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M52 297/1 nm/jre  
2006-03-02

**Thermal Hemp 045  
40 mm and 160 mm  
Type Hock Vertriebs GmbH & Co.KG**

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

**Test Report No. M52 297/1**

Manufacturer:	Hock Vertriebs GmbH & Co. KG Helmholtzstrasse 14 D-76297 Stutensee
Client:	FIW Forschungsinstitut für Wärmeschutz e.V. München Lochhamer Schlag 4 D-82166 Gräfelfing
Consultant:	Dipl.-Ing. (FH) Andreas Niermann
Date of test report:	2006-03-02
Date of measurements:	2006-05-11
Total number of pages:	In total 12 pages: 5 pages of text, 2 pages of appendix A, 3 pages of appendix B, 1 page of appendix C and 1 page of appendix D.

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## 1 Task

On behalf of the FIW Forschungsinstitut für Wärmeschutz e.V. München, D-82166 Gräfelfing the sound absorption of 40 mm and 160 mm thick thermal hemp 045, produced by Hock Vertriebs GmbH & Co. KG, D-76297 Stutensee has to be measured in the reverberation room according to DIN EN ISO 354.

## 2 Test objects and measurement conditions

On 8 April 2004 we received the material to be tested. The tests took place on 11 May 2004.

The test constructions were built up considering paragraph 6.2.1 of DIN EN ISO 354 "Acoustics, measurement of sound absorption in reverberation rooms" of December 2003 and the corresponding appendix B, paragraph B2, as mounting type A. The mounting was made by employees of the Müller-BBM company in accordance with the client.

The test construction is described in the following (from top to bottom):

- Thermal hemp 045  
Type Hock Vertriebs GmbH & Co. KG, Stutensee  
in plates length x width = 0.625 x 1.200 m<sup>2</sup>  
laid loosely, offset and butt jointed
- Floor of the reverberation room

For the first test/measurement 160 mm thick insulation was laid, for the second test the 40 mm thick insulation was built in.

An 160 mm or 40 mm high enclosing frame of 19 mm thick coated chipboards was arranged all around the respective test construction. The joints between the floor of the reverberation room and the frame were sealed (air tight).

According to the manufacturer it is a fibre insulation according to DIN 18165, part 1, assembling type W and WL of 80 – 85 % hemp fibres, 10 – 15 % bicomponent fibres and 3 – 5 % soda as fire prevention. The plates were laid loosely, offset and butt jointed on the floor of the reverberation room. For the test construction each 3 x 5 = 15 separate plates were arranged for the test surface of each 11,25 m<sup>2</sup>.

The test certificates in appendix A, pages 1 and 2 as well as the figures and drawings in appendix B show details of the constructions.

### 3 Execution of the measurements

The measurements were effected and evaluated according to DIN EN ISO 354 "Measurement of sound absorption in the reverberation room", edition 12/2003.

The measurements were carried out on 11 May 2004 in the reverberation room of the Müller-BBM company in Planegg. The reverberation room has a volume of approx. 200 m<sup>3</sup> and a surface of approx. 216 m<sup>2</sup>.

Six omnidirectional microphones and two loudspeakers were installed in the reverberation room. In order to improve the diffusivity, seven composite sheet metal boards (1.2 m x 1.4 m) and six composite sheet metal boards (1.2 m x 1.2 m) were suspended curved and irregularly.

In all tests, pink noise was used as a test signal.

The climatic conditions during the measurements are stated in the test certificates, appendix A, pages 1 to 3. The different dissipation during the sound propagation in the air was taken into account according to DIN EN 20354. The calculation of the dissipation was effected according to ISO 9613-1: 1993(E) "Acoustics - Attenuation of sound during propagation outdoors" - Part 1: Calculation of the absorption of sound by the atmosphere".

The table 1 in appendix C shows the measured reverberation times in the reverberation room with and without test object.

The test equipment listed in appendix D was used for the measurements.

### 4 Measurement results

The measurement results shown in the following table are described in the test certificates in appendix A, pages 1 to 2.

In addition to the sound absorption coefficients  $\alpha_S$  in single third-octave bands, the practical sound absorption coefficients  $\alpha_p$  in octave bands, which are calculated from these values, are stated. The weighted sound absorption coefficient  $\alpha_w$  is determined as a single number value from the practical sound absorption coefficients  $\alpha_p$  from 250 Hz to 4000 Hz. The practical and weighted sound absorption coefficient were calculated according to DIN EN ISO 11654 "Sound absorber for use in buildings – Rating of Sound absorption", edition July 1997.

**Table 1.** Measurement results of the practical sound absorption coefficient  $\alpha_p$  according to DIN EN ISO 11654

Octave centre frequency $f$ / Hz	125	250	500	1000	2000	4000	appendix A page
160 mm thermal hemp 045 without cavity	0,85	1,00	1,00	1,00	1,00	1,00	1
40 mm thermal hemp 045 without cavity	0,20	0,45	0,70	0,85	0,90	0,95	2

## 5 Remark

This test report may only be published and copied as a whole including all of its appendixes. The publishing of extracts requires the prior written consent of Müller-BBM GmbH.



Dipl.-Ing. (FH) Andreas Niermann



Lorenz Huber

**MÜLLER-BBM**

Akkreditiertes Prüflaboratorium  
nach ISO/IEC 17025



DAP-PL-2465.10

# Sound absorption coefficient ISO 354

## Measurement of sound absorption in a reverberation room

**Client:** FIW Forschungsinstitut für Wärmeschutz e.V. München  
D-82166 Gräfelfing

**Test specimen:** Thermal Hemp 045  
thickness  $d = 160$  mm

construction from top to bottom:

- 160 mm Thermal Hemp 045  
Product of Hock Vertriebs GmbH & Co. KG, Stutensee  
in plates  $L \times W = 0,625 \times 1,200$  m<sup>2</sup>  
laid loosely, butt jointed
- floor of reverberation room

enclosing frame of 19 mm coated chip board  $t = 19$  mm  
joints between floor and frame sealed air tight all around

fiber insulation acc. to DIN 18165 Teil 1 assembly type W and WL  
of 80 - 85 % hemp fiber, 10 - 15 % bicomponent fiber, 3 - 5 % Soda ash fire prevention  
(manufacturer specification)

Room: Hallraum E  
Volume: 199.60 m<sup>3</sup>  
Size: 11.25 m<sup>2</sup>  
Date of test: 2004-05-11

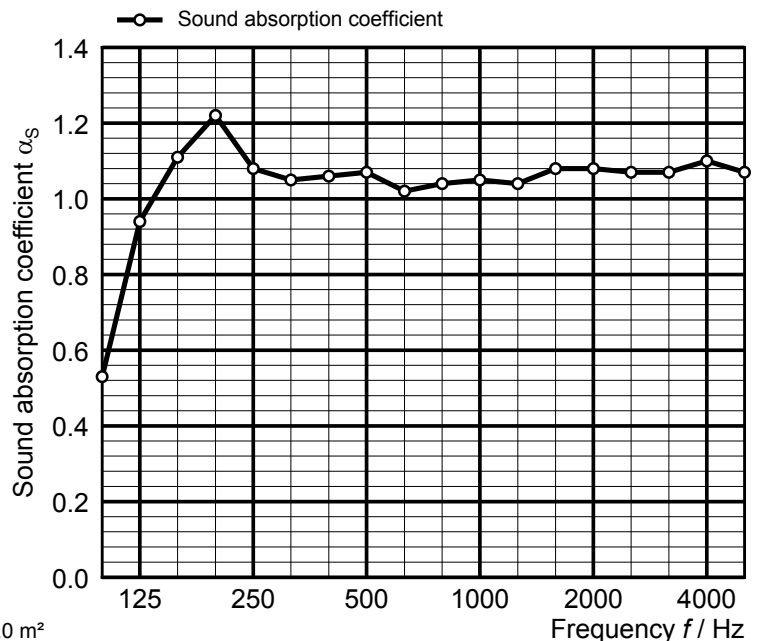
	$\Theta$ [°C]	r. h. [%]	$B$ [kPa]
with specimen	20.2	36	95.2
without specimen	20.0	34	95.2

Accredited testing laboratory  
according to ISO/IEC 17025



DAP-PL-2465.10

Frequency [Hz]	$\alpha_s$ 1/3 octave	$\alpha_p$ oktave
100	0.53	0.85
125	0.94	
160	• 1.11	
200	• 1.22	1.00
250	• 1.08	
315	1.05	
400	1.06	1.00
500	• 1.07	
630	1.02	
800	1.04	1.00
1000	1.05	
1250	1.04	
1600	• 1.08	1.00
2000	• 1.08	
2500	• 1.07	
3150	• 1.07	1.00
4000	• 1.10	
5000	• 1.07	



• Equivalent sound absorption area greater than 12.0 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:

**Weighted sound absorption coefficient  $\alpha_w = 1.00$**

Sound absorption class: A

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Appendix A

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# Sound absorption coefficient ISO 354

## Measurement of sound absorption in a reverberation room

**Client:** FIW Forschungsinstitut für Wärmeschutz e.V. München  
D-82166 Gräfelfing

**Test specimen:** Thermal Hemp 045  
thickness  $d = 40$  mm

construction from top to bottom:

- 40 mm Thermal Hemp 045  
Product of Hock Vertriebs GmbH & Co. KG, Stutensee  
in plates  $L \times W = 0,625 \times 1,200$  m<sup>2</sup>  
laid loosely, butt jointed
- floor of reverberation room

enclosing frame of 19 mm coated chip board  $t = 19$  mm  
joints between floor and frame sealed air tight all around

fiber insulation acc. to DIN 18165 Teil 1 assembly type W and WL  
of 80 - 85 % hemp fiber, 10 - 15 % bicomponent fiber, 3 - 5 % Soda ash fire prevention  
(manufacturer specification)

Room: Hallraum E  
Volume: 199.60 m<sup>3</sup>  
Size: 11.25 m<sup>2</sup>  
Date of test: 2006-03-21

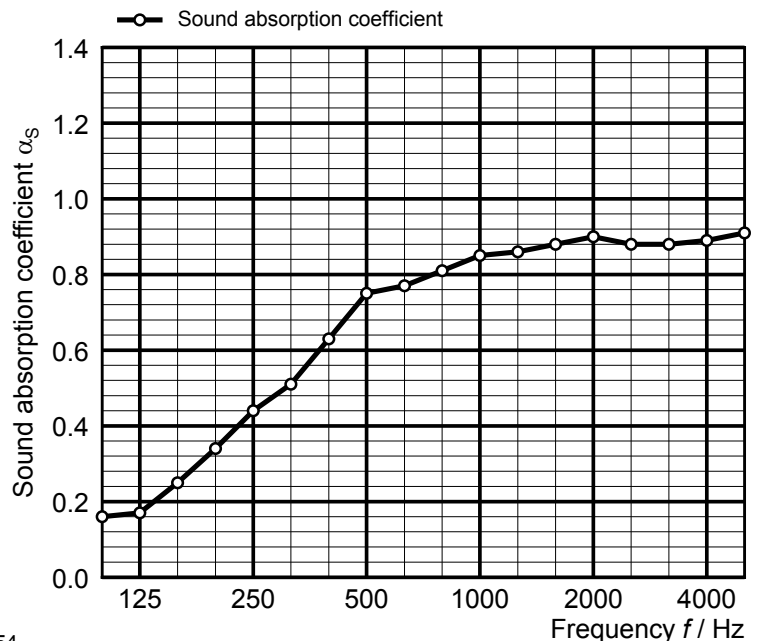
	$\Theta$ [°C]	r. h. [%]	$B$ [kPa]
with specimen	20.2	36	95.2
without specimen	20.0	34	95.2

Accredited testing laboratory  
according to ISO/IEC 17025



DAP-PL-2465.10

Frequency [Hz]	$\alpha_s$ 1/3 octave	$\alpha_p$ oktave
100	0.16	0.20
125	0.17	
160	0.25	
200	0.34	0.45
250	0.44	
315	0.51	
400	0.63	0.70
500	0.75	
630	0.77	
800	0.81	0.85
1000	0.85	
1250	0.86	
1600	0.88	0.90
2000	0.90	
2500	0.88	
3150	0.88	0.90
4000	0.89	
5000	0.91	



$\alpha_s$  Sound absorption coefficient according to ISO 354

$\alpha_p$  Practical sound absorption coefficient according to ISO 11654

Rating according to ISO 11654:

**Weighted sound absorption coefficient  $\alpha_w = 0.70$  (H)**

Sound absorption class: C

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Appendix A

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**Figure 1.** Test construction in the reverberation room, example with 40 mm thermal hemp 045



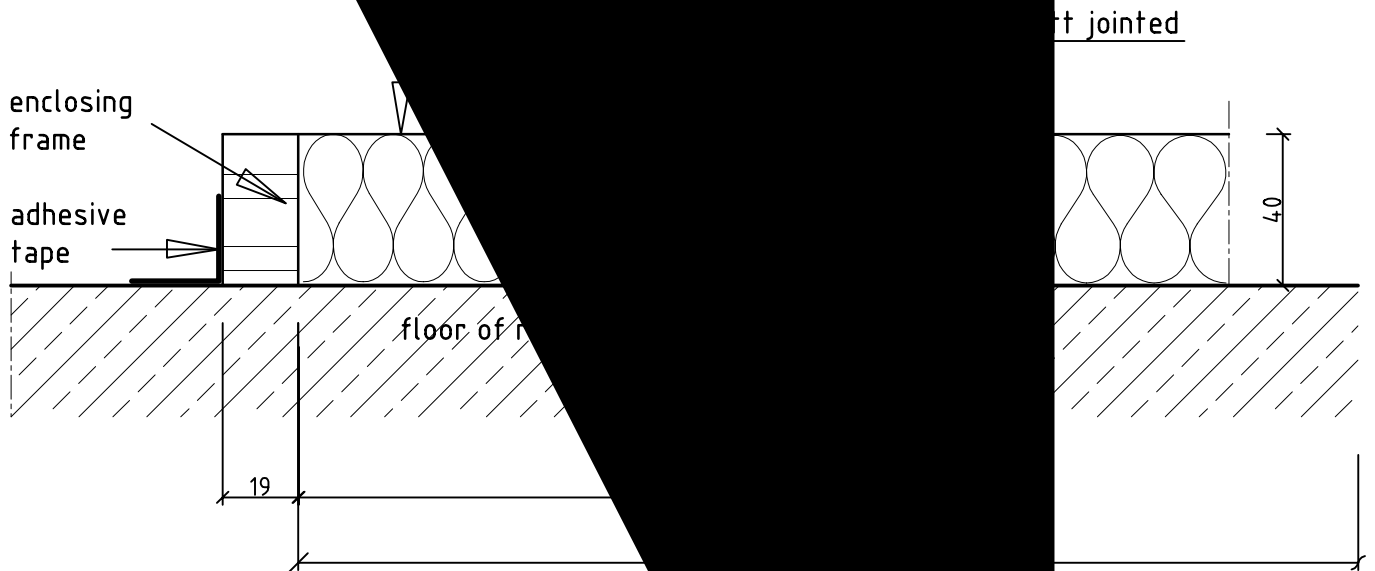
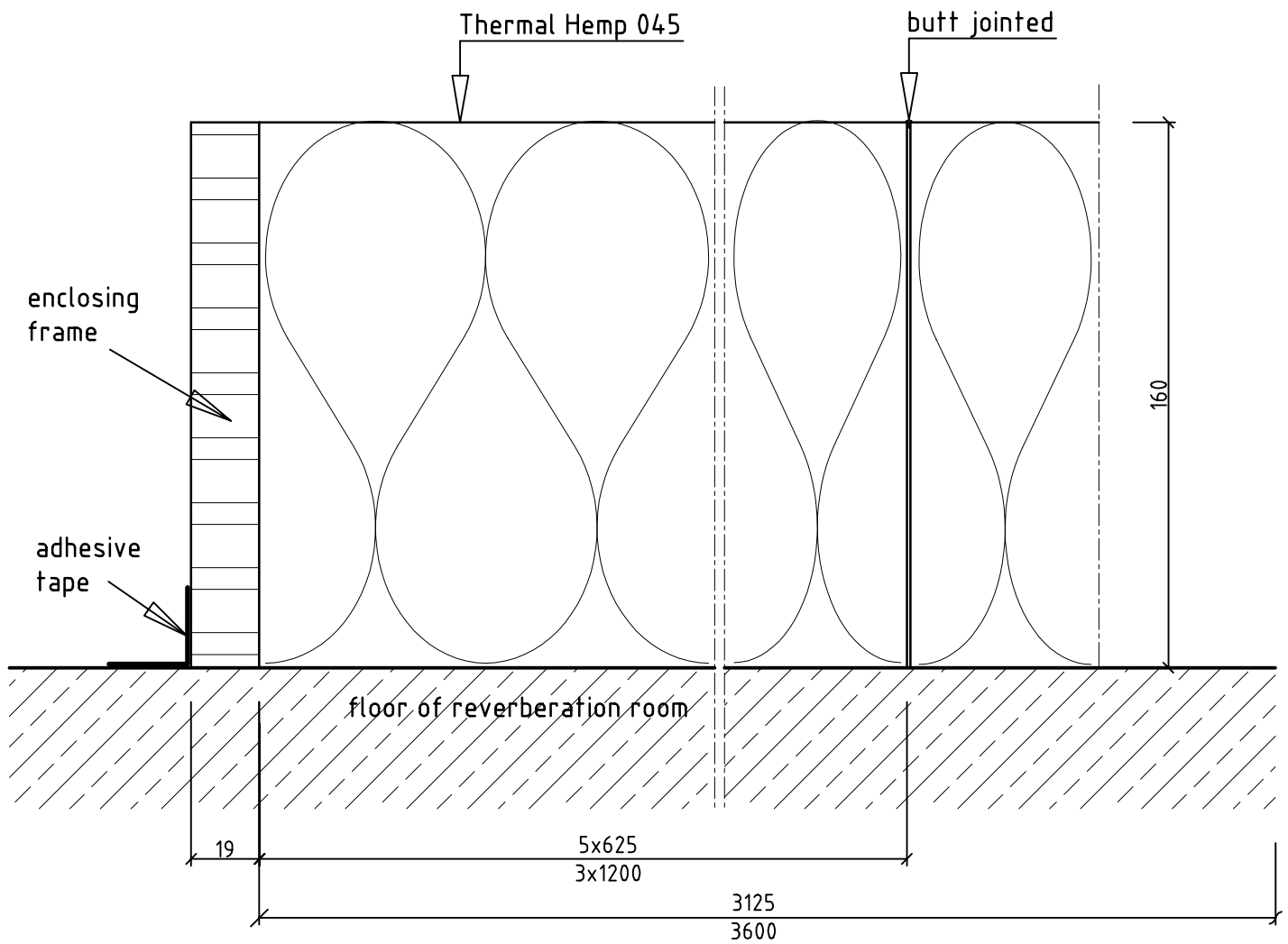


Figure 3: Detailed drawing of tested setup with  
160 mm Thermal Hemp 045



**Table 1.** Mean values of reverberation time  $T_1$  (without sample) and  $T_2$  (with sample)

Frequency f / Hz	Mean values of reverberation time		
	without sample	with sample $T_2$ / s	
	$T_1$ / s	sample 1	sample 2
100	6,90	3,04	5,00
125	6,34	2,06	4,57
160	7,42	1,91	4,52
200	8,32	1,82	4,18
250	8,75	2,04	3,72
315	8,18	2,05	3,32
400	7,26	1,97	2,80
500	6,53	1,90	2,41
630	5,95	1,90	2,30
800	5,73	1,86	2,18
1000	5,82	1,86	2,14
1250	5,96	1,87	2,13
1600	5,56	1,79	2,05
2000	4,97	1,72	1,93
2500	4,36	1,64	1,84
3150	3,40	1,47	1,64
4000	2,61	1,28	1,41
5000	1,97	1,10	1,18

## List of test equipment

Name	Manufacturer	Type	Serial-No.
Building acoustics measurement system	Norsonic	121	26342
Amplifier	Norsonic	235	14582
Reverberation loudspeaker (2 x in the reverberation room)	Allsound LT	--	--
Dynamic microphones (6 x in the reverberation room)	Sennheiser	MD21N	102805
Aspiration psychrometer	Wilh.Lambrecht KG	761	450157
Software for measurement and evaluation	Müller-BBM	Bau 4	Version 1.3