Hochschule für Technik Stuttgart

Institute of Applied Sciences
- Acoustics -

Test Report No. 122 002 14T-396

Measurements of sound absorption for ECHOJAZZ EchoBaffle Plain

Measurements of sound absorption in the reverberation room according to DIN EN ISO 354

Applicant: ECHOJAZZ AG
Ringstrasse 25
CH-6010 Kriens

Project-No.: 122 002 14T-396

1 Task

The measurements of the sound absorption were realised on Juliy 29th, 2021 in the reverberation room of the sound technical laboratory of the University of Applied Sciences Stuttgart (HFT Stuttgart), Centre for Building Physics, Pfaffenwaldring 10a, 70569 Stuttgart-Vaihingen.

2 Measurements of sound absorption in the reverberation room

2.1 Sampling

The specimen were delivered by Mr. Bonnard of ECHOJAZZ AG and built up from Mr. Bonnard and the staff of HFT Stuttgart in the reverberation room.

2.2 Measurement

Client:	ECHOJAZZ AG, CH-6010 Kriens
Producer:	ECHOJAZZ AG, CH-6010 Kriens
Test specimen:	1 EchoBaffle 24 mm – Plain L and 2 EchoBaffle 12 mm - Plain L

Test specimen 1: EchoBaffle 24 mm – Plain L (see picture 1)

- 24 pieces 2,360 m x 0,195 m x 0,024 m
  2 crossbars 4,800 m x 0,100 m x 0,024 m
- 24 rows, distance (panel center): 0,200 m
- Surface area of test specimen: 2,36 m x 4,80 m = 11,33 m²
- Wooden frame around the test specimen

Test specimen 2: EchoBaffle 12 mm - Plain L (see picture 2)

- 30 pieces 2,380 m x 0,195 m x 0,012 m
  2 crossbars 4,800 m x 0,100 m x 0,012 m
- 30 rows, distance (panel center): 0,160 m
- Surface area of test specimen: 4,80 m x 2,36 m = 11,33 m²
- Wooden frame around the test specimen

3 Execution of the measurements

The measurements were realised in a reverberation room according to DIN EN ISO 354, issue 12/2003 considering annexes A, B and ZA. The method was applied with disconnected noise. The specimen were observed as rectangular baffles according chapter 6.2.2.1 and were arranged in the reverberation room according annex B, layout type J. The arrangement of test specimen deviated from the proposals of layout type J. The test areas represented 11,33 m². A wooden frame enclosed two sides of the test specimen area. Air gaps between wooden frame and ground floor were sealed.

The sound absorption coefficient α_s for rectangular baffles was determined after following relation:

$$\alpha_s = A_T/S$$

With:

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

That means:

A_T	=	equivalent sound absorption area of specimen 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 incl. specimen in m²;
S	=	the area of the specimen in m²;
V	=	volume of the empty reverberation room in m³;
c_1	=	sound velocity in the air in m/s at temperature T_1;
c_2	=	sound velocity in the 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 positioning the specimen in s;
$m_{1/2}$	=	air absorption coefficient in 1/m, calculated with the existing climate terms during the particular measurements.

The evaluation of the sound absorption coefficient is carried out according to DIN EN ISO 11654, issue 5/2018.

The 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

Following measuring instruments were used:

Analyser:	Manufacturer: Sinus	Type: Soundbook	SN: 07296
Amplifier:	Manufacturer: Falm	Type: PA1000	SN: 280121
Loudspeaker:	Manufacturer: Norsonic	Type: 229	SN: 15013
4 x preamplifier:	Manufacturer: MicroTech Gefell	Type: MV210	SN: 13643 SN: 13644 SN: 13668 SN: 13674
4 x microphone:	Manufacturer: MicroTech Gefell	Type: 1220	SN: 4016 SN: 4017 SN: 4018 SN: 4019
Calibrator:	Manufacturer: Larson	Type: Cal200	SN: 7237
Climate measurement:	Manufacturer: Extech Instr.	Type: SD700	SN: 026717

Test sound was pink noise.

The used airborne sound measurement chain was DAkkS calibrated and bears the calibration mark *2020*.

4 Measuring results

Table 1 and 2 show the average values of the reverberation time of the test specimen. In annex 1 and 2 the measured sound absorption coefficients α_s for the specimen is represented. The values of the sound absorption coefficients α_s and the practical absorption coefficients α_p are shown next to the diagram.

Test specimen 1:

Ratings DIN EN ISO 11654: weighted sound absorption value α_w = 0,5 (H)
Absorption Class according DIN EN ISO 11654: D
Ratings according ASTM C 423: Sound Absorption Average SAA = 0,54
Classification according ASTM E 1264 Noise Reduction Coefficient NRC = 0,55

Test specimen 2:

Ratings DIN EN ISO 11654: weighted sound absorption value α_w = 0,45 (H)
Absorption Class according DIN EN ISO 11654: D
Ratings according ASTM C 423: Sound Absorption Average SAA = 0,46
Classification according ASTM E 1264 Noise Reduction Coefficient NRC = 0,50

The report contains: 4 pages text
2 tables
2 pictures
2 annexes

To publish this report in extracts has to be allowed in advance by University of Applied Sciences Stuttgart. The mentioned measuring results refer only to the specimen with the described layout.

Stuttgart, the 10th of August 2021

Issuer: Laboratory Manager:

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

test specimen 1			test specimen 2		
Frequenz [Hz]	**T_1 [s]**	**T_2 [s] with test specimen**	**Frequenz [Hz]**	**T_1 [s]**	**T_2 [s] with test specimen**
100	7,16	5,58	**100**	7,16	5,67
125	7,22	5,07	**125**	7,22	4,86
160	8,19	4,65	**160**	8,19	4,53
200	7,01	4,04	**200**	7,01	4,16
250	6,69	3,98	**250**	6,69	3,96
315	6,48	3,68	**315**	6,48	3,89
400	6,14	3,52	**400**	6,14	3,61
500	5,29	3,08	**500**	5,29	3,27
630	5,12	2,93	**630**	5,12	3,19
800	5,38	2,80	**800**	5,38	3,20
1000	5,53	2,54	**1000**	5,53	2,83
1250	5,28	2,20	**1250**	5,28	2,52
1600	4,97	2,01	**1600**	4,97	2,32
2000	4,69	1,98	**2000**	4,69	2,09
2500	4,32	1,88	**2500**	4,32	1,92
3150	3,85	1,76	**3150**	3,85	1,79
4000	3,20	1,63	**4000**	3,20	1,64
5000	2,58	1,45	**5000**	2,58	1,44
temperature [°C]	24,7	24,9	**temperature [°C]**	24,7	24,7
humidity [%]	48,5	48,6	**humidity [%]**	48,5	48,1
air pressure [hPa]	960,6	960,7	**air pressure [hPa]**	960,6	960,8

Table 1: Climate data at the time of the measurements and the average values of the reverberation time T_1 in the empty reverberation room respectively T_2 in the reverberation room with the specimen.

Picture 1: Photography of test specimen 1 in the reverberation room.

Picture 2: Photography of test specimen 2 in the reverberation room.

	Sound absorption coefficient α_s according EN ISO 354 Measurement of sound absorption in a reverberation room	Annex 1 122 002 14T - 396

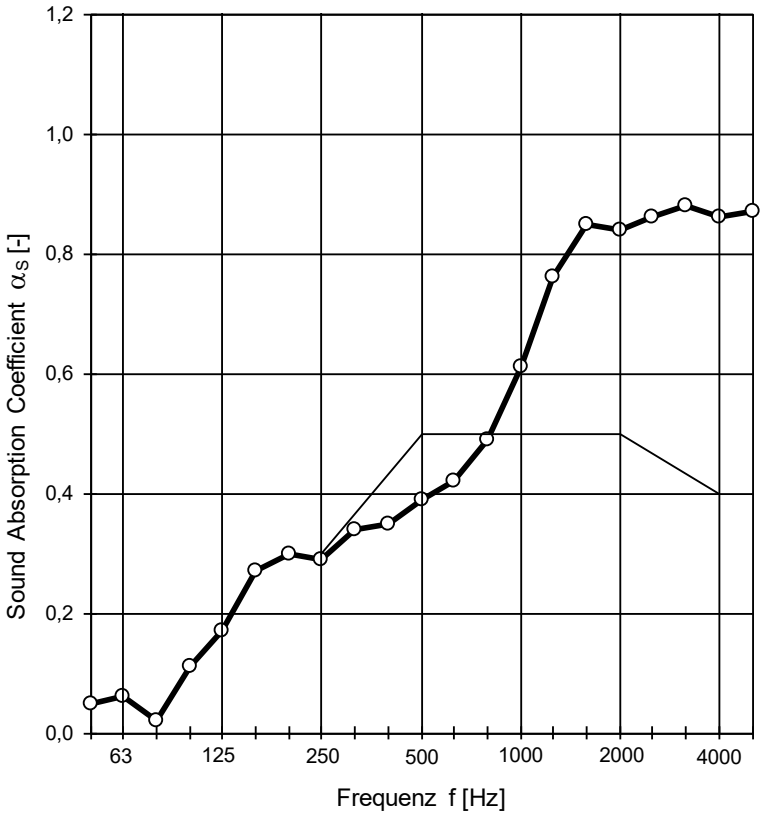
Client: ECHOJAZZ
Producer: ECHOJAZZ AG, Ringstrasse 25, CH-6010 Kriens
Test specimen: **EchoBaffle 24 mm - Plain L**
24 pieces 2,360 m x 0,195 m x 0,024 m
2 crossbars 4,800 m x 0,100 m x 0,024 m
24 rows, distance (panel center): 0,200 m
Surface area of test specimen: 4,8 m x 2,36 m = 11,33 m²
Wooden frame around the test specimen

Setup according to EN ISO 354 layout type J, except number of rows.

Room Volume: V_S = 203,3 m³
Surface of test specimen S = 11,3 m²

Frequency [Hz]	α_S [-]	α_p [-]
50	0,05	
63	0,06	
80	0,02	
100	0,11	
125	0,17	0,20
160	0,27	
200	0,30	
250	0,29	0,30
315	0,34	
400	0,35	
500	0,39	0,40
630	0,42	
800	0,49	
1000	0,61	0,60
1250	0,76	
1600	0,85	
2000	0,84	0,85
2500	0,86	
3150	0,88	
4000	0,86	0,85
5000	0,87	

Excitation signal: Pink noise
Filtering: Third octave band filtering



Ratings according EN ISO 11654: **weighted sound absorption value:** **α_w = 0,5 (H)**
Absorption Class according EN ISO 11654: D
Rating according ASTM C 423: **Sound Absorption Average:** **SAA = 0,54**
Classification according ASTM E 1264: **Noise Reduction Coefficient:** **NRC = 0,55**
The determination is based on 1/3 octave laboratory measurement results.

	Sound absorption coefficient α_s according EN ISO 354 Measurement of sound absorption in a reverberation room	Annex 2 122 002 14T - 396

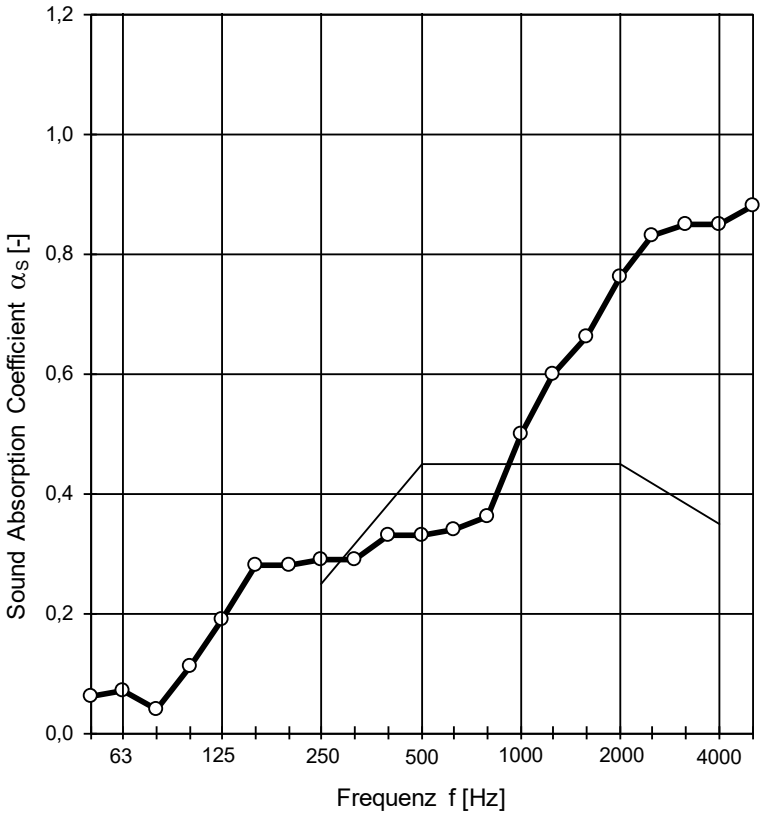
Client: ECHOJAZZ
Producer: ECHOJAZZ AG, Ringstrasse 25, CH-6010 Kriens
Test specimen: **EchoBaffle 12 mm - Plain L**
30 pieces 2,360 m x 0,195 m x 0,012 m
2 crossbars 4,800 m x 0,100 m x 0,012 m
30 rows, distance (panel center): 0,160 m
Surface area of test specimen: 4,8 m x 2,36 m = 11,33 m²
Wooden frame around the test specimen

Setup according to EN ISO 354 layout type J, except number of rows.

Room Volume: V_S = 203,3 m³
Surface of test specimen S = 11,3 m²

Frequency [Hz]	α_S [-]	α_p [-]
50	0,06	
63	0,07	
80	0,04	
100	0,11	0,20
125	0,19	
160	0,28	
200	0,28	0,30
250	0,29	
315	0,29	
400	0,33	0,35
500	0,33	
630	0,34	
800	0,36	0,50
1000	0,50	
1250	0,60	
1600	0,66	0,75
2000	0,76	
2500	0,83	
3150	0,85	0,85
4000	0,85	
5000	0,88	

Excitation signal: Pink noise
Filtering: Third octave band filtering



Ratings according EN ISO 11654:	**weighted sound absorption value:**	**α_w = 0,45 (H)**
	Absorption Class according EN ISO 11654:	D
Rating according ASTM C 423:	**Sound Absorption Average:**	**SAA = 0,46**
Classification according ASTM E 1264:	**Noise Reduction Coefficient:**	**NRC = 0,50**

The determination is based on 1/3 octave laboratory measurement results.