PEUTZ

Laboratory for Acoustics

TESTING
RvA L 334

Determination of the sound absorption (reverberation room method) of ceiling panels type Nittobu Graphite Soprano B, manufacturer Hecht & Efraim

Report number A 3974-2E-RA-001 d.d. May 26, 2021

Laboratory for Acoustics

Determination of the sound absorption (reverberation room method) of ceiling panels type Nittobu Graphite Soprano B, manufacturer Hecht & Efraim

Principal	Hecht & Efraim Ltd.
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Reference	TS/TS/DJ/A 3974-2E-RA-001
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1 Introduction

At the request of Hecht & Efraim Ltd. based in HOLON (ISRAEL), laboratory measurements of the sound absorption (reverberation room method) were carried out on:

ceiling panels type Nittobu Graphite Soprano B ,
manufacturer Hecht & Efraim

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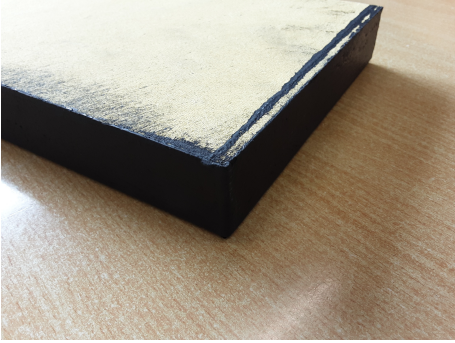
EA: "Certificates and reports issued by bodies accredited by MLA and MRA members are considered to have the same degree of credibility, and are accepted in MLA and MRA countries."

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 constructions

The data presented here were taken from the information supplied by the principal. The density of the materials as reported is derived from the actual weighing by the laboratory staff of the materials under test.

The following ceiling panels have been tested.

Type	Nittobu Graphite Soprano B	*view side*
Manufacturer	Hecht & Efraim Ltd.	
Material	Glass wool	
Finish front	smooth black painted glass-tissue	
Finish rear	glass-tissue	
Panel sizes:	1200 mm x 600 mm	
Thickness:	40 mm	
Mass:	4,58 kg/m^2 (weighted)	*rear side*

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 measured in following 3 different measurement set-ups:

1. directly on the floor of the reverberation room;
2. on a (unfilled) 20 mm air cavity;
3. on a support structure with a total construction height of 200 mm (160 mm cavity).

Set-up 1 and 2 are according to mounting type A and set-up 3 is according to mounting type E-200 according to ISO 354:2003. The facing side of the panels was up. The sides of the set-up were enclosed by 18 mm thick plastic covered chip-wood board and sealed by tape.

f1   Mounting setups

mounting type A

mounting type E-200
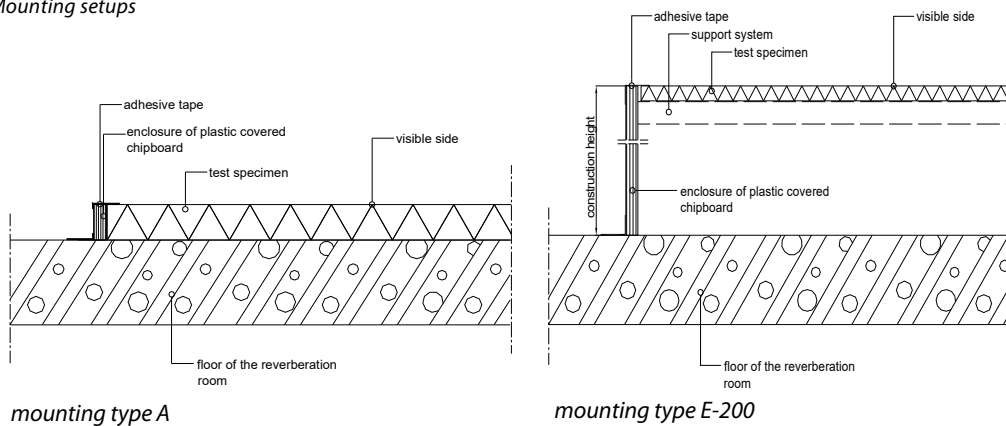
4.2 Method

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]

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

(2)

in which:

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

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

(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

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

(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

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

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:

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

in which:
S   =   the area of the test specimen   [m^2]

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 May 6th, 2021*

reverberation room	temperature [°C]	barometric pressure [kPa]	relative humidity [%]
empty	14,7	100,4	49,3
occupied	14,8-15,3	100,4	49,9-54,0

4.5 Results

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

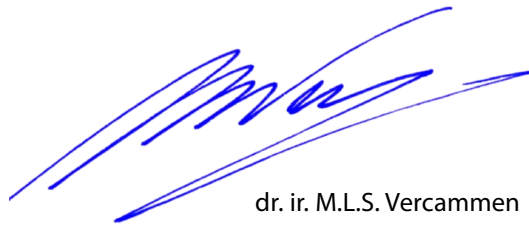t4.2 *Measurement results 40 mm Nittobu Graphite Soprano B panels*

	sound absorption coefficient α_s					
Variant nr.	1		2		3	
Air cavity	0 mm		20 mm		160 mm	
record nr.	#73		#110		#147	
See figure	3		4		5	
frequency [Hz]	1/3 oct.	1/1 oct.	1/3 oct.	1/1 oct.	1/3 oct.	1/1 oct.
100	0,08		0,11		0,34	
125	0,16	0,17	0,22	0,24	0,43	0,47
160	0,28		0,38		0,64	
200	0,38		0,41		0,57	
250	0,59	0,59	0,68	0,64	0,71	0,70
315	0,80		0,84		0,83	
400	0,89		0,92		0,90	
500	0,91	0,92	0,92	0,92	0,89	0,88
630	0,95		0,92		0,85	
800	1,01		0,98		0,89	
1000	1,00	1,01	0,99	0,98	0,97	0,95
1250	1,02		0,98		1,00	
1600	1,02		1,01		1,02	
2000	1,02	1,02	1,00	1,00	1,05	1,03
2500	1,02		1,00		1,02	
3150	1,06		1,07		1,08	
4000	1,01	1,04	1,02	1,04	1,05	1,06
5000	1,04		1,04		1,04	
α_w	0,90		0,90		0,95	
SAA	0,88		0,89		0,89	

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.
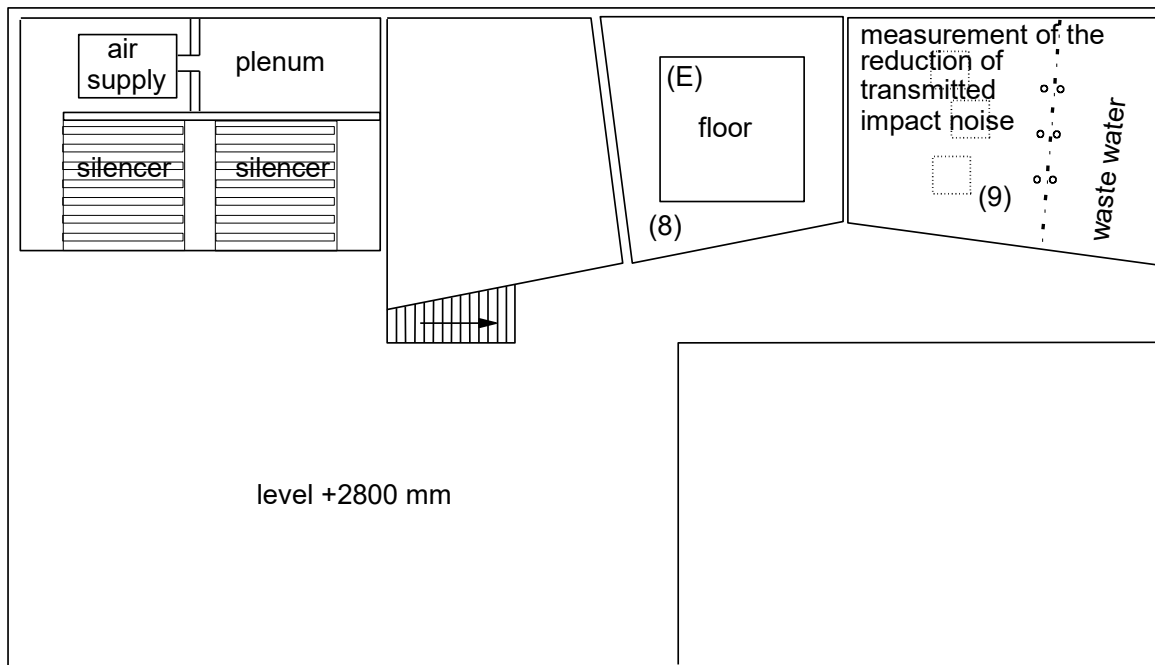
Mook,

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)

sanitairy installations

reverberation room (3)

receiving room (2)

sending room (1)

(7)

(B)

(5) | (4)

suspended ceilings or raised floors

workshop | heating | wc | shower | conference room | analyses

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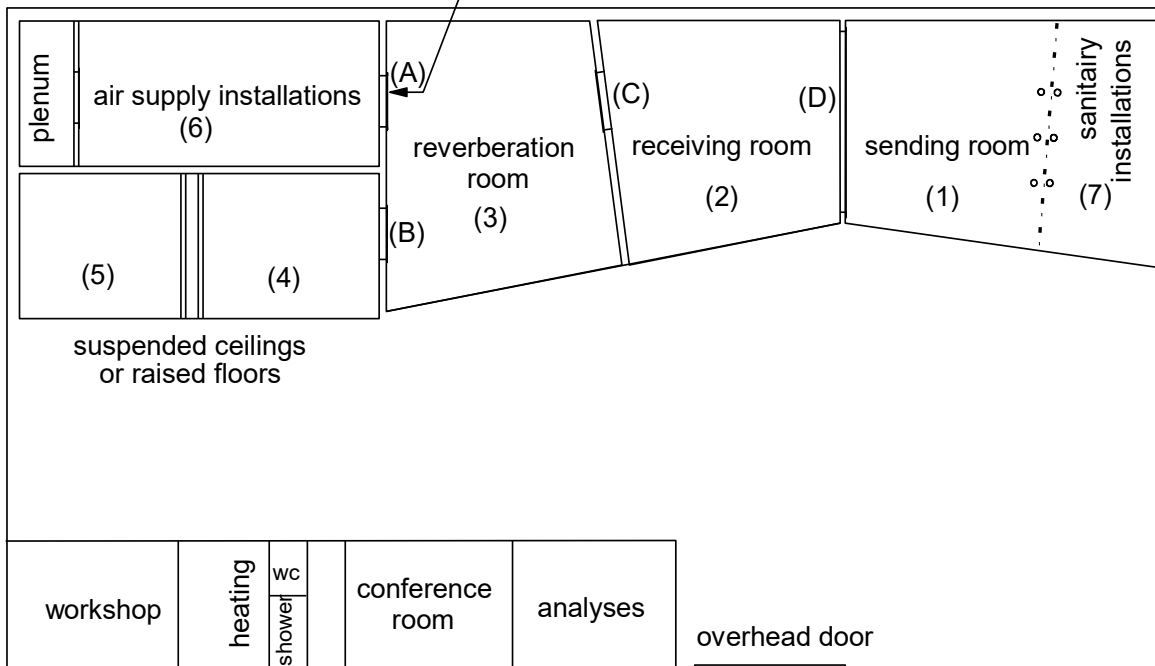
TEST OPENINGS (w x h in mm)
(B) 1000 x 2200
(C) 1500 x 1250
(D) 4300 x 2800
(E) 4000 x 4000

0 1 2 3 4 5 m
scale

LABORATORY FOR ACOUSTICS
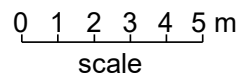
PEUTZ

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
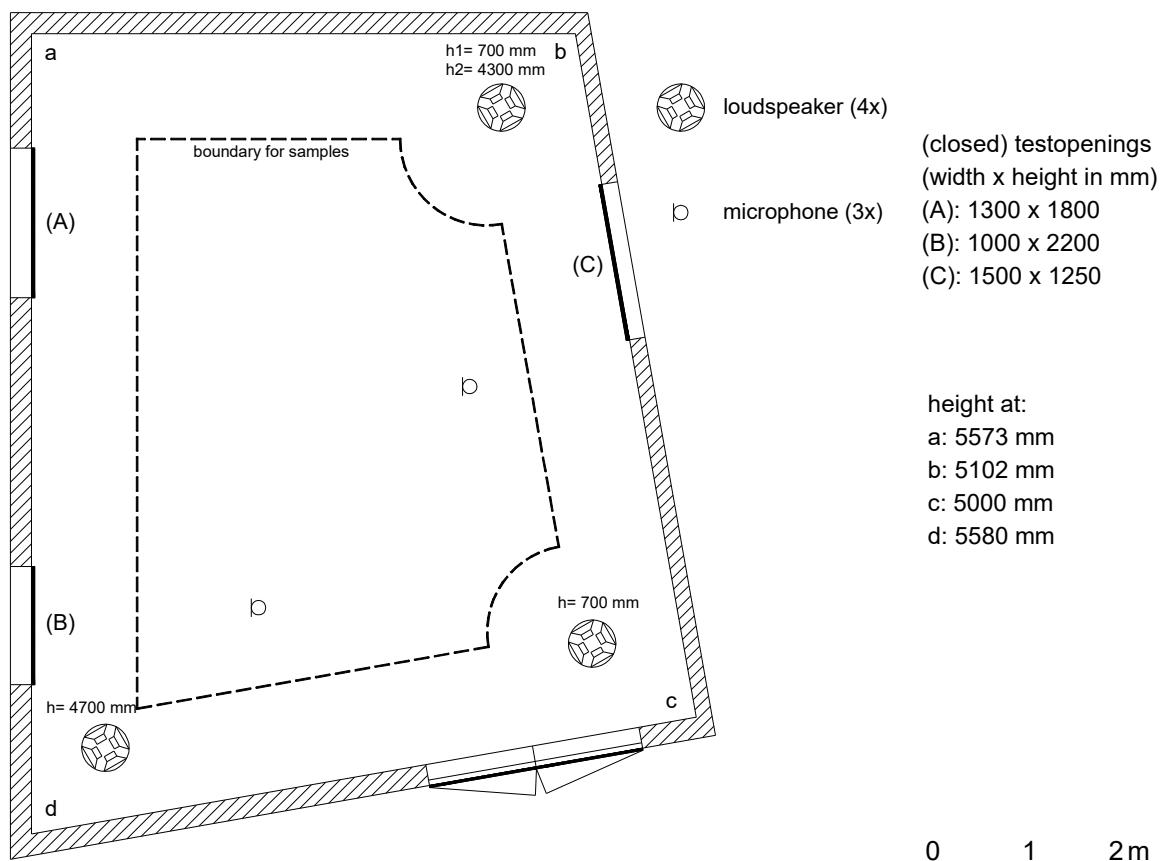sufficient diffusion has been gained.

reverberation time of the empty reverberation room during measurements of 06-05-2021

frequency (1/1 oct.)	125	250	500	1000	2000	4000	Hz
reverberationtime	9,13	7,42	6,99	6,37	4,57	2,67	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

a

h1= 700 mm
h2= 4300 mm
b

boundary for samples

(A)

(B)

h= 4700 mm

h= 700 mm

c

d

loudspeaker (4x)

microphone (3x)

(C)

(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: a3974   E#:1-36   T$_1$ = 14,7 °C p$_1$ = 100,4 kPa h$_1$ = 49,3 %

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Figure 2

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PEUTZ

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

principal: Hecht & Efraim

Variant 1; 40 mm Nittobu Graphite Soprano B panels directly on the floor

adhesive tape
test specimen
floor of the reverberation room

volume reverberation room: 214 m³

surface area sample: 10,8 m²

heigth of the construction: 0,040 m

measured at: Peutz Laboratory for Acoustics

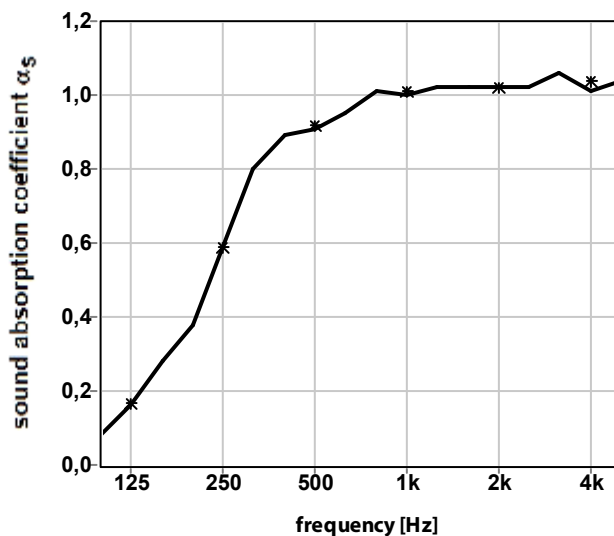signal: broad-band noise

bandwidth: 1/3 octave

α_w (ISO 11654) = 0,90

SAA (ASTM - C423) = 0,88

— 1/3 oct.
✳ 1/1 oct.

	125	250	500	1k	2k	4k
	0,08	0,38	0,89	1,01	1,02	1,06
1/3 oct.	0,16	0,59	0,91	1,00	1,02	1,01
	0,28	0,80	0,95	1,02	1,02	1,04
1/1 oct.	**0,17**	**0,59**	**0,92**	**1,01**	**1,02**	**1,04**

publication is permitted for the entire page only

Mook, measured at 06-05-2021

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figure 3

Absorb, versie 5.9 mode 7, PM: JK, file: a3974   E#:1-36   F#:37-72   A#:73   T₁ = 14,7°C   T₂ = 14,8°C   p₁ = 100,4 kPa   p₂ = 100,4 kPa   h₁ = 49,3 %   h₂ = 54,0 %

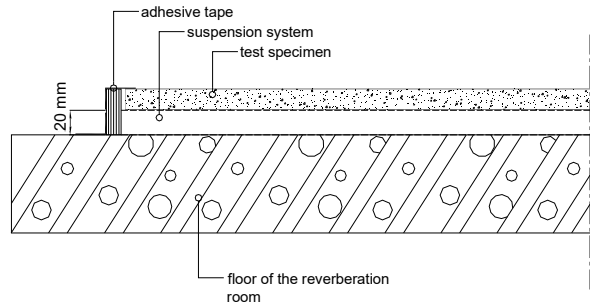A 3974-2E-RA-001 /E9f1B86E/ THEO

LABORATORY FOR ACOUSTICS

PEUTZ

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

principal: Hecht & Efraim

Variant 2; 40 mm Nittobu Graphite Soprano B panels on 20 mm cavity

adhesive tape
suspension system
test specimen
20 mm
floor of the reverberation room

volume reverberation room: 214 m^3

surface area sample: 10,8 m^2

heigth of the construction: 0,060 m
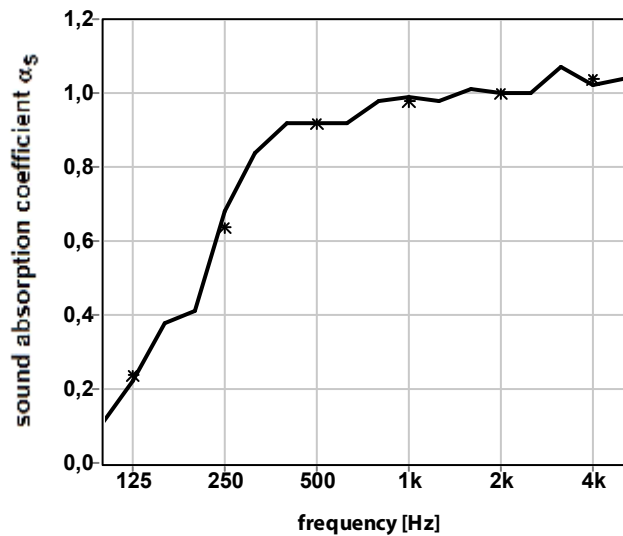
measured at: Peutz Laboratory for Acoustics

signal: broad-band noise

bandwidth: 1/3 octave

α$_w$ (ISO 11654) = 0,90

SAA (ASTM - C423) = 0,89

— 1/3 oct.
✳ 1/1 oct.

	125	250	500	1k	2k	4k
	0,11	0,41	0,92	0,98	1,01	1,07
1/3 oct.	0,22	0,68	0,92	0,99	1,00	1,02
	0,38	0,84	0,92	0,98	1,00	1,04
1/1 oct.	**0,24**	**0,64**	**0,92**	**0,98**	**1,00**	**1,04**

publication is permitted for the entire page only

Mook, measured at 06-05-2021

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figure 4

Absorb, versie 5.9 mode 7, PM: JK, file: a3974   E#:1-36   F#:74-109   A#:110   T$_1$ = 14,7°C   T$_2$ = 15,3 °C   p$_1$ = 100,4 kPa   p$_2$ = 100,4 kPa   h$_1$ = 49,3 %   h$_2$ = 50,8 %
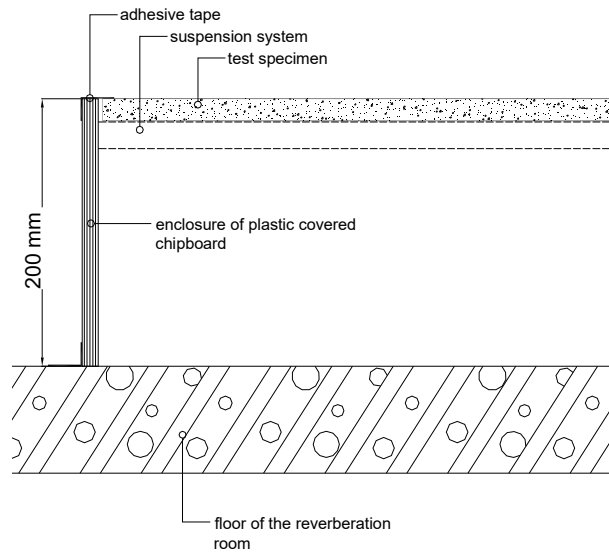
A 3974-2E-RA-001 /E9118B6E/ THEO

LABORATORY FOR ACOUSTICS

PEUTZ

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

principal: Hecht & Efraim

Variant 3; 40 mm Nittobu Graphite Soprano B panels on 160 mm cavity

- adhesive tape
- suspension system
- test specimen

200 mm

enclosure of plastic covered chipboard

floor of the reverberation room

— 1/3 oct.
✳ 1/1 oct.

volume reverberation room: 214 m³

surface area sample: 10,8 m²

heigth of the construction: 0,200 m

measured at: Peutz Laboratory for Acoustics

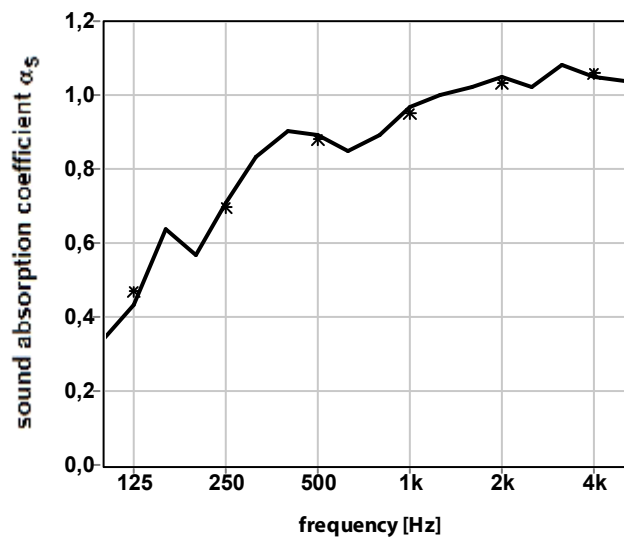signal: broad-band noise

bandwidth: 1/3 octave

α_w (ISO 11654) = 0,95

SAA (ASTM - C423) = 0,89

	125	250	500	1k	2k	4k
	0,34	0,57	0,90	0,89	1,02	1,08
1/3 oct.	0,43	0,71	0,89	0,97	1,05	1,05
	0,64	0,83	0,85	1,00	1,02	1,04
1/1 oct.	**0,47**	**0,70**	**0,88**	**0,95**	**1,03**	**1,06**

Left margin: T₁ = 14,7 °C T₂ = 15,3 °C p₁ = 100,4 kPa p₂ = 100,4 kPa h₁ = 49,3 % h₂ = 49,9 %
E#:1-36 F#:111-146 A#:147
Absorb, versie 5.9 mode 7, PM: JK, file: a3974
A 3974-2E-RA-001 /E9/1BB6/ THEO

publication is permitted for the entire page only

Mook, measured at 06-05-2021

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figure 5