



1262

TEST REPORT No : 3995-3591

DATE OF ISSUE : 23 November 2018

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**BS EN ISO 354:2003**

**ACOUSTICS – MEASUREMENT OF SOUND ABSORPTION IN A  
REVERBERATION ROOM**

**CLIENT:** Forbo Flooring UK  
High Holborn Road  
Ripley  
Derbyshire  
DE5 3NT

**JOB NUMBER:** ACOUS/03995

**MANUFACTURER:** Forbo

**MODEL:** Flotex Tile

**TYPE:** Type A Mounting

**DATE ORDER RECEIVED:** 17 October 2018

**DATE OF TEST:** 18 October 2018

Signed:.....

D Wong-McSweeney  
Laboratory Manager

Approved:.....

D J M°Caul  
Technical Manager

# **1** **TEST SAMPLES**

## **1.1** **Description of Test Samples**

**Test Reference:** 3995-3591

**Sample Reference:** Flotex Tile

**Sample Description:** Carpet Tiles - Type A Mounting

48 carpet tiles, selected at random from the 60 supplied by the client, were laid directly onto the concrete floor of the reverberation room.

Sample area: 4005 × 3004 mm

Thickness: 4.8 mm

Mass per unit area: 4.6 kg/m<sup>2</sup>

## **1.2** **Photographs**



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## **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 1.22 m × 2.44 m, 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 7.4 m long × ~6.6 m wide × 4.5 m high with a volume of 217 m<sup>3</sup> and a total surface area of 224 m<sup>2</sup>. The volume of the room permits a maximum sample size of 12.79m<sup>2</sup> 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 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

$\alpha_s$  is the absorption coefficient of the sample

$S$  is the area covered by the test specimen (m<sup>2</sup>)

$A_T$  is the equivalent sound absorption area of the test specimen (m<sup>2</sup>)

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

$A_1$  is the equivalent sound absorption area of the empty reverberation room (m<sup>2</sup>).

$A_2$  is the equivalent sound absorption area of the room reverberation containing the test specimen (m<sup>2</sup>).

$V$  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,  $\alpha_w$ , 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)

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### **3      EQUIPMENT**

	<b>Departmental Record No</b>
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 × broadband loudspeakers (receiving room)	LS3-LS4
4 × Brüel & Kjær random incidence condenser microphone type 4166 in the receiving room	M8, M9 M18, M19
2 × 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, BM2
Norsonic Sound Calibrator type 1251	C8
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	217 m <sup>3</sup>		
Sample size	4005 × 3004 mm		
Sample thickness	4.8 mm		
	Sample out	Sample in	
Temperature [°C ± 0.3]	19.8	19.8	
Rel. humidity [% ± 3.0]	40.8	40.6	
Atm. Pressure [kPa ± 0.2]	102.6	102.5	

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:** Forbo Flooring UK  
High Holborn Road, Ripley, Derbyshire,  
DE5 3NT

**Product Identification:** Flotex Tile  
**Description of Sample:** Carpet Tiles - Type A Mounting

Room Volume: 217 m<sup>3</sup>      Location: Acoustic Transmission Suite  
Sample Size: 12.03 m<sup>2</sup>      Test Room Large reverberation Room  
Sample Thickness: 4.8 mm      Condition: Clean

<b>Sample Out</b>		<b>Sample In</b>	
Temperature	19.8 °C	Temperature	19.8 °C
Relative Humidity	40.8 %	Relative Humidity	40.6 %
Static Pressure	102.6 kPa	Static Pressure	102.5 kPa

#### Random Incidence Sound Absorption Coefficient

Frequency [Hz]	$T_1$ [s]	$T_2$ [s]	$\alpha_S$
100	4.29	4.49	-0.03
125	4.87	4.87	0.00
160	3.49	3.40	0.02
200	3.35	3.36	0.00
250	3.64	3.55	0.02
315	4.08	3.93	0.02
400	3.97	3.85	0.02
500	4.38	4.17	0.03
630	4.28	4.02	0.04
800	4.22	3.89	0.06
1000	4.08	3.63	0.09
1250	3.84	3.30	0.12
1600	3.60	2.97	0.17
2000	3.31	2.71	0.19
2500	2.87	2.43	0.18
3150	2.48	2.11	0.20
4000	2.00	1.76	0.20
5000	1.55	1.38	0.22

**Test reference: 3995-3591**

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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:** Forbo Flooring UK  
 High Holborn Road, Ripley, Derbyshire,  
 DE5 3NT

**Product Identification:** Flotex Tile

**Description of Sample:** Carpet Tiles - Type A Mounting

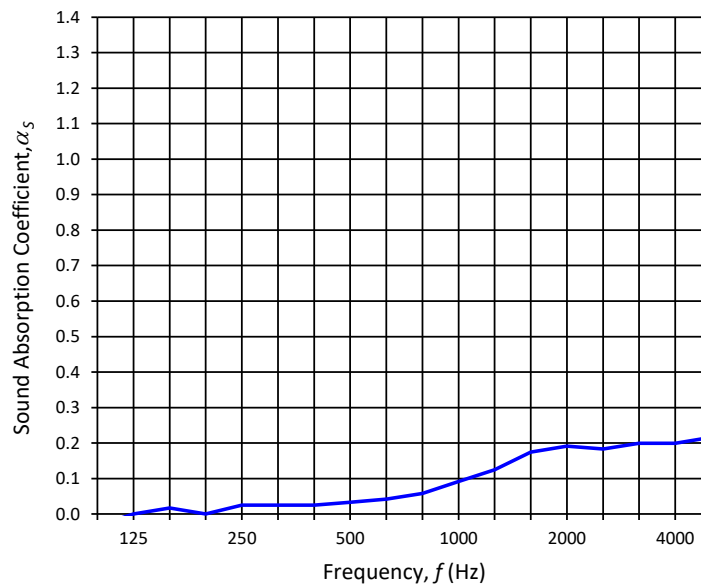
Room Volume: 217 m<sup>3</sup>      Location: Acoustic Transmission Suite  
 Sample Size: 12.03 m<sup>2</sup>      Test Room Large reverberation Room  
 Sample Thickness: 4.8 mm      Condition: Clean


**Sample Out**      **Sample In**

Temperature 19.8 °C      Temperature 19.8 °C  
 Relative Humidity 40.8 %      Relative Humidity 40.6 %  
 Static Pressure 102.6 kPa      Static Pressure 102.5 kPa

**Random Incidence Sound Absorption Coefficient**

Frequency [Hz]	$\alpha_s$
100	-0.03
125	0.00
160	0.02
200	0.00
250	0.02
315	0.02
400	0.02
500	0.03
630	0.04
800	0.06
1000	0.09
1250	0.12
1600	0.17
2000	0.19
2500	0.18
3150	0.20
4000	0.20
5000	0.22



Signed: 

**Test reference: 3995-3591**

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

**Client:** Forbo Flooring UK  
 High Holborn Road, Ripley, Derbyshire,  
 DE5 3NT

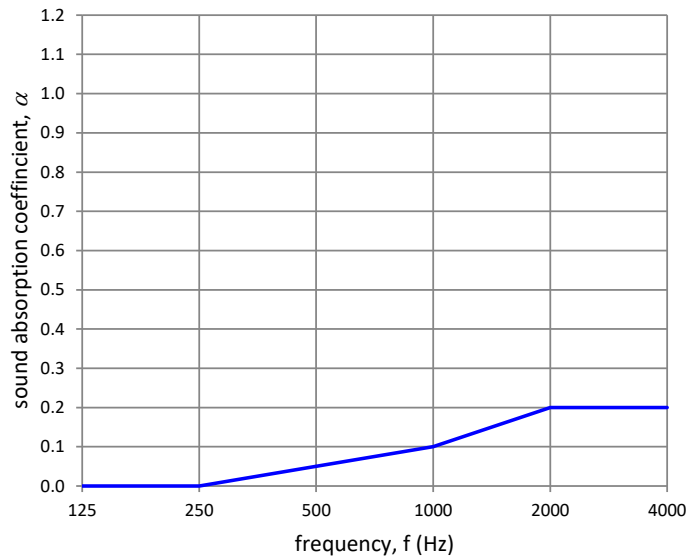
**Product Identification:** Flotex Tile  
**Description of Sample:** Carpet Tiles - Type A Mounting

Room Volume: 217 m<sup>3</sup>                      Location: Acoustic Transmission Suite  
 Sample Size: 12.03 m<sup>2</sup>                      Test Room Large reverberation Room  
 Sample Thickness: 4.8 mm                      Condition: Clean

<b>Sample Out</b>		<b>Sample In</b>	
Temperature	19.8 °C	Temperature	19.8 °C
Relative Humidity	40.8 %	Relative Humidity	40.6 %
Static Pressure	102.6 kPa	Static Pressure	102.5 kPa

**Random Incidence Sound Absorption Coefficient**

Frequency [Hz]	$\alpha_{pi}$
125	0.00
250	0.00
500	0.05
1000	0.10
2000	0.20
4000	0.20



**$\alpha_w = 0.10$**

**Classification: Not Categorised**

Signed: 

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