

**REPORT ON THE DETERMINATION OF SOUND
ABSORPTION COEFFICIENTS OF WOVEN IMAGE “ECHO PANEL 7MM”
TESTED WITH NO AIR GAP IN A REVERBERATION ROOM.**

Testing Procedure: AS ISO 354 - 2006

Testing Laboratory: Applied Acoustics Laboratory
RMIT University, School of Applied Sciences
Melbourne, Victoria 3000, Australia
NATA Accreditation Number 1421

Client: Woven Image Pty. Limited
37-39 Chard Road
Brookvale NSW 2100
Australia

Date of Test: 5th August 2009

Date of Report: 6th August 2009

Report Number: 1211/09-133/PD

Testing Officer: Peter Dale



Peter Dale
Approved NATA Signatory



This document issued in compliance with NATA's
accreditation requirements.
Accredited for compliance with ISO/IEC 17025

REPORT ON THE DETERMINATION OF SOUND ABSORPTION COEFFICIENTS OF WOVEN IMAGE “ECHO PANEL 7MM” TESTED WITH NO AIR GAP IN A REVERBERATION ROOM.

1. INTRODUCTION

The tests described in this report were carried out at the request of the Woven Image Pty. Limited to determine the sound absorption coefficients of a sample of “Echo Panel 7mm” tested with no air gap.

The tests were carried out using the reverberation room of the Applied Physics Discipline, The Royal Melbourne Institute of Technology Limited.

Testing has been carried out in accordance with AS ISO 354–2006 “Acoustics: Measurement of sound absorption in a reverberation room”. At the request of the client the weighted sound absorption coefficient α_w has been determined in accordance with AS ISO 11654-1997 “Acoustics: Sound Absorbers for Use in Buildings - Rating of sound absorption”.

The equipment used to perform these tests has been calibrated at an accredited laboratory and is in current calibration.

2. TEST FACILITIES AND PROCEDURES

2.1 Facilities The reverberation room is of pentagonal plan with the ceiling inclined with respect to the floor. No two room dimensions are equal or in the ratio of small whole numbers. The volume of the room is 200.0 cubic metres. A sufficiently diffuse sound field is established by the inclusion of 17 stationary diffusing boards of panelboard, each of one-sided area approximately one square metre and suspended with random orientation. The total two-sided area of the diffusing elements is 0.16 of the total boundary surface area of the room. Previous tests carried out in the room have established that diffusivity of the room sound field is acceptable.

The total surface area of the room boundaries and diffusing elements is 235.6 square metres.

2.2 Generation of sound field The test signals is random noise, band limited to a frequency range of 40Hz to 6300Hz. Three individual loudspeaker positions are used to excite the sound field in the reverberation chamber. The signal is fed to each loudspeaker in turn.

2.3 Receipt of signals Four microphones each mounted in statistically independent locations in the reverberation room are used to measure the sound field decays in the room. Ten sound decays are obtained at each of the twelve loudspeaker/microphone combinations, thus representing 120 decays for each frequency band.

The microphone signal is relayed via a microphone amplifier, to a Bruel & Kjaer 3560 Pulse Multi Analyser System. The Pulse analyser is interfaced to a personal computer. A program running on the personal computer allows the determination of the reverberation time from the sound decays in accordance with the standard. The measuring equipment has been calibrated by an external laboratory, and is in current calibration.

3. SAMPLE FOR TESTING

Sample: Woven Image Echo Panel 7mm

Description: Material: 100% PET
Std Board Size: 2700mm x 1200mm x 7mm thick.
Nominal Surface density: 1400gsm
Air Gap: 0.0mm

The sample tested comprised of 3.5 panels arranged on the floor of the reverberation room floor to give a sample size of 2700mm wide x 4230mm long as depicted in Figure 1 below. The sample was tested with the perimeter edges enclosed by metal edges in accordance with the recommendations contained in AS ISO 354.

The sample was tested with the sample resting on the floor of the reverberation chamber. The total surface area of the sample was 11.42m².

Figure 1: Woven Image Echo Panel 7mm installed in the reverberation chamber for testing with no air gap.



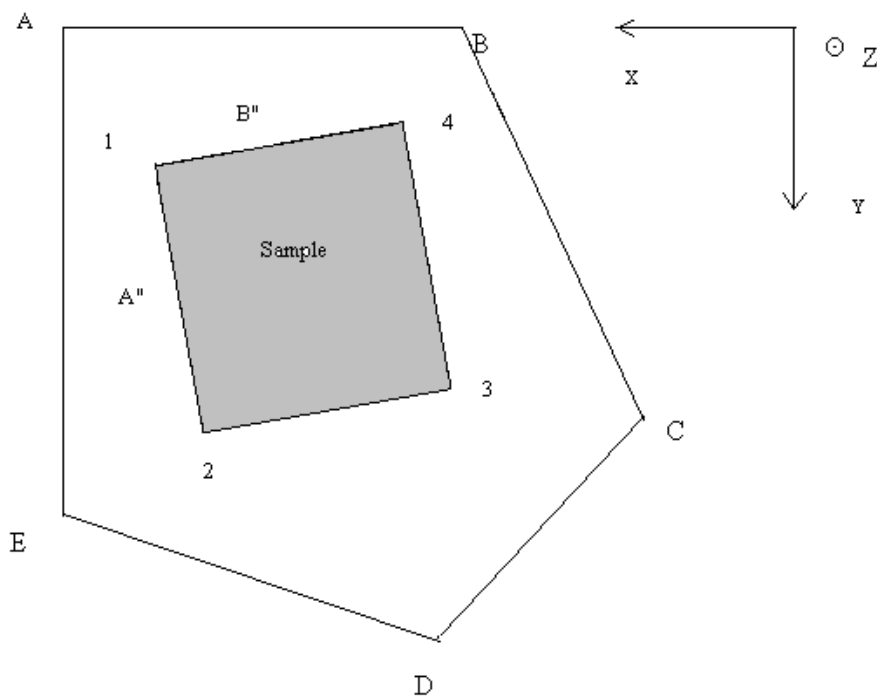
LOCATION OF SAMPLE IN THE REVERBERATION ROOM

Reverberation Chamber (Not to scale):

X and Y co-ordinates of the sample location in the Reverberation Room

Corner Ref. Number	X co-ordinate (metres)	Y co-ordinate (metres)
1	-1.00	1.79
2	-1.76	5.95
3	-4.41	5.47
4	-3.66	1.31

Descriptor	Diagram Reference	Length (m)
Sample Length 1 to 2	Diagram Ref. A''	4.23
Sample Length 1 to 4	Diagram Ref. B''	2.70



4. RESULTS

The mean reverberation times at each frequency for the empty room, $T60_e$, the room with the sample installed, $T60_{e+s}$, the sound absorption coefficient and the 95% confidence interval are provided in Table 1. The results are rounded to 0.01. The 95% confidence interval for each frequency is determined from the standard deviation of the reverberation times of the empty room and the room with the sample. The k factor used to determine the 95% Confidence interval is 2.201.

The results for the sample are detailed in Table 1 and Graph 1 of this report.

Test conditions:

Room Empty Air temperature 19.5°C,
Relative Humidity 47%
Barometric Pressure 0.7656 metre of mercury.

Room with Sample Air temperature 19.5°C,
Relative Humidity 47%
Barometric Pressure 0.7656 metres of mercury

Table 1: Reverberation times and Sound Absorption Coefficients of Woven Image Echo Panel 7mm tested with no air gap

Octave Centre Frequency Bands, Hz	Average RT's for empty room. $T60_e$	Average RT's for room. with sample $T60_{e+s}$	Sound Absorption Coefficient α_s	95% Confidence Interval for α_s
100	8.365	8.480	0.00	0.05
125	7.209	6.885	0.02	0.05
160	8.252	8.096	0.01	0.03
200	9.472	8.892	0.02	0.02
250	9.029	8.239	0.03	0.02
315	8.042	7.140	0.04	0.03
400	7.364	6.056	0.08	0.02
500	6.798	5.474	0.10	0.02
630	6.477	4.923	0.14	0.02
800	6.395	4.401	0.20	0.03
1000	5.879	3.780	0.27	0.02
1250	5.280	3.198	0.35	0.03
1600	4.721	2.689	0.45	0.02
2000	4.023	2.315	0.52	0.03
2500	3.441	1.940	0.64	0.05
3150	2.811	1.652	0.71	0.03
4000	2.277	1.371	0.82	0.04
5000	1.800	1.160	0.87	0.06

The weighted sound absorption coefficient α_w of the sample determined in accordance with AS ISO 11654-1997 “Acoustics: Sound Absorbers for Use in Buildings - Rating of sound absorption” is:

$$\alpha_w = 0.20(H)$$

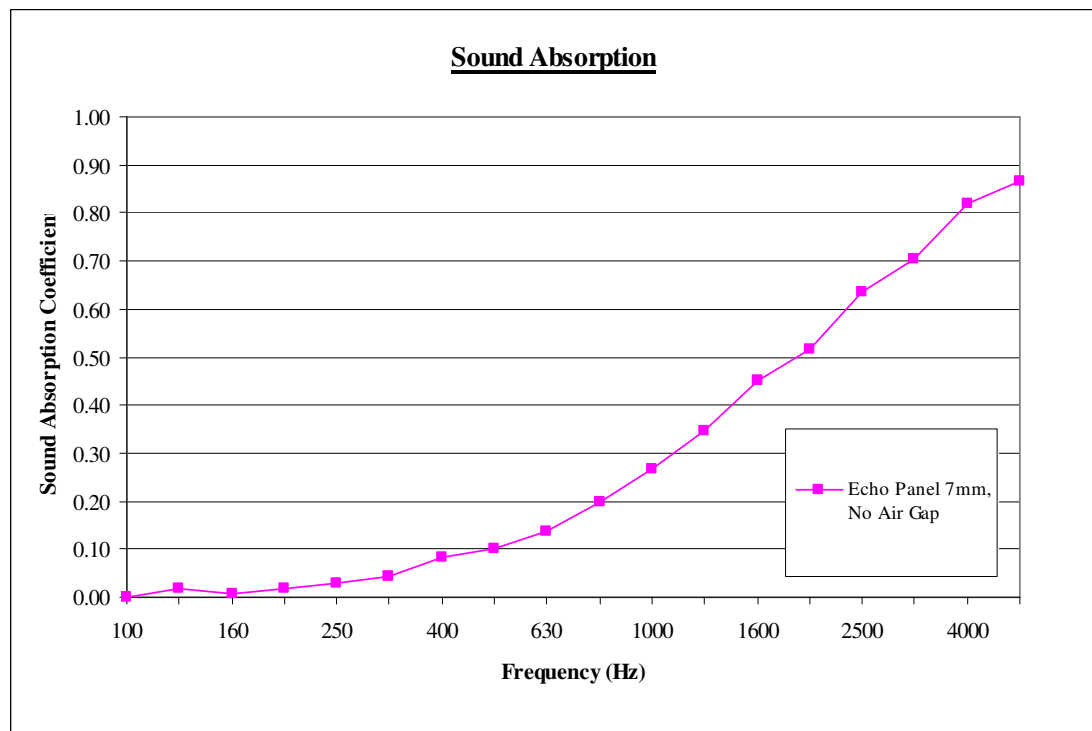
The Practical Sound Absorption Coefficients are detailed below in Table 2. These values have been determined in accordance with AS ISO 11654-1997 “Acoustics: Sound Absorbers for Use in Buildings - Rating of sound absorption”.

Table 2: Practical Sound Absorption Coefficients for the Sample

Frequency (Hz)	125	250	500	1000	2000	4000
Practical Sound Absorption Coefficient, α_p	0.00	0.05	0.10	0.25	0.55	0.80

NRC of the sample calculated in accordance with ASTM C423-90A is: 0.25

Graph 1: Sound Absorption Coefficients of Woven Image Echo Panel 7mm tested with no air gap



**REPORT ON THE DETERMINATION OF SOUND
ABSORPTION COEFFICIENTS OF WOVEN IMAGE “ECHO PANEL 7MM”
TESTED WITH A 20MM AIR GAP IN A REVERBERATION ROOM.**

Testing Procedure: AS ISO 354 - 2006

Testing Laboratory: Applied Acoustics Laboratory
RMIT University, School of Applied Sciences
Melbourne, Victoria 3000, Australia
NATA Accreditation Number 1421

Client: Woven Image Pty. Limited
37- 39 Chard Road
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Date of Test: 5th August 2009

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Testing Officer: Peter Dale



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REPORT ON THE DETERMINATION OF SOUND ABSORPTION COEFFICIENTS OF WOVEN IMAGE “ECHO PANEL 7MM” TESTED WITH A 20MM AIR GAP IN A REVERBERATION ROOM.

1. INTRODUCTION

The tests described in this report were carried out at the request of the Woven Image Pty. Limited to determine the sound absorption coefficients of a sample of Woven Image Echo Panel 7mm tested with a 20mm air gap.

The tests were carried out using the reverberation room of the Applied Physics Discipline, The Royal Melbourne Institute of Technology Limited.

Testing has been carried out in accordance with AS ISO 354–2006 “Acoustics: Measurement of sound absorption in a reverberation room”. At the request of the client the weighted sound absorption coefficient α_w has been determined in accordance with AS ISO 11654-1997 “Acoustics: Sound Absorbers for Use in Buildings - Rating of sound absorption”.

The equipment used to perform these tests has been calibrated at an accredited laboratory and is in current calibration.

2. TEST FACILITIES AND PROCEDURES

2.1 Facilities The reverberation room is of pentagonal plan with the ceiling inclined with respect to the floor. No two room dimensions are equal or in the ratio of small whole numbers. The volume of the room is 200.0 cubic metres. A sufficiently diffuse sound field is established by the inclusion of 17 stationary diffusing boards of panelboard, each of one-sided area approximately one square metre and suspended with random orientation. The total two-sided area of the diffusing elements is 0.16 of the total boundary surface area of the room. Previous tests carried out in the room have established that diffusivity of the room sound field is acceptable.

The total surface area of the room boundaries and diffusing elements is 235.6 square metres.

2.2 Generation of sound field The test signals is random noise, band limited to a frequency range of 40Hz to 6300Hz. Three individual loudspeaker positions are used to excite the sound field in the reverberation chamber. The signal is fed to each loudspeaker in turn.

2.3 Receipt of signals Four microphones each mounted in statistically independent locations in the reverberation room are used to measure the sound field decays in the room. Ten sound decays are obtained at each of the twelve loudspeaker/microphone combinations, thus representing 120 decays for each frequency band.

The microphone signal is relayed via a microphone amplifier, to a Bruel & Kjaer 3560 Pulse Multi Analyser System. The Pulse analyser is interfaced to a personal computer. A program running on the personal computer allows the determination of the reverberation time from the sound decays in accordance with the standard. The measuring equipment has been calibrated by an external laboratory, and is in current calibration.

3. SAMPLE FOR TESTING

Sample: Woven Image Echo Panel 7mm

Description: Material: 100% PET
Std Board Size: 2700mm x 1200mm x 7mm thick.
Nominal Surface density: 1400gsm
Air Gap: 20mm

The sample tested comprised of 3.5 panels arranged on the floor of the reverberation room floor to give a sample size of 2700mm wide x 4230mm long as depicted in Figure 1 below. The sample was tested with the perimeter edges enclosed by metal edges in accordance with the recommendations contained in AS ISO 354.

The sample was tested with the sample mounted with 20mm air gap between the sample and the floor of the reverberation chamber. The total surface area of the sample was 11.42m².

Figure 1: Woven Image Echo Panel 7mm installed for testing in the reverberation chamber with a 20mm air gap.



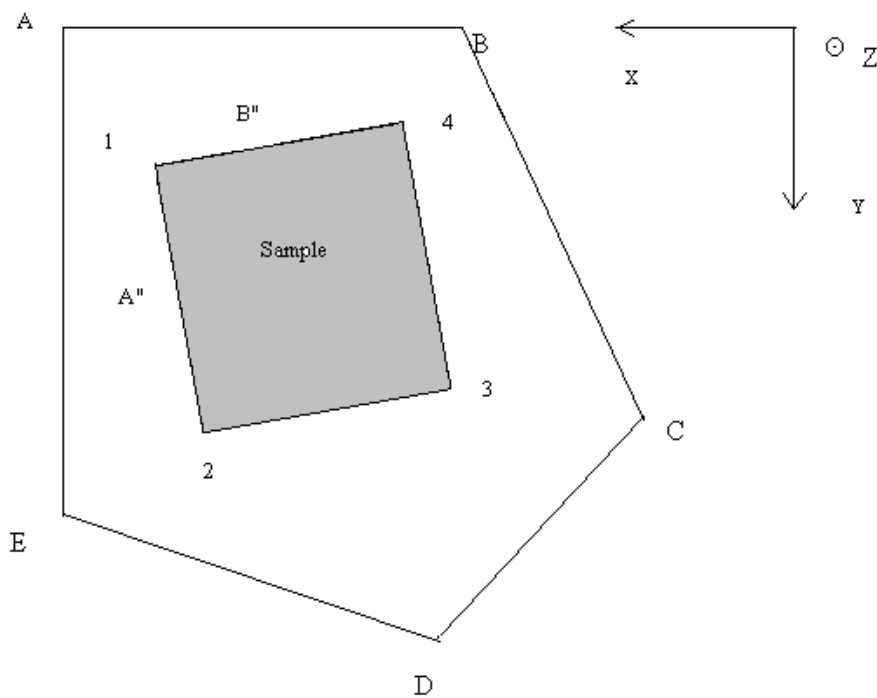
LOCATION OF SAMPLE IN THE REVERBERATION ROOM

Reverberation Chamber (Not to scale):

X and Y co-ordinates of the sample location in the Reverberation Room

Corner Ref. Number	X co-ordinate (metres)	Y co-ordinate (metres)
1	-1.00	1.79
2	-1.76	5.95
3	-4.41	5.47
4	-3.66	1.31

Descriptor	Diagram Reference	Length (m)
Sample Length 1 to 2	Diagram Ref. A''	4.23
Sample Length 1 to 4	Diagram Ref. B''	2.70



4. RESULTS

The mean reverberation times at each frequency for the empty room, $T60_e$, the room with the sample installed, $T60_{e+s}$, the sound absorption coefficient and the 95% confidence interval are provided in Table 1. The results are rounded to 0.01. The 95% confidence interval for each frequency is determined from the standard deviation of the reverberation times of the empty room and the room with the sample. The k factor used to determine the 95% Confidence interval is 2.201.

The results for the sample are detailed in Table 1 and Graph 1 of this report.

Test conditions:

Room Empty Air temperature 19.5°C,
Relative Humidity 47%
Barometric Pressure 0.7656 metre of mercury.

Room with Sample Air temperature 19.7°C,
Relative Humidity 48%
Barometric Pressure 0.7645 metres of mercury

Table 1: Reverberation times and Sound Absorption Coefficients of Woven Image Echo Panel 7mm tested with a 20mm air gap

Octave Centre Frequency Bands, Hz	Average RT's for empty room. $T60_e$	Average RT's for room. with sample $T60_{e+s}$	Sound Absorption Coefficient α_s	95% Confidence Interval for α_s
100	8.365	8.424	0.00	0.05
125	7.209	6.488	0.04	0.05
160	8.252	7.567	0.03	0.03
200	9.472	8.005	0.05	0.02
250	9.029	7.088	0.09	0.03
315	8.042	6.038	0.12	0.04
400	7.364	4.909	0.19	0.03
500	6.798	4.287	0.24	0.03
630	6.477	3.582	0.35	0.02
800	6.395	3.135	0.46	0.03
1000	5.879	2.619	0.60	0.04
1250	5.280	2.250	0.72	0.04
1600	4.721	1.964	0.84	0.03
2000	4.023	1.767	0.90	0.04
2500	3.441	1.577	0.97	0.05
3150	2.811	1.438	0.97	0.03
4000	2.277	1.274	0.99	0.05
5000	1.800	1.142	0.92	0.06

The weighted sound absorption coefficient α_w of the sample determined in accordance with AS ISO 11654-1997 “Acoustics: Sound Absorbers for Use in Buildings - Rating of sound absorption” is:

$$\alpha_w = 0.30(M,H)$$

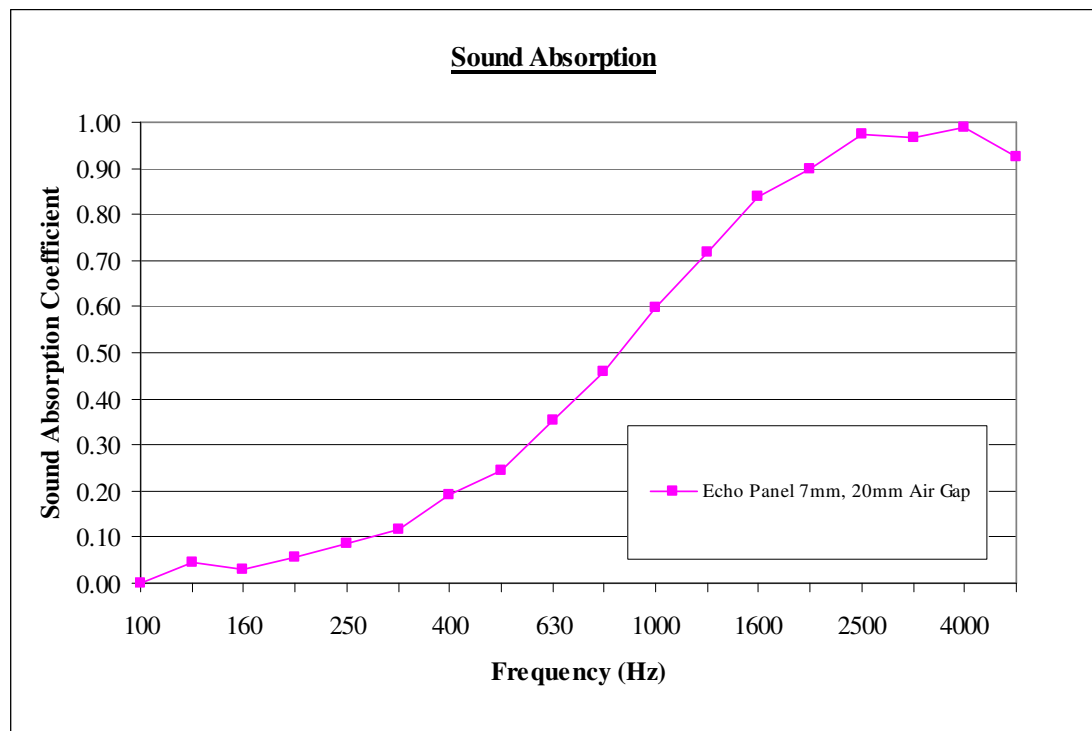
The Practical Sound Absorption Coefficients are detailed below in Table 2. These values have been determined in accordance with AS ISO 11654-1997 “Acoustics: Sound Absorbers for Use in Buildings - Rating of sound absorption”.

Table 2: Practical Sound Absorption Coefficients for the Sample

Frequency (Hz)	125	250	500	1000	2000	4000
Practical Sound Absorption Coefficient, α_p	0.00	0.10	0.25	0.60	0.90	0.95

NRC of the sample calculated in accordance with ASTM C423-90A is: 0.45

Graph 1: Sound Absorption Coefficients of Woven Image Echo Panel 7mm tested with a 20mm air gap



**REPORT ON THE DETERMINATION OF SOUND
ABSORPTION COEFFICIENTS OF WOVEN IMAGE “ECHO PANEL 7MM”
TESTED WITH A 50MM AIR GAP IN A REVERBERATION ROOM.**

Testing Procedure: AS ISO 354 - 2006

Testing Laboratory: Applied Acoustics Laboratory
RMIT University, School of Applied Sciences
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NATA Accreditation Number 1421

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REPORT ON THE DETERMINATION OF SOUND ABSORPTION COEFFICIENTS OF WOVEN IMAGE “ECHO PANEL 7MM” TESTED WITH A 50MM AIR GAP IN A REVERBERATION ROOM.

1. INTRODUCTION

The tests described in this report were carried out at the request of the Woven Image Pty. Limited to determine the sound absorption coefficients of a sample of Woven Image Echo Panel 7mm tested with a 50mm air gap.

The tests were carried out using the reverberation room of the Applied Physics Discipline, The Royal Melbourne Institute of Technology Limited.

Testing has been carried out in accordance with AS ISO 354–2006 “Acoustics: Measurement of sound absorption in a reverberation room”. At the request of the client the weighted sound absorption coefficient α_w has been determined in accordance with AS ISO 11654-1997 “Acoustics: Sound Absorbers for Use in Buildings - Rating of sound absorption”.

The equipment used to perform these tests has been calibrated at an accredited laboratory and is in current calibration.

2. TEST FACILITIES AND PROCEDURES

2.1 Facilities The reverberation room is of pentagonal plan with the ceiling inclined with respect to the floor. No two room dimensions are equal or in the ratio of small whole numbers. The volume of the room is 200.0 cubic metres. A sufficiently diffuse sound field is established by the inclusion of 17 stationary diffusing boards of panelboard, each of one-sided area approximately one square metre and suspended with random orientation. The total two-sided area of the diffusing elements is 0.16 of the total boundary surface area of the room. Previous tests carried out in the room have established that diffusivity of the room sound field is acceptable.

The total surface area of the room boundaries and diffusing elements is 235.6 square metres.

2.2 Generation of sound field The test signals is random noise, band limited to a frequency range of 40Hz to 6300Hz. Three individual loudspeaker positions are used to excite the sound field in the reverberation chamber. The signal is fed to each loudspeaker in turn.

2.3 Receipt of signals Four microphones each mounted in statistically independent locations in the reverberation room are used to measure the sound field decays in the room. Ten sound decays are obtained at each of the twelve loudspeaker/microphone combinations, thus representing 120 decays for each frequency band.

The microphone signal is relayed via a microphone amplifier, to a Bruel & Kjaer 3560 Pulse Multi Analyser System. The Pulse analyser is interfaced to a personal computer. A program running on the personal computer allows the determination of the reverberation time from the sound decays in accordance with the standard. The measuring equipment has been calibrated by an external laboratory, and is in current calibration.

3. SAMPLE FOR TESTING

Sample: Woven Image Echo Panel 7mm

Description: Material: 100% PET
Std Board Size: 2700mm x 1200mm x 7mm thick.
Nominal Surface density: 1400gsm
Air Gap: 50mm

The sample tested comprised of 3.5 panels arranged on the floor of the reverberation room floor to give a sample size of 2700mm wide x 4230mm long as depicted below in Figure 1. The sample was tested with the perimeter edges enclosed by metal edges in accordance with the recommendations contained in AS ISO 354.

The sample was tested with the sample mounted with a 50mm air gap between the sample and the floor of the reverberation chamber. The total surface area of the sample was 11.42m².

Figure 1: Woven Image Echo Panel 7mm installed in the reverberation chamber for testing with a 50mm air gap.



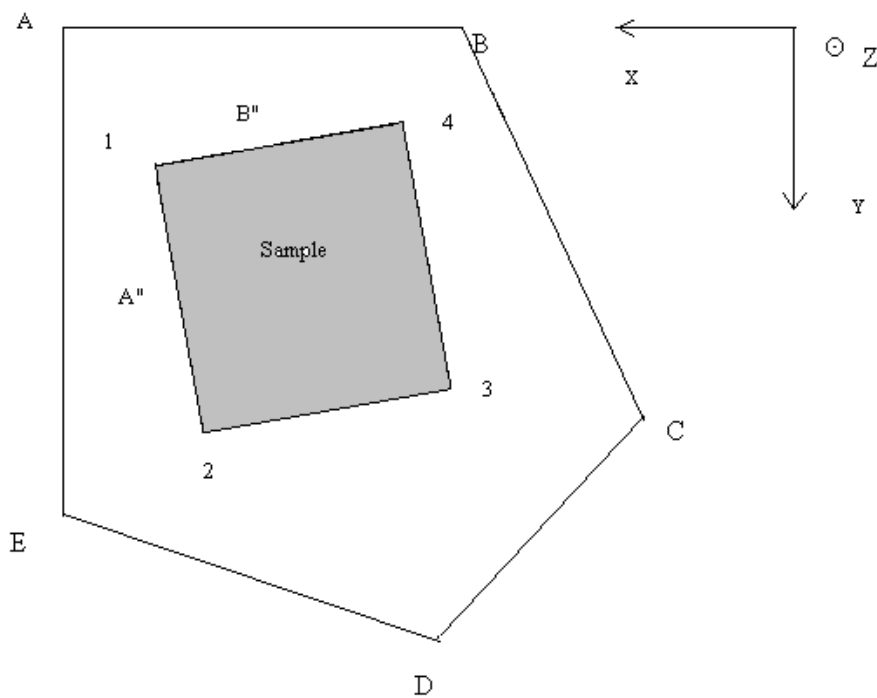
LOCATION OF SAMPLE IN THE REVERBERATION ROOM

Reverberation Chamber (Not to scale):

X and Y co-ordinates of the sample location in the Reverberation Room

Corner Ref. Number	X co-ordinate (metres)	Y co-ordinate (metres)
1	-1.00	1.79
2	-1.76	5.95
3	-4.41	5.47
4	-3.66	1.31

Descriptor	Diagram Reference	Length (m)
Sample Length 1 to 2	Diagram Ref. A''	4.23
Sample Length 1 to 4	Diagram Ref. B''	2.70



4. RESULTS

The mean reverberation times at each frequency for the empty room, $T60_e$, the room with the sample installed, $T60_{e+s}$, the sound absorption coefficient and the 95% confidence interval are provided in Table 1. The results are rounded to 0.01. The 95% confidence interval for each frequency is determined from the standard deviation of the reverberation times of the empty room and the room with the sample. The k factor used to determine the 95% Confidence interval is 2.201.

The results for the sample are detailed in Table 1 and Graph 1 of this report.

Test conditions:

Room Empty Air temperature 19.5°C,
Relative Humidity 47%
Barometric Pressure 0.7656 metre of mercury.

Room with Sample Air temperature 19.7°C,
Relative Humidity 48%
Barometric Pressure 0.7645 metres of mercury

Table 1: Reverberation times and Sound Absorption Coefficients of Woven Image Echo Panel 7mm tested with a 50mm air gap

Octave Centre Frequency Bands, Hz	Average RT's for empty room. $T60_e$	Average RT's for room. with sample $T60_{e+s}$	Sound Absorption Coefficient α_s	95% Confidence Interval for α_s
100	8.365	6.844	0.08	0.07
125	7.209	5.431	0.13	0.06
160	8.252	5.955	0.13	0.04
200	9.472	6.203	0.16	0.03
250	9.029	4.852	0.27	0.03
315	8.042	4.030	0.35	0.04
400	7.364	3.123	0.52	0.03
500	6.798	2.783	0.60	0.05
630	6.477	2.397	0.74	0.04
800	6.395	2.208	0.84	0.04
1000	5.879	1.955	0.96	0.05
1250	5.280	1.842	1.00	0.05
1600	4.721	1.756	1.01	0.04
2000	4.023	1.669	0.99	0.05
2500	3.441	1.576	0.97	0.05
3150	2.811	1.521	0.86	0.03
4000	2.277	1.334	0.89	0.04
5000	1.800	1.136	0.94	0.07

The weighted sound absorption coefficient α_w of the sample determined in accordance with AS ISO 11654-1997 “Acoustics: Sound Absorbers for Use in Buildings - Rating of sound absorption” is:

$$\alpha_w = 0.55(M,H)$$

The Practical Sound Absorption Coefficients are detailed below in Table 2. These values have been determined in accordance with AS ISO 11654-1997 “Acoustics: Sound Absorbers for Use in Buildings - Rating of sound absorption”.

Table 2: Practical Sound Absorption Coefficients for the Sample

Frequency (Hz)	125	250	500	1000	2000	4000
Practical Sound Absorption Coefficient, α_p	0.10	0.25	0.60	0.95	1.00	0.90

NRC of the sample calculated in accordance with ASTM C423-90A is: 0.70

Graph 1: Sound Absorption Coefficients of Woven Image Echo Panel 7mm tested with a 50mm air gap

