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M56 910/7 msg/jre

Curtain fabric Colorama 2
Manufacturer Silent Gliss

Measurement of sound absorption in a reverberation room according to EN ISO 354

Test Report No. M56 910/7

Client:	Silent Gliss GmbH Rebgartenweg 5 79576 Weil am Rhein Germany
Consultant:	M. Eng. Philipp Meistring
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1 Task

On behalf of the company Silent Gliss GmbH, 79576 Weil am Rhein, Germany, the sound absorption coefficient of the curtain fabric type Colorama 2 was to be determined by measurements in the reverberation room according to EN ISO 354 [1]. The fabric was tested in a flat arrangement with a distance to the reflecting wall of 200 mm. The results are to be evaluated according to EN ISO 11654 [2].

2 Basis

This test report is based on the following documents:

[1] EN ISO 354: Acoustics - Measurement of sound absorption in a reverberation room. 2003-05

[2] EN ISO 11654: Acoustics – Sound absorbers for use in buildings – Rating of sound absorption. 1997-04

[3] ISO 9613-1: Acoustics; Attenuation of sound during propagation outdoors; part 1: calculation of the absorption of sound by the atmosphere. June 1993

3 Test assembly and test objects

3.1 Measurement conditions

According to the client's instructions the test construction was mounted as type G-200 according to EN ISO 354 [1], section 6.2.1 and Appendix B.

The test objects were assembled in the reverberation room by the company Raumtec Westermeier, 85570 Markt Schwaben, Germany.

3.2 Test objects

The tested material can be is described as follows:

- curtain fabric type *Colorama 2*, color No. 410, white (manufacturer information)
- material: 100 % Trevira (polyester)
- thickness t = 0.45 mm
- area specific mass m'' = 265 g/m^2
- specific airflow resistance acc. to EN 29053: R_s = 172 Pa · s/m

The information on area specific mass, thickness and airflow resistance were determined by the testing laboratory. The measurement of the airflow resistance was effected according to EN 29053.

For the test assembly in mounting type G-200 according to EN ISO 354 [1] one curtain width x height = 3000 mm x 4000 mm was used. The curtain was fixed in flat arrangement directly underneath the ceiling, suspended on a metal rail (height 40 mm). The clear distance to the wall was 200 mm.

There was no enclosing frame. The total dimensions of the test surface were width x height = 4000 mm x 2960 mm.

Further information on the test assembly are presented in the test certificate in Appendix A. Appendix B shows photos of the test assembly.

4 Execution of the measurements

The measurements were executed and evaluated according to EN ISO 354 [1].

The test method, the test facility and the test equipment used are described in Appendix C.

5 Evaluation

The sound absorption coefficient α_S was determined in one-third octave bands between 100 Hz and 5000 Hz according to EN ISO 354 [1].

In addition to the sound absorption coefficients the following characteristic values were determined according to EN ISO 11654 [2].

- Practical sound absorption coefficient α_p in octave bands
- Weighted sound absorption coefficient α_w as single value:

  The weighted sound absorption coefficient α_w is determined from the practical sound absorption coefficients α_p in the octave bands of 250 Hz to 4000 Hz.

6 Measurement results

The sound absorption coefficients α_S in one third-octave bands, the practical sound absorption coefficients α_p in octave bands and the single values α_w are indicated in the test certificate in Appendix A.

7 Remarks

The test results exclusively refer to the conditions on the day of measurements.

M. Eng. Philipp Meistring

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Sound absorption coefficient ISO 354

Measurement of sound absorption in reverberation rooms

Client: Silent Gliss GmbH
Rebgartenweg 5, D-79576 Weil am Rhein, Germany

Test specimen: Curtain fabric Colorama 2
flat arrangement, wall distance 200 mm

Fabric:

- manufacturer Silent Gliss
- curtain fabric "Colorama 2", color 410 (white)
- material 100 % Trevira (polyester)
- area specific mass approx. m'' = 265 g/m²
- specific airflow resistance R_S = 172 Pa s/m
- thickness t = 0.45 mm

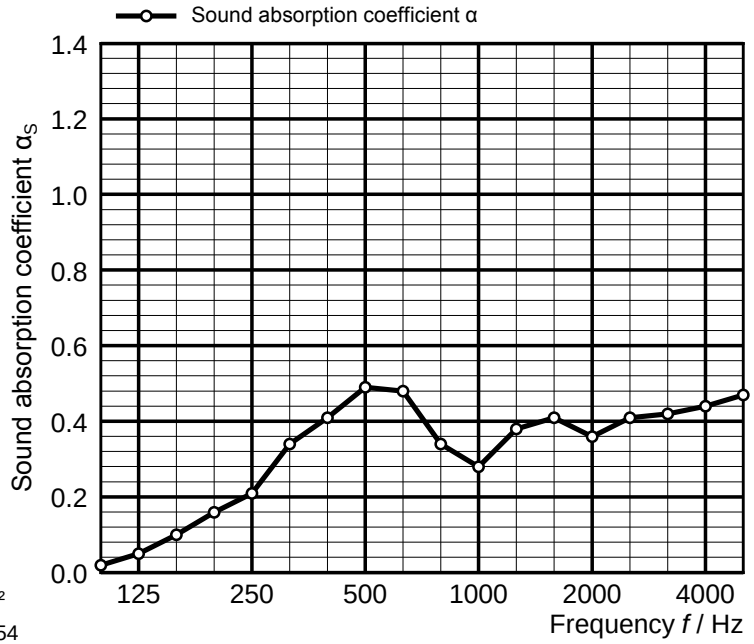
Test arrangement:

- mounting type G-200 acc. to EN ISO 354, without enclosing frame
- curtain 4000 mm x 3000 mm
- flat arrangement with a distance of 200 mm to the reverberation room wall
- suspended on a metal rail (height 40 mm)
- test area height x width = 2960 mm x 4000 mm

Room: E
Volume: 199.60 m³
Size: 11.84 m²
Date of test: 2010-05-26

	θ [°C]	r. h. [%]	B [kPa]
without specimen	21.1	50.3	94.9
with specimen	21.1	50.9	94.9

Frequency [Hz]	α_S 1/3 octave	α_p octave
100	∘ 0.02	
125	∘ 0.05	0.05
160	0.10	
200	0.16	
250	0.21	0.25
315	0.34	
400	0.41	
500	0.49	0.45
630	0.48	
800	0.34	
1000	0.28	0.35
1250	0.38	
1600	0.41	
2000	0.36	0.40
2500	0.41	
3150	0.42	
4000	0.44	0.45
5000	0.47	



∘ Equivalent sound absorption area less than 1.0 m²

α_S Sound absorption coefficient according to ISO 354

α_p Practical sound absorption coefficient according to ISO 11654

Rating according to ISO 11654:

Weighted sound absorption coefficient α_w = 0.40

Sound absorption class: D

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Appendix A
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Curtain fabric Colorama 2, Manufacturer Silent Gliss

Figure B.1. Curtain fabric suspended on a metal rail.

Figure B.2. Test object mounted in the reverberation room.

Description of the test procedure for the determination of the sound absorption in a reverberation room

1 Measurand

The sound absorption coefficient α of the test object was determined. For this purpose the mean value of the reverberation time in the reverberation room with and without the test object was measured. The sound absorption coefficient was calculated using the following equation:

$$\alpha_S = \frac{A_T}{S}$$

$$A_T = 55{,}3\,V\left(\frac{1}{c_2 T_2} - \frac{1}{c_1 T_1}\right) - 4\,V\,(m_2 - m_1)$$

With:

α_S sound absorption coefficient;

A_T equivalent sound absorption area of the test object in m^2;

S area covered by the test object in m^2;

V volume of the reverberation room in m^3;

c_1 propagation speed of sound in air in the reverberation room without test object in m/s;

c_2 propagation speed of sound in air in the reverberation room with test object in m/s;

T_1 reverberation time in the reverberation room without test object in s;

T_2 reverberation time in the reverberation room with test object in s;

m_1 power attenuation coefficient in the reverberation room without test object in m^{-1};

m_2 power attenuation coefficient in the reverberation room with test object in m^{-1}.

The different dissipation during the sound propagation in the air was taken into account according to paragraph 8.1.2 of EN ISO 354 [1]. The dissipation was calculated according to ISO 9613-1 [4]. The climatic conditions during the measurements are indicated in the test certificates.

Information on the repeatability and reproducibility of the test procedure are given in EN ISO 354 [1].

2 Test procedure

2.1 Description of the reverberation room

The reverberation room complies with the requirements according to EN ISO 354 [1].

The reverberation room has a volume of V = 199.6 m^3 and a surface of S = 216 m^2.

Six omni-directional microphones and four loudspeakers were installed in the reverberation room.

In order to improve the diffusivity, six composite sheet metal boards dimensioned 1.2 m x 2.4 m and six composite sheet metal boards dimensioned 1.2 m x 1.2 m were suspended curved and irregularly.

Figure C.1 shows the drawings of the reverberation room.

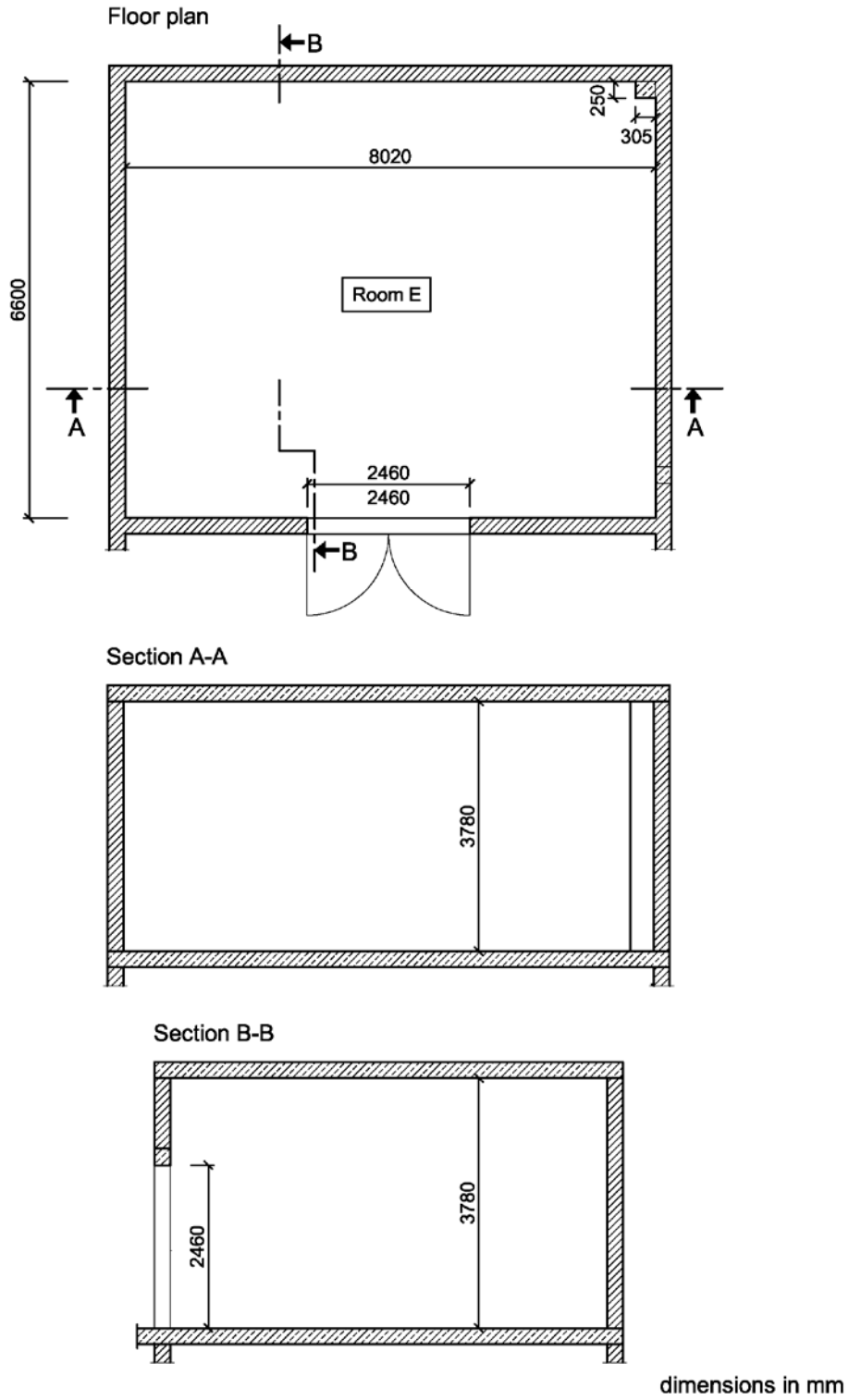

Figure C.1. Plan view and sections of the reverberation room.

2.2 Measurement of reverberation time

The determination of the impulse responses were carried out according to the indirect method. In all tests, a sinusoidal sweep with pink noise spectrum was used as test signal. In the reverberation room with and without test objects each 24 independent combinations of loudspeakers and microphones were measured. The reverberation time was evaluated according to EN ISO 354 [1], using a linear regression for the calculation of the reverberation time T_{20} from the level of the a backward integrated impulse response.

The determined reverberation times in the reverberation are indicated in table C.1.

Table 1. Reverberation times without and with test object.

Frequency in Hz	**Reverberation time *T* in s**	
	***T*₁ (without test object)**	***T*₂ (with test object)**
100	4.99	4.80
125	4.73	4.38
160	5.22	4.37
200	5.76	4.33
250	5.33	3.78
315	4.83	3.02
400	4.74	2.76
500	4.93	2.61
630	4.93	2.64
800	5.06	3.09
1000	5.29	3.41
1250	5.35	3.06
1600	5.29	2.95
2000	4.91	2.96
2500	4.33	2.61
3150	3.55	2.29
4000	2.86	1.95
5000	2.23	1.61

2.3 List of test equipment

The test equipment used is listed in table C.2.

Tabelle C.2. Test equipment.

Name	Manufacturer	Type	Serial-No.
Sound card	RME	Multiface II	22460388
Amplifier	APart	Champ One	09070394
Dodecahedron	Müller-BBM	DOD130B	265201
Dodecahedron	Müller-BBM	DOD130B	265202
Dodecahedron	Müller-BBM	DOD130B	265203
Dodecahedron	Müller-BBM	DOD130B	265204
Microphone	Microtech	M360	1783
Microphone	Microtech	M360	1785
Microphone	Microtech	M360	1786
Microphone	Microtech	M360	1787
Microphone	Microtech	M360	1788
Microphone	Microtech	M360	1789
Hygro-/Thermometer	Testo	Saveris H1E	01554624
Software for measurement and evaluation	Müller-BBM	Bau 4	Version 1.6