

## SOUND ABSORPTION MEASUREMENTS FOR CUBIC FROM JOHANSON DESIGN

### CONCLUSIONS

The sound absorption area for Cubic from Johanson Design has been measured according to the reverberation room method (SS-EN ISO 354:2003). The measurements have been evaluated according to SS 25269:2013 and are presented as measurement protocols.

### 1. CLIENT

Johanson Design AB, Anders Anderssons väg 7, 285 35 Markaryd, Sweden  
Contact: Daniel Ilic, Daniel.i@johansondesign.se, +46 (0)433 725 11

### 2. ASSIGNMENT

To measure the sound absorption for Cubic from Johanson Design according to SS-EN ISO 354:2003 and evaluate according to SS 25269:2013.

### 3. TEST OBJECT

#### Cubic

Cubic is a square pillar shaped sound absorber with side dimensions 400 x 400 mm and height 2000 mm. It is built up by a wooden frame with sides and top of 40 mm glass fibre slabs (Ecophon Master A) covered with a foam laminated fabric. Measurements were also made with the space inside filled with glass fibre wool with density 13-15 kg/m<sup>3</sup> (approximately 2.3 kg per object), and with the objects placed in the corners of the room.



Figure 1: Measuring setup for Cubic



Figure 2: Inside space filled with mineral wool

#### 4. MEASUREMENT PROCEDURE

The absorption measurements were performed according to the standard SS-EN ISO 354:2003. The measurements were made with three speaker positions and four microphone positions. The results for sound absorption area were evaluated according to SS 25269:2013. The test specimen area fulfils the requirements in SS-EN ISO 354:2003.

The measurements were performed by Carl Nyqvist 2020-01-14 in Akustikverkstan's reverberation room in Skulptorp, Skövde, Sweden. More information on the test facilities can be found in Appendix 2.

## 5. MEASUREMENT EQUIPMENT

Table 1 lists the equipment used during the measurements. The equipment fulfils class 1 according to SS-EN 61672-1, 60942 and 61260. Date for the latest calibration is available in the instrument journal of Akustikverkstan.

Instrument	Manufacture and type	Serial number	Internal designation
Measurement computer	HP Zbook		DA02
Front end	National Instruments NI 9234	1918620/190DB0B	AN05
Microphone	Roga MI-17	592	MI04
Microphone	Roga MI-17	593	MI05
Microphone	Roga MI-17	594	MI06
Microphone	Roga MI-17	595	MI07
Speaker	IMA Kub 1	8	HÖ7
Speaker	IMA Kub 1	9	HÖ8
Speaker	IMA Kub 1	10	HÖ9
Equalizer	Monacor MEQ-2152	-	Lab
Amplifier	Denon POA-2200	-	Lab

Table 1: Equipment used during the measurements.

## 6. RESULTS

Detailed measurement results for all test specimens are available in the measurement protocols belonging to this report 20-702-M1 to M4. The results are only valid for the tested samples.

## 7. COMMENTS AND INTERPRETATIONS

### 7.1 $N_{10}$ -value

*Kammarkollegiet*, the Swedish authority dealing with public purchasing, has published advice regarding purchasing of sound absorbers. They define the value  $N_{10}$  according to the formula:

$$N_{10} = \frac{10}{A_{500}}$$

$A_{500}$  is the sound absorption area at the 500 Hz octave band for the sound absorber. The  $N_{10}$  value is developed to be a single value metric for speech sound absorption and describes how many objects are needed to obtain 10 m<sup>2</sup> of sound absorption area in the 500 Hz octave band. If the sound absorption is lower in any octave above 500 Hz, the lower value will be used instead.

Measurement protocol	Test object	$N_{10}$
M1	Cubic	3.8
M2	Cubic with filling of mineral wool	3.4
M3	Cubic, corner position	5.6
M4	Cubic with filling of mineral wool, corner pos.	5.3

Table 2:  $N_{10}$ -value based on sound absorption area measurements of the products.

## 7.2 Corner position

According to ISO 354, the sound absorption of an object should be measured with the object placed directly on the floor with preferably at least 1 m distance to the walls. Measurements were also made with the test objects placed in three corners of the room as this can benefit sound absorption in low frequencies. The tests shows an increased sound absorption in third octave frequencies between 50 and 125 Hz.



Figure 3: Cubic measured in corner positions.



Figure 4: Cubic measured in corner positions (third position).

## 8. MEASUREMENT UNCERTAINTY

The uncertainties in the measured sound absorption coefficients have been estimated to the values in table 3. The uncertainty corresponds to one standard deviation. The uncertainties for the sound absorption area measurement are concluded from the same values multiplied with the test specimen area.

<b>50 Hz</b>	<b>63 Hz</b>	<b>80 Hz</b>	<b>100 Hz</b>	<b>125 Hz</b>	<b>160 Hz</b>	<b>200 Hz</b>
± 0.10	± 0.08	± 0.07	± 0.06	± 0.05	± 0.04	± 0.03
<b>250 Hz</b>	<b>315 Hz</b>	<b>400 Hz</b>	<b>500 Hz</b>	<b>630 Hz</b>	<b>800 Hz</b>	<b>1 kHz</b>
± 0.03	± 0.03	± 0.03	± 0.03	± 0.03	± 0.03	± 0.03
<b>1,25 kHz</b>	<b>1,6 kHz</b>	<b>2 kHz</b>	<b>2,5 kHz</b>	<b>3,15 kHz</b>	<b>4 kHz</b>	<b>5 kHz</b>
± 0.03	± 0.03	± 0.03	± 0.03	± 0.03	± 0.03	± 0.03

Table 3: Measurement uncertainty for each third octave.

This report should always be used in its complete context, though the measurement protocols may be used independently.

## 9. DEVIATIONS FROM THE TEST PROCEDURE

The corner position measurements presented in 20-702-M3 and M4 deviates from the test procedure.

Carl Nyqvist

Reviewed by Johan Jernstedt, 2020-01-17

## APPENDIX 1: MEASURED REVERBERATION TIMES

f(Hz)	Empty	Cubic	Cubic filled with mineral wool	Cubic, corner position	Cubic filled with mineral wool, corner position
50	8.06	6.10	5.67	5.79	4.84
63	8.70	6.57	6.09	6.25	5.07
80	7.91	5.87	5.61	5.36	3.77
100	7.19	5.10	4.48	4.75	3.59
125	6.89	3.71	3.35	2.96	2.46
160	5.61	3.00	2.61	2.94	2.70
200	5.70	2.86	2.68	2.53	2.57
250	5.36	2.69	2.56	2.71	2.65
315	5.43	2.66	2.50	2.76	2.59
400	5.22	2.51	2.28	2.73	2.64
500	4.72	2.22	2.08	2.46	2.41
630	4.27	2.00	1.95	2.30	2.29
800	4.64	1.91	1.91	2.43	2.44
1000	4.57	1.95	1.98	2.46	2.45
1250	3.90	1.82	1.82	2.30	2.29
1600	3.59	1.75	1.76	2.18	2.16
2000	3.17	1.62	1.63	2.05	2.04
2500	2.77	1.54	1.52	1.90	1.90
3150	2.36	1.41	1.43	1.67	1.66
4000	1.94	1.22	1.23	1.46	1.46
5000	1.53	1.06	1.06	1.21	1.21

Number of test objects	0	3	3	3	3
Temperature (°C)	17.7	17.3	16.5	17.0	16.5
RH (%)	40	40	42	40	42

## APPENDIX 2: INFORMATION ABOUT THE REVERBERATION ROOM

The reverberation room is rectangular, measuring Length x Width x Height = 5.85 x 4.65 x 7.35 m. The room volume is 200 m<sup>3</sup> and the total area of the walls, ceiling and floor is 209 m<sup>2</sup>. There are 22 diffusors (size 0.775 x 1.25 m) randomly installed in the room. The reverberation time between 50 and 200 Hz is controlled with membrane absorbers on the walls.

The test specimens are put on the floor on the mounting area (10 m<sup>2</sup>, 2.6 x 3.85 m) according to figure A2.1. The mounting area consists of a concrete slab that can be lowered up to 700 mm below the floor.

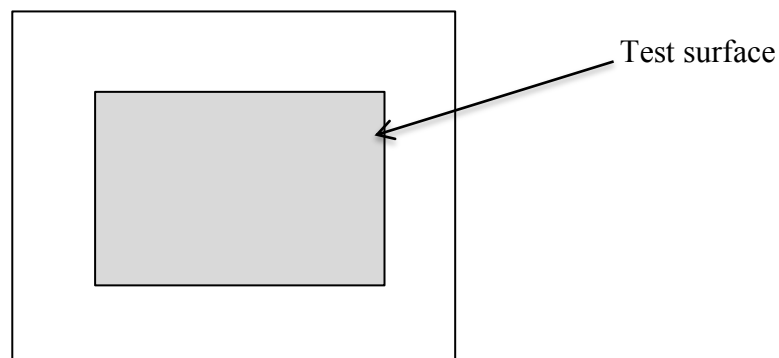


Figure A2.1: Plane drawing of the reverberation room.

# Cubic

SOUND ABSORPTION AREA ACCORDING TO ISO 354 AND SS 25269

Measurement of sound absorption area in a reverberation room



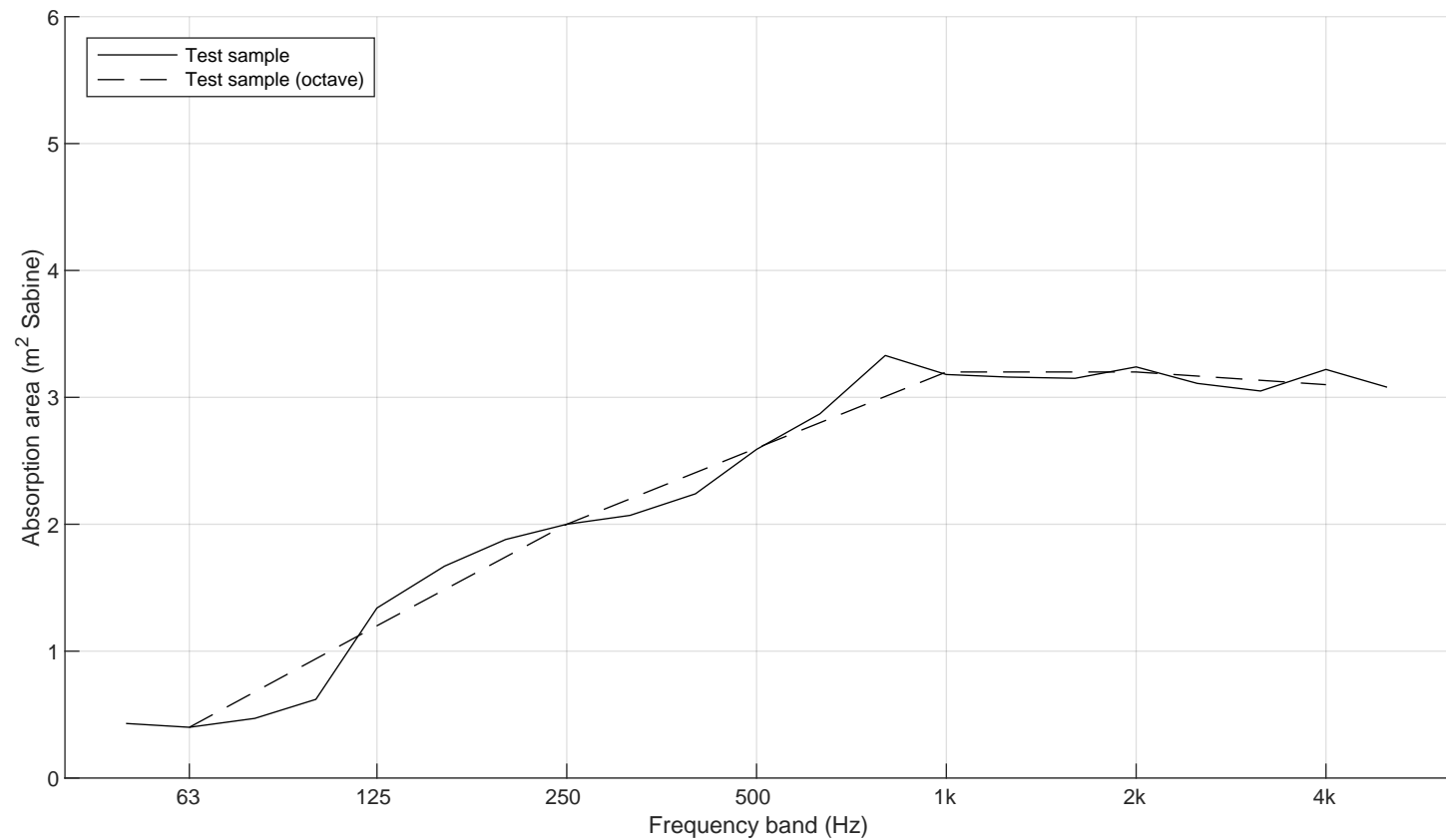
Report number:  
**20-702-M1**  
Date  
**2020-01-16**

Frequency f [Hz]	Sound absorption area [m <sup>2</sup> Sabine]	
50	0.43	
63	0.40	0.4
80	0.47	
100	0.62	
125	1.34	1.2
160	1.67	
200	1.88	
250	2.00	2.0
315	2.07	
400	2.24	
500	2.59	2.6
630	2.87	
800	3.33	
1000	3.18	3.2
1250	3.16	
1600	3.15	
2000	3.24	3.2
2500	3.11	
3150	3.05	
4000	3.22	3.1
5000	3.08	

Client: Johanson Design  
Manufacturer: Johanson Design  
Product identification: Cubic  
Description of test specimen: Sound absorbing pillar 400 x 400 x 2000 mm. Wooden frame with sides and top of 40 mm glass fibre slabs (Ecophon Master A). Covered with foam laminated fabric.

Reverberation room volume: 200 m<sup>3</sup>  
Temperature: 17.3 °C (empty: 17.7 °C)  
Air humidity: 40 % (empty: 40 %)  
Air pressure: 97.2 kPa (empty: 97.2 kPa)  
Number of specimens: 3

Measurement date: 2020-01-14  
Measured by: Carl Nyqvist



$$N_{10} = 3.8$$

# Cubic filled with mineral wool

SOUND ABSORPTION AREA ACCORDING TO ISO 354 AND SS 25269

Measurement of sound absorption area in a reverberation room



Report number:  
20-702-M2  
Date  
2020-01-16

Frequency f [Hz]	Sound absorption area [m <sup>2</sup> Sabine]	
50	0.57	
63	0.54	0.6
80	0.56	
100	0.91	
125	1.67	1.6
160	2.23	
200	2.15	
250	2.21	2.2
315	2.35	
400	2.67	
500	2.93	2.9
630	3.02	
800	3.35	
1000	3.11	3.2
1250	3.16	
1600	3.14	
2000	3.24	3.2
2500	3.23	
3150	3.01	
4000	3.19	3.1
5000	3.07	

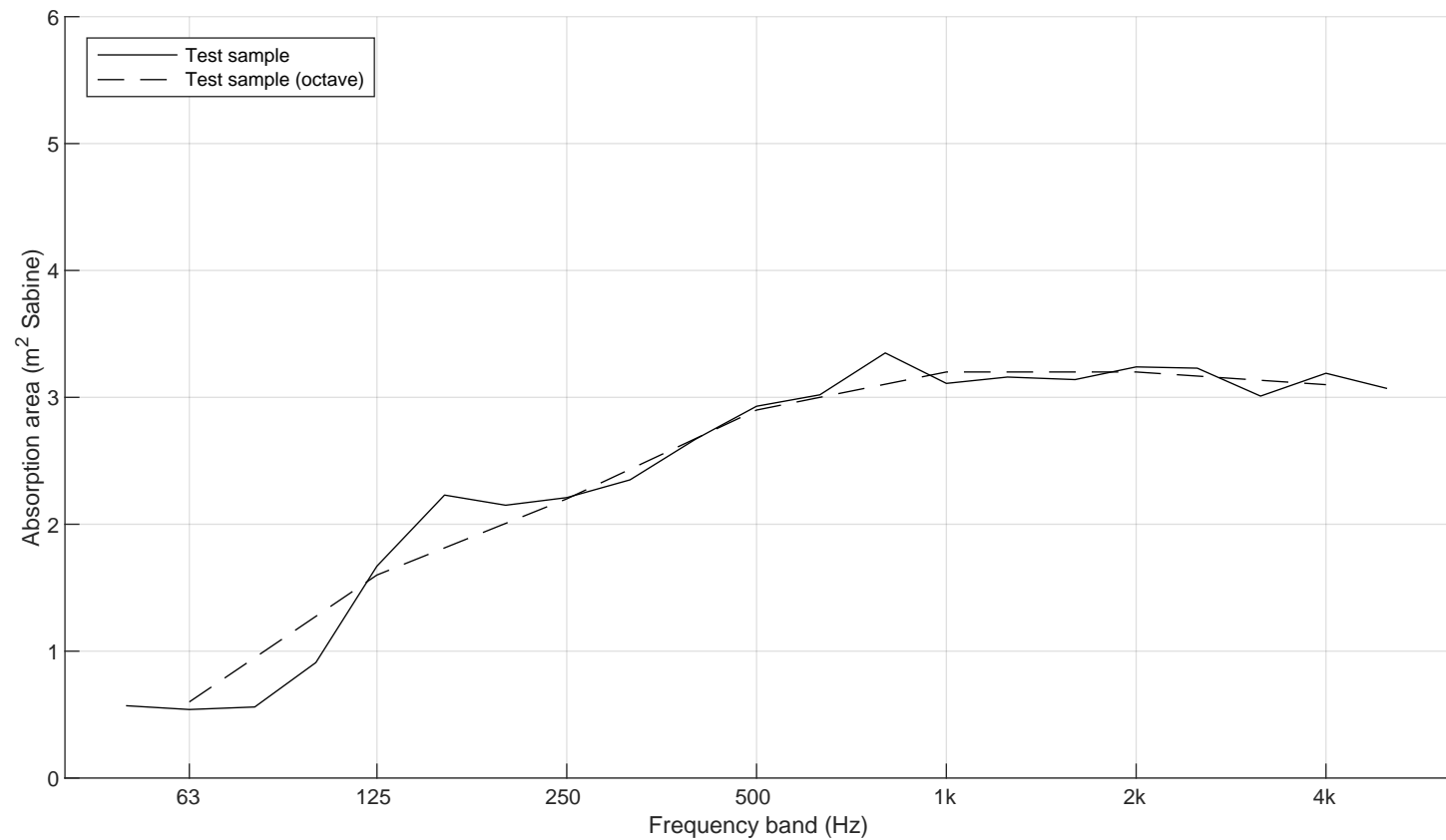
Client: Johanson Design  
 Manufacturer: Johanson Design  
 Product identification: Cubic

Description of test specimen: Sound absorbing pillar 400 x 400 x 2000 mm. Wooden frame with sides and top of 40 mm glass fibre slabs (Ecophon Master A). Covered with foam laminated fabric. Space inside filled with glass fibre wool.

Reverberation room volume: 200 m<sup>3</sup>  
 Temperature: 16.5 °C (empty: 17.7 °C)  
 Air humidity: 42 % (empty: 40 %)  
 Air pressure: 97.2 kPa (empty: 97.2 kPa)  
 Number of specimens: 3

Measurement date: 2020-01-14  
 Measured by: Carl Nyqvist

$$N_{10} = 3.4$$



## Cubic, corner position

SOUND ABSORPTION AREA ACCORDING TO ISO 354 AND SS 25269

Measurement of sound absorption area in a reverberation room



Report number:  
20-702-M3  
Date  
2020-01-16

Frequency f [Hz]	Sound absorption area [m <sup>2</sup> Sabine]	
50	0.53	
63	0.49	0.6
80	0.65	
100	0.78	
125	2.09	1.5
160	1.76	
200	2.37	
250	1.97	2.1
315	1.93	
400	1.89	
500	2.10	2.1
630	2.18	
800	2.12	
1000	2.04	2.0
1250	1.93	
1600	1.93	
2000	1.86	1.9
2500	1.77	
3150	1.83	
4000	1.75	1.8
5000	1.74	

Client: Johanson Design

Manufacturer: Johanson Design

Product identification: Cubic

Description of test specimen: Sound absorbing pillar 400 x 400 x 2000 mm. Wooden frame with sides and top of 40 mm glass fibre slabs (Ecophon Master A). Covered with foam laminated fabric.  
Corner position deviates from ISO 354.

Reverberation room volume: 200 m<sup>3</sup>

Temperature: 17.0 °C (empty: 17.7 °C)

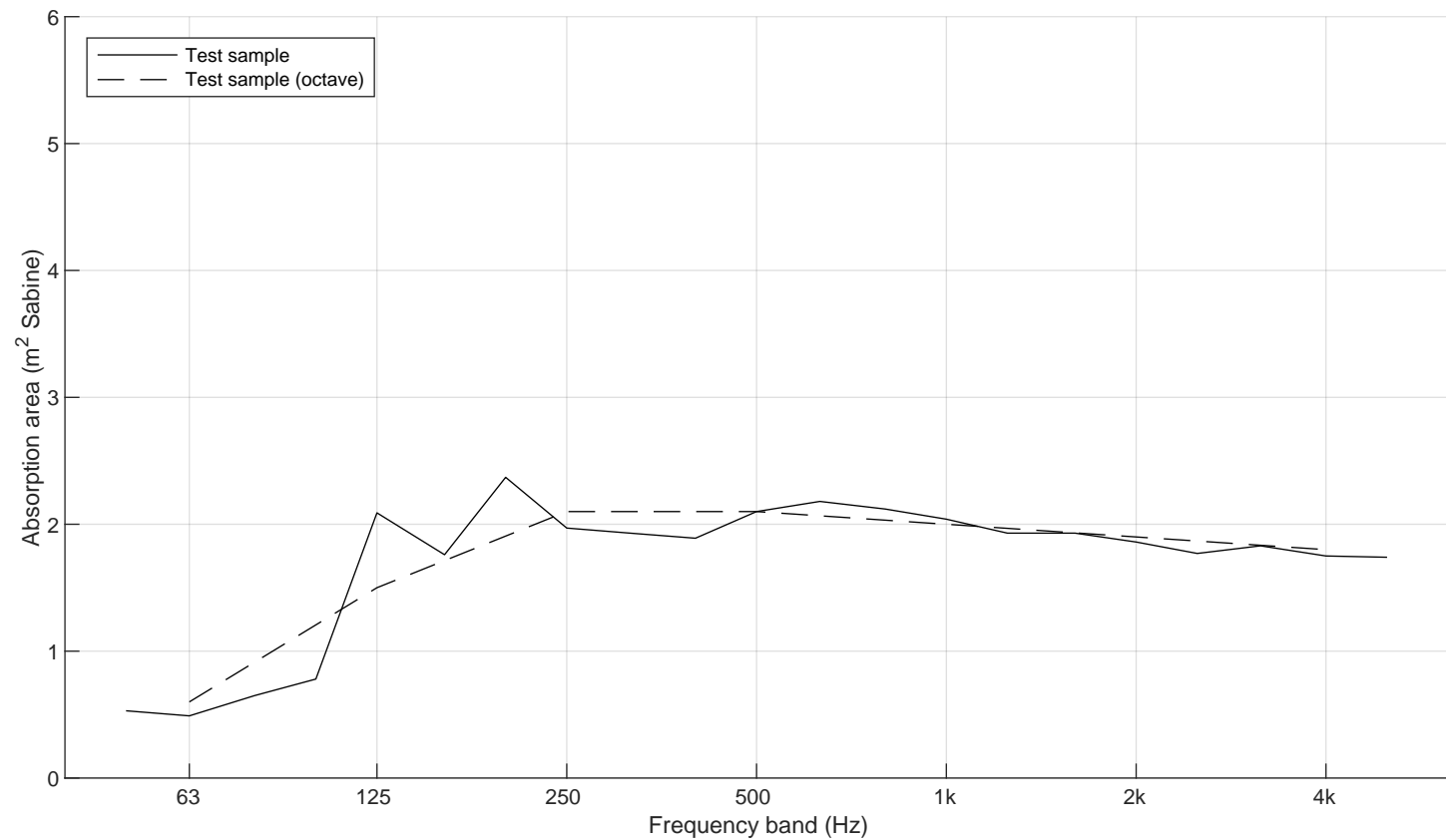
Air humidity: 40 % (empty: 40 %)

Air pressure: 97.2 kPa (empty: 97.2 kPa)

Number of specimens: 3

Measurement date: 2020-01-14

Measured by: Carl Nyqvist



$N_{10} = 5.6$

# Cubic filled with mineral wool, corner position

SOUND ABSORPTION AREA ACCORDING TO ISO 354 AND SS 25269

Measurement of sound absorption area in a reverberation room



Report number:  
20-702-M4  
Date  
2020-01-16

Frequency f [Hz]	Sound absorption area [m <sup>2</sup> Sabine]	
50	0.90	
63	0.89	1.1
80	1.51	
100	1.51	
125	2.83	2.1
160	2.08	
200	2.32	
250	2.07	2.2
315	2.19	
400	2.03	
500	2.21	2.1
630	2.19	
800	2.12	
1000	2.05	2.0
1250	1.97	
1600	1.99	
2000	1.91	1.9
2500	1.80	
3150	1.94	
4000	1.86	1.9
5000	1.87	

Client: Johanson Design  
 Manufacturer: Johanson Design  
 Product identification: Cubic

Description of test specimen: Sound absorbing pillar 400 x 400 x 2000 mm. Wooden frame with sides and top of 40 mm glass fibre slabs (Ecophon Master A). Covered with foam laminated fabric. Space inside filled with glass fibre wool. Corner position deviates from ISO 354.

Reverberation room volume: 200 m<sup>3</sup>  
 Temperature: 16.5 °C (empty: 17.7 °C)  
 Air humidity: 42 % (empty: 40 %)  
 Air pressure: 97.2 kPa (empty: 97.2 kPa)  
 Number of specimens: 3  
 Measurement date: 2020-01-14  
 Measured by: Carl Nyqvist

$$N_{10} = 5.3$$

