CSIRO ACOUSTIC MEASUREMENT REPORT

Commonwealth Scientific and Industrial Research Organisation, Infrastructure Technologies
Acoustics Testing Laboratory, Research Way, Clayton, Vic 3168 Australia

Report No:
AC316-03-1

Client: Woven Image Pty. Ltd.
37-39 Chard Road, Brookvale, NSW 2100 Australia

Measurement Type: Sound Absorption

AS ISO 354–2006 [R2016]: *Acoustics–Measurement of sound absorption in a reverberation room*
AS ISO 11654–2002 [R2016] (ISO 11654:1997): *Acoustics–Rating of sound absorption–Materials and systems*

Test Specimen

[Specimen area: 3.646 x 3.010 m (10.974 m^2)]

Description: Woven Image 9 mm thick *'Embossed IV"* panels, laid on 18 mm thick *'Epsilon'* panels, laid directly on the concrete floor of the room.

Embossed IV and Epsilon Panel Details[3]

- Embossed IV composition: 9 mm thick 100% PET (51% recycled) composite panel of Mura™ face laminated to Epsilon and embellished with compressed surface pattern (pattern repeating at 25 mm intervals varying thickness from 7 mm to 9 mm – see lower image at right), compressed polyester fibre composition (non-woven), 5° backwards bevel straight cut edges on all four sides; Supplied for testing as panels of dimension 2800 mm (±2 mm) x 1130 mm (±2 mm) x 9 mm (±7%), Weight (meas.): 2570 g/m^2
- Epsilon Composition: 100% PET (50% recycled) panel, compressed polyester fibre composition (non-woven), Straight cut edge on all four sides; Supplied for testing as panels of dimension 3000 mm (±3 mm) x 1210 mm (±3 mm) x 18 mm (±7%), Weight (meas.): 2006 g/m^2

Installation

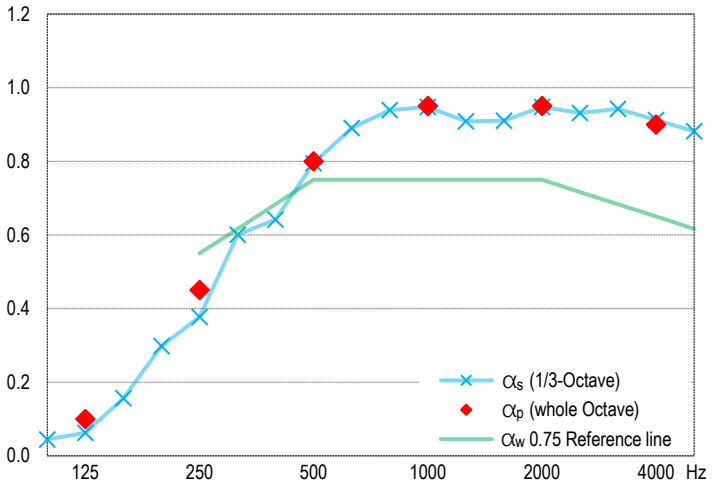
- The reverberation chamber was swept and vacuumed.
- The Epsilon panels were laid directly on the floor of the test chamber and consisted of 3 complete panels; the Embossed IV panels consisted of 3 complete panels and segments cut to cover the Epsilon panels completely with the installed test specimen forming a rectangle 3.646 x 3.010 m, at an angle of 10° from the nearest chamber wall (not parallel, as per AS ISO 354 cl 6.2.1.2).
- The perimeter edges of the test specimen were covered with a skirt of 1 mm thick folded steel angle, 30 mm high. Skirting members were pushed against the edges of the panels; pushing the panels against each other and minimising gaps at the skirt. Gaps between the skirting members and the surrounding chamber floor were sealed with tape.
- Specimen installation was carried out by laboratory staff.

Test specimen installed in laboratory for testing

Detail of patterned face and side of Embossed IV panel and side of the Epsilon panel.

Measurement Details & Results

Freq	Absorption coefficients			Reverberation times, T_{60} (sec)	
Hz	α_s	α_p	95% Conf	Empty room	with Specimen
100	0.04		0.04	5.10	4.74
125	0.06	0.10	0.03	5.82	5.19
160	0.16		0.04	6.51	4.84
200	0.30		0.05	6.03	3.75
250	0.38	0.45	0.06	4.67	2.93
315	0.60		0.06	5.90	2.68
400	0.64		0.07	5.79	2.56
500	0.79	0.80	0.04	5.40	2.20
630	0.89		0.05	5.20	2.03
800	0.94		0.04	4.94	1.92
1000	0.95	0.95	0.06	4.74	1.88
1250	0.91		0.05	4.30	1.85
1600	0.91		0.05	3.84	1.76
2000	0.95	0.95	0.04	3.54	1.66
2500	0.93		0.05	3.11	1.57
3150	0.94		0.04	2.81	1.48
4000	0.91	0.90	0.04	2.34	1.36
5000	0.88		0.04	1.91	1.22



Performance Indices[1,2]

α_w = 0.75 (H)
SAA = 0.77
NRC = 0.75
Sound Absorption Class = C

The required 12 spatially independent decay curves came from ensemble averaging 10 successive decays with each of 3 different source loudspeaker positions, all sampled by 4 fixed microphones, using linear averaging.

Measurement Conditions

	Empty room	with Test Specimen
Date of measurement:	8 Feb 2022	8 Feb 2022
Temperature & humidity:	24 °C, 45 % R.H.	23 °C, 47 % R.H.
Atmospheric pressure:	998 mBar	1004 mBar

Notes, Deviations etc

1. Shape indicators (L, M, and H), if any, following the α_w index, indicate α_p values above the reference contour by ≥ 0.25 in the Low, Medium or High frequency ranges respectively; it is strongly recommended to use this single number rating in combination with the complete sound absorption coefficient curve.
2. SAA and NRC are defined in ASTM C423; laboratory requirements for which differ from AS ISO 354.
3. Physical characteristics of materials may be as per client or supplier's advice; not necessarily verified by CSIRO.

Issuing Authority

Signed: .....
John Watson
Date: 24 February 2022

Instrumentation

Real time analyser: • Brüel & Kjær PULSE LAN-XI type 3160-A-4/2
Microphones/preamps: • 4 microphones (1 x B&K 4134, 1 x B&K 4166, and 2 x GRAS 40AR) on B&K and GRAS preamps, in fixed positions as per AS ISO 354
Noise source: • Room populated with three Norsonic NOR276 dodecahedron loudspeakers, driven in turn by a Norsonic NOR280 power amplifier.
Calibration: • Analyser: September 2021 (NATA cal)

Laboratory Construction

Reverb room: • 300 mm thick concrete (closed off from the adjoining room by a plaster-board wall) • parallelepiped with dimensional proportions 1:1.3:1.6 for distribution of room modes • approx. 202 m^3 total room volume • approx. 215 m^2 surface area excluding diffusers
Diffusers: • 20 stationary diffusers, approx. 40 m^2 total surface area
Absorption area: • in accordance with AS ISO 354, unless noted otherwise