# 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:
**AC287-16-1**

**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 "EcoCheck Acoustic Coffer" ceiling tiles, • drop-in type (600 mm ceiling grid), • with pre-fitted glass fibre batts behind the perforated area (stapled to rear of tile)

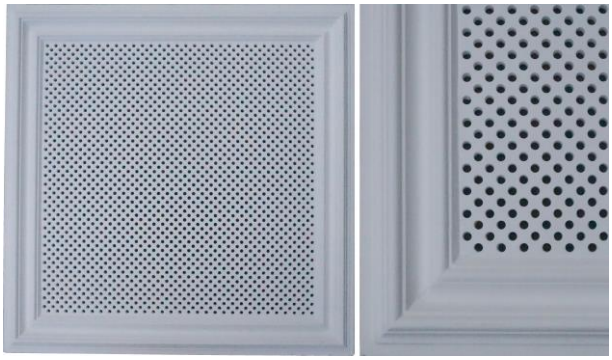
Tile Details[3]

- Moulded plaster ceiling tiles, approx 588 x 588 mm, designed to drop into a standard 600 mm suspended ceiling grid.
- Factory-fitted with a glass fibre batt (500 x 500 mm, Bradford Supertel, ≈42 kg/m³, 20 mm thick, faced with black Regina tissue fabric), stapled to the rear of the tile behind the perforated area.
- Perforated with a regular pattern of holes, approx 5.5 mm dia (1922 count), all penetrating through the plaster tile and exposing the tissue fabric face of the glass fibre batt behind; the decorative effect of the perforations was supplemented by a raised coffer profile framing the perforated area.
- Open area percentage[4] (estimated): 12.7%

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.

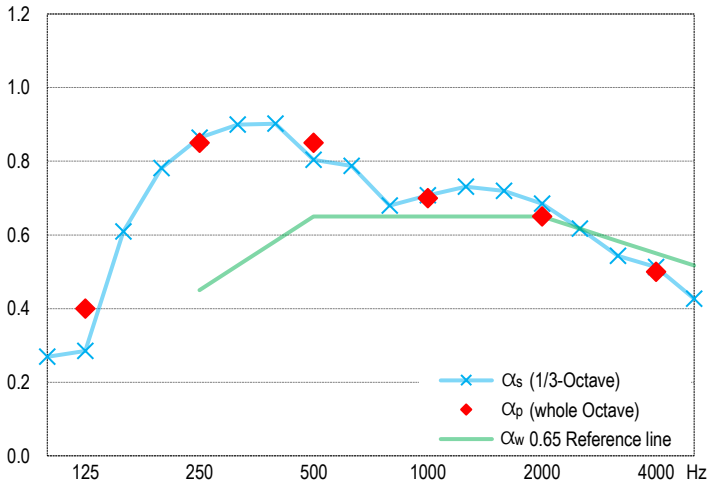
*Test specimen installed for testing (image inverted to depict ceiling installation)*



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

## Measurement Details & Results

| Freq | Absorption coefficients | | | Reverberation times, $T_{60}$ (sec) | |
|---|---|---|---|---|---|
| Hz | $\alpha_s$ | $\alpha_p$ | 95% Conf (δ) | Empty room | with Specimen |
| 100 | 0.27 | | 0.06 | 5.25 | 3.59 |
| 125 | 0.28 | 0.40 | 0.06 | 6.26 | 3.94 |
| 160 | 0.61 | | 0.08 | 6.70 | 2.86 |
| 200 | 0.78 | | 0.12 | 5.92 | 2.35 |
| 250 | 0.86 | 0.85 | 0.09 | 4.83 | 2.03 |
| 315 | 0.90 | | 0.05 | 6.21 | 2.19 |
| 400 | 0.90 | | 0.06 | 6.06 | 2.16 |
| 500 | 0.80 | 0.85 | 0.06 | 5.75 | 2.28 |
| 630 | 0.79 | | 0.04 | 5.52 | 2.27 |
| 800 | 0.68 | | 0.04 | 5.22 | 2.41 |
| 1000 | 0.71 | 0.70 | 0.05 | 5.06 | 2.32 |
| 1250 | 0.73 | | 0.04 | 4.58 | 2.18 |
| 1600 | 0.72 | | 0.04 | 4.13 | 2.09 |
| 2000 | 0.68 | 0.65 | 0.03 | 3.72 | 2.02 |
| 2500 | 0.62 | | 0.03 | 3.28 | 1.97 |
| 3150 | 0.54 | | 0.03 | 2.87 | 1.90 |
| 4000 | 0.51 | 0.50 | 0.03 | 2.35 | 1.68 |
| 5000 | 0.43 | | 0.04 | 1.89 | 1.49 |




Performance Indices[1,2]
$\alpha_w$ = 0.65 (L)
SAA = 0.76
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: | 9 Aug 2021 | 9 Aug 2021 |
| Temperature & humidity: | 17 °C, 56 % R.H. | 16 °C, 58 % R.H. |
| Atmospheric pressure: | 1011 mBar | 1011 mBar |

## Notes, Deviations etc

1. Shape indicators (L, M, and H), if any, following the $\alpha_w$ index, indicate $\alpha_p$ 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: 11 August 2021

## Instrumentation

Real time analyser: • Brüel & Kjær PULSE LAN-XI type 3050-A-060
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: December 2019 (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 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