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TNO-report

MON-RPT-033-DTS-2008-00750

Sound absorption in number of Sonaspray constructions

Date	March 2008
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Project number	33.12685
Number of pages	13 (incl. enclosures)

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Indien dit rapport in opdracht werd uitgebracht, wordt voor de rechten en verplichtingen van opdrachtgever en opdrachtnemer verwezen naar de Algemene Voorwaarden voor onderzoeksopdrachten aan TNO, dan wel de betreffende terzake tussen de partijen gesloten overeenkomst.

Het ter inzage geven van het TNO-rapport aan direct belanghebbenden is toegestaan.

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1 Introduction

In order of Asona Nederland B.V. is de sound absorption specified from numer of soundabsorbing wall systems.

De tests are done with following construction:

- Sonaspray FC in thickness of approximately 16 mm.
- Combined construction of approx. 50 mm mineral wool with Sonaspray layer applied in 10 mm thickness.
- Sonaspray in thickness of approx. 10 mm trowel directly after spraying.
- Sonaspray K-13 Standard in thickness of approx. 25 mm.

All constructions are applied on hard acoustic boards, placed on granite floor in de reverberation chamber and supplied with wooden frame in height as thickness of the constructions. The measurements of all constructions deceived $3 \times 3,33 \text{ m}^2$.

De tests are done on 24.05.2006 in de reverberation chamber of TNO in Delft, NL.



2 Measuring procedure

2.1 Measuring method

Measurement is carried out in accordance with the regulations which are fixed with the Dutch Norm NEN-EN-ISO 354:2003 "Acoustics - measuring of absorption in reverberation chamber"

The equivalent sound absorbing surface A is in m^2 , for the 1/3 octave bands from 50 Hz to 5 kHz, calculated with help of the following formula:

$$A = 55,3 \frac{V}{c} \left(\frac{1}{T_2} - \frac{1}{T_1} \right)$$

in which:

V = volume of the empty reverberation chamber in m^3 ;

c = sound speed in m/s;

T_1 = echo time in the empty reverberation chamber in seconds;

T_2 = echo time in the reverberation chamber in which object was tested in seconds.

Since the temperature and moisture during all tests was the same, is the concerning phrase in above-mentioned formula was not come off.

The echo time is in both situations on six microphone positions measured with twelve broadband noise (six by loudspeaker position) from what it becomes sound sampled by a digital frequency analyzer type of 2133 from manufacturer Bruël & Kjær.

The sound absorption coefficient is calculated with the following formula:

$$\alpha_s = \frac{A}{S}$$

in which:

A = the equivalent sound absorbing surface A in m^2 , calculated with the above specified formula;

S = surface of the tested object in m^2 .

The sound absorption coefficient, for each octave band is calculated from the 1/3 octave sound absorption coefficients with the following formula:

$$\alpha_{pi} = \frac{(\alpha_{i1} + \alpha_{i2} + \alpha_{i3})}{3}$$

in which:

α_{i1} , α_{i2} en α_{i3} = three 1/3 octave band sound absorption coefficients inside octave band i .

The value of α_{pi} is rounded to 0,05.

2.2 Used equipment

At measurements used equipment has been incorporated in table mentioned below.

Apparatus	Manufacturer	Type	Ser. no.	TPD no.
sound level calibrator	Bruël & Kjær	4231	2147248	15366
condenser microphone	Bruël & Kjær	4176	1072982	12565/1
preamplifier	Bruël & Kjær	2639	1605931	
microphone feeding	Bruël & Kjær	2804	315500	1998
2 loudspeakers	Philips	AD12202/M8		
50W amplifier	Quad	50E	9908	3719
real-time-frequency-analyser	Bruël & Kjær	2133	1469056	15131

2.3 Measuring accuracy

Depending on the concerning frequency and the size of the absorption coefficient amounts to the exactitude of the measured absorption coefficients $\pm 0,1$ till $\pm 0,03$.
By low frequencies and small absorption are the possible error largest.

3 Measuring results

The measure results have been given on page 12 and 13 of this report in graphs and table form. Beside the sound absorption coefficient in tierce bands also the practice sound absorption coefficient α_p has been given in octave links, as stipulated according to NEN-EN-ISO 11654.

Under the graph the weighted α_w have been given as stipulated according to NEN-EN-ISO 11654.

4 Signature

Delft, 5 March 2008

A handwritten signature in blue ink, appearing to read 'P. Hendriksen', enclosed within a blue oval shape.

ing. P Hendriksen
department manager

TNO Industrie & Techniek

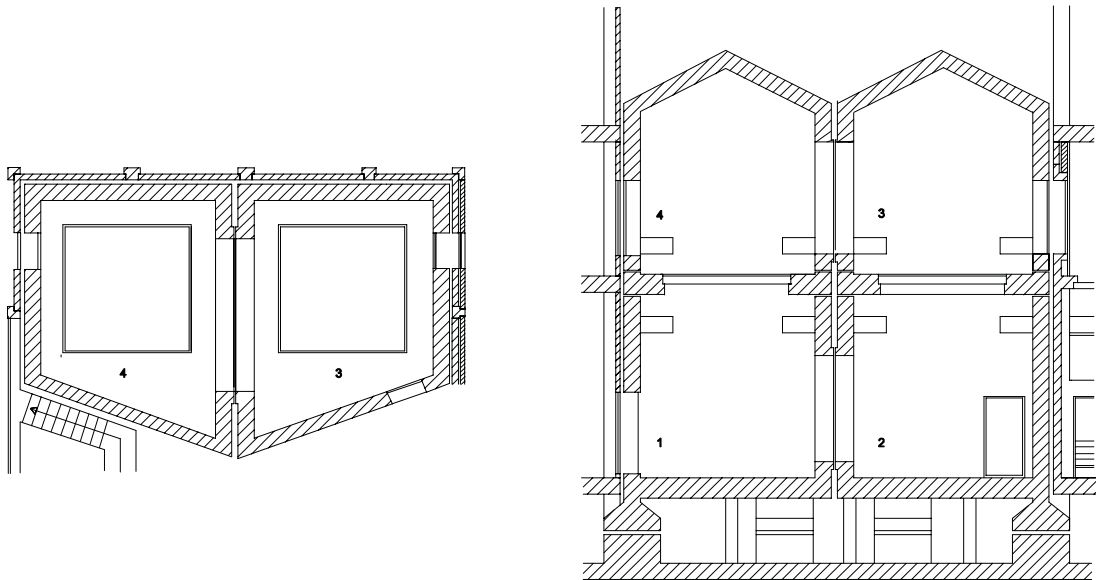
A handwritten signature in blue ink, appearing to read 'F.J.W. Biegstraaten', with a long horizontal stroke extending to the right.

ing. F.J.W. Biegstraaten
author

INSULATION MEASURING CHAMBERS TNO DELFT

The insulation measuring chambers of TNO at dig forms a block-system of four chambers, each with a volume of approx. 100 m^3 . The chambers have constructively separated mutually. The chambers have a rapidly finished floor and hard finished walls, of which has not been placed at least two mutually parallel. In each chamber 4 diffuser nozzles have been hung with a total unilateral surface of $5,7 \text{ m}^2$.

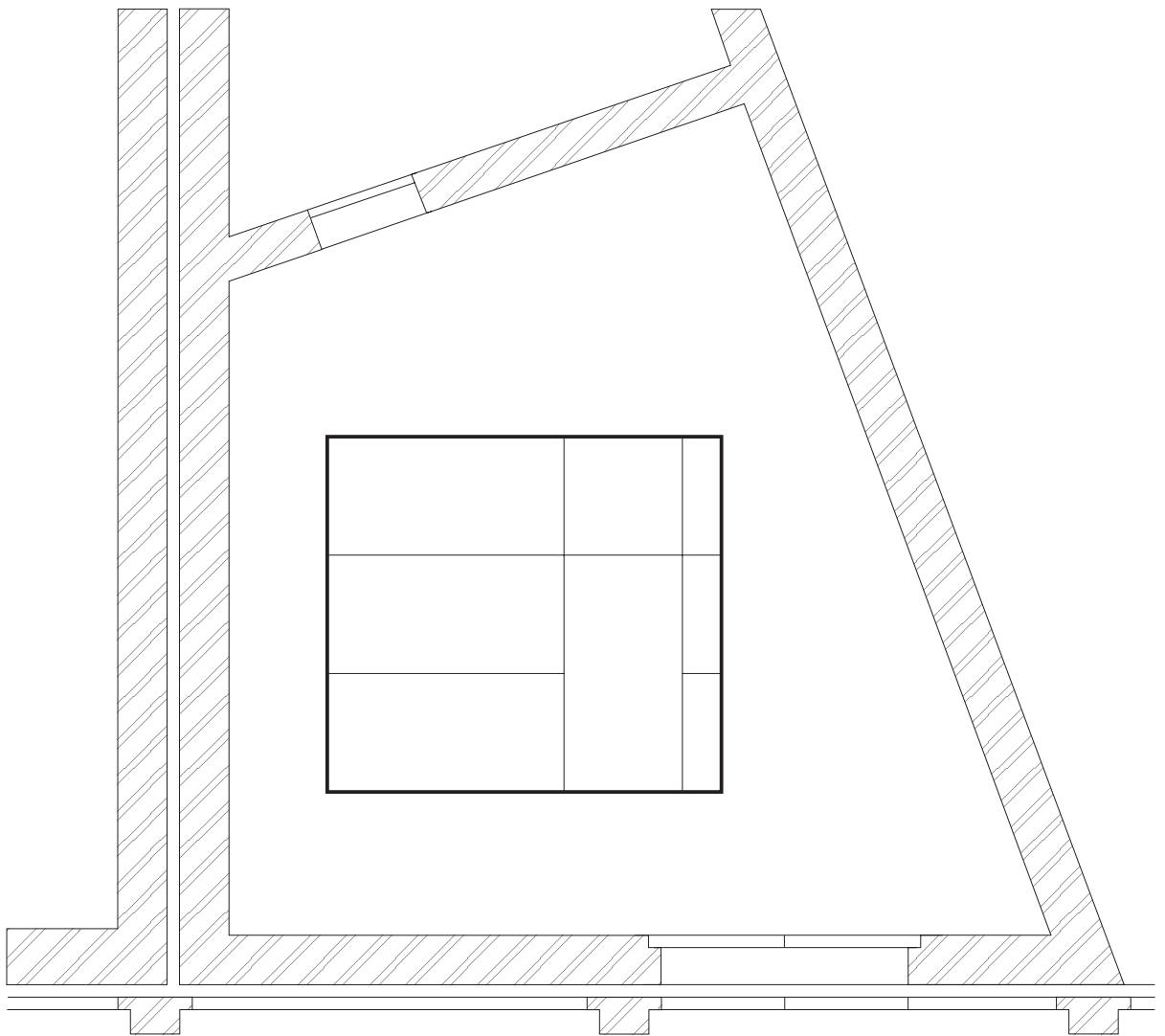
Between measure chambers 1 and 2 is himself a test opening for partition constructions of $3,75 \times 2,65 \text{ m}^2$; between measure chambers 3 and 4 is himself double a framework with a test opening for glass measurings with dimensions $1,500 \times 1,250 \text{ m}^2$. Between measure chambers 1 and 4 is himself concrete a standard floor of 100 mm (approx. 260 kg/m^2) and between measure chambers 2 and 3 a test opening for floor constructions of $3,15 \times 3,15 \text{ m}^2$.



The insulation measuring chambers satisfy to ISO 140-1:1997. The test opening for glass satisfies to ISO 140-3:1995 and the standard floor satisfy to ISO 140-8:1997.

Measure procedure with 2 loudspeaker positions and a rotating microphone satisfies to ISO 140-3: 1995 and measure procedure with four positions for the hammer machine and a rotating microphone satisfies to ISO 140-6:1998.

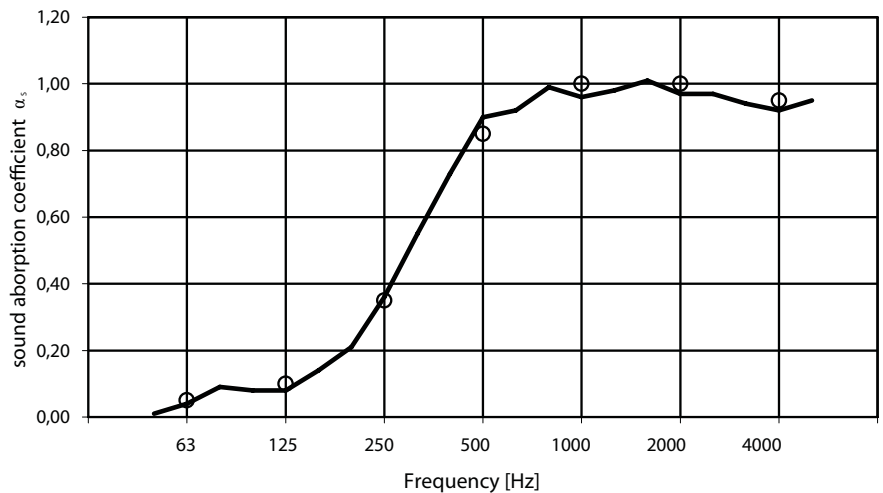
There is met the requirements for her feasibility and reproducibility of ISO 140-2:1991.



SOUND ABSORPTION according to NEN-EN-ISO 354

Client	: Asona B.V.	Product	: Sonaspray FC
Project number	: 033.12685	Test room	: Rev. chamber TNO Delft
Assembled by	: Asona	Date of test	: 2006-05-24
Description	: Sonaspray FC in thickness of approx. 16 mm, sprayed on acoustically hard plates, construction placed on granite floor, 3 x 3,33 m ² , in wooden framework		
Surface	: 10,0 m ²	Volume	: 200 m ²
Temperature	: 20 °C	Two speaker position	
Rel. humidity	: 38 %		

Freq. Hz	α_s 1/3 oct dB	α_p 1/1 oct dB
	50	0,01
63	0,04	0,05
80	0,09	
100	0,08	
125	0,08	0,10
160	0,14	
200	0,21	
250	0,36	0,35
315	0,55	
400	0,73	
500	0,90	0,85
630	0,92	
800	0,99	
1000	0,96	1,00
1250	0,98	
1600	1,01	
2000	0,97	1,00
2500	0,97	
3150	0,94	
4000	0,92	0,95
5000	0,95	

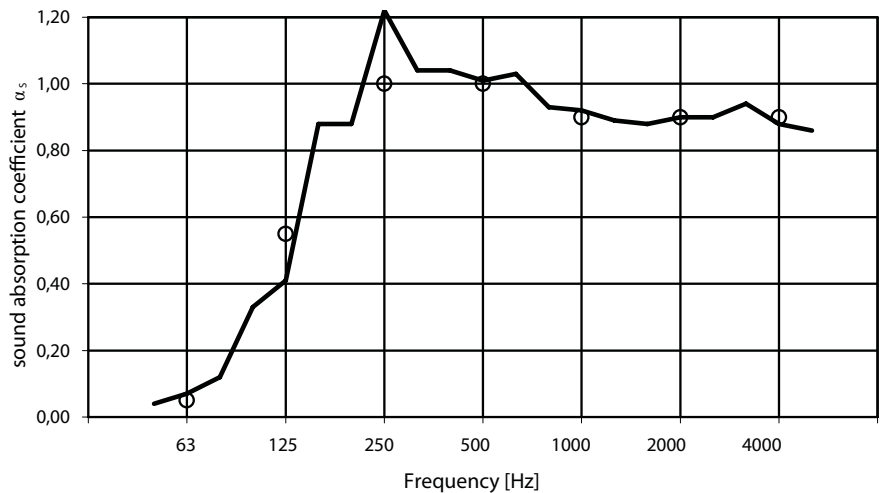


Weighted sound absorption coefficient (EN-ISO 11654)	$\alpha_w = 0,65$ (MH); class C
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SOUND ABSORPTION according to NEN-EN-ISO 354

Client : Asona B.V. Product : Sonaspray
 Project number : 033.12685 Test room : Rev. chamber TNO Delft
 Assembled by : Asona Date of test : 2006-05-24
 Description : construction of 50 mm mineralwool on acoustically hard plates on which is
 Sonaspray in thickness of approx. sprayed, 3 x 3,33 m², in wooden framework
 Surface : 10,0 m² Volume : 200 m²
 Temperature : 20 °C Two speaker position
 Rel. humidity : 38 %

Freq. Hz	α_s 1/3 oct dB	α_p 1/1 oct dB
	50	0,04
63	0,07	0,05
80	0,12	
100	0,33	
125	0,41	0,55
160	0,88	
200	0,88	
250	1,22	1,00
315	1,04	
400	1,04	
500	1,01	1,00
630	1,03	
800	0,93	
1000	0,92	0,90
1250	0,89	
1600	0,88	
2000	0,90	0,90
2500	0,90	
3150	0,94	
4000	0,88	0,90
5000	0,86	

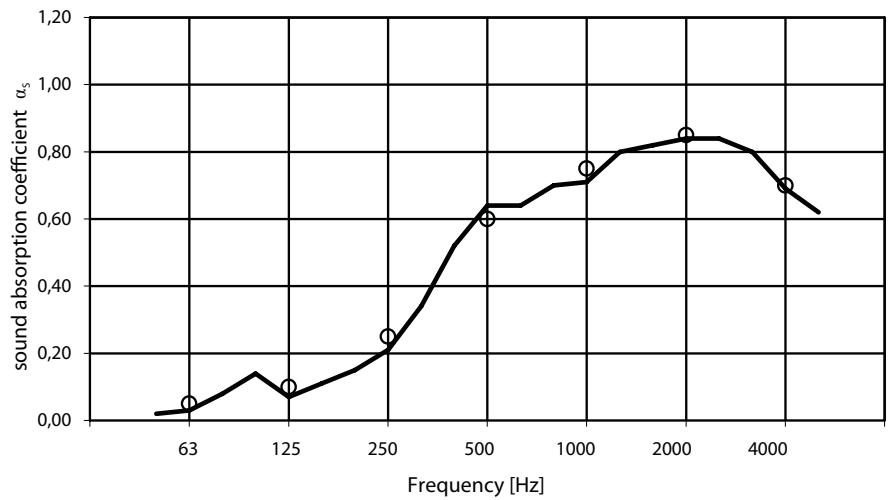


Weighted sound absorption coefficient (EN-ISO 11654) $\alpha_w = 0,95$ (L); class A

SOUND ABSORPTION according to NEN-EN-ISO 354

Client : Asona B.V. Product : Sonaspray FCX
 Project number : 033.12685 Test room : Rev. chamber TNO Delft
 Assembled by : Asona Date of test : 2006-05-24
 Description : Sonaspray FCX in thickness of approx. 10 mm, sprayed and trowelled on acoustically hard plates, construction placed on granite floor, 3 x 3,33 m², in wooden framework
 Surface : 10,0 m² Volume : 200 m²
 Temperature : 20 °C Two speaker position
 Rel. humidity : 38 %

Freq. Hz	α_s 1/3 oct dB	α_p 1/1 oct dB
	50	0,02
63	0,03	0,05
80	0,08	
100	0,14	
125	0,07	0,10
160	0,11	
200	0,15	
250	0,21	0,25
315	0,34	
400	0,52	
500	0,64	0,60
630	0,64	
800	0,70	
1000	0,71	0,75
1250	0,80	
1600	0,82	
2000	0,84	0,85
2500	0,84	
3150	0,80	
4000	0,69	0,70
5000	0,62	

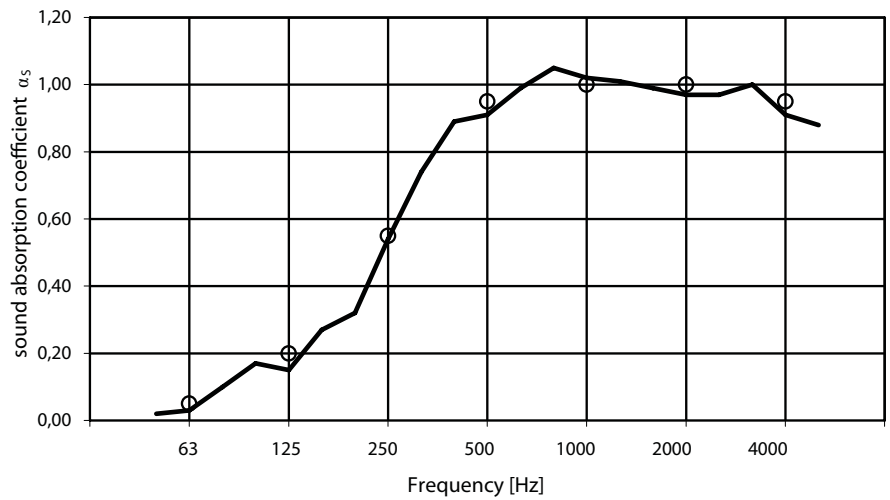


Weighted sound absorption coefficient (EN-ISO 11654) $\alpha_w = 0,55$ (H); class D

SOUND ABSORPTION according to NEN-EN-ISO 354

Client	: Asona B.V.	Product	: Sonaspray K-13
Project number	: 033.12685	Test room	: Rev. chamber TNO Delft
Assembled by	: Asona	Date of test	: 2006-05-24
Description	: Sonaspray K-13 Standard in the thickness of approx. 25 mm, sprayed on acoustically hard plates, construction placed on the granite floor, 3 x 3,33 m ² , in wooden framework		
Surface	: 10,0 m ²	Volume	: 200 m ²
Temperature	: 20 °C	Two speaker position	
Rel. humidity	: 38 %		

Freq. Hz	α_s 1/3 oct dB	α_p 1/1 oct dB
	50	0,02
63	0,03	0,05
80	0,1	
100	0,17	
125	0,15	0,20
160	0,27	
200	0,32	
250	0,54	0,55
315	0,74	
400	0,89	
500	0,91	0,95
630	0,99	
800	1,05	
1000	1,02	1,00
1250	1,01	
1600	0,99	
2000	0,97	1,00
2500	0,97	
3150	1,00	
4000	0,91	0,95
5000	0,88	



Weighted sound absorption coefficient (EN-ISO 11654)	$\alpha_w = 0,85$ () ; class B
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