Title: Sound Absorption Test Results

Product: H2 Echo Barrier

Application: Wall

Testing Standard: ASTM C423 A-Mount

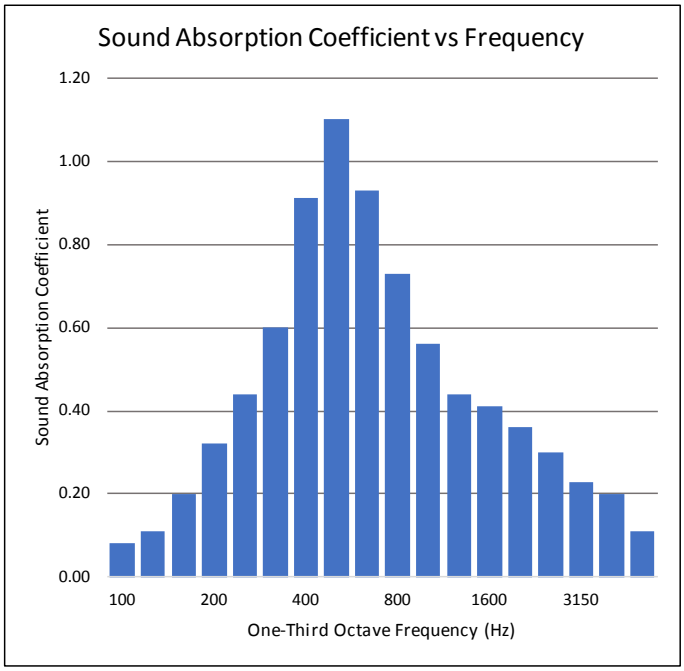
Test Date: 01/16/2012

Why this test: This test evaluates a products efficiency of absorbing sound at multiple frequencies. The test simulates the product's acoustical performance with a direct installation on a wall.

Test Result Summary: NRC - 0.60; SAA - 0.62

NRC	SAA
0.60	0.62

Frequency (Hz)	Absorption Coefficient
100	0.08
125	0.11
160	0.20
200	0.32
250	0.44
315	0.60
400	0.91
500	1.10
630	0.93
800	0.73
1000	0.56
1250	0.44
1600	0.41
2000	0.36
2500	0.30
3150	0.23
4000	0.20
5000	0.11



Test ID: C/22011/R01

123 Columbia Court North Suite 201 Chaska, MN 55318 | TOLL FREE 800.448.0121 | PHONE 952.448.5300 | FAX 952.448.2613 | WEB SITE www.acousticalsurfaces.com

Title: Sound Absorption Test Results

Product: H3 Echo Barrier

Application: Wall

Testing Standard: ASTM C423 A-Mount

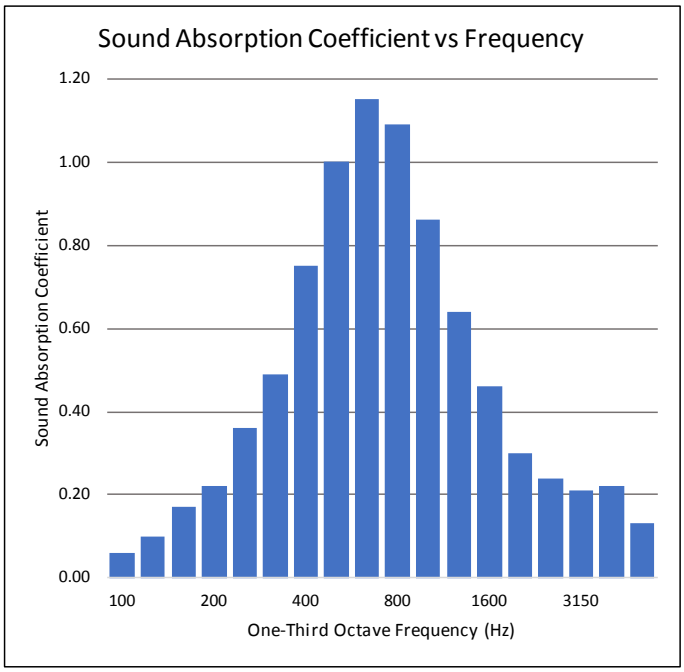
Test Date: 01/16/2012

Why this test: This test evaluates a products efficiency of absorbing sound at multiple frequencies. The test simulates the product's acoustical performance with a direct installation on a wall.

Test Result Summary: NRC - 0.65; SAA - 0.67

NRC	SAA
0.65	0.67

Frequency (Hz)	Absorption Coefficient
100	0.06
125	0.10
160	0.17
200	0.22
250	0.36
315	0.49
400	0.75
500	1.00
630	1.15
800	1.09
1000	0.86
1250	0.64
1600	0.46
2000	0.30
2500	0.24
3150	0.21
4000	0.22
5000	0.13



Test ID: C/22011/R01

123 Columbia Court North Suite 201 Chaska, MN 55318 | TOLL FREE 800.448.0121 | PHONE 952.448.5300 | FAX 952.448.2613 | WEB SITE www.acousticalsurfaces.com

Title: Sound Absorption Test Results

Product: H3 Echo Barrier (Foam Only)

Application: Wall

Testing Standard: ASTM C423 A-Mount

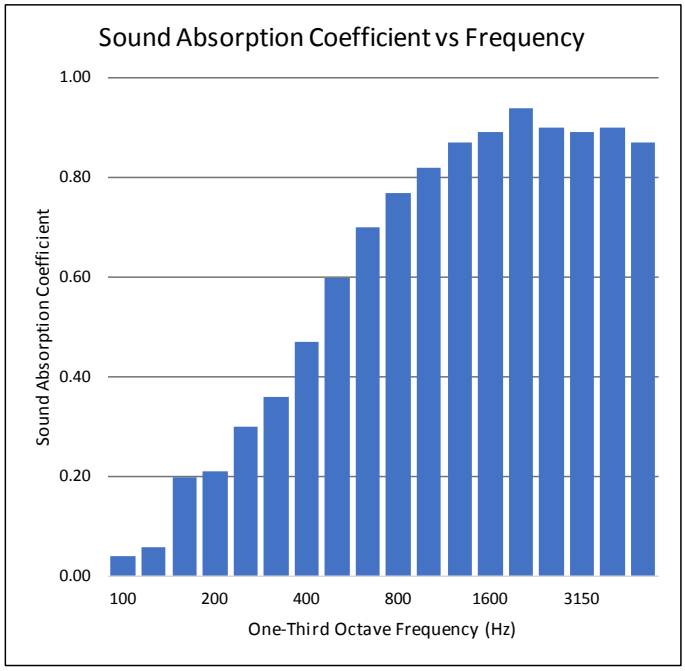
Test Date: 01/16/2012

Why this test: This test evaluates a products efficiency of absorbing sound at multiple frequencies. The test simulates the product's acoustical performance with a direct installation on a wall.

Test Result Summary: NRC - 0.65; SAA - 0.69

NRC	SAA
0.65	0.69

Frequency (Hz)	Absorption Coefficient
100	0.04
125	0.06
160	0.20
200	0.21
250	0.30
315	0.36
400	0.47
500	0.60
630	0.70
800	0.77
1000	0.82
1250	0.87
1600	0.89
2000	0.94
2500	0.90
3150	0.89
4000	0.90
5000	0.87



Test ID: C/22011/R01

123 Columbia Court North Suite 201 Chaska, MN 55318 | TOLL FREE 800.448.0121 | PHONE 952.448.5300 | FAX 952.448.2613 | WEB SITE www.acousticalsurfaces.com

Technical Report

Ref Number *C/22011/R01*

Date *16 January 2012*

Project

The Laboratory Determination of Random Incidence Sound Absorption Coefficient of Various Barriers

Prepared for

Echo Barrier Ltd
Drury Drive
Woodhall Business Park
Sudbury
Suffolk
CO10 1WH

By

Allen Smalls

Sound Research Laboratories

Southern Office & Laboratory
Holbrook House, Little Waldingfield, Sudbury, Suffolk CO10 0TH
Tel: +44(0)1787 247595 Fax: +44(0)1787 248420
e-mail:srl@srltsl.com

0444

S R L

1.0 Summary

Tests have been done in SRL's Laboratory at Holbrook House, Sudbury, Suffolk, to determine the sound absorption coefficient of various barriers in accordance with BS EN ISO 354:2003.

From these measurements the required results have been derived and are presented in both tabular and graphic form in Data Sheets 1 to 3.

The results are given in 1/3rd octave bands over the frequency range 50Hz to 10kHz, which is beyond that required by the test standard. Measurements outside the standard frequency range are not UKAS accredited.

Allen Smalls
For and on behalf of
SRL Technical Services Limited
Tel: 01787 247595
Email: asmalls@srltsl.com

Trevor Hickman
Deputy Technical Manager

S R L

Contents

S R L

2.0 Details of Measurements

2.1 Location

Sound Research Laboratories
Holbrook House
Little Waldingfield
Sudbury
Suffolk
CO10 OTH

2.2 Test Dates

16 January 2012

2.3 Instrumentation and Apparatus Used

Make	Description	Type
E D I	Microphone Multiplexer Microphone Power Supply Unit	
Norwegian Electronics	Real Time Analyser	830
Brüel & Kjaer	12mm Condenser Microphones Windshields Pre Amplifiers Microphone Calibrator Omnipower Sound Source Power Amplifier	4166 UA0237 2639, 2669C 4231 4296 2716
Larson Davis	12mm Condenser Microphone	2560
Darton	Fortin Barometer	P411
Thermo Hygro	Temperature & Humidity Probe	
TOA	Graphic Equalizer	E-1231
QSC Audio	Power Amplifier	RMX 1450

2.4 References

BS EN ISO 11654:1997	Sound absorbers for use in buildings. Rating of sound absorption.
BS EN ISO 354:2003	Measurement of sound absorption in a reverberation room

2.5 Personnel Present

D Lindsay	Echo Barrier
P Wilson	Echo Barrier

3.0 Description of Test

3.1 Description of Sample

Two types of barrier were tested:

- H2 Echo Barrier
- H3 Echo Barrier

See Photographs 1 and 2.

The H3 Echo Barrier was also tested with the foam only.

All test items were nominally 32mm thick.

Sampling plan:	Selected at random
Sample condition:	New
Details supplied by:	Echo Barrier
Sample installed by:	Echo Barrier / SRL

3.2 Sample Delivery date

16 January 2012

3.3 Test Procedures

The sample was mounted/located and tested in accordance with the relevant standard. The method and procedure is described in Appendix 1. The measurement uncertainty is given in Appendix 2.

4.0 Results

The results of the measurements and subsequent analysis are given in Data Sheets 1 to 3 and summarised below.

Results relate only to the items tested.

SRL Test No.	Description in Brief	α_w
2	H2 Echo Barrier	0.35 (LM)
3	H3 Echo Barrier	0.35 (M)
4	H3 Foam Only	0.60 (H)

End of Text

SRL

Data Sheet 1

The Laboratory Measurement of Random Incidence Sound Absorption to BS EN ISO 354:2003

Client: Echo Barrier
Test Date: 16/01/2012

Empty Room:	**Temperature:**	16.0	°C	**Humidity:**	36	%RH	**Pressure:**	1020 mbar
Room with Sample:	**Temperature:**	15.3	°C	**Humidity:**	37	%RH	**Pressure:**	1020 mbar

Sample Description: H2 Echo Barrier

Mounting Method: A
Sample Area: 13.27 m2
Chamber Volume: 300 m3

	Test 2			
Freq Hz	T1 sec	T2 sec	Absorp Coeff	Practical Absorp Coeff #
*50**	*5.93*	*5.70*	*0.03*	
*63**	*4.15*	*4.12*	*0.01*	*n/a*
*80**	*4.73*	*4.54*	*0.03*	
100	6.08	5.40	0.08	
125	6.57	5.50	0.11	0.15
160	6.61	4.88	0.20	
200	6.96	4.34	0.32	
250	7.44	3.95	0.44	0.45
315	7.45	3.37	0.60	
400	7.03	2.57	0.91	
500	5.94	2.14	1.10	1.00
630	5.29	2.27	0.93	
800	5.86	2.71	0.73	
1000	6.27	3.20	0.56	0.60
1250	6.06	3.53	0.44	
1600	5.31	3.34	0.41	
2000	4.51	3.14	0.36	0.35
2500	3.77	2.87	0.30	
3150	2.96	2.50	0.23	
4000	2.30	2.04	0.20	0.20
5000	1.72	1.63	0.11	
*6300**	*1.12*	*1.11*	*0.02*	
*8000**	*0.92*	*0.93*	*-0.04*	*n/a*
*10000**	*0.65*	*0.66*	*-0.07*	

α_w 0.35(LM)

Class D

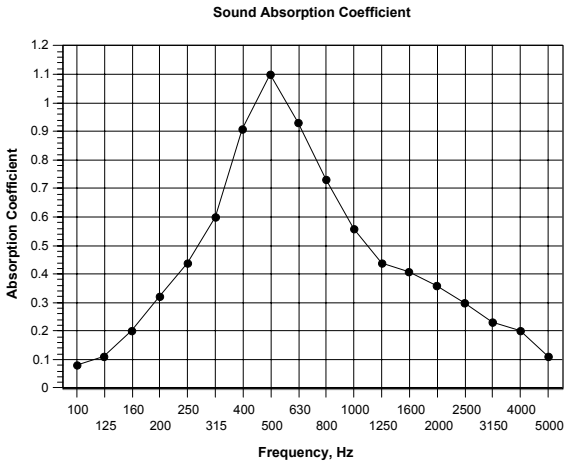
Calculated to EN ISO 11654:1997

NRC 0.60

Calculated to ASTM C 423-01

** Denotes frequencies outside the range covered by BS EN ISO 354:2003*

T1, empty room reverberation time
T2, room reverberation time with sample



Practical absorption coefficient, BS EN ISO 11654:1997

v4.2

SRL

Data Sheet 2

The Laboratory Measurement of Random Incidence Sound Absorption to BS EN ISO 354:2003

Client: Echo Barrier
Test Date: 16/01/2012

Empty Room:	**Temperature:**	16.0	°C	**Humidity:**	36	%RH	**Pressure:**	1020 mbar
Room with Sample:	**Temperature:**	16.0	°C	**Humidity:**	37	%RH	**Pressure:**	1020 mbar

Sample Description: H3 Echo Barrier

Mounting Method: A
Sample Area: 10.62 m2
Chamber Volume: 300 m3

	Test 3			
Freq Hz	T1 sec	T2 sec	Absorp Coeff	Practical Absorp Coeff #
*50**	*5.93*	*5.66*	*0.04*	
*63**	*4.15*	*4.18*	*-0.01*	*n/a*
*80**	*4.73*	*4.65*	*0.02*	
100	6.08	5.65	0.06	
125	6.57	5.78	0.10	0.10
160	6.61	5.31	0.17	
200	6.96	5.19	0.22	
250	7.44	4.68	0.36	0.35
315	7.45	4.16	0.49	
400	7.03	3.26	0.75	
500	5.94	2.59	1.00	0.95
630	5.29	2.27	1.15	
800	5.86	2.45	1.09	
1000	6.27	2.88	0.86	0.85
1250	6.06	3.28	0.64	
1600	5.31	3.48	0.46	
2000	4.51	3.50	0.30	0.35
2500	3.77	3.18	0.24	
3150	2.96	2.65	0.21	
4000	2.30	2.11	0.22	0.20
5000	1.72	1.67	0.13	
*6300**	*1.12*	*1.15*	*-0.03*	
*8000**	*0.92*	*0.97*	*-0.17*	*n/a*
*10000**	*0.65*	*0.68*	*-0.21*	

α_w 0.35(M)

Class D

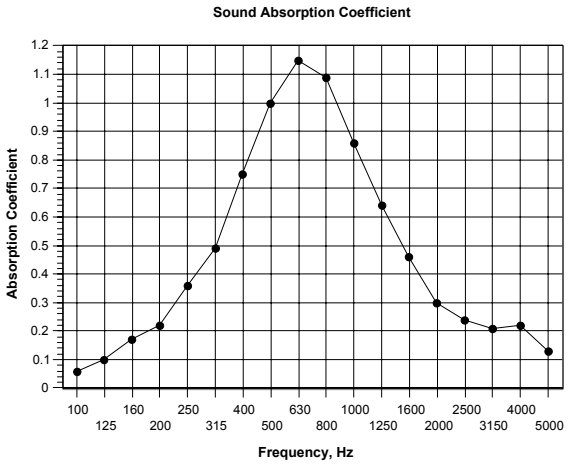
Calculated to EN ISO 11654:1997

NRC 0.65

Calculated to ASTM C 423-01

** Denotes frequencies outside the range covered by BS EN ISO 354:2003*

T1, empty room reverberation time
T2, room reverberation time with sample



Practical absorption coefficient, BS EN ISO 11654:1997

v4.2

SRL

Data Sheet 3

The Laboratory Measurement of Random Incidence Sound Absorption to BS EN ISO 354:2003

Client: Echo Barrier
Test Date: 16/01/2012

Empty Room:	**Temperature:**	16.0	°C	**Humidity:**	36	%RH	**Pressure:**	1020 mbar
Room with Sample:	**Temperature:**	15.2	°C	**Humidity:**	39	%RH	**Pressure:**	1020 mbar

Sample Description: H3 foam only

Mounting Method: A
Sample Area: 10.62 m2
Chamber Volume: 300 m3

	Test 4			
Freq Hz	T1 sec	T2 sec	Absorp Coeff	Practical Absorp Coeff #
*50**	*5.93*	*5.46*	*0.07*	
*63**	*4.15*	*4.04*	*0.03*	*n/a*
*80**	*4.73*	*4.69*	*0.01*	
100	6.08	5.82	0.04	
125	6.57	6.03	0.06	0.10
160	6.61	5.17	0.20	
200	6.96	5.31	0.21	
250	7.44	5.01	0.30	0.30
315	7.45	4.73	0.36	
400	7.03	4.10	0.47	
500	5.94	3.35	0.60	0.60
630	5.29	2.93	0.70	
800	5.86	2.97	0.77	
1000	6.27	2.97	0.82	0.80
1250	6.06	2.83	0.87	
1600	5.31	2.64	0.89	
2000	4.51	2.36	0.94	0.90
2500	3.77	2.19	0.90	
3150	2.96	1.91	0.89	
4000	2.30	1.62	0.90	0.90
5000	1.72	1.33	0.87	
*6300**	*1.12*	*0.96*	*0.81*	
*8000**	*0.92*	*0.82*	*0.77*	*n/a*
*10000**	*0.65*	*0.61*	*0.66*	

α_w 0.60(H)

Class C

Calculated to EN ISO 11654:1997

NRC 0.65

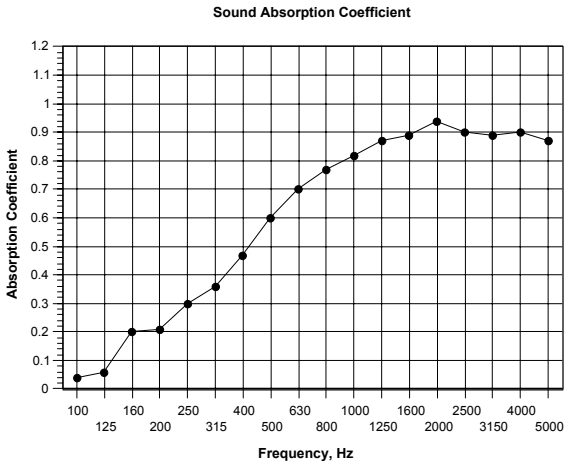
Calculated to ASTM C 423-01

** Denotes frequencies outside the range covered by BS EN ISO 354:2003*

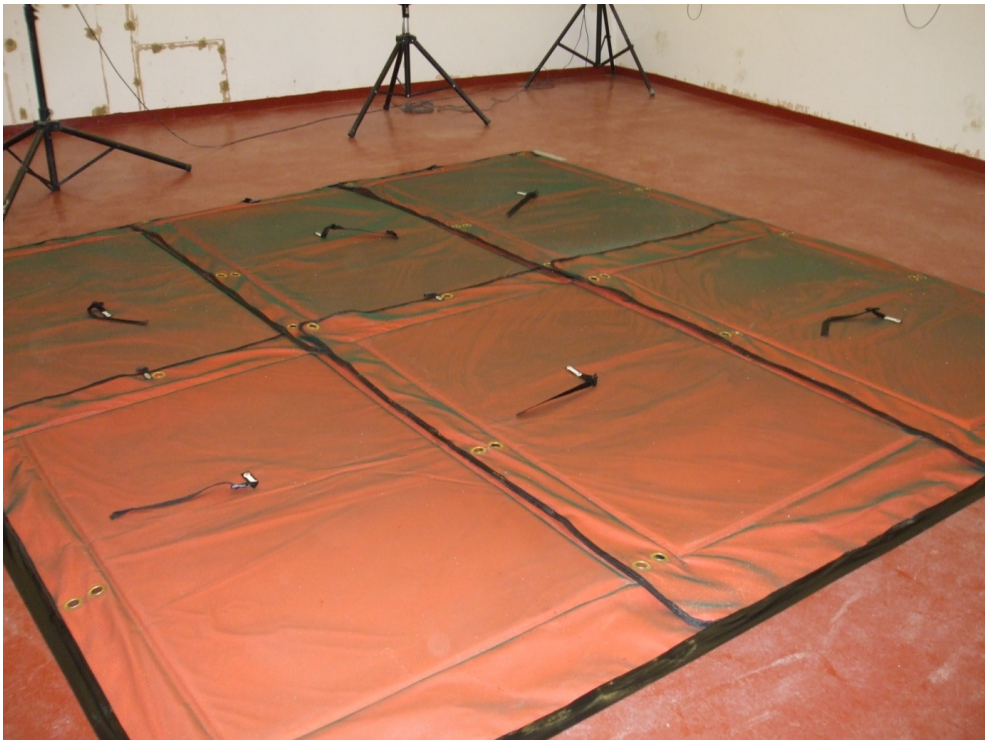
T1, empty room reverberation time
T2, room reverberation time with sample

Practical absorption coefficient, BS EN ISO 11654:1997

v4.2



Photograph 1 -: H2 Echo Barrier



Photograph 2 -: H3 Echo Barrier

SRL

Appendix 1

Test Procedure

Measurements of Random Incidence Sound Absorption Coefficients to BS EN ISO 354:2003 - TP14 (Plane Absorbers)

In the laboratory, random incidence sound absorption coefficients are determined from the rate of decay of a sound field in a reverberation room, with and without a test sample installed. The rate of decay is described by the time a sound field takes to decay by 60dB, known as the reverberation time.

The reverberation room is constructed from 215mm brick, which is internally plastered with a reinforced concrete roof and floor. The reverberation room is rectangular, measuring 8.3 metres long, 6.7 metres wide, 5.4 metres high. The volume is 300m^3, the total surface area, 275m^2. From the ceiling hang 10 randomly positioned diffusers, with a total surface area (for one side) of 20m^2. The room is isolated from the surrounding structure by the use of resilient mountings and seals, ensuring good acoustic isolation.

Using at least two omnidirectional loudspeaker positions, broad band random noise is produced in the room using an electronic generator and power amplifier. When the amplification system is switched off, the decay of sound is filtered into one-third octave band widths and the reverberation times measured. This process is repeated for each of six microphone positions and the values arithmetically averaged to obtain a final value for each frequency.

The sample area should normally be between 10m^2 and 15.7m^2, this may be larger if it is suspected that the absorption properties will be low. The sample is laid on the floor of the reverberation room so that no part of it is closer than one metre from any edge of the boundaries. The procedure of measuring the reverberation times then repeated.

The sound absorption coefficients are calculated from the difference in decay rates for each frequency according to the formula:

$$a_s = \frac{A_T}{S}$$

where

a_s	is the random incidence absorption coefficient
A_t	is the increase in equivalent sound absorption area of the test specimen (m^2)
S	is the area covered by the test specimen (m^2)

The equivalent absorption area of the test specimen is further defined as:

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

where

V is the volume of the empty reverberation room (m^3)

c_1 is the speed of sound in the empty room (m/sec)

T_1 is the reverberation time in the empty room (sec)

m_1 is the power attenuation coefficient calculated according to ISO 9613-1 using the climatic conditions that have been present in the empty rooms during the measurement.

c_1, T_1 and m_2 have the same meanings as c_1, T_1 and m_1 but with the test specimen in the room.

It is occasionally found that the absorption coefficient derived in this manner reaches a value greater than unity. This is impossible, by definition, and investigation has shown that this anomaly is due to diffraction of the impinging sound waves at the edges of the sample. In practical terms this is insignificant.

SRL

Appendix 2

Measurement Uncertainty
BS EN ISO 354:2003 - TP14

1. Introduction

The estimated values of uncertainty are based on a standard uncertainty multiplied by a coverage factor of K = 2, which provides a level of confidence of approximately 95%.

Table 1: Uncertainty For Equivalent Absorption Area Measurement

Frequency, Hz	Expanded uncertainty K = 2, 95% % of A_1 or A_2
100	9.0
125	8.1
160	5.6
200	6.7
250	4.3
315	8.1
400	4.6
500	5.0
630	5.3
800	3.2
1000	3.5
1250	3.1
1600	2.8
2000	2.7
2500	2.2
3150	1.8
4000	1.6
5000	1.6

2. Estimation of Expanded Uncertainty For Sample Equivalent Sound Absorption Area

The expanded uncertainty, U_A,m^2 is estimated by using the following formulae:-

$$U_A=\sqrt{\left(\frac{uA_1}{100}\right)^2+\left(\frac{uA_2}{100}\right)^2}$$

Where

U_A is the expanded uncertainty for the sample equivalent sound absorption area, for K = 2, 95%, m^2

u is the estimated expanded uncertainty for the equivalent sound absorption area, taken from Table 1 above, K = 2, 95%, % of A_1 or A_2

A_1 is the equivalent sound absorption area of the empty room, m^2

A_2 is the equivalent sound absorption area of the room with the sample, m^2

3. Estimation of expanded Uncertainty For Sound Absorption Coefficients

The expanded uncertainty for sound absorption coefficients, U_{α_s} , is estimated using the following formulae:-

$$U_{\alpha_s}=\frac{\alpha_s U_A}{A}$$

where

U_{α_s} is the expanded uncertainty for sound absorption coefficients, K=2, 95%

α_s is the sound absorption coefficient

U_A is the expanded uncertainty for the sample equivalent sound absorption area, K=2, 95%, m^2

A is the sample equivalent sound absorption area, m^2

Southern Office & Laboratory
Holbrook House
Little Waldingfield
Sudbury
Suffolk
CO10 0TH
Tel: +44(0)1787 247595

Northern Office
Lynnfield House
Church Street
Altrincham
Cheshire
WA14 4DZ
Tel: +44(0)161 929 5585

London Office
70 Cowcross Street
London
EC1M 6EJ
Tel: +44 (0)207 251 3585

South Africa Office
Ground Floor, Liesbeek House
River Park
Gloucester Road
Mowbray
7700
South Africa
Tel: +27(0)21 680 5305
e-mail: srl@srlsa.co.za

Dubai Office

Website: www.srltsl.com
e-mail: srl@srltsl.com

SRL offers services in:
Acoustics
Laboratory and Site Testing
Fire
BREEAM
Air Tightness
Air Quality

SRL's Laboratory is accredited for testing under UKAS Number 0444

Member of the Association of Noise Consultants
Investors in People Accreditation
Robust Details Appointed Inspectors
Notified Body Under Noise Directive 2000/14/EC

Registered Name and Address:
SRL Technical Services Limited
Holbrook House
Little Waldingfield
Sudbury
Suffolk
CO10 0TH
Registered Number: 907694 England

INVESTOR IN PEOPLE