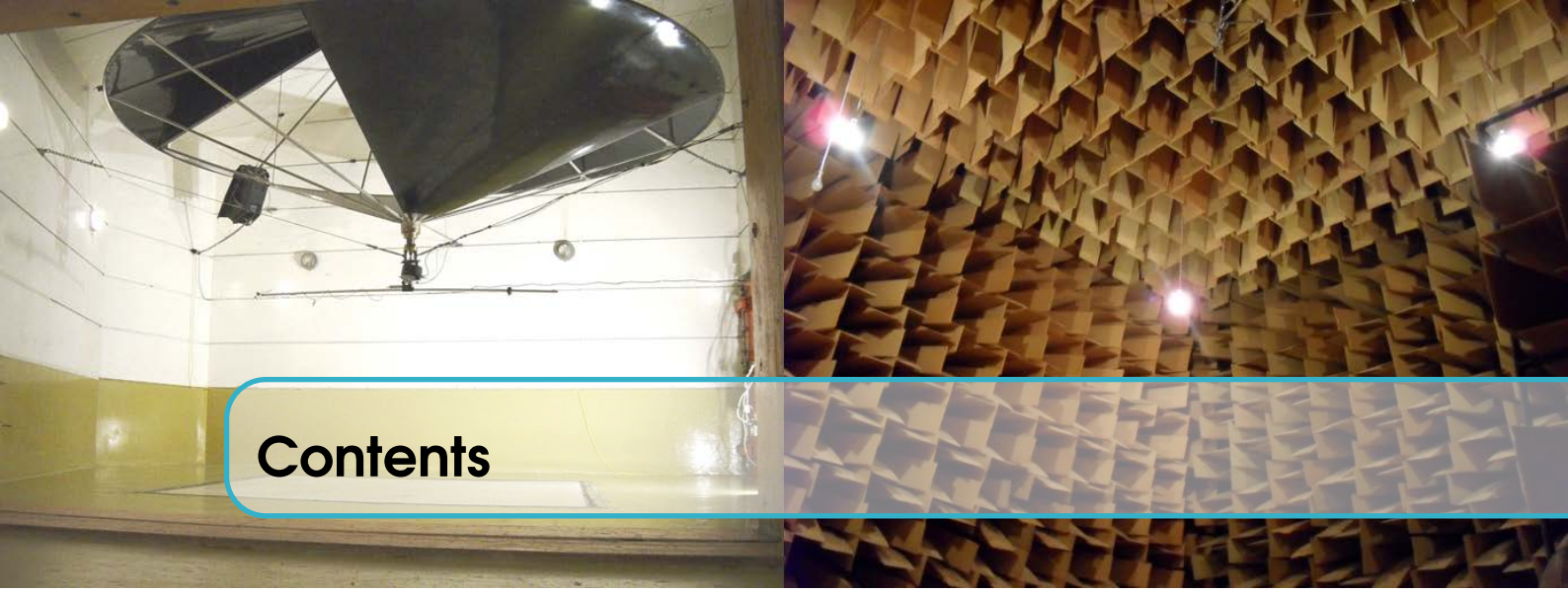
Acoustics Testing Service



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1. Test Report

1.1 Photos of test specimen

Figure 1.1: Test sample on chamber floor

Figure 1.2: Sample detail

Sound absorption coefficients according to ISO 354
Measurement of sound absorption in a reverberation room

Client: CSR Martini Pty Ltd

Date of test: 5-Dec-18
Test room: Chamber A

Description of the test specimen:

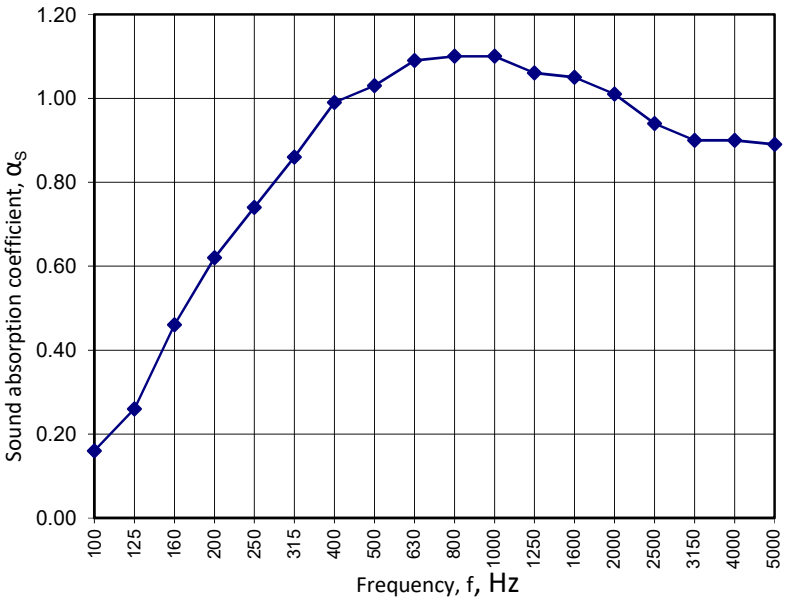
Sample brand name: dECO 3D tile MEC1
Sample: 500 mm x 500 mm x 50mm, 5 mm thick nominally,
2 layers of polyester infill placed inside tiles, 450 mm x 450 mm x 20 mm nominall
Dimensions: 24 tiles in 7 tile by 6 tile configuration
Placement: Placed on chamber floor, arranged and connected using acoustic tile clips provide
Perimeter enclosure: N/A

The shape of the reverberation chamber and its diffusion treatment are described in the Annexes of the full test report.
Associated computer fil RT-Empty: T1842 Empty Chamber.pls ID.64 RT-Sample: T1842 Sample.pls ID.63

Area of test specimen: 10.50 m^2
Air temp in the test roor 21 °C
Air humidity in test roon 69 %

Number of sound source positions: 2
Number of microphone positions per sound source position: 12
Type of noise used: Pink random noise.
Type of mounting used: Type: A

Frequency f (Hz)	T_1 - Empty Chamber (seconds)	T_2 - With Sample (seconds)	α_S One-third octave
100	**7.80**	**5.51**	**0.16**
125	**6.86**	**4.37**	**0.26**
160	**7.56**	**3.57**	**0.46**
200	**8.41**	**3.15**	**0.62**
250	**7.92**	**2.74**	**0.74**
315	**8.24**	**2.51**	**0.86**
400	**8.20**	**2.27**	**0.99**
500	**8.02**	**2.18**	**1.03**
630	**7.59**	**2.07**	**1.09**
800	**7.18**	**2.02**	**1.10**
1000	**6.37**	**1.95**	**1.10**
1250	**5.70**	**1.94**	**1.06**
1600	**5.16**	**1.88**	**1.05**
2000	**4.43**	**1.81**	**1.01**
2500	**3.78**	**1.76**	**0.94**
3150	**3.43**	**1.71**	**0.90**
4000	**2.99**	**1.60**	**0.90**
5000	**2.47**	**1.44**	**0.89**



Ratings according to ISO 11654

Weighted sound absorption coefficient:

α_W = 1

Sound absorption class: A

Practical sound absorption coefficients

Frequency (Hz)	α_P
125	**0.30**
250	**0.75**
500	**1.00**
1000	**1.00**
2000	**1.00**
4000	**0.90**

Rating according to ASTM C423 - 99

Noise Reduction Coefficient = 0.95 **Sound Absorption Average = 0.97**

Evaluation based on laboratory measurement results obtained by an engineering method.

No. of test report: T1842-2
Date: 10 December 2018

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

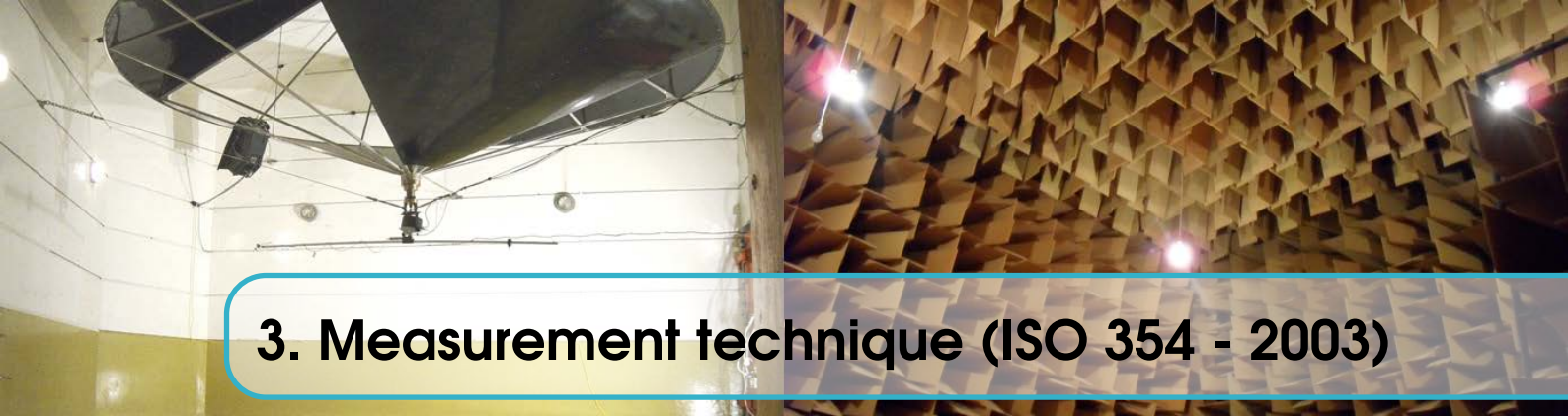
Acoustics Testing Service

2. Additional information about equipment used

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

GRAS		
EQUIPMENT	TYPE	SERIAL No.
1/2" Microphone	46AE	259988
1/2" Microphone	46AE	259987
1/2" Microphone	46AE	319877
1/2" Microphone	46AE	319879

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



3. Measurement technique (ISO 354 - 2003)

3.1 Method

The reverberation times in the empty reverberation chamber are usually measured first. The test sample is then arranged in the reverberation chamber. For planar samples and arrays of objects such as seating systems, the sample is enclosed by a surround the same height as the sample. The microphone system consists of a B&K 4190 microphone and 3 G.R.A.S 46AE microphones on stands positioned within the space and moved accordingly to subsequent positions so as to not come within 1 m of any room surface or diffuser, or within 2 m. of the sound source.

The instrumentation system consists of a Bruel & Kjaer Pulse multi channel analyzer. The reverberation times are measured according to the procedures outlined in ISO 354. The microphones are stationary during each noise burst and measurement The bare chamber absorption is checked to ensure it is within the limits specified in ISO 354, and any deviation noted. The absorption coefficients are then calculated.

3.2 Presentation of results

The results may be presented in one of two ways: in terms of an absorption coefficient (the absorption per unit area), or in terms of equivalent absorption area (the perfectly absorbing area which gives the same sound absorption). An absorption coefficient is used for planar objects and may be used for arrays of objects; an equivalent absorption area is used for discrete non-planar objects and possibly for arrays of objects. In both cases the results are presented in table and graph form.

For the absorption coefficient some single figure ratings are also presented. The Noise Reduction Coefficient is the average of the absorption coefficients at 250, 500, 1000, and 2000Hz frequencies rounded to the nearest 0.05. The Weighted Sound Absorption Coefficient is determined from the fitting of a reference curve of absorption to the octave band absorption coefficients (the so called practical sound absorption coefficients α_W, which are rounded to the nearest 0.05 and are limited to a maximum of 1.00). This reference curve is shown in Graph 1 for the lower limiting values of the four classes of absorbers. From a sound absorption class is determined. There are five classes from E to A, A being most absorbent (see 3.1). If α_W is less than 0.10 then the sample is deemed to be not classifiable. If the absorption of the sample differs greatly from the reference curve then this is indicated by the shape indicators, L, M, or H in parenthesis following the α_W rating: L indicating significant low frequency deviation, M significant medium frequency deviation, and H significant high frequency deviation. When one or more of the shape indicators are presented one is advised to consider the whole absorption curve and not to rely on a single figure rating.

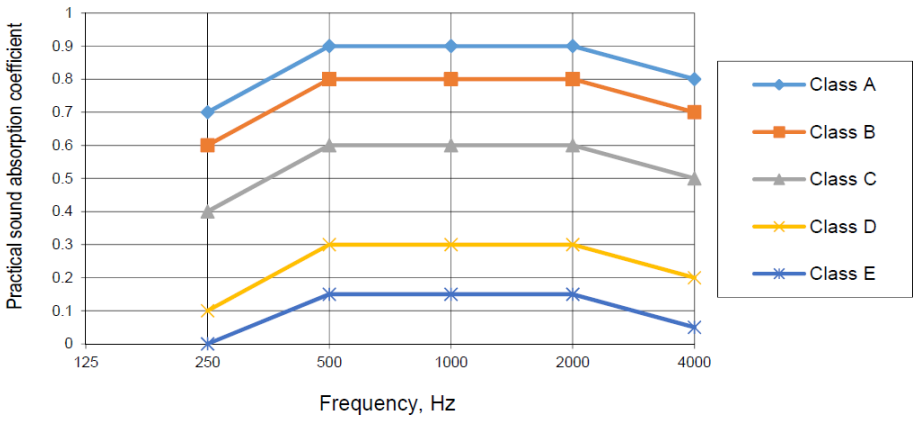


Figure 3.1: The reference curves limiting the different sound absorption classes.

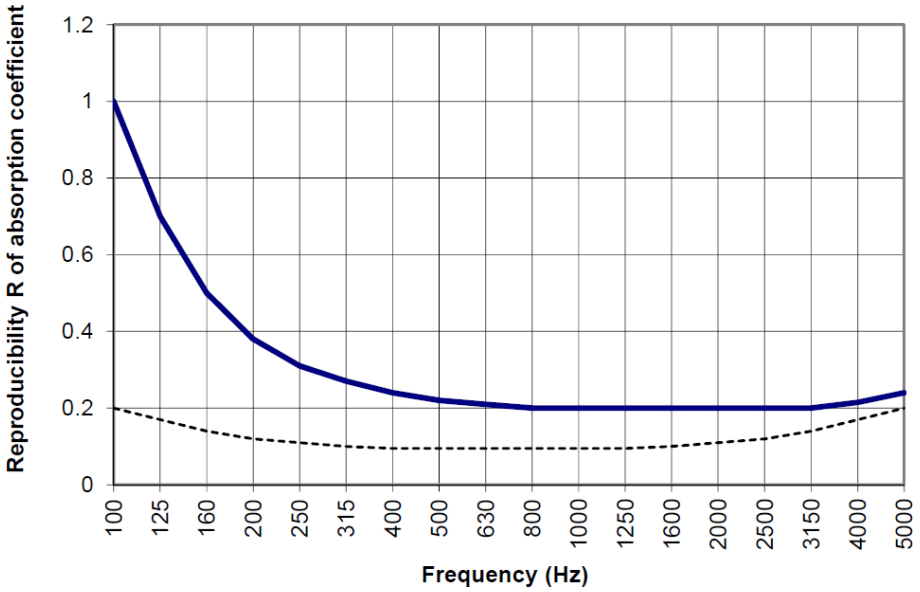


Figure 3.2: Assessment of absorption coefficient reproducibility R from ISO 354-2003(E) – for absorbers with high absorption coefficients (α_W 1.00) in all bands (continuous line) and for absorbers with low absorption coefficients (α_W=0.05) in all bands (dashed line).

3.3 Test reproducibility

3.2 shows an assessment of the reproducibility of the results of a test performed as specified in ISO 354-2003(E). The reproducibility is the value below which the absolute difference between two single test results obtained using the same method on the same test material under different conditions (different operator and apparatus) may be expected to lie within, with a probability of 95%.

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 repositionde 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.

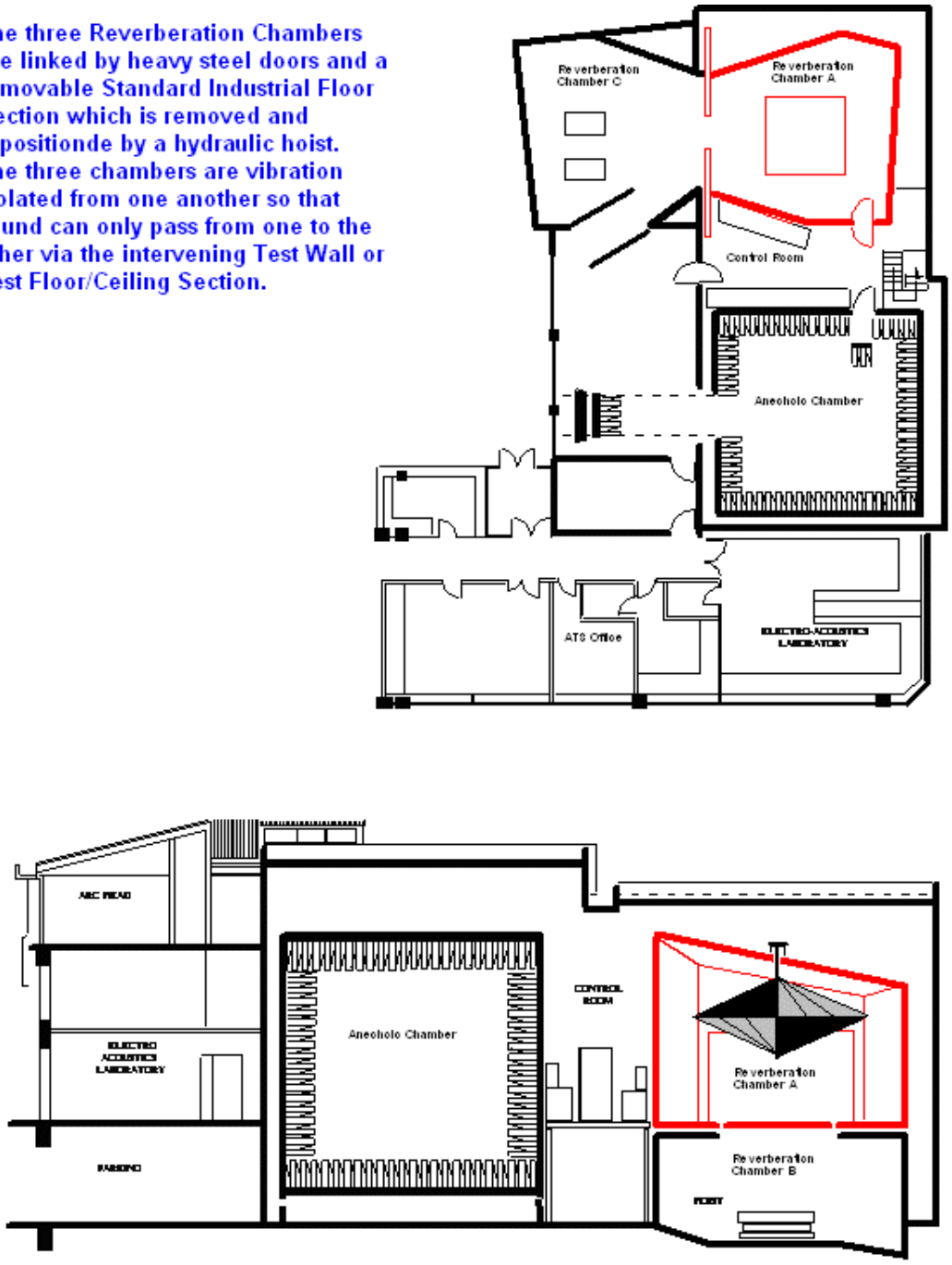


Figure 4.1: Acoutic Testing Service, The red lines show chambers used in measurements