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TEST REPORT No : 2531-2121

DATE OF ISSUE : 18 February 2016

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BS EN ISO 354:2003
ACOUSTICS – MEASUREMENT OF SOUND ABSORPTION IN A
REVERBERATION ROOM

CLIENT: Superfly Space
Fountain House
4 South Parade
Leeds
LS1 5QX

JOB NUMBER: ACOUS/02531

MANUFACTURER: Client

MODEL: “Fabricks 3D”

TYPE: Type A Mounting

DATE RECEIVED: 18 December 2015

DATE OF TEST: 15 December 2015

Signed:.....*S. M. Furlong*.....
S. M. Furlong
Technical Assistant

Approved:.....*C. Lomax*.....
C. Lomax
Quality Manager

1 **TEST SAMPLES**

1.1 **Description of Test Samples**

Test Reference: **2531-2121**

Sample Reference: “Fabricks 3D”

Sample Description: Plane Absorber – Acoustic Panel Units. Eighteen acoustic panel units were arranged by the client to make up a single sample; this was measured to be 3600 mm x 2415 mm. Metal baseplates were used to cover one edge of the sample. The individual units had faceted front and back faces and were covered in wool fabric. The nominal dimensions of each unit (as advised by the client) were; length 1200mm, width 400mm, overall depth 200mm.

Measured sample area = 3600 mm x 2415 mm = 8.694 m²

Mass per unit area = 5.67 kg/ m²

Total exposed surface area =10.38 m² (Top plus three exposed edges)

1.2 **Photograph**



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 220m³ and a total surface area of 224m². The volume of the room permits a maximum sample size of 12.79m² 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 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.

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.

The single-number rating, α_w , has been calculated in accordance with BS EN ISO 11654:1997.

(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 random incidence sound absorption coefficients are given in the table(s) overleaf.

Reverberant room volume	220 m ²		
Sample size	3600 × 2415 mm*		
Sample thickness	200 mm**		
Atm. pressure	100.3 kPa		
		Sample out	Sample in
Temperature [°C ± 0.3]		19.8	19.8
Rel. humidity [% ± 3.0]		47.9	49.8

* Please note that the ratio of the width and length of the sample is less than the required 0.7, as defined in BS EN ISO 354:2003.

** Please also note that three edges of the sample are included in the calculation.

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: **Superfly Space**
 Fountain House, 4 South Parade,, Leeds
 LS1 5QX

Product Identification: Fabricks 3D

Description of Sample: Plane absorber - acoustic panel modules
Please note that the ratio of the width and length of the sample is less than the required 0.7, as defined in BS EN ISO 354:2003. Please also note that three edges of the sample are included in the calculation.

Room Volume: 220 m³ **Location:** Acoustic Transmission Suite
Sample Size: 10.38 m² **Test Room Large reverberation Room**
Sample Thickness: 200 mm **Condition:** Clean

Sample Out **Sample In**

Relative Humidity 19.8 °C **Relative Humidity** 19.8 °C
Relative Humidity 47.9 % **Relative Humidity** 49.8 %
Static Pressure 100.3 kPa **Static Pressure** 100.3 kPa

Random Incidence Sound Absorption Coefficient

Frequency [Hz]	T_1 [s]	T_2 [s]	α_S
100	3.92	2.57	0.45
125	3.93	2.03	0.82
160	3.69	1.78	0.99
200	3.41	1.70	1.01
250	3.70	1.90	0.88
315	4.01	1.82	1.02
400	4.09	1.80	1.07
500	4.39	1.85	1.07
630	4.42	1.93	0.99
800	4.39	1.97	0.95
1000	4.29	1.98	0.93
1250	4.02	1.93	0.92
1600	3.84	1.90	0.92
2000	3.54	1.83	0.91
2500	3.19	1.74	0.90
3150	2.75	1.60	0.91
4000	2.30	1.45	0.90
5000	1.81	1.24	0.91

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University of Salford, School of Computing Science & Engineering

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

Client: Superfly Space
 Fountain House, 4 South Parade,, Leeds
 LS1 5QX

Product Identification: Fabricks 3D

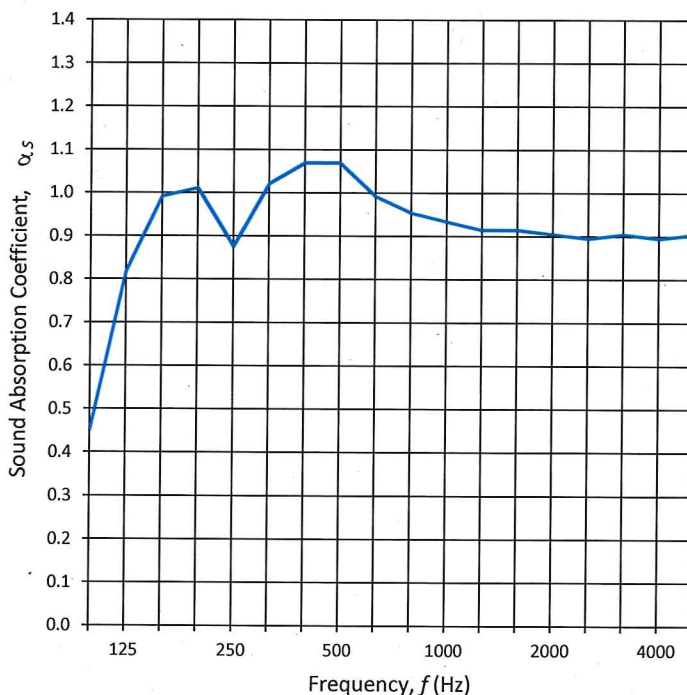
Description of Sample: Plane absorber - acoustic panel modules
Please note that the ratio of the width and length of the sample is less than the required 0.7, as defined in BS EN ISO 354:2003. Please also note that three edges of the sample are included in the calculation.

Room Volume: 220 m³ Location: Acoustic Transmission Suite
 Sample Size: 10.38 m² Test Room Large reverberation Room
 Sample Thickness: 200 mm Condition: Clean

Sample Out **Sample In**
 Temperature 19.8 °C Temperature 19.8 °C
 Relative Humidity 47.9 % Relative Humidity 49.8 %
 Static Pressure 100.3 kPa Static Pressure 100.3 kPa

Random Incidence Sound Absorption Coefficient

Frequency [Hz]	α_s
100	0.45
125	0.82
160	0.99
200	1.01
250	0.88
315	1.02
400	1.07
500	1.07
630	0.99
800	0.95
1000	0.93
1250	0.92
1600	0.92
2000	0.91
2500	0.90
3150	0.91
4000	0.90
5000	0.91



Signed: *[Signature]*

Test reference: 2531-2121

Date: 15 December 2015

University of Salford, School of Computing Science & Engineering

BS EN ISO 11654:1997
Acoustics - Sound absorbers for use in buildings

Client: Superfly Space
 Fountain House, 4 South Parade,, Leeds
 LS1 5QX

Product Identification: Fabricks 3D
Description of Sample: Plane absorber - acoustic panel modules

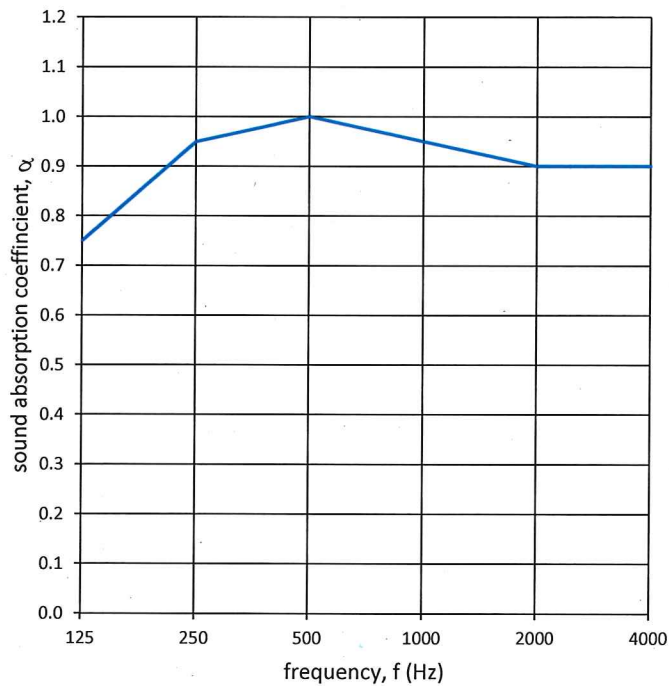
Please note that the ratio of the width and length of the sample is less than the required 0.7, as defined in BS EN ISO 354:2003. Please also note that three edges of the sample are included in the calculation.

Room Volume: 220 m³ Location: Acoustic Transmission Suite
 Sample Size: 10.38 m² Test Room Large reverberation Room
 Sample Thickness: 200 mm Condition: Clean

Sample Out		Sample In	
Temperature	19.8 °C	Temperature	19.8 °C
Relative Humidity	47.9 %	Relative Humidity	49.8 %
Static Pressure	100.3 kPa	Static Pressure	100.3 kPa

Random Incidence Sound Absorption Coefficient

Frequency [Hz]	α_{pi}
125	0.75
250	0.95
500	1.00
1000	0.95
2000	0.90
4000	0.90



$\alpha_w = 0.95$
Classification: A

Signed:

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Date: 15 December 2015

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