PEUTZ

Laboratory for Acoustics

TESTING
RvA L 334

Determination of the sound absorption (reverberation room method) of a Acoustic Lamp type Fost, manufacturer De Vorm

Report number A 4122-3E-RA-001 d.d. February 10, 2022

Laboratory for Acoustics

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mook – zoetermeer – groningen – düsseldorf – dortmund – berlijn – leuven – parijs – lyon

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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 a:

Acoustics lamp
type Fost
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 lamp

Type;	Fost
Manufacturer;	De Vorm
Shell;	Pet Felt, thickness 5 mm
Inner inlay;	stretch cloth
Diameter (bottom);	755 mm
Height;	250 mm
Mass (with light);	4,20 kg

The measurements were performed with three lamp in the measuring room.

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

Three lamps are installed for the laboratory test in the same manner as they are typically installed in practice;
- free hanging in the reverberation room

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

$$A_1 = \frac{55{,}3\,V}{c\,T_1} - 4V\,m_1 \qquad (1)$$

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]

$$c = 331 + 0{,}6t \quad (2)$$

in which:

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

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

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

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

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

$$A = A_2 - A_1 \quad (5)$$

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	19	103,5	51
occupied	19	103,5	56

4.5 Results

The results of the measurements are given in table 4.2 and in figure 3. 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.

*t4.2 Measurement results equivalent sound absorption area A [m²] per **Fost** lamp*

	sound absorption A [m²] per lamp	
record nr.	#370	
figure nr.	3	
frequency [Hz]	1/3 oct.	1/1 oct.
100	0,10	
125	0,13	0,14
160	0,20	
200	0,42	
250	0,50	0,49
315	0,54	
400	0,59	
500	0,52	0,56
630	0,58	
800	0,60	
1000	0,59	0,60
1250	0,61	
1600	0,65	
2000	0,67	0,69
2500	0,74	
3150	0,74	
4000	0,84	0,84
5000	0,93	

The equivalent sound absorption area 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

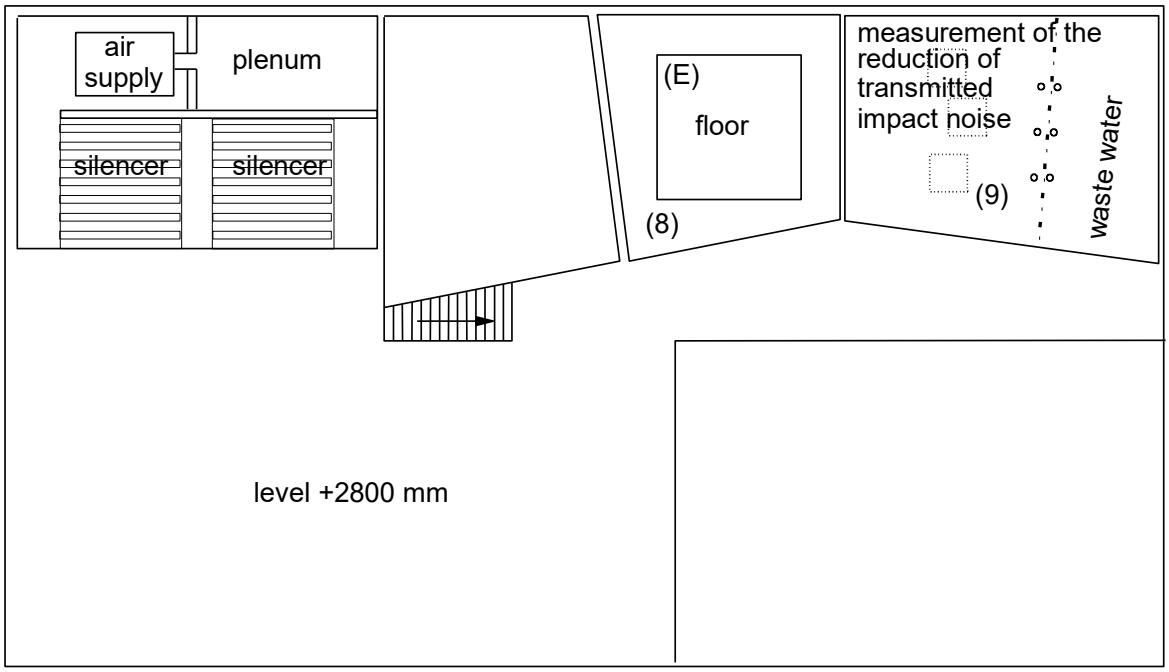
dr. ir. M.L.S. Vercammen
Manager

This report contains 11 pages and 3 figures.

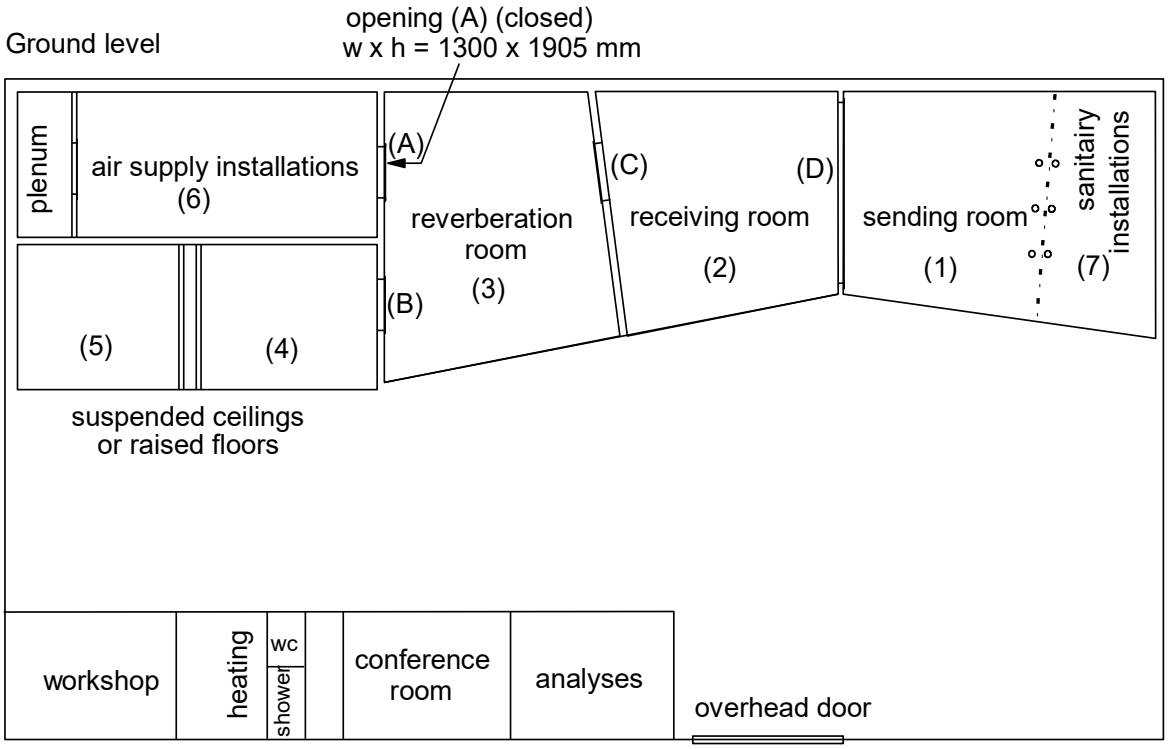
PEUTZ bv
Lindenlaan 41, NL-6584 AC MOLENHOEK (LB), THE NETHERLANDS

OVERVIEW

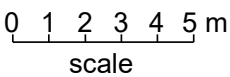
Story



Ground level



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



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.

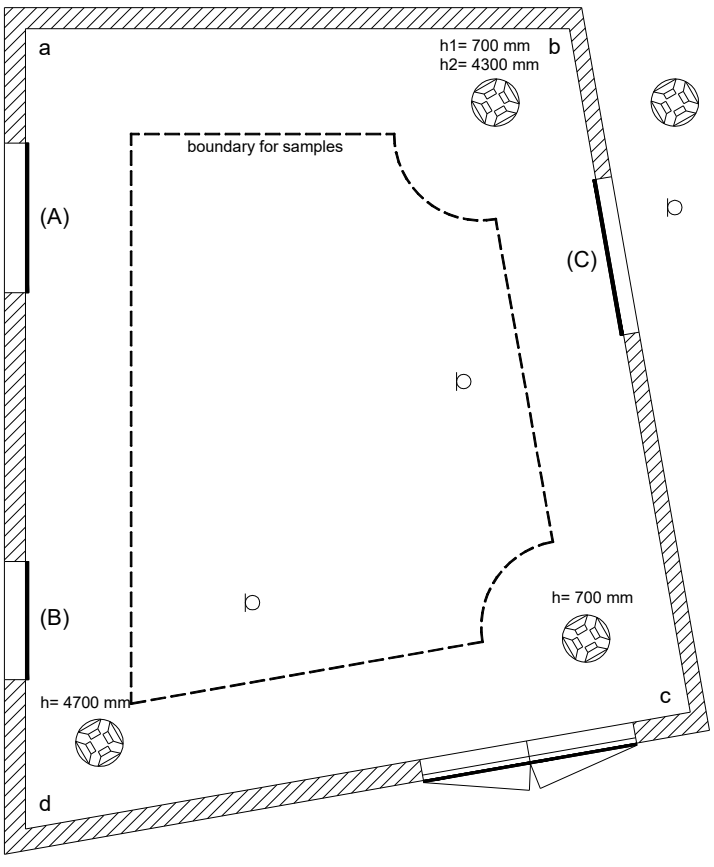
reverberation time of the empty reverberation room during measurements of 18-01-2022

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.

repeatibility 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



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 %

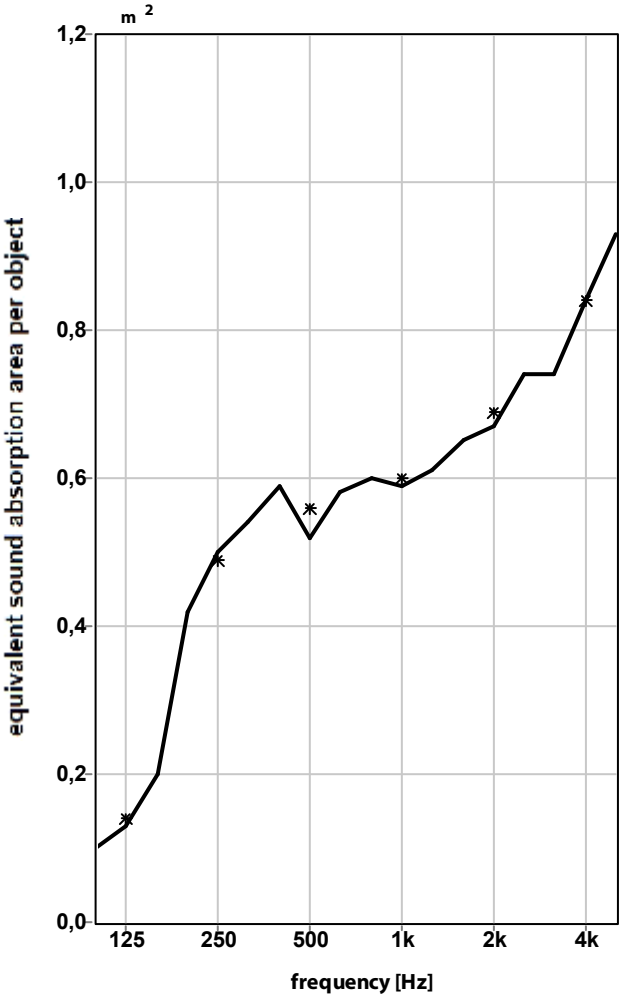
LABORATORY FOR ACOUSTICS

EQUIVALENT SOUNDABSORPTION AREA PER OBJECT conform ISO 354:2003

principal: De Vorm

TESTEN
RvA L 334

element tested; **Fost Acoustic Lamp**
manufacturer De Vorm
equivalent sound absorption per lamp



volume reverberation room: 214 m^3

number of elements during test: 3

measured at: Peutz Laboratory for Acoustics

signal: broad-band noise

bandwidth: 1/3 octave

	0,10	0,42	0,59	0,60	0,65	0,74
1/3 oct.	0,13	0,50	0,52	0,59	0,67	0,84
	0,20	0,54	0,58	0,61	0,74	0,93
1/1 oct.	**0,14**	**0,49**	**0,56**	**0,60**	**0,69**	**0,84**

Absorb, versie 5.9 mode 9, PM: RA, file: a4122 E#:1-36 F#:334-369 A#:370 T_1 = 18,5 °C T_2 = 18,7 °C p_1 = 103,5 kPa p_2 = 103,5 kPa h_1 = 50,6 % h_2 = 56,4 %

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Mook, measured at 18-01-2022