

ABSORPTION MEASUREMENTS FOR PRODUCTS FROM GÖTESSONS INDUSTRI AB

CONCLUSIONS

The sound absorption area for The Hut, Half a Hut, Honey och Hang Over, in different versions from Götessons Industri AB 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 in separate measurement protocols as absorption area per object.

1. CLIENT

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2. ASSIGNMENT

To measure the sound absorption area according to SS-EN ISO 354:2003 for The Hut, Half a Hut, Honey och Hang Over, in different versions from Götessons Industri AB. The measurements shall be evaluated according to SS 25269:2013. Akustikverkstan is accredited for both these standards.

3. TEST OBJECTS

The Hut

A hut with outer dimensions (WxHxD) 1880 x 2270 x 1800 mm. Made from panels with pine frame and PET-filling covered in fabric. Front panels are 60 mm thick, the rest of the panels are 40 mm thick. The Hut was measured with front panels and with front panels with an 8 mm plexiglas door. Both versions were measured in the middle of the room and with backside facing a wall.

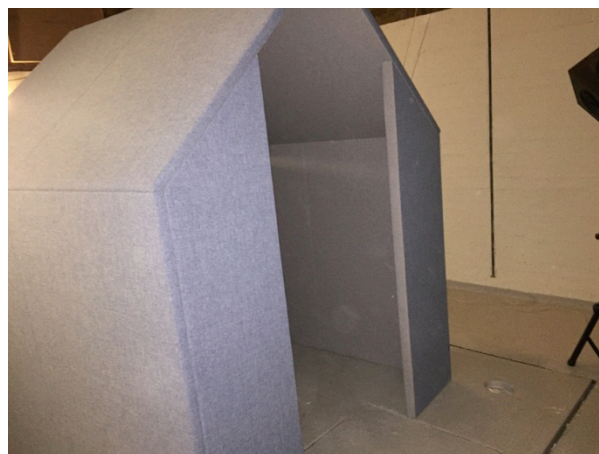


Figure 1: The Hut with front panels

Half a Hut

A hut with outer dimensions (WxHxD) 1880 x 2270 x 900 mm. Made from panels with pine frame and PET-filling covered in fabric. Front panels are 60 mm thick, the rest of the panels are 40 mm thick. Half a Hut was measured with open front, with front panels and with front panels with an 8 mm plexiglas door. All versions were measured in the middle of the room and with backside facing a wall.



Figure 2: Half a Hut with door, against wall

Honey

Hexagonal wall absorber with outer dimensions 520 x 600 mm, thickness 50 mm (area 0.234 m²). Ecosund PET-filling dressed with Hush fabric. Honey was measured as a single object and in a group of 8 pieces (out. meas. 1950 x 1560 mm).



Figure 3: Honey 8 pieces

Hang Over Large

Absorber for mounting on wall, ceiling, or hanging freely. 3 mm MDF with sound absorbing filling covered in foam laminated fabric. Outer dimensions approximately 810 x 690 mm. Thickness 130 mm. Hang Over was measured hanging freely.



Figure 4: Hang Over

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 2017-11-21 in the reverberation room of Akustikverkstan in Skultorp, Skövde, Sweden. More information on the test facilities can be found in Appendix 2.

The results for all measurements of The Hut, Half a Hut and Honey in group of 8, are averaged from measurement of one object in 2 different positions. According to SS-EN ISO 354:2003 an average of at least 3 positions shall be made. This deviation from standard was due to the size of the test objects and should not affect the results.

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	Manufacturer and type	Serial number	Internal designation
Measurement computer	HP Zbook	-	DA02
Front end	National Instruments NI 9234/NI cDAQ-9171	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 according to table 2. The results are only valid for the tested samples.

Test sample	Size (mm)	Measurement protocol
The Hut with front panels	1880 x 2270 x 1800	17-321-M1
The Hut with door	1880 x 2270 x 1800	17-321-M2
The Hut with front panels, against wall	1880 x 2270 x 1800	17-321-M3
The Hut with door, against wall	1880 x 2270 x 1800	17-321-M4
Half a Hut	1880 x 2270 x 900	17-321-M5
Half a Hut with front panels	1880 x 2270 x 900	17-321-M6
Half a Hut with door	1880 x 2270 x 900	17-321-M7
Half a Hut, against wall	1880 x 2270 x 900	17-321-M8
Half a Hut with front panels, against wall	1880 x 2270 x 900	17-321-M9
Half a Hut with door, against wall	1880 x 2270 x 900	17-321-M10
Honey, group of 8 pieces	1950 x 1560 x 50	17-321-M11
Honey, single object	520 x 600 x 50	17-185-M12
Hang Over Large	810 x 690 x 130	17-185-M13

Table 2: List of measurement protocols.

7. COMMENTS AND INTERPRETATIONS

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 tested object. 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 m² 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	The Hut with front panels	1.1
M2	The Hut with door	1.1
M3	The Hut with front panels, against wall	1.2
M4	The Hut with door, against wall	1.3
M5	Half a Hut	1.4
M6	Half a Hut with front panels	1.4
M7	Half a Hut with door	1.5
M8	Half a Hut, against wall	1.8
M9	Half a Hut with front panels, against wall	1.8
M10	Half a Hut with door, against wall	2.1
M11	Honey, group of 8 pieces	5
M12	Honey, single object	33
M13	Hang Over Large	17

Tabell 3: N_{10} - values for the measured products.

8. MEASUREMENT UNCERTAINTY

The uncertainties in the measured sound absorption coefficients have been estimated to the values in table 4. 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.

50 Hz ± 0.10	63 Hz ± 0.08	80 Hz ± 0.07	100 Hz ± 0.06	125 Hz ± 0.05	160 Hz ± 0.04	200 Hz ± 0.03
250 Hz ± 0.03	315 Hz ± 0.03	400 Hz ± 0.03	500 Hz ± 0.03	630 Hz ± 0.03	800 Hz ± 0.03	1 kHz ± 0.03
1.25 kHz ± 0.03	1.6 kHz ± 0.03	2 kHz ± 0.03	2.5 kHz ± 0.03	3.15 kHz ± 0.03	4 kHz ± 0.03	5 kHz ± 0.03

Table 4: Measurement uncertainty for each third octave.

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

Carl Nyqvist

Reviewed by Johan Jernstedt, 2017-12-08

APPENDIX 1: MEASURED REVERBERATION TIMES

f(Hz)	Empty	The Hut w. front panels meas. 1	The Hut w. front panels meas. 2	The Hut w. door meas. 1	The Hut w. door meas. 2	The Hut w. front panels, against wall meas. 1	The Hut w. front panels, against wall meas. 2	The Hut w. door against wall meas. 1	The Hut w. door against wall meas. 2
50	9.03	3.61	3.67	3.42	3.38	2.79	2.73	2.82	2.64
63	8.95	4.11	4.15	4.04	4.01	3.83	3.77	3.28	3.56
80	8.08	4.41	4.44	4.25	4.04	4.39	4.40	3.97	4.41
100	7.34	4.52	4.63	4.64	4.54	4.63	4.36	4.06	4.32
125	6.86	4.08	4.15	3.97	4.05	3.76	3.64	3.26	3.30
160	5.69	3.16	3.10	3.00	3.23	2.67	2.63	2.81	2.78
200	5.54	2.48	2.57	2.46	2.53	2.79	2.72	2.80	2.82
250	5.55	2.50	2.55	2.49	2.36	2.62	2.61	2.60	2.69
315	5.34	2.33	2.38	2.40	2.29	2.49	2.50	2.48	2.55
400	5.28	2.24	2.26	2.30	2.22	2.33	2.29	2.43	2.39
500	4.66	2.07	1.99	2.06	2.04	2.12	2.19	2.30	2.20
630	4.17	1.89	1.89	1.92	1.87	1.97	2.03	2.13	2.06
800	4.76	1.95	1.95	2.03	1.97	2.08	2.06	2.15	2.20
1000	4.62	1.87	1.91	1.92	1.93	2.03	2.03	2.15	2.16
1250	3.97	1.72	1.74	1.77	1.78	1.86	1.93	2.00	2.02
1600	3.57	1.62	1.63	1.65	1.70	1.77	1.83	1.91	1.86
2000	3.17	1.50	1.49	1.53	1.59	1.60	1.67	1.74	1.72
2500	2.74	1.38	1.36	1.42	1.43	1.48	1.51	1.60	1.56
3150	2.28	1.24	1.24	1.26	1.27	1.33	1.33	1.40	1.37
4000	1.86	1.08	1.07	1.12	1.11	1.17	1.16	1.21	1.21
5000	1.46	0.90	0.91	0.94	0.94	0.97	0.97	1.01	1.01

Number of test objects	0	1	1	1	1	1	1	1	1
Temperature (°C)	14.5	14.9	14.8	16.9	16.5	14.7	14.7	14.5	14.5
RH (%)	42	41	42	39	39	42	42	42	42

f(Hz)	Half a Hut meas. 1	Half a Hut meas. 2	Half a Hut w. front panels meas. 1	Half a Hut w. front panels meas. 2	Half a Hut w. door meas. 1	Half a Hut w. door meas. 2	Half a Hut, against wall meas. 1	Half a Hut, against wall meas. 2	Half a Hut w. front panels, against wall meas. 1	Half a Hut w. front panels, against wall meas. 2
50	5.11	5.14	5.06	4.99	4.70	5.06	4.44	4.68	4.00	4.18
63	5.19	5.24	5.20	5.01	5.32	5.19	5.44	5.42	4.43	4.39
80	5.63	5.68	5.34	5.09	5.06	5.22	5.70	5.71	4.66	5.03
100	5.42	5.66	5.23	5.18	4.95	5.26	5.26	5.48	4.57	5.03
125	4.60	4.84	4.30	4.40	4.21	4.45	4.34	4.53	4.22	4.15
160	3.41	3.61	3.52	3.32	3.48	3.71	3.58	3.55	3.39	3.51
200	2.91	2.91	2.94	2.95	3.03	3.16	3.32	3.37	3.15	3.31
250	2.82	2.84	2.77	2.75	2.92	2.94	3.19	3.15	2.95	2.99
315	2.84	2.76	2.64	2.81	2.81	2.72	3.07	3.03	2.86	2.92
400	2.57	2.52	2.45	2.49	2.60	2.57	2.81	2.83	2.77	2.77
500	2.32	2.35	2.26	2.23	2.47	2.31	2.58	2.55	2.53	2.50
630	2.17	2.18	2.12	2.13	2.29	2.23	2.43	2.36	2.45	2.37
800	2.23	2.26	2.20	2.23	2.37	2.28	2.46	2.47	2.42	2.43
1000	2.14	2.12	2.13	2.15	2.30	2.25	2.51	2.48	2.45	2.38
1250	1.99	1.95	1.98	1.98	2.10	2.10	2.23	2.23	2.25	2.20
1600	1.89	1.82	1.82	1.83	1.99	1.89	2.11	2.08	2.12	2.07
2000	1.72	1.66	1.69	1.70	1.83	1.78	1.91	1.92	1.94	1.93
2500	1.56	1.53	1.55	1.54	1.65	1.62	1.75	1.76	1.72	1.75
3150	1.39	1.38	1.37	1.36	1.45	1.44	1.53	1.52	1.50	1.52
4000	1.20	1.20	1.18	1.18	1.25	1.25	1.33	1.30	1.32	1.31
5000	0.99	0.98	0.98	0.98	1.03	1.04	1.08	1.08	1.07	1.08

Number of test objects	1	1	1	1	1	1	1	1	1	1
Temperature (°C)	14.7	14.6	14.9	14.8	15.9	15.6	14.5	14.5	15.1	15.0
RH (%)	41	41	41	41	41	47	41	41	40	41

f(Hz)	Half a Hut w. door against wall meas. 1	Half a Hut w. door against wall meas. 2	Honey, 8 pieces meas. 1	Honey, 8 pieces meas. 2	Honey, 1 piece	Hang Over
50	3.78	3.66	8.75	8.67	8.75	8.25
63	5.07	4.64	8.53	8.37	8.58	7.96
80	4.81	4.82	7.64	7.65	7.70	7.31
100	4.55	4.62	6.76	6.86	6.85	6.59
125	3.93	3.92	6.31	6.42	6.59	6.22
160	3.58	3.32	4.97	4.95	5.13	4.85
200	3.31	3.20	4.73	4.83	4.84	4.68
250	3.06	3.00	4.53	4.61	4.67	4.11
315	3.14	3.09	4.24	4.30	4.28	4.12
400	3.00	2.99	4.04	4.06	3.99	3.70
500	2.76	2.81	3.60	3.66	3.58	3.25
630	2.58	2.55	3.26	3.27	3.25	2.87
800	2.74	2.66	3.51	3.54	3.48	3.01
1000	2.66	2.66	3.47	3.49	3.42	2.88
1250	2.47	2.45	3.07	3.12	3.06	2.55
1600	2.32	2.26	2.88	2.83	2.87	2.40
2000	2.07	2.09	2.51	2.55	2.58	2.17
2500	1.88	1.87	2.29	2.31	2.29	1.99
3150	1.66	1.63	1.99	1.97	1.99	1.72
4000	1.42	1.39	1.63	1.66	1.65	1.47
5000	1.14	1.13	1.31	1.31	1.33	1.19

Number of test objects	1	1	1	1	6	5
Temperature (°C)	15.5	15.2	15.0	14.9	14.8	15.7
RH (%)	40	40	40	40	41	40

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 m³ and the total area of the walls, ceiling and floor is 209 m². 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 specimen is put on the floor on the mounting area (10 m², 2.6 x 3.85 m) according to figure B2.1. The mounting area consists of a concrete slab that can be lowered up to 700 mm below the floor.

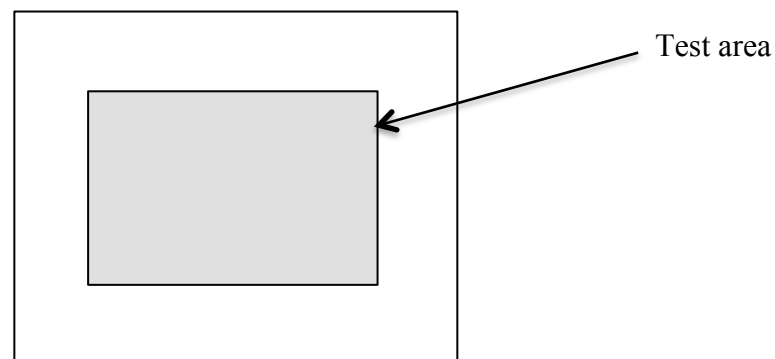


Figure A2.1: Plane drawing of the reverberation room with the test area.