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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**

**1.5. Test Reference:** **4775-4325**

**Sample Reference:** Turbo Traps

**Sample Description:** Bass Traps – Non-Standard Mounting

Eight bass traps were installed, by the client, on their sides around the edges of reverberation chamber. The cylindrical traps were 916 mm long with a 410 mm diameter.

# 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

$\alpha_s$ 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, $\alpha_W$, 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, $\alpha_s$, are given in the tables over leaf where applicable.

Also given, where applicable, are the octave-band practical sound absorption coefficients, $\alpha_{pi}$, and the weighted sound absorption coefficient, $\alpha_W$.

The random incidence sound absorption coefficients per object, $\alpha_{obj}$ ($m^2$), 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: | **Turbo Traps** |
| Description of Sample: | Bass Traps - Non-Standard Mounting |
| | *Frequencies 50, 63 and 80 Hz are not accredited.* |

| | | | |
|---|---|---|---|
| Room Volume: | 221 m³ | Location: | Acoustic Transmission Suite |
| No. of Samples: | 8 | 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 | 50.9 % |
| Static Pressure | 100.5 kPa | Static Pressure | 100.5 kPa |

### Random Incidence Equivalent Absorption Area

| Frequency [Hz] | $T_1$ [s] | $T_2$ [s] | $A_{obj}$ |
|---|---|---|---|
| *50* | *6.55* | *2.40* | *0.2* |
| *63* | *6.84* | *2.12* | *0.3* |
| *80* | *6.60* | *2.33* | *0.8* |
| 100 | 8.26 | 2.22 | 1.5 |
| 125 | 6.87 | 2.02 | 1.6 |
| 160 | 6.55 | 2.40 | 1.2 |
| 200 | 6.84 | 2.12 | 1.5 |
| 250 | 6.60 | 2.33 | 1.2 |
| 315 | 6.89 | 2.28 | 1.3 |
| 400 | 6.85 | 2.54 | 1.1 |
| 500 | 6.93 | 2.59 | 1.1 |
| 630 | 6.91 | 2.69 | 1.0 |
| 800 | 6.63 | 2.75 | 1.0 |
| 1000 | 6.35 | 2.82 | 0.9 |
| 1250 | 5.82 | 2.76 | 0.9 |
| 1600 | 5.37 | 2.71 | 0.8 |
| 2000 | 4.74 | 2.62 | 0.8 |
| 2500 | 4.04 | 2.37 | 0.8 |
| 3150 | 3.33 | 2.13 | 0.8 |
| 4000 | 2.47 | 1.75 | 0.7 |
| 5000 | 2.11 | 1.58 | 0.7 |

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University of Salford, School of Computing Science & Engineering

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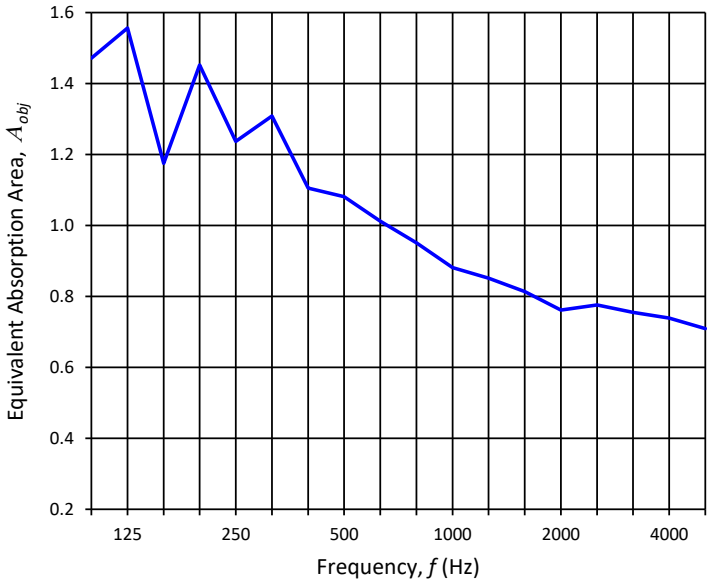
|---|---|---|---|
| Room Volume: | 221 m³ | Location: | Acoustic Transmission Suite |
| No. of Samples: | 8 | Test Room | Large reverberation Room |
| | | Condition: | Clean |

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

### Random Incidence Equivalent Absorption Area

| Frequency [Hz] | $A_{obj}$ |
|---|---|
| *50* | *0.2* |
| *63* | *0.3* |
| *80* | *0.8* |
| 100 | 1.5 |
| 125 | 1.6 |
| 160 | 1.2 |
| 200 | 1.5 |
| 250 | 1.2 |
| 315 | 1.3 |
| 400 | 1.1 |
| 500 | 1.1 |
| 630 | 1.0 |
| 800 | 1.0 |
| 1000 | 0.9 |
| 1250 | 0.9 |
| 1600 | 0.8 |
| 2000 | 0.8 |
| 2500 | 0.8 |
| 3150 | 0.8 |
| 4000 | 0.7 |
| 5000 | 0.7 |

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