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TEST REPORT No : 4775 **DATE OF ISSUE : 19 November 2020**

BS EN ISO 354:2003

Acoustics – Measurement of Sound Absorption in a Reverberation Room

Client:	GIK Acoustics Europe
Job Number:	ACOUS/04775
Sample Reference:	Various Absorbers
Date(s) of Test:	08 October 2020

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

Approved: . . . . . D J McCaul
Technical Manager

1.3. Test Reference: **4775-4323**

Sample Reference: Boom Box

Sample Description: Bass Traps – Non-Standard Mounting

Sixteen bass traps were installed, by the client, at an angle around the edges of reverberation chamber. The boxes, 600 × 600 mm and 252 mm thick, consisted of an absorbent material in a timber frame all enclosed in fabric.

Number of samples: 16

Mass per unit area: 29.2 kg/m^2

1.4. Test Reference: **4775-4324**

Sample Reference: Boom Box

Sample Description: Bass Traps - Type A Mounting

Sixteen bass traps (the same as in test 4775-4323) were installed, by the client, directly on the concrete floor of the reverberation chamber. The boxes, 600 × 600 mm and 252 mm thick, consisted of an absorbent material in a timber frame all enclosed in fabric. The dimensions of the sample were 2410 × 2411 mm (5.81 m^2) which is a smaller area than specified in BS EN ISO 354:2003.

Sample area:	2410 × 2411 mm
Thickness:	252 mm
Mass per unit area:	29.2 kg/m^2

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 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 7.4 m long × ~6.6 m wide × 4.5 m high with a volume of 221 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 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 either 50 Hz or 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 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.

2.3. Calculation

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

$$\alpha_s = \frac{A_T}{S}$$

Where

α_s is the absorption coefficient of the sample

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

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

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

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.

Where applicable, the single-number rating, α_W, has been calculated in accordance with BS EN ISO 11654:1997, *Acoustics – Sound absorbers for use in buildings – Rating of sound absorption.*

(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, HG1, HG2, BM2
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, α_s, are given in the tables over leaf where applicable.

Also given, where applicable, are the octave-band practical sound absorption coefficients, α_{pi}, and the weighted sound absorption coefficient, α_W.

The random incidence sound absorption coefficients per object, α_{obj} (m^2), are given in the tables over leaf, where applicable.

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

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

Client:	**GIK Acoustics Europe**
	Unit F, Perseverance Mills, Giles Street, Wibsey
	BD6 3HS
Sample Reference:	**Boom Box**
Description of Sample:	Bass Traps - Non-Standard Mounting
	Frequencies, 50, 63 and 80 Hz not accredited

Room Volume:	221 m³	Location:	Acoustic Transmission Suite
No. of Samples:	16	Test Room	Large reverberation Room
		Condition:	Clean

Sample Out		***Sample In***	
Temperature	20.0 °C	Temperature	20.0 °C
Relative Humidity	50.9 %	Relative Humidity	50.7 %
Static Pressure	100.5 kPa	Static Pressure	100.4 kPa

Random Incidence Equivalent Absorption Area

Frequency [Hz]	T_1 [s]	T_2 [s]	A_{obj}
50	*6.87*	*1.51*	*0.1*
63	*6.55*	*1.81*	*0.2*
80	*6.84*	*2.06*	*0.5*
100	6.60	1.35	1.4
125	6.87	1.24	1.5
160	6.55	1.51	1.1
200	6.84	1.81	0.9
250	6.60	2.06	0.7
315	6.89	2.00	0.8
400	6.85	2.08	0.7
500	6.93	2.12	0.7
630	6.91	2.20	0.7
800	6.63	2.25	0.7
1000	6.35	2.29	0.6
1250	5.82	2.25	0.6
1600	5.37	2.23	0.6
2000	4.74	2.13	0.6
2500	4.04	1.98	0.6
3150	3.33	1.77	0.6
4000	2.47	1.48	0.6
5000	2.11	1.34	0.6

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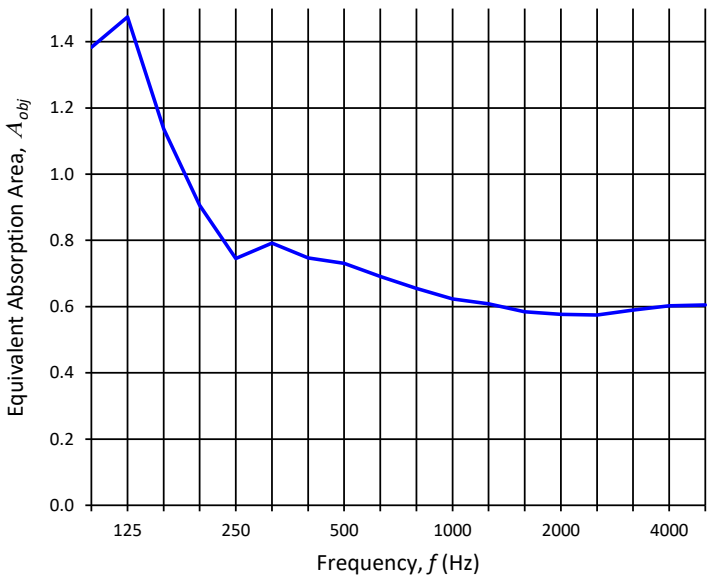
No. of Samples:	16	Test Room	Large reverberation Room
		Condition:	Clean

Sample Out		***Sample In***	
Temperature	20.0 °C	Temperature	20.0 °C
Relative Humidity	50.9 %	Relative Humidity	50.7 %
Static Pressure	100.5 kPa	Static Pressure	100.4 kPa

Random Incidence Equivalent Absorption Area

Frequency [Hz]	A_{obj}
50	*0.1*
63	*0.2*
80	*0.5*
100	1.4
125	1.5
160	1.1
200	0.9
250	0.7
315	0.8
400	0.7
500	0.7
630	0.7
800	0.7
1000	0.6
1250	0.6
1600	0.6
2000	0.6
2500	0.6
3150	0.6
4000	0.6
5000	0.6



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

Sample Reference: **Boom Box - Laid Flat**

Description of Sample: Bass Traps - Type A Mounting

Please note that the surface area of the sample is outside the required range specified, as defined in BS EN ISO 354:2003. Frequencies 50, 63 and 80 Hz are not accredited.

Room Volume:	221 m³	Location:	Acoustic Transmission Suite
Sample Size:	5.81 m²	Test Room	Large reverberation Room
Sample Thickness:	250 mm	Condition:	Clean

Sample Out		***Sample In***	
Temperature	20.0 °C	Temperature	20.0 °C
Relative Humidity	50.9 %	Relative Humidity	50.9 %
Static Pressure	100.5 kPa	Static Pressure	100.5 kPa

Random Incidence Sound Absorption Coefficient

Frequency [Hz]	T_1 [s]	T_2 [s]	α_S
50	*8.26*	*3.65*	*0.36*
60	*6.87*	*3.52*	*0.98*
80	*6.55*	*2.87*	*1.30*
100	8.26	3.65	0.94
125	6.87	3.52	0.85
160	6.55	2.87	1.20
200	6.84	2.90	1.22
250	6.60	2.79	1.27
315	6.89	2.98	1.17
400	6.85	2.90	1.22
500	6.93	2.97	1.18
630	6.91	2.98	1.17
800	6.63	2.91	1.18
1000	6.35	2.87	1.18
1250	5.82	2.79	1.14
1600	5.37	2.73	1.11
2000	4.74	2.52	1.15
2500	4.04	2.30	1.16
3150	3.33	2.03	1.18
4000	2.47	1.66	1.21
5000	2.11	1.49	1.20

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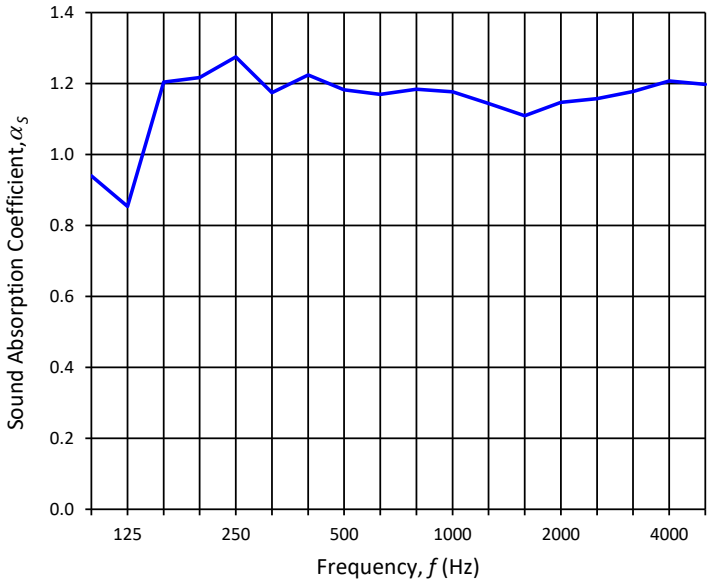
Client:	**GIK Acoustics Europe** Unit F, Perseverance Mills, Giles Street, Wibsey BD6 3HS
Sample Reference:	**Boom Box - Laid Flat**
Description of Sample:	Bass Traps - Type A Mounting *Please note that the surface area of the sample is outside the required range specified, as defined in BS EN ISO 354:2003. Frequencies 50, 63 and 80 Hz are not accredited.*

Room Volume:	221 m³	Location:	Acoustic Transmission Suite
Sample Size:	5.81 m²	Test Room	Large reverberation Room
Sample Thickness:	250 mm	Condition:	Clean

Sample Out		***Sample In***	
Temperature	20.0 °C	Temperature	20.0 °C
Relative Humidity	50.9 %	Relative Humidity	50.9 %
Static Pressure	100.5 kPa	Static Pressure	100.5 kPa

Random Incidence Sound Absorption Coefficient

Frequency [Hz]	α_S
50	*0.36*
63	*0.98*
80	*1.30*
100	0.94
125	0.85
160	1.20
200	1.22
250	1.27
315	1.17
400	1.22
500	1.18
630	1.17
800	1.18
1000	1.18
1250	1.14
1600	1.11
2000	1.15
2500	1.16
3150	1.18
4000	1.21
5000	1.20



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