Acoustics
Testing Service

uniservices

LABORATORY MEASUREMENT OF SOUND ABSORPTION COEFFICIENT OF A POD PANEL
According to ISO 354

AUCKLAND UNISERVICES LIMITED
a wholly owned company of
THE UNIVERSITY OF AUCKLAND

Report prepared for:

PLN Group.
21 Honan Place
Avondale
Auckland 1026
Date: 27th July 2016

Report prepared by:

Mr Gian Schmid
Dr Michael Kingan

Acoustics Testing Service

uniservices

Acoustics
Testing Service

SOUND ABSORPTION COEFFICIENT OF A POD PANEL

(According to ISO 354)

Prepared For: PLN Group
21 Honan Place
Avondale
Auckland 1026

Prepared by: Acoustics Testing Services
Department of Mechanical Engineering
The University of Auckland

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

Report prepared by: Mr Gian Schmid

Report checked by: Dr Michael Kingan

Acoustics
Testing Service

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

Client: PLN Group

Date of test: 21-Jun-16
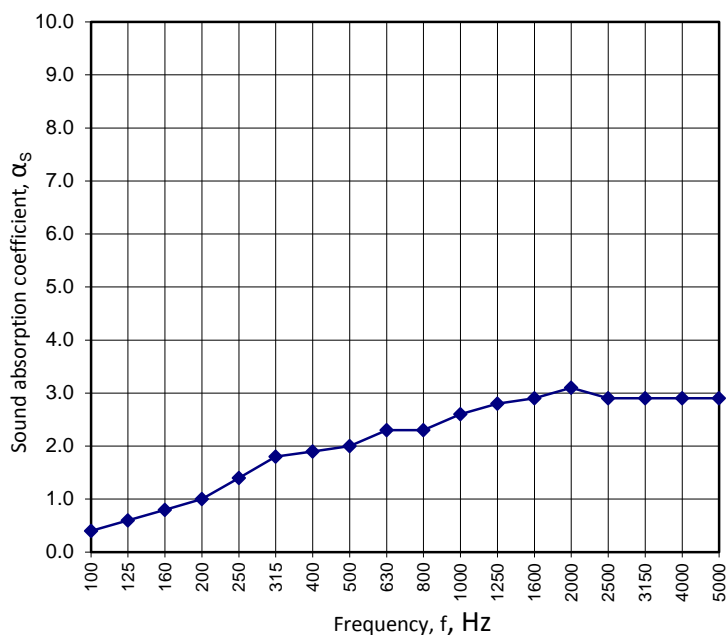Test room: Chamber A

Description of the test specimen:

A single *Keystone* pod panel with phonix tested at three different positions around the reverberation chamber.

The shape of the reverberation chamber and its diffusion treatment are described in the Annexes of the full test report.
Associated computer files: RT-Empty: T1630 ID.78   RT-Sample: CMG4 ID.222

Number of sound source positions: 2

Area of test specimen: N/A m^2

Number of microphone positions per sound source position: 8

Air temp in the test room: 18.00 ^{o}C

Type of noise used: Pink random noise.

Air humidity in test room: 65.00 %

Type of mounting used: Type A

Frequency f (Hz)	T_1 - Empty Chamber (seconds)	T_2 - With Sample (seconds)	□ Third octave (m2)
100	8.19	7.41	0.40
125	6.90	6.11	0.60
160	7.82	6.54	0.80
200	8.66	6.85	1.00
250	8.77	6.40	1.40
315	8.91	5.99	1.80
400	8.50	5.67	1.90
500	8.42	5.51	2.00
630	8.20	5.20	2.30
800	7.76	4.99	2.30
1000	7.12	4.53	2.60
1250	6.42	4.14	2.80
1600	5.68	3.78	2.90
2000	4.82	3.31	3.10
2500	4.02	2.96	2.90
3150	3.56	2.70	2.90
4000	3.02	2.39	2.90
5000	2.48	2.03	2.90

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

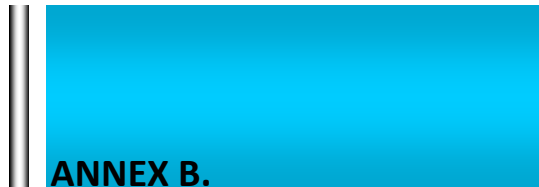No. of test report: T1630-4
Date: *Monday, 8 August 2016*

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

ANNEX A.
PHOTOGRAPHS OF TEST SPECIMEN .

Figure 1. Single panel with phonix in place for
testing

ANNEX B.

ADDITIONAL INFORMATION ABOUT EQUIPMENT USED.

Manufacturer	Equipment	Type / Serial No.
Brüel & Kjær	1/2" Microphone	4190 / 2150379
Brüel & Kjær	Preamplifier	2619 / 945952
Brüel & Kjær	Calibrator	4231 / 2241899
01dB	Analyser	Symphonie / 01381
Calibration of the above equipment was conducted by Electroacoustic Calibration Services (ECS), an IANZ registered laboratory.		
Brüel & Kjær	Rotating Boom	3923 / 936497

Acoustics
Testing Service

ANNEX C.

SUMMARY OF THE MEASUREMENT OF SOUND ABSORPTION IN A REVERBERATION ROOM. (ISO 354 - 2003)

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 Bruel & Kjaer 3923 boom microphone system and a B&K 4190 microphone. The radius of the boom is set at greater than 1.5 m., but not so great that it comes within 1 m. of any room surface or diffuser, or within 2 m. of the sound source.

The instrumentation system consists of a 01dB Stell Symphonie duel channel analyzer. The reverberation times are measured according to the procedures outlined in ISO 354. The boom is stationary during each noise burst and measurement, but is rotated while the signal analyzer is processing the previous result.

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.

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** α_w is determined from the fitting of a reference curve of absorption to the octave band absorption coefficients (the so called practical sound absorption coefficients, 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 four of the classes of absorbers. From α_w a sound absorption class is determined. There are five classes from E to A, A being most absorbent (see Graph 1). If αW 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 αW 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.

Graph 1: The reference curves limiting the different sound absorption classes

Acoustics
Testing Service
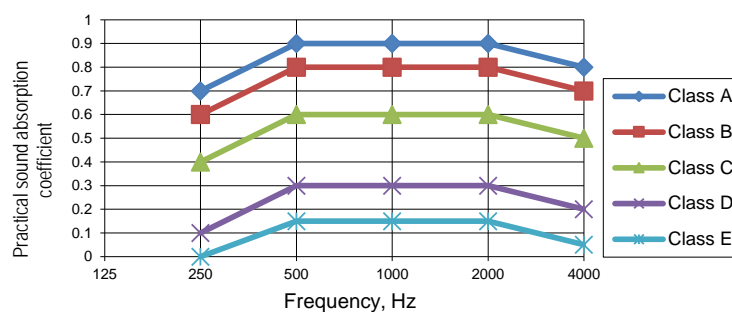
ANNEX D.

DESCRIPTION OF REVERBERATION CHAMBERS AT
THE ACOUSTICS RESEARCH CENTRE

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 have 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 center 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.

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.

	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

Acoustics
Testing Service

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.