CSIRO ACOUSTIC MEASUREMENT REPORT

Commonwealth Scientific and Industrial Research Organisation, Infrastructure Technologies
Acoustics Testing Laboratory, Gate 5, 2 Normanby Road, Clayton, Vic 3168 Australia

Report No: **AC270-06-1**

Client: Bailey Interiors Pty Ltd
83-85 Boundary Road, Mortdale, NSW 2223

Measurement Type: Sound Absorption

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

Test Specimen

[Specimen area: 3.6 x 3.0 m (10.8 m²), Test configuration: Type E-400]

Description: • Bailey "Random" nail-up acoustic ceiling tiles
• with integral glass fibre batt behind, non-encapsulated

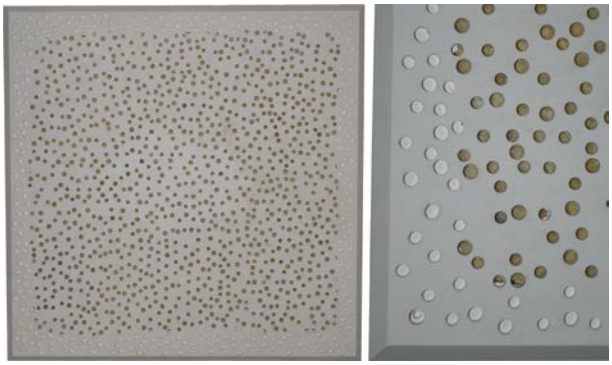
Tile Details[3]

- Perforated moulded plaster ceiling tiles, nominal size 600 x 600 mm (x 30 mm thick) designed to be nail/screw fixed to overhead ceiling battens.
- Manufactured with an integral glass fibre batt (Bradford Supertel, 32 kg/m³, 20 mm thick) behind the perforated face, constrained around the perimeter at the rear with plaster skim-coat covering the outer 60 mm of the batt (approx).
- Perforated in a random pattern with a mixture of 6.5 and 8.0 mm dia holes (approx 915 and 475 of each size respectively); the perforations in the vicinity of the perimeter being open only at the face (closed at the rear), with the perforations away from the perimeter being open front and back (exposing the glass fibre batt behind).
- Open area percentage[4] (estimated): 12.0% (only holes open front and back); 15.1% (all holes).

Installation

- The test specimen was installed as an upside down ceiling on the floor of the chamber.
- A 400 mm deep enclosure (32 mm MDF timber, approx 23 kg/m², built to surround an area of 3600 x 3000 mm) was placed on the floor of the chamber, 11° off parallel with the walls. The enclosure was taped at all joints to prevent air leakage between the enclosed space and the outside.
- A system of steel wall studs/track was set up inside the enclosure to support the specimen tiles. The cavity behind the panels was a single undivided cavity without internal partitions.
- Specimen tiles were arranged in a 6 x 5 array on the support system; tiles installed along two of the edges of the enclosure were rasped as required to fit into the 3.6 x 3.0 m enclosure.
- All edges where adjacent tiles met each other and at the perimeter junction with the enclosure, were sealed with PVC electrical tape or paper masking tape.
- Specimen installation was carried out by laboratory staff.

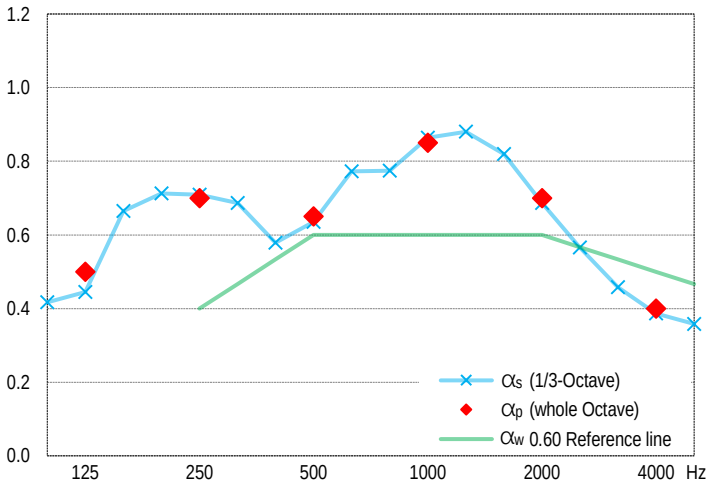
Test specimen installed for testing (image inverted to depict ceiling installation)



Tile details – Left: whole tile, Right: close-up view

Measurement Details & Results

Freq	Absorption coefficients			Reverberation times, T_{60} (sec)	
Hz	α_s	α_p	95% Conf (δ)	Empty room	with Specimen
100	0.42		0.07	5.82	3.20
125	0.44	0.50	0.07	6.86	3.38
160	0.66		0.06	6.59	2.66
200	0.71		0.08	6.43	2.52
250	0.71	0.70	0.07	5.40	2.35
315	0.69		0.05	6.57	2.60
400	0.58		0.04	6.31	2.82
500	0.64	0.65	0.04	5.91	2.60
630	0.77		0.06	5.47	2.25
800	0.77		0.03	5.00	2.17
1000	0.86	0.85	0.04	4.84	2.01
1250	0.88		0.04	4.30	1.89
1600	0.82		0.04	3.93	1.89
2000	0.69	0.70	0.03	3.53	1.94
2500	0.57		0.03	3.22	1.98
3150	0.46		0.03	2.96	2.00
4000	0.39	0.40	0.03	2.58	1.88
5000	0.36		0.03	2.21	1.67



Performance Indices[1,2]
α_w = 0.60 (LM)
SAA = 0.72
NRC = 0.75

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:	15 Jan 2020	15 Jan 2020
Temperature & humidity:	27 °C, 58 % R.H.	28 °C, 46 % R.H.
Atmospheric pressure:	996 mBar	995 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.
4. Open area estimates are based on 600 x 600 mm of ceiling area being 'treated' by each tile.

Issuing Authority

Signed: .....
David Truett
Date: 24 January 2020

Instrumentation

Real time analyser: • Brüel & Kjær PULSE LAN-XI type 3160-A-4/2
Microphones/preamps: • 2 x GRAS type 40AP and 2 x B&K type 4134 microphones, all on B&K type 2669 preamps, in 4 fixed positions as per AS ISO 354
Noise source: • Room populated with three decahedron loudspeakers; 2 Norsonic NOR276 & 1 x B&K 4296, driven in turn by a Norsonic NOR280 power amplifier.
Calibration: • Analyser: July 2018 (NATA cal)

Laboratory Construction

Reverb room: • 300 mm thick concrete (closed off from the adjoining room by a plasterboard wall) • parallelepiped with dimensional proportions 1:1.3:1.6 for distribution of room modes • approx 202 m³ total room volume • approx 215 m² surface area excluding diffusers
Diffusers: • 20 stationary diffusers, approx 40 m² total surface area
Absorption area: • in accordance with AS ISO 354, unless noted otherwise