University of SALFORD
MANCHESTER

BS EN ISO 354:2003

ACOUSTICS – MEASUREMENT OF SOUND ABSORPTION IN A REVERBERATION ROOM

Equivalent Sound Absorption Area

CLIENT:	GIK Acoustics Europe
	Unit A
	Perseverance Mills
	Giles Street
	Wibsey
	BD6 3HS
JOB NUMBER:	ACOUS/01772
MANUFACTURER:	Client
MODEL:	"Alpha Corner Trap"
TYPE:	Non-standard, corner mounted panels
DATE RECEIVED:	6 May 2014
DATE OF TEST:	2 December 2015

Signed: ....

C Lomax

Quality Manager

Approved: ....

D J McCaul

Technical Manager

1   TEST SAMPLES

1.1   Description of Test Samples

**Test Reference:**   **1772-2105**

Sample Reference: "Alpha Corner Trap"

Sample Description: Acoustic panels, triangular prism section. Each unit has a length of 1200 mm, and triangular ends with sides of 578 mm (front face), 412mm & 412mm (back panels). The unit has a measured weight of 8.7 kg. Each panel consists of back and end panels of MDF containing a Rockwool core. The face and back of the panel were covered with cloth. The front of each panel was faced with a perforated sheet of 3 mm thick MDF. The end of each panel was faced with a solid sheet of 3 mm thick PVC. Ten panels (of the ten supplied) were arranged at random, by the client, at the corners of the floor and wall of the reverberation room.

At the client's request, the additional frequencies 50 Hz, 63 Hz, 80 Hz, 6.3 kHz, 8 kHz and 10 kHz were measured.

Tabulated data for these additional frequencies can be found in Appendix A.

1.2   Photographs
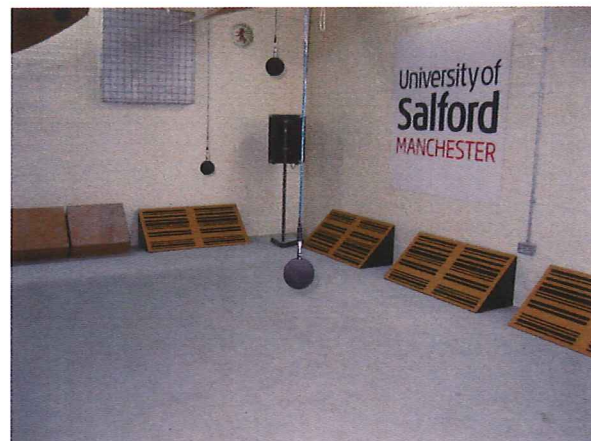
1.2   Photographs

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 11 plywood panels, each panel 1.22m × 2.44m, 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 a loudspeaker system mounted in a cabinet facing a corner. The sound was monitored at each of 6 microphone positions. The room is 7.4m long × ~6.6m wide × 4.5m high with a volume of 220m^3 and a total surface area of 224m^2. The volume of the room permits a maximum sample size of 12.79m^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 ISO 354. 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 100Hz to 5000Hz[1] 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 20dB is measured and tripled 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 every 32 milliseconds. The reverberation time was obtained from the arithmetically averaged decays at each frequency. The measurements with and without 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.

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[1] At the client's request, the measured frequency response was 50 Hz – 10,000Hz

2.3   Calculation

At the request of the client, the equivalent sound absorption area, A_T of the test specimen were determined from the measured data by means of the equations below:

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

$$A_T = A_2 - A_1 = 55.3V\left(\frac{1}{c_2 T_2} - \frac{1}{c_1 T_1}\right) - 4V(m_2 - m_1)$$

Where:

A_1 is the equivalent sound absorption area of the empty reverberation room (m^2).

A_2 is the equivalent sound absorption area of the room reverberation containing the test specimen (m^2).

V is the volume, in cubic metres, of the empty reverberation room:

c_1 is the propagation speed of sound at air temperature t_1;

c_2 is the propagation speed of sound at air temperature t_2;

T_1 is the mean reverberation times of the empty reverberation room in each frequency band (sec).

T_2 is the mean reverberation times of the reverberation room containing the test specimen in each frequency band (sec)

m_1 is the power attenuation, in reciprocal metres, using the climatic conditions that have been presented in the empty reverberation room.

m_2 is the power attenuation, in reciprocal metres, using the climatic conditions that have been presented in the reverberation room containing the test specimen.

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

3   EQUIPMENT

	Departmental 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
2 of broadband loudspeakers (receiving room)	LS3-LS4
4 x Brüel & Kjær random incidence condenser microphone type 4166 in the receiving room	M8, M9 M18, M19
2 x G.R.A.S. random incidence condenser microphones type 40AP in the receiving room	M20, M31
Environmental sensor data logger, hygrometers and barometer	HL1, HG1, HG2, BM1
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 equivalent sound absorption area is given in the table(s) overleaf.

Reverberant room volume	220 m^2
Number of Samples	10
Sample dimensions	Length of sample, 1200 mm Sides of Triangular Ends, 578 mm x 412 mm x 412 mm
Atm. pressure	100.2 kPa

	Sample out	Sample in
Temperature [°C ± 0.3]	19.52	19.63
Rel. humidity [% ± 3.0]	46.01	49.17

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: **GIK Acoustics Europe**
Unit A, Perseverance Mills, Giles Street, Wibsey
BD6 3HS

Product Identification: Alpha Corner Trap
Description of Sample: Acoustic Panel
Please note that the surface area of the sample is outside the required range specified, as defined in BS EN ISO 354:2003.

Room Volume: 220 m³   Location: Acoustic Transmission Suite
No. of Samples: 10.00   Test Room Large reverberation Room
           Condition: Clean

Sample Out		*Sample In*	
Temperature	19.5 °C	Temperature	19.6 °C
Relative Humidity	46.0 %	Relative Humidity	49.2 %
Static Pressure	100.2 kPa	Static Pressure	100.2 kPa

Random Incidence Equivalent Absorption Area

Frequency [Hz]	T_1 [s]	T_2 [s]	A_T
100	4.10	2.13	8.00
125	3.86	1.76	11.00
160	3.52	1.46	14.30
200	3.51	1.54	13.00
250	3.70	1.75	10.70
315	3.99	1.79	11.00
400	4.18	1.85	10.70
500	4.42	1.94	10.30
630	4.47	1.98	10.00
800	4.38	2.07	9.10
1000	4.28	2.20	7.80
1250	4.04	2.21	7.30
1600	3.82	2.19	7.00
2000	3.53	2.15	6.50
2500	3.14	2.08	5.90
3150	2.74	1.93	5.70
4000	2.24	1.70	5.40
5000	1.71	1.43	4.70

Test reference: 1772-2105   Date: 02 December 2015

University of Salford, School of Computing Science & Engineering

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Client:	**GIK Acoustics Europe**
	Unit A, Perseverance Mills, Giles Street, Wibsey
	BD6 3HS
Product Identification:	Alpha Corner Trap
Description of Sample:	Acoustic Panel

Please note that the surface area of the sample is outside the required range specified, as defined in BS EN ISO 354:2003.
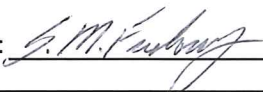
Room Volume:	220 m³	Location:	Acoustic Transmission Suite
No. of Samples:	10.00	Test Room	Large reverberation Room
		Condition:	Clean

Sample Out		*Sample In*	
Temperature	19.5 °C	Temperature	19.6 °C
Relative Humidity	46.0 %	Relative Humidity	49.2 %
Static Pressure	100.2 kPa	Static Pressure	100.2 kPa

Random Incidence Equivalent Absorption Area

Frequency [Hz]	A_T
100	8.00
125	11.00
160	14.30
200	13.00
250	10.70
315	11.00
400	10.70
500	10.30
630	10.00
800	9.10
1000	7.80
1250	7.30
1600	7.00
2000	6.50
2500	5.90
3150	5.70
4000	5.40
5000	4.70
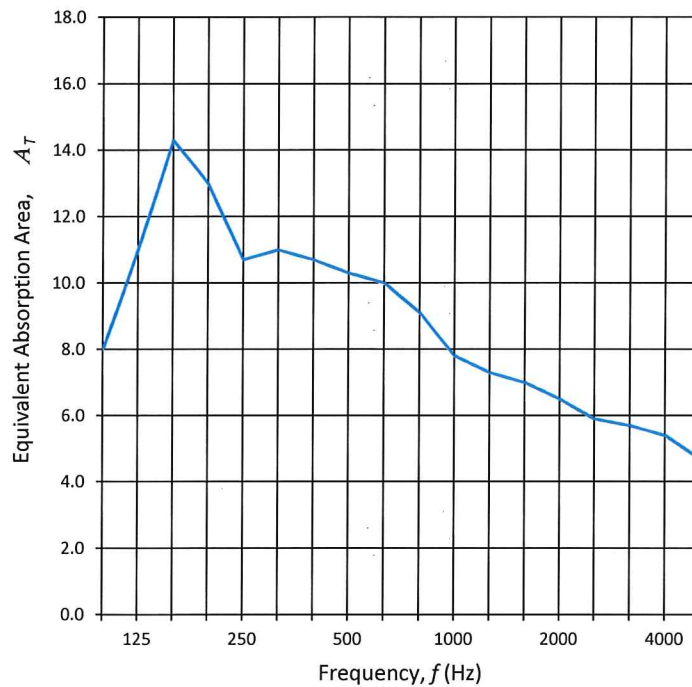
Signed: [signature]

Test reference: 1772-2105

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APPENDIX A

At the client's request, the following additional frequencies were measured.

Frequency [Hz]	A_T	T_1 [s]	T_2 [s]
50	1.40	9.72	7.08
63	3.10	6.11	3.99
80	4.30	4.79	3.02
6,300	4.60	1.47	1.28
8,000	5.50	1.10	0.98
10,000	4.10	0.76	0.73