PEUTZ

Laboratory for Acoustics

Determination of the sound absorption (reverberation room method) of BuzziSpace designs, manufacturer BuzziSpace

TESTING
RvA L 334

4   **M e a s u r e m e n t s**

The products are installed for the laboratory test in the same manner as they are typically installed in practice;
- free-standing on the floor of the reverberation room
- free hanging from the ceiling of the reverberation room

For discrete absorbers like this particular case, the results are expressed as the equivalent sound absorption area per object A (m^2).

4.1   **M e t h o d**

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 3 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]

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

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   [m^2]

4.2 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.

4.3 Environmental conditions during the measurements

t4.1   *Environmental conditions during the measurements*

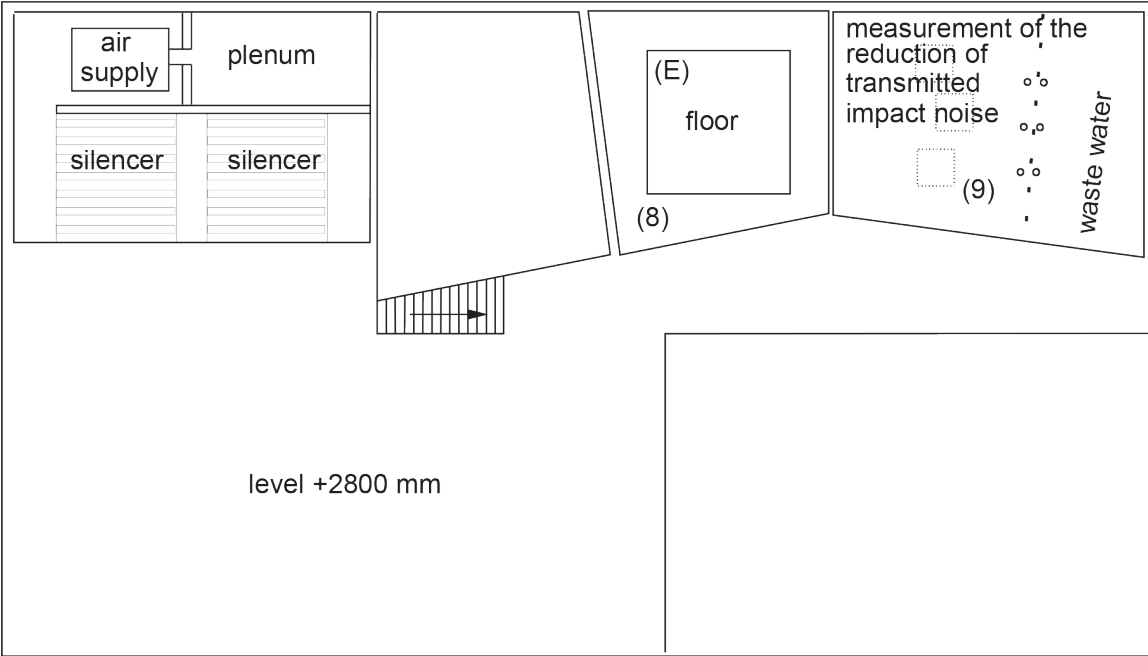| reverberation room		temperature [°C]	barometric pressure [kPa]	relative humidity [%]
empty	05-01-2017	15,6	103,1	56
	24-01-2017	15,3	102,7	50,3
With objects	05-01-2017	15,5 – 16,3	103,1 – 103,3	50,7 - 58,3
	24-01-2017	15,2 – 16,0	102,8 – 103,0	50,9 – 52,9

4.4 Results

The results of the measurements are given in table t4.2 up and including table t4.9 and in figure 4 to 20. 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 octaveband.
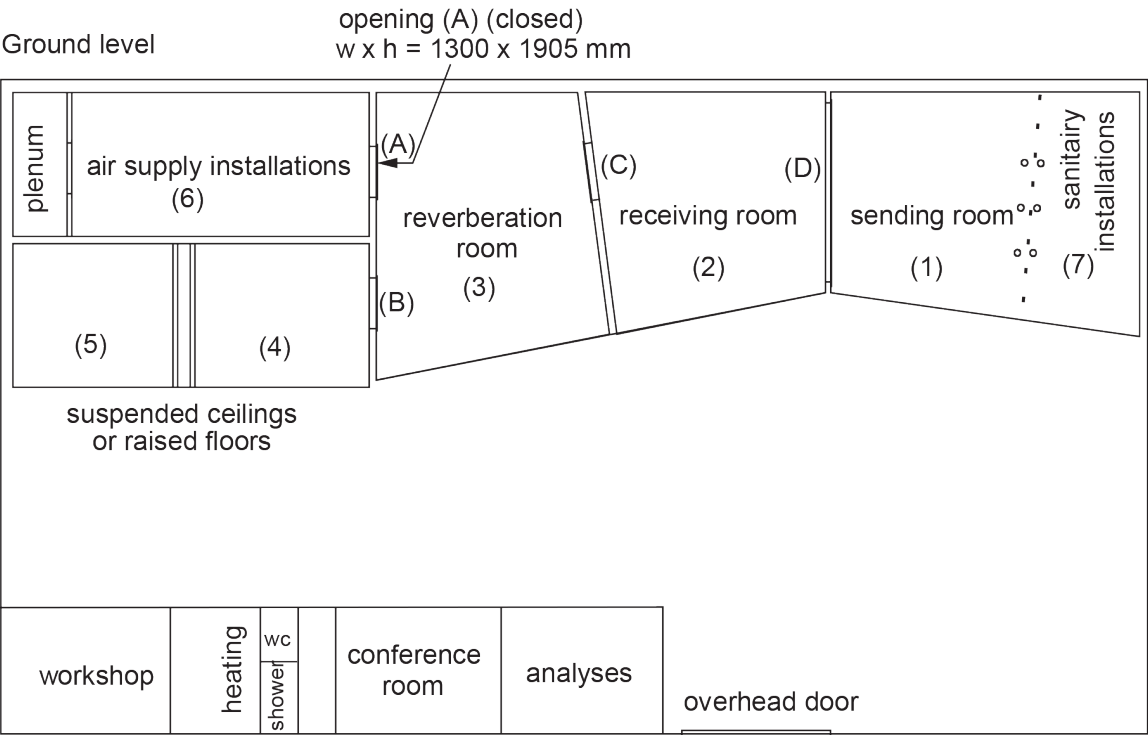
LABORATORY FOR ACOUSTICS

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

waste water

(9)

level +2800 mm

Ground level

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

plenum

air supply installations
(6)

(5)

(4)

suspended ceilings
or raised floors

(A)

reverberation
room
(3)

(B)

(C)

receiving room
(2)

(D)

sending room
(1)

sanitairy installations

(7)

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

figure 1

PEUTZ bv
Lindenlaan 41, 6584 AC MOLENHOEK (LB)

REVERBERATION ROOM

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

additional data:

volume : 214 m³

total area S_t (walls, floor and ceiling) : 219 m²

diffusion: by the shape of the room and by adding 6 curved and 2 flat reflecting elements with a total area of approx. 13 m² a sufficient diffusion has been gained.
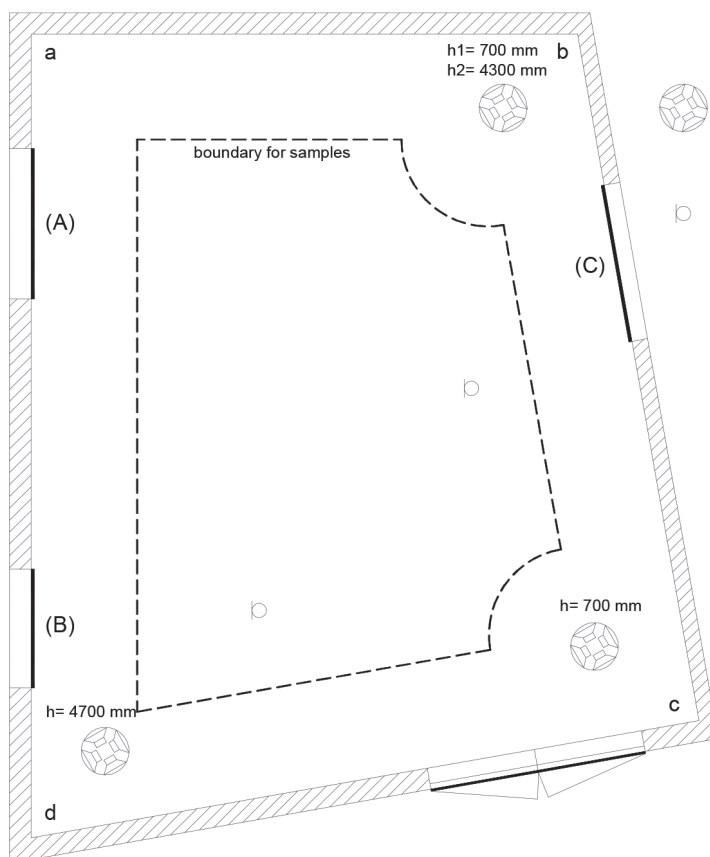
reverberation time of the empty reverberation room during measurements of 24-01-2017

frequency (1/1 oct.)	125	250	500	1000	2000	4000	Hz
reverberationtime	7,84	6,35	6,09	5,45	4,04	2,54	sec.

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

r bij hoge α	0,13	0,04	0,04	0,02	0,02	0,08	-
r bij lage α	0,09	0,02	0,01	0,02	0,02	0,04	-

plan

figure 2

LABORATORY FOR ACOUSTICS

PEUTZ

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

principal: BuzziSpace

BUZZISPACE – BUZZIBACK

Material:	Felt
Size: (4x)	1700 x 960 mm
(4x)	1700 x 905 mm

volume reverberation room: 214 m³

surface area sample: 12,96 m²

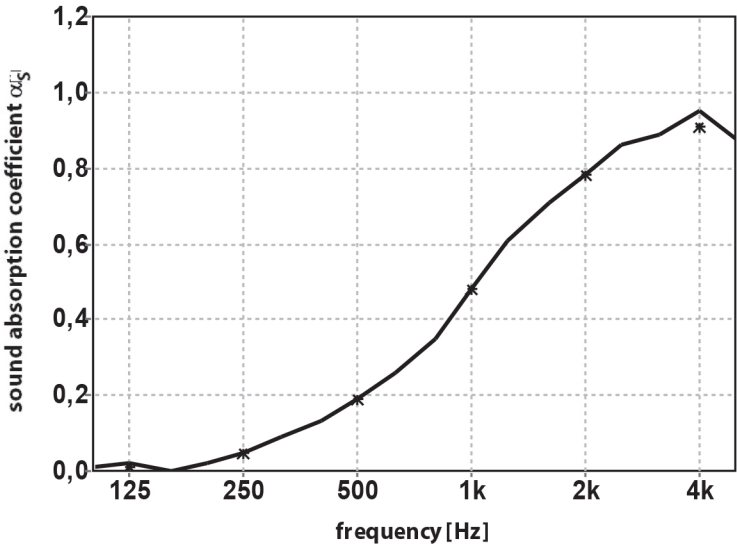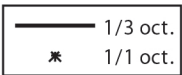measured at: Peutz Laboratory for Acoustics

signal: broad-band noise

bandwidth: 1/3 octave

α_w (ISO 11654) = 0,25(MH)

NRC (ASTM - C423) = 0,40

SAA (ASTM - C423) = 0,38

CLASS (ISO 11654); E

	125	250	500	1k	2k	4k
	0,01	0,02	0,13	0,35	0,71	0,89
1/3 oct.	0,02	0,05	0,19	0,48	0,78	0,95
	0,00	0,09	0,26	0,61	0,86	0,88
1/1 oct.	**0,01**	**0,05**	**0,19**	**0,48**	**0,78**	**0,91**