



TEST REPORT No : 2099-1

DATE OF ISSUE : 5 January 2015

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

**CLIENT:** OCEE Design  
Design House,  
Caswell Road,  
Brackmills,  
Northampton,  
NN4 7PW

**JOB NUMBER:** ACOUS/02099

**MANUFACTURER:** OCEE Design

**MODEL:** “Lucia”, “Blazer” & “Blazer Quilt”

**TYPE:** Discrete Panel Absorbers

**DATE RECEIVED:** 3 December 2014

**DATE OF TEST:** 16 September 2014

Signed: 

I G Rattigan  
Laboratory Manager

Approved: 

D J M'caul  
Technical Manager

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

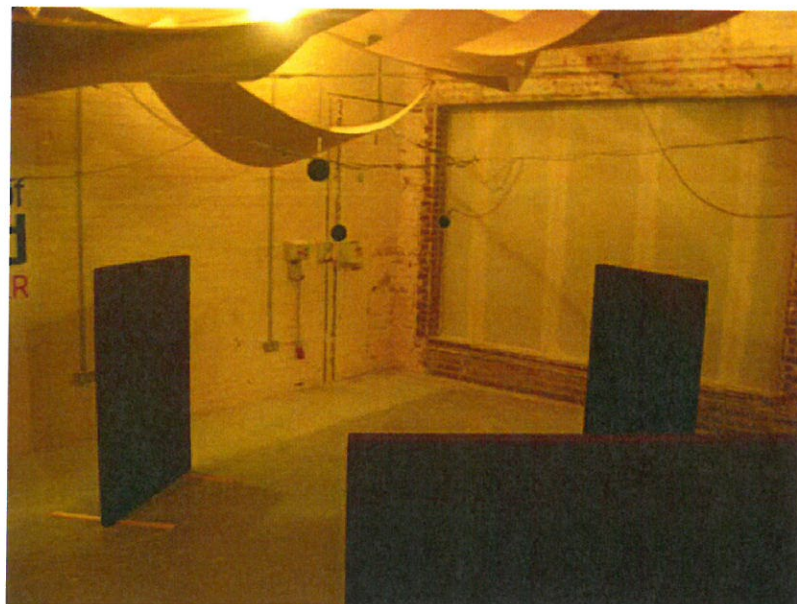
### **1.1** **Description of Test Samples**

Three modular / back panels of the models described on the following pages were installed by the client into randomly marked locations in the centre of the floor of the reverberation room. The panels were positioned at positions greater than 2m away from each other and greater than 1m from any room surface and microphone position.

**Test Reference:** 1884-1542

**Sample Reference:** "Lucia" – fabric covered modular / back panel

**Sample Dimensions:** 1480mm high × 1050mm wide × 50mm thick (measured)



**Test Reference:** 1884-1543

**Sample Reference:** "Blazer" – fabric covered modular / back panel

**Sample Dimensions:** 1483mm high  $\times$  1054mm wide  $\times$  52mm thick (measured)





**Test Reference:** 1884-1544

**Sample Reference:** "Blazer Quilt" – fabric covered modular / back panel

**Sample Dimensions:** 1480mm high × 1045mm wide × 55mm thick (measured)



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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 1.22m × 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<sup>3</sup> and a total surface area of 224m<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 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 equivalent sound absorption area of the test specimen in  $m^2$  was determined at each frequency from the measured data by means of the equations below:

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

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)

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### **3    EQUIPMENT**

|   | <b>Departmental<br/>Record No</b> |
|---|-----------------------------------|
| Norwegian Electronics 1/3 octave band real time analyser<br>type 840 with in-built random noise generator | RTA2                              |
| Quad 510 power amplifier  | PA7                               |
| 2 of broadband loudspeakers (receiving room)  | LS3-LS4                           |
| 5 of Bruel &Kjaer random incidence condenser microphone<br>type 4166 in the receiving room                | M7-M9<br>M18, M19                 |
| 1 of G.R.A.S. random incidence condenser microphones<br>type 40AP in the receiving room                   | M20                               |
| 1 of Norsonic Multiplexers type 834A  | MP2                               |
| HP Brio Pentium personal computer and related peripheral<br>equipment (printer, plotter, monitor etc.)    | COM6                              |
| 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<sup>3</sup>  
 Static Pressure: 101.5 kPa

| <b>Test Reference:</b>        | <b>1884...</b>    | <b>1542</b> | <b>1543</b> | <b>1544</b> |
|-------------------------------|-------------------|-------------|-------------|-------------|
| Sample size:                  | [m <sup>2</sup> ] | 1480 × 1050 | 1483 × 1054 | 1480 × 1045 |
| Sample thickness:             | [mm]              | 50          | 52          | 55          |
| Sample out temperature:       | [°C]              | 21.6        | 21.6        | 21.6        |
| Sample out relative humidity: | [%]               | 53.5        | 53.5        | 53.5        |
| Sample in temperature:        | [°C]              | 21.7        | 21.6        | 21.8        |
| Sample in relative humidity:  | [%]               | 55.7        | 57.0        | 56.4        |

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



| <b>BS EN ISO 354:2003</b>   |                                  |                     |                     |                  |  |      |
|---|----------------------------------|---------------------|---------------------|------------------|--|------|
| <b>Acoustics - Measurement of absorption in a reverberation room</b>                    |                                  |                     |                     |                  |  |      |
| Client: OCEE Design<br>Design House<br>Caswell Road, Brackmills<br>Northampton, NN4 7PW |                                  |                     |                     |                  |  |      |
| Object: "Lucia"   |                                  |                     |                     |                  |  |      |
| Size: Three panels 1480mm high x 1050mm wide x 50mm thick                               |                                  |                     |                     |                  |  |      |
| Receiving room:   |                                  |                     |                     |                  |  |      |
| Volume: 220 m <sup>3</sup>  |                                  |                     |                     |                  |  |      |
| Condition: clean  |                                  |                     |                     |                  |  |      |
| Type: large reverberation room  |                                  |                     |                     |                  |  |      |
| Location: acoustic transmission suite   |                                  |                     |                     |                  |  |      |
| Sample out: Temperature [°C]: 21.6 Humidity [%]: 53.5                                   |                                  |                     |                     |                  |  |      |
| Sample in: Temperature [°C]: 21.7 Humidity [%]: 55.7                                    |                                  |                     |                     |                  |  |      |
| <b>Equivalent absorption Area A<sub>T</sub></b>   |                                  |                     |                     |                  |  |      |
| Frequency<br>Hz   | A <sub>T</sub><br>m <sup>2</sup> | T <sub>1</sub><br>s | T <sub>2</sub><br>s |                  |  |      |
| 100   | 1.7                              | 5.30                | 4.22                |                  |  |      |
| 125   | 2.3                              | 4.57                | 3.50                |                  |  |      |
| 160   | 2.8                              | 3.57                | 2.77                |                  |  |      |
| 200   | 4.4                              | 3.71                | 2.55                |                  |  |      |
| 250   | 4.4                              | 3.98                | 2.67                |                  |  |      |
| 315   | 4.2                              | 4.34                | 2.87                |                  |  |      |
| 400   | 4.8                              | 4.36                | 2.75                |                  |  |      |
| 500   | 4.4                              | 4.68                | 2.95                |                  |  |      |
| 630   | 4.2                              | 4.62                | 2.98                |                  |  |      |
| 800   | 4.3                              | 4.67                | 2.99                |                  |  |      |
| 1000  | 4.3                              | 4.52                | 2.92                |                  |  |      |
| 1250  | 4.1                              | 4.35                | 2.89                |                  |  |      |
| 1600  | 4.2                              | 4.13                | 2.79                |                  |  |      |
| 2000  | 4.4                              | 3.76                | 2.56                |                  |  |      |
| 2500  | 4.9                              | 3.34                | 2.29                |                  |  |      |
| 3150  | 6.0                              | 2.98                | 1.99                |                  |  |      |
| 4000  | 6.9                              | 2.47                | 1.68                |                  |  |      |
| 5000  | 8.2                              | 1.98                | 1.37                |                  |  |      |
|   |                                  |                     |                     |                  |  |      |
|   |                                  |                     |                     |                  |  |      |
| Test reference number: 1884-1542  |                                  |                     |                     | Date: 16/09/2014 |  |      |
| University of Salford, School of Computing, Science & Engineering                       |                                  |                     |                     |                  |  | SSV1 |

| <p><b>BS EN ISO 354:2003</b></p> <p><b>Acoustics - Measurement of absorption in a reverberation room</b></p>  |                                  |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |  |  |  |
|---|----------------------------------|----------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|-----|------|-----|------|-----|------|-----|------|-----|------|-----|------|-----|------|-----|--|--|--|--|--|--|--|--|
| <p>Client: OCEE Design<br/>Design House<br/>Caswell Road, Brackmills<br/>Northampton, NN4 7PW</p>   |                                  |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |  |  |  |
| <p>Object: "Lucia"</p>  |                                  |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |  |  |  |
| <p>Size: Three panels 1480mm high x 1050mm wide x 50mm thick</p>  |                                  |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |  |  |  |
| <p>Receiving room:</p> <p>Volume: 220 m<sup>3</sup><br/>Condition: clean<br/>Type: large reverberation room<br/>Location: acoustic transmission suite</p>   |                                  |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |  |  |  |
| <p>Sample out: Temperature [°C]: 21.6      Humidity [%]: 53.5<br/>Sample in: Temperature [°C]: 21.7      Humidity [%]: 55.7</p>   |                                  |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |  |  |  |
| <p><b>Equivalent absorption Area A<sub>T</sub></b></p>  |                                  |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |  |  |  |
| <table border="1"> <thead> <tr> <th>Frequency<br/>Hz</th> <th>A<sub>T</sub><br/>m<sup>2</sup></th> </tr> </thead> <tbody> <tr><td>100</td><td>1.7</td></tr> <tr><td>125</td><td>2.3</td></tr> <tr><td>160</td><td>2.8</td></tr> <tr><td>200</td><td>4.4</td></tr> <tr><td>250</td><td>4.4</td></tr> <tr><td>315</td><td>4.2</td></tr> <tr><td>400</td><td>4.8</td></tr> <tr><td>500</td><td>4.4</td></tr> <tr><td>630</td><td>4.2</td></tr> <tr><td>800</td><td>4.3</td></tr> <tr><td>1000</td><td>4.3</td></tr> <tr><td>1250</td><td>4.1</td></tr> <tr><td>1600</td><td>4.2</td></tr> <tr><td>2000</td><td>4.4</td></tr> <tr><td>2500</td><td>4.9</td></tr> <tr><td>3150</td><td>6.0</td></tr> <tr><td>4000</td><td>6.9</td></tr> <tr><td>5000</td><td>8.2</td></tr> <tr><td></td><td></td></tr> <tr><td></td><td></td></tr> <tr><td></td><td></td></tr> </tbody> </table> | Frequency<br>Hz                  | A <sub>T</sub><br>m <sup>2</sup> | 100 | 1.7 | 125 | 2.3 | 160 | 2.8 | 200 | 4.4 | 250 | 4.4 | 315 | 4.2 | 400 | 4.8 | 500 | 4.4 | 630 | 4.2 | 800 | 4.3 | 1000 | 4.3 | 1250 | 4.1 | 1600 | 4.2 | 2000 | 4.4 | 2500 | 4.9 | 3150 | 6.0 | 4000 | 6.9 | 5000 | 8.2 |  |  |  |  |  |  |  |  |
| Frequency<br>Hz   | A <sub>T</sub><br>m <sup>2</sup> |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |  |  |  |
| 100   | 1.7                              |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |  |  |  |
| 125   | 2.3                              |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |  |  |  |
| 160   | 2.8                              |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |  |  |  |
| 200   | 4.4                              |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |  |  |  |
| 250   | 4.4                              |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |  |  |  |
| 315   | 4.2                              |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |  |  |  |
| 400   | 4.8                              |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |  |  |  |
| 500   | 4.4                              |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |  |  |  |
| 630   | 4.2                              |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |  |  |  |
| 800   | 4.3                              |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |  |  |  |
| 1000  | 4.3                              |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |  |  |  |
| 1250  | 4.1                              |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |  |  |  |
| 1600  | 4.2                              |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |  |  |  |
| 2000  | 4.4                              |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |  |  |  |
| 2500  | 4.9                              |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |  |  |  |
| 3150  | 6.0                              |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |  |  |  |
| 4000  | 6.9                              |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |  |  |  |
| 5000  | 8.2                              |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |  |  |  |
|   |                                  |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |  |  |  |
|   |                                  |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |  |  |  |
|   |                                  |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |  |  |  |
| <p>Test reference number: 1884-1542</p>   |                                  | <p>Date: 16/09/2014</p>          |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |  |  |  |
| <p>University of Salford, School of Computing, Science &amp; Engineering</p>  |                                  | <p>SSV1</p>                      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |  |  |  |

| <b>BS EN ISO 354:2003</b>  |                                  |                        |                     |
|--|----------------------------------|------------------------|---------------------|
| <b>Acoustics - Measurement of absorption in a reverberation room</b>   |                                  |                        |                     |
| Client: OCEE Design<br>Design House<br>Caswell Road, Brackmills<br>Northampton, NN4 7PW  |                                  |                        |                     |
| Object: "Blazer"   |                                  |                        |                     |
| Size: Three panels 1483mm high x 1054mm wide x 52mm thick  |                                  |                        |                     |
| Receiving room:<br><br>Volume: 220 m <sup>3</sup><br>Condition: clean<br>Type: large reverberation room<br>Location: acoustic transmission suite |                                  |                        |                     |
| Sample out:  |                                  | Temperature [°C]: 21.6 | Humidity [%]: 53.5  |
| Sample in:   |                                  | Temperature [°C]: 21.6 | Humidity [%]: 57.0  |
| <b>Equivalent absorption Area A<sub>T</sub></b>  |                                  |                        |                     |
| Frequency<br>Hz  | A <sub>T</sub><br>m <sup>2</sup> | T <sub>1</sub><br>s    | T <sub>2</sub><br>s |
| 100  | 1.8                              | 5.30                   | 4.17                |
| 125  | 2.2                              | 4.57                   | 3.55                |
| 160  | 2.5                              | 3.57                   | 2.84                |
| 200  | 4.3                              | 3.71                   | 2.56                |
| 250  | 4.3                              | 3.98                   | 2.68                |
| 315  | 4.3                              | 4.34                   | 2.85                |
| 400  | 4.7                              | 4.36                   | 2.77                |
| 500  | 4.5                              | 4.68                   | 2.93                |
| 630  | 4.4                              | 4.62                   | 2.95                |
| 800  | 4.5                              | 4.67                   | 2.94                |
| 1000   | 4.3                              | 4.52                   | 2.92                |
| 1250   | 4.3                              | 4.35                   | 2.85                |
| 1600   | 4.3                              | 4.13                   | 2.76                |
| 2000   | 4.9                              | 3.76                   | 2.47                |
| 2500   | 5.5                              | 3.34                   | 2.20                |
| 3150   | 6.5                              | 2.98                   | 1.94                |
| 4000   | 7.1                              | 2.47                   | 1.67                |
| 5000   | 7.9                              | 1.98                   | 1.39                |
|  |                                  |                        |                     |
|  |                                  |                        |                     |
| Test reference number: 1884-1543   |                                  | Date: 16/09/2014       |                     |
| University of Salford, School of Computing, Science & Engineering  |                                  |                        | SSV1                |

| <b>BS EN ISO 354:2003</b>   |   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |
|---|---|----------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|-----|------|-----|------|-----|------|-----|------|-----|------|-----|------|-----|------|-----|--|
| <b>Acoustics - Measurement of absorption in a reverberation room</b>  |   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |
| Client:   | OCEE Design<br>Design House<br>Caswell Road, Brackmills<br>Northampton, NN4 7PW   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |
| Object:   | "Blazer"  |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |
| Size:   | Three panels 1483mm high x 1054mm wide x 52mm thick   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |
| Receiving room:   | Volume: 220 m <sup>3</sup><br>Condition: clean<br>Type: large reverberation room<br>Location: acoustic transmission suite |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |
| Sample out:   | Temperature [°C]: 21.6      Humidity [%]: 53.5  |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |
| Sample in:  | Temperature [°C]: 21.6      Humidity [%]: 57.0  |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |
| <b>Equivalent absorption Area A<sub>T</sub></b>   |   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |
| <table border="1"> <thead> <tr> <th>Frequency<br/>Hz</th> <th>A<sub>T</sub><br/>m<sup>2</sup></th> </tr> </thead> <tbody> <tr><td>100</td><td>1.8</td></tr> <tr><td>125</td><td>2.2</td></tr> <tr><td>160</td><td>2.5</td></tr> <tr><td>200</td><td>4.3</td></tr> <tr><td>250</td><td>4.3</td></tr> <tr><td>315</td><td>4.3</td></tr> <tr><td>400</td><td>4.7</td></tr> <tr><td>500</td><td>4.5</td></tr> <tr><td>630</td><td>4.4</td></tr> <tr><td>800</td><td>4.5</td></tr> <tr><td>1000</td><td>4.3</td></tr> <tr><td>1250</td><td>4.3</td></tr> <tr><td>1600</td><td>4.3</td></tr> <tr><td>2000</td><td>4.9</td></tr> <tr><td>2500</td><td>5.5</td></tr> <tr><td>3150</td><td>6.5</td></tr> <tr><td>4000</td><td>7.1</td></tr> <tr><td>5000</td><td>7.9</td></tr> </tbody> </table> | Frequency<br>Hz   | A <sub>T</sub><br>m <sup>2</sup> | 100 | 1.8 | 125 | 2.2 | 160 | 2.5 | 200 | 4.3 | 250 | 4.3 | 315 | 4.3 | 400 | 4.7 | 500 | 4.5 | 630 | 4.4 | 800 | 4.5 | 1000 | 4.3 | 1250 | 4.3 | 1600 | 4.3 | 2000 | 4.9 | 2500 | 5.5 | 3150 | 6.5 | 4000 | 7.1 | 5000 | 7.9 |  |
| Frequency<br>Hz   | A <sub>T</sub><br>m <sup>2</sup>  |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |
| 100   | 1.8   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |
| 125   | 2.2   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |
| 160   | 2.5   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |
| 200   | 4.3   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |
| 250   | 4.3   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |
| 315   | 4.3   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |
| 400   | 4.7   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |
| 500   | 4.5   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |
| 630   | 4.4   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |
| 800   | 4.5   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |
| 1000  | 4.3   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |
| 1250  | 4.3   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |
| 1600  | 4.3   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |
| 2000  | 4.9   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |
| 2500  | 5.5   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |
| 3150  | 6.5   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |
| 4000  | 7.1   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |
| 5000  | 7.9   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |
| Test reference number: 1884-1543  | Date: 16/09/2014  |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |
| University of Salford, School of Computing, Science & Engineering   | SSV1  |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |

| <b>BS EN ISO 354:2003</b>   |                                  |                        |                     |
|---|----------------------------------|------------------------|---------------------|
| <b>Acoustics - Measurement of absorption in a reverberation room</b>                    |                                  |                        |                     |
| Client: OCEE Design<br>Design House<br>Caswell Road, Brackmills<br>Northampton, NN4 7PW |                                  |                        |                     |
| Object: "Blazer Quilt"  |                                  |                        |                     |
| Size: Three panels 1480mm high x 1045mm wide x 55mm thick                               |                                  |                        |                     |
| Receiving room:   |                                  |                        |                     |
| Volume: 220 m <sup>3</sup>  |                                  |                        |                     |
| Condition: clean  |                                  |                        |                     |
| Type: large reverberation room  |                                  |                        |                     |
| Location: acoustic transmission suite   |                                  |                        |                     |
| Sample out:   |                                  | Temperature [°C]: 21.6 | Humidity [%]: 53.5  |
| Sample in:  |                                  | Temperature [°C]: 21.8 | Humidity [%]: 56.4  |
| <b>Equivalent absorption Area A<sub>T</sub></b>   |                                  |                        |                     |
| Frequency<br>Hz   | A <sub>T</sub><br>m <sup>2</sup> | T <sub>1</sub><br>s    | T <sub>2</sub><br>s |
| 100   | 2.1                              | 5.30                   | 4.04                |
| 125   | 2.1                              | 4.57                   | 3.59                |
| 160   | 2.9                              | 3.57                   | 2.76                |
| 200   | 4.6                              | 3.71                   | 2.52                |
| 250   | 4.4                              | 3.98                   | 2.66                |
| 315   | 4.6                              | 4.34                   | 2.78                |
| 400   | 5.6                              | 4.36                   | 2.59                |
| 500   | 5.2                              | 4.68                   | 2.77                |
| 630   | 5.0                              | 4.62                   | 2.80                |
| 800   | 5.2                              | 4.67                   | 2.76                |
| 1000  | 5.7                              | 4.52                   | 2.62                |
| 1250  | 5.9                              | 4.35                   | 2.53                |
| 1600  | 6.6                              | 4.13                   | 2.34                |
| 2000  | 7.2                              | 3.76                   | 2.13                |
| 2500  | 7.9                              | 3.34                   | 1.92                |
| 3150  | 8.8                              | 2.98                   | 1.72                |
| 4000  | 9.2                              | 2.47                   | 1.52                |
| 5000  | 9.3                              | 1.98                   | 1.32                |
|   |                                  |                        |                     |
|   |                                  |                        |                     |
| Test reference number: 1884-1544  |                                  | Date: 16/09/2014       |                     |
| University of Salford, School of Computing, Science & Engineering                       |                                  |                        | SSV1                |



| <b>BS EN ISO 354:2003</b>   |   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |
|---|---|----------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|-----|------|-----|------|-----|------|-----|------|-----|------|-----|------|-----|------|-----|--|--|--|--|--|
| <b>Acoustics - Measurement of absorption in a reverberation room</b>  |   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |
| Client:   | OCEE Design<br>Design House<br>Caswell Road, Brackmills<br>Northampton, NN4 7PW   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |
| Object:   | "Blazer Quilt"  |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |
| Size:   | Three panels 1480mm high x 1045mm wide x 55mm thick   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |
| Receiving room:   | Volume: 220 m <sup>3</sup><br>Condition: clean<br>Type: large reverberation room<br>Location: acoustic transmission suite |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |
| Sample out:   | Temperature [°C]: 21.6      Humidity [%]: 53.5  |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |
| Sample in:  | Temperature [°C]: 21.8      Humidity [%]: 56.4  |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |
| <b>Equivalent absorption Area A<sub>T</sub></b>   |   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |
| <table border="1"> <thead> <tr> <th>Frequency<br/>Hz</th> <th>A<sub>T</sub><br/>m<sup>2</sup></th> </tr> </thead> <tbody> <tr><td>100</td><td>2.1</td></tr> <tr><td>125</td><td>2.1</td></tr> <tr><td>160</td><td>2.9</td></tr> <tr><td>200</td><td>4.6</td></tr> <tr><td>250</td><td>4.4</td></tr> <tr><td>315</td><td>4.6</td></tr> <tr><td>400</td><td>5.6</td></tr> <tr><td>500</td><td>5.2</td></tr> <tr><td>630</td><td>5.0</td></tr> <tr><td>800</td><td>5.2</td></tr> <tr><td>1000</td><td>5.7</td></tr> <tr><td>1250</td><td>5.9</td></tr> <tr><td>1600</td><td>6.6</td></tr> <tr><td>2000</td><td>7.2</td></tr> <tr><td>2500</td><td>7.9</td></tr> <tr><td>3150</td><td>8.8</td></tr> <tr><td>4000</td><td>9.2</td></tr> <tr><td>5000</td><td>9.3</td></tr> <tr><td></td><td></td></tr> <tr><td></td><td></td></tr> </tbody> </table> | Frequency<br>Hz   | A <sub>T</sub><br>m <sup>2</sup> | 100 | 2.1 | 125 | 2.1 | 160 | 2.9 | 200 | 4.6 | 250 | 4.4 | 315 | 4.6 | 400 | 5.6 | 500 | 5.2 | 630 | 5.0 | 800 | 5.2 | 1000 | 5.7 | 1250 | 5.9 | 1600 | 6.6 | 2000 | 7.2 | 2500 | 7.9 | 3150 | 8.8 | 4000 | 9.2 | 5000 | 9.3 |  |  |  |  | <p>The graph plots the sound absorption coefficient, <math>\alpha_s</math>, against frequency, <math>f</math> (Hz). The x-axis is logarithmic, ranging from 100 Hz to 4000 Hz. The y-axis is linear, ranging from 0.0 to 10.0. The data points from the table are plotted and connected by a blue line, showing a general upward trend with some fluctuations.</p> |
| Frequency<br>Hz   | A <sub>T</sub><br>m <sup>2</sup>  |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |
| 100   | 2.1   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |
| 125   | 2.1   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |
| 160   | 2.9   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |
| 200   | 4.6   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |
| 250   | 4.4   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |
| 315   | 4.6   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |
| 400   | 5.6   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |
| 500   | 5.2   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |
| 630   | 5.0   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |
| 800   | 5.2   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |
| 1000  | 5.7   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |
| 1250  | 5.9   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |
| 1600  | 6.6   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |
| 2000  | 7.2   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |
| 2500  | 7.9   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |
| 3150  | 8.8   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |
| 4000  | 9.2   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |
| 5000  | 9.3   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |
|   |   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |
|   |   |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |
| Test reference number: 1884-1544  | Date: 16/09/2014  |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |
| University of Salford, School of Computing, Science & Engineering   | SSV1  |                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |  |  |  |  |  |