Technische Universität Berlin
Fachgebiet Technische Akustik
Akustik-Prüfstelle
Einsteinufer 25
10587 Berlin

Test Report

Sound absorption of the fabric article “Shake”

Customer: rohi Stoffe GmbH
Schoenlinderstrasse 1
D-82538 Geretsried
Germany

Test Report No.: 19010

Date: May 20, 2019

Person in charge:
Dr.-Ing. Roman Tschakert

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1. Scope of measurements

The sound absorption of a fabric article was evaluated in the reverberation room at the Department of Engineering Acoustics. The test object was:

a) Shake plane
95 % WV / 5 % PA, mass per unit area 440 g/m^2,
1 curtain size 3000 × 3500 mm, 50 mm wrapped for hanging, plane,
type G-100 mounting with 100 mm distance from the wall,

b) Shake gathered
95 % WV / 5 % PA, mass per unit area 440 g/m^2,
2 curtains size 3000 × 3500 mm, gathered, 100 % gathering,
type G-100 mounting with 100 mm distance from the wall.

Photos of the test setup are given in Figure 1.

2. Procedure

The sound absorption was determined in one-third-octave bands according to the ISO 354 [5]. The practical sound absorption coefficient according to ISO 11654 [6] for each octave band was calculated by averaging the three one-third-octave absorption coefficients whithin the octave. By shifting a reference curve the weighted sound absorption coefficient and the sound absorption class were determined.

The mounting of each test object, the measurement procedure and the climatic conditions are given in the test certificates in the appendix A.

Person in charge:	Roman Tschakert (TU Berlin)
Operators:	Arne Hoelter (TU Berlin)
	Artur Paszkiewicz (TU Berlin)

2.1. Measuring equipment

Measuring devices:

- four NTi XL2 sound level meter, firmware 4.10 ,S.-No. A2A-02022-C0, S.-No. A2A-10883-E0, S.-No A2A-10886-E0, S.-No. A2A-10887-E0 [1] [2] ,
- eight ½" microphones PCB Piezotronics Inc. type 378B2, S.-No. 112513 to 112518 and S.-No. 112521 to 112522 [1] ,
- calibrator Norsonic type 1251, S.-No. 20833 [3] ,
- dodekaeder loudspeaker Norsonic type K100/12, S.-No. 534 [4] ,
- dodekaeder loudspeaker Schalltechnik Süd & Nord type DO12-S [4] ,
- amplifier Norsonic type 215, S.-No. 511 [4] ,
- noise generator NTi Audio type Minirator MR-PRO, S.-No. G2P-RAFXW-GO .

Test lab:

The measurements were done in the reverberation room at the Department of Engineering Acoustics, which complies to the ISO 354 [5]. Its volume is 200m^3 and it is equipped with 13 diffusors.

Software:

The sound absorption was calculated with Gnu Octave version 4.4.1 [1].

3. Test results

The test results for Shake plane are documented in the certificates in Figure 2 and Figure 4.

The test results for Shake gathered are documented in the certificates in Figure 3 and Figure 5.

[1] Class 1 according to EN 61672 part 1 [3]
[2] Class 1 according to EN 61260 part 1 [2]
[3] Class 1 according to EN IEC 60942 [4]
[4] tested by the PTB in Braunschweig regularly

References

[1] EATON, John W. u. a.: *GNU Octave 4.4.1*. `https://www.gnu.org/software/octave`, 2018

[2] Standard EN 61260-1 June 2014. *Electroacoustics - Octave-band and fractional-octave-band filters - Part 1: Specifications (IEC 61260-1:2014)*

[3] Standard EN 61672-1 December 2013. *Electroacoustics - Sound level meters - Part 1: Specifications (IEC 61672-1:2013)*

[4] Standard EN IEC 60942 March 2018. *Electroacoustics - Sound calibrators (IEC 60942:2017)*

[5] Standard ISO 354 May 2003. *Acoustics - Measurement of sound absorption in a reverberation room*

[6] Standard ISO 11654 April 1997. *Acoustics - Sound absorbers for use in buildings - Rating of sound absorption*

A. Appendix

Figure 1: Test setup (from the top to the bottom): Shake plane, Shake gathered.

Sound absorption coefficient according to ISO 11654
Laboratory measurements of sound absorption in a reverberation room

Client: rohi Stoffe GmbH Date of test: 24.4.2019

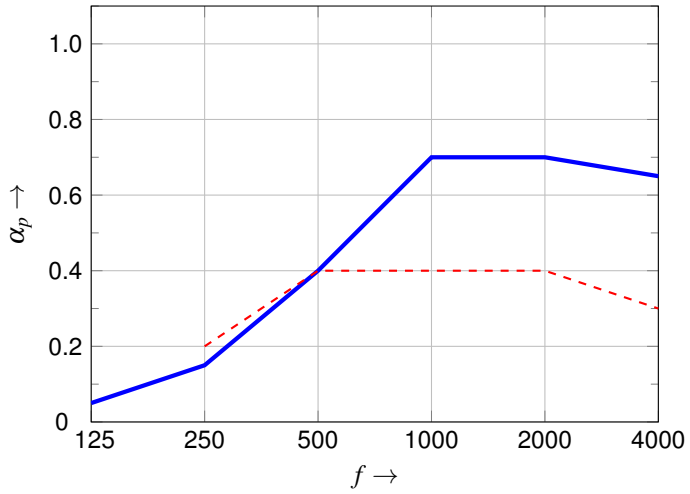
Shake plane

95 % WV / 5 % PA, mass per unit area 440 g/m^2,
1 curtain size 3000 × 3500 mm, 50 mm wrapped for hanging, plane,
type G-100 mounting with 100 mm distance from the wall

Size of the specimen:	10.3 m^2		
Volume of the reverb. room:	200.9 m^2		
Reverberation room with the test specimen		Empty reverberation room	
Temperature:	20.7 ℃	Temperature:	20.6 ℃
Air humidity:	42.8 %	Air humidity:	42.9 %
Atmospheric pressure:	1003.2 hPa	Atmospheric press.:	1003.1 hPa

f	α_p
125	0.05
250	0.15
500	0.40
1000	0.70
2000	0.70
4000	0.65

Legend:
α_p practical sound absorption coefficient
f frequency one-third-octave bands in Hz
---- shifted reference curve (ISO 11654)



Weighted sound absorption coefficient acc. to ISO 11654:

$\alpha_w = 0.40$ (M) Sound absorption class: D

Evaluation based on laboratory measurements. Results obtained with a standard procedure: Interrupted noise method with 3 measurements averaged at each microphone/loudspeaker position. 2 Loudspeaker positions each with 8 microphone positions.

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Date: 20.5.2019 Signature:

Figure 2: Test certificate 19010I, Shake plane, weighted sound absorption coefficient.

Sound absorption coefficient according to ISO 11654
Laboratory measurements of sound absorption in a reverberation room

Client: rohi Stoffe GmbH Date of test: 9.5.2019

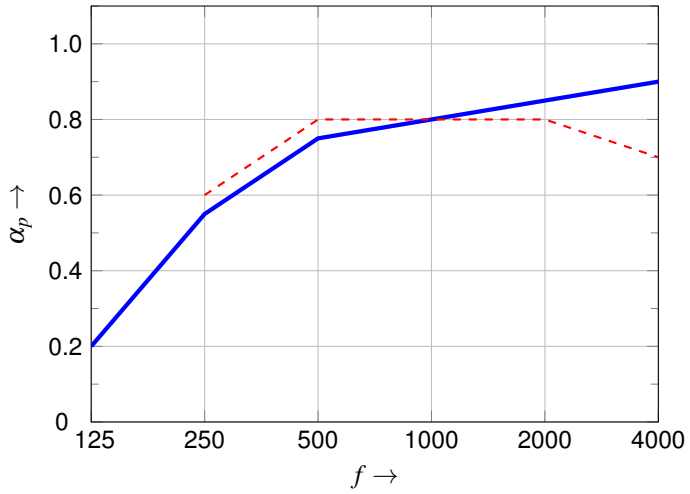
Shake gathered

95 % WV / 5 % PA, mass per unit area 440 g/m^2,
2 curtains size 3000 × 3500 mm, gathered, 100 % gathering,
type G-100 mounting with 100 mm distance from the wall

Size of the specimen:	10.5 m^2		
Volume of the reverb. room:	200.9 m^2		
Reverberation room with the test specimen		Empty reverberation room	
Temperature:	18.8 ℃	Temperature:	18.7 ℃
Air humidity:	43.1 %	Air humidity:	43.4 %
Atmospheric pressure:	996.0 hPa	Atmospheric press.:	995.9 hPa

f	α_p
125	0.20
250	0.55
500	0.75
1000	0.80
2000	0.85
4000	0.90

Legend:
α_p practical sound absorption coefficient
f frequency one-third-octave bands in Hz
---- shifted reference curve (ISO 11654)



Weighted sound absorption coefficient acc. to ISO 11654:

α_w = 0.80 Sound absorption class: B

Evaluation based on laboratory measurements. Results obtained with a standard procedure: Interrupted noise method with 3 measurements averaged at each microphone/loudspeaker position. 2 Loudspeaker positions each with 8 microphone positions.

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Figure 3: Test certificate 19010II, Shake gathered, weighted sound absorption coefficient.

Sound absorption coefficient according to ISO 354
Laboratory measurements of sound absorption in a reverberation room

Client: rohi Stoffe GmbH Date of test: 24.4.2019

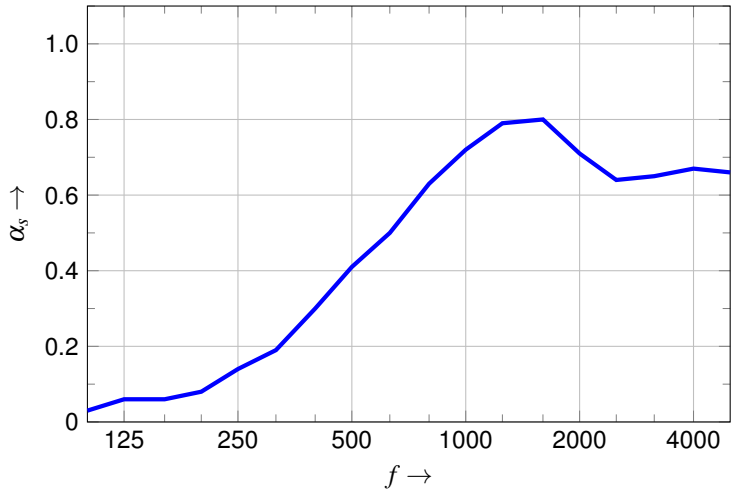
Shake plane

95 % WV / 5 % PA, mass per unit area 440 g/m^2,
1 curtain size 3000 × 3500 mm, 50 mm wrapped for hanging, plane,
type G-100 mounting with 100 mm distance from the wall

Size of the specimen:	10.3 m^2		
Volume of the reverb. room:	200.9 m^2		
Reverberation room with the test specimen		Empty reverberation room	
Temperature:	20.7 ℃	Temperature:	20.6 ℃
Air humidity:	42.8 %	Air humidity:	42.9 %
Atmospheric pressure:	1003.2 hPa	Atmospheric press.:	1003.1 hPa

f	α_S	T_1	T_2
100	0.03	8.7	8.0
125	0.06	8.2	7.0
160	0.06	7.6	6.6
200	0.08	7.8	6.5
250	0.14	8.0	5.9
315	0.19	8.0	5.3
400	0.30	8.0	4.5
500	0.41	8.4	4.0
630	0.50	7.9	3.5
800	0.63	7.5	3.0
1000	0.72	6.9	2.7
1250	0.79	6.4	2.4
1600	0.80	5.5	2.3
2000	0.71	4.6	2.3
2500	0.64	3.7	2.1
3150	0.65	3.1	1.9
4000	0.67	2.7	1.7
5000	0.66	2.1	1.5

Legend:
α_s sound absorption coefficient
f frequency one-third-octave bands in Hz
T_1 reverberation time, in seconds, of the empty rev. room
T_2 reverberation time, in seconds, with the test specimen



Evaluation based on laboratory measurements. Results obtained with a standard procedure: Interrupted noise method with 3 measurements averaged at each microphone/loudspeaker position. 2 Loudspeaker positions each with 8 microphone positions.

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Figure 4: Test certificate 19010I, Shake plane, sound absorption coefficient.

Sound absorption coefficient according to ISO 354
Laboratory measurements of sound absorption in a reverberation room

Client: rohi Stoffe GmbH Date of test: 9.5.2019

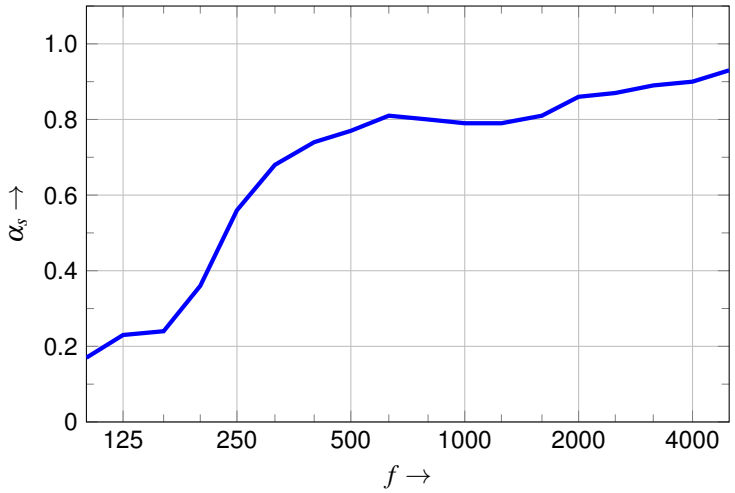
Shake gathered

95 % WV / 5 % PA, mass per unit area 440 g/m^2,
2 curtains size 3000 × 3500 mm, gathered, 100 % gathering,
type G-100 mounting with 100 mm distance from the wall

Size of the specimen:	10.5 m^2		
Volume of the reverb. room:	200.9 m^2		
Reverberation room with the test specimen		Empty reverberation room	
Temperature:	18.8 ℃	Temperature:	18.7 ℃
Air humidity:	43.1 %	Air humidity:	43.4 %
Atmospheric pressure:	996.0 hPa	Atmospheric press.:	995.9 hPa

f	α_S	T_1	T_2
100	0.17	8.6	5.9
125	0.23	7.8	5.0
160	0.24	7.3	4.6
200	0.36	7.8	4.1
250	0.56	8.0	3.3
315	0.68	7.8	2.9
400	0.74	8.1	2.8
500	0.77	8.4	2.7
630	0.81	7.9	2.6
800	0.80	7.6	2.6
1000	0.79	7.1	2.5
1250	0.79	6.5	2.4
1600	0.81	5.5	2.3
2000	0.86	4.5	2.0
2500	0.87	3.7	1.8
3150	0.89	3.1	1.6
4000	0.90	2.6	1.5
5000	0.93	2.1	1.3

Legend:
α_s sound absorption coefficient
f frequency one-third-octave bands in Hz
T_1 reverberation time, in seconds, of the empty rev. room
T_2 reverberation time, in seconds, with the test specimen



Evaluation based on laboratory measurements. Results obtained with a standard procedure: Interrupted noise method with 3 measurements averaged at each microphone/loudspeaker position. 2 Loudspeaker positions each with 8 microphone positions.

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Date: 20.5.2019 Signature:

Figure 5: Test certificate 19010II, Shake gathered, sound absorption coefficient.