

for
Yorkshire Building Services Limited
The Craggs Industrial Park
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**LABORATORY MEASUREMENTS
OF THE
SOUND ABSORPTION COEFFICIENTS
OF
SUPERQUILT 001**

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**LABORATORY MEASUREMENTS
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SUPERQUILT 001**

1. INTRODUCTION

This report presents the results of measurements made in the AIRO Acoustics Laboratory of the sound absorption of SuperQuilt 001.

The measurements were made on 21 March 2013 for Yorkshire Building Services Limited.

Measurements of sound absorption, Sound Absorption Coefficient (α_s), were conducted in accordance with British Standard BS EN ISO 354 (ref 1). Single figure ratings of sound absorption performance, known as the Weighted Sound Absorption Coefficient (α_w) and Sound Absorption Class, are derived from these measurements in accordance with British Standard BS EN ISO 11654 (ref 2).

AIRO is a UKAS accredited testing laboratory No. 0483 and measurements to the above British Standards are included on our schedule of accreditation. UKAS is the United Kingdom Accreditation Service.

2. SUMMARY OF RESULTS

The results of the measurements presented in this report are summarised in the following table:

AIRO Test No.	Test Specimen	α_w	Class
L/3259	SuperQuilt 001	0.50 (M)	D

Approved by:

Report Author:

D L Watts

M Sawyer

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Principal Consultant

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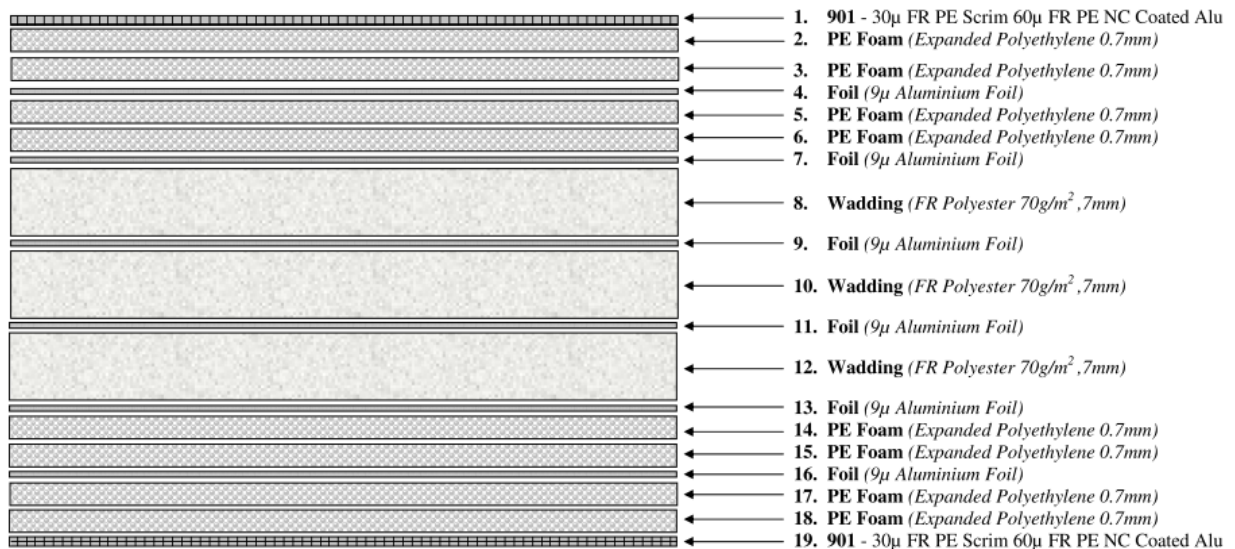
3. TEST SPECIMEN DETAILS AND CONDITIONS

3.1 SuperQuilt 001

Test No. L/3259

The specimen comprised SuperQuilt 001 which consisted of a 19 layered sandwich of 0.7 mm PE Foam, 9 µm Aluminium Foil, and 7 mm FR Polyester 70 g/m² Wadding all encased in reinforced 30 µm FR PE Scrim with 60 µm FR PE NC Coated Aluminium held together by 55 mm long flexible staples at 250 x 330 mm centres. The specimen was supplied as a 1500 mm wide x 10 m long roll which was stitched along its long edges. Two 3.6 m lengths of SuperQuilt 001 were laid directly over the floor of the test chamber adjacent to each other to form a 2.96 m wide x 3.60 m long sample. The cut edges were taped, the central joint taped, and the sample perimeter taped to the floor.

The following build-up of SuperQuilt 001 has been supplied by Yorkshire Building Services Limited.



Sound Absorption Coefficient according to BS EN ISO 354:2003

Test No. L/3259

Date of Test: 21 March 2013

Client: Yorkshire Building Services Limited

Specimen: SuperQuilt 001

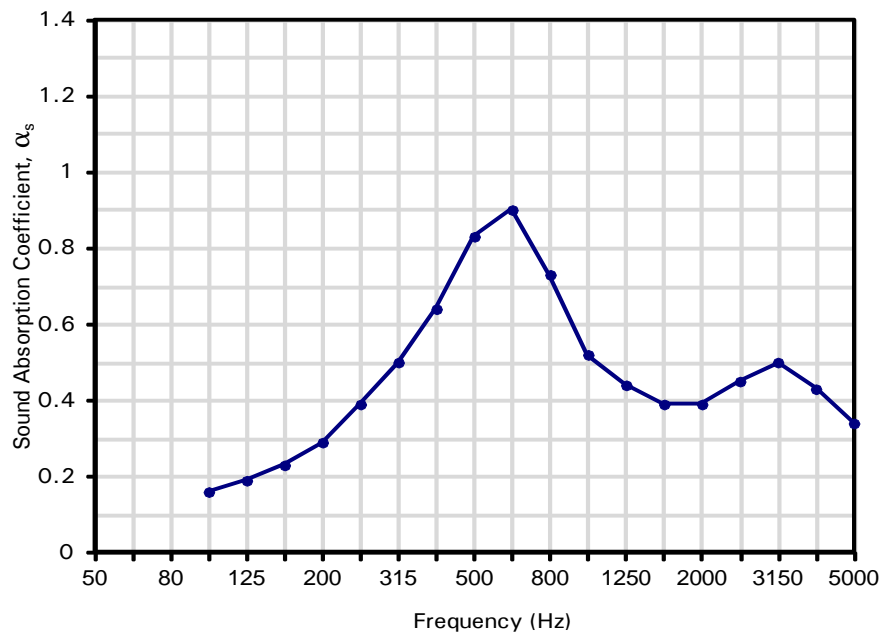
Installed by: AIRO

Specimen area: 10.66 m²

Mass per unit area: 0.94 kg/m²

Chamber Conditions	Volume	Air Temperature	Relative Humidity	Air Pressure
Empty Chamber	221 m ³	7°C	80%	999 mbar
Chamber with Specimen	221 m ³	7°C	80%	999 mbar

Frequency (Hz)	α_s	α_p
50		
63		
80		
100	0.16	
125	0.19	0.20
160	0.23	
200	0.29	
250	0.39	0.40
315	0.50	
400	0.64	
500	0.83	0.80
630	0.90	
800	0.73	
1000	0.52	0.55
1250	0.44	
1600	0.39	
2000	0.39	0.40
2500	0.45	
3150	0.50	
4000	0.43	0.40
5000	0.34	
6300		
8000		
10000		



See Appendix A5 for Reverberation Times of Empty Chamber and Chamber with Specimen

Rating according to BS EN ISO 11654:1997

$\alpha_w = 0.50$ (M)

Sound Absorption Class: D

Approved by:

Report Author:

DL Watts

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Principal Consultant

M Sawyer

M Sawyer MIOA
Laboratory Supervisor

APPENDIX A1 - METHOD OF MEASUREMENT TO BS EN ISO 354:2003

The sound absorption of a specimen is measured under diffuse field conditions where sound is incident upon the specimen from all directions.

The specimen is installed directly over the floor of a purpose built reverberation chamber. The chamber is constructed of 215 mm brick with a 250 mm thick reinforced concrete floor and ceiling and has a volume of 221 cubic metres and surface area of 225 square metres. The chamber rests on resilient mountings to give it good acoustical isolation from the building exterior. In order to give a good diffusion of the sound field, the walls are non-parallel, the ceiling pitched and twenty randomly suspended diffuser panels are included with a surface area of 37.2 square metres.

A steady sound source with a continuous spectrum in the frequency bands of interest is used to drive an omnidirectional loudspeaker which is located in the chamber. The reverberation times of the chamber are determined using the interrupted noise method with three decay measurements made at each of four microphone positions for each of three loudspeaker positions to obtain a good average at each of the one-third octave intervals from 100 Hz to 5000 Hz as prescribed in the Standard (ref 1). The test is conducted with the specimen installed within the chamber, and also in the absence of the specimen and any associated framework.

The Sound Absorption Coefficient (α_s) of the specimen is calculated using the following formula:

$$\alpha_s = 55.3 \frac{V}{S} \left(\frac{1}{c_2 T_2} - \frac{1}{c_1 T_1} \right) - 4V(m_2 - m_1) \quad \text{Equation (i)}$$

where: V is the volume of the empty reverberation chamber (m³)

S is the area of the test specimen (m²)

T_1 is the mean reverberation time of the empty reverberation chamber (seconds)

T_2 is the mean reverberation time of the reverberation chamber with the test specimen installed (seconds)

m_1 and m_2 are the power attenuation coefficient at T_1 and T_2 calculated according to ISO 9613:1993 (ref 3)

c_1 and c_2 are the velocity of sound calculated from the following formula:

$$c = 331 + 0.6t \quad \text{m/s} \quad \text{Equation (ii)}$$

where: t is the air temperature of the reverberation chamber (Celsius)

The Standard requires that the specimen and chamber should be environmentally stable before testing can commence. It is possible for coefficients greater than unity to be measured due to the diffraction effects at the boundaries of finite specimens. Where this occurs the Standard requires that no 'correction' term be applied.

Octave band values of Practical Sound Absorption Coefficient (α_p) are calculated from the one-third octave results. The Weighted Sound Absorption Coefficient (α_w) is calculated by comparing the five values of α_p from 250 Hz to 4000 Hz with a defined reference curve which is moved towards the measured values until the requirements of BS EN ISO 11654:1997 are met.

In addition, shape indicators of L, M and H are given in parenthesis to represent the low, middle and high frequency bands whenever the α_p exceeds the shifted reference curve by 0.25 or more.

From the α_w the Sound Absorption Class is also determined.

The calibration of all equipment is traceable via an unbroken chain to National Standards.

APPENDIX A2 - PRACTICAL APPLICATION OF TEST RESULTS

The Sound Absorption Coefficient is an absolute physical constant of a material, however its effect upon the acoustic environment will be influenced by the method of mounting and the distribution of the material or system within a space.

APPENDIX A3 - REFERENCES

1. British Standard BS EN ISO 354:2003
Acoustics - Measurement of sound absorption in a reverberation room

2. British Standard BS EN ISO 11654:1997
Acoustics - Sound absorbers for use in buildings - Rating of sound absorption

3. International Standard ISO 9613
Acoustics - Attenuation of sound during propagation outdoors

ISO 9613-1:1993
Calculation of the absorption of sound by the atmosphere

APPENDIX A4 - SCHEDULE OF EQUIPMENT

Use	Type	Serial No.
Measuring System	Norsonic 840 Real Time Analyzer	16009
	B&K 4165 ½" Condenser Microphone	1042002
	B&K 4165 ½" Condenser Microphone	1471398
	B&K 2669 Microphone Pre-Amplifier	1856926
	B&K 2669 Microphone Pre-Amplifier	2221217

APPENDIX A5 - MEAN REVERBERATION TIMES

Frequency Hz	Mean Reverberation Times, secs	
	Empty Chamber	Chamber with Test Specimen
100	9.49	6.60
125	7.65	5.35
160	5.79	4.19
200	5.77	3.89
250	6.36	3.68
315	7.01	3.47
400	7.16	3.06
500	7.17	2.61
630	7.40	2.52
800	7.35	2.86
1000	7.01	3.40
1250	6.55	3.56
1600	5.79	3.49
2000	4.99	3.18
2500	4.05	2.65
3150	3.24	2.20
4000	2.55	1.93
5000	1.90	1.60