

SOUND ABSORPTION MEASUREMENTS FOR COBOGO, PLAINPANEL AND PLANTPANEL

The sound absorption for the products Cobogo, PlainPanel and PlantPanel has been measured according to the reverberation room method (SS-EN ISO 354:2003) for sound absorption coefficient and sound absorption area. The sound absorption coefficient has been evaluated according to SS-EN ISO 11654:1997. The sound absorption area has been evaluated according to SS 25269:2013 and ISO 20189:2018.

The results as weighted sound absorption coefficient and sound absorption class are presented in the table below.

Measurement protocol	Test object	α_w	Sound absorption class
M1	Cobogo G-100, 88 units, 10 m ²	0.20(H)	E
M2	Cobogo, free-hanging in the room. 44 units, 5 m ² , double-sided exposure	0.15(H)	E

The results as N_{10} -values as defined by *Kammarkollegiet* for the objects measured for sound absorption area are presented in the table below.

Measurement protocol	Test object	N_{10}
M3	Cobogo free-hanging group of twelve objects, 1.31 m ²	53
M4	PlainPanel group of six objects, 2.02 m ²	9.1
M5	PlantPanel group of six objects, 2.02 m ²	6.7
M6	PlainPanel and PlantPanel group of six objects, 2.02 m ²	7.1

1 CLIENT

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2 ASSIGNMENT

To measure the sound absorption for the products Cobogo, PlantPanel and PlainPanel in different setups according to SS-EN ISO 354:2003 and evaluate according to SS-EN ISO 11654:1997, SS 25269:2013 and ISO 20189:2018.

3 TEST OBJECTS

3.1 Cobogo – Room divider

Cobogo consist of moulded felt made of at least 55% recycled PET with a thickness of 5 mm. Each object is 372 x 372 mm and can be put together with plastic rivets.

The absorber is intended to be free hanging in the room or like a curtain close to a wall. The absorber was both measured as a free hanging room divider (figure 1) and as a curtain G-100 (figure 2).

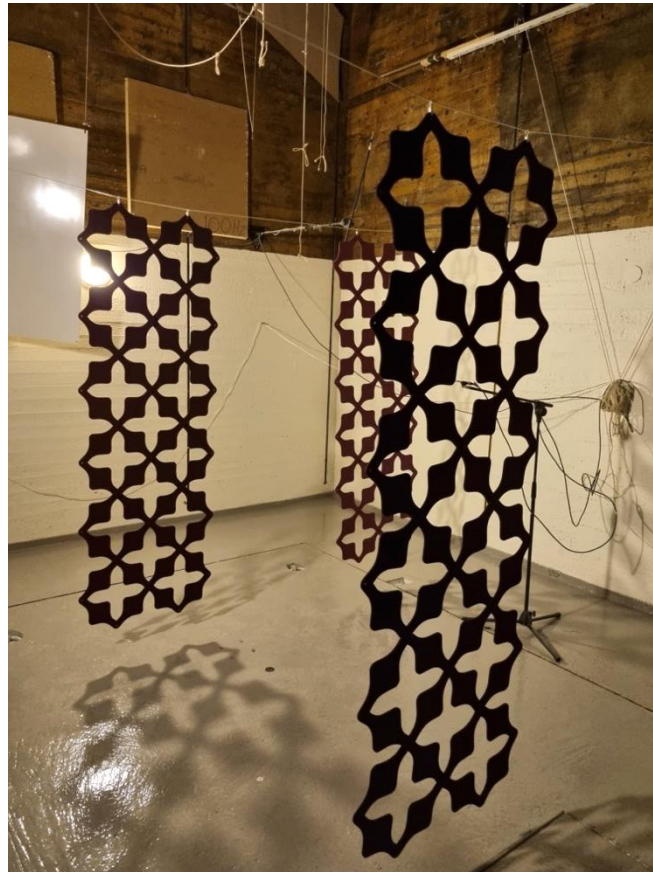


Figure 1: Cobogo free hanging

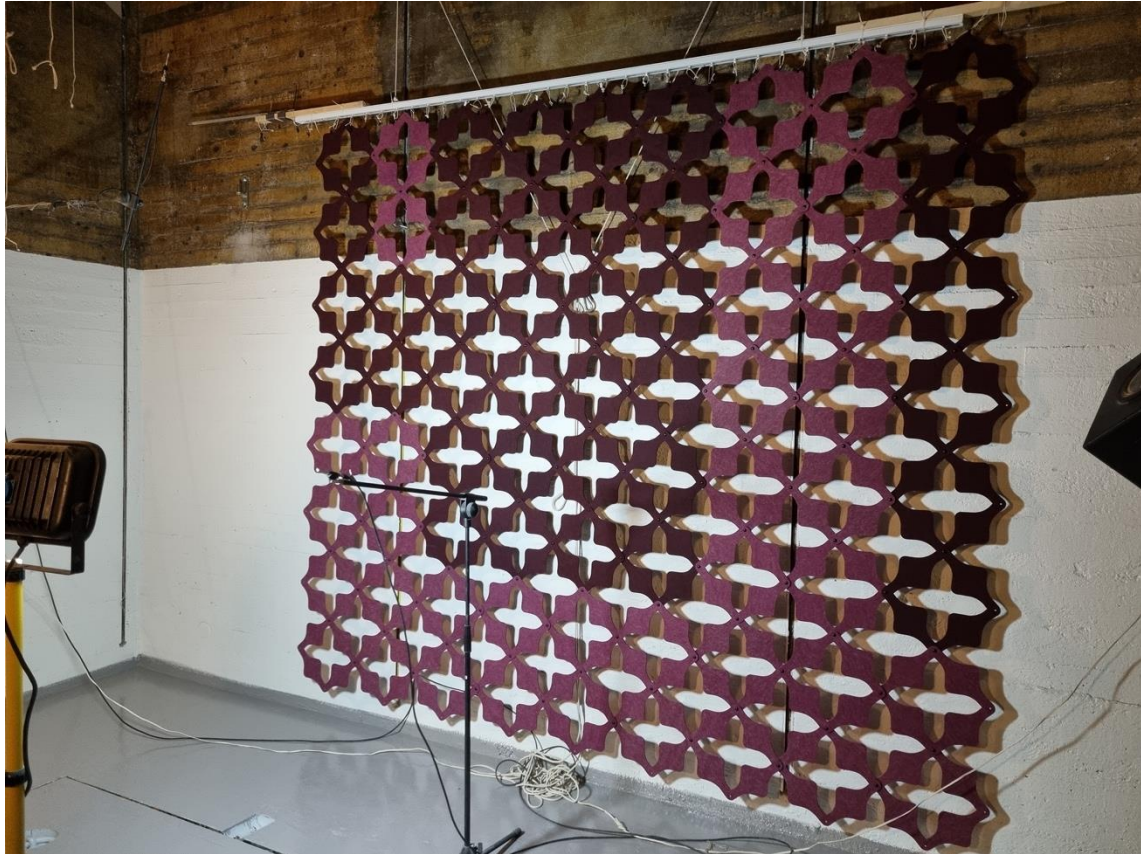


Figure 2: Cobogo measured as G-100

3.2 PlainPanel – Wall absorber

PlainPanel consists of moulded felt made of at least 55% recycled PET. Each object is 580 x 580 mm and the panel is intended to be mounted on a wall.



Figure 3: Two groups of six PlainPanels absorbers, measured for sound absorption area.

3.3 PlantPanel – Wall absorber

PlantPanel consists of moulded felt made of at least 55% recycled PET. The panel has a socket for an artificial plant. Each object is 580 x 580 x 210 mm and the panel is intended to be mounted on a wall.



Figure 4: Two groups of six PlantPanel absorbers with artificial plant 580 x 580 mm, measured for sound absorption area.



Figure 5: A mix of three PlantPanels and three PlainPanels absorbers 580 x 580 mm, measured for sound absorption area.

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 test specimen area fulfils the requirements in SS-EN ISO 354:2003.

The measurements were performed by Richard Karlsson 2022-02-09 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

Detailed measurement results are available in the measurement protocols belonging to this report, 22-702-M1 to M6. The results are only valid for the tested sample. The measurement accuracy is described in Appendix 4.

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

6 COMMENTS AND INTERPRETATIONS

6.1 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 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.

7 DEVIATIONS FROM THE STANDARD

The total measured sound absorption area at lower frequencies is below 1 m². According to ISO 20189:2018, the total sound absorption should exceed 1 m² in each frequency band.

ISO 354 has a requirement that the temperature shall be at least 15°. The temperature was below 15° during the measurements. This deviation is not experienced to influence the results of fibrous sound absorbers.

Richard Karlsson

Reviewed by Johan Jernstedt, 2022-02-25

APPENDIX 1: MEASURED REVERBERATION TIMES

f(Hz)	Empty	M1: Cobogo G100	M2: Cobogo free-hanging double sided exposure	M3: Cobogo	M4: PlainPanel	M5: PlantPanel	M6: PlainPanel and PlantPanel
50	7.61	7.89	7.74	7.72	7.44	7.32	7.46
63	8.37	8.49	8.23	8.34	8.13	7.90	8.03
80	7.34	7.50	7.37	7.44	7.31	6.85	7.06
100	6.83	6.92	6.71	6.87	6.64	6.23	6.52
125	6.59	6.64	6.49	6.47	6.27	5.92	6.10
160	5.29	5.18	5.30	5.15	4.88	4.14	4.48
200	5.43	5.36	5.19	5.29	4.77	4.05	4.40
250	5.37	5.26	5.19	5.22	4.66	3.90	4.30
315	5.44	5.10	5.17	5.15	4.38	3.81	4.11
400	5.46	4.83	5.00	5.06	4.18	3.58	3.75
500	4.80	4.17	4.30	4.46	3.60	3.36	3.46
630	4.35	3.47	3.83	3.92	3.22	3.04	3.12
800	4.79	3.41	3.95	4.12	3.18	3.06	3.14
1000	4.63	3.12	3.68	3.92	3.09	3.01	3.04
1250	4.01	2.78	3.22	3.35	2.76	2.68	2.72
1600	3.58	2.62	2.85	2.97	2.51	2.45	2.50
2000	3.08	2.40	2.47	2.61	2.23	2.17	2.21
2500	2.70	2.06	2.14	2.21	2.02	1.99	2.04
3150	2.23	1.71	1.78	1.86	1.72	1.70	1.73
4000	1.82	1.47	1.46	1.54	1.49	1.45	1.50
5000	1.44	1.19	1.20	1.24	1.22	1.20	1.22

Test area (m ²)/ Number of objects	0	10	10	3	2	2	2
Temperature (°C)	13.2	14.6	13.5	14.0	13.7	13.1	13.2
RH (%)	44	41	41	40	42	44	43

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.

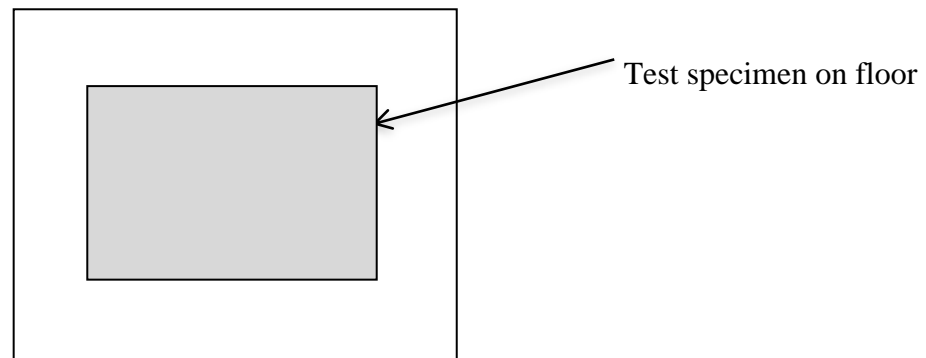


Figure A2.1: Plane drawing of the reverberation room with the positions of the test specimens.

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	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 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.

Cobogo G-100

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



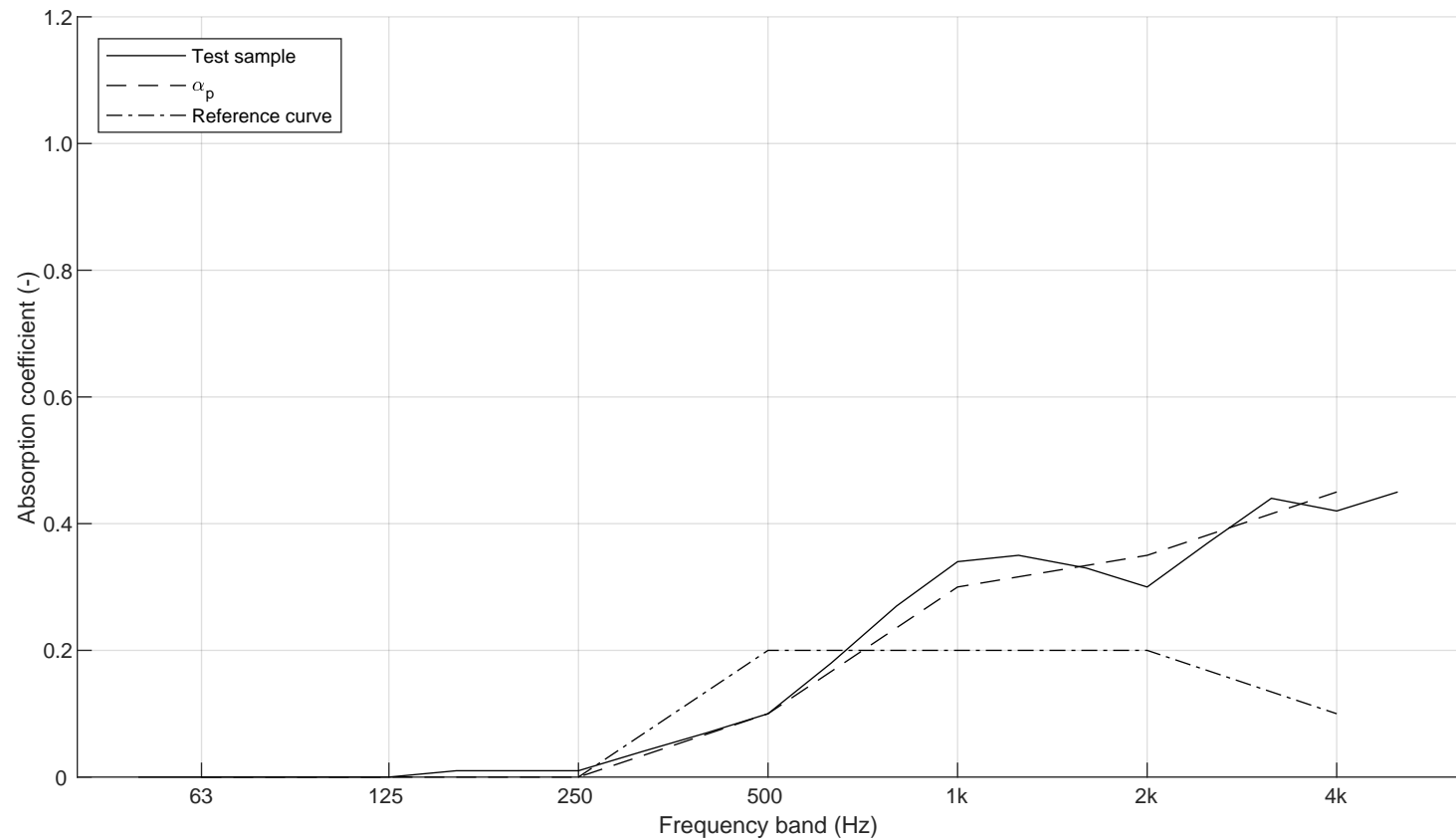
Report number:
22-702-M1
Date
2022-02-11

Frequency f [Hz]	Sound absorption coefficient	
	α_s	α_p
50	0.00	
63	0.00	0.00
80	0.00	
100	0.00	
125	0.00	0.00
160	0.01	
200	0.01	
250	0.01	0.00
315	0.04	
400	0.07	
500	0.10	0.10
630	0.18	
800	0.27	
1000	0.34	0.30
1250	0.35	
1600	0.33	
2000	0.30	0.35
2500	0.37	
3150	0.44	
4000	0.42	0.45
5000	0.45	

Client: Götessons
 Manufacturer: Götessons
 Product identification: Cobogo
 Description of test specimen: Room divider of cut PET felt, thickness 5 mm.
 Measured in curtain assembly G-100.
 The sample area consists of 88 units.

Reverberation room volume: 200 m³
 Temperature: 14.6 °C (empty: 13.2 °C)
 Air humidity: 41 % (empty: 44 %)
 Air pressure: 98.2 kPa (empty: 98.2 kPa)
 Size of specimen: 10 m²

Measurement date: 2022-02-09
 Measured by: Richard Karlsson



$\alpha_w = 0.20(H)$

Absorption class = E

Cobogo free-hanging

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:
22-702-M2
Date
2022-02-11

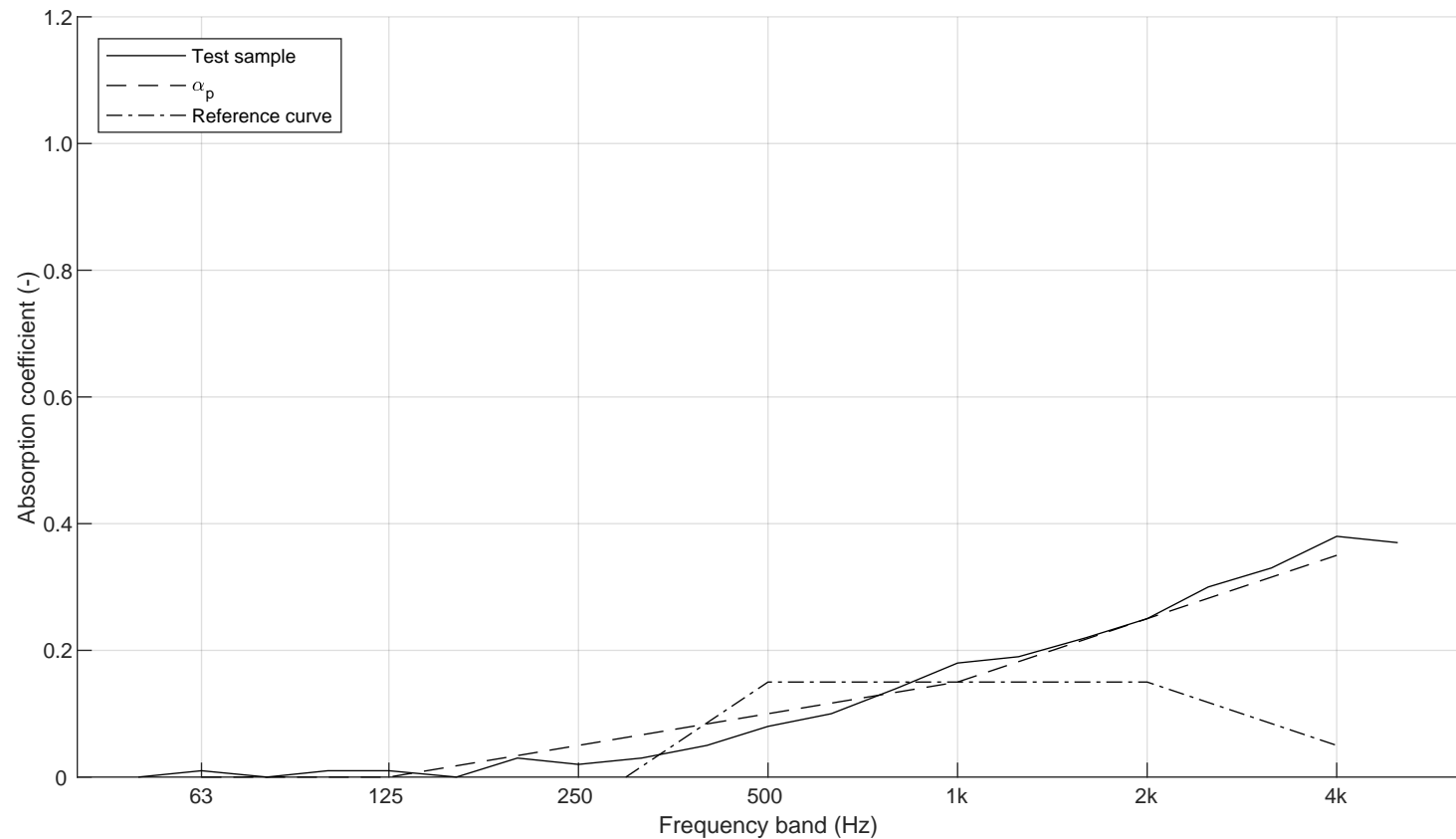
Frequency f [Hz]	Sound absorption coefficient	
	α_s	α_p
50	0.00	
63	0.01	0.00
80	0.00	
100	0.01	
125	0.01	0.00
160	0.00	
200	0.03	
250	0.02	0.05
315	0.03	
400	0.05	
500	0.08	0.10
630	0.10	
800	0.14	
1000	0.18	0.15
1250	0.19	
1600	0.22	
2000	0.25	0.25
2500	0.30	
3150	0.33	
4000	0.38	0.35
5000	0.37	

Client: Götessons
 Manufacturer: Götessons
 Product identification: Cobogo

Description of test specimen: Room divider of cut PET felt, thickness 5 mm.
 Measured free-hanging in the room.
 The sample area consist of 44 units (5 square meters), specified sample area refers to double-sided exposure.

Reverberation room volume: 200 m³
 Temperature: 13.5 °C (empty: 13.2 °C)
 Air humidity: 41 % (empty: 44 %)
 Air pressure: 98.2 kPa (empty: 98.2 kPa)
 Size of specimen: 10 m²

Measurement date: 2022-02-09
 Measured by: Richard Karlsson



$\alpha_w = 0.15(H)$

Absorption class = E

Cobogo group of 12 objects

SOUND ABSORPTION AREA ACCORDING TO SS-EN ISO 354:2003, SS 25269:2013 and ISO 20189:2018

Measurement of sound absorption area in a reverberation room

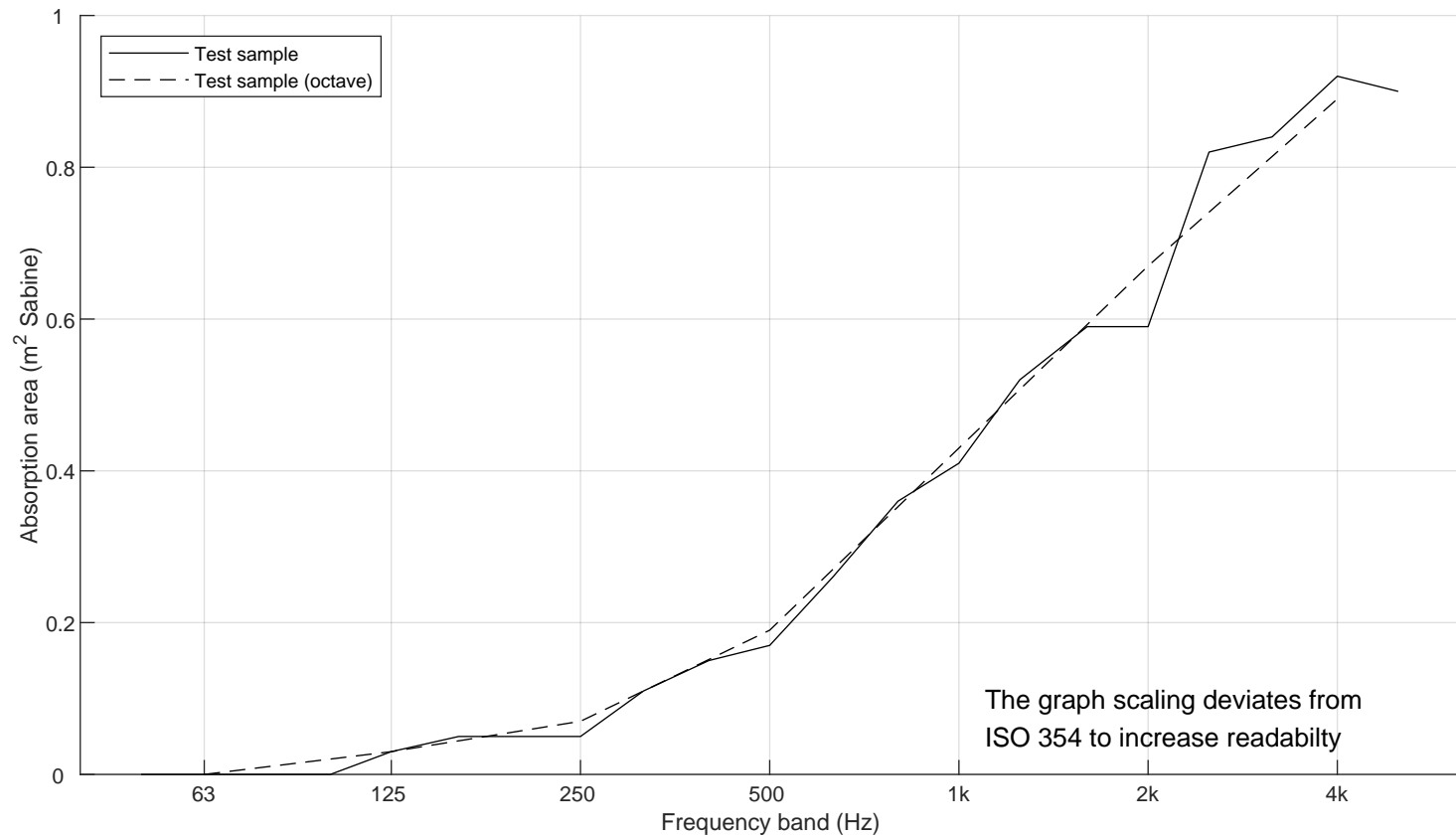


Report number:
22-702-M3
Date
2022-02-28

Frequency f [Hz]	Sound absorption area per object [m ² Sabine]	
50	0.00	
63	0.00	0.00
80	0.00	
100	0.00	
125	0.03	0.03
160	0.05	
200	0.05	
250	0.05	0.07
315	0.11	
400	0.15	
500	0.17	0.19
630	0.26	
800	0.36	
1000	0.41	0.43
1250	0.52	
1600	0.59	
2000	0.59	0.67
2500	0.82	
3150	0.84	
4000	0.92	0.89
5000	0.90	

Client: Götessons
 Manufacturer: Götessons
 Product identification: Cobogo
 Description of test specimen: Room divider of cut PET felt, thickness 5 mm.
 Measured free-hanging in the room.
 The sample area consists of 3 groups of 12 units, 1,31 square meters.
 The stated absorption area refers to 1 group of 12 units.

Reverberation room volume: 200 m³
 Temperature: 14.0 °C (empty: 13.2 °C)
 Air humidity: 40% (empty: 44%)
 Air pressure: 98.2 kPa (empty: 98.2 kPa)
 Number of objects: 3
 Measurement date: 2022-02-09
 Measured by: Richard Karlsson



The graph scaling deviates from ISO 354 to increase readability

$N_{10} = 53$

PlainPanel group of 6 objects

SOUND ABSORPTION AREA ACCORDING TO SS-EN ISO 354:2003, SS 25269:2013 and ISO 20189:2018

Measurement of sound absorption area in a reverberation room



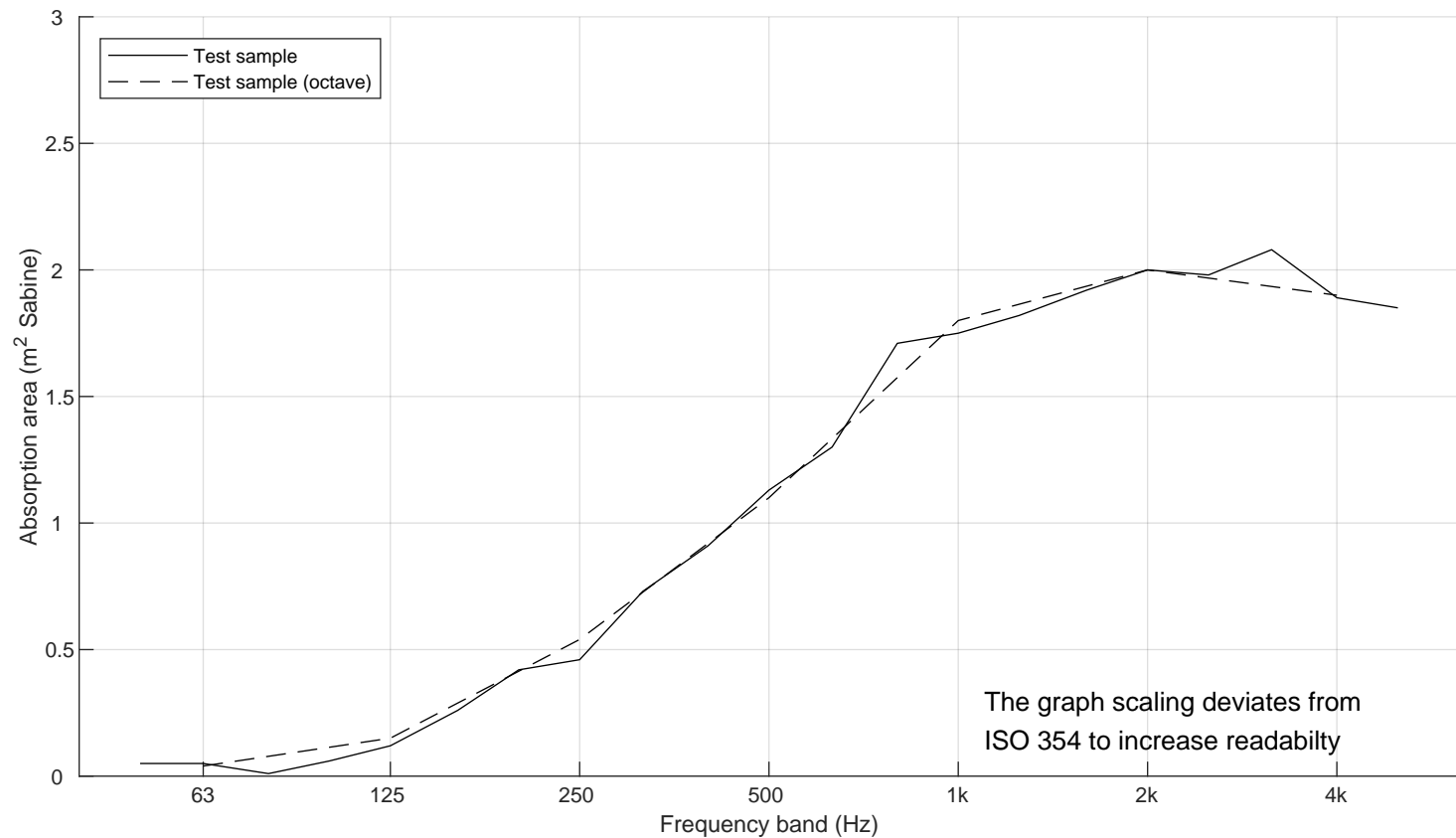
Report number:
22-702-M4
Date
2022-02-11

Frequency f [Hz]	Sound absorption area per object [m ² Sabine]	
50	0.05	
63	0.05	0.04
80	0.01	
100	0.06	
125	0.12	0.15
160	0.26	
200	0.42	
250	0.46	0.54
315	0.73	
400	0.91	
500	1.13	1.1
630	1.30	
800	1.71	
1000	1.75	1.8
1250	1.82	
1600	1.92	
2000	2.00	2.0
2500	1.98	
3150	2.08	
4000	1.89	1.9
5000	1.85	

Client: Götessons
 Manufacturer: Götessons
 Product identification: PlainPanel
 Description of test specimen: Wall absorber made of moulded felt (PET).
 The sample area consists of 2 groups of 6 units, 2,02 square meters. Each unit is 58 x 58 x 21 cm.
 The stated absorption area refers to 1 group of 6 units.

Reverberation room volume: 200 m³
 Temperature: 13.7 °C (empty: 13.2 °C)
 Air humidity: 42 % (empty: 44 %)
 Air pressure: 98.2 kPa (empty: 98.2 kPa)
 Number of objects: 2
 Measurement date: 2022-02-09
 Measured by: Richard Karlsson

$$N_{10} = 9.1$$



PlantPanel group of 6 objects

SOUND ABSORPTION AREA ACCORDING TO SS-EN ISO 354:2003, SS 25269:2013 and ISO 20189:2018

Measurement of sound absorption area in a reverberation room



Report number:
22-702-M5
Date
2022-02-28

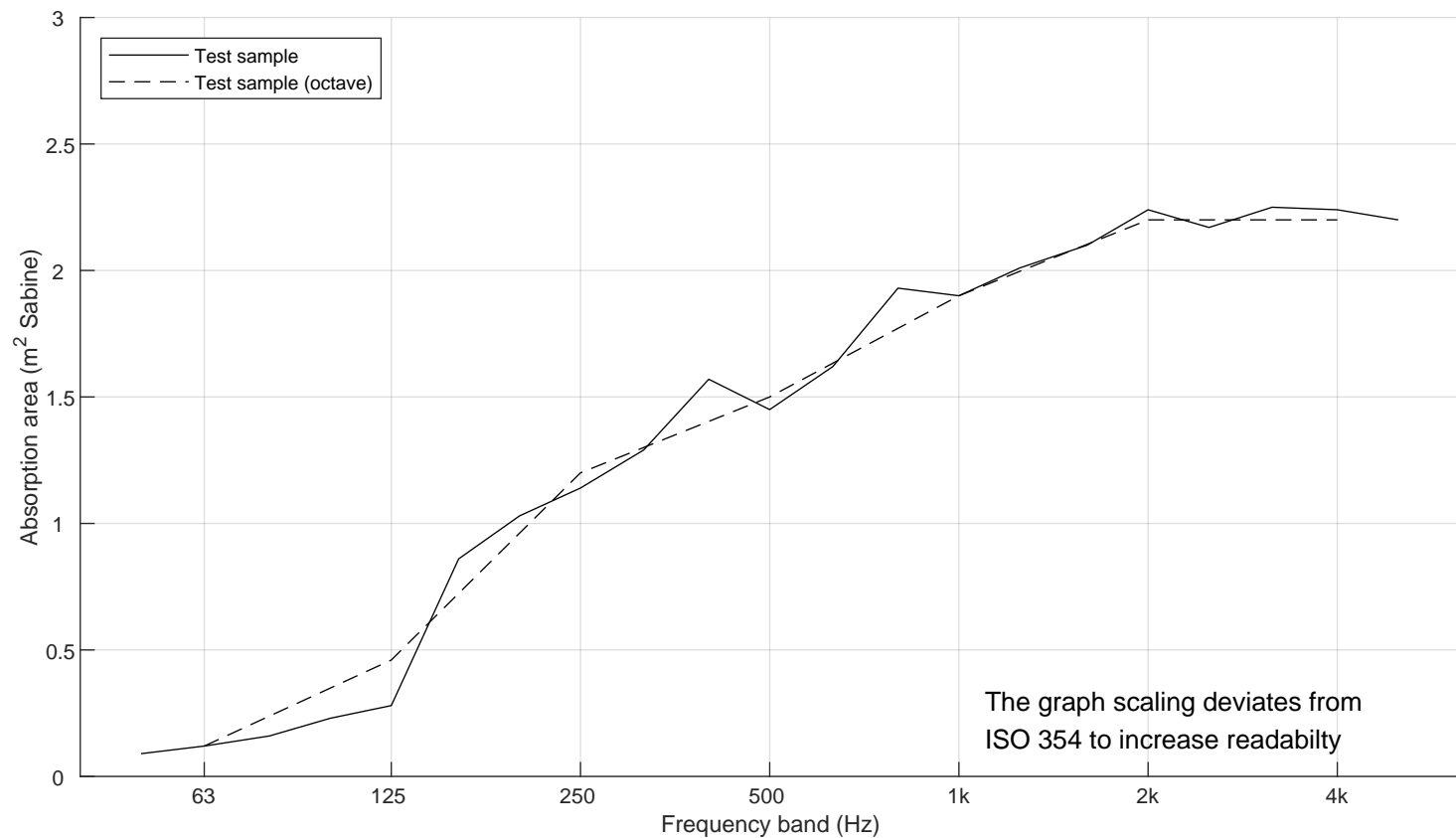
Frequency f [Hz]	Sound absorption area per object [m ² Sabine]	
50	0.09	
63	0.12	0.12
80	0.16	
100	0.23	
125	0.28	0.46
160	0.86	
200	1.03	
250	1.14	1.2
315	1.29	
400	1.57	
500	1.45	1.5
630	1.62	
800	1.93	
1000	1.90	1.9
1250	2.01	
1600	2.10	
2000	2.24	2.2
2500	2.17	
3150	2.25	
4000	2.24	2.2
5000	2.20	

Client: Götessons
 Manufacturer: Götessons
 Product identification: PlantPanel

Description of test specimen: Wall absorber made of moulded felt (PET) with socket for plant.
 The sample area consists of 2 groups of 6 units, 2,02 square meters.
 Each unit is 58 x 58 x 21 cm.
 The stated absorption area refers to 1 group of 6 units.

Reverberation room volume: 200 m³
 Temperature: 13.1 °C (empty: 13.2 °C)
 Air humidity: 44 % (empty: 44 %)
 Air pressure: 98.2 kPa (empty: 98.2 kPa)
 Number of objects: 2

Measurement date: 2022-02-09
 Measured by: Richard Karlsson



$N_{10} = 6.7$

PlantPanel and PlainPanel mixed group of 6 objects

SOUND ABSORPTION AREA ACCORDING TO SS-EN ISO 354:2003, SS 25269:2013 and ISO 20189:2018

Measurement of sound absorption area in a reverberation room



Report number:
22-702-M6
Date
2022-02-28

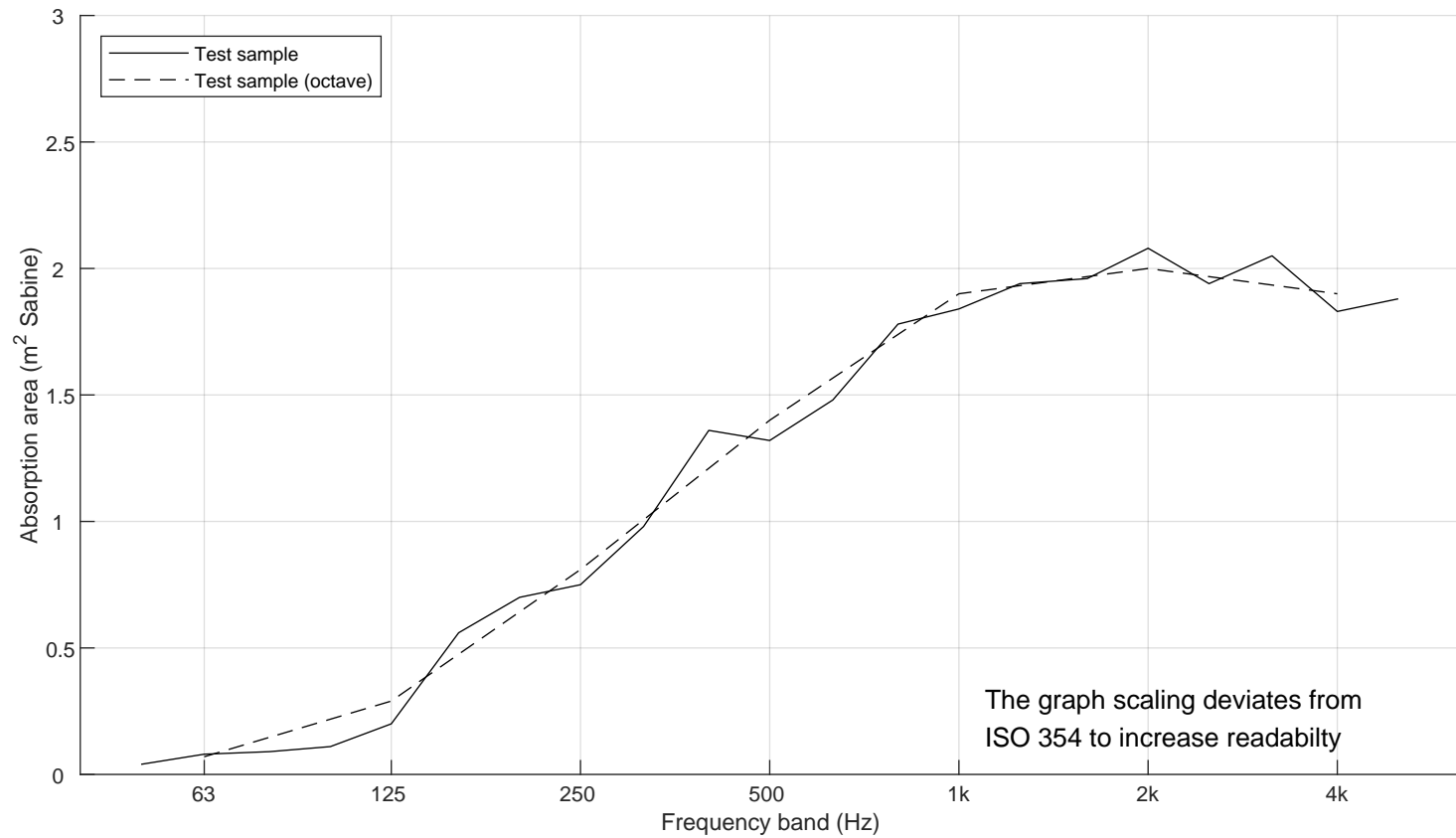
Frequency f [Hz]	Sound absorption area per object [m ² Sabine]	
50	0.04	
63	0.08	0.07
80	0.09	
100	0.11	
125	0.20	0.29
160	0.56	
200	0.70	
250	0.75	0.81
315	0.98	
400	1.36	
500	1.32	1.4
630	1.48	
800	1.78	
1000	1.84	1.9
1250	1.94	
1600	1.96	
2000	2.08	2.0
2500	1.94	
3150	2.05	
4000	1.83	1.9
5000	1.88	

Client: Götessons
 Manufacturer: Götessons
 Product identification: PlantPanel and PlainPanel

Description of test specimen: Wall absorber made of moulded felt (PET) with and without socket for plant.
 The sample area consists of 2 groups of 6 units, 2,02 square meters.
 Each group consists of 3 PlantPanels and 3 PlainPanels.
 The stated absorption area refers to 1 group of 6 units.

Reverberation room volume: 200 m³
 Temperature: 13.2 °C (empty: 13.2 °C)
 Air humidity: 43 % (empty: 44 %)
 Air pressure: 98.2 kPa (empty: 98.2 kPa)
 Number of objects: 2

Measurement date: 2022-02-09
 Measured by: Richard Karlsson



$N_{10} = 7.1$