



1262



University of  
**Salford**  
MANCHESTER

**Acoustic Test Laboratory**  
The University of Salford  
Salford, Greater Manchester  
M5 4WT, United Kingdom

T: +44 (0) 161 295 3814  
E: acoustic.testing@salford.ac.uk

**TEST REPORT No : 06443-6331**

**DATE OF ISSUE : 15 November 2023**

**Page 1 of 9**

**BS EN ISO 354:2003**


**Acoustics – Measurement of Sound Absorption in a Reverberation Room**

**Client:** Whitecroft Lighting Limited

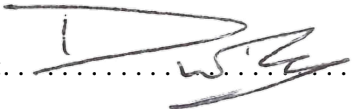
**Job Number:** 06443

**Sample Reference:** Luminaire

**Date(s) of Test:** 25 October 2023

Signed:  .....

L Cambridge  
**Specialist Acoustics Technician**

Approved:  .....

D Wong-McSweeney  
**Laboratory Manager**

## Contents

1. Test Samples .....	3
1.1. Description of Test Samples .....	3
1.2. Test Reference: 06443-6331 .....	3
2. Description of Test Procedure.....	4
2.1. Description of Test Facility.....	4
2.2. Test Procedure .....	4
2.3. Calculation .....	5
3. Equipment.....	6
4. Results.....	7

**Client Details:** Whitecroft Lighting Limited  
Burlington Street  
Ashton-under-Lyne  
Lancashire  
OL07 OAX

**Manufacturer:** Client

**Mounting Type:** Discrete Object Mounting

**Date Order Received:** 18 September 2023

# 1. Test Samples

The following sample was installed in the large reverberation room of the University of Salford Acoustic Test Laboratory. It was installed in accordance with Annex B of BS EN ISO 354:2003. All information regarding the samples comes from laboratory measurements unless marked with “cs” or otherwise stated.

## 1.1. Description of Test Samples

- 1.2. **Test Reference:** 06443-6331  
**Sample Reference<sup>cs</sup>:** Luminaire  
**Sample Description:** Lighting Fixture

Two of the same sample were installed, as received from the client, in the reverberation chamber. Each was elevated above the chamber’s floor by 780 mm on a trestle without occluding the infill material that was exposed on both the top and bottom surfaces. The light faced upwards into the room. One of the samples had a lighting diffuser projecting from the surface and the other did not.

Sample Dimensions: 2400 × 780 × 55 mm (not including the lighting diffuser)



## **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  $\times$  ~6.6 m wide  $\times$  4.5 m high with a volume of 221 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 12.79 m<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. 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.

(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, HG2, BM3
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 equivalent absorption area coefficients per object,  $A_{obj}$ , are given in the tables over leaf.

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:** **Whitecroft Lighting Limited**  
Burlington Street, Ashton-under-Lyne, Lancashire,  
OL07 OAX

**Sample Reference:** **Luminaire**  
**Description of Sample:** Lighting Fixture

Room Volume: 221 m<sup>3</sup>      Location: Acoustic Transmission Suite  
No. of Samples: 2      Test Room Large reverberation Room  
Condition: Clean

<b>Sample Out</b>		<b>Sample In</b>	
Temperature	20.0 °C	Temperature	20.1 °C
Relative Humidity	47.4 %	Relative Humidity	48.3 %
Static Pressure	99.5 kPa	Static Pressure	99.5 kPa

### Random Incidence Equivalent Absorption Area

Frequency [Hz]	$T_1$ [s]	$T_2$ [s]	$A_{obj}$
100	6.42	5.35	0.6
125	4.78	3.98	0.7
160	5.16	3.97	1.0
200	5.71	4.29	1.0
250	6.74	4.27	1.5
315	6.58	3.59	2.2
400	6.26	3.46	2.3
500	6.22	3.09	2.9
630	5.94	2.78	3.4
800	5.78	2.66	3.6
1000	5.36	2.56	3.6
1250	4.96	2.45	3.7
1600	4.52	2.45	3.3
2000	4.06	2.34	3.2
2500	3.47	2.15	3.2
3150	2.95	1.96	3.1
4000	2.31	1.66	3.1
5000	1.93	1.47	3.0

---

**Test reference: 06443-6331**

Date: 25 October 2023

University of Salford, School of Computing Science & Engineering



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

**Client:** **Whitecroft Lighting Limited**  
Burlington Street, Ashton-under-Lyne, Lancashire,  
OL07 OAX

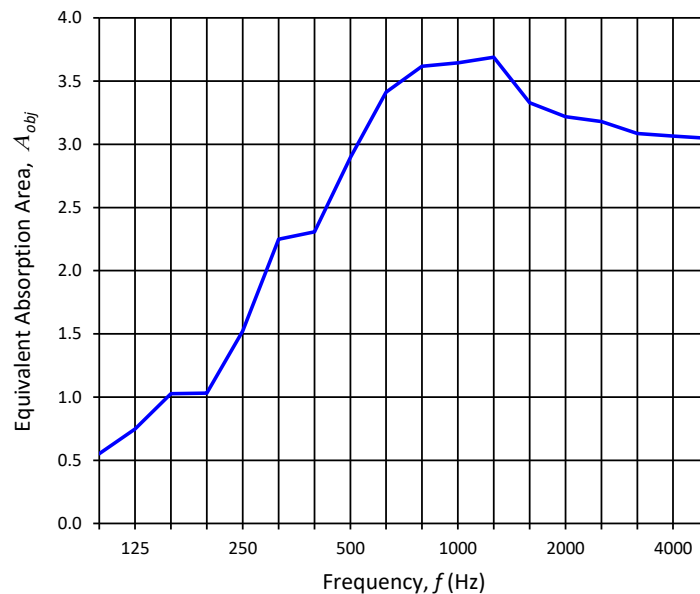
**Sample Reference:** **Luminaire**  
**Description of Sample:** Lighting Fixture

Room Volume: 221 m<sup>3</sup> Location: Acoustic Transmission Suite  
No. of Samples: 2 Test Room Large reverberation Room  
Condition: Clean

<b>Sample Out</b>		<b>Sample In</b>	
Temperature	20.0 °C	Temperature	20.1 °C
Relative Humidity	47.4 %	Relative Humidity	48.3 %
Static Pressure	99.5 kPa	Static Pressure	99.5 kPa

### Random Incidence Equivalent Absorption Area

Frequency [Hz]	$A_{obj}$
100	0.6
125	0.7
160	1.0
200	1.0
250	1.5
315	2.2
400	2.3
500	2.9
630	3.4
800	3.6
1000	3.6
1250	3.7
1600	3.3
2000	3.2
2500	3.2
3150	3.1
4000	3.1
5000	3.0



Signed: \_\_\_\_\_

Test reference: 06443-6331

Date: 25 October 2023

University of Salford, School of Computing Science &amp; Engineering