



Laboratory for Acoustics



Determination of the sound absorption (reverberation room method) of Integra Feltline and Feltline Climate Ceiling Systems, manufactured by Integra Metal Ceiling Systems B.V.



Laboratory for Acoustics

Determination of the sound absorption (reverberation room method) of Integra Feltline and Feltline Climate Ceiling Systems, manufactured by Integra Metal Ceiling Systems B.V.

Principal	DNS International Postbus 4042 4900 CA OOSTERHOUT
	and
	INTEGRA Metal Ceiling System B.V. Rak 222, 1551 NA WESTZAAN
Report number	A 3855-4E-RA-001
Date	9 April 2021
Reference	TS/MH/DJ/A 3855-4E-RA-001
Representative	Th.W. Scheers
Author	M.L.H. Hax +31 85 82 28 689 m.hax@peutz.nl

peutz bv, postbus 66, 6585 zh mook, +31 85 822 86 00, info@peutz.nl, www.peutz.nl

All orders are accepted and executed according to 'De Nieuwe Regeling 2011' (The New Rules)

BTW NL004933837B01 KvK: 12028033

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

Table of contents

1	Introduction	4
2	Standards and guidelines	5
3	Tested construction	6
4	Measurements	9
4.1	Method	9
4.2	Accuracy	10
4.3	Environmental conditions during the measurements	11
4.4	Results	11

1 Introduction

At the request of DNS International based in Oosterhout and INTEGRA Metal Ceiling System B.V. based in Westzaan (The Netherlands), laboratory measurements of the sound absorption (reverberation room method) were carried out on:

**Integra Feltline and Feltline Climate Ceiling Systems,
manufactured by Integra Metal Ceiling Systems B.V.**

in the Laboratory for Acoustics of Peutz bv, at Mook, the Netherlands (see figure 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: European Accreditation Organisation MultiLateral Agreement**: <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 Standards and guidelines

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

ISO 354:2003¹ Acoustics Measurement of sound absorption in a reverberation room
NOTE: this international standard has been accepted within all EU-countries
 as European standard EN ISO 354:2003

Various other related norms:

EN 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 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 construction

The test specimen is placed directly at the floor of the reverberation room by the principal.

Felt panels

Feltline 40x55-40-9

Felt panels on a structure c.t.c: 80 mm

width: 40 mm

height: 55 mm

joint width: 40 mm

thickness: 9 mm



Feltline 40x55-100-6

Felt panels on a structure c.t.c: 140 mm

width: 40 mm

height: 55 mm

joint width: 100 mm

thickness: 6 mm



Ceiling panel

Elapto Panels

Manufacturer: INTEGRA Metal Ceiling System B.V.

Type: Lay-in Flat Elapto Panel

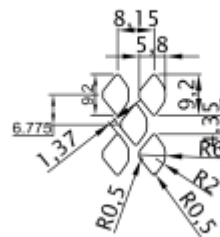
Material: Painted metal sheet with backing fleece

Thickness: 1 mm

Height of panel: 40 mm

panel dimensions: 1200 mm x 600 mm

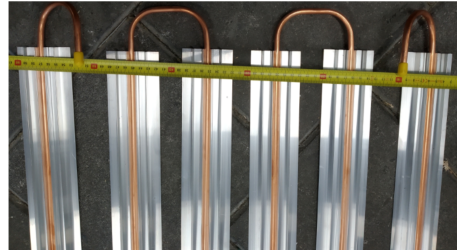
perforation rate: 9.2x5,8 % 62,2 (see perforation pattern)



Activation ceiling panel

Meander

pipelines activation:	copper pipelines Ø 8 mm
number of strips:	6
material strips:	aluminium
dimensions strips:	1050 x 70 mm
c.t.c pipelines:	100 mm
thickness strips:	1,5 mm



Mineral wool

Nofisol Seal S100/20

Sealed stonewool

dimensions:	1200 mm x 600 mm
thickness:	20 mm
mass:	2,15 kg/m ² / 107,5 kg/m ³



Nylon Wrapped Rockwool

dimensions:	1150 mm x 580 mm
thickness:	30 mm
mass:	1,35 kg/m ² / 45,0 kg/m ³ (weighted)
nominal mass:	40 kg/m ³

Using the described materials, the following variants were measured (facing side → floor):

- Variant 1: Feltline 40x55-40-9, Build-up height: 200 mm
- Variant 2:
 1. Feltline 40x55-40-9
 2. Nofisol Seal S100/20, Build-up height: 200 mm
- Variant 3:
 1. Feltline 40x55-100-6
 2. Nofisol Seal S100/20, Build-up height: 200 mm
- Variant 4:
 1. Elapto; 12 panels with Meander, 3 panels without Meander
 2. Nylon Wrapped Rockwool, Build-up height: 150 mm
- Variant 4B:
 1. Elapto; 12 panels with Meander, 3 panels without Meander
 2. Nylon Wrapped Rockwool, Build-up height: 200 mm
- Variant 5:
 1. Feltline 40x55-40-9
 2. Elapto; 12 panels with Meander, 3 panels without Meander
 3. Nylon Wrapped Rockwool, Build-up height: 200 mm
- Variant 6: Elapto; 12 panels with Meander, 3 panels without Meander, Build-up height: 200 mm
- Variant 7:
 1. Elapto; (100% passive/without Meander)
 2. Nylon Wrapped Rockwool, Build-up height: 200 mm
- Variant 8: Elapto; (100% passive/without Meander), Build-up height: 200 mm



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

The ceiling systems to be measured (see chapter 3) are mounted on a support structure at a distance of 150 or 200 mm above the floor of the reverberation room, the facing side of the panels was up (Type E mounting according to ISO 354:2003).

No suspension-system has been used, the panels were put tight to each other. The sides of the set-up were enclosed by 18 mm thick plastic covered chipwood board and sealed by tape.

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 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

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

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 A_2 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

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

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	19,7	101,8	66
With material	19,7 – 20,1	101,7 – 101,9	78 – 82

4.4 Results

The results of the measurements are given in table 4.2 to 4.4 and in figure 3 up and including figure 11. 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.

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 2500 Hz, rounded to the nearest 0,01.
- the sound absorption class according to ISO 11654

t4.2 Measurement results

	sound absorption coefficient α_s					
variant nr.	1		2		3	
build-up (facing side → floor)	Feltline 40x55-40-9		1. Feltline 40x55-40-9 2. Nofisol Seal S100/20		1. Feltline 40x55-100-6 2. Nofisol Seal S100/20	
build-up height	200mm		200 mm		200 mm	
record nr.	#1961		#1998		#2035	
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	0,02		0,16		0,16	
125	0,08	0,08	0,36	0,35	0,36	0,34
160	0,14		0,53		0,51	
200	0,18		0,61		0,54	
250	0,29	0,28	0,84	0,80	0,76	0,73
315	0,38		0,94		0,88	
400	0,53		1,00		0,99	
500	0,53	0,53	0,94	0,99	0,96	0,98
630	0,53		1,03		1,00	
800	0,49		1,05		1,00	
1000	0,49	0,56	1,04	1,03	0,98	0,98
1250	0,71		1,00		0,95	
1600	0,79		0,96		0,92	
2000	0,81	0,83	1,00	0,99	0,99	0,98
2500	0,90		1,01		1,03	
3150	0,94		1,01		1,05	
4000	0,98	0,97	1,02	1,02	1,02	1,02
5000	0,99		1,03		0,98	
α_w	0,55(H)		1,00		1,00	
SAA	0,55		0,95		0,92	
Class	D		A		A	

t4.3 Measurement results

	sound absorption coefficient α_s					
variant nr. build-up (facing side → floor)	4 1. Elapto Panels 12 panels with Meander, 3 panels without Meander 2. Nylon Wrapped Rockwool		4B 1. Elapto Panels 12 panels with Meander, 3 panels without Meander 2. Nylon Wrapped Rockwool		5 1. Feltline 40x55-40-9 2. Elapto Panels 12 panels with Meander, 3 panels without Meander 3. Nylon Wrapped Rockwool	
build-up height	150		200		200	
record nr.	#2072		#2146		#2109	
figure nr.	6		7		8	
frequency [Hz]	1/3 oct.	1/1 oct.	1/3 oct.	1/1 oct.	1/3 oct.	1/1 oct.
100	0,18		0,22		0,16	
125	0,35	0,38	0,49	0,46	0,44	0,43
160	0,60		0,67		0,70	
200	0,57		0,59		0,72	
250	0,82	0,76	0,84	0,78	0,95	0,88
315	0,90		0,91		0,98	
400	0,96		0,93		0,99	
500	0,95	0,95	0,88	0,89	0,98	0,99
630	0,94		0,87		0,99	
800	0,83		0,78		1,01	
1000	0,78	0,80	0,80	0,81	1,03	1,02
1250	0,80		0,85		1,02	
1600	0,80		0,80		0,98	
2000	0,77	0,75	0,77	0,76	0,94	0,96
2500	0,68		0,70		0,95	
3150	0,66		0,66		1,00	
4000	0,64	0,63	0,65	0,64	1,04	1,03
5000	0,60		0,60		1,05	
α_w	0,80		0,80		1,00	
SAA	0,82		0,81		0,96	
Class	B		B		A	

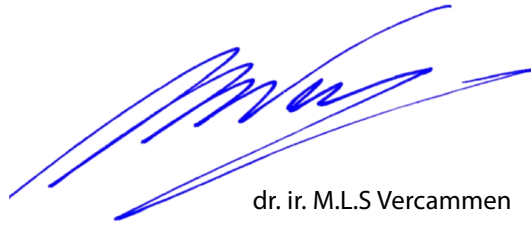
t4.4 Measurement results

	sound absorption coefficient α_s					
variant nr.	6		7		8	
build-up (facing side → floor)	Elapto Panels 12 panels with Meander, 3 panels without Meander		1. ElaptoPanels ; (100% passive/without Meander) 2. Nylon Wrapped Rockwool		Elapto Panels;(100% passive/without Meander)	
build-up height	200		200		200	
record nr.	#2183		#2220		#2257	
figure nr.	9		10		11	
frequency [Hz]	1/3 oct.	1/1 oct.	1/3 oct.	1/1 oct.	1/3 oct.	1/1 oct.
100	0,15		0,19		0,14	
125	0,22	0,24	0,36	0,37	0,18	0,19
160	0,35		0,56		0,26	
200	0,43		0,61		0,30	
250	0,61	0,58	0,83	0,78	0,44	0,43
315	0,69		0,91		0,55	
400	0,75		0,97		0,59	
500	0,73	0,71	0,92	0,93	0,62	0,61
630	0,66		0,90		0,61	
800	0,52		0,83		0,49	
1000	0,45	0,51	0,81	0,86	0,36	0,42
1250	0,55		0,94		0,42	
1600	0,54		0,94		0,53	
2000	0,52	0,54	0,95	0,93	0,48	0,51
2500	0,55		0,91		0,53	
3150	0,56		0,88		0,52	
4000	0,56	0,56	0,83	0,84	0,55	0,54
5000	0,56		0,81		0,54	
α_w	0,55(L)		0,95		0,50	
SAA	0,58		0,88		0,49	
Class	D		A		D	

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.



Th. Scheers
Laboratory Supervisor



dr. ir. M.L.S Vercammen
Manager

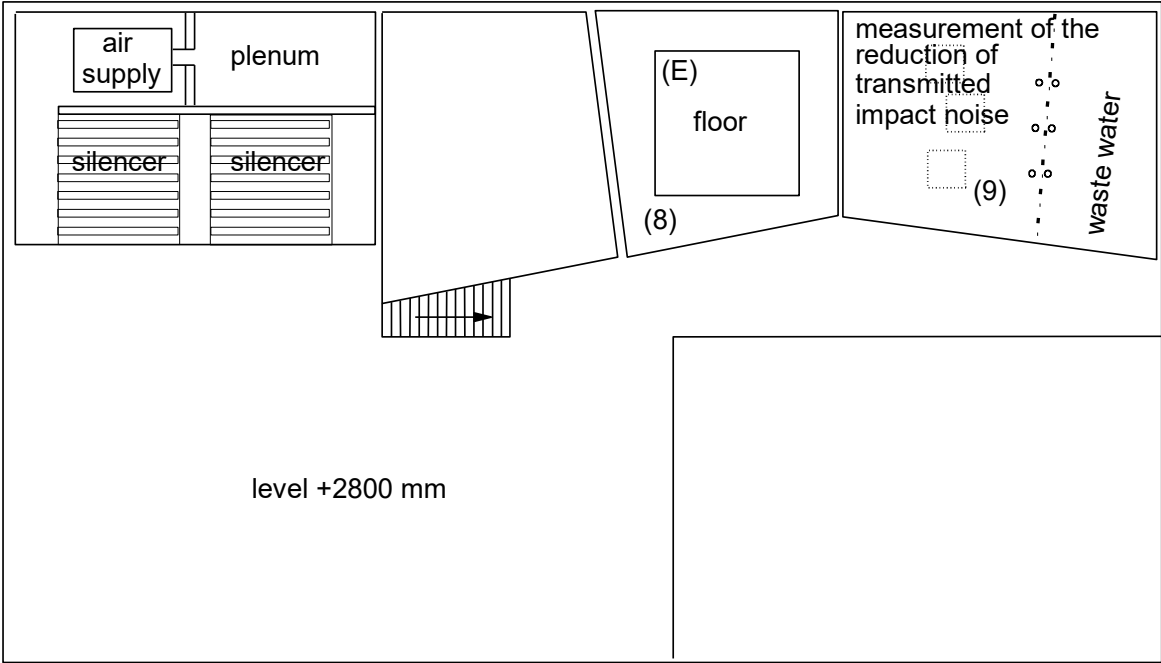
Mook,

This report contains 15 pages and 11 figures.

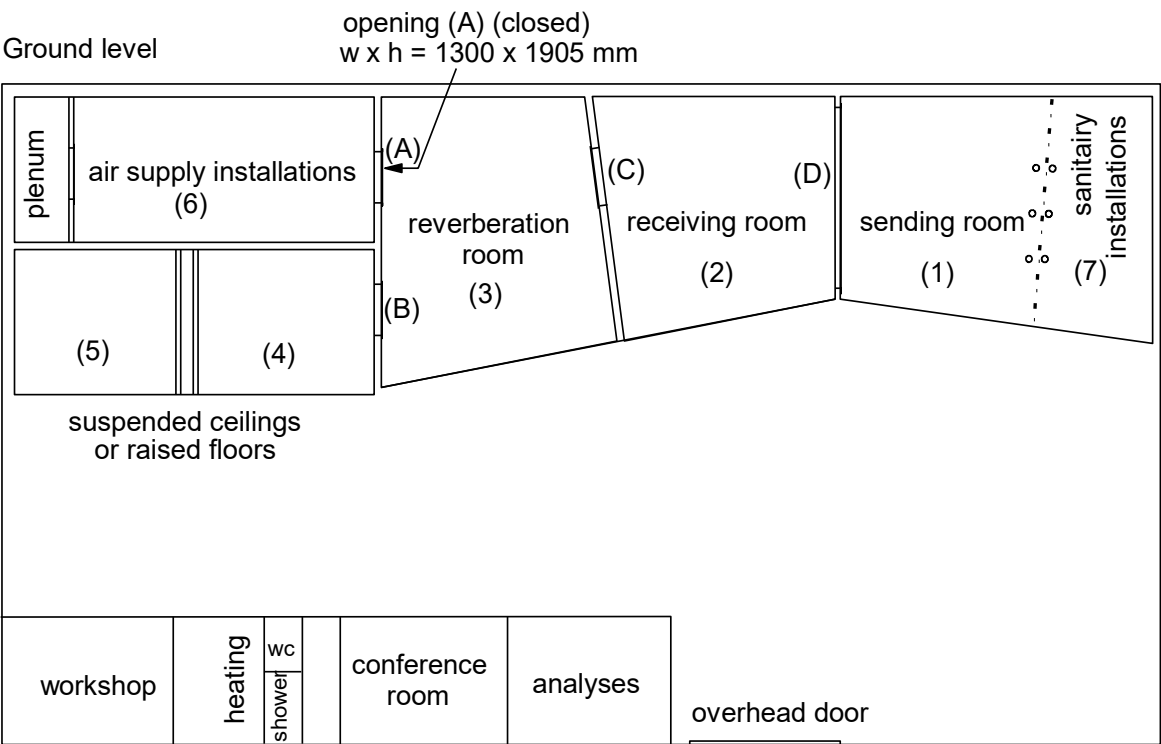
PEUTZ bv
Lindenlaan 41, NL-6584 AC MOLENHOEK (LB), THE NETHERLANDS

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

0 1 2 3 4 5 m
scale

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 St (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.

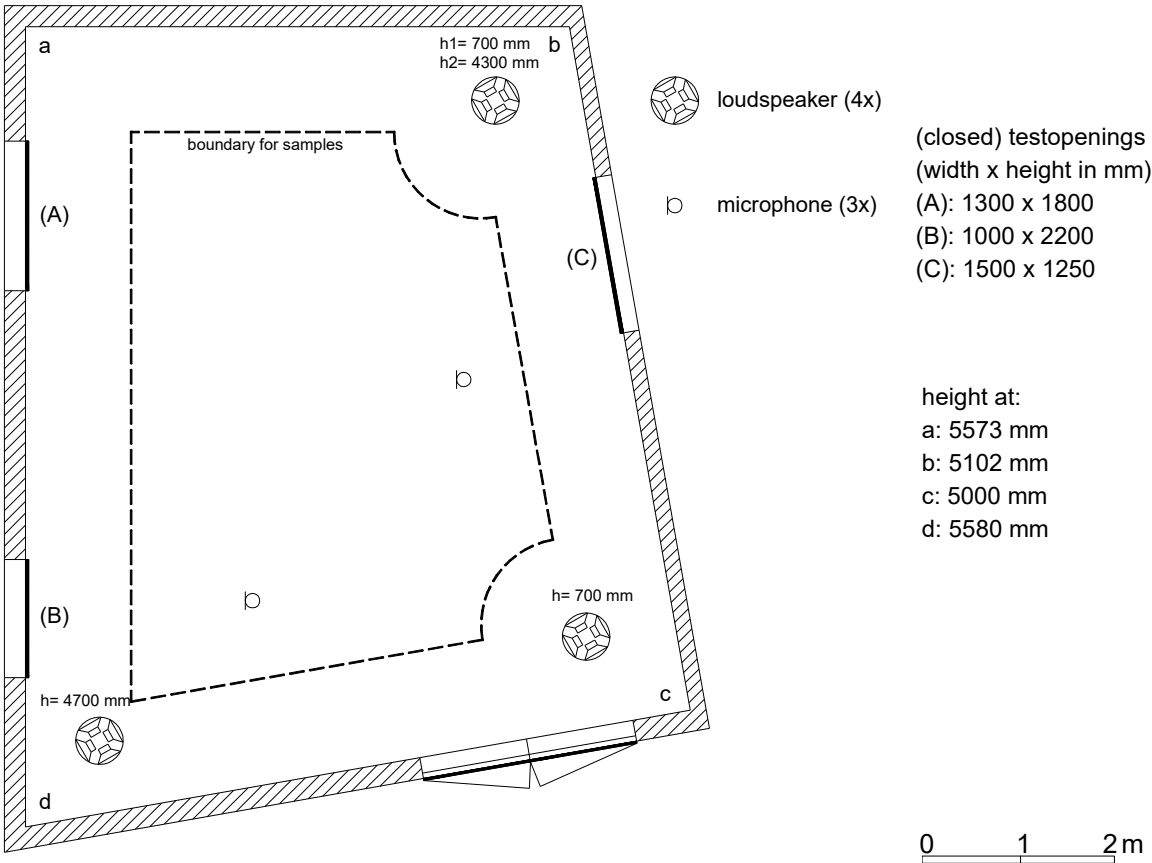
reverberation time of the empty reverberation room during measurements of 09-09-2020

frequency (1/1 oct.)	125	250	500	1000	2000	4000	Hz
reverberationtime	8,57	7,38	7,05	6,49	4,97	3,28	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



Absorb, versie 5.9 mode 7, file: a3855 E#:1667-1702 T₁ = 19,7 °C p₁ = 101,8 kPa h₁ = 65,9 %

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



principal: Integra

Variant 1 (facing side → floor):

Feltline 40x55-40-9, Build-up height: 200 mm

Feltline 40x55-40-9

Felt panels on a structure c.t.c: 80 mm

width: 40 mm

height: 55 mm

joint width: 40 mm

thickness: 9 mm



volume reverberation room: 214 m³

surface area sample: 10,8 m²

height of the construction: 0,200 m

measured at: Peutz Laboratory for Acoustics

signal: broad-band noise

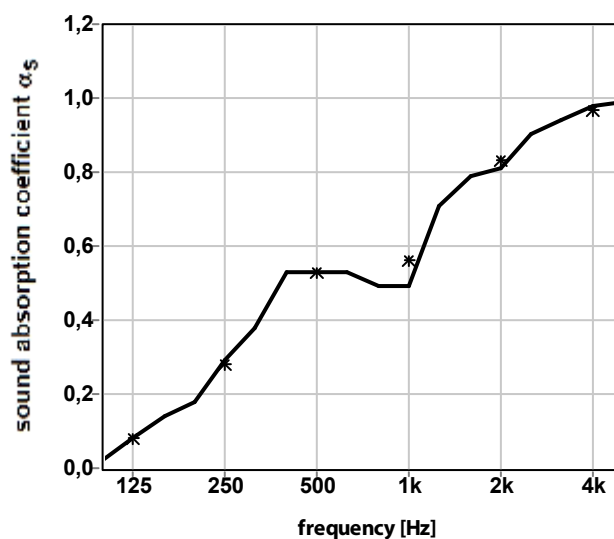
bandwidth: 1/3 octave

α_w (ISO 11654) = 0,55(H)

SAA (ASTM - C423) = 0,55

Class= D

— 1/3 oct.
* 1/1 oct.



	0,02	0,18	0,53	0,49	0,79	0,94
1/3 oct.	0,08	0,29	0,53	0,49	0,81	0,98
	0,14	0,38	0,53	0,71	0,90	0,99
1/1 oct.	0,08	0,28	0,53	0,56	0,83	0,97

publication is permitted for the entire page only

Mook, measured at 09-09-2020

A 3855-4E-RA

figure 3

Absorb, versie 5.9 mode 7, PM: RA, file: a3855 E#:1667-1702 F#:1925-1960 A#:1961 T₁ = 19,7 °C T₂ = 19,7 °C p₁ = 101,8 kPa p₂ = 101,9 kPa h₁ = 65,9 % h₂ = 78,1 %

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



principal: Integra

Variant 2 (facing side → floor):

1. Feltline 40x55-40-9
2. Nofisol Seal S100/20, Build-up height: 200 mm

Feltline 40x55-40-9

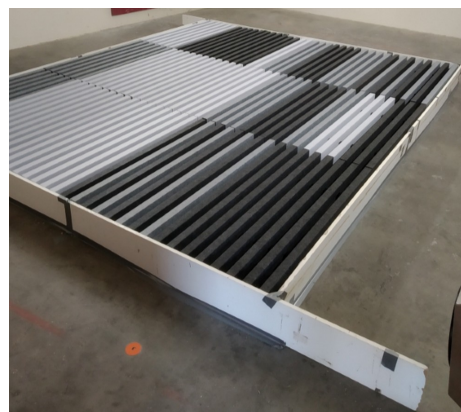
Felt panels on a structure c.t.c: 80 mm

width: 40 mm
height: 55 mm
joint width: 40 mm
thickness: 9 mm

Nofisol Seal S100/20

Sealed mineral wool

dimensions: 1200 mm x 600 mm
thickness: 20 mm
mass: 2,15 kg/m² / 107,5 kg/m³



volume reverberation room: 214 m³

surface area sample: 10,8 m²

height of the construction: 0,200 m

measured at: Peutz Laboratory for Acoustics

signal: broad-band noise

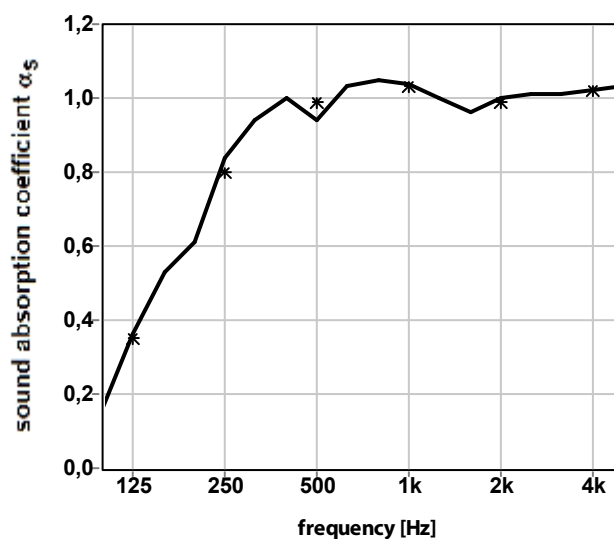
bandwidth: 1/3 octave

α_w (ISO 11654) = 1,00

SAA (ASTM - C423) = 0,95

Class= A

— 1/3 oct.
* 1/1 oct.



	0,16	0,61	1,00	1,05	0,96	1,01
1/3 oct.	0,36	0,84	0,94	1,04	1,00	1,02
	0,53	0,94	1,03	1,00	1,01	1,03
1/1 oct.	0,35	0,80	0,99	1,03	0,99	1,02

publication is permitted for the entire page only

Mook, measured at 09-09-2020

A 3855-4E-RA

figure 4

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



principal: Integra

Variant 3 (facing side → floor):

1. **Feltline 40x55-100-6**
2. **Nofisol Seal S100/20, Build-up height: 200 mm**

Feltline 40x55-100-6

Felt panels on a structure c.t.c: 140 mm

width: 40 mm
height: 55 mm
joint width: 100 mm
thickness: 6 mm

Nofisol Seal S100/20

Sealed mineral wool

dimensions: 1200 mm x 600 mm
thickness: 20 mm
mass: 2,15 kg/m² / 107,5 kg/m³



volume reverberation room: 214 m³

surface area sample: 10,8 m²

height of the construction: 0,200 m

measured at: Peutz Laboratory for Acoustics

signal: broad-band noise

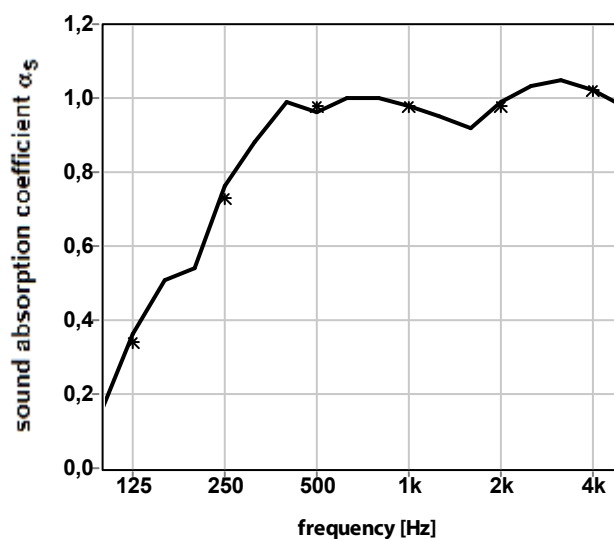
bandwidth: 1/3 octave

α_w (ISO 11654) = 1,00

SAA (ASTM - C423) = 0,92

Class= A

— 1/3 oct.
* 1/1 oct.



	0,16	0,54	0,99	1,00	0,92	1,05
1/3 oct.	0,36	0,76	0,96	0,98	0,99	1,02
	0,51	0,88	1,00	0,95	1,03	0,98
1/1 oct.	0,34	0,73	0,98	0,98	0,98	1,02

publication is permitted for the entire page only

Mook, measured at 09-09-2020

A 3855-4E-RA

figure 5

Absorb, versie 5.9 mode 7, PM: RA, file: a3855 E#:1667-1702 F#:1999-2034 A#:2035 T₁ = 19,7 °C T₂ = 20,0 °C p₁ = 101,8 kPa p₂ = 101,8 kPa h₁ = 65,9 % h₂ = 79,0 %

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



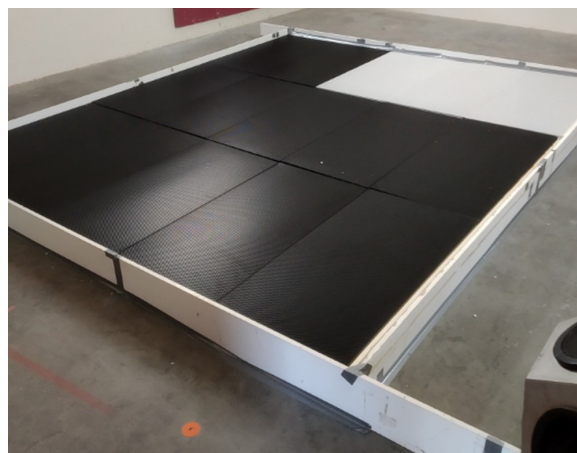
principal: Integra

Variant 4 (facing side → floor):

1. Elapto; 12 panels with Meander, 3 panels without Meander
2. Nylon wrapped Rockwool, Build-up height: 150 mm

Elapto Panels

Manufacturer: INTEGRA Metal Ceiling System B.V.
Type: Lay-in Flat Elapto Panel
Material: Painted metal sheet with backing fleece
Thickness: 1 mm
Height of panel: 40 mm
panel dimensions: 1200 mm x 600 mm
perforation rate: 9.2x5,8 % 62,2 (see perforation pattern)



Meander

pipelines activation: copper pipelines Ø 8 mm
number of strips: 6
material strips: aluminium
dimensions strips: 1050x 70 mm
c.t.c pipelines: 100 mm
thickness strips: 1,5 mm

Nylon wrapped Rockwool

Sealed mineral wool
dimensions: 1150 mm x 580 mm
thickness: 30 mm
mass: 1,35 kg/m² / 45,0 kg/m³

volume reverberation room: 214 m³

surface area sample: 10,7 m²

height of the construction: 0,150 m

measured at: Peutz Laboratory for Acoustics

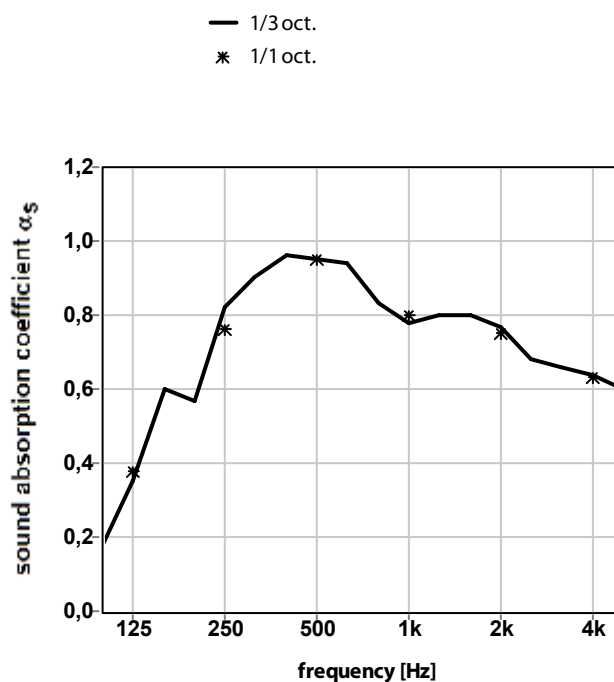
signal: broad-band noise

bandwidth: 1/3 octave

α_w (ISO 11654) = 0,80

SAA (ASTM - C423) = 0,82

Class= B



	0,18	0,57	0,96	0,83	0,80	0,66
1/3 oct.	0,35	0,82	0,95	0,78	0,77	0,64
	0,60	0,90	0,94	0,80	0,68	0,60
1/1 oct.	0,38	0,76	0,95	0,80	0,75	0,63

publication is permitted for the entire page only

Mook, measured at 09-09-2020

A 3855-4E-RA

figure 6

Absorb, versie 5.9 mode 7, PM: RA, file: a3855 E#:1667-1702 F#:2036-2071 A#:2072 T₁ = 19,7 °C T₂ = 20,1 °C p₁ = 101,8 kPa p₂ = 101,8 kPa h₁ = 65,9 % h₂ = 80,4 %

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



principal: Integra

Variant 4B (facing side → floor):

1. Elapto; 12 panels with Meander, 3 panels without Meander
2. Nylon wrapped Rockwool, Build-up height: 200 mm

Elapto Panels

Manufacturer: INTEGRA Metal Ceiling System B.V.
Type: Lay-in Flat Elapto Panel
Material: Painted metal sheet with backing fleece
Thickness: 1 mm
Height of panel: 40 mm
panel dimensions: 1200 mm x 600 mm
perforation rate: 9.2x5,8 % 62,2 (see perforation pattern)

Meander

pipelines activation: copper pipelines Ø 8 mm
number of strips: 6
material strips: aluminium
dimensions strips: 1050x 70 mm
c.t.c pipelines: 100 mm
thickness strips: 1,5 mm

Nylon wrapped Rockwool

Sealed mineral wool
dimensions: 1150 mm x 580 mm
thickness: 30 mm
mass: 1,35 kg/m² / 45,0 kg/m³

volume reverberation room: 214 m³

surface area sample: 10,7 m²

height of the construction: 0,200 m

measured at: Peutz Laboratory for Acoustics

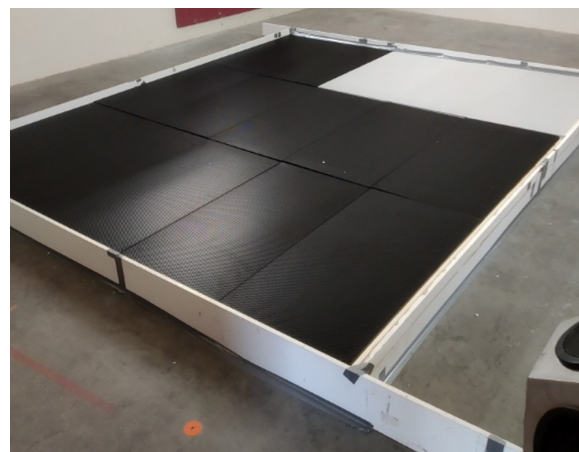
signal: broad-band noise

bandwidth: 1/3 octave

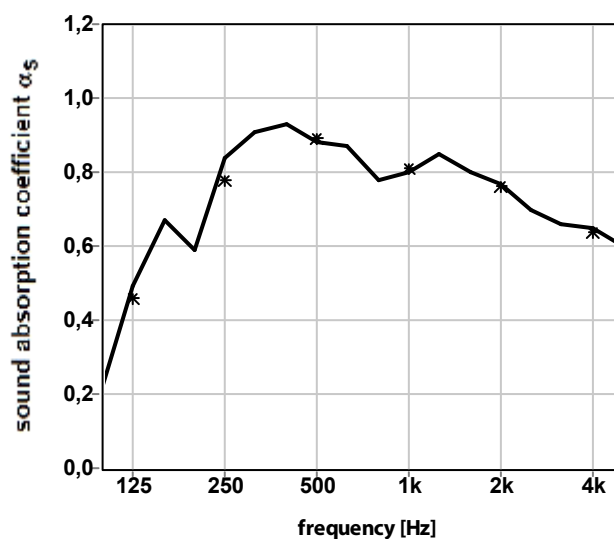
α_w (ISO 11654) = 0,80

SAA (ASTM - C423) = 0,81

Class= B



— 1/3 oct.
* 1/1 oct.



	0,22	0,59	0,93	0,78	0,80	0,66
1/3 oct.	0,49	0,84	0,88	0,80	0,77	0,65
	0,67	0,91	0,87	0,85	0,70	0,60
1/1 oct.	0,46	0,78	0,89	0,81	0,76	0,64

publication is permitted for the entire page only

Mook, measured at 09-09-2020

A 3855-4E-RA

figure 7

Absorb, versie 5.9 mode 7, PM: RA, file: a3855 E#:1667-1702 F#:2110-2145 A#:2146 T₁ = 19,7 °C T₂ = 20,0 °C p₁ = 101,8 kPa p₂ = 101,8 kPa h₁ = 65,9 % h₂ = 81,7 %

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



principal: Integra

Variant 5 (facing side → floor): mass:

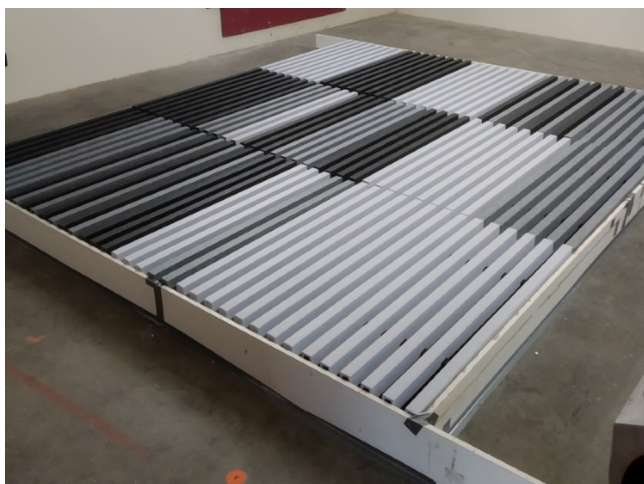
1. Feltline 40x55-40-9
2. Elapto; 12 panels with Meander, 3 panels without Meander
3. Nylon wrapped Rockwool, Build-up height: 200 mm

Feltline 40x55-40-9

Felt panels on a structure c.t.c: 80 mm
width: 40 mm
height: 55 mm
joint width: 40 mm
thickness: 9 mm

Elapto Panels

Manufacturer: INTEGRA Metal Ceiling System B.V.
Type: Lay-in Flat Elapto Panel
Material: Painted metal sheet with backing fleece
Thickness: 1 mm
Height of panel: 40 mm
panel dimensions: 1200 mm x 600 mm
perforation rate: 9.2x5,8 % 62,2 (see perforation pattern)



Meander

pipelines activation: copper pipelines Ø 8 mm
number of strips: 6
material strips: aluminium
dimensions strips: 1050x 70 mm
c.t.c pipelines: 100 mm
thickness strips: 1,5 mm

Nylon wrapped Rockwool

Sealed mineral wool
dimensions: 1150 mm x 580 mm
thickness: 30 mm
mass: 1,35 kg/m² / 45,0 kg/m³

volume reverberation room: 214 m³

surface area sample: 10,8 m²

height of the construction: 0,200 m

measured at: Peutz Laboratory for Acoustics

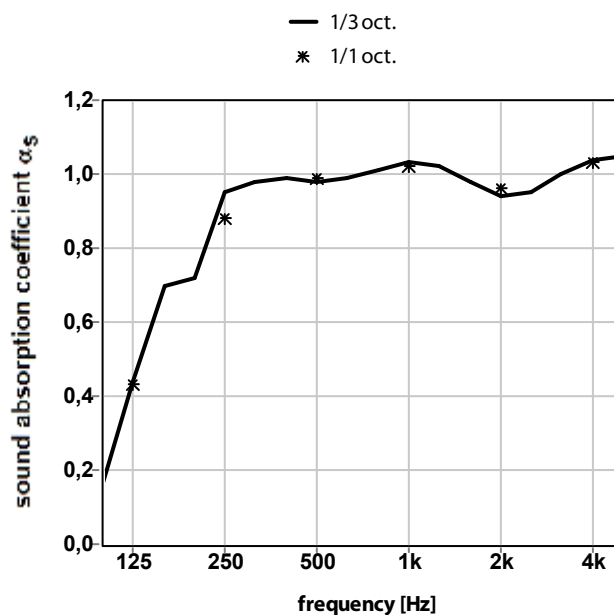
signal: broad-band noise

bandwidth: 1/3 octave

α_w (ISO 11654) = 1,00

SAA (ASTM - C423) = 0,96

Class= A



	0,16	0,72	0,99	1,01	0,98	1,00
1/3 oct.	0,44	0,95	0,98	1,03	0,94	1,04
	0,70	0,98	0,99	1,02	0,95	1,05
1/1 oct.	0,43	0,88	0,99	1,02	0,96	1,03

publication is permitted for the entire page only

Mook, measured at 09-09-2020

A 3855-4E-RA

figure 8

Absorb, versie 5.9 mode 7, PM: RA, file: a3855 E#:1667-1702 F#:2073-2108 A#:2109 T₁ = 19,7 °C T₂ = 20,0 °C p₁ = 101,8 kPa p₂ = 101,8 kPa h₁ = 65,9 % h₂ = 80,9 %

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



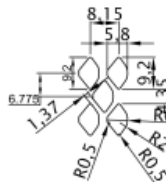
principal: Integra

Variant 6 (facing side → floor):

Elapto; 12 panels with Meander, 3 panels without Meander, Build-up height: 200 mm

Elapto Panels

Manufacturer: INTEGRA Metal Ceiling System B.V.
Type: Lay-in Flat Elapto Panel
Material: Painted metal sheet with backing fleece
Thickness: 1 mm
Height of panel: 40 mm
panel dimensions: 1200 mm x 600 mm
perforation rate: 9.2x5,8 % 62,2 (see perforation pattern)



Meander

pipelines activation: copper pipelines Ø 8 mm
number of strips: 6
material strips: aluminium
dimensions strips: 1050x 70 mm
c.t.c pipelines: 100 mm
thickness strips: 1,5 mm

volume reverberation room: 214 m³

surface area sample: 10,7 m²

height of the construction: 0,200 m

measured at: Peutz Laboratory for Acoustics

signal: broad-band noise

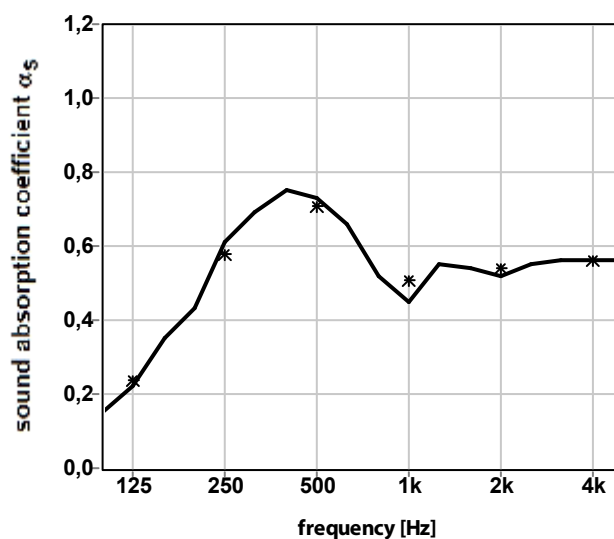
bandwidth: 1/3 octave

α_w (ISO 11654) = 0,55(L)

SAA (ASTM - C423) = 0,58

Class= D

— 1/3 oct.
* 1/1 oct.



	0,15	0,43	0,75	0,52	0,54	0,56
1/3 oct.	0,22	0,61	0,73	0,45	0,52	0,56
	0,35	0,69	0,66	0,55	0,55	0,56
1/1 oct.	0,24	0,58	0,71	0,51	0,54	0,56

publication is permitted for the entire page only

Mook, measured at 09-09-2020

A 3855-4E-RA

figure 9

Absorb, versie 5.9 mode 7, PM: RA, file: a3855 EH:1667-1702 F#:2147-2182 A#:2183 T₁ = 19,7 °C T₂ = 20,0 °C p₁ = 101,8 kPa p₂ = 101,8 kPa h₁ = 65,9 % h₂ = 82,0 %

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



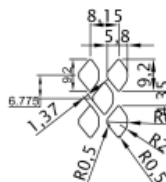
principal: Integra

Variant 7 (facing side → floor):

1. Elapto; (100% passive/without Meander)
2. Nylon wrapped Rockwool , Build-up height: 200 mm

Elapto Panels

Manufacturer: INTEGRA Metal Ceiling System B.V.
Type: Lay-in Flat Elapto Panel
Material: Painted metal sheet with backing fleece
Thickness: 1 mm
Height of panel: 40 mm
panel dimensions: 1200 mm x 600 mm
perforation rate: 9.2x5,8 % 62,2 (see perforation pattern)k



Nylon wrapped Rockwool

Sealed mineral wool
dimensions: 1150 mm x 580 mm
thickness: 30 mm
mass: 1,35 kg/m² / 45,0 kg/m³

volume reverberation room: 214 m³

surface area sample: 10,7 m²

height of the construction: 0,200 m

measured at: Peutz Laboratory for Acoustics

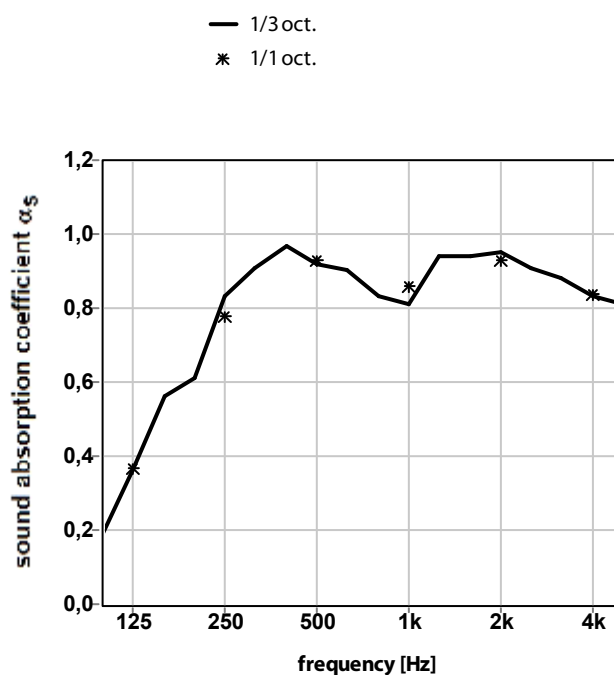
signal: broad-band noise

bandwidth: 1/3 octave

α_w (ISO 11654) = 0,95

SAA (ASTM - C423) = 0,88

Class= A



	0,19	0,61	0,97	0,83	0,94	0,88
1/3 oct.	0,36	0,83	0,92	0,81	0,95	0,83
	0,56	0,91	0,90	0,94	0,91	0,81
1/1 oct.	0,37	0,78	0,93	0,86	0,93	0,84

publication is permitted for the entire page only

Mook, measured at 09-09-2020

A 3855-4E-RA

figure 10

Absorb, versie 5.9 mode 7, PM: RA, file: a3855 E#:1667-1702 F#:2184-2219 A#:2220 T₁ = 19,7 °C T₂ = 20,0 °C p₁ = 101,8 kPa p₂ = 101,8 kPa h₁ = 65,9 % h₂ = 80,9 %

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



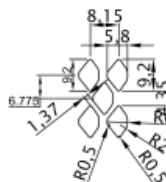
principal: Integra

Variant 8 (facing side → floor):

Elapto; (100% passive/without Meander), Build-up height: 200 mm

Elapto Panels

Manufacturer: INTEGRA Metal Ceiling System B.V.
Type: Lay-in Flat Elapto Panel
Material: Painted metal sheet with backing fleece
Thickness: 1 mm
Height of panel: 40 mm
panel dimensions: 1200 mm x 600 mm
perforation rate: 9.2x5,8 % 62,2 (see perforation pattern)k



volume reverberation room: 214 m³

surface area sample: 10,7 m²

height of the construction: 0,200 m

measured at: Peutz Laboratory for Acoustics

signal: broad-band noise

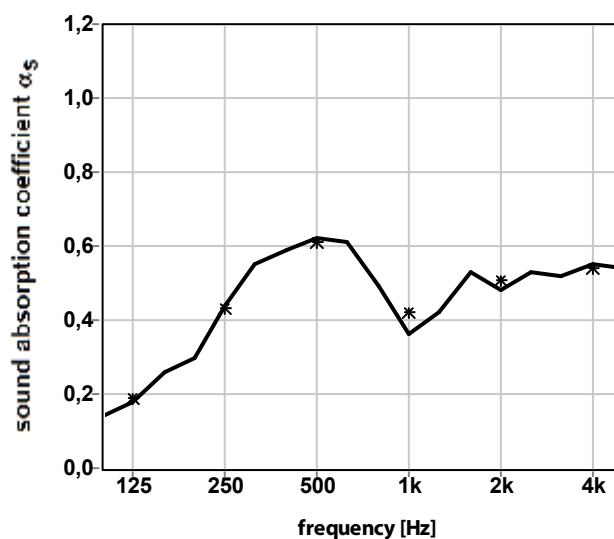
bandwidth: 1/3 octave

α_w (ISO 11654) = 0,50

SAA (ASTM - C423) = 0,49

Class= D

— 1/3 oct.
* 1/1 oct.



	0,14	0,30	0,59	0,49	0,53	0,52
1/3 oct.	0,18	0,44	0,62	0,36	0,48	0,55
	0,26	0,55	0,61	0,42	0,53	0,54
1/1 oct.	0,19	0,43	0,61	0,42	0,51	0,54

publication is permitted for the entire page only

Mook, measured at 09-09-2020

A 3855-4E-RA

figure 11

Absorb, versie 5.9 mode 7, PM: RA, file: a3855 E#:1667-1702 F#:2221-2256 A#:2257 T₁ = 19,7 °C T₂ = 20,1 °C p₁ = 101,8 kPa p₂ = 101,7 kPa h₁ = 65,9 % h₂ = 80,4 %