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:
AC287-11-1

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

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: 3.6 x 3.0 m (10.8 m²), Test configuration: Type E-200]

Description: • Bailey "Hush" ceiling tiles, • drop-in type (600 mm ceiling grid),
• with integral glass fibre batts (batts open to ceiling cavity at rear)

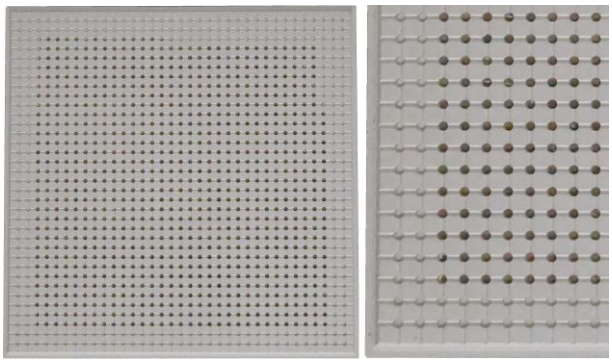
Tile Details[3]

- Perforated moulded plaster ceiling tiles, approx 588 x 588 mm (x 30 mm thick) designed to drop into a standard 600 mm suspended ceiling grid.
- Manufactured with an integral glass fibre batt (Bradford Supertel, ≈42 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 with a regular pattern of 7.0 mm dia holes (1225 count; approx 16 mm centres); the holes near the edges being closed at the rear, the remaining holes opening into the glass fibre batt behind.
- Open area percentage[4] (estimated): 10.5% (only holes open front and back); 13.1% (all holes).
- Decorative effect o
- f perforations supplemented by additional moulding details (grooves between the perforations).

Installation

- The test specimen was installed as an upside-down ceiling on the floor of the chamber.
- A 200 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 at an 11° angle to the chamber walls (not parallel, as per AS ISO 354 cl 6.2.1.2). Two modules (each 100 mm deep) were stacked to create the E-200 enclosure.
- A system of plastic support feet sitting on aluminium extrusions (upside-down Tees) was set up inside the enclosure to support the tiles with their exposed face nominally flush with the enclosure. The cavity behind was a single undivided cavity without internal partitions.
- Tiles were arranged in a 6 x 5 array on the support system, then a full grid of main and cross tees was placed on top to cover the gaps between the tiles, matching a normal ceiling installation.
- All relevant joins in the installation were taped to close off any gaps – ie the junctions of the enclosure modules to each other, to the floor, and to the tile array.
- Specimen installation was carried out by laboratory staff.

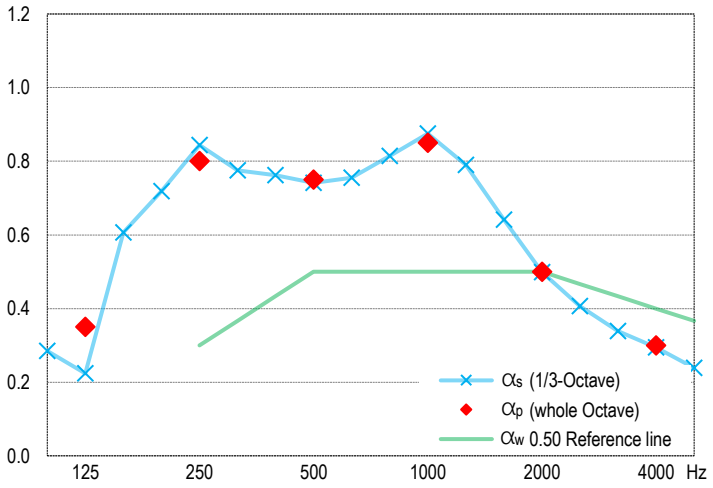
Test specimen installed for testing (image inverted to depict ceiling installation)



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	0.28		0.06	5.02	3.42
125	0.22	0.35	0.06	5.81	4.07
160	0.61		0.08	6.30	2.79
200	0.72		0.08	5.79	2.44
250	0.84	0.80	0.12	4.84	2.06
315	0.78		0.05	5.94	2.36
400	0.76		0.04	5.79	2.36
500	0.74	0.75	0.05	5.55	2.36
630	0.76		0.03	5.27	2.28
800	0.81		0.04	5.09	2.15
1000	0.88	0.85	0.05	4.84	2.02
1250	0.79		0.04	4.36	2.04
1600	0.64		0.03	3.86	2.13
2000	0.50	0.50	0.03	3.48	2.22
2500	0.41		0.03	3.08	2.20
3150	0.34		0.03	2.68	2.09
4000	0.29	0.30	0.04	2.18	1.83
5000	0.24		0.04	1.72	1.55



Performance Indices[1,2]
α_w = 0.50 (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:	1 Jun 2021	1 Jun 2021
Temperature & humidity:	17 °C, 48 % R.H.	17 °C, 52 % R.H.
Atmospheric pressure:	1009 mBar	1007 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: 25 June 2021

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: July 2018 (NATA cal)

Laboratory Construction

Reverb room: • 300 mm thick concrete (closed off from the adjoining room by an MDF 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