

Test Report P-BA 112/2020

Sound absorption of acoustic insulation according to DIN EN ISO 354

Client: ISOPIPE®S.A.
Nafliou & Daskaloyianni
144 52 Metamorfofi, Attikis
Greece

Test specimen: Sound Absorption High Performance Acoustic Insulation out of open - cell elastomeric foam based on synthetic rubber; type: "ISOSOUND 150 kg/m³" thickness: 15 mm (version 1) and 25 mm (version 2), (test objects S 11330-01, -02).

Content: Results 1+3: Test setup and sound absorption coefficient
Results 2+4: Test setup and practical sound absorption coefficient

Table 1+2: Average values of reverberation times and sound absorption coefficient

Figure 1: Sketch of the test object

Annex F4: Test method

Annex M7: Measurement equipment

Annex P20: Description of the test facility

Assembly and date of the measurement: Delivery: May 14, 2020 (by a carrier)
Assembly: May 19, 2020 (by a specialized company)
Test date: May 20, 2020

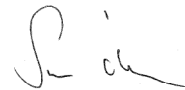
Stuttgart, July 17, 2020

Test Engineer:



Dipl.-Ing.(FH) S. Müller

Head of the test laboratory:



M.BP. Dipl.-Ing.(FH) S. Öhler

The test was carried out in laboratory facilities of the IBP which is accredited according to DIN EN ISO/IEC 17025:2018 by the Dakks. The accreditation certificate is D-PL-11140-11-01.

Any publication of excerpts is subject to written authorization of Fraunhofer Institute of Building Physics.

Client: ISOPIPE®S.A.
144 52 Metamorfofi, Attikis

Results 1

Test specimen:

Sound Absorption High Performance Acoustic Insulation out of open - cell elastomeric foam based on synthetic rubber; type: "ISOSOUND 150 kg/m³" thickness: 15 mm (version 1) and 25 mm (version 2), (test objects S 11330-01, -02).

Test setup:

Version 1: Acoustic Insulation, type: "ISOSOUND 150 kg/m³"; thickness: **15 mm**; (test objects S 11330-02).

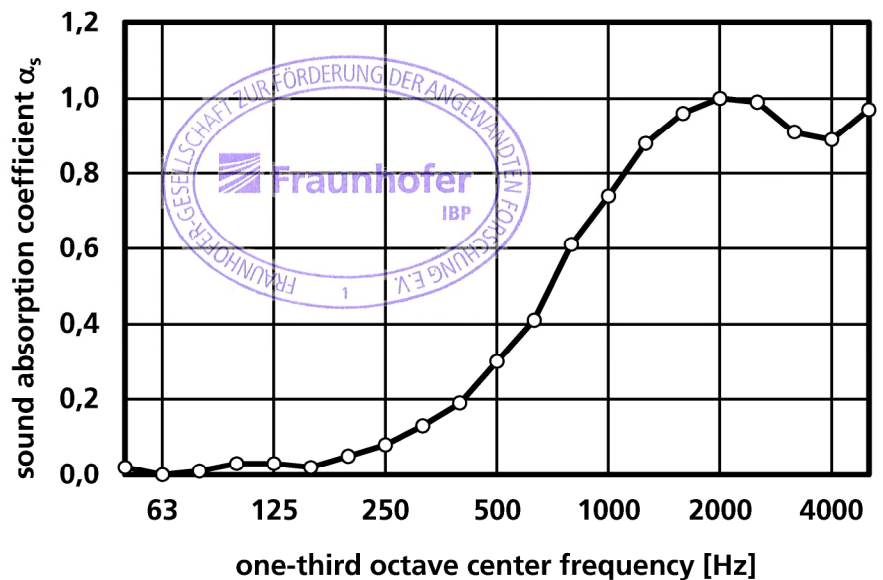
density: ≥ 100 kg/m³ (information of the client)
 determined density: 225 kg/m³ (determined from the weight of 12 sheets)
 Determined mass per unit: 3.4 kg/m² (determined from the weight of 12 sheets)
 air flow resistivity r: not determined (upon the request of the customer)
 dimensions of a sheet (L x W x H): 1 m x 1 m x 15 mm (information of the client);
 configuration: 3 x 4 sheets;
 dimensions of the test area (L x W x H): 3.95 m x 2.96 m x 0.15 m;
 size of the test area: 11.8 m².

The insulating sheets were laid together directly on the floor of the reverberation room. The edges of the test area were covered by a tape.

Further details of the test set-up see figure 1.

Test date:	20.05.2020		without test obj.	with test obj.
Test lab:	rev. room P20	Air temp.:	23,7 ± 0,3 °C	23,7 ± 0,3 °C
Test area:	11,8 m ²	Rel. Humidity:	43 ± 2 %	42 ± 2 %
Volume:	V = 392 m ³	Stat. pressure:	967 ± 1 hPa	967 ± 1 hPa
Test noise:	sine sweep			

f [Hz]	α_s [-]
50	0,02
63	0,00
80	0,01
100	0,03
125	0,03
160	0,02
200	0,05
250	0,08
315	0,13
400	0,19
500	0,30
630	0,41
800	0,61
1000	0,74
1250	0,88
1600	0,96
2000	1,00
2500	0,99
3150	0,91
4000	0,89
5000	0,97



The test was carried out in laboratory facilities of the IBP which is accredited according to DIN EN ISO/IEC 17025 by the Dakks. The accreditation certificate is D-PL-11140-11-01.

Stuttgart, July 17, 2020
Head of the test laboratory:

Client: ISOPIPE®S.A.
144 52 Metamorfoosi, Attikis

Results 2

Test specimen:

Sound Absorption High Performance Acoustic Insulation out of open - cell elastomeric foam based on synthetic rubber; type: "ISOSOUND 150 kg/m³" thickness: 15 mm (version 1) and 25 mm (version 2), (test objects S 11330-01, -02).

Test setup:

Version 1: Acoustic Insulation, type: "ISOSOUND 150 kg/m³"; thickness: **15 mm**; (test objects S 11330-02).

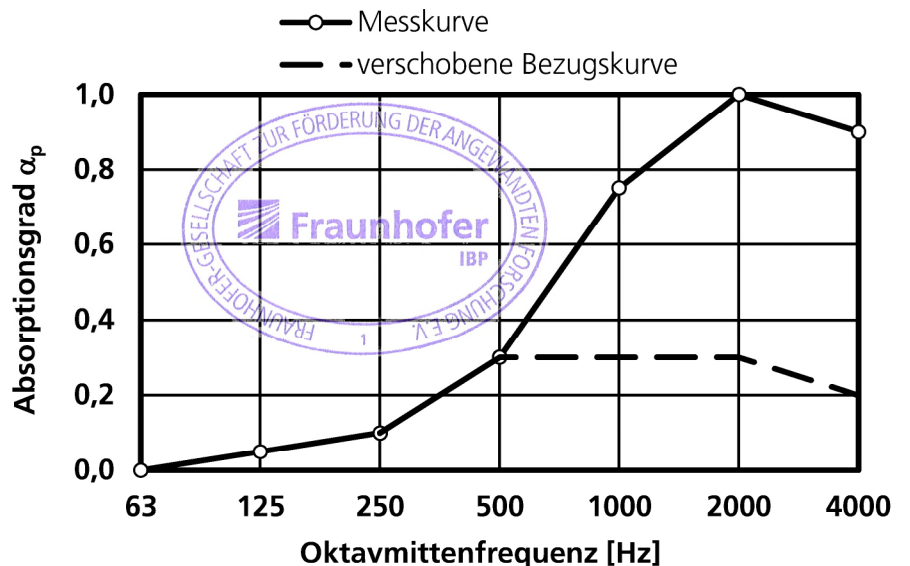
density: ≥ 100 kg/m³ (information of the client)
 determined density: 225 kg/m³ (determined from the weight of 12 sheets)
 Determined mass per unit: 3.4 kg/m² (determined from the weight of 12 sheets)
 air flow resistivity r: not determined (upon the request of the customer)
 dimensions of a sheet (L x W x H): 1 m x 1 m x 15 mm (information of the client);
 configuration: 3 x 4 sheets;
 dimensions of the test area (L x W x H): 3.95 m x 2.96 m x 0.15 m;
 size of the test area: 11.8 m².

The insulating sheets were laid together directly on the floor of the reverberation room. The edges of the test area were covered by a tape.

Further details of the test set-up see figure 1.

Test date:	20.05.2020		without test obj.	with test obj.
Test lab:	rev. room P20	Air temp.:	23,7 ± 0,3 °C	23,7 ± 0,3 °C
Test area:	11,8 m ²	Rel. Humidity:	42 ± 2 %	39 ± 2 %
Volume:	V = 392 m ³	Stat. pressure:	967 ± 1 hPa	967 ± 1 hPa
Test noise:	sine sweep			

f [Hz]	α_p [-]
63	0,00
125	0,05
250	0,10
500	0,30
1000	0,75
2000	1,00
4000	0,90



It is recommended to use this singular rating in conjunction with the complete sound absorption curve.

weighted sound absorption coefficient
 $\alpha_w = 0,30$ (MH)
sound absorber class D



The test was carried out in laboratory facilities of the IBP which is accredited according to DIN EN ISO/IEC 17025 by the Dakks. The accreditation certificate is D-PL-11140-11-01.

Stuttgart, July 17, 2020
 Head of the test laboratory:

Client: ISOPIPE®S.A.
144 52 Metamorfoosi, Attikis

Results 3

Test specimen:

Sound Absorption High Performance Acoustic Insulation out of open - cell elastomeric foam based on synthetic rubber; type: "ISOSOUND 150 kg/m³" thickness: 15 mm (version 1) and 25 mm (version 2), (test objects S 11330-01, -02).

Test setup:

Version 2: Acoustic Insulation, type: "ISOSOUND 150 kg/m³"; thickness: **25 mm**; (test objects S 11330-01);

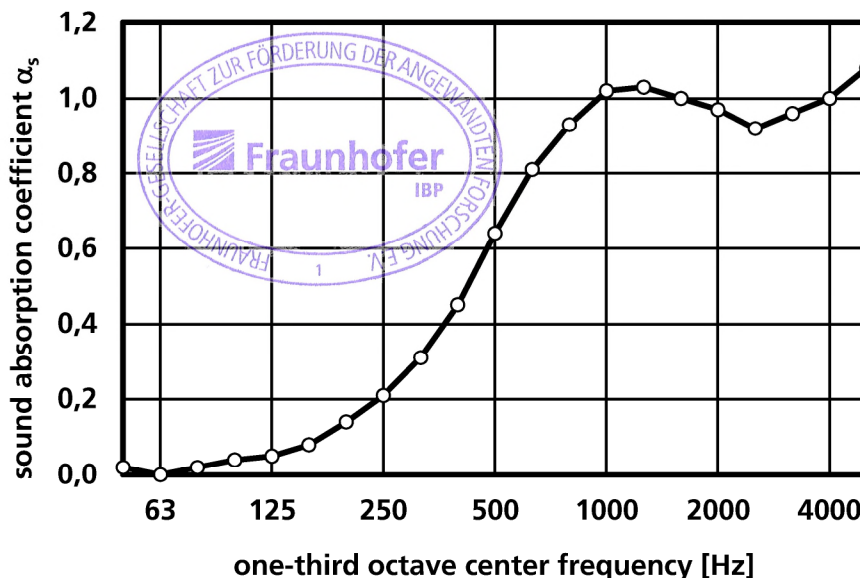
density: ≥ 100 kg/m³ (information of the client)
 determined density: 225 kg/m³ (determined from the weight of 12 sheets)
 Determined mass per unit: 5.3 kg/m² (determined from the weight of 12 sheets)
 air flow resistivity r: not determined (upon the request of the customer)
 dimensions of a sheet (L x W x H): 1 m x 1 m x 25 mm (information of the client);
 configuration: 3 x 4 sheets;
 dimensions of the test area (L x W x H): 3.97 m x 2.98 m x 0.25 m;
 size of the test area: 11.8 m².

The insulating sheets were laid together directly on the floor of the reverberation room. The edges of the test area were covered by a wooden frame all around the test area (25 mm x 40 mm). The joint between the frame and the floor of the reverberation room was sealed elastically. The joint between sheets and frame was sealed with a tape.

Further details of the test set-up see figure 1.

Test date:	20.05.2020		without test obj.	with test obj.
Test lab:	rev. room P20	Air temp.:	23,7 ± 0,3 °C	23,7 ± 0,3 °C
Test area:	11,8 m ²	Rel. Humidity:	43 ± 2 %	41 ± 2 %
Volume:	V = 392 m ³	Stat. pressure:	967 ± 1 hPa	967 ± 1 hPa
Test noise:	sine sweep			

f [Hz]	α_s [-]
50	0,02
63	0,00
80	0,02
100	0,04
125	0,05
160	0,08
200	0,14
250	0,21
315	0,31
400	0,45
500	0,64
630	0,81
800	0,93
1000	1,02
1250	1,03
1600	1,00
2000	0,97
2500	0,92
3150	0,95
4000	0,99
5000	1,06



The test was carried out in laboratory facilities of the IBP which is accredited according to DIN EN ISO/IEC 17025 by the Dakks. The accreditation certificate is D-PL-11140-11-01.

Stuttgart, July 17, 2020
Head of the test laboratory:

Client: ISOPIPE®S.A.
144 52 Metamorfoosi, Attikis

Results 4

Test specimen:

Sound Absorption High Performance Acoustic Insulation out of open - cell elastomeric foam based on synthetic rubber; type: "ISOSOUND 150 kg/m³" thickness: 15 mm (version 1) and 25 mm (version 2), (test objects S 11330-01, -02).

Test setup:

Version 2: Acoustic Insulation, type: "ISOSOUND 150 kg/m³"; thickness: **25 mm**; (test objects S 11330-01);

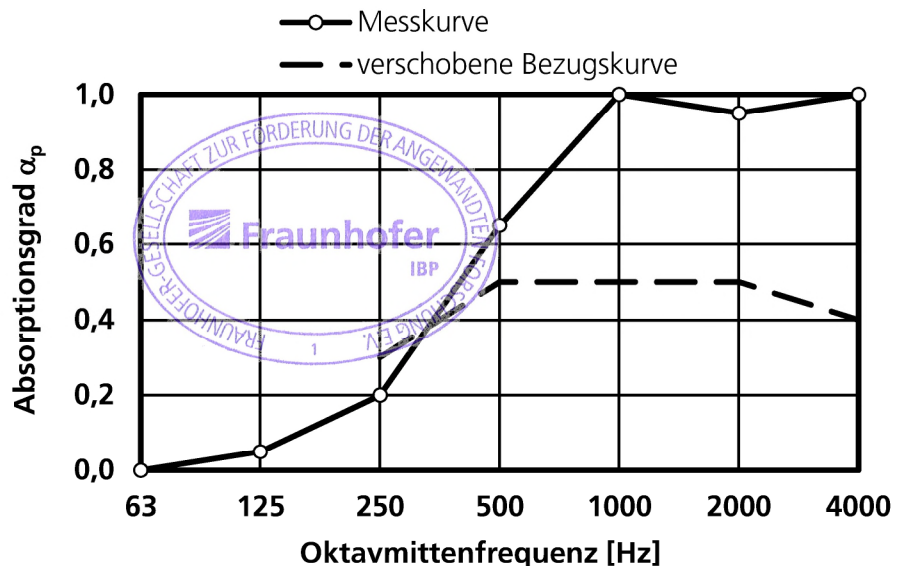
density: ≥ 100 kg/m³ (information of the client)
 determined density: 225 kg/m³ (determined from the weight of 12 sheets)
 Determined mass per unit: 5.3 kg/m² (determined from the weight of 12 sheets)
 air flow resistivity r: not determined (upon the request of the customer)
 dimensions of a sheet (L x W x H): 1 m x 1 m x 25 mm (information of the client);
 configuration: 3 x 4 sheets;
 dimensions of the test area (L x W x H): 3.97 m x 2.98 m x 0.25 m;
 size of the test area: 11.8 m².

The insulating sheets were laid together directly on the floor of the reverberation room. The edges of the test area were covered by a wooden frame all around the test area (25 mm x 40 mm). The joint between the frame and the floor of the reverberation room was sealed elastically. The joint between sheets and frame was sealed with a tape.

Further details of the test set-up see figure 1.

Test date:	20.05.2020		without test obj.	with test obj.
Test lab:	rev. room P20	Air temp.:	23,7 ± 0,3 °C	23,7 ± 0,3 °C
Test area:	11,8 m ²	Rel. Humidity:	43 ± 2 %	41 ± 2 %
Volume:	V = 392 m ³	Stat. pressure:	967 ± 1 hPa	967 ± 1 hPa
Test noise:	sine sweep			

f [Hz]	α_p [-]
63	0,00
125	0,05
250	0,20
500	0,65
1000	1,00
2000	0,95
4000	1,00



It is recommended to use this singular rating in conjunction with the complete sound absorption curve.

weighted sound absorption coefficient
 $\alpha_w = 0,50$ (MH)
sound absorber class D



The test was carried out in laboratory facilities of the IBP which is accredited according to DIN EN ISO/IEC 17025 by the Dakks. The accreditation certificate is D-PL-11140-11-01.

Stuttgart, July 17, 2020
Head of the test laboratory:

Reverberation times and absorption coefficients**P-BA 112/2020**Client: ISOPIPE@S.A.
144 52 Metamorfoosi, Attikis**Table 1****Test specimen:**Sound Absorption High Performance Acoustic Insulation out of open - cell elastomeric foam based on synthetic rubber; type: "ISOSOUND 150 kg/m³" thickness: 15 mm (version 1) and 25 mm (version 2), (test objects S 11330-01, -02).**Version 1 (15 mm):**

Frequency f [Hz]	T ₁ [s]	T ₂ [s]	sound absorption coefficients α_s [-]	practical absorption coefficients α_p [-]
50	21,99	20,26	0,02	0,00
63	13,58	16,09	0,00	
80	19,20	18,51	0,01	
100	19,14	17,24	0,03	0,05
125	17,81	16,19	0,03	
160	17,39	16,39	0,02	
200	17,18	14,60	0,05	0,10
250	15,94	12,79	0,08	
315	14,86	10,80	0,13	
400	12,54	8,72	0,19	0,30
500	9,20	6,10	0,30	
630	8,41	5,11	0,41	
800	8,73	4,39	0,61	0,75
1000	9,26	4,07	0,74	
1250	8,87	3,59	0,88	
1600	7,75	3,24	0,96	1,00
2000	6,69	2,97	1,00	
2500	5,46	2,72	0,99	
3150	4,35	2,50	0,91	0,90
4000	3,39	2,17	0,89	
5000	2,68	1,80	0,97	
weighted sound absorption coefficient acc. to DIN EN ISO 11654				$\alpha_w = 0,30$ (MH)
sound absorber class acc. to DIN EN ISO 11654				D

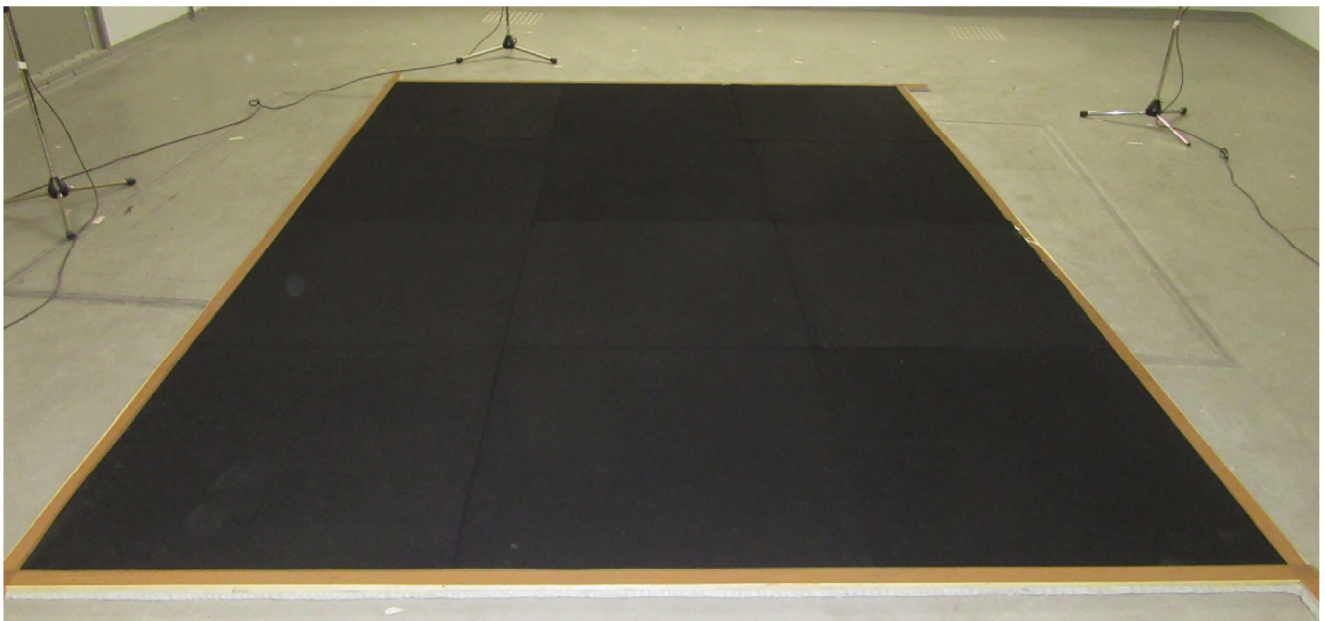
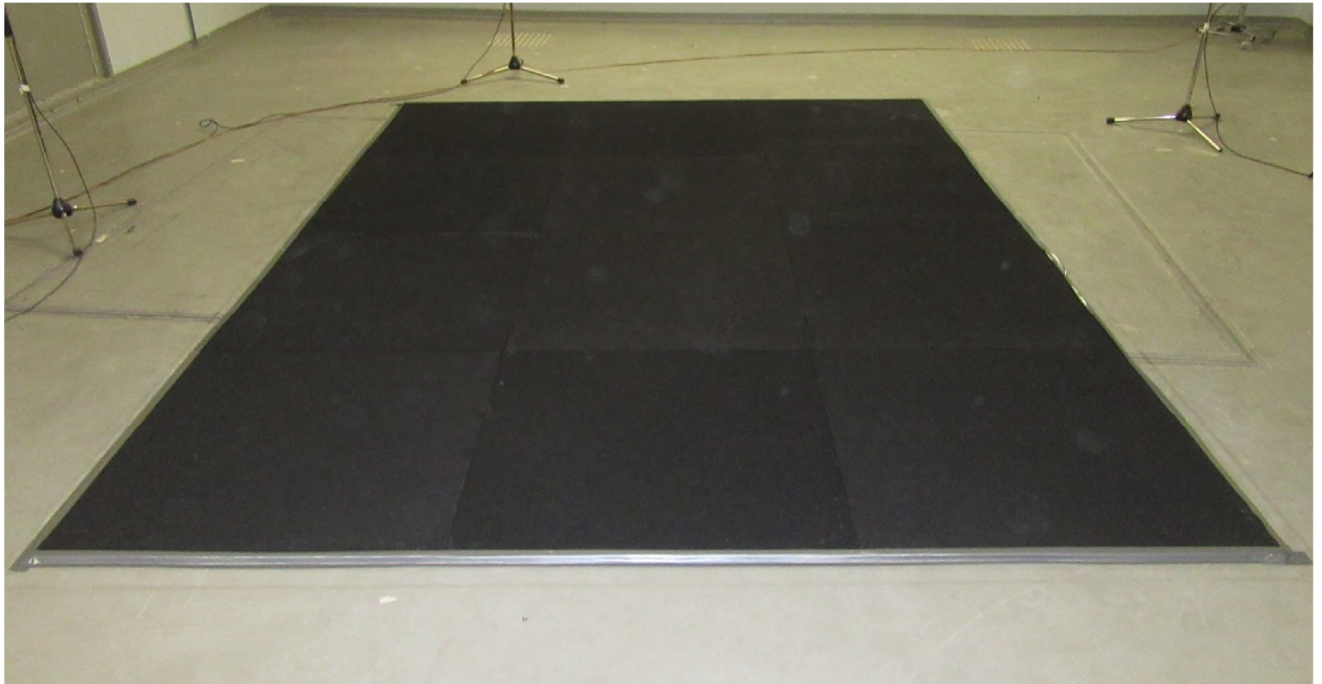
Reverberation times and absorption coefficients**P-BA 112/2020**Client: ISOPIPE@S.A.
144 52 Metamorfozi, Attikis**Table 2****Test specimen:**Sound Absorption High Performance Acoustic Insulation out of open - cell elastomeric foam based on synthetic rubber; type: "ISOSOUND 150 kg/m³" thickness: 15 mm (version 1) and 25 mm (version 2), (test objects S 11330-01, -02).**Version 2 (25 mm):**

Frequency f [Hz]	T ₁ [s]	T ₂ [s]	sound absorption coefficients α_s [-]	practical absorption coefficients α_p [-]
50	21,99	20,40	0,02	0,00
63	13,58	16,43	0,00	
80	19,20	17,82	0,02	
100	19,14	16,93	0,04	0,05
125	17,81	15,14	0,05	
160	17,39	13,86	0,08	
200	17,18	11,80	0,14	0,20
250	15,94	9,84	0,21	
315	14,86	7,94	0,31	
400	12,54	6,09	0,45	0,65
500	9,20	4,37	0,64	
630	8,41	3,68	0,81	
800	8,73	3,45	0,93	1,00
1000	9,26	3,34	1,02	
1250	8,87	3,27	1,03	
1600	7,75	3,15	1,00	0,95
2000	6,69	3,00	0,97	
2500	5,46	2,78	0,92	
3150	4,35	2,42	0,95	1,00
4000	3,39	2,04	0,99	
5000	2,68	1,70	1,06	
weighted sound absorption coefficient acc. to DIN EN ISO 11654				$\alpha_w = 0,50$ (MH)
sound absorber class acc. to DIN EN ISO 11654				D

Client: ISOPIPE®S.A.
144 52 Metamorfoosi, Attikis

Figure 1**Test specimen:**

Sound Absorption High Performance Acoustic Insulation out of open - cell elastomeric foam based on synthetic rubber; type: "ISOSOUND 150 kg/m³" thickness: 15 mm (version 1) and 25 mm (version 2), (test objects S 11330-01, -02).



Test Method

The measurements were performed according to DIN EN ISO 354:2003 in a reverberation room. The reverberation room and measuring equipment are described in Annex P20. The measured value was the reverberation time in the reverberation room with and without test object determined in each case according to the methods described in the mentioned measurement standard.

The sound absorption coefficient was determined as follows:

$$\alpha_s = A_T/S.$$

with:

α_s	=	sound absorption coefficient	
A_T	=	equivalent sound absorption area of the test object	[m ²]
S	=	area covered by the test object	[m ²].

The equivalent sound absorption area A_T of the test object was calculated according to DIN EN ISO 354:2003:

$$A_T = A_2 - A_1 = 55,3 V (1/c_2 T_2 - 1/c_1 T_1) - 4 V (m_2 - m_1).$$

with:

A_1	=	equivalent sound absorption area of the empty reverberation room	[m ²]
A_2	=	equivalent sound absorption area of the reverberation room with test object	[m ²]
V	=	volume of the empty reverberation room	
c_1	=	acoustic velocity in the air at temperature t_1	
c_2	=	acoustic velocity in the air at temperature t_2	
T_1	=	reverberation time of the empty reverberation room	[s]
T_2	=	reverberation time of the reverberation room after installing the test object	[s]
m_1	=	air absorption coefficient, calculated acc. to ISO 9613-1:1993 with climatic conditions during the measurement in the empty reverberation room	[1/m]
m_2	=	air absorption coefficient, calculated acc. to ISO 9613-1:1993 with climatic conditions during the measurement with the installed test object	[1/m].

Explanations to the indication of the measurement results on the result sheet

For the measurements, the informative requirements as per DIN EN ISO 10140-4:2010, Annex A - "Additional methods for measuring at low frequencies" were taken into account as far as possible. However, at low frequencies (particularly below 100 Hz), a reduced reproducibility and comparability with test results of other test laboratories have to be expected.

Measurement equipment

Measurement equipment used:

Analyzer:	Sinus Soundbook_MK2_8L G S/N 07318
Software:	Sinus Samurai Ver. 2.8.2
Microphone-set:	G.R.A.S. 46AE S/N 294216
Microphone-set:	G.R.A.S. 46AE S/N 294217
Microphone-set:	G.R.A.S. 46AE S/N 294218
Microphone-set:	G.R.A.S. 46AE S/N 294219
Microphone-set:	G.R.A.S. 46AE S/N 294220
Microphone-set:	G.R.A.S. 46AE S/N 294257
Calibrator:	Larson Davis CAL200 S/N 13583
Amplifier:	Klein & Hummel AK 120 S.Nr. 2078
Loudspeaker:	Lanny MLS 87

The used analyser is a type-approved Class 1 sound level meter. All measurement devices are tested frequently by internal and external testing laboratories, are calibrated and if necessary gauged.

Test facility

The measurements were performed in the reverberation room P20 of the Fraunhofer Institute for Building Physics. The test facility meets the requirements of DIN EN ISO 354. Walls and ceilings are made of concrete.

Geometry of the reverberation room

Width: 7.05 m ... 7.75 m
 Length: 7.86 m ... 8.46 m
 Height: 5.92 m ... 7.08 m

Volume: 392 m³
 Surface: 322 m²

Angle between opposite walls: approx. 5°
 Angle between floor and ceiling: approx. 8°.

10 diffusors à 1.60 m x 1.25 m
 5 diffusors à 1.25 m x 1.25 m

Overall surface (one-side)
 of the diffusors: 27.8 m²
 Material: composite sheet, slightly curved

Measuring equipment

For the measurement of the reverberation time the average of three positions of the loudspeaker (corners of the room) with 4 microphone positions each or of two positions of the loudspeaker (corners of the room) with 6 microphone positions each was used. At least 3 reverberation time evaluations per microphone position were measured when pink noise was used. The microphones were placed from 1.75 m to 2.25 m above floor level, distributed in a random pattern around the sample with a distance to each other $\geq 1,5$ m and ≥ 2 m to the source ($\geq 1,2$ m distance to the test specimen, diffusors and room surface).

Ground plan and sectional view of the test facility

