BUILDING COMMON GROUND

MAX FRANK®

Test Report

Sorp10®

Measurement of the sound absorption of Sorp 10® sound absorbers in the reverberation room according to EN ISO 354

122 002 14T-401 | 16.03.2022

Tested by: Stuttgart University of Applied Sciences, Acoustic and Thermal Building Physics Centre

(Translation of the original German text not checked by Stuttgart University of Applied Sciences)

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Stuttgart University of Applied Sciences

Acoustic and Thermal Building Physics Centre

Test report no. 122 002 14T-401

Measurement of the sound absorption of Sorp 10® sound absorbers in the reverberation room according to EN ISO 354

Applicant: Max Frank GmbH & Co. KG
Mitterweg 1
94339 Leiblfing

Manufacturer: Max Frank GmbH & Co. KG
Mitterweg 1
94339 Leiblfing

1 Task

The sound absorption of Max Frank Sorp 10® sound absorbers is to be determined. To this end, measurements were carried out in the reverberation room at the Stuttgart University of Applied Sciences (HFT Stuttgart).

Stuttgart University of Applied Sciences
Acoustic and Thermal Building Physics Centre
Schellingstrasse 24, D-70174 Stuttgart

2 Measurement of the sound absorption coefficient in the reverberation room

2.1 Location and date of measurements

The measurements were carried out on 9 February 2022 in the reverberation room of the sound laboratory at the HFT Stuttgart, Building Physics Centre, Pfaffenwaldring 10a, 70569 Stuttgart-Vaihingen.

2.2 Sampling

The test objects were delivered by the manufacturer and set up in the reverberation room by employees of the manufacturer and the HFT Stuttgart.

Test object 1: Sorp 10® with acoustic plaster

Ground surface 3.32 m x 3.60 m = 11.95 m²
Arrangement:
14 U-shaped fibre concrete bars with integrated absorber strips, manufacturer's designation Sorp 10®, width 70 mm, height 35 mm. Absorber strips made of expanded glass granulate (50 mm x 30 mm), manufacturer's designation Reapor (270 kg/m³).
There are 180 mm-wide chipboard strips (height 35 mm with sealed, non-absorbing surface) between the acoustically active U-bars. Bars and chipboard strips are butt-jointed (fig. 1).
Acoustic plaster:
Sorp acoustic plaster made of recycled mineral lightweight fillers, organic binding agents and aggregates; weight per unit area approx. 1.20 kg/m².
Application thickness: approx. 2-3 mm; application method: Apply and smooth using suitable tools according to the specifications of the manufacturer, Max Frank GmbH & Co. KG.

Dimensions or U-bars:	1200 mm x 70 mm x 35 mm
Mass of the U-bar:	3.38 kg
Test arrangement:	14 x 3 U-bars with absorber strips + acoustic plaster, 13 chipboard strips

Test object 2: Sorp 10® classic

Ground surface 3.32 m x 3.60 m = 11.95 m²
Arrangement:
14 U-shaped fibre concrete bars with integrated absorber strips, manufacturer's designation Sorp 10®, width 70 mm, height 35 mm. Absorber strips made of expanded glass granulate (50 mm x 30 mm), manufacturer's designation Reapor (270 kg/m³).
There are 180 mm-wide chipboard strips (height 35 mm with sealed, non-absorbing surface) between the acoustically active U-bars. Bars and chipboard strips are butt-jointed (fig. 2).

Dimensions or U-bars:	1200 mm x 70 mm x 35 mm
Mass of the U-bar:	3.35 kg
Test arrangement:	14 x 3 U-bars with absorber strips, 13 chipboard strips

3 Test method

The measurements were carried out in a reverberation room according to EN ISO 354, edition 12/2003, taking into account Annexes A, B and ZA. The method with noise switched off was used. The test setup was regarded as a laminar absorber in accordance with section 6.2.1 and placed on the floor of the reverberation room according to Annex B, setup type A. The test area was 11.95 m².

The sound absorption coefficient α_s for laminar absorbers was determined according to the following relationship:

$$\alpha_s = AT/S$$

where:

$$A_T = A_2 - A_1 = 55.3\ V\ (1/c_2T_2 - 1/c_1T_1) - 4\ V\ (m_2 - m_1)$$

Meanings:

A_T	=	equivalent sound absorption area of the test object in m²;
A_1	=	equivalent sound absorption area of the empty reverberation room in m²;
A_2	=	equivalent sound absorption area of the reverberation room with test object in m²;
S_B	=	area of the test object in m²;
V	=	volume of the empty reverberation room in m³;
c_1	=	speed of sound in air in m/s at temperature T_1;
c_2	=	speed of sound in air in m/s at temperature T_2;
T_1	=	reverberation time of the empty reverberation room in s;
T_2	=	reverberation time of the reverberation room after bringing in the test object in s;
$m_{1/2}$	=	atmospheric absorption coefficient in 1/m, calculated with the climatic conditions prevailing during the respective measurement.

The sound absorption coefficient was evaluated according to EN ISO 11654, edition 07/1997.

The empty reverberation room has the following dimensions:

(L x W x H): 7.89 m x 5.54 m x 4.65 m; $V_{Reverberation\ room}$ = 203 m³

<u>The following measuring instruments were used:</u>

Analyser:	Manufacturer: Sinus	Type: Soundbook MK2	SN: 07296
Amplifier:	Manufacturer: Falm	Type: PA1000	SN: 280121
Loudspeakers:	Manufacturer: Norsonic	Type: 229	SN: 15013
4 preamplifiers:	Manufacturer: Microtech Gefell	Type: MV210	SN: 13643 SN: 13644 SN: 13668 SN: 13674

4 microphones:	Manufacturer: Microtech Gefell	Type: MK255	SN: 4016 SN: 4017 SN: 4018 SN: 4019
Calibrator:	Manufacturer: Larson	Type: Cal200	SN: 10517
Climate measurement:	Manufacturer: Extech	Type: SD700	SN: 026717

The test sound was pink noise.

All test equipment is subject to test equipment monitoring to ensure regular calibration and traceability. The DAkkS calibration of the airborne sound measuring chain took place in 2020.

4 Measurement results

Tables 1 and 2 show the average values of the reverberation times T_1 in the empty reverberation room and T_2 in the reverberation room with the test objects in relation to the frequency.
Appendices 1 and 2 show the sound absorption coefficient α_s. The values of the sound absorption coefficients α_s as well as the practical sound absorption coefficients α_p can be taken from the table next to the diagram.

The report consists of:

4	pages of text
2	Tables
2	image appendices
2	Appendices

Publication of extracts of the report requires the prior approval of the Stuttgart University of Applied Sciences. The mentioned measurement results only refer to the tested object with the described setup.

Stuttgart, 16 March 2022

Person responsible: Laboratory manager:

Dipl.-Ing. (FH) A. Drechsler Prof. Dr. Berndt Zeitler

Table 1: Average values of the reverberation times T_1 in the empty reverberation room or, respectively, T_2 in the reverberation room with test setup 1.

Test object 1

Frequency [Hz]	T_1 [s]	T_2 [s] with setup 1
100	7.16	5.58
125	7.22	5.07
160	8.19	4.65
200	7.01	4.04
250	6.69	3.98
315	6.48	3.68
400	6.14	3.52
500	5.29	3.08
630	5.12	2.93
800	5.38	2.80
1000	5.53	2.54
1250	5.28	2.20
1600	4.97	2.01
2000	4.69	1.98
2500	4.32	1.88
3150	3.85	1.76
4000	3.20	1.63
5000	2.58	1.45
Temperature [°C]	22.1	22.0
Humidity [%]	36.7	34.0
Atmospheric pressure [hPa]	972.4	972.8

Table 2: Average values of the reverberation times T_1 in the empty reverberation room or, respectively, T_2 in the reverberation room with test setup 2.

Test object 2

Frequency [Hz]	T_1 [s]	T_2 [s] with setup 2
100	7.16	5.67
125	7.22	4.86
160	8.19	4.53
200	7.01	4.16
250	6.69	3.96
315	6.48	3.89
400	6.14	3.61
500	5.29	3.27
630	5.12	3.19
800	5.38	3.20
1000	5.53	2.83
1250	5.28	2.52
1600	4.97	2.32
2000	4.69	2.09
2500	4.32	1.92
3150	3.85	1.79
4000	3.20	1.64
5000	2.58	1.44
Temperature [°C]	22.1	22.1
Humidity [%]	36.7	34.1
Atmospheric pressure [hPa]	972.4	972.5

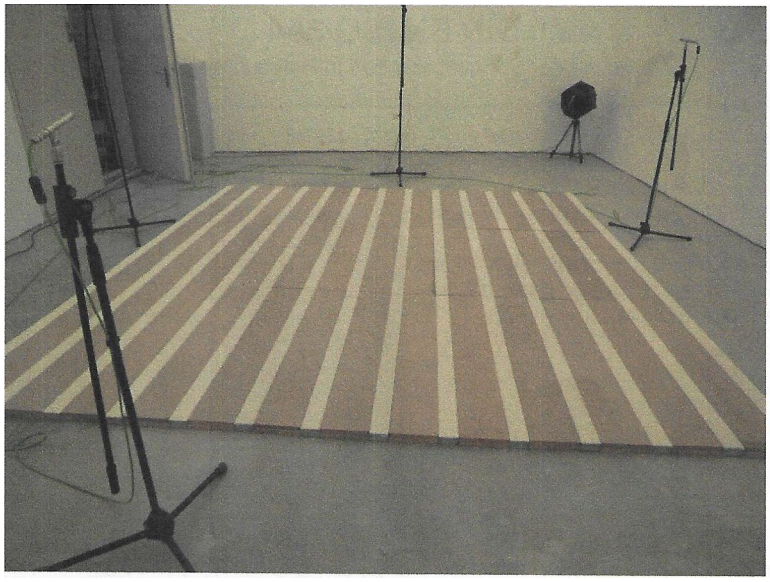


Image appendix 1: test setup 1 in the reverberation room of the HFT Stuttgart.

Image appendix 2: test setup 2 in the reverberation room of the HFT Stuttgart.

	Sound absorption coefficient α_s according to EN ISO 354 Measurement of sound absorption in reverberation rooms	Annex 1 122 002 14T - 401

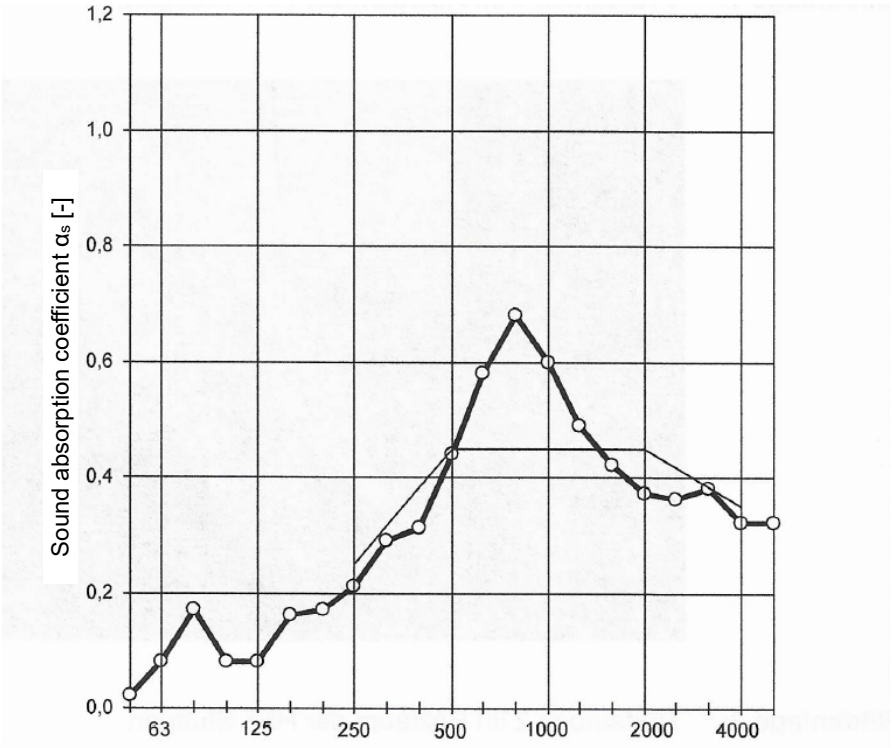
Client: Max Frank GmbH & Co. KG, Mitterweg 1, 94339 Leiblfing

Test object: **Sorp 10® with acoustic plaster**

Footprint 3.32 m x 3.60 m = 11.95 m²
Arrangement:
14 pieces Sorp 10® with acoustic plaster (70 mm), in between chipboard width 180 mm,construction height 35 mm.

Volume of reverberation room: V = 203.3 m²
Area of the test object: S = 12.0 m²

Frequency [Hz]	α_s [-]	α_p [-]
50	0.02	
63	0.08	
80	0.17	
100	0.08	
125	0.08	0.10
160	0.16	
200	0.17	
250	0.21	0.20
315	0.29	
400	0.31	
500	0.44	0.45
630	0.58	
800	0.68	
1000	0.60	0.60
1250	0.49	
1600	0.42	
2000	0.37	0.40
2500	0.36	
3150	0.38	
4000	0.32	0.35
5000	0.32	



Test sound: Pink noise
Receive filter: one-third octave filter

Evaluation according to EN ISO 11654:

Evaluated sound absorption coefficient: α_w = 0.45

Sound absorber class: D

The determination is based on test bench measurements obtained in one-third octave bands.

Project number: 122 002 14T - 401

Test date: 09/02/2022

Stuttgart University of Applied Sciences

Date 15/02/2022

	Sound absorption coefficient α_s according to EN ISO 354 Measurement of sound absorption in reverberation rooms	Annex 2 122 002 14T - 401

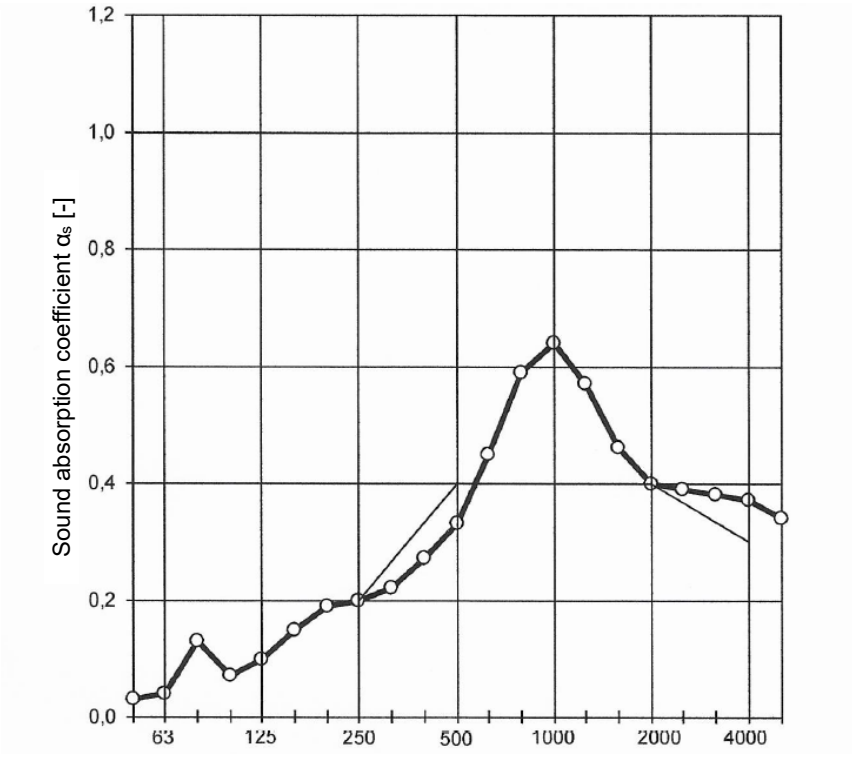
Client: Max Frank GmbH & Co. KG, Mitterweg 1, 94339 Leiblfing

Test object: **Sorp 10® classic**

Footprint 3.32 m x 3.60 m = 11.95 m²
Arrangement:
14 pieces Sorp 10® classic (70 mm),
in between chipboard width 180 mm,
construction height 35 mm.

Volume of reverberation room: V = 203.3 m²
Area of the test object: S = 12.0 m²

Frequency [Hz]	α_s [-]	α_p [-]
50	0.03	
63	0.04	
80	0.13	
100	0.07	
125	0.10	0.10
160	0.15	
200	0.19	
250	0.20	0.20
315	0.22	
400	0.27	
500	0.33	0.35
630	0.45	
800	0.59	
1000	0.64	0.60
1250	0.57	
1600	0.46	
2000	0.40	0.40
2500	0.39	
3150	0.38	
4000	0.37	0.35
5000	0.34	



Test sound: Pink noise
Receive filter: one-third octave filter

Evaluation according to EN ISO 11654:

Evaluated sound absorption coefficient: α_w = 0.4

Sound absorber class: D

The determination is based on test bench measurements obtained in one-third octave bands.

Project number: 122 002 14T - 401

Test date: 09/02/2022

Stuttgart University of Applied Sciences

Date 15/02/2022