REPORT

Issued by an Accredited Testing Laboratory

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O100282-1108164

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Determination of sound absorption coefficients in a reverberation room according to ISO 354 and ISO 11654

(2 appendices)

Client

Ovacon AB

Test object

Sound absorption panels delivered by Ovacon AB and made by fiberglass materials applied by SprayTec technology. The panels were tested unpainted (as received). The panels were then spray-painted with acrylate paint named Jotun, Jota Proof PVA Interior and tested again.

Date of test

March 24th and 28th, 2022.

Results

The sound absorption coefficient (α_S) and the practical sound absorption coefficient (α_p) are given in the enclosures 1-2. The weighted sound absorption coefficient (α_w) and the sound absorption classes have been calculated according to ISO 11654 and the results are given in table 1 below.

Table 1 – Summary of results

Test object:	ISO 11654		Enclosure
	Absorption class	α_w	
Spray-Tec-G, thickness 70 mm, unpainted	A	1,00	1
Spray-Tec-G, thickness 70 mm, painted	A	1,00	2

The test object consisted of 16 parts that were placed on the floor in the reverberation room in a rectangular shape. For practical reasons, the fiberglass material were applied on 12,5 mm plasterboards as a base on each part.

The thickness of the test objects are reported as a mean value from five measurements on each part taken randomly. The thickness is the distance from the upper side of the plasterboard to the top side of the sound absorber material.

Confidentiality level
C2 - Internal

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Measurement method

The measurements have been carried out according to ISO 354:2003, which is equivalent to EN ISO 354 and SS-EN ISO 354. The evaluation has been carried out according to ISO 11654, which is equivalent to EN ISO 11654 and SS-EN ISO 11654. 4 loudspeaker positions and 6 microphone positions have been used giving 24 different combinations for the reverberation time measurements. For empty room 3 decays have been used for averaging the time and for test objects 5 decays have been used, for each combination of loudspeaker and microphone.

The absorption coefficient α_S has been evaluated from:

$$\alpha_S = \frac{55.3\,V}{c \cdot S}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

where

V = Volume of the reverberation room (m³)
S = Area of the test object (m²)
c = Speed of sound in air (m/s)
c = 331 + 0.6t
t = Temperature in the air (°C)
T_1 = Reverberation time of the room without test object (s)
T_2 = Reverberation time of the room with test object (s)

The reverberation time of the empty room in each frequency band is expressed by the arithmetic mean of the total number of reverberation time measurements made in that frequency band. In table 3 the reverberation time for the empty room, T_1, is given.

Table 3 – The reverberation time of the empty reverberation room measured March 24th and 28th respectively.

Frequency [Hz]	**T_1** [s]	**T_1** [s]
50	12,24	12,36
63	14,51	14,85
80	10,24	10,49
100	8,83	8,61
125	7,77	8,17
160	6,32	6,66
200	7,06	7,03
250	6,45	6,47
315	6,23	6,17
400	5,68	5,64
500	5,14	5,11
630	5,03	5,01
800	5,39	5,38
1000	5,55	5,58
1250	5,25	5,30
1600	4,89	4,87
2000	4,39	4,37
2500	3,84	3,84
3150	3,42	3,43
4000	2,99	2,98
5000	2,52	2,52

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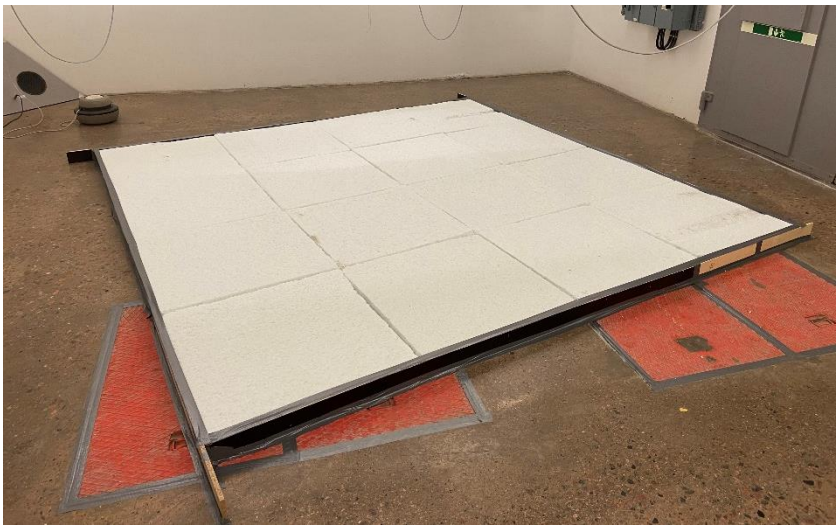
Pictures of the test objects



Picture 1 – The unpainted Spray-Tec-G with thickness 70 mm mounted on the floor in the reverberation room.

Picture 2 – The painted Spray-Tec-G with thickness 70 mm mounted on the floor in the reverberation room.

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Picture 3 -

Measurement uncertainty

From a world wide Round Robin[1)], in which SP took part, with 23 participating laboratories from 11 countries, the measurement uncertainties in table 3 has been calculated.

Table 3

Frequencies (Hz)	Uncertainty
100-630	± 0,15
800-1250	± 0,10
1600-2500	± 0,15
3150-5000	± 0,20

[1)] The figures are calculated from twice the standard deviations, rounded to the nearest 0,05. The data from the Round Robin is documented in a letter from the ASTM to the participating laboratories.

Test room

A reverberation room with the dimensions 7,64 m x 6,16 m x 4,25 m giving the volume 200 m³ and the total surface area 211 m² was used.

Mounting

The panels were placed on the floor and the edges were sealed with a wooden frame and a tape (made of an elastic woven material) to prevent air leakage. The mounting depth is the distance between the floor and the front surface (upper) of the test objects.

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List of instruments

Instrument	Manufacturer	Type	Serial no/SP no.
Microphone	Brüel & Kjaer	4943	BX41346
Microphone	Brüel & Kjaer	4943	503326
Microphone	Brüel & Kjaer	4943	503324
Microphone	Brüel & Kjaer	4943	503325
Microphone	Brüel & Kjaer	4943	503323
Microphone	Brüel & Kjaer	4943	503322
Microphone Preamplifier	Brüel & Kjaer	2619	502246
Microphone Preamplifier	Brüel & Kjaer	2619	502244
Microphone Preamplifier	Brüel & Kjaer	2619	502259
Microphone Preamplifier	Brüel & Kjaer	2619	502217
Microphone Preamplifier	Brüel & Kjaer	2619	502225
Microphone Preamplifier	Brüel & Kjaer	2619	503322
Analyzer	Norsonic	850	BX41346
Hygrometer/ Temperature meter	Testo	605i	BX80648
Loudspeakers	SP	HGT2, HGT7, HGT4, HGTtak	

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Performed by

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Appendices

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Appendix 1

Sound absorption coefficient according to ISO 11654

Measurement of sound absorption coefficient in a reverberation room

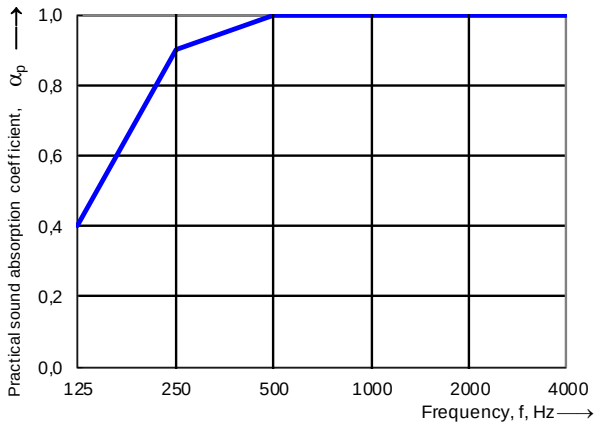
Client: Ovacon AB
Date of test: 2022-03-28
Description: Unpainted (as received)
Thickness 70 mm
Mounted directly on the floor

Object: Spray-Tec-G

Empty reverberation room:			Reverberation room with object		
Relative humidity:	80,9	%	Relative humidity:	80,9	%
Temperature:	19,4	℃	Temperature:	19,6	℃
Barometric pressure:	100,7	kPa	Barometric pressure:	100,6	kPa

Surface area:	11,42	m²
Room volume:	200,0	m³
Total room area S_t:	211,4	m²

Frequency f [Hz]	α_p 1/1octave
100 125 160	0,40
200 250 315	0,90
400 500 630	1,00
800 1000 1250	1,00
1600 2000 2500	1,00
3150 4000 5000	1,00



Weighted sound absorption coefficient according to ISO 11654

α_w = 1,00

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Appendix 1

Sound absorption coefficient according to ISO 354

Measurement of sound absorption coefficient in a reverberation room

Client: Ovacon AB
Description: Unpainted (as received)
Thickness 70 mm
Mounted directly on the floor

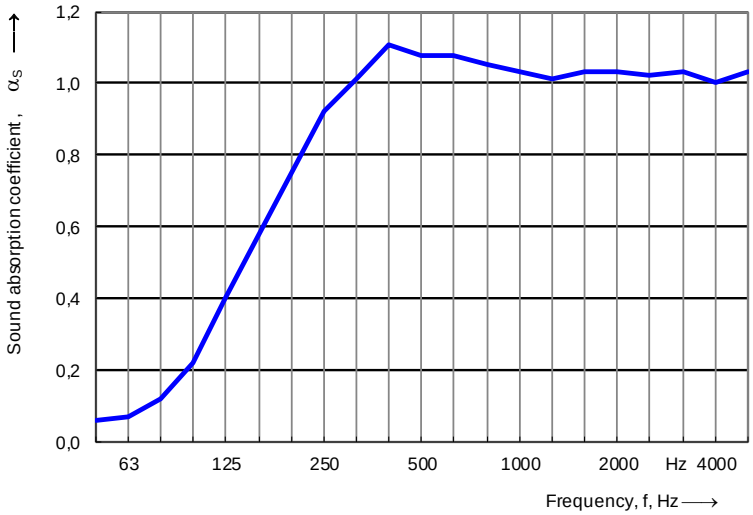
Date of test: 2022-03-28

Object: Spray-Tec-G

Empty reverberation room:		Reverberation room with object	
Relative humidity:	80,9 %	Relative humidity:	80,9 %
Temperature:	19,4 °C	Temperature:	19,6 °C
Barometric pressure:	100,7 kPa	Barometric pressure:	100,6 kPa

Surface area: 11,42 m²
Room volume: 200,0 m³
Total room area S_t: 211,4 m²

Frequency f [Hz]	α_s 1/3 octave
50	0,06
63	0,07
80	0,12
100	0,22
125	0,40
160	0,58
200	0,75
250	0,92
315	1,01
400	1,11
500	1,08
630	1,08
800	1,05
1000	1,03
1250	1,01
1600	1,03
2000	1,03
2500	1,02
3150	1,03
4000	1,00
5000	1,03



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Appendix 2

Sound absorption coefficient according to ISO 11654

Measurement of sound absorption coefficient in a reverberation room

Client: Ovacon AB Date of test: 2022-03-28

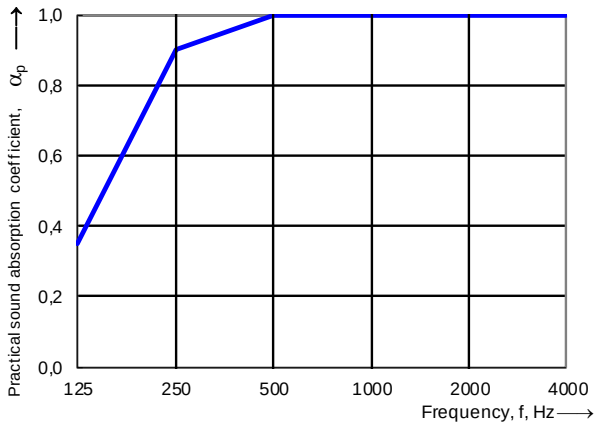
Description: Spray-painted with acrylate paint named Jotun, Jota Proff PVA Interior
Thickness 70 mm
Mounted directly on the floor

Object: Spray-Tec-G

Empty reverberation room:		Reverberation room with object	
Relative humidity:	80,9 %	Relative humidity:	79,5 %
Temperature:	19,5 °C	Temperature:	20,1 °C
Barometric pressure:	99,2 kPa	Barometric pressure:	99,2 kPa

Surface area:	11,06 m²
Room volume:	200,0 m³
Total room area S_t:	211,4 m²

Frequency f [Hz]	α_p 1/1octave
100 125 160	0,35
200 250 315	0,90
400 500 630	1,00
800 1000 1250	1,00
1600 2000 2500	1,00
3150 4000 5000	1,00



Weighted sound absorption coefficient according to ISO 11654

α_w = 1,00

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Appendix 2

Sound absorption coefficient according to ISO 354

Measurement of sound absorption coefficient in a reverberation room

Client: Ovacon AB Date of test: 2022-03-28

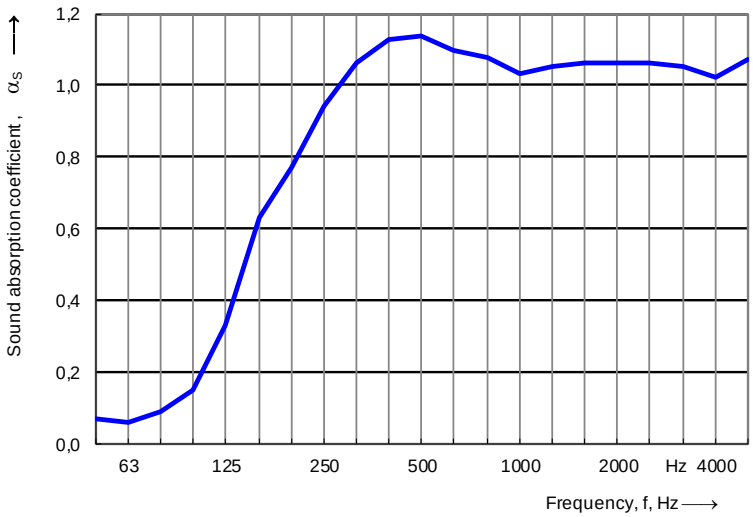
Description: Spray-painted with acrylate paint named Jotun, Jota Proff PVA Interior
Thickness 70 mm
Mounted directly on the floor

Object: Spray-Tec-G

Empty reverberation room:		Reverberation room with object	
Relative humidity:	80,9 %	Relative humidity:	79,5 %
Temperature:	19,5 °C	Temperature:	20,1 °C
Barometric pressure:	99,2 kPa	Barometric pressure:	99,2 kPa

Surface area:	11,06 m²
Room volume:	200,0 m³
Total room area S_t:	211,4 m²

Frequency f [Hz]	α_s 1/3 octave
50	0,07
63	0,06
80	0,09
100	0,15
125	0,33
160	0,63
200	0,77
250	0,94
315	1,06
400	1,13
500	1,14
630	1,10
800	1,08
1000	1,03
1250	1,05
1600	1,06
2000	1,06
2500	1,06
3150	1,05
4000	1,02
5000	1,07



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Verifikat

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Dokument

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