

for
Bisley Office Equipment Ltd
F C Brown (Steel Equipment) Ltd
Caswell Way
Reevesland Industrial Estate
Newport
NP19 4PW

Dated: 22 February 2012

**LABORATORY MEASUREMENTS
OF THE
EQUIVALENT SOUND ABSORPTION AREA
OF
GLIDE CABINETS**

Report Author: M Sawyer MIOA

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**LABORATORY MEASUREMENTS
OF THE
EQUIVALENT SOUND ABSORPTION AREA
OF
GLIDE CABINETS**

1. INTRODUCTION

This report presents the results of measurements made in the AIRO Acoustics Laboratory of the sound absorption of Glide sliding door cabinets with both standard and absorbent backs and doors, when both filled and also empty.

The measurements were made on 15 February 2012 for Bisley Office Equipment Ltd.

Measurements of sound absorption, Equivalent Sound Absorption Area (A_{obj}), were conducted in accordance with British Standard BS EN ISO 354 (ref 1).

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

2. SUMMARY OF RESULTS

The following table presents a summary of the measurements included in this report.

AIRO Test No.	Test Specimen
L/3228/1	Glide with Standard Back and Standard Doors - Filled
L/3228/2	Glide with Standard Back and Standard Doors - Empty
L/3228/3	Glide with Standard Back and Absorbent Doors - Filled
L/3228/4	Glide with Standard Back and Absorbent Doors - Empty
L/3228/5	Glide with Absorbent Back and Absorbent Doors - Filled
L/3228/6	Glide with Absorbent Back and Absorbent Doors - Empty
L/3228/7	Glide with Absorbent Back and Standard Doors - Filled
L/3228/8	Glide with Absorbent Back and Standard Doors - Empty

Approved by:

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Laboratory Supervisor

Glide cabinets with standard backs and fronts



Glide cabinets with absorbent backs and fronts



Equivalent Sound Absorption Area according to BS EN ISO 354:2003

Test No. L/3228/1

Date of Test: 15 February 2012

Client: Bisley Office Equipment Ltd

Specimen: Glide with Standard Back and Standard Doors - Filled

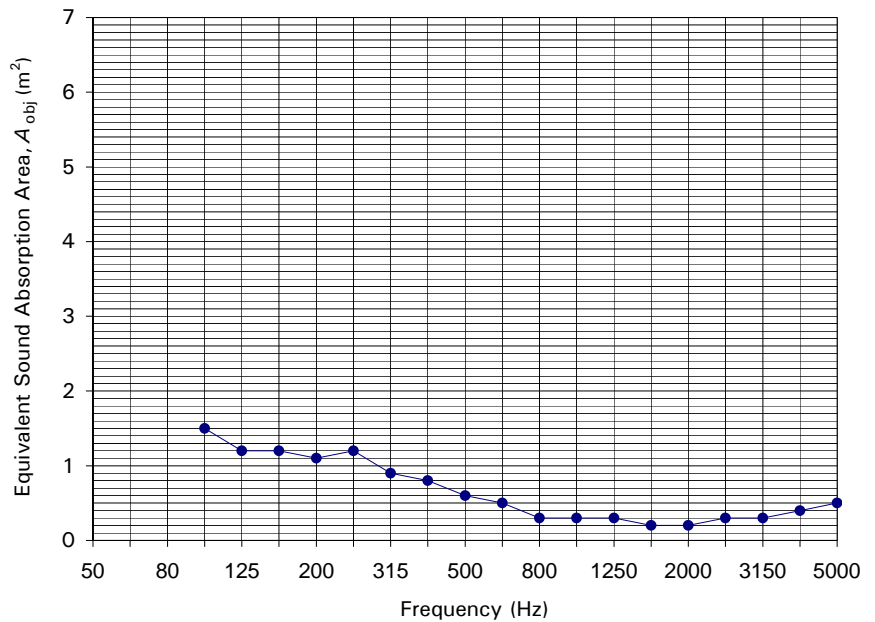
Installed by: Bisley Office Equipment Ltd

Area per object: 1.8 m²

Mass per object: 190 kg

Chamber Conditions	Volume	Air Temperature	Relative Humidity	Air Pressure
Empty Chamber	221 m ³	6 °C	85%	1008 mbar
Chamber with Specimen	221 m ³	6 °C	85%	1008 mbar

Frequency (Hz)	A_{obj} One-third Octave (m ²)	A_{obj} Octave (m ²)
50		
63		
80		
100	1.5	
125	1.2	1.3
160	1.2	
200	1.1	
250	1.2	1.1
315	0.9	
400	0.8	
500	0.6	0.6
630	0.5	
800	0.3	
1000	0.3	0.3
1250	0.3	
1600	0.2	
2000	0.2	0.2
2500	0.3	
3150	0.3	
4000	0.4	0.4
5000	0.5	
6300		
8000		
10000		



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

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Equivalent Sound Absorption Area according to BS EN ISO 354:2003

Test No. L/3228/2

Date of Test: 15 February 2012

Client: Bisley Office Equipment Ltd

Specimen: Glide with Standard Back and Standard Doors - Empty

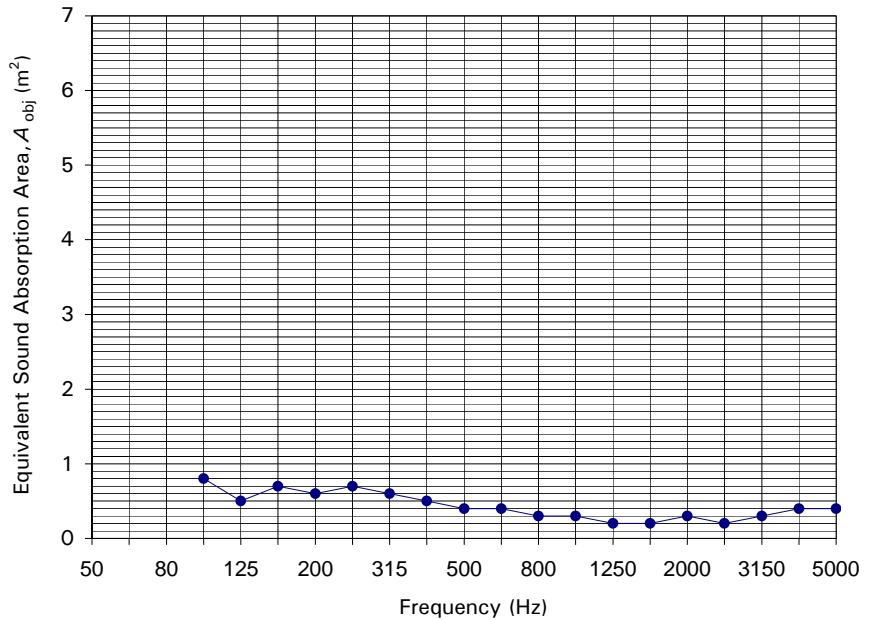
Installed by: Bisley Office Equipment Ltd

Area per object: 1.8 m²

Mass per object: 86 kg

Chamber Conditions	Volume	Air Temperature	Relative Humidity	Air Pressure
Empty Chamber	221 m ³	6 °C	85%	1008 mbar
Chamber with Specimen	221 m ³	6 °C	85%	1008 mbar

Frequency (Hz)	A_{obj} One-third Octave (m ²)	A_{obj} Octave (m ²)
50		
63		
80		
100	0.8	
125	0.5	0.7
160	0.7	
200	0.6	
250	0.7	0.6
315	0.6	
400	0.5	
500	0.4	0.4
630	0.4	
800	0.3	
1000	0.3	0.3
1250	0.2	
1600	0.2	
2000	0.3	0.2
2500	0.2	
3150	0.3	
4000	0.4	0.4
5000	0.4	
6300		
8000		
10000		



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

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Equivalent Sound Absorption Area according to BS EN ISO 354:2003

Test No. L/3228/3

Date of Test: 15 February 2012

Client: Bisley Office Equipment Ltd

Specimen: Glide with Standard Back and Absorbent Doors - Filled

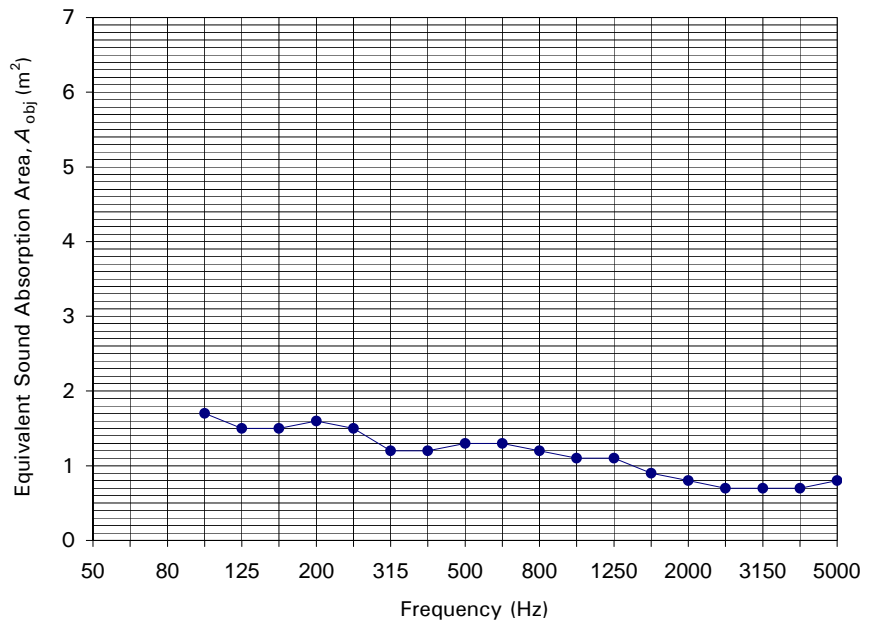
Installed by: Bisley Office Equipment Ltd

Area per object: 1.8 m²

Mass per object: 195 kg

Chamber Conditions	Volume	Air Temperature	Relative Humidity	Air Pressure
Empty Chamber	221 m ³	6 °C	85%	1008 mbar
Chamber with Specimen	221 m ³	6 °C	85%	1008 mbar

Frequency (Hz)	A_{obj} One-third Octave (m ²)	A_{obj} Octave (m ²)
50		
63		
80		
100	1.7	
125	1.5	1.6
160	1.5	
200	1.6	
250	1.5	1.4
315	1.2	
400	1.2	
500	1.3	1.3
630	1.3	
800	1.2	
1000	1.1	1.1
1250	1.1	
1600	0.9	
2000	0.8	0.8
2500	0.7	
3150	0.7	
4000	0.7	0.7
5000	0.8	
6300		
8000		
10000		



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

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Equivalent Sound Absorption Area according to BS EN ISO 354:2003

Test No. L/3228/4

Date of Test: 15 February 2012

Client: Bisley Office Equipment Ltd

Specimen: Glide with Standard Back and Absorbent Doors - Empty

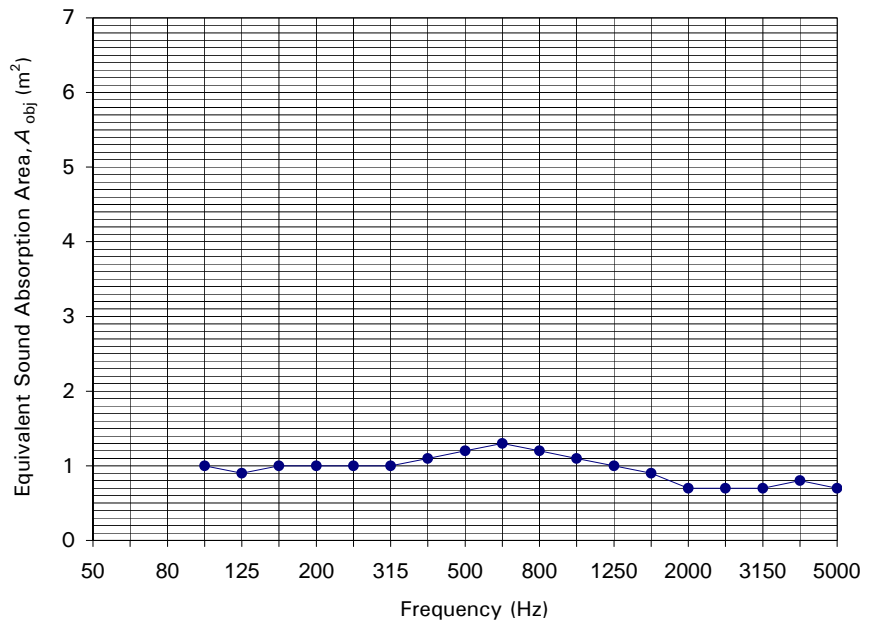
Installed by: Bisley Office Equipment Ltd

Area per object: 1.8 m²

Mass per object: 91 kg

Chamber Conditions	Volume	Air Temperature	Relative Humidity	Air Pressure
Empty Chamber	221 m ³	6 °C	85%	1008 mbar
Chamber with Specimen	221 m ³	6 °C	85%	1008 mbar

Frequency (Hz)	A_{obj} One-third Octave (m ²)	A_{obj} Octave (m ²)
50		
63		
80		
100	1.0	
125	0.9	1.0
160	1.0	
200	1.0	
250	1.0	1.0
315	1.0	
400	1.1	
500	1.2	1.2
630	1.3	
800	1.2	
1000	1.1	1.1
1250	1.0	
1600	0.9	
2000	0.7	0.8
2500	0.7	
3150	0.7	
4000	0.8	0.7
5000	0.7	
6300		
8000		
10000		



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

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Equivalent Sound Absorption Area according to BS EN ISO 354:2003

Test No. L/3228/5

Date of Test: 15 February 2012

Client: Bisley Office Equipment Ltd

Specimen: Glide with Absorbent Back and Absorbent Doors - Filled

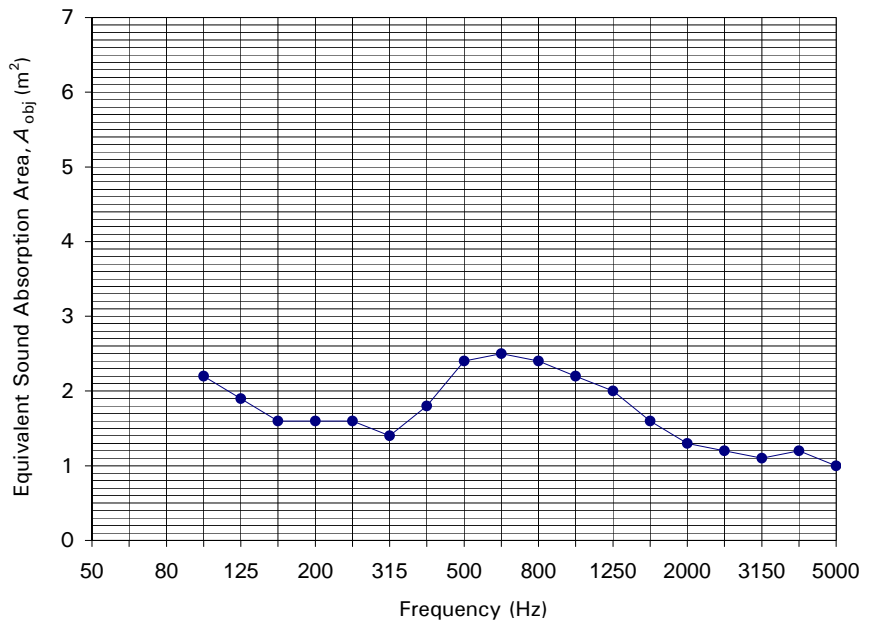
Installed by: Bisley Office Equipment Ltd

Area per object: 1.8 m²

Mass per object: 198 kg

Chamber Conditions	Volume	Air Temperature	Relative Humidity	Air Pressure
Empty Chamber	221 m ³	6 °C	85%	1008 mbar
Chamber with Specimen	221 m ³	6 °C	85%	1008 mbar

Frequency (Hz)	A_{obj} One-third Octave (m ²)	A_{obj} Octave (m ²)
50		
63		
80		
100	2.2	
125	1.9	1.9
160	1.6	
200	1.6	
250	1.6	1.5
315	1.4	
400	1.8	
500	2.4	2.2
630	2.5	
800	2.4	
1000	2.2	2.2
1250	2.0	
1600	1.6	
2000	1.3	1.4
2500	1.2	
3150	1.1	
4000	1.2	1.1
5000	1.0	
6300		
8000		
10000		



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

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Equivalent Sound Absorption Area according to BS EN ISO 354:2003

Test No. L/3228/6

Date of Test: 15 February 2012

Client: Bisley Office Equipment Ltd

Specimen: Glide with Absorbent Back and Absorbent Doors - Empty

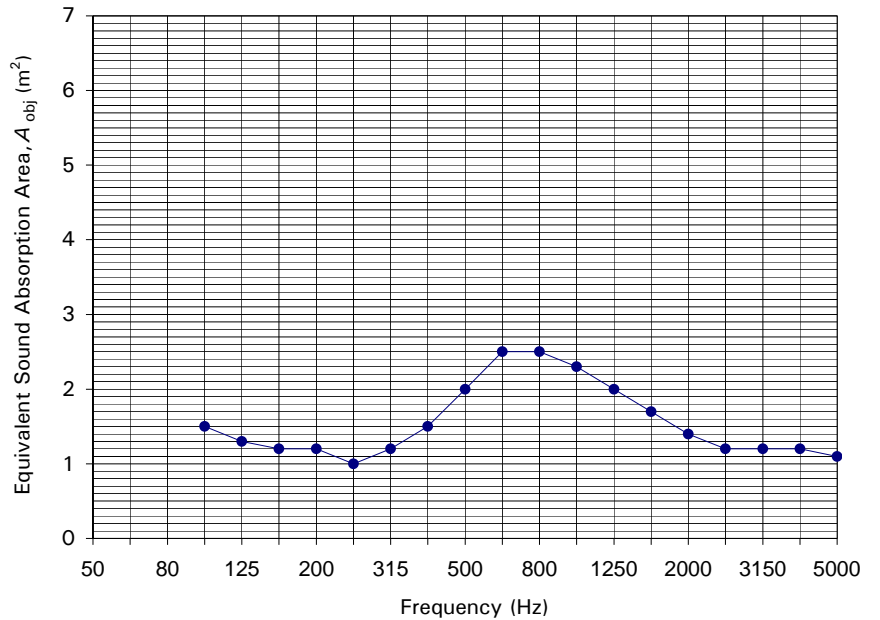
Installed by: Bisley Office Equipment Ltd

Area per object: 1.8 m²

Mass per object: 94 kg

Chamber Conditions	Volume	Air Temperature	Relative Humidity	Air Pressure
Empty Chamber	221 m ³	6 °C	85%	1008 mbar
Chamber with Specimen	221 m ³	6 °C	85%	1008 mbar

Frequency (Hz)	A_{obj} One-third Octave (m ²)	A_{obj} Octave (m ²)
50		
63		
80		
100	1.5	
125	1.3	1.3
160	1.2	
200	1.2	
250	1.0	1.1
315	1.2	
400	1.5	
500	2.0	2.0
630	2.5	
800	2.5	
1000	2.3	2.3
1250	2.0	
1600	1.7	
2000	1.4	1.4
2500	1.2	
3150	1.2	
4000	1.2	1.2
5000	1.1	
6300		
8000		
10000		



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

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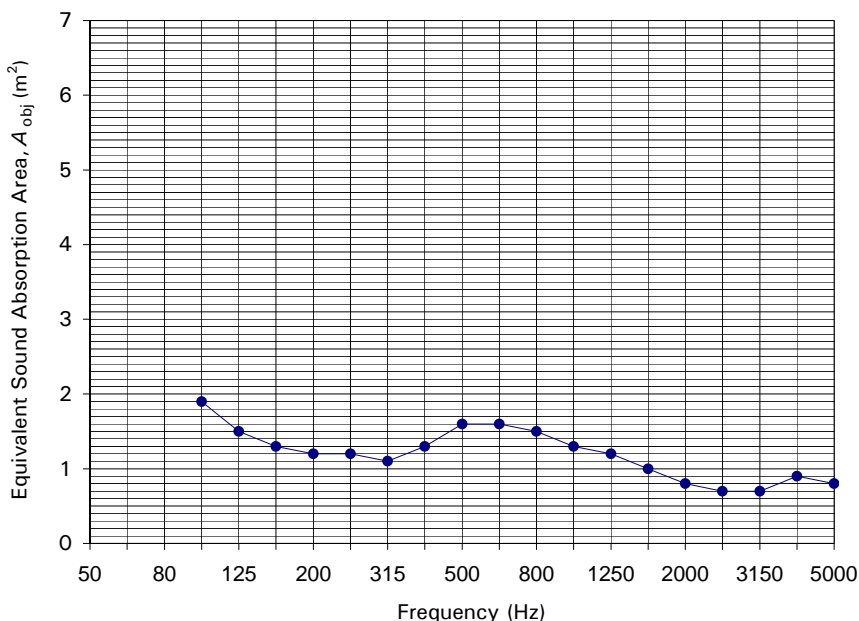
M Sawyer MIOA
Laboratory Supervisor

Equivalent Sound Absorption Area according to BS EN ISO 354:2003

Test No. L/3228/7 Date of Test: 15 February 2012
 Client: Bisley Office Equipment Ltd
 Specimen: Glide with Absorbent Back and Standard Doors - Filled
 Installed by: Bisley Office Equipment Ltd
 Area per object: 1.8 m² Mass per object: 192 kg

Chamber Conditions	Volume	Air Temperature	Relative Humidity	Air Pressure
Empty Chamber	221 m ³	6 °C	85%	1008 mbar
Chamber with Specimen	221 m ³	6 °C	85%	1008 mbar

Frequency (Hz)	A_{obj} One-third Octave (m ²)	A_{obj} Octave (m ²)
50		
63		
80		
100	1.9	
125	1.5	1.6
160	1.3	
200	1.2	
250	1.2	1.2
315	1.1	
400	1.3	
500	1.6	1.5
630	1.6	
800	1.5	
1000	1.3	1.3
1250	1.2	
1600	1.0	
2000	0.8	0.8
2500	0.7	
3150	0.7	
4000	0.9	0.8
5000	0.8	
6300		
8000		
10000		



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

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Report Author:

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Equivalent Sound Absorption Area according to BS EN ISO 354:2003

Test No. L/3228/8

Date of Test: 15 February 2012

Client: Bisley Office Equipment Ltd

Specimen: Glide with Absorbent Back and Standard Doors - Empty

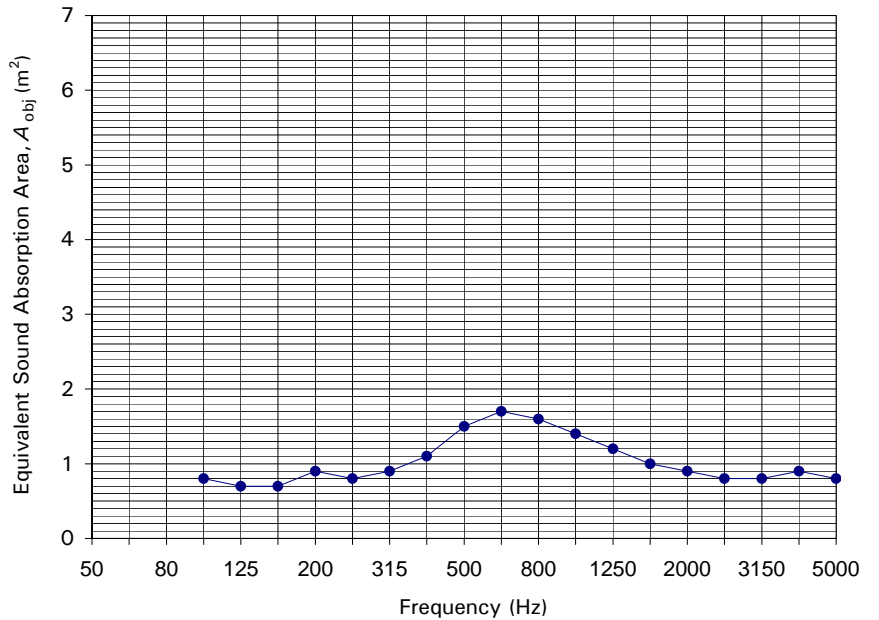
Installed by: Bisley Office Equipment Ltd

Area per object: 1.8 m²

Mass per object: 88 kg

Chamber Conditions	Volume	Air Temperature	Relative Humidity	Air Pressure
Empty Chamber	221 m ³	6 °C	85%	1008 mbar
Chamber with Specimen	221 m ³	6 °C	85%	1008 mbar

Frequency (Hz)	A_{obj} One-third Octave (m ²)	A_{obj} Octave (m ²)
50		
63		
80		
100	0.8	
125	0.7	0.7
160	0.7	
200	0.9	
250	0.8	0.9
315	0.9	
400	1.1	
500	1.5	1.4
630	1.7	
800	1.6	
1000	1.4	1.4
1250	1.2	
1600	1.0	
2000	0.9	0.9
2500	0.8	
3150	0.8	
4000	0.9	0.8
5000	0.8	
6300		
8000		
10000		



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

Approved by:

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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 Equivalent Sound Absorption Area (A_{obj}) of the specimen is calculated using the following formula:

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

where: V is the volume of the empty reverberation chamber (m^3)

n is the number of discrete objects

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 2)

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.

Octave band values of Equivalent Sound Absorption Area are calculated from the one-third octave results following the methodology set out in BS EN ISO 11654:1997.

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

APPENDIX A2 - PRACTICAL APPLICATION OF TEST RESULTS

The Equivalent Sound Absorption Area 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. International Standard ISO 9613
Acoustics - Attenuation of sound during propagation outdoors

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

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

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							
		Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8
100	8.04	3.47	4.83	3.22	4.24	2.70	3.41	3.05	4.69
125	6.96	3.67	5.00	3.22	4.18	2.87	3.44	3.22	4.50
160	5.82	3.33	4.11	2.94	3.59	2.85	3.31	3.15	3.94
200	5.77	3.37	4.15	2.86	3.56	2.88	3.26	3.26	3.72
250	6.03	3.34	4.10	3.02	3.60	2.94	3.63	3.39	3.94
315	6.79	4.05	4.66	3.63	3.83	3.31	3.63	3.69	4.15
400	7.14	4.36	5.03	3.62	3.88	2.92	3.33	3.52	3.85
500	7.15	4.82	5.35	3.57	3.75	2.47	2.76	3.12	3.29
630	7.28	5.27	5.58	3.58	3.64	2.44	2.43	3.15	3.12
800	7.23	5.76	5.87	3.68	3.68	2.47	2.43	3.34	3.21
1000	7.03	5.73	5.82	3.74	3.73	2.61	2.52	3.51	3.43
1250	6.50	5.50	5.52	3.71	3.74	2.67	2.65	3.57	3.52
1600	5.81	5.05	5.03	3.66	3.72	2.84	2.76	3.57	3.49
2000	4.97	4.43	4.37	3.50	3.57	2.88	2.81	3.45	3.36
2500	4.16	3.71	3.75	3.16	3.14	2.68	2.66	3.11	3.05
3150	3.30	2.99	2.96	2.67	2.65	2.35	2.32	2.62	2.54
4000	2.65	2.39	2.38	2.20	2.17	1.98	1.97	2.11	2.11
5000	1.94	1.75	1.78	1.67	1.69	1.60	1.57	1.65	1.66