



# REPORT

issued by an Accredited Testing Laboratory

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## Determination of equivalent sound absorption area in a reverberation room according to ISO 354 and SS 25269

(7 appendices)

*This is a translation from the Swedish original document. In the event of any dispute as to the content of the document, the Swedish text shall take precedence.*

### Client

Götessons Industri AB

### Test object

SP has performed accredited sound absorption measurements of different office screens and furniture. The test objects are listed in table 1 and further described in the enclosures.

### Date of test

November 24, 26-27 and 30, 2015

### Results

The equivalent sound absorption area ( $A_{obj}$ ) in octave band 125-4000 Hz is given in table 1. Octave band values are calculated as arithmetic averages of the three 1/3 octave band values in the band of interest, according to EN 12354-6 and SS 25269. The equivalent sound absorption area in 1/3 octave bands 50-5000 Hz is given in enclosure 1-7.

The results are valid for tested objects only.

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Table 1 – Summary of equivalent sound absorption area according to Swedish standard SS 25269.

Test object:	Equivalent sound absorption area per test object in octave bands, ( $A_{obj}$ m <sup>2</sup> Sabine)						Enclosure
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	
SCREENIT AT40	0,2	0,5	1,0	1,4	2,0	2,5	1
PAZ Bordsskärm	0,3	0,8	0,9	1,0	1,1	1,1	2
The Hut <i>Normal mounting</i>	5,2	9,3	11,5	12,7	13,8	14,8	3
The Hut <i>Back covered corresponding to placement at wall or similar</i>	4,6	8,6	10,6	11,9	13,0	14,0	4
The Hut Sofa	2,2	3,3	4,2	4,6	5,0	5,4	5
Sofa Sound Booth	2,7	3,8	5,0	5,5	5,7	5,6	6
Sofa Sound Booth <i>Back covered corresponding to placement at wall or similar</i>	2,5	3,1	3,6	3,8	4,2	4,5	7

### Measurement method

The measurements have been carried out according to ISO 354:2003, to which SP is accredited. The standard is equivalent to EN ISO 354 and SS-EN ISO 354.

4 loudspeaker positions and 6 microphone positions have been used giving 24 different combinations for the reverberation time measurements. For empty room 3 decays have been used for averaging the time and for test objects 5 decays have been used, for each combination of loudspeaker and microphone.

The evaluation has been carried out according to ISO 354:2003 and SS 25269:2013.

The equivalent sound absorption area per object  $A_{obj}$  has been evaluated from:

$$A_{obj} = \frac{55.3 V}{c \cdot n} \left( \frac{1}{T_2} - \frac{1}{T_1} \right)$$

where

- V = Volume of the reverberation room (m<sup>3</sup>)
- n = Number of test objects
- c = Speed of sound in air (m/s)
- c = 331 + 0.6t
- t = Temperature in the air (°C)
- T<sub>1</sub> = Reverberation time of the room without test object (s)
- T<sub>2</sub> = Reverberation time of the room with test object (s)

The equivalent sound absorption area of the test objects deviates from the limits in the standard in some of the measurements. This depends on the size and configuration of test objects and also because sufficient distance between test objects were to be achieved. The extent of the deviation varied between the different test objects.

### Measurement uncertainty

From a world wide Round Robin, in which SP took part, with 23 participating laboratories from 11 countries, the following measurement uncertainty for the absorption coefficient has been calculated

Frequencies (Hz)	Uncertainty
100-630	$\pm 0,15$
800-1250	$\pm 0,10$
1600-2500	$\pm 0,15$
3150-5000	$\pm 0,20$

The figures are calculated from twice the standard deviations, rounded to the nearest 0,05. The data from the Round Robin is documented in a letter from the ASTM to the participating laboratories.

No values for the uncertainty of the equivalent absorptions area of small or big test objects are available, but might be estimated from the uncertainty of the absorption coefficients. The measurement uncertainty is also affected by the deviation from the standard regarding the equivalent absorption area.

### Test room

A reverberation room with the dimensions 7,64 m x 6,16 m x 4,25 m giving the volume 200 m<sup>3</sup> and the total surface area 211 m<sup>2</sup> was used as test room. The diffusors are placed according to ISO 354.

### Mounting

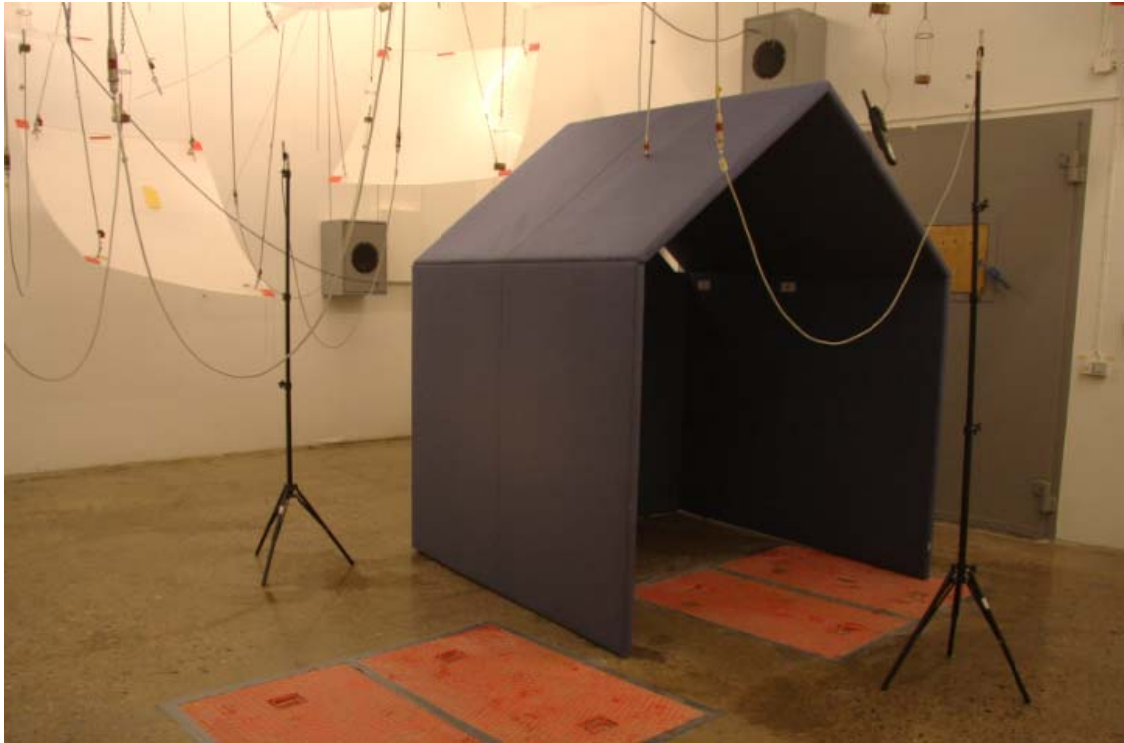
Three test objects were placed randomly in the room, at least one meter from the walls and at least 1,8-2 m between the test objects.



*Picture 1 – Four test objects type SCREENIT AT40 was tested.*



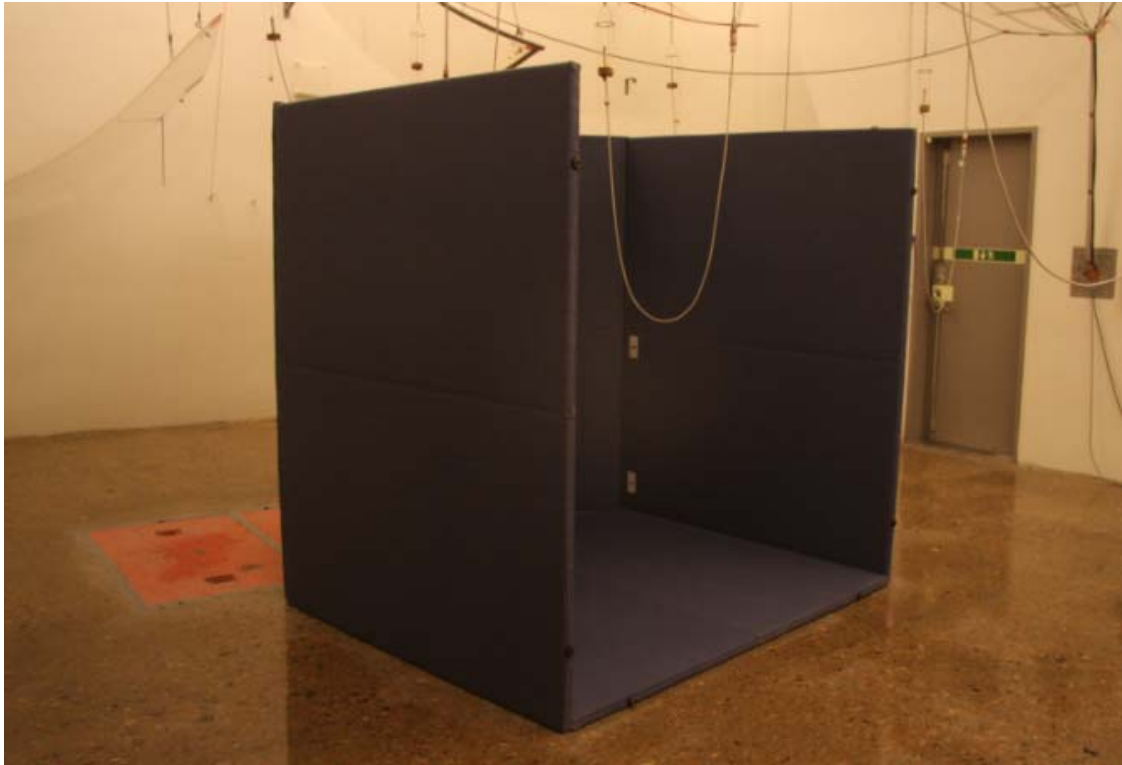
*Picture 2 – Three test objects type PAZ Bordsskärm was tested.*



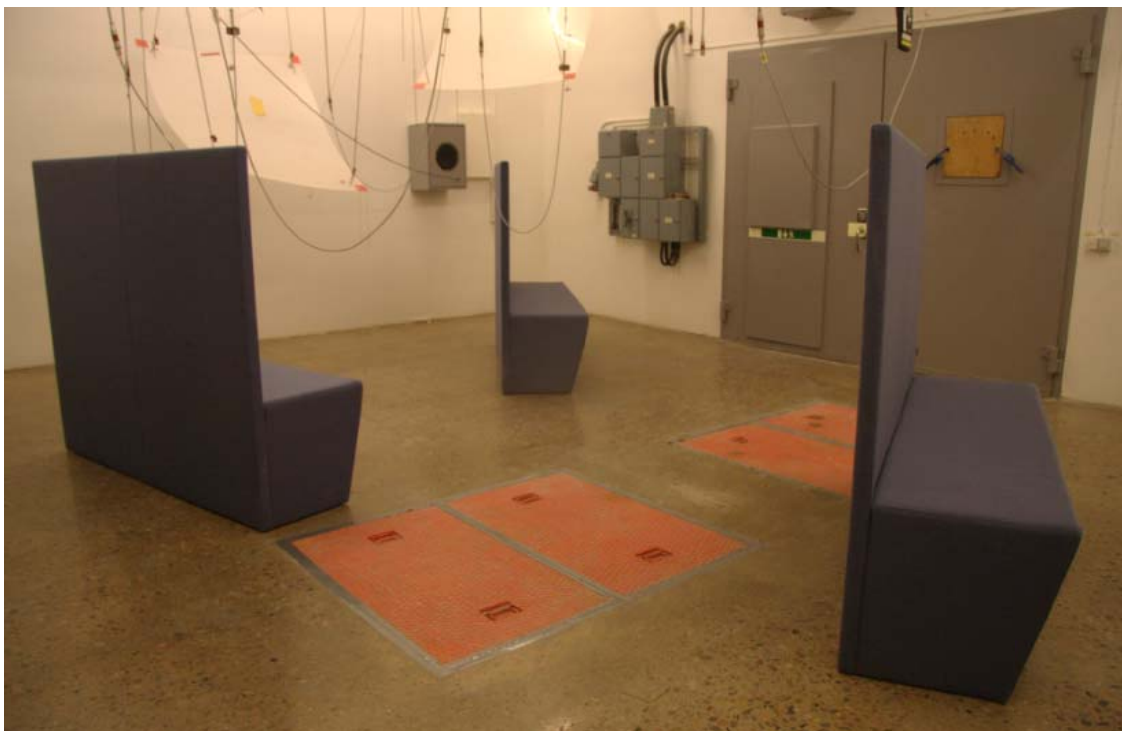
*Picture 3 – One test object type The Hut was tested in three different positions. The Hut is seen from the front.*



*Picture 4 – One test object type The Hut was tested in three different positions. The Hut is seen from the back.*



*Picture 5 – The Hut was also tested placed with the back against the floor. The measurement corresponds to a placement of the The Hut at a wall or similar.*



*Picture 6 – Three test objects type The Hut Sofa was tested.*



*Picture 7 – One test object type Sofa Sound Booth was tested in three different positions. The Hut is seen from the back.*



*Picture 8 – Sofa Sound Booth was also tested placed with the back against the floor and a board covering the bottom. The measurement corresponds to a placement of the Sofa Sound Boot at a wall or similar.*

**List of instruments**

<b>Instrument</b>	<b>Manufacturer</b>	<b>Type</b>	<b>Serial no</b>
Microphone	Brüel & Kjaer	4943	2749979
Microphone	Brüel & Kjaer	4943	2206273
Microphone	Brüel & Kjaer	4943	2206274
Microphone	Brüel & Kjaer	4943	2206276
Microphone	Brüel & Kjaer	4943	2206277
Microphone	Brüel & Kjaer	4943	2206278
Microphone Preamplifier	Brüel & Kjaer	2619	726818
Microphone Preamplifier	Brüel & Kjaer	2619	726624
Microphone Preamplifier	Brüel & Kjaer	2619	970996
Microphone Preamplifier	Brüel & Kjaer	2619	726792
Microphone Preamplifier	Brüel & Kjaer	2619	970865
Microphone Preamplifier	Brüel & Kjaer	2619	970968
Microphone Multiplexer	Norsonic	834	10050
Real-Time Analyzer	Norsonic	830	11533
Sound Level Calibrator	Brüel & Kjaer	4230	502528
Programme	SP	Absorp 960627	
Power amplifier	PA1		
Noise generator	NG1 ( white noise )		
Loudspeakers	SP	HGT2, HGT7, HGT4, HGTtak	
Hygrometer/ Temperature meter	Testo	615	502233

**SP Technical Research Institute of Sweden  
Sustainable Built Environment - Sound and vibration**

Performed by

Examined by

Malin Lindgren

Krister Larsson

**Appendices**



Appendix 1

**Measurement of sound absorption area**

Test Measurement of sound absorption area in a reverberation room according to EN ISO 354 and SS 25269.

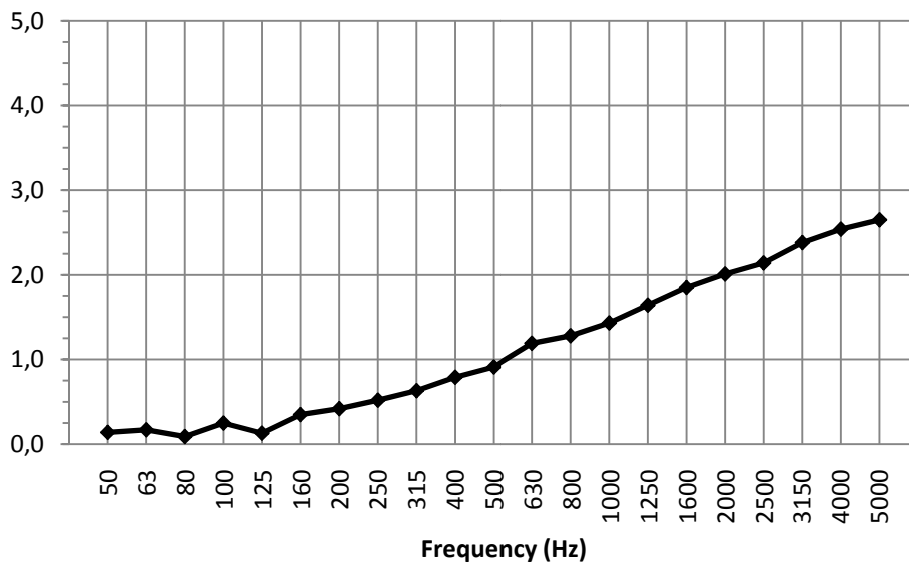
Client Götessons Industri AB

Object SCREENIT AT40  
Desk screen  
Material description: Product lined with fabric with a frame out of pine and filling out of PET-fibre.  
Number of tested objects: 4  
Thickness: 40 mm  
Panel size: 660 mm x 1605 mm

Date of test November 26, 2015

Conditions Room volume: 200 m<sup>3</sup>  
Temperature at measurement on object/in empty room: 20/ 20 °C  
Relative humidity at measurement on object/in empty room: 30/ 31 %

Equivalent sound absorption area per object (m<sup>2</sup> Sabine)



Frequency (Hz)	A <sub>obj</sub>
50	0,1
63	0,2
80	0,1
100	0,3
125	0,1
160	0,4
200	0,4
250	0,5
315	0,6
400	0,8
500	0,9
630	1,2
800	1,3
1000	1,4
1250	1,6
1600	1,9
2000	2,0
2500	2,1
3150	2,4
4000	2,5
5000	2,7

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Appendix 2

**Measurement of sound absorption area**

Test Measurement of sound absorption area in a reverberation room according to EN ISO 354 and SS 25269.

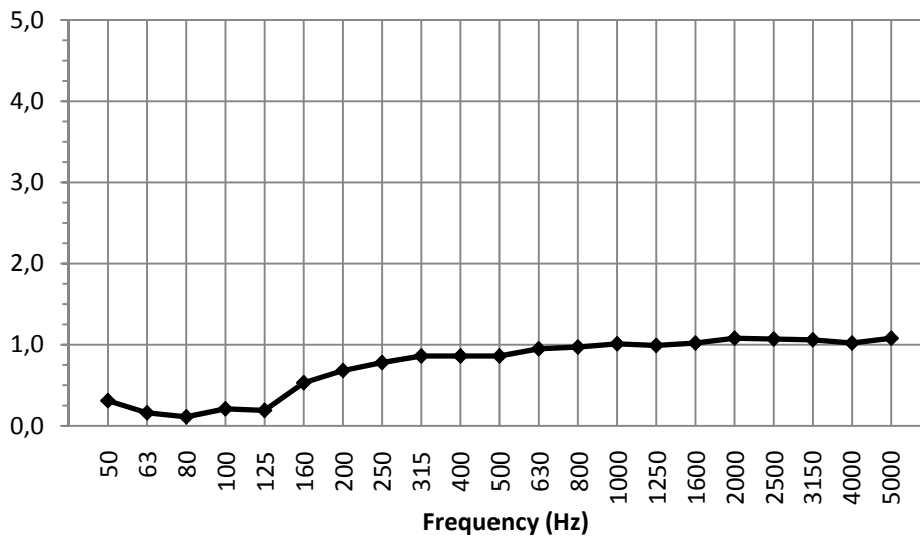
Client Götessons Industri AB

Object PAZ Bordsskärm  
Desk screen  
Material description: Product lined with fabric with a frame out of pine and filling out of PET-fibre.  
Number of tested objects: 3  
Thickness: 52 mm  
Panel size: 685 mm x 1605 mm  
The Screen also had a projection part for air filtration at one side measuring 220 x 1025 x 190 mm (H x W x D)

Date of test November 27, 2015

Conditions Room volume: 200 m<sup>3</sup>  
Temperature at measurement on object/in empty room: 20/ 20 °C  
Relative humidity at measurement on object/in empty room: 36/ 31 %

Equivalent sound absorption area per object (m<sup>2</sup> Sabine)



Frequency (Hz)	A <sub>obj</sub>
50	0,3
63	0,2
80	0,1
100	0,2
125	0,2
160	0,5
200	0,7
250	0,8
315	0,9
400	0,9
500	0,9
630	1,0
800	1,0
1000	1,0
1250	1,0
1600	1,0
2000	1,1
2500	1,1
3150	1,1
4000	1,0
5000	1,1

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Appendix 3

**Measurement of sound absorption area**

Test Measurement of sound absorption area in a reverberation room according to EN ISO 354 and SS 25269.

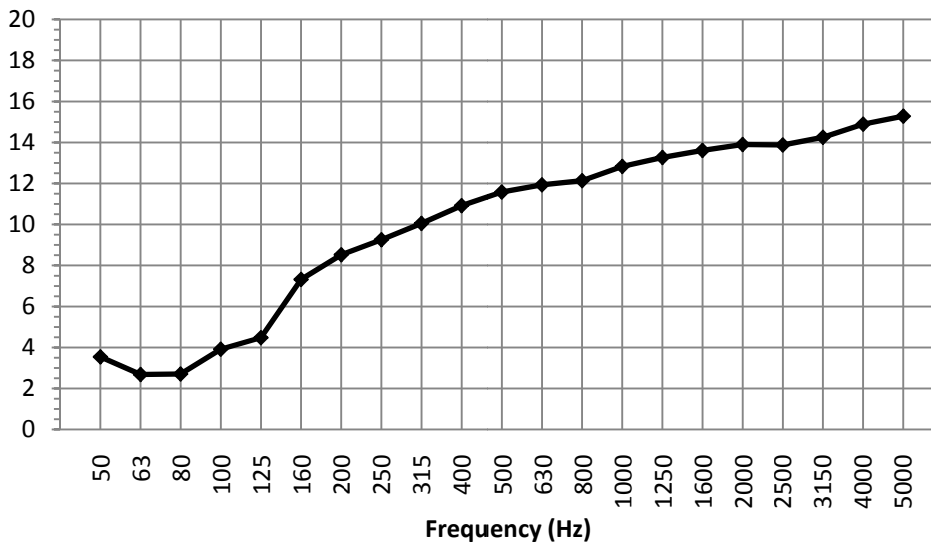
Client Götessons Industri AB

Object The Hut  
A screening hut  
Material description: Product lined with fabric with a frame out of pine and filling out of PET-fibre.  
Number of tested objects: 1 in 3 different positions. Result averaged.  
Thickness: 35 mm  
Size: 1870 mm x 2270 mm x 1800 mm (W x H x D)

Date of test November 30, 2015

Conditions Room volume: 200 m<sup>3</sup>  
Temperature at measurement on object/in empty room: 20/ 20 °C  
Relative humidity at measurement on object/in empty room: 90/93 %

Equivalent sound absorption area per object (m<sup>2</sup> Sabine)



Frequency (Hz)	A <sub>obj</sub>
50	3,5
63	2,7
80	2,7
100	3,9
125	4,5
160	7,3
200	8,5
250	9,3
315	10,1
400	10,9
500	11,6
630	11,9
800	12,1
1000	12,8
1250	13,3
1600	13,6
2000	13,9
2500	13,9
3150	14,3
4000	14,9
5000	15,3

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Appendix 4

**Measurement of sound absorption area**

Test Measurement of sound absorption area in a reverberation room according to EN ISO 354 and SS 25269.

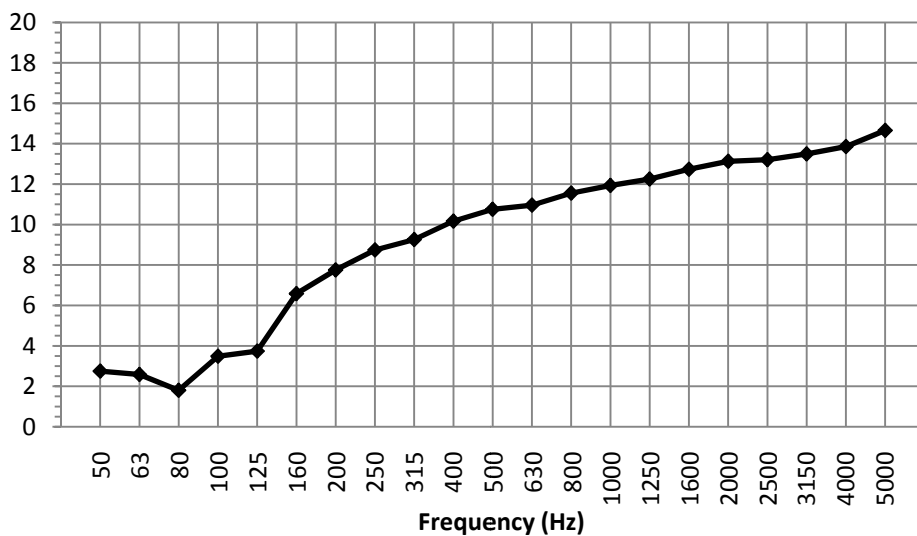
Client Götessons Industri AB

Object The Hut  
 A screening hut  
*Tested with the back of the test object covered (the back against the floor) corresponding to mounting it against a wall or similar*  
 Material description: Product lined with fabric with a frame out of pine and filling out of PET-fibre.  
 Number of tested objects: 1 in 3 different positions. Result averaged.  
 Thickness: 35 mm  
 Size: 1870 mm x 2270 mm x 1800 mm (W x H x D)

Date of test November 27, 2015

Conditions Room volume: 200 m<sup>3</sup>  
 Temperature at measurement on object/in empty room: 20/ 20 °C  
 Relative humidity at measurement on object/in empty room: 69/72 %

Equivalent sound absorption area per object (m<sup>2</sup> Sabine)



Frequency (Hz)	A <sub>obj</sub>
50	2,8
63	2,6
80	1,8
100	3,5
125	3,7
160	6,6
200	7,8
250	8,7
315	9,3
400	10,2
500	10,8
630	11,0
800	11,6
1000	11,9
1250	12,3
1600	12,7
2000	13,1
2500	13,2
3150	13,5
4000	13,9
5000	14,7

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Appendix 5

**Measurement of sound absorption area**

Test Measurement of sound absorption area in a reverberation room according to EN ISO 354 and SS 25269.

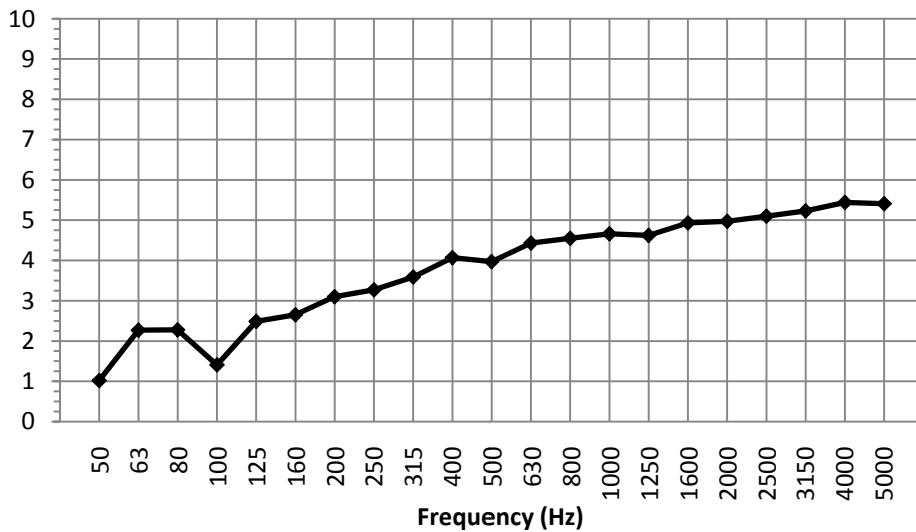
Client Götessons Industri AB

Object The Hut Sofa  
Sofa  
Material description: Product lined with fabric with a frame out of pine and filling out of PET-fibre.  
Number of tested objects: 3  
Thickness: 50 mm  
Size: 1770 mm x 1470 mm x 440 mm (W x H x D)

Date of test November 26, 2015

Conditions Room volume: 200 m<sup>3</sup>  
Temperature at measurement on object/in empty room: 20/ 20 °C  
Relative humidity at measurement on object/in empty room: 31/31 %

Equivalent sound absorption area per object (m<sup>2</sup> Sabine)



Frequency (Hz)	A <sub>obj</sub>
50	1,0
63	2,3
80	2,3
100	1,4
125	2,5
160	2,7
200	3,1
250	3,3
315	3,6
400	4,1
500	4,0
630	4,4
800	4,6
1000	4,7
1250	4,6
1600	4,9
2000	5,0
2500	5,1
3150	5,2
4000	5,4
5000	5,4

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Appendix 6

**Measurement of sound absorption area**

Test Measurement of sound absorption area in a reverberation room according to EN ISO 354 and SS 25269.

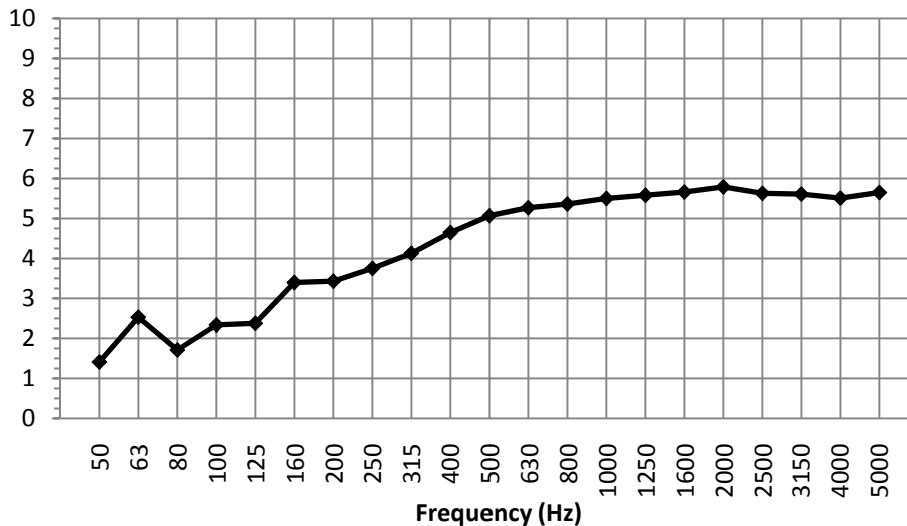
Client Götessons Industri AB

Object Sofa Sound Booth  
Sofa  
Material description: Product lined with fabric with a frame out of pine and filling out of PET-fibre.  
Number of tested objects: 1 in 3 different positions. Result averaged.  
Thickness: 40 mm  
Size: 1690 mm x 14000 mm x 695 mm (W x H x D)

Date of test November 24, 2015

Conditions Room volume: 200 m<sup>3</sup>  
Temperature at measurement on object/in empty room: 20/ 20 °C  
Relative humidity at measurement on object/in empty room: 32/31 %

Equivalent sound absorption area per object (m<sup>2</sup> Sabine)



Frequency (Hz)	A <sub>obj</sub>
50	1,4
63	2,5
80	1,7
100	2,3
125	2,4
160	3,4
200	3,4
250	3,8
315	4,1
400	4,7
500	5,1
630	5,3
800	5,4
1000	5,5
1250	5,6
1600	5,7
2000	5,8
2500	5,6
3150	5,6
4000	5,5
5000	5,7

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Appendix 7

**Measurement of sound absorption area**

Test Measurement of sound absorption area in a reverberation room according to EN ISO 354 and SS 25269.

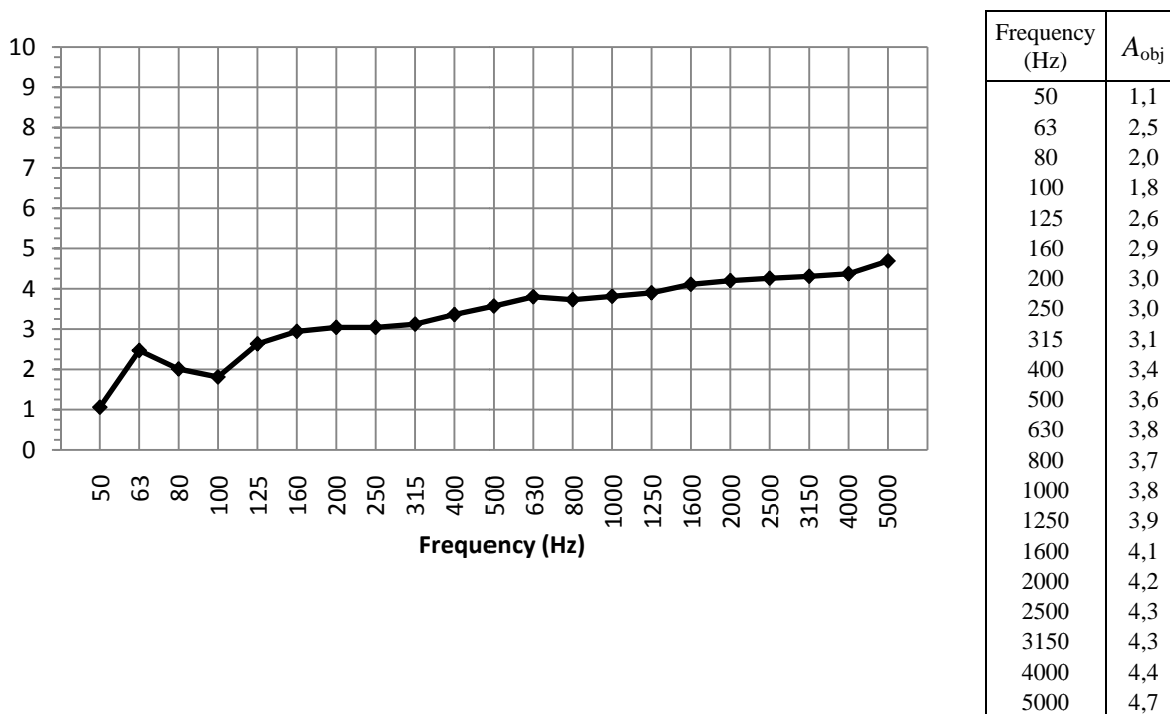
Client Götessons Industri AB

Object Sofa Sound Booth  
Sofa  
*Tested with the back of the test object covered (the back against the floor and the bottom covered with a board) corresponding to mounting it against a wall or similar*  
Material description: Product lined with fabric with a frame out of pine and filling out of PET-fibre.  
Number of tested objects: 1 in 3 different positions. Result averaged.  
Thickness: 40 mm  
Size: 1690 mm x 14000 mm x 695 mm (W x H x D)

Date of test November 26, 2015

Conditions Room volume: 200 m<sup>3</sup>  
Temperature at measurement on object/in empty room: 20/ 20 °C  
Relative humidity at measurement on object/in empty room: 31/31 %

Equivalent sound absorption area per object (m<sup>2</sup> Sabine)



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