Acoustic Test Laboratory
The University of Salford
Salford, Greater Manchester
M5 4WT, United Kingdom

T: +44 (0) 161 295 4615
E: d.j.mccaul@salford.ac.uk

1262

TEST REPORT No : 05896-6013 Rail **DATE OF ISSUE : 23 August 2023**

BS EN 16272-1:2012

Railway Applications – Track – Noise Barriers and Related Devices Acting on Airborne Sound Propagation – Test Method for Determining the Acoustic Performance

Part 1: Intrinsic Characteristics – Sound Absorption in the Laboratory under Diffuse Sound Field Conditions

Client:	Set 6 Ltd
Job Number:	05896
Test Sample:	Mute Acoustic Fence 80
Date(s) of Test:	17 May 2023

Signed: . . . . . L Cambidge
Specialist Acoustics Technician

Approved:. . . . . D Wong-McSweeney
Laboratory Manager

Contents

Client Details:

Set 6 Ltd

Unit 5 Birch Court

Grosvenor Grange

Padgate

Warrington

WA1 4GD

Manufacturer: Client

Mounting Type: Type A Mounting

Date Order Received: 06 April 2023

1. Test Samples

The following sample was installed in the large reverberation room of the University of Salford Acoustic Test Laboratory. It was installed in accordance with clause 5 of BS EN 16272-1:2012. All information regarding the samples comes from laboratory measurements unless marked with "*cs*" or otherwise stated.

1.1. Description of Test Samples

Test Reference: **05896-6013**
Sample Reference *cs*: Mute Acoustic Fence 80
Sample Description: Rail Noise Barrier

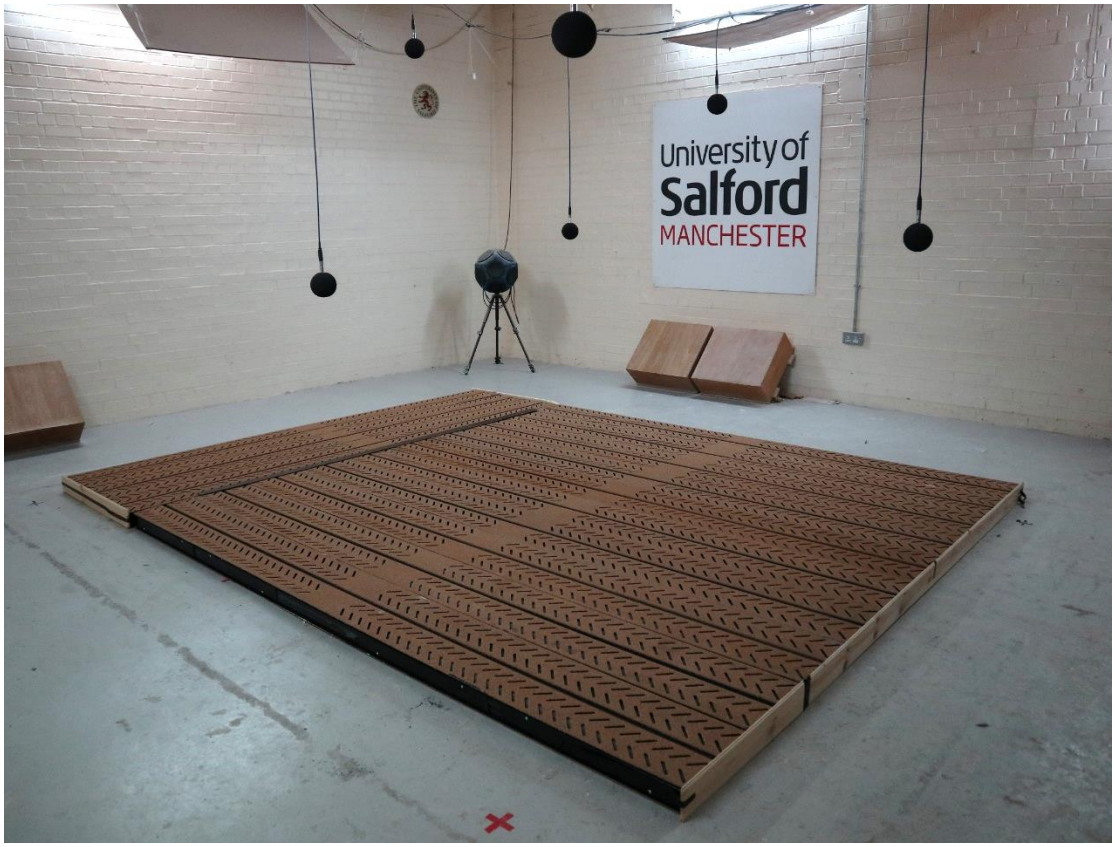
The test sample was installed by the client, directly onto the concrete floor of the reverberation room. The sample was constructed from acoustic panels, composed of rectangular, metal, box-section planks, filled with different types of plastic absorption. The upper face of each panel (as installed) had a central groove and was pierced with holes to expose the infill. The surface of the panels was covered with a layer of rubber and cork granules. A single panel was measured to be 2400 mm long × 297 mm wide, with a mass of 21.3 kg. Nine panels were laid next to each other (without seals) and a T-section metal post was laid along across the ends of the panels. On the other side of the post, two further panels were laid at 90 degrees to the first set, to complete the test sample.

– The post, at 2.4 m long, was shorter than the 2.99 m width of the test sample –

The Client was made aware that the post was short of the full width of the test sample and agreed to go ahead with the test. Sections of timber were taped in place over the open ends of the panels. Some sections of absorption infill remained exposed; at points along the edges, and where the too-short post did not cover them.

Sample area:	3905 × 2990 mm
Thickness:	75 mm
Mass per unit area:	29.9 kg/m^2

1.2. Photographs



2. Description of Test Procedure

2.1. Description of Test Facility

The tests were carried out in the large reverberation room at the University of Salford. The room has been designed with hard surfaces and non-parallel walls to give long empty room reverberation times with uniform decays. It has the shape of a truncated wedge. In addition 18 plywood panels, of various sizes, were hung in the room to improve the diffusivity of the sound field. The test sample was placed in the centre of the floor.

The excitation signal comprised wide band random noise played into the room via two dodecahedron, omnidirectional loudspeakers mounted in room corners. The sound was monitored at each of 6 microphone positions. The room is approximately 7.4 m long × ~6.6 m wide × 4.5 m high with a volume of 222 m^3 and a total surface area of 224 m^2. The volume of the room permits a maximum sample size of 12.79 m^2 to be tested, in accordance with Clause 6.2.1.1 in BS EN ISO 354: 2003, "Acoustics - Measurement of sound absorption in a reverberation room".

2.2. Test Procedure

The procedure followed that detailed in BS EN 16272-1:2012, conforming to the conditions laid out within BS EN ISO 354:2003. Measurements were made on the rate of decay of sound in the test chamber with and without the sample in place. The frequency range from 100 Hz to 5000 Hz was covered in one-third octave bands. An average reverberation time was taken from five decays at each of six microphone positions for each of two loudspeaker positions (i.e. 60 decays per third octave band).

The decays were produced by exciting the room with amplified wide band random noise and stopping the excitation once the chamber became saturated. The time taken for the sound to decay by a given amount is measured and extrapolated to give the reverberation time. In practice this was determined by sampling the decaying sound field on a one-third octave band frequency analyser and storing the spectrum in a

computer. The reverberation time was obtained from the ensemble averaged decays at each frequency. The measurements with and without (T_2 and T_1 respectively) the sample in the room were carried out consecutively to avoid significant changes in relative humidity and temperature that influence air absorption at higher frequencies.

2.3. Calculation

The random incidence sound absorption coefficients were determined from the measured data by means of the equation below:

$$\alpha_{si} = \frac{A_T}{S}$$

where,

A_T is the equivalent sound absorption area of the test specimen (m^2)

S is the area covered by the test specimen (m^2)

The single-number rating, DL_α, is given by:

$$DL_\alpha = -10\log\left|1 - \frac{\sum_{i=1}^{18} \alpha_{Si} 10^{0.1L_i}}{\sum_{i=1}^{18} 10^{0.1L_i}}\right|$$

where α_{Si} is the absorption coefficient in the *i*th one-third octave band

L_i is the normalized A-weighted sound pressure level of the normalised railway noise spectrum in the *i*th one-third octave band as defined in BS EN 16272-3-1:1998.

No correction is applied for the absorption of the surface covered by the test sample.

3. Equipment

Equipment	Laboratory Equipment Record No.
Norwegian Electronics 1/3 octave band real time analyser type 850 with in-built random noise generator	RTA3-07 to 12
Quad 510 power amplifier	PA7
Norsonic Sound Calibrator type 1251	C8
2 × Norsonic Dodecahedron Loudspeakers	LS10-LS11
2 × Bruel &Kjaer random incidence condenser microphone type 4166 in the receiving room	M9, M18
4 × G.R.A.S. random incidence condenser microphones type 40AP in the receiving room	M20, M31, M19, M32
Environmental sensor data logger, hygrometers and barometer	HL1, HG2, BM3
Toshiba TECRA R850 119 laptop computer and related peripheral equipment (network switch, printer, monitor etc.)	RTA3-00
Yamaha GQ1031BII graphic equalizer	GEQ1

4. Results

The random incidence sound absorption coefficients in the *i*th one-third octave band, α_{Si}, are given in the tables over leaf.

Also given is the single-number rating of sound absorption, DL_a, in decibels.

The results here presented relate only to the items tested and described in this report.

BS EN ISO 354:2003
Acoustics - Measurement of absorption in a reverberation room

Client: **Set 6 Ltd**
Unit 5 Birch Court, Grosvenor Grange, Padgate, Warrington
WA1 4GD
Sample Reference: **Mute Acoustic Fence 80**
Description of Sample: Rail Noise Barrier

– The post, at 2.4 m long, was shorter than the 2.99 m width of the test sample –

Room Volume:	222 m³	Location:	Acoustic Transmission Suite
Sample Size:	11.68 m²	Test Room	Large reverberation Room
Sample Thickness:	75.0 mm	Condition:	Clean

Sample Out		***Sample In***	
Temperature	20.6 °C	Temperature	20.6 °C
Relative Humidity	44.2 %	Relative Humidity	44.1 %
Static Pressure	102.5 kPa	Static Pressure	102.6 kPa

Random Incidence Sound Absorption Coefficient

Frequency [Hz]	T_1 [s]	T_2 [s]	α_{Si}
100	5.74	4.70	0.12
125	4.55	4.07	0.08
160	5.30	4.22	0.15
200	5.72	4.81	0.10
250	6.56	4.83	0.17
315	6.21	4.28	0.22
400	6.03	3.40	0.39
500	5.93	2.58	0.67
630	5.76	2.23	0.84
800	5.60	2.17	0.86
1000	5.29	2.32	0.74
1250	4.96	2.52	0.60
1600	4.55	2.25	0.69
2000	4.07	1.98	0.79
2500	3.46	1.95	0.69
3150	2.89	1.80	0.63
4000	2.20	1.61	0.51
5000	1.86	1.48	0.41

Test reference: 05896-6013 Date: 17 May 2023

University of Salford, School of Computing Science & Engineering

BS EN 16272-1 : 2012
Acoustics - Track-noise barriers and related devices acting on airborne sound propagation. Test method for determining the acoustic performance

Client: **Set 6 Ltd**
Unit 5 Birch Court, Grosvenor Grange, Padgate, Warrington
WA1 4GD

Sample Reference: **Mute Acoustic Fence 80**

Description of Sample: Rail Noise Barrier

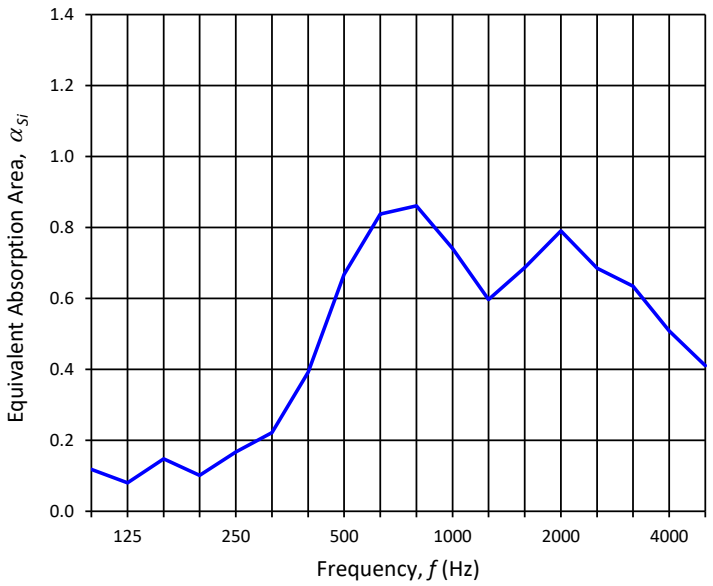
– The post, at 2.4 m long, was shorter than the 2.99 m width of the test sample –

Room Volume:	222 m³	Location:	Acoustic Transmission Suite
Sample Size:	11.68 m²	Test Room	Large reverberation Room
Sample Thickness:	75.0 mm	Condition:	Clean

Sample Out		***Sample In***	
Temperature	20.6 °C	Temperature	20.6 °C
Relative Humidity	44.2 %	Relative Humidity	44.1 %
Static Pressure	102.5 kPa	Static Pressure	102.6 kPa

Random Incidence Sound Absorption Coefficient

Frequency [Hz]	α_{Si}
100	0.12
125	0.08
160	0.15
200	0.10
250	0.17
315	0.22
400	0.39
500	0.67
630	0.84
800	0.86
1000	0.74
1250	0.60
1600	0.69
2000	0.79
2500	0.69
3150	0.63
4000	0.51
5000	0.41



DL α = 5 dB

Signed:

Test reference: 05896-6013 Date: 17 May 2023

University of Salford, School of Computing Science & Engineering