PEUTZ

Laboratory for Acoustics

Determination of the sound absorption (reverberation room method) of wall panels type Mute Fraction, manufacturer De Vorm

Report number A 4122-2E-RA-001 d.d. 10 February 2022

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Determination of the sound absorption (reverberation room method) of wall panels type Mute Fraction, manufacturer De Vorm

Principal	De Vorm
	Leemansweg 45
	6827 BX ARNHEM
	The Netherlands
Report number	A 4122-2E-RA-001
Date	10 February 2022
Reference	TS/JvB/DJ/A 4122-2E-RA-001
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1 Introduction

At the request of De Vorm based in Arnhem (the Netherlands), laboratory measurements of the sound absorption (reverberation room method) were carried out on:

wall panels
type Mute Fraction
manufacturer De Vorm

in the Laboratory for Acoustics of Peutz bv, at Mook, the Netherlands (see figure 1).

2 Standards and guidelines

The measurements have been carried out according to the Quality Manual of the Laboratory for Acoustics aswell as:

EN-ISO 354:2003[1,2]   Acoustics Measurement of sound absorption in a reverberation room

ISO 11654:1997   Acoustics Sound absorbers for use in buildings Rating of sound absorption

ASTM C423-17   Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method

[1] For these type of measurements the Laboratory for Acoustics has been accredited by the Dutch Accreditation Council (RvA).

The RvA is member of the EA MLA (**EA MLA**: **E**uropean **A**ccreditation Organisation **M**ulti**L**ateral **A**greement: http://www.european-accreditation.org).

EA: "Certificates and reports issued by bodies accredited by MLA and MRA members are considered to have the same degree of credibility, and are accepted in MLA and MRA countries."

[2] According to this norm, the report should include for each measurement the mean reverberation times T_1 and T_2 at each frequency. Because these figures are not relevant for judging the quality of the product being tested, but merely for judging the accuracy of the calculations, they have been omitted in this report. It is possible of course to reproduce those figures at any time if the principal requests this.

3 Tested panels

The data presented here have been received from the principal or obtained by own observations. Used materials;

Mute Fraction PET Felt Acoustic Panel

material:	arrhythmic formed PET Felt
manufacturer:	De Vorm
thickness Felt:	approx. 10 mm
thickness panel:	approx. 40 mm
width rips:	approx. 40 mm
number of ribs:	approx. $6,7/m^1$
mass:	approx. $3,4 \text{ kg}/m^2$

Stone wool

thickness:	approx. 50 mm
mass:	approx. $36 \text{ kg}/m^3$

The following systems have been tested

variant	Top	cavity	cavity filling	
1	Mute Fraction	none	-	
2	Mute Fraction	50 mm	-	
3	Mute Fraction	50 mm	50 mm stone wool	

The results as presented here relate only to the tested items and laboratory conditions as described in this report. The laboratory can make no judgement about the representativity of the tested samples. The test report ahead is valid as long as the tested constructions and/or materials are unchanged.

4 Measurements

4.1 Mounting set-up

The panels to be measured (see chapter 3) have been mounted directly on the floor, mounting type A, or on a support structure with a total construction height of 90 mm, mounting type E according to ISO 354:2003. The facing side of the panels was up. The sides of the set-up were enclosed and sealed by tape.

4.2 Method

The tests were conducted in accordance with the provisions of the test method ISO 354 in the reverberation room of "Peutz bv" in Mook (the Netherlands) (see figure 1). The relevant data regarding the reverberation room are given in figure 2 of this report.

By means of reverberation measurements the reverberation time of the room is measured under two conditions:
– when the reverberation room is empty
– when the construction under test is inside the reverberation room

In general, once material is placed into the reverberation room a lower reverberation time will result.

The difference in reverberation times is a measure of the amount of absorption brought into the room.

Measurements and calculations were carried out in 1/3-octave bandwidth from 100 to 5000 Hz, according to the norms. Where applicable the octave values have been calculated from these 1/3-octave values.

From the reverberation measurements in the empty reverberation room the equivalent sound absorption A_1 is calculated (per frequency band) according to formula 1 and expressed in m^2

$$A_1 = \frac{55{,}3\,V}{c\,T_1} - 4V\,m_1$$

(1)

in which:
V   =   the volume of the reverberation room   [m^3]
T_1 =   the reverberation time in the empty reverberation room   [sec.]
m_1 =   "power attenuation coefficient" in the empty room,
          calculated according to formula   [m^{-1}]
c   =   the speed of sound in the air, in m/s, calculated according to   [m/s]

$$c = 331 + 0,6\,t \tag{2}$$

in which:

t = the temperature; this formula is valid for temperatures between 15 and 30 ºC   [°C]

$$m = \frac{\alpha}{10\log(e)} \tag{3}$$

in which:

α = "attenuation coefficient" according to ISO 9613-1

In the same manner the equivalent sound absorption A2 for the room with the test specimen is calculated according to formula 4, also expressed in m^2

$$A_2 = \frac{55,3\,V}{c\,T_2} - 4\,V\,m_2 \tag{4}$$

in which:

c and V have the same definition as in formula 1 and

T_2 = the reverberation time of the reverberation room with the test
        specimen placed inside   [sec]

m_2 = "power attenuation coefficient" in the room with the test specimen
        placed inside, calculated according to formula 3   [m⁻¹]

The equivalent sound absorption A of the test specimen has been calculated according to formula 5 and is expressed in m^2

$$A = A_2 - A_1 \tag{5}$$

When the test specimen consists of one plane with an area between 10 and 12 m^2 the sound absorption coefficient α_S has to be calculated according to formula 6:

$$\alpha = \frac{A}{S} \tag{6}$$

in which:

S = the area of the test specimen   [m²]

4.3 Accuracy

The accuracy of the sound absorption as calculated can be expressed in terms of repeatability (tests within one laboratory) and reproducibility (between various laboratories). When:

– two tests are performed on identical test material
– within a short period of time
– by the same person or team
– using the same instrumentation

– under unchanged environmental conditions

the probability will be 95% that the difference between the two test results will be less than or equal to r.

In order to evaluate the repeatability r for the sound absorption measurements performed in the reverberation room of "Peutz bv" in Mook (the Netherlands) eight series of measurements have been carried out according to ISO 354:1985 annex C. From the results of those measurements the repeatability r has been calculated. It was found that for the frequency range from 100 to 200 Hz and at 5000 Hz the repeatability r is 0,21 as a maximum. For the frequency range 250 to 4000 Hz the repeatability r is 0,09 as a maximum.

4.4 Environmental conditions during the measurements

t4.1 *Environmental conditions during the measurements at January 18th, 2022*

reverberation room	temperature [°C]	barometric pressure [kPa]	relative humidity [%]
empty	18	103,5	51
occupied	19	103,6	51 - 54

4.5 Results

The results of the measurements are given in table 4.2 and in the in figures 3 up till and including 5. The measurements were made in 1/3-octave bands. The results presented in octave-bands are the arithmetic average of the results of the three 1/3-octave bands belonging to that octave band.

From those values the following one-figure ratings have been calculated and stated :
– the "weighted sound absorption coefficient α_w" according to ISO 11654;
– the "Sound Absorption Average SAA" according to ASTM-C423, being the average of the absorption coefficients (1/3 octave values) at the frequencies of 200 Hz up to and including 2500 Hz, rounded to the nearest 0,01.
– the "Noise Reduction Coefficient NRC" according to ASTM-C423, being the average of the absorption coefficients (1/3 octave values) at the frequencies of 250, 500, 1000 and 2000 Hz, rounded to the nearest 0,05.

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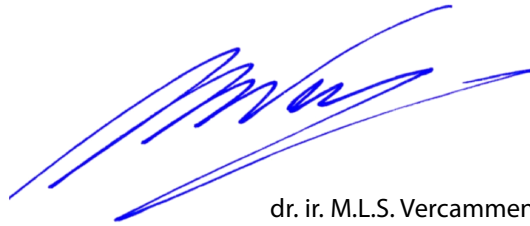t4.2 *Measurement results **Mute Fraction PET Felt Acoustic Panel***

	sound absorption coefficient α_s					
variant nr.	1		2		3	
Built-up	panel		panel		panel	
(top → bottom)			50 mm air gap		50 mm stone wool	
built-up height	40 mm		90 mm		90 mm	
record nr.	#73		#147		#110	
figure nr.	3		4		5	
frequency [Hz]	1/3 oct.	1/1 oct.	1/3 oct.	1/1 oct.	1/3 oct.	1/1 oct.
100	0,03		0,08		0,25	
125	0,03	0,04	0,13	0,14	0,42	0,44
160	0,06		0,20		0,64	
200	0,09		0,29		0,69	
250	0,14	0,16	0,48	0,46	0,79	0,78
315	0,24		0,62		0,85	
400	0,32		0,65		0,79	
500	0,43	0,43	0,67	0,69	0,76	0,78
630	0,53		0,76		0,79	
800	0,64		0,78		0,79	
1000	0,68	0,68	0,81	0,80	0,78	0,79
1250	0,72		0,81		0,79	
1600	0,77		0,81		0,82	
2000	0,79	0,80	0,80	0,81	0,80	0,80
2500	0,85		0,81		0,79	
3150	0,84		0,82		0,80	
4000	0,87	0,87	0,83	0,84	0,83	0,83
5000	0,90		0,87		0,86	
α_w	0,45(MH)		0,70(H)		0,80	
SAA	0,52		0,69		0,79	
NRC	0,50		0,70		0,80	

The sound absorption coefficient of a material is not a material property. It should be taken into account that the sound absorption of a construction depends on the dimensions, the way of mounting of the material and its position in the room.

Mook,

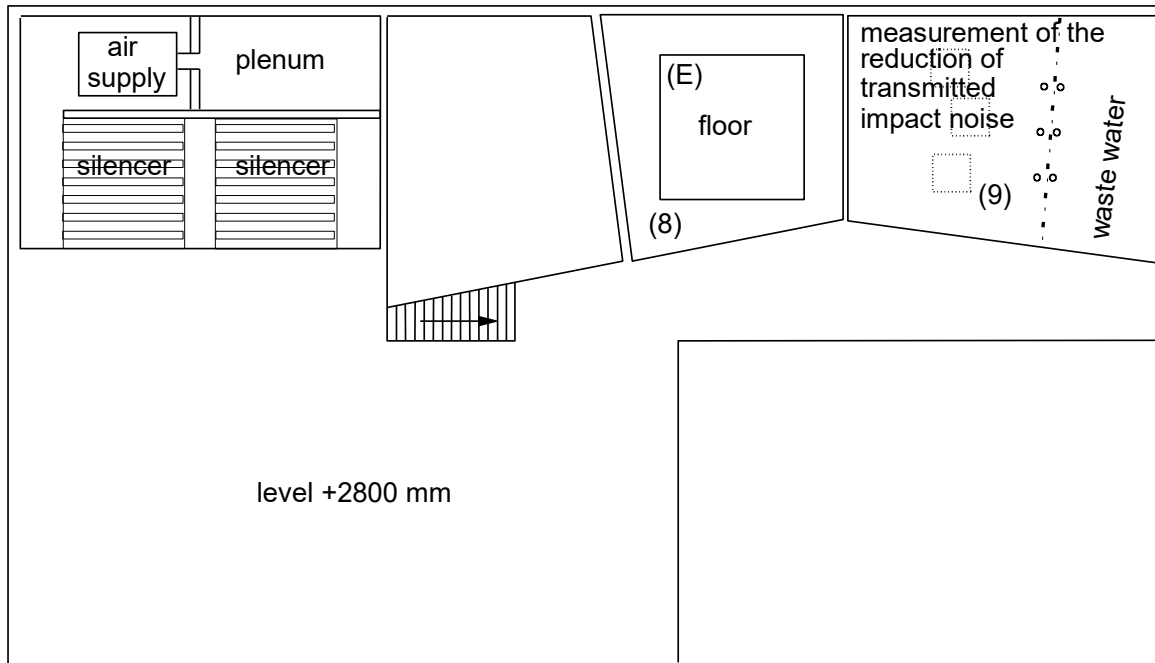Th. Scheers
Laboratory Supervisor

dr. ir. M.L.S. Vercammen
Manager

This report contains 11 pages and 5 figures.

LABORATORY FOR ACOUSTICS

PEUTZ

PEUTZ bv
Lindenlaan 41, NL-6584 AC MOLENHOEK (LB), THE NETHERLANDS

OVERVIEW

Story

air supply

plenum

silencer silencer

(E)

floor

(8)

measurement of the reduction of transmitted impact noise

(9)

waste water

level +2800 mm

Ground level

opening (A) (closed)
w x h = 1300 x 1905 mm

plenum

air supply installations
(6)

(A)

(C)

(D)

reverberation room
(3)

(B)

receiving room
(2)

sending room
(1)

sanitairy installations
(7)

(5)

(4)

suspended ceilings
or raised floors

workshop

heating

wc

shower

conference room

analyses

overhead door
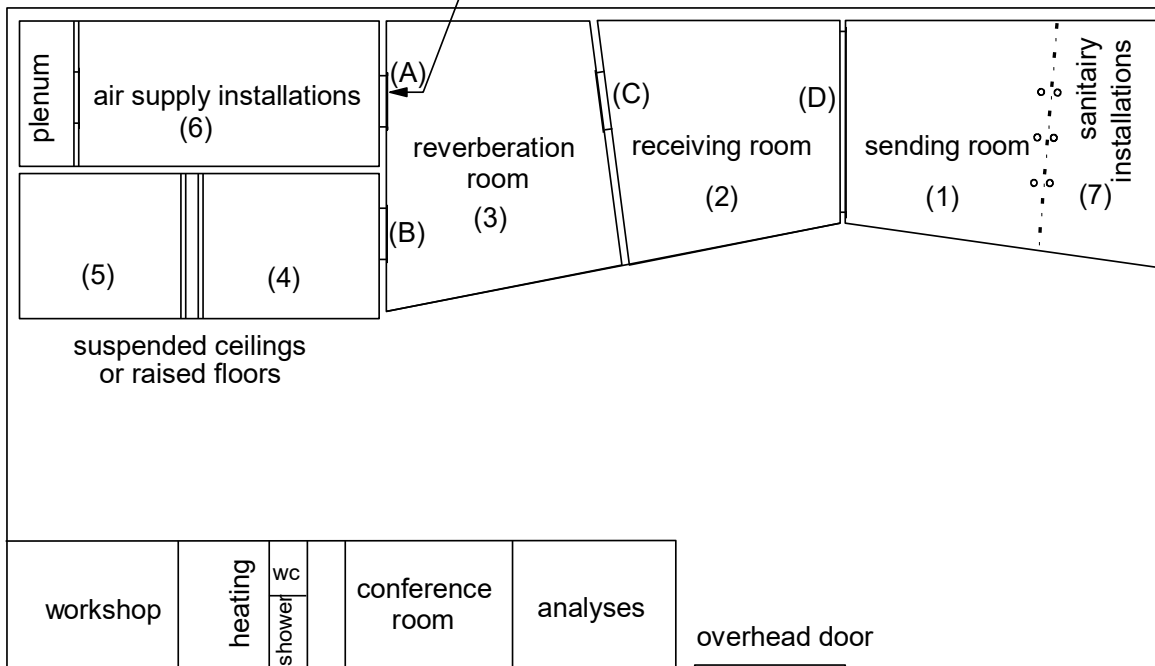
TEST OPENINGS (w x h in mm)
(B) 1000 x 2200
(C) 1500 x 1250
(D) 4300 x 2800
(E) 4000 x 4000

0 1 2 3 4 5 m
scale

A 4122-2E-RA

figure 1

LABORATORY FOR ACOUSTICS
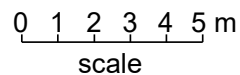
PEUTZ

PEUTZ bv

Lindenlaan 41, 6584 AC MOLENHOEK (LB)

REVERBERATION ROOM

The reverberation room meets the requirements of ISO 354:2003.

additional data:

volume : 214 m^3

total area St (walls, floor and ceiling) : 219 m^2

diffusion: by the shape of the room and by adding 6 curved and 2 flat reflecting elements with a total area of approx. 13 m^2 a sufficient diffusion has been gained.
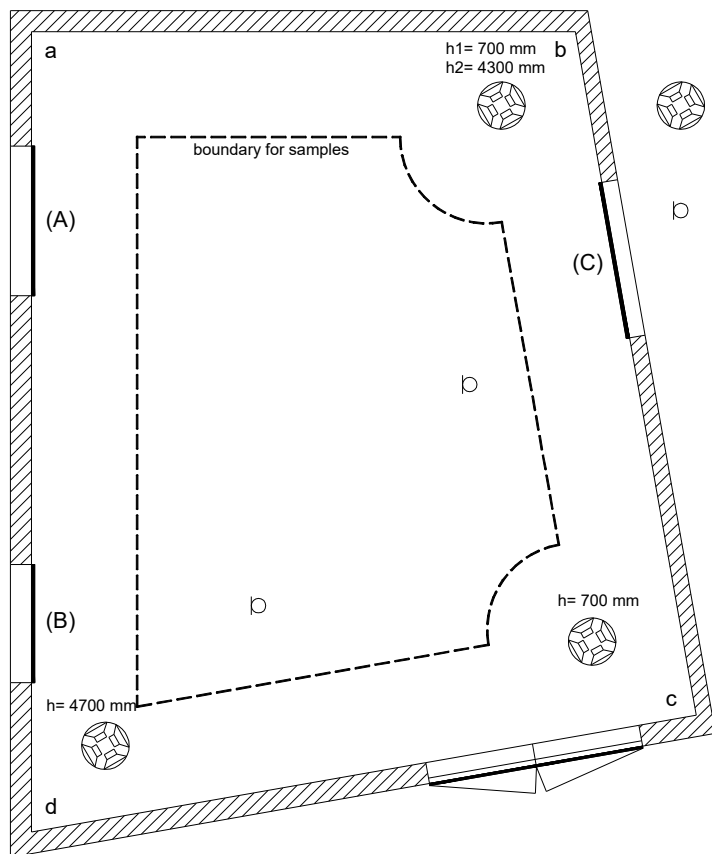
reverberation time of the empty reverberation room during measurements of 18-01-2022

frequency (1/1 oct.)	125	250	500	1000	2000	4000	Hz
reverberationtime	8,98	7,29	6,86	6,40	4,66	2,89	sec.

repeatability r (1/1 oct.) c.f. ISO 354:1985 annex C (see chapter 4.2 of this report).

r at high α	0,13	0,04	0,04	0,02	0,02	0,08	-
r at low α	0,09	0,02	0,01	0,02	0,02	0,04	-

plan

loudspeaker (4x)

microphone (3x)

(closed) testopenings
(width x height in mm)
(A): 1300 x 1800
(B): 1000 x 2200
(C): 1500 x 1250

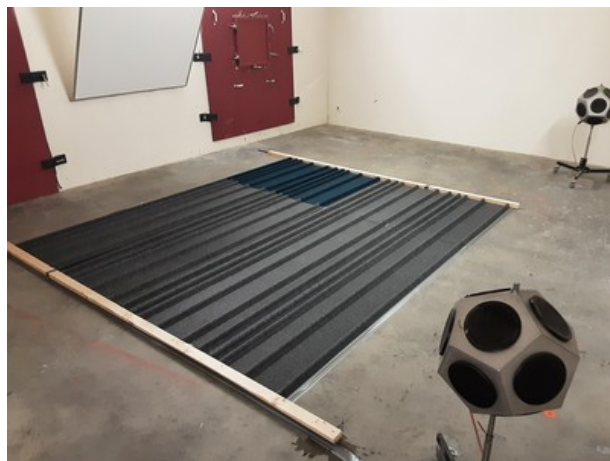height at:
a: 5573 mm
b: 5102 mm
c: 5000 mm
d: 5580 mm

0   1   2 m

Absorb, versie 5.9 mode 7, file: a4122   E#:1-36   T$_1$ = 18,5 °C p$_1$ = 103,5 kPa h$_1$ = 50,6 %

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MEASUREMENT OF SOUND ABSORPTION IN A REVERBERATION ROOM
ACCORDING TO ISO 354:2003

principal: De Vorm

#1;	type;	**Mute Fraction PET Felt Acoustic Panel**
	manufacturer;	De Vorm
	built-up;	panels directly on floor (no cavity)

volume reverberation room: 214 m³

surface area sample: 11,3 m²

heigth of the construction: 0,040 m

measured at: Peutz Laboratory for Acoustics
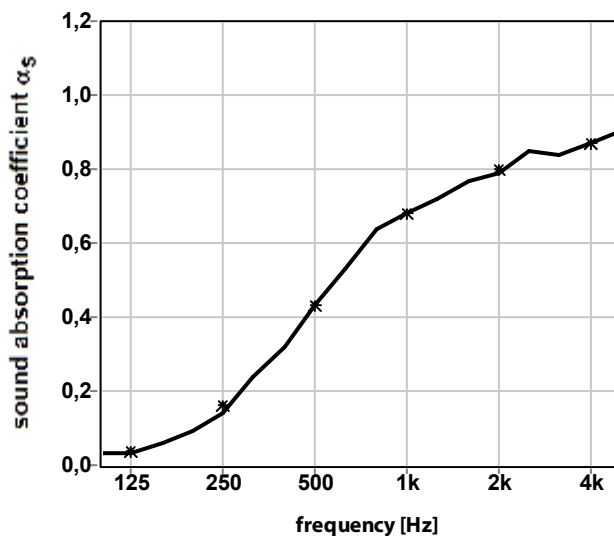
signal: broad-band noise

bandwidth: 1/3 octave

α_w **(ISO 11654) = 0,45(MH)**

SAA (ASTM - C423) = 0,52
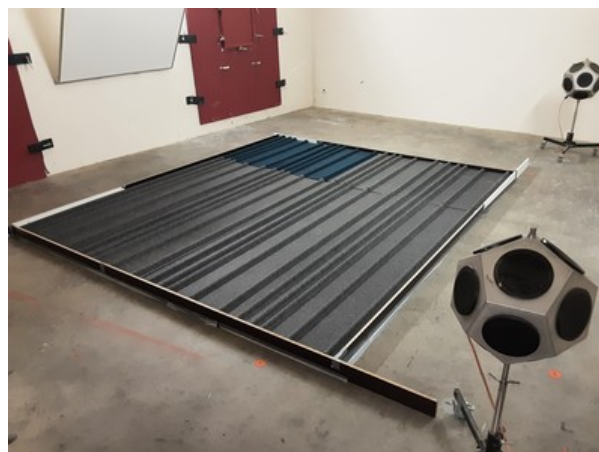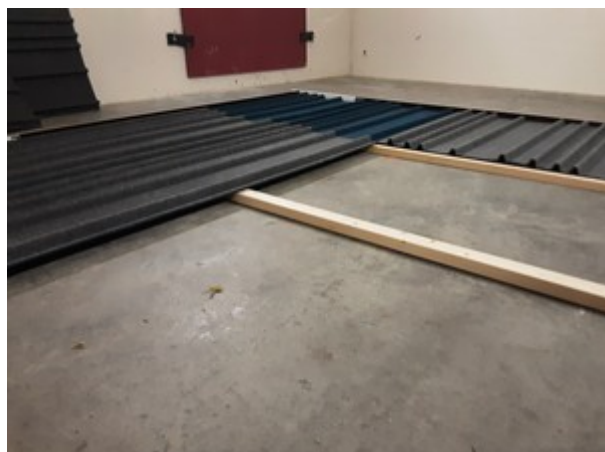
NRC (ASTM - C423) = 0,50

— 1/3 oct.
✳ 1/1 oct.

	125	250	500	1k	2k	4k
	0,03	0,09	0,32	0,64	0,77	0,84
1/3 oct.	0,03	0,14	0,43	0,68	0,79	0,87
	0,06	0,24	0,53	0,72	0,85	0,90
1/1 oct.	**0,04**	**0,16**	**0,43**	**0,68**	**0,80**	**0,87**

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Mook, measured at 18-01-2022

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figure 3

LABORATORY FOR ACOUSTICS

PEUTZ

MEASUREMENT OF SOUND ABSORPTION IN A REVERBERATION ROOM
ACCORDING TO ISO 354:2003

principal: De Vorm

#3;	type;	**Mute Fraction PET Felt Acoustic Panel**
	manufacturer;	De Vorm
	built-up;	panels on 50 mm cavity (empty)

— 1/3 oct.
✳ 1/1 oct.

volume reverberation room: 214 m^3

surface area sample: 11,3 m^2

heigth of the construction: 0,090 m

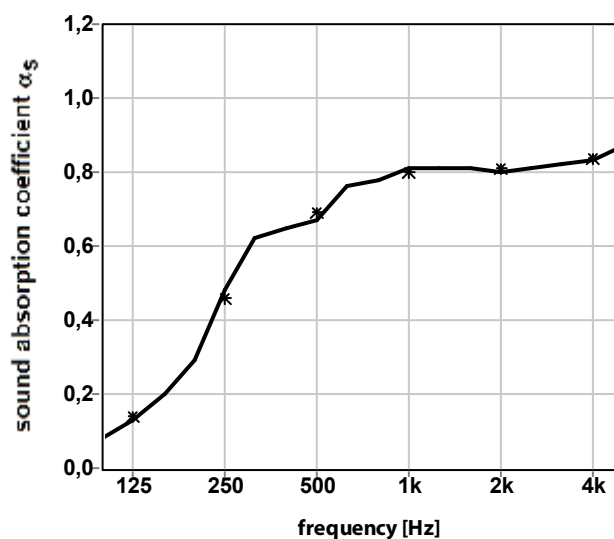measured at: Peutz Laboratory for Acoustics

signal: broad-band noise

bandwidth: 1/3 octave

α$_w$ (ISO 11654) = 0,70(H)
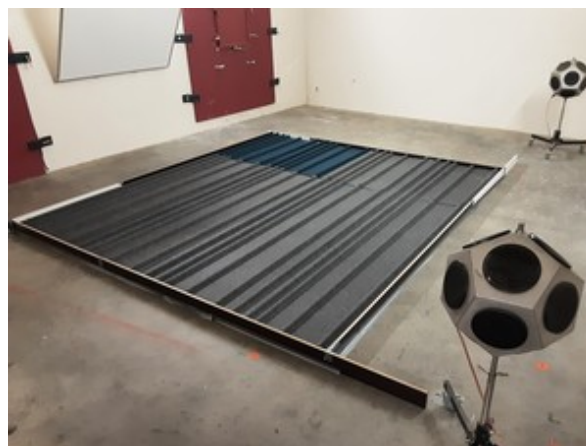
SAA (ASTM - C423) = 0,69

NRC (ASTM - C423) = 0,70

Left margin: Absorb, versie 5.9 mode 7, PM:RA, file: a4122   E#:1-36   F#:111-146   A#:147   T$_1$ = 18,5 °C T$_2$ = 18,5 °C p$_1$ = 103,5 kPa p$_2$ = 103,6 kPa h$_1$ = 50,6 % h$_2$ = 54,0 %

	125	250	500	1k	2k	4k
	0,08	0,29	0,65	0,78	0,81	0,82
1/3 oct.	0,13	0,48	0,67	0,81	0,80	0,83
	0,20	0,62	0,76	0,81	0,81	0,87
1/1 oct.	**0,14**	**0,46**	**0,69**	**0,80**	**0,81**	**0,84**

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Mook, measured at 18-01-2022

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figure 4

LABORATORY FOR ACOUSTICS

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MEASUREMENT OF SOUND ABSORPTION IN A REVERBERATION ROOM
ACCORDING TO ISO 354:2003

principal: De Vorm

#2;	type;	**Mute Fraction PET Felt Acoustic Panel**
	manufacturer;	De Vorm
	built-up;	panels on 50 mm stone wool

volume reverberation room: 214 m³

surface area sample: 11,3 m²

heigth of the construction: 0,090 m

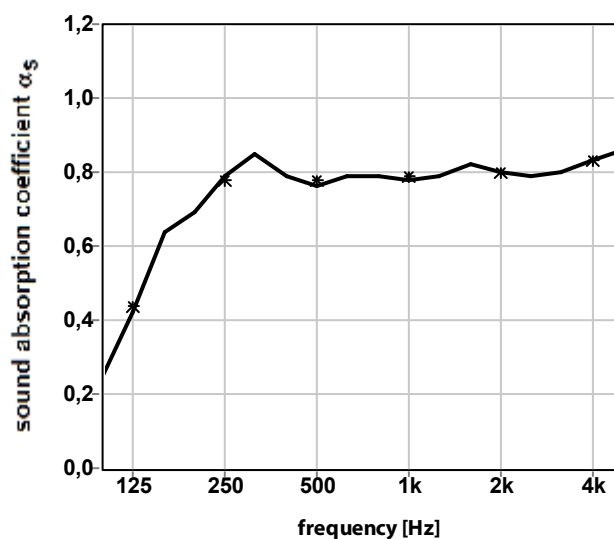measured at: Peutz Laboratory for Acoustics

signal: broad-band noise

bandwidth: 1/3 octave

α_w (ISO 11654) = 0,80

SAA (ASTM - C423) = 0,79

NRC (ASTM - C423) = 0,80

— 1/3 oct.
∗ 1/1 oct.

	125	250	500	1k	2k	4k
	0,25	0,69	0,79	0,79	0,82	0,80
1/3 oct.	0,42	0,79	0,76	0,78	0,80	0,83
	0,64	0,85	0,79	0,79	0,79	0,86
1/1 oct.	**0,44**	**0,78**	**0,78**	**0,79**	**0,80**	**0,83**

publication is permitted for the entire page only

Mook, measured at 18-01-2022

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figure 5