

Müller-BBM GmbH  
Robert-Koch-Str. 11  
82152 Planegg bei München

Telephone +49(89)85602 0  
Telefax +49(89)85602 111

www.MuellerBBM.de

Dipl.-Ing. (FH) Dominik Reif  
Telephone +49(89)85602 3566  
Dominik.Reif@mbbm.com

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M102794/22 RFD/STY

## **Roller blind fabric SHADE MEDIUM R**

**Measurement of sound absorption  
according to EN ISO 354**

**Test Report No. M102794/22**

Client:	Création Baumann AG Bern-Zürich-Strasse 23 4901 Langenthal Switzerland
Consultant:	Dipl.-Ing. (FH) Dominik Reif M.Eng. Philipp Meistring
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Müller-BBM GmbH  
HRB Munich 86143  
VAT Reg. No. DE812167190

Managing directors:  
Joachim Bittner, Walter Grotz,  
Dr. Carl-Christian Hantschk, Dr. Alexander Ropertz,  
Stefan Schierer, Elmar Schröder

**Table of contents**

<b>1</b>	<b>Task</b>	<b>3</b>
<b>2</b>	<b>Basis</b>	<b>3</b>
<b>3</b>	<b>Test object and test assembly</b>	<b>3</b>
<b>4</b>	<b>Execution of the measurements</b>	<b>5</b>
<b>5</b>	<b>Evaluation</b>	<b>5</b>
<b>6</b>	<b>Measurement results</b>	<b>5</b>
<b>7</b>	<b>Remarks</b>	<b>6</b>

Appendix A: Test certificate

Appendix B: Photograph of the test assembly

Appendix C: Description of test method,  
test facility and test equipment

## 1 Task

On behalf of the company Création Baumann AG, CH – 4901 Langenthal, the sound absorption of the roller blind fabric type SHADE MEDIUM R had to be measured according to EN ISO 354 [1] in the reverberation room. The fabric was tested as a curtain in a flat arrangement with a distance of 150 mm to the reflective wall.

## 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. 1993-06
- [4] ASTM C 423-09a: Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method. Revision: 09a. 2009-10
- [5] EN 29053: Acoustics – Materials for acoustical applications – Determination of airflow resistance. 1993-05

## 3 Test object and test assembly

### 3.1 Test object

The tested material is described by the manufacturer as follows:

- manufacturer: Création Baumann
- fabric: SHADE MEDIUM R, article no. 171375
- colorit: 7463
- material: 100 % PLF CS

The testing laboratory has measured as follows:

- thickness:  $t = 0.4 \text{ mm}$
- air flow resistance acc. to EN 29053 [5]:  $R_S = 202 \text{ Pa}\cdot\text{s}/\text{m}$
- area specific mass:  $m'' = 141 \text{ g}/\text{m}^2$

### 3.2 Test assembly

The installation of the test object was carried out by employees of the test laboratory at the reverberation room of Müller-BBM. The test object was installed in a flat arrangement (G-150).

The mounting details are as follows:

- distance to the wall 150 mm
- fixed directly underneath the ceiling, suspended from a metal rail, height 50 mm
- construction without enclosing frame

The mounting details for the tested arrangement are as follows:

- mounting type G-150 according to EN ISO 354 [1] section 6.2.1 and appendix B of EN ISO 354 [1]
- test object made of one fabric panel
- total dimensions of the test surface  
(starting at the lower border of the metal rail):  
width x height = 3.64 m x 2.99 m = 10.88 m<sup>2</sup>

The photograph in Appendix B shows details of the test arrangement.

## 4 Execution of the measurements

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

The test procedure, the test stand and the test equipment used for the measurements are described in Appendix C.

## 5 Evaluation

The sound absorption coefficient  $\alpha_S$  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  $\alpha_p$  in octave bands
- Weighted sound absorption coefficient  $\alpha_w$  as single value:

The weighted sound absorption coefficient  $\alpha_w$  is determined from the practical sound absorption coefficients  $\alpha_p$  in the octave bands of 250 Hz to 4000 Hz.

According to ASTM C 423-09a [4] the following characteristic values were determined:

- Noise reduction coefficient *NRC* as single value:

Arithmetical mean value of the sound absorption coefficients in the four one third-octave bands 250 Hz, 500 Hz, 1000 Hz and 2000 Hz; mean value rounded to 0.05.

- Sound absorption average *SAA* as single value:

Arithmetical mean value of the sound absorption coefficients in the twelve one third-octave bands between 250 Hz and 2500 Hz; mean value rounded to 0.01.

## 6 Measurement results


The sound absorption coefficients  $\alpha_S$  in one third-octave bands, the practical sound absorption coefficients  $\alpha_p$  in octave bands and the single values ( $\alpha_w$ , *NRC* and *SAA*) are indicated in the test certificate in Appendix A.

## 7 Remarks

The test results exclusively relate to the investigated subjects and conditions described.



Dipl.-Ing. (FH) Dominik Reif  
(Consultant)



M.Eng. Philipp Meistring  
(Project Leader)

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# Sound absorption coefficient ISO 354

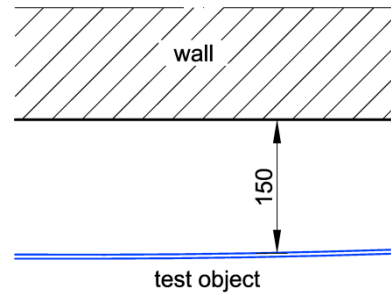
## Measurement of sound absorption in reverberation rooms

**Client:** Cr ation Baumann AG  
Bern-Z rich-Strasse 23, CH - 4901 Langenthal

**Test specimen:** SHADE MEDIUM R, flat arrangement

**Material details:**

- fabric: SHADE MEDIUM R; nr. 171375
- manufacturer: Cr ation Baumann AG
- material: 100 % PLF CS
- colorit: 7463
- thickness  $t = 0.4$  mm
- area specific mass  $m'' = 141$  g/m<sup>2</sup>
- airflow resistance acc. to EN 29053:  $R_s = 202$  Pa s/m



**Test arrangement:**

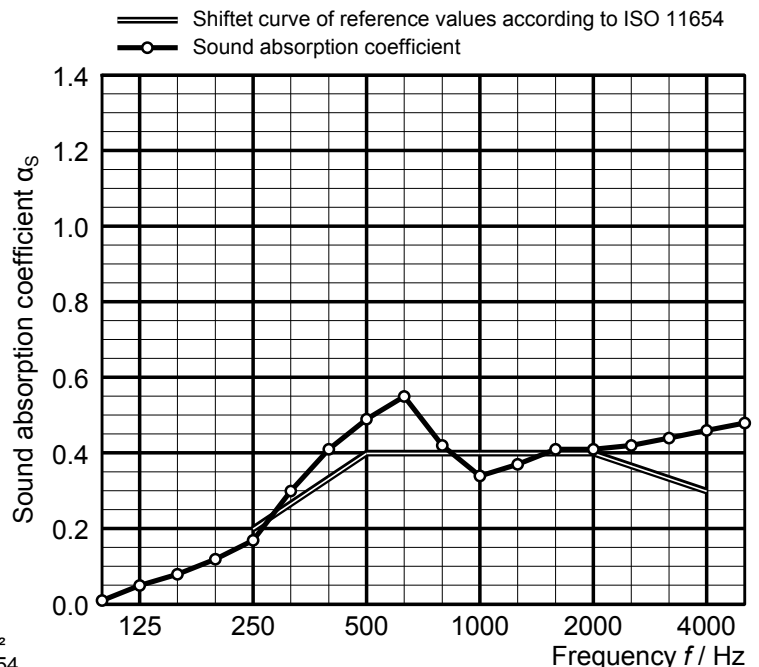
- mounting type G-150 acc. to ISO 354, paragraph 6.2.1
- suspended flat
- 150 mm clear distance between fabric and the wall of the reverberation room
- arranged without enclosing frame

A steel angle with a side length of 5 cm is mounted to the reverberation room ceiling. The material was suspended from this steel angle by means of magnets. The specimen was made of one fabric piece. The dimensions of the test area without mounting construction were width x height = 3.64 m x 2.99 m.

Room: Hallraum E  
Volume: 199.60 m<sup>3</sup>  
Size: 10.88 m<sup>2</sup>  
Date of test: 2016-05-31

	$\theta$ [°C]	r. h. [%]	$B$ [kPa]
without specimen	22.6	50.3	94.9
with specimen	22.7	52.2	94.8

Frequency [Hz]	$\alpha_s$ 1/3 octave	$\alpha_p$ octave
100	0.01	
125	0.05	0.05
160	0.08	
200	0.12	
250	0.17	0.20
315	0.30	
400	0.41	
500	0.49	0.50
630	0.55	
800	0.42	
1000	0.34	0.40
1250	0.37	
1600	0.41	
2000	0.41	0.40
2500	0.42	
3150	0.44	
4000	0.46	0.45
5000	0.48	



◦ Equivalent sound absorption area less than 1.0 m<sup>2</sup>  
 $\alpha_s$  Sound absorption coefficient according to ISO 354  
 $\alpha_p$  Practical sound absorption coefficient according to ISO 11654

Rating according to ISO 11654: <b>Weighted sound absorption coefficient</b> $\alpha_w = 0.40$ Sound absorption class: D	Rating according to ASTM C423: <b>Noise Reduction Coefficient <math>NRC = 0.35</math></b> <b>Sound Absorption Average <math>SAA = 0.37</math></b>
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**Roller blind fabric SHADE MEDIUM R, Création Baumann**

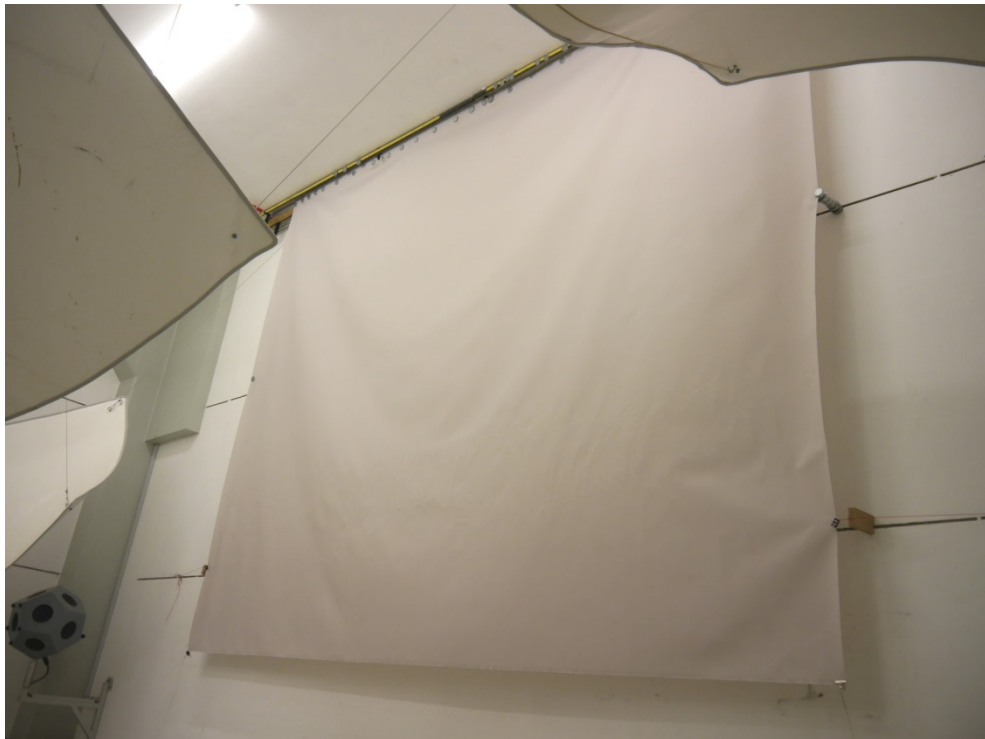


Figure B.1. Flat arrangement of the test object in the reverberation room.



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

### 1 Measurand

The sound absorption coefficient  $\alpha$  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:

- $\alpha_s$  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 [3]. 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.

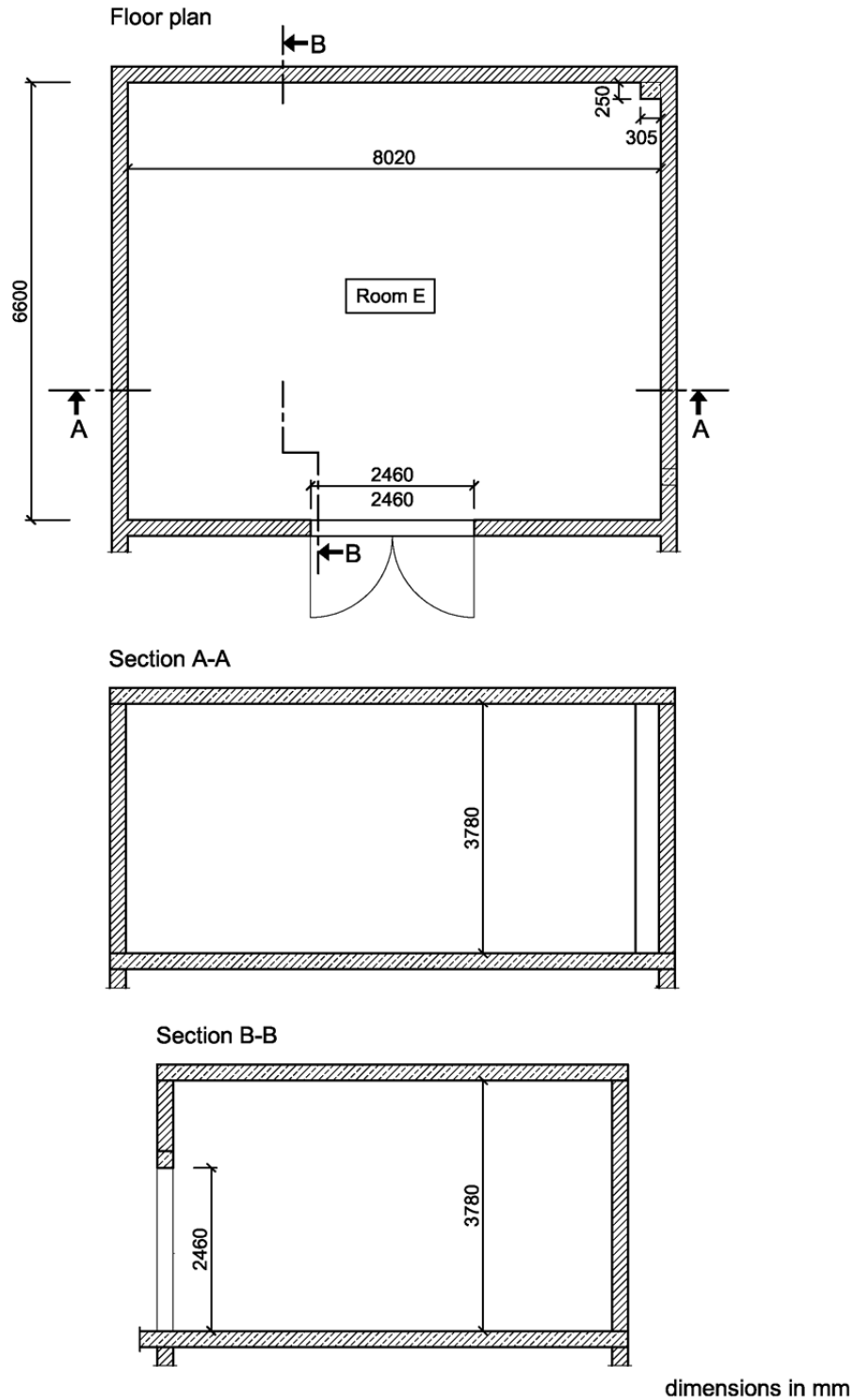


Figure C.1. Plan view and sections of the reverberation room.

## 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 backward integrated impulse response.

The determined reverberation times in the reverberation room with and without test object are indicated in Table C.1.

Table C.1. Reverberation times.

Frequency $f$ in Hz	Reverberation time $T$ in s	
	$T_1$ (without test object)	$T_2$ (with test object)
100	5.11	5.01
125	4.58	4.25
160	5.03	4.43
200	5.75	4.67
250	5.13	3.96
315	5.24	3.42
400	5.38	3.08
500	5.27	2.80
630	5.23	2.65
800	4.92	2.88
1000	5.19	3.22
1250	5.33	3.20
1600	5.26	3.03
2000	4.90	2.91
2500	4.34	2.69
3150	3.59	2.34
4000	2.84	1.98
5000	2.22	1.65

### 2.3 List of test equipment

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

Table C.2. List of test equipment.

Name	Manufacturer	Type	Serial-No.
AD-/DA-converter	RME	Multiface II	23556871
Amplifier	APart	Champ 2	09050048
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
Microphone power supply	MFA	IV80F	330364
Hygro-/Thermometer	Testo	Saveris H1E	01554624
Barometer	Lufft	Opus 10	030.0910.0003.9. 4.1.30
Software for measurement and evaluation	Müller-BBM	Bau 4	Version 1.8