

## SOUND ABSORPTION MEASUREMENTS FOR UNIT FLOOR SCREENS FROM LINTEX

### CONCLUSIONS

The sound absorption for Unit floor screens from Lintex has been measured according to the reverberation room method (SS-EN ISO 354:2003). The sound absorption coefficient has been evaluated according to SS-EN ISO 11654:1997. The sound absorption area for the product used as desk screen and floor screen 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	$\alpha_w$	Sound absorption class
M1	Unit textile/textile 1800 x 1200 mm	0.70	C
M2	Unit textile/glass 1800 x 1200 mm	0.40	D
M3	Unit glass/glass 1800 x 1200 mm	0.05	-

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

Measurement protocol	Test object	$N_{10}$
M4	Unit textile/textile 1800 x 1200 mm	3.1
M5	Unit textile/glass 1800 x 1200 mm	5.6
M6	Unit glass/glass 1800 x 1200 mm	53

## 1. CLIENT

Lintex AB, Madesjövägen 17, 382 45 Nybro

Contact: Ronny Samuelsson, +46 481 799 210, ronny.samuelsson@lintex.se

## 2. ASSIGNMENT

To measure the sound absorption for the product Unit from Lintex according to SS-EN ISO 354:2003 for three different setups. The sound absorption coefficient should be evaluated for three different absorber setups according to SS-EN ISO 11654:1997. The sound absorption area should be evaluated according to SS 25269:2013 / ISO 20189:2018 for the product used as sound absorbing screens.

Akustikverkstan is accredited for SS 25269:2013, SS-EN ISO 11654:1997, SS-EN ISO 354:2003 and ISO 20189:2018. ISO 20189:2018 is similar to SS 25269:2013 to a large extent and will most likely replace SS 25269:2013 in a near future.

## 3. TEST OBJECTS

The test objects are three different setups of the movable floor screen Unit in the size 1800 mm x 1200 mm. The screens are positioned on a 55 mm high foot. The screen is built up with an 165 mm wide aluminium frame. The sides can be altered with textile or glass. The samples tested were:

1. Textile/Textile
2. Textile/Glass
3. Glass/Glass

Every textile side on Unit includes 48 mm of sound absorbent filling made from recycled polyester (Fiberspring 401, 2200 g/m<sup>2</sup>).



Figure 1: Lintex Unit floor absorbers



Figure 2: Two Lintex Unit 1800x1200 mm textile/textile, measured for sound absorption.



Figure 3: Two Lintex Unit 1800x1200 mm textile/glass, measured for sound absorption..



Figure 4: Three Lintex Unit 1800x1200 mm glass/glass, measured for sound absorption.

#### 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 SS 25269:2013 / ISO 20189:2018. The test specimen area fulfils the requirements in SS-EN ISO 354:2003.

The measurements were performed by Magnus Karlsson 2021-02-17 and 2021-03-10 in Akustikverkstan's reverberation room in Skultorp, 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.

<b>Instrument</b>	<b>Manufacture and type</b>	<b>Serial number</b>	<b>Internal designation</b>
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 21-707-R1-M1 to M6. The results are only valid for the tested samples.

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

Measurement protocol	Test object	$\alpha_w$	Sound absorption class
M1	Unit textile/textile 1800 x 1200 mm	0.70	C
M2	Unit textile/glass 1800 x 1200 mm	0.40	D
M3	Unit glass/glass 1800 x 1200 mm	0.05	-

Table 2: Results for weighted sound absorption coefficient and sound absorption class for the three setups of absorbers.

## 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	$N_{10}$
M4	Unit textile/textile 1800 x 1200 mm	3.1
M5	Unit textile/glass 1800 x 1200 mm	5.6
M6	Unit glass/glass 1800 x 1200 mm	53

Table 3:  $N_{10}$ -value based on sound absorption area of the products.

## 8. MEASUREMENT UNCERTAINTY

The uncertainties in the measured sound absorption coefficients have been estimated to the values in table 5. 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 5: Measurement uncertainty for each third octave.

## 9. DEVIATIONS FROM THE STANDARD

The total measured sound absorption area at lower frequencies is below 1 m<sup>2</sup>. According to ISO 20189:2018, the total sound absorption should exceed 1 m<sup>2</sup> in each frequency band.

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

Magnus Karlsson  
Master of Science, Civil engineering

Reviewed by Carl Nyqvist, 2021-04-19

## APPENDIX 1: MEASURED REVERBERATION TIMES

f(Hz)	Empty morning 210217	Empty morning 210310	Unit textile/textile 1800 x 1200 mm	Unit textile/textile 1800 x 1200 mm, N10	Unit textile/glass 1800 x 1200 mm	Unit textile/glass 1800 x 1200 mm, N10	Unit glass/glass 1800 x 1200 mm	Unit glass/glass 1800 x 1200 mm, N10
50	7.26	7.18	5.31	5.31	6.20	6.20	6.34	6.34
63	7.28	7.29	6.22	6.22	6.55	6.55	7.01	7.01
80	6.84	6.95	5.25	5.25	5.67	5.67	5.68	5.68
100	6.63	6.56	4.69	4.69	5.55	5.55	5.90	5.90
125	6.63	6.81	4.24	4.24	5.05	5.05	5.14	5.14
160	5.23	5.40	3.32	3.32	3.81	3.81	4.42	4.42
200	5.39	5.66	3.03	3.03	3.68	3.68	4.25	4.25
250	5.08	5.19	2.86	2.86	3.46	3.46	4.53	4.53
315	5.20	5.33	2.71	2.71	3.28	3.28	4.76	4.76
400	5.15	5.20	2.59	2.59	3.02	3.02	4.73	4.73
500	4.63	4.63	2.36	2.36	2.88	2.88	4.20	4.20
630	4.26	4.24	2.26	2.26	2.74	2.74	3.81	3.81
800	4.67	4.66	2.40	2.40	3.01	3.01	4.32	4.32
1000	4.58	4.55	2.40	2.40	3.05	3.05	4.24	4.24
1250	4.05	3.96	2.24	2.24	2.76	2.76	3.83	3.83
1600	3.56	3.48	1.99	1.99	2.41	2.41	3.27	3.27
2000	3.13	3.01	1.82	1.82	2.14	2.14	2.70	2.70
2500	2.73	2.62	1.64	1.64	1.96	1.96	2.42	2.42
3150	2.30	2.15	1.44	1.44	1.66	1.66	2.02	2.02
4000	1.87	1.75	1.25	1.25	1.40	1.40	1.68	1.68
5000	1.51	1.38	1.04	1.04	1.15	1.15	1.36	1.36

Number of test objects/test area	0	0	10.20	2	10.20	2	14.70	3
Temperature (°C)	18.6	19.4	16.3	16.3	18.2	18.2	15.6	15.6
RH (%)	39	33	35	35	33	33	38	38

## 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 specimen is put on the floor on the mounting area (10 m<sup>2</sup>, 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.

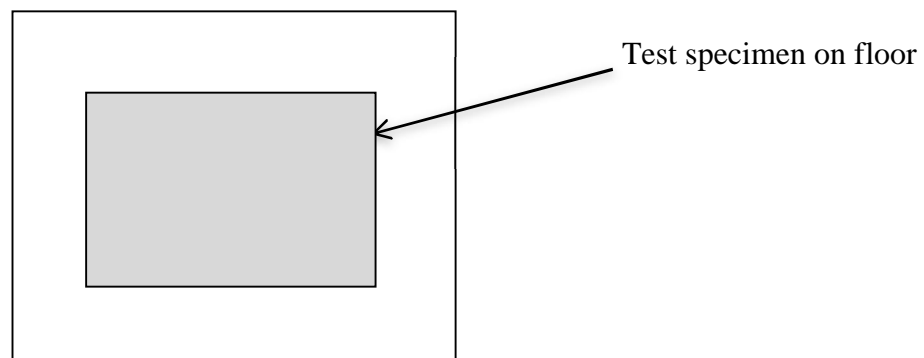


Figure B2.1: Plane drawing of the reverberation room with the positions of the test specimens.



# Unit 1800 mm x 1200 mm, textile on both sides, free standing objects

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

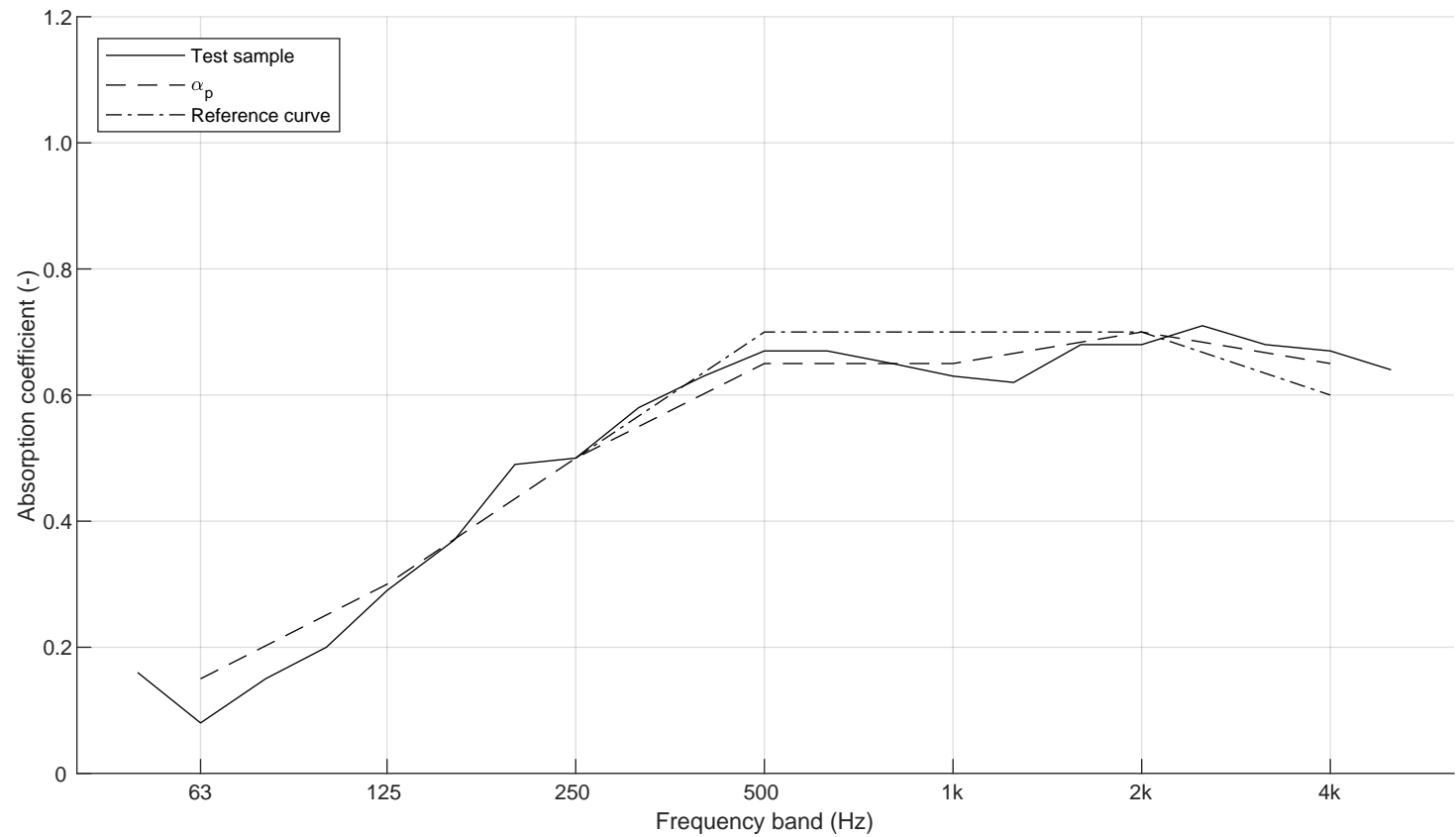


Report number:  
21-707-R1-M1  
Date  
2021-03-19

Frequency f [Hz]	Sound absorption coefficient	
	$\alpha_s$	$\alpha_p$
50	0.16	
63	0.08	0.15
80	0.15	
100	0.20	
125	0.29	0.30
160	0.37	
200	0.49	
250	0.50	0.50
315	0.58	
400	0.63	
500	0.67	0.65
630	0.67	
800	0.65	
1000	0.63	0.65
1250	0.62	
1600	0.68	
2000	0.68	0.70
2500	0.71	
3150	0.68	
4000	0.67	0.65
5000	0.64	

Client: Lintex  
 Manufacturer: Lintex  
 Product identification: Unit  
 Description of test specimen: Unit 1800 mm x 1200 mm  
 Textile fabric on both sides

Reverberation room volume: 200 m<sup>3</sup>  
 Temperature: 16.3 °C (empty: 19.4 °C)  
 Air humidity: 35 % (empty: 33 %)  
 Air pressure: 102.1 kPa (empty: 102.1 kPa)  
 Size of specimen: 10.2 m<sup>2</sup>  
 Measurement date: 2021-03-10  
 Measured by: Magnus Karlsson



$\alpha_w = 0.70$

Absorption class = C

# Unit 1800 mm x 1200 mm, Textile and glass fabric, free standing object

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



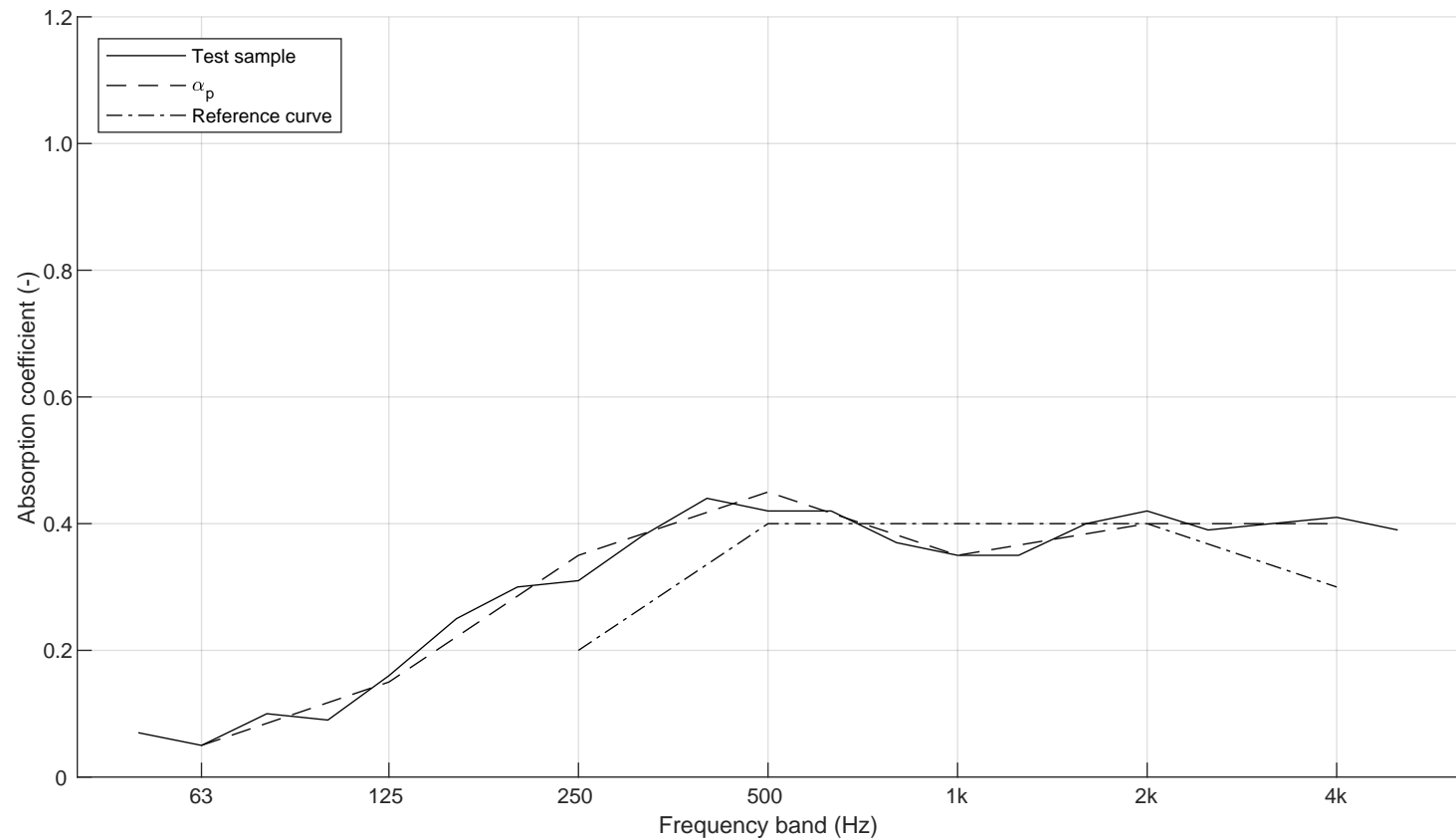
Report number:  
21-707-R1-M2  
Date  
2021-03-19

Frequency f [Hz]	Sound absorption coefficient	
	$\alpha_s$	$\alpha_p$
50	0.07	
63	0.05	0.05
80	0.10	
100	0.09	
125	0.16	0.15
160	0.25	
200	0.30	
250	0.31	0.35
315	0.38	
400	0.44	
500	0.42	0.45
630	0.42	
800	0.37	
1000	0.35	0.35
1250	0.35	
1600	0.40	
2000	0.42	0.40
2500	0.39	
3150	0.40	
4000	0.41	0.40
5000	0.39	

Client: Lintex  
 Manufacturer: Lintex  
 Product identification: Unit  
 Description of test specimen: Unit 1800 mm x 1200 mm  
 Textile and glass fabric

Reverberation room volume: 200 m<sup>3</sup>  
 Temperature: 18.2 °C (empty: 19.4 °C)  
 Air humidity: 33 % (empty: 33 %)  
 Air pressure: 102.1 kPa (empty: 102.1 kPa)  
 Size of specimen: 10.2 m<sup>2</sup>

Measurement date: 2021-03-10  
 Measured by: Magnus Karlsson



$\alpha_w = 0.40$

Absorption class = D

# Unit 1800 mm x 1200 mm, glass fabric on both sides, free standing objects

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



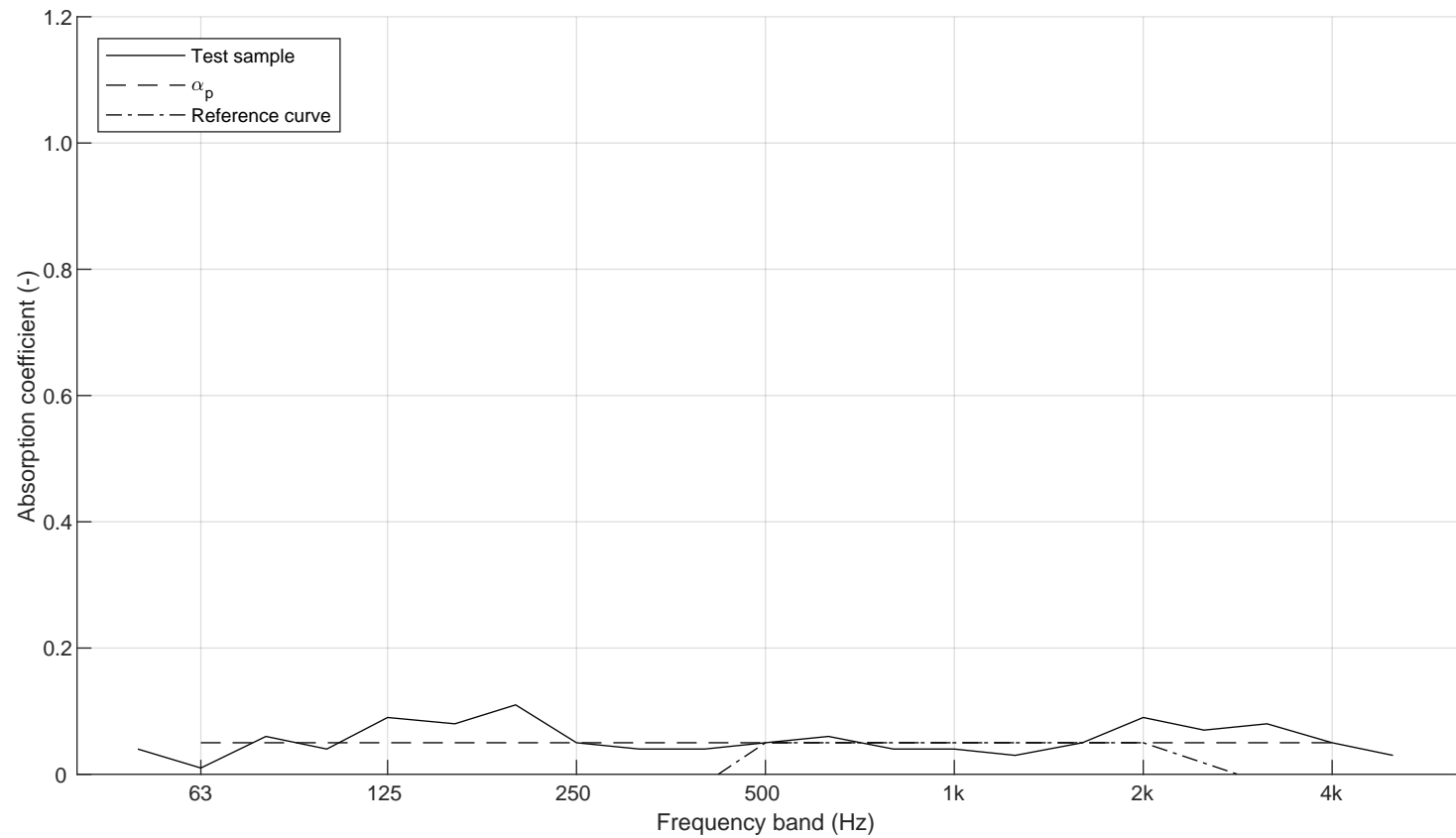
Report number:  
21-707-R1-M3  
Date  
2021-04-19

Frequency f [Hz]	Sound absorption coefficient	
	$\alpha_s$	$\alpha_p$
50	0.04	
63	0.01	0.05
80	0.06	
100	0.04	
125	0.09	0.05
160	0.08	
200	0.11	
250	0.05	0.05
315	0.04	
400	0.04	
500	0.05	0.05
630	0.06	
800	0.04	
1000	0.04	0.05
1250	0.03	
1600	0.05	
2000	0.09	0.05
2500	0.07	
3150	0.08	
4000	0.05	0.05
5000	0.03	

Client: Lintex  
 Manufacturer: Lintex  
 Product identification: Unit  
 Description of test specimen: Unit 1800 mm x 1200 mm  
 Glass fabric on both sides

Reverberation room volume: 200 m<sup>3</sup>  
 Temperature: 15.6 °C (empty: 18.6 °C)  
 Air humidity: 38 % (empty: 39 %)  
 Air pressure: 98.7 kPa (empty: 101.3 kPa)  
 Size of specimen: 15.3 m<sup>2</sup>

Measurement date: 2021-02-17  
 Measured by: Magnus Karlsson



$\alpha_w = 0.05$

Absorption class =

# Unit 1800 mm x 1200 mm, textile fabric on both sides, free standing 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:  
21-707-R1-M4  
Date  
2021-03-19

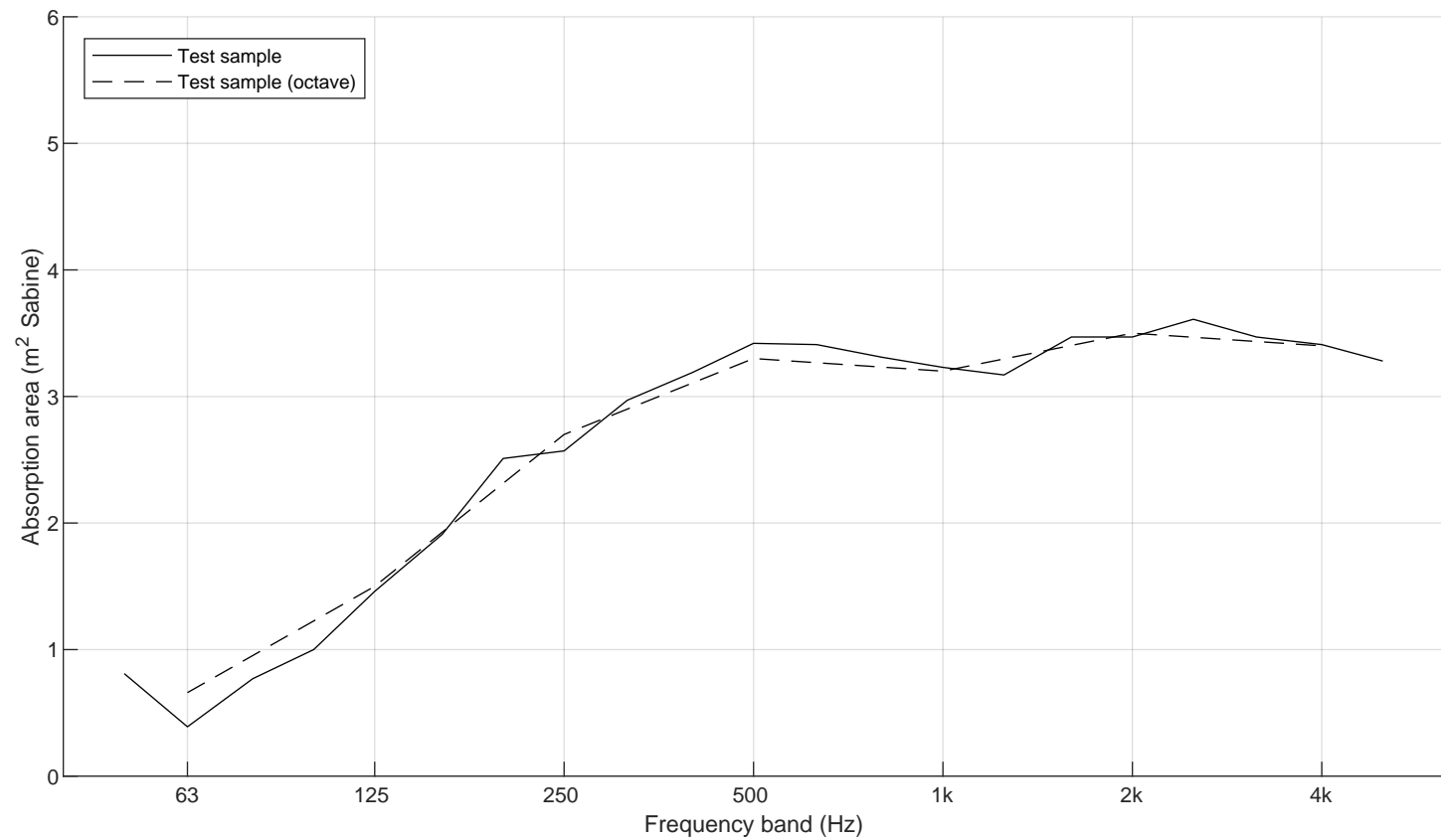
Frequency f [Hz]	Sound absorption area per object [m <sup>2</sup> Sabine]	
50	0.81	
63	0.39	0.66
80	0.77	
100	1.00	
125	1.46	1.5
160	1.91	
200	2.51	
250	2.57	2.7
315	2.97	
400	3.19	
500	3.42	3.3
630	3.41	
800	3.31	
1000	3.23	3.2
1250	3.17	
1600	3.47	
2000	3.47	3.5
2500	3.61	
3150	3.47	
4000	3.41	3.4
5000	3.28	

Client: Lintex  
 Manufacturer: Lintex  
 Product identification: Unit  
 Description of test specimen: Unit 1800 mm x 1200 mm  
 Textile fabric on both sides

Reverberation room volume: 200 m<sup>3</sup>  
 Temperature: 16.3 °C (empty: 19.4 °C)  
 Air humidity: 35 % (empty: 33 %)  
 Air pressure: 102.1 kPa (empty: 102.1 kPa)  
 Number of objects: 2

Measurement date: 2021-03-10  
 Measured by: Magnus Karlsson

$$N_{10} = 3.1$$



# Unit 1800 mm x 1200 mm, textile and glass fabric, free standing 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



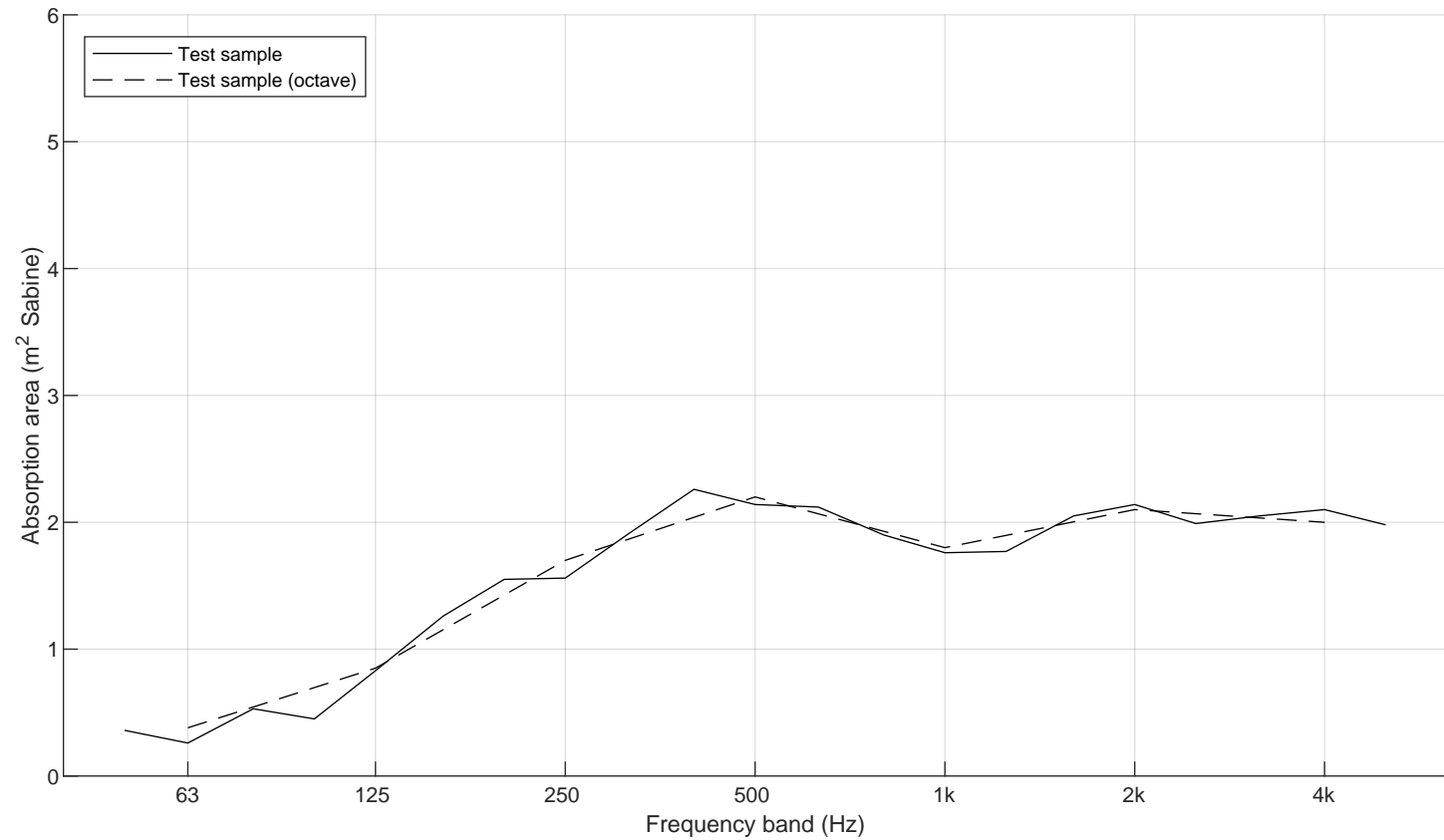
Report number:  
21-707-R1-M5  
Date  
2021-03-19

Frequency f [Hz]	Sound absorption area per object [m <sup>2</sup> Sabine]	
50	0.36	
63	0.26	0.38
80	0.53	
100	0.45	
125	0.83	0.85
160	1.26	
200	1.55	
250	1.56	1.7
315	1.91	
400	2.26	
500	2.14	2.2
630	2.12	
800	1.90	
1000	1.76	1.8
1250	1.77	
1600	2.05	
2000	2.14	2.1
2500	1.99	
3150	2.05	
4000	2.10	2.0
5000	1.98	

Client: Lintex  
 Manufacturer: Lintex  
 Product identification: Unit  
 Description of test specimen: Unit 1800 mm x 1200 mm  
 Textile and glass fabric

Reverberation room volume: 200 m<sup>3</sup>  
 Temperature: 18.2 °C (empty: 19.4 °C)  
 Air humidity: 33 % (empty: 33 %)  
 Air pressure: 102.1 kPa (empty: 102.1 kPa)  
 Number of objects: 2

Measurement date: 2021-03-10  
 Measured by: Magnus Karlsson



$$N_{10} = 5.6$$

# Unit 1800 mm x 1200 mm, glass fabric on both sides, free standing object

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: 21-707-R1-M6  
Date: 2021-03-19

Frequency f [Hz]	Sound absorption area per object [m <sup>2</sup> Sabine]	
50	0.22	
63	0.06	0.20
80	0.33	
100	0.21	
125	0.48	0.36
160	0.39	
200	0.56	
250	0.28	0.35
315	0.22	
400	0.21	
500	0.27	0.27
630	0.33	
800	0.21	
1000	0.20	0.19
1250	0.15	
1600	0.24	
2000	0.46	0.35
2500	0.36	
3150	0.39	
4000	0.28	0.28
5000	0.17	

Client: Lintex  
 Manufacturer: Lintex  
 Product identification: Unit  
 Description of test specimen: Unit 1800 mm x 1200 mm  
 Glass fabric on both sides

Reverberation room volume: 200 m<sup>3</sup>  
 Temperature: 15.6 °C (empty: 18.6 °C)  
 Air humidity: 38 % (empty: 39 %)  
 Air pressure: 98.7 kPa (empty: 101.3 kPa)  
 Number of objects: 3

Measurement date: 2021-02-17  
 Measured by: Magnus Karlsson

$N_{10} = 53$

