PEUTZ

Laboratory for Acoustics

TESTING
RvA L 334

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

4 Measurements

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 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

$$A_2 = \frac{55{,}3V}{cT_2} - 4Vm_2 \quad (4)$$

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

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

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:

$$\alpha = \frac{A}{S} \quad (6)$$

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*

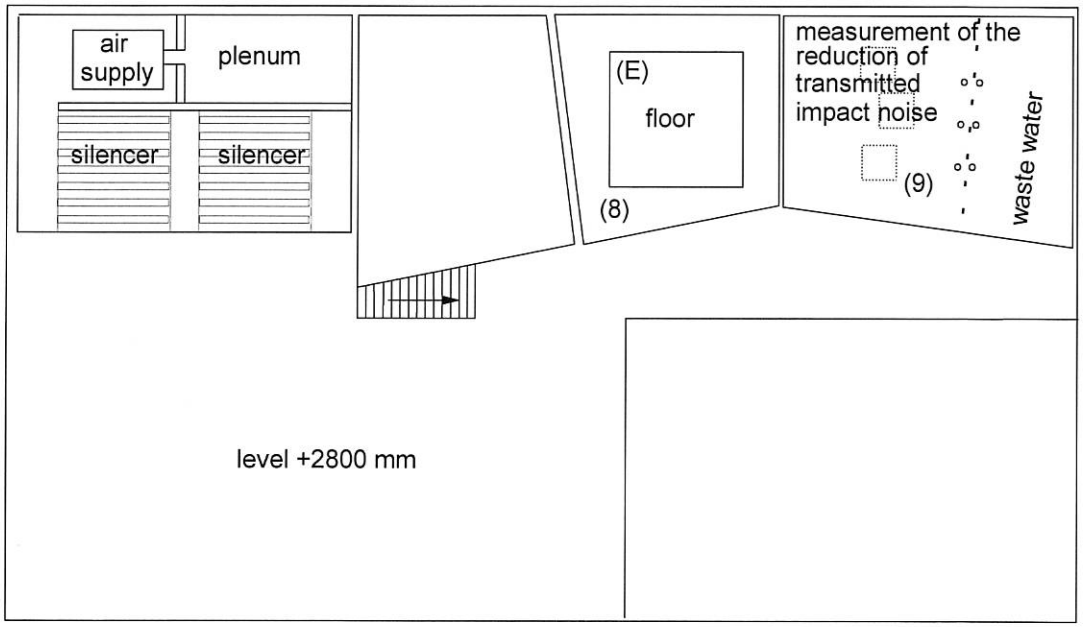
reverberation room	temperature [°C]	barometric pressure [kPa]	relative humidity [%]
empty	19.0	101.5	50.9
With ojects	19.1 – 19.9	101.5 – 101.6	49.4 – 53.7

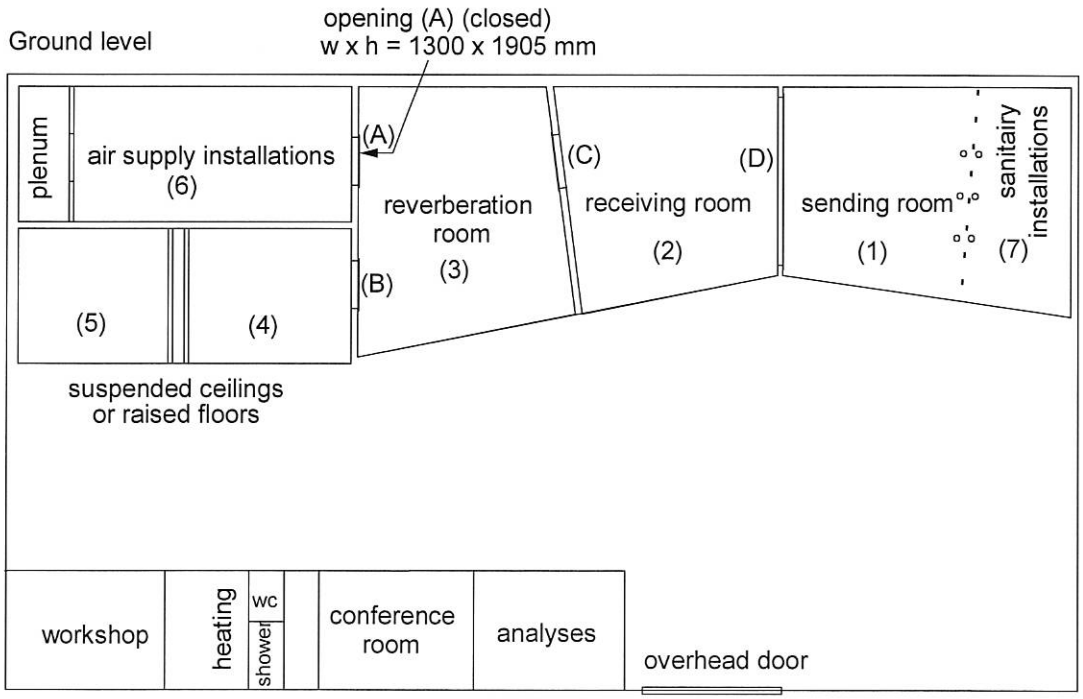
4.4 Results

The results of the measurements are given in table t4.2 to tabel t4.4 and in figure 3 up and including 12. 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.

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

OVERVIEW





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 m^3

total area S_t (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.

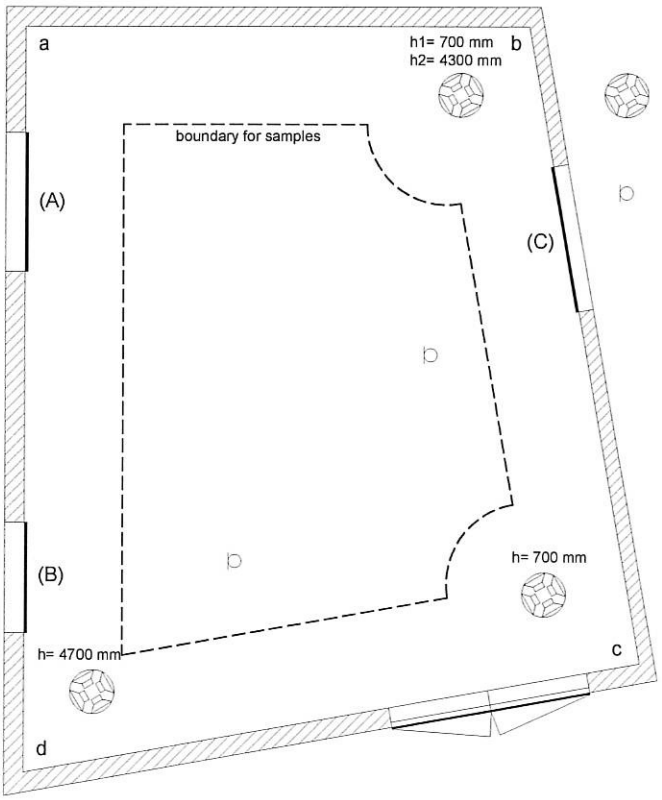
reverberation time of the empty reverberation room during measurements of 09-05-2016

frequency (1/1 oct.)	125	250	500	1000	2000	4000	Hz
reverberationtime	7,91	6,31	6,08	5,42	4,12	2,74	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



Absorb, versie 5.8.2 mode 7, file: a 2979 E#:1076-1111 T_i = 19,0 °C p_i = 101,5 kPa h_i = 50,9 %

figure 2

EQUIVALENT SOUNDABSORPTION AREA PER OBJECT conform ISO 354:2003

principal: BuzziSpace

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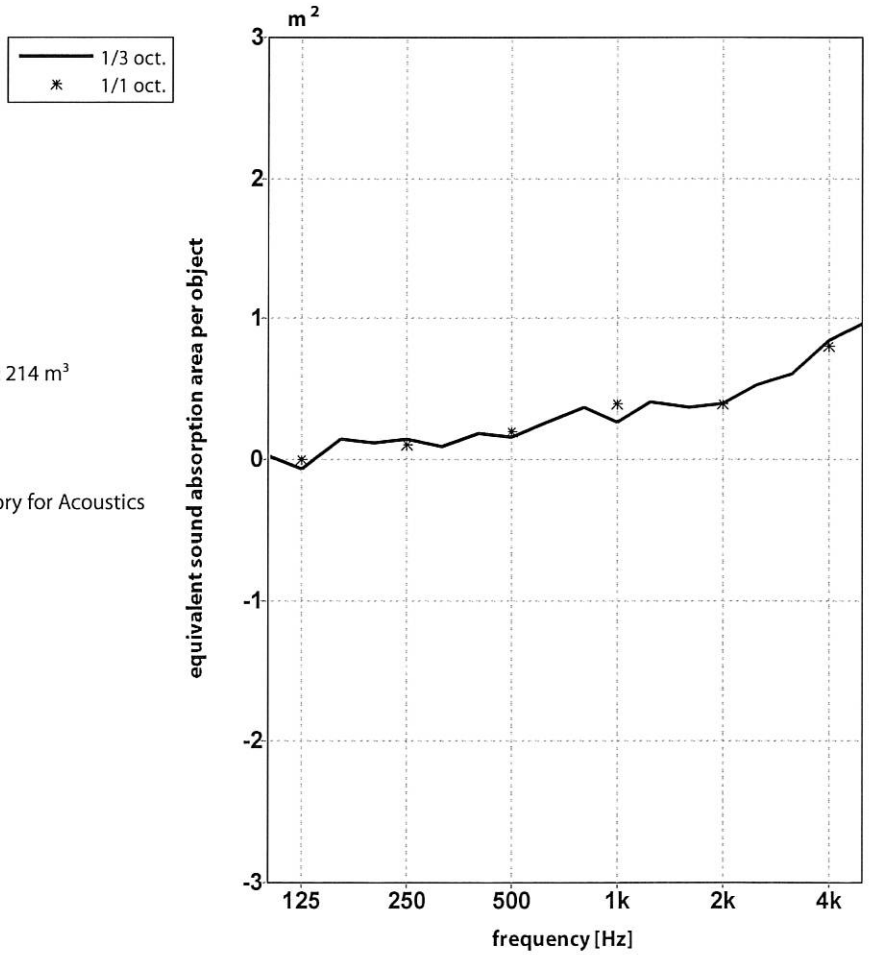
Variant 6: BuzziLight Mono L
dimensions: Ø 275 mm (on the top and bottom)
Ø 650 mm (middle)
height: 630 mm



volume reverberation room: 214 m³

number of elements: 1

measured at: Peutz Laboratory for Acoustics

signal: broad-band noise

bandwidth: 1/3 octave

	0,0	0,1	0,2	0,4	0,4	0,6	
1/3 oct.	-0,1	0,1	0,2	0,3	0,4	0,9	m²
	0,1	0,1	0,3	0,4	0,5	1,0	
1/1 oct.	**0,0**	**0,1**	**0,2**	**0,4**	**0,4**	**0,8**	**m²**

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RA

Mook, 09-05-2016

Absorb, versie 5.8.2 mode 9, PM: MH, file: a 2979 E#:1076-1111 F#:1334-1369 A#:1370 T_1 = 19,0 °C T_2 = 19,9 °C p_1 = 101,5 kPa p_2 = 101,5 kPa h_1 = 50,9 % h_2 = 49,4 %
A 2979-2E-RA-001 (ASE1A7D4-REMK)

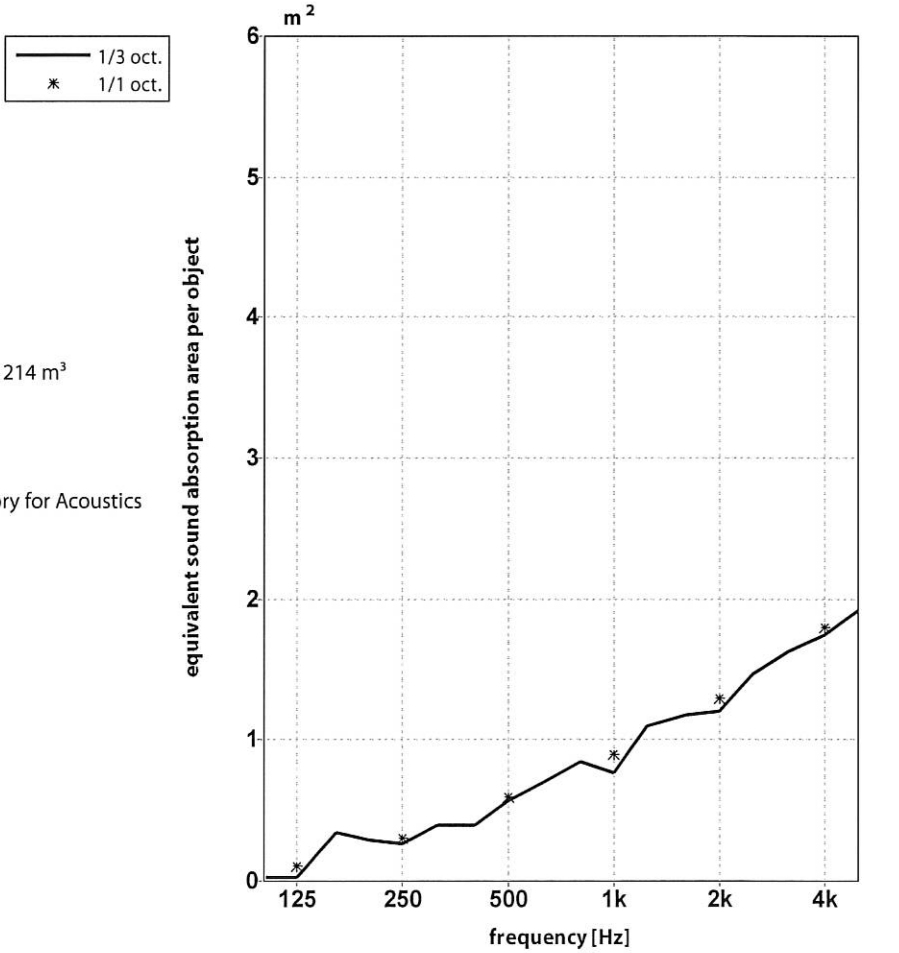
PEUTZ

EQUIVALENT SOUNDABSORPTION AREA PER OBJECT conform ISO 354:2003

TESTING
RvA L 334

principal: BuzziSpace

Variant 7: BuzziLight Mono XL High
dimensions: Ø 410 mm (on the top and bottom)
Ø 850 mm (middle)
height: 930 mm



volume reverberation room: 214 m³

number of elements: 1

measured at: Peutz Laboratory for Acoustics

signal: broad-band noise

bandwidth: 1/3 octave

	0,0	0,3	0,4	0,8	1,2	1,6	
1/3 oct.	0,0	0,3	0,6	0,8	1,2	1,8	m²
	0,3	0,4	0,7	1,1	1,5	1,9	
1/1 oct.	**0,1**	**0,3**	**0,6**	**0,9**	**1,3**	**1,8**	**m²**

RA

Mook, 09-05-2016

Absorb, versie 5.8.2 mode 9, PM: MH, file: a 2979 E#:1076-1111 F#:1445-1480 A#:1481 T_1 = 19,0 °C T_2 = 19,6 °C p_1 = 101,5 kPa p_2 = 101,5 kPa h_1 = 50,9 % h_2 = 50,1 %