

SOUND ABSORPTION MEASUREMENTS FOR CHESTERFIELD, CIRCUIT, LOOP AND ROMB

CONCLUSIONS

The sound absorption for combinations of the products Chesterfield, Circuit and Romb has been measured according to the reverberation room method (SS-EN ISO 354:2003) for sound absorption coefficient and sound absorption area. The measurements have been evaluated according to SS-EN ISO 11654:1997 and ISO 20189:2018. The N_{10} -value, as used by the Swedish authority dealing with public purchasing, *Kammarkollegiet*, has been calculated.

A summary of the results is presented in table 1 and 2.

Measurement protocol	Test object	α_w	Sound absorption class
M1	Mix of Chesterfield, Circuit, Loop and Romb, 10 m ²	0.80(H)	B

Table 1: Summary of the results for weighted sound absorption coefficient and sound absorption class for Mix 1.

Measurement protocol	Test object	Sound absorption area in frequency band (Hz)						N_{10}
		125	250	500	1000	2000	4000	
M2	Dense mix of Chesterfield, Circuit, Loop and Romb	0.37	1.2	2.0	2.6	2.6	2.4	5.1
M3	Sparse mix of Chesterfield, Circuit, Loop and Romb	0.43	1.3	2.0	2.6	2.6	2.4	5.0

Table 2: Summary of the results as octave band sound absorption area as described in ISO 20189:2018 and as N_{10} -value as used by Kammarkollegiet.

1 CLIENT

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2 ASSIGNMENT

To measure the sound absorption coefficient and sound absorption area for combinations of Chesterfield, Circuit, Loop and Romb from Decibel by Johansson according to SS-EN ISO 354:2003. The measurements shall be evaluated according to SS-EN ISO 11654:1997 and ISO 20189:2018 where applicable.

3 TEST OBJECTS

Chesterfield, Circuit and Romb are wall mounted sound absorbing panels consisting of an MDF plate with Ecophon glass wool covered with fabric. The edges are covered with a frame made of steel sheet. Different decorative surface patterns are created with combinations of welded steel wires on the top of the panels.

The dimensions of the panels are 605 x 605 mm with a measured thickness of 70 mm, including the mounting brackets on the back.

The different patterns are presented in figure 1 and 2 below.

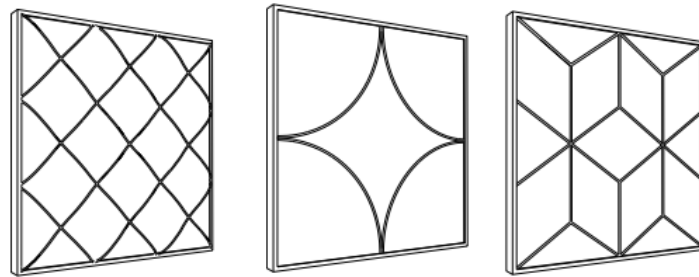


Figure 1. From right: Chesterfield, Loop and Romb

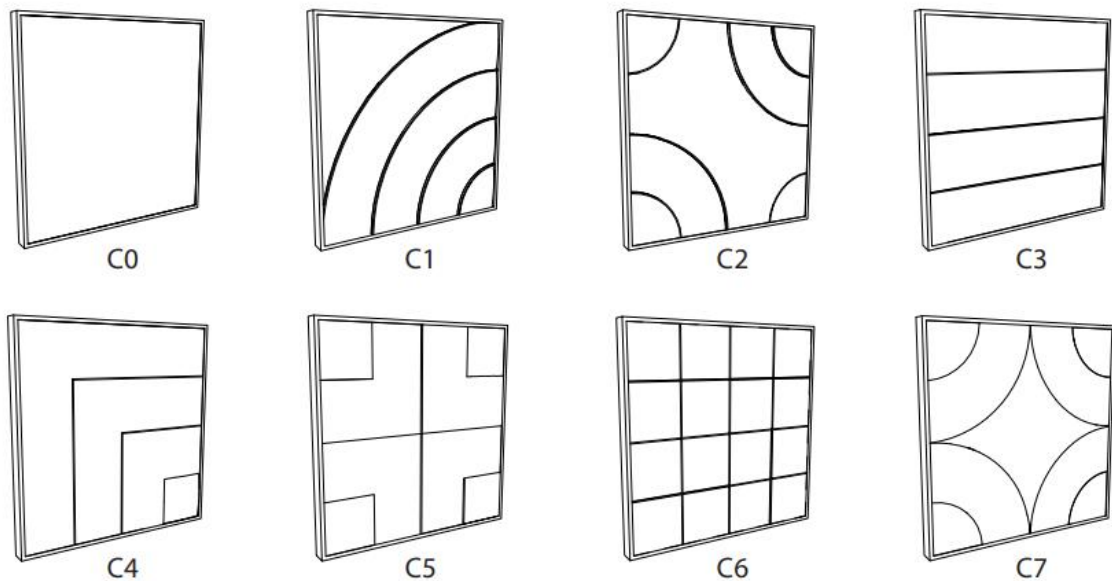


Figure 2. Circuit family patterns

Three tests were made with mixes of different patterns. In the first mix, all available panels were tested, in the dense mix, the panels with more dense wire patterns were tested and in sparse mix, panels with least dense wire patterns were tested.

The panels were measured placed directly on the floor. The test set-ups are shown in figure 3 to 5.



Figure 3. Mix of all available panels evaluated for sound absorption coefficient.

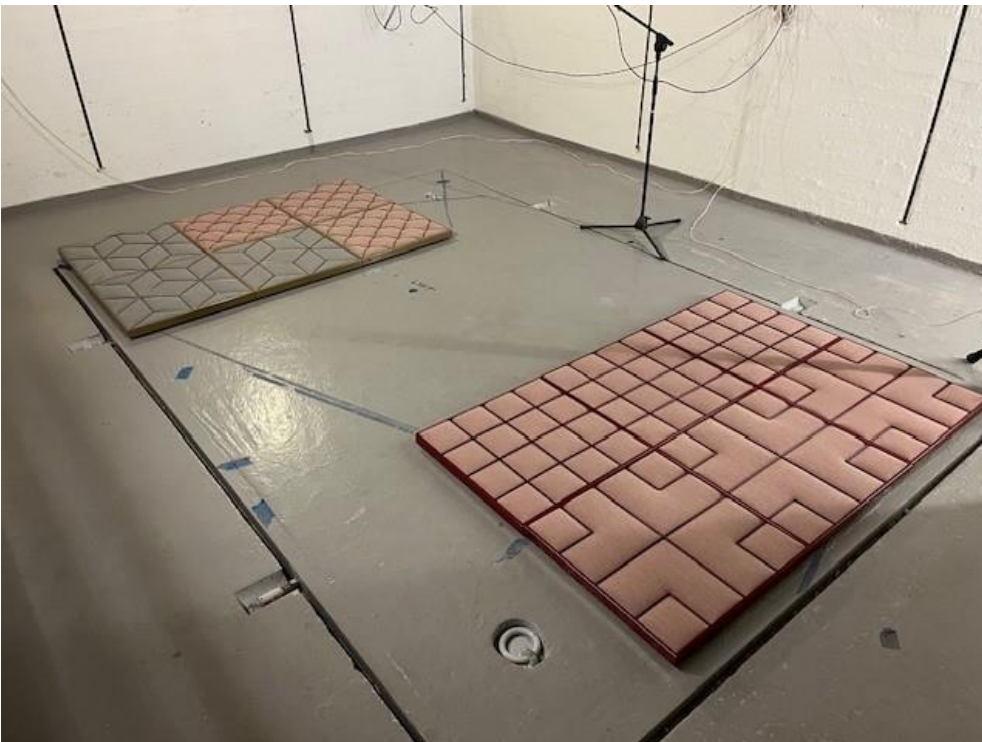


Figure 4. Dense mix (1810x1210) evaluated for sound absorption area.

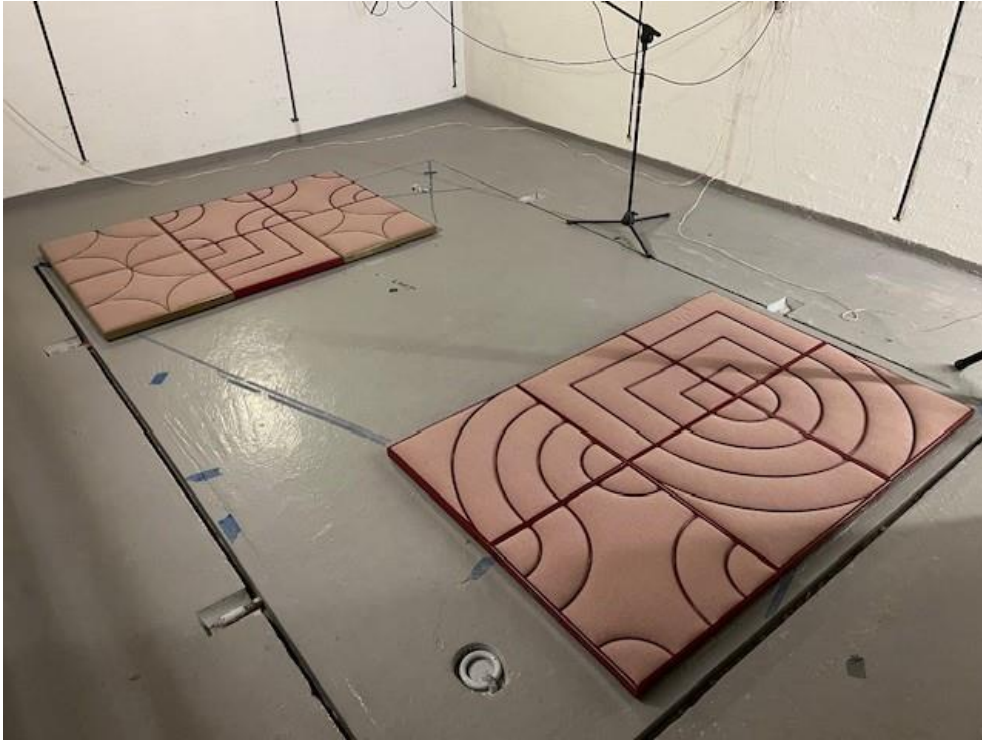


Figure 5. Sparse mix (1810x1210) evaluated for sound absorption area.

Details of panels in the different mixes together with measured weights are presented in table 1.

Panel	Weight (kg)	No of panels in first mix	No of panels in dense mix	No of panels in sparse mix
Chesterfield	5.0	3	3	-
Loop	4.7	3	-	3
Romb	4.9	3	3	-
Circuit C1	4.9	3	-	3
Circuit C2	4.9	3	-	3
Circuit C4	4.8	3	-	3
Circuit C5	5.0	3	3	-
Circuit C6	5.2	3	3	-
Circuit C7	4.9	3	-	-

Table 1. Tested panels used in three different mixes.

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 coefficient were evaluated according to SS-EN ISO 11654:1997. The results for sound absorption area were evaluated according to ISO 20189:2018/SS 25269:2013.

The measurements were performed by Joachim Schubert 2024-11-15 in Akustikverkstan's reverberation room in Skultorp, Skövde, Sweden. More information on the test facilities can be found in Appendix 2.

The equipment used is presented in Appendix 3.

5 RESULTS

Result as weighted sound absorption coefficient α_w is given in table 1 on the first page. Result as sound absorbing area and N_{10} -values, used by *Kammarkollegiet*, are given in table 2.

Detailed measurement results for all test objects are available in the measurement protocols 3997-M1 to 3997-M3 attached to this report. The results are only valid for the tested samples.

6 COMMENTS AND INTERPRETATIONS

6.1 N_{10} -value

The N_{10} value is a comparative value that applies to acoustic products with sound absorbing properties. *Kammarkollegiet*, the Swedish authority dealing with public purchasing, uses the value in their advice regarding purchasing of sound absorbers. The N_{10} value is calculated with the formula:

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

A_{dim} is the average sound absorption area of the three 1/3 octave bands in the 500 Hz octave band. 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.

6.2 Comparison of results

The objective with testing two different mixes of panels was to compare results, to see if only small differences in results can be expected between different patterns of steel wires. A comparison is made in figure 6.

Dense patterns gave a slightly lower sound absorption area than sparse patterns.

The difference in measured results is of the same order of magnitude as the uncertainty in the measurement method.

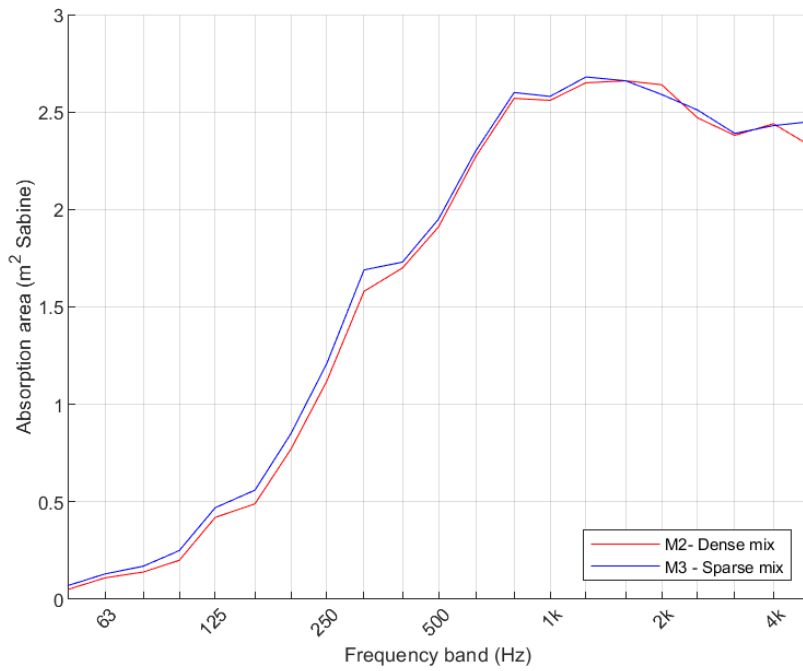


Figure 6. Comparison of measurements with dense and sparse mix

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

Joachim Schubert

Reviewed by Johan Jernstedt, 2024-12-06

APPENDIX 1: MEASURED REVERBERATION TIMES

f(Hz)	Empty	M1: Mix 1 (10 m ²)	M2: Mix 2 (dense mix), group of 6 panels	M3: Mix 2 (sparse mix), group of 6 panels
50	7.90	7.36	7.72	7.63
63	8.56	7.48	8.08	8.00
80	8.14	6.88	7.59	7.50
100	7.37	6.07	6.74	6.61
125	7.27	5.23	6.11	6.00
160	5.62	3.98	4.80	4.71
200	5.73	3.46	4.50	4.41
250	5.49	2.99	3.97	3.89
315	5.55	2.55	3.60	3.51
400	5.28	2.43	3.40	3.38
500	4.73	2.20	3.03	3.01
630	4.33	1.98	2.69	2.68
800	4.88	1.94	2.75	2.73
1000	4.67	1.93	2.68	2.68
1250	4.11	1.79	2.45	2.45
1600	3.78	1.69	2.33	2.33
2000	3.37	1.58	2.17	2.19
2500	2.97	1.53	2.04	2.03
3150	2.50	1.38	1.83	1.83
4000	2.06	1.23	1.57	1.58
5000	1.67	1.06	1.35	1.34

Test area (m ²)/ Number of objects	0	9.9	2	2
Temperature (°C)	17.3	18.1	17.8	17.5
RH (%)	44	42	43	44

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 A2.1. The mounting area consists of a concrete slab that can be lowered up to 700 mm below the floor.

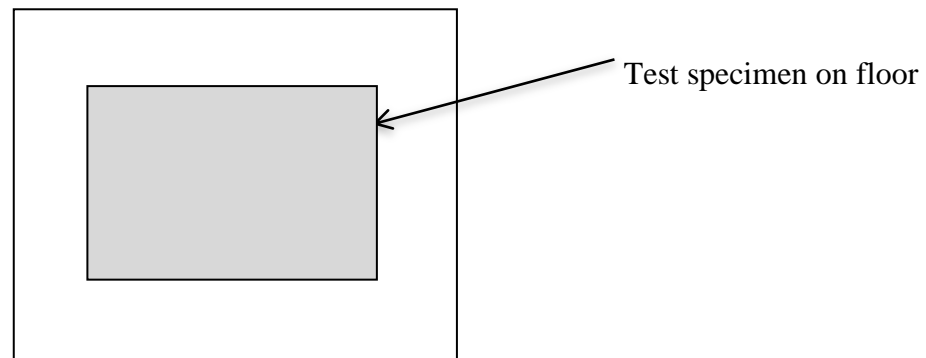


Figure A2.1: Plane drawing of the reverberation room with the positions of the test specimens.

APPENDIX 3: MEASUREMENT EQUIPMENT

Table A3.1 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	3186	MI31
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 A3.1: Equipment used during the measurements.

APPENDIX 4: MEASUREMENT UNCERTAINTY

The uncertainties in the measured sound absorption coefficients have been estimated to the values in table A4.1. The uncertainty corresponds to one standard deviation.

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

Table A4.1: Measurement uncertainty for each third octave.

Chesterfield, Circuit, Loop and Romb (mix of panels)

SOUND ABSORPTION COEFFICIENT ACCORDING TO SS-EN ISO 354:2003 AND SS-EN ISO 11654:1997

Measurement of sound absorption coefficient in a reverberation room



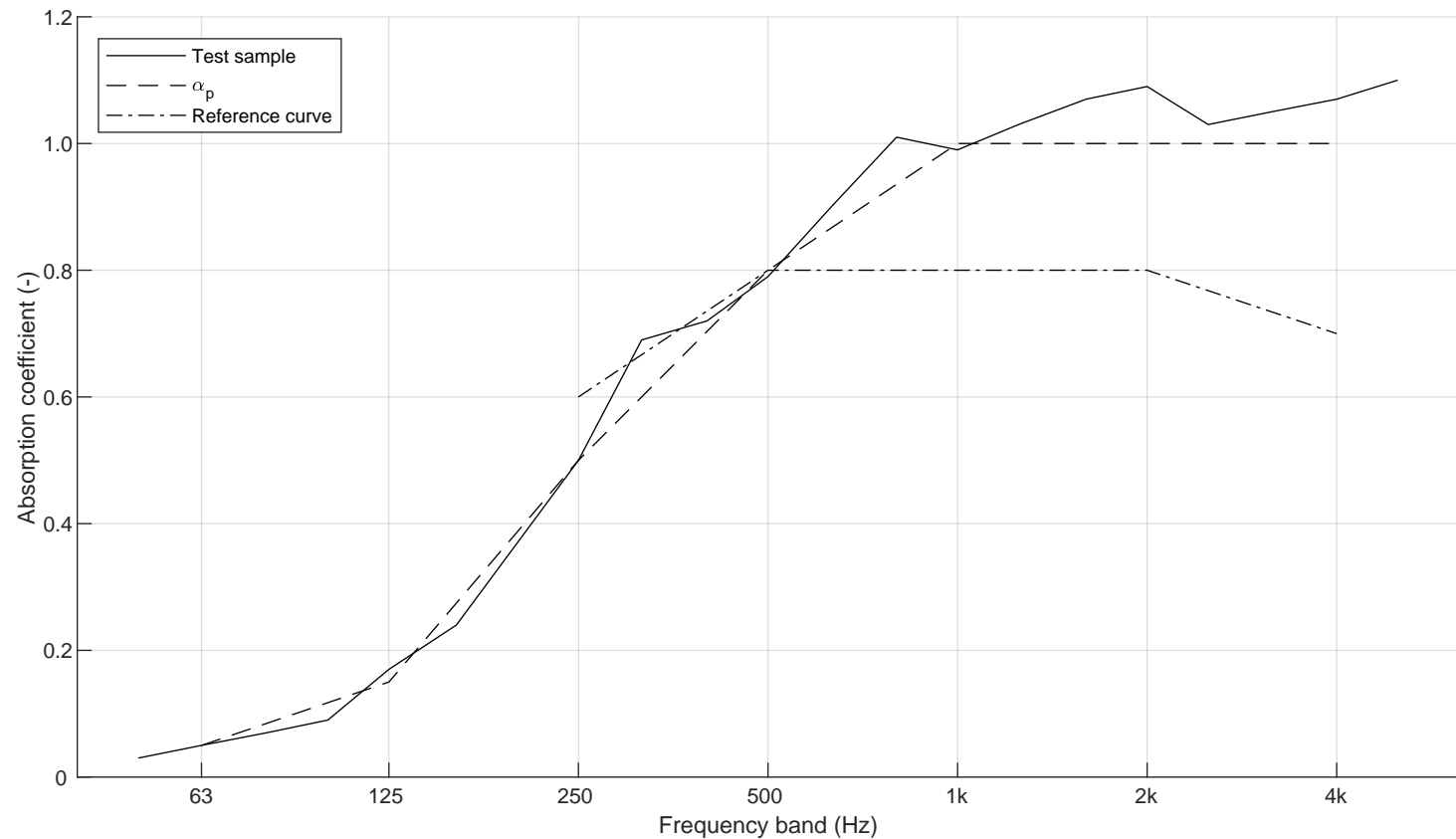
Report number:
3997-M1
Date
2024-12-10

Frequency f [Hz]	Sound absorption coefficient	
	α_s	α_p
50	0.03	
63	0.05	0.05
80	0.07	
100	0.09	
125	0.17	0.15
160	0.24	
200	0.37	
250	0.50	0.50
315	0.69	
400	0.72	
500	0.79	0.80
630	0.90	
800	1.01	
1000	0.99	1.00
1250	1.03	
1600	1.07	
2000	1.09	1.00
2500	1.03	
3150	1.05	
4000	1.07	1.00
5000	1.10	

Client: Decibel By Johansson
 Manufacturer: Decibel By Johansson
 Product identification: Chesterfield, Circuit, Loop and Romb

Description of test specimen: Chesterfield, Circuit, Loop and Romb are wall panels 605x605 mm with similar construction, consisting of a steel frame with MDF board and glass fiber filling covered with fabric and a decorative steel grid. Measured height with mounting bracket is 70 mm. Description of the mix is given in the measurement report. Tested directly on the floor.

Reverberation room volume: 200 m³
 Temperature: 18.1 °C (empty: 17.3 °C)
 Air humidity: 42 % (empty: 44 %)
 Air pressure: 98.8 kPa (empty: 98.8 kPa)
 Size of specimen: 9.9 m²
 Measurement date: 2024-11-15
 Measured by: Joachim Schubert



$\alpha_w = 0.80(H)$

Absorption class = B

Chesterfield, Circuit, Loop and Romb - group of 6 panels (dense mix of panels)

SOUND ABSORPTION AREA ACCORDING TO SS-EN ISO 354:2003 and ISO 20189:2018

Measurement of sound absorption area in a reverberation room



Report number:
3997-M2
Date:
2024-12-10

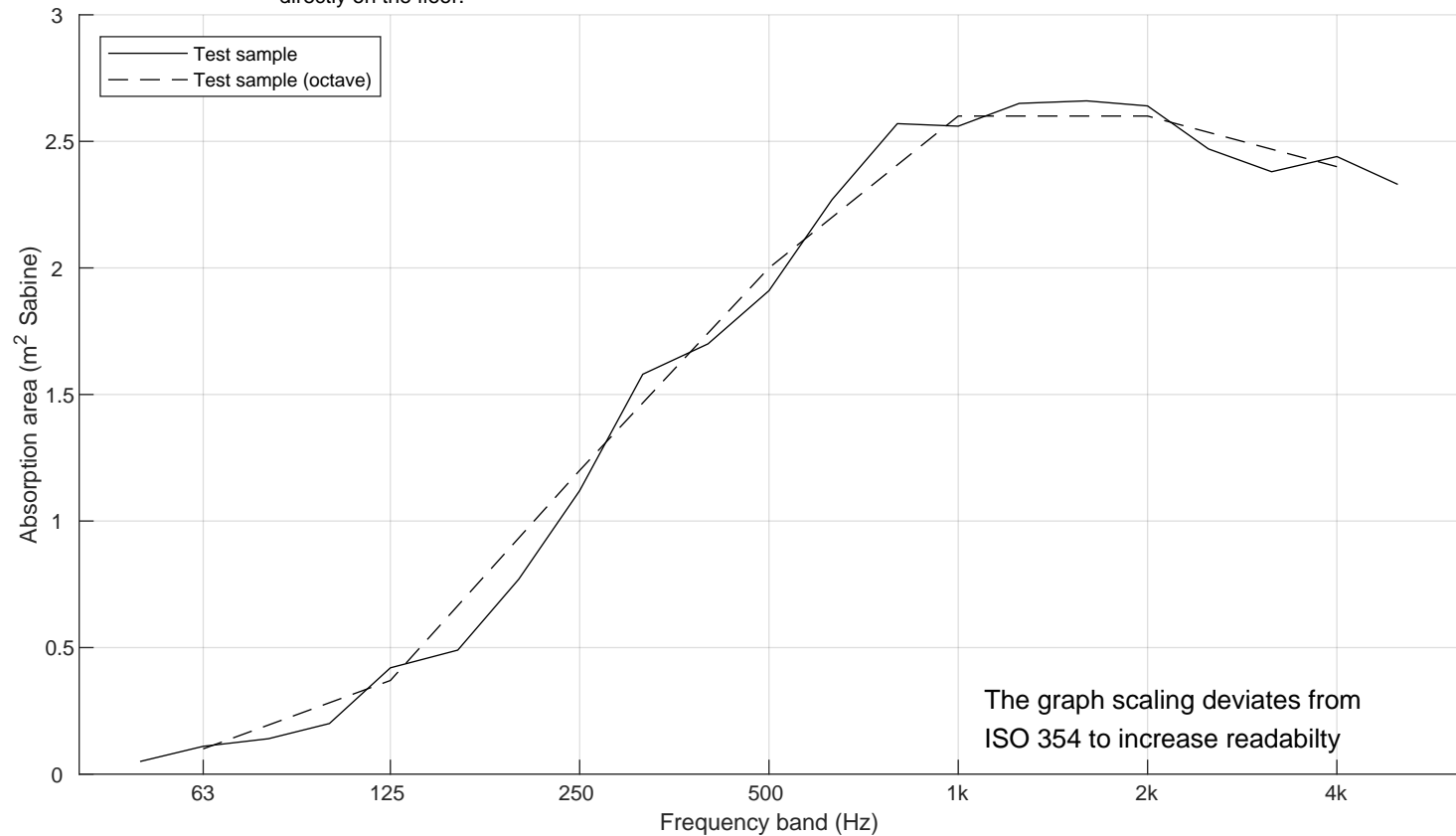
Frequency f [Hz]	Sound absorption area per object [m ² Sabine]	
50	0.05	
63	0.11	0.10
80	0.14	
100	0.20	
125	0.42	0.37
160	0.49	
200	0.77	
250	1.12	1.2
315	1.58	
400	1.70	
500	1.91	2.0
630	2.27	
800	2.57	
1000	2.56	2.6
1250	2.65	
1600	2.66	
2000	2.64	2.6
2500	2.47	
3150	2.38	
4000	2.44	2.4
5000	2.33	

Client: Decibel By Johansson
 Manufacturer: Decibel By Johansson
 Product identification: Chesterfield, Romb, Circuit (C5, C6) - mix of panels

Description of test specimen: Chesterfield, Circuit, Loop and Romb are wall panels 605x605 mm with similar construction, consisting of a steel frame with MDF board and glass fiber filling covered with fabric and a decorative steel grid. Measured height with mounting bracket is 70 mm. This measurement refers to a group of 6 panels (1810x1210 mm) with dense decorative steel grid tested directly on the floor.

Reverberation room volume: 200 m³
 Temperature: 17.8 °C (empty: 17.3 °C)
 Air humidity: 43 % (empty: 44 %)
 Air pressure: 98.8 kPa (empty: 98.8 kPa)
 Number of objects: 2
 Measurement date: 2024-11-15
 Measured by: Joachim Schubert

$N_{10} = 5.1$



Chesterfield, Circuit, Loop and Romb - group of 6 panels (sparse mix of panels)

SOUND ABSORPTION AREA ACCORDING TO SS-EN ISO 354:2003 and ISO 20189:2018

Measurement of sound absorption area in a reverberation room



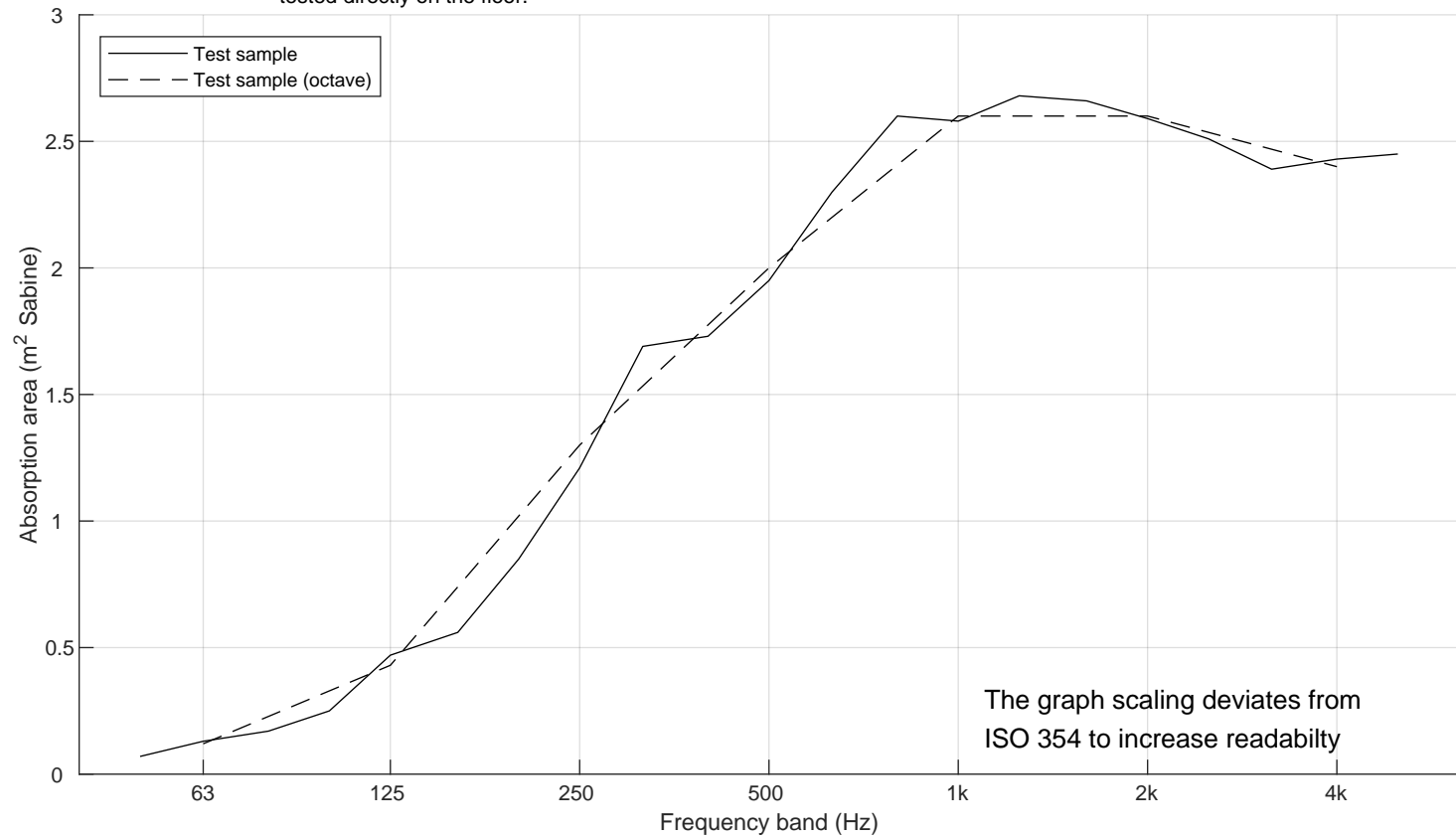
Report number:
3997-M3
Date
2024-12-10

Frequency f [Hz]	Sound absorption area per object [m ² Sabine]	
50	0.07	
63	0.13	0.12
80	0.17	
100	0.25	
125	0.47	0.43
160	0.56	
200	0.85	
250	1.21	1.3
315	1.69	
400	1.73	
500	1.95	2.0
630	2.30	
800	2.60	
1000	2.58	2.6
1250	2.68	
1600	2.66	
2000	2.59	2.6
2500	2.51	
3150	2.39	
4000	2.43	2.4
5000	2.45	

Client: Decibel By Johansson
 Manufacturer: Decibel By Johansson
 Product identification: Loop, Circuit (C1, C2, C4) - mix of panels

Description of test specimen: Chesterfield, Circuit, Loop and Romb are wall panels 605x605 mm with similar construction, consisting of a steel frame with MDF board and glass fiber filling covered with fabric and a decorative steel grid. Measured height with mounting bracket is 70 mm. This measurement refers to a group of 6 panels (1810x1210 mm) with sparse decorative steel grid tested directly on the floor.

Reverberation room volume: 200 m³
 Temperature: 17.5 °C (empty: 17.3 °C)
 Air humidity: 44 % (empty: 44 %)
 Air pressure: 98.8 kPa (empty: 98.8 kPa)
 Number of objects: 2
 Measurement date: 2024-11-15
 Measured by: Joachim Schubert



$N_{10} = 5$