PEUTZ

Laboratory for Acoustics

TESTING
RvA L 334

Determination of the sound absorption (reverberation room method) of a facade type ***Metfiber ECO Wall Sound 120 mm*** *manufacturer Metecno Bausysteme GmbH*

Report number A 2651-3E-RA-001 d.d. March 18, 2014

Laboratory for Acoustics

Determination of and sound absorption (reverberation room method) of a facade type ***Metfiber ECO Wall Sound 120 mm,*** *manufacturer Metecno Bausysteme GmbH*

Principal	Metecno Bausysteme GmbH Am Amselberg, 1 D-99444 BLANKENHAIN Germany
Report number	A 2651-3E-RA-001
Date	March 18, 2014
Reference	TS/TS/KS/A 2651-3E-RA-001
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BTW NL004933837B01 KvK: 12028033

mook – zoetermeer – groningen – düsseldorf – dortmund – berlijn – leuven – parijs – lyon – sevilla

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1 Introduction

At the request of Metecno Bausysteme GmbH based at Blankenhain (Germany) sound absorption measurements have been carried out on a:

facade type
Metfiber *ECO* Wall Sound 120 mm
manufactured by Metecno Bausysteme GmbH

in the Laboratory for Acoustics of Peutz bv, at Mook, the Netherlands (see figure 1).

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For these type of measurements the Laboratory for Acoustics has been accredited by the Dutch Accreditation Council (RvA).

The RvA is member of the EA MLA (**EA MLA**: **E**uropean **A**ccreditation Organisation **M**ulti**L**ateral **A**greement: http://www.european-accreditation.org).

EA: "Certificates and reports issued by bodies accredited by MLA and MRA members are considered to have the same degree of credibility, and are accepted in MLA and MRA countries."

2 Standards and guidelines

The measurements have been carried out according to the Quality Manual of the Laboratory for Acoustics as well as:

ISO 354:2003[1] Acoustics Measurement of sound absorption in a reverberation room
NOTE: this international standard has been accepted within all EU-countries as European European standard EN ISO 354:2003

Various other related norms:

EN ISO 11654:1997 Acoustics Sound absorbers for use in buildings Rating of sound absorption

ASTM C423-08a Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method

1 According to this norm, the report should include for each measurement the mean reverberation times T1 end T2 at each frequency. Because these figures are not relevant for judging the quality of the product being tested, but merely for judging the accuracy of the calculations, they have been omitted in this report. It is possible of course to reproduce those figures at any time if the principal requests this.

3 Tested construction

The following data have been provided by the principal, supplemented by observations in the laboratory where applicable.

Construction tested:
facade type **Metfiber *ECO* Wall Sound 120 mm** manufactured by Metecno Bausysteme GmbH
Sandwich construction with the following composition:

- perforated metal sheet thickness 0,6 mm, perforation rate 32,7% (triangle pattern, hole diameter 3,0 mm, c.t.c. 5,0 mm)
- glass wool thickness 120 mm, density about 55 kg/m^3
- (closed) metal sheet thickness 0,6 mm

Width elements approximately 1000 mm. Mass approximately 17,0 kg/m^2 (weighted).

See figure 3 for a drawing of the tested construction supplied by the principal.

The results as presented here relate only to the tested items and laboratory conditions as described in this report. The laboratory can make no judgement about the representativity of the tested samples. The test report ahead is valid as long as the tested constructions and/or materials are unchanged.

4 Measurements

The panels to be measured (see chapter 3) have been placed directly on the floor of the reverberation room, with the perforated side facing the room (Type A mounting according to ISO 354:2003). The panels were put tight to each other. The sides of the setup were enclosed by 18 mm thick plastic covered chipwood board (see figure 4).

4.1 Method

The tests were conducted in accordance with the provisions of the test method ISO 354 in the reverberation room of “Peutz bv" in Mook (the Netherlands) (see figure 1). The relevant data regarding the reverberation room are given in figure 2 of this report.

By means of reverberation measurements the reverberation time of the room is measured under two conditions:

- when the reverberation room is empty
- when the construction under test is inside the reverberation room

In general, once material is placed into the reverberation room a lower reverberation time will result.

The difference in reverberation times is a measure of the amount of absorption brought into the room.

Measurements and calculations were carried out in 1/3-octave bandwidth from 100 to 5000 Hz, according to the norms. Where applicable the octave values have been calculated from these 1/3-octave values.

From the reverberation measurements in the empty reverberation room the equivalent sound absorption A_1 is calculated (per frequency band) according to formula 1 and expressed in m^2

$$A_1 = \frac{55{,}3\,V}{c\,T_1} - 4V\,m_1 \qquad (1)$$

in which:

V	=	the volume of the reverberation room	[m^3]
T_1	=	the reverberation time in the empty reverberation room	[sec.]
m_1	=	"power attenuation coefficient" in the empty room, calculated according to formula	[m^{-1}]
c	=	the speed of sound in the air, in m/s, calculated according to	[m/s]

$$c = 331 + 0{,}6\,t \qquad (2)$$

in which:

t = the temperature; this formula is valid for temperatures between 15 and 30 °C [°C]

$$m = \frac{\alpha}{10\log(e)} \quad (3)$$

in which:
α = "attenuation coefficient" according to ISO 9613-1

In the same manner the equivalent sound absorption A2 for the room with the test specimen is calculated according to formula 4, also expressed in m^2

$$A_2 = \frac{55{,}3\,V}{c\,T_2} - 4\,V\,m_2 \quad (4)$$

in which:
c and V have the same definition as in formula 1 and
T_2 = the reverberation time of the reverberation room with the test specimen placed inside [sec]
m_2 = "power attenuation coefficient" in the room with the test specimen placed inside, calculated according to formula 3 [m^{-1}]

The equivalent sound absorption A of the test specimen has been calculated according to formula 5 and is expressed in m^2

$$A = A_2 - A_1 \quad (5)$$

When the test specimen consists of one plane with an area between 10 and 12 m^2 the sound absorption coefficient α_s has to be calculated according to formula 6:

$$\alpha = \frac{A}{S} \quad (6)$$

in which:
S = the area of the test specimen [m^2]

4.2 Accuracy

The accuracy of the sound absorption as calculated can be expressed in terms of repeatability (tests within one laboratory) and reproducibility (between various laboratories).

When:
- two tests are performed on identical test material
- within a short period of time
- by the same person or team
- using the same instrumentation
- under unchanged environmental conditions

the probability will be 95% that the difference between the two test results will be less than or equal to r.

In order to evaluate the repeatability r for the sound absorption measurements performed in the reverberation room of “Peutz bv" in Mook (the Netherlands) eight series of measurements have been carried out according to ISO 354:1985 annex C. From the results of those measurements the repeatability r has been calculated. It was found that for the frequency range from 100 to 200 Hz and at 5000 Hz the repeatability r is 0,21 as a maximum. For the frequency range 250 to 4000 Hz the repeatability r is 0,09 as a maximum.

4.3 Environmental conditions during the measurements

t4.1 *Environmental conditions during the measurements at January 28th, 2014*

reverberation room	temperature [°C]	barometric pressure [kPa]	relative humidity [%]
empty	16	99,7	55
with facade	16	99,8	55

4.4 Results

The results of the measurements are given in table 4.2 and in figure 4. The measurements were made in 1/3-octave bands. The results presented in octave-bands are the arithmetic average of the results of the three 1/3-octave bands belonging to that octaveband. From those values the following one-figure ratings have been calculated and stated :

- the "weighted sound absorption coefficient α_w" according to ISO 11654
- the "Noise Reduction Coefficient NRC" according to ASTM-C423, being the average of the absorption coefficients (1/3 octave values) at the frequencies of 250, 500, 1000 and 2000 Hz, rounded to the nearest 0,05.

t4.2 Measurements results ***Metfiber ECO Wall Sound 120 mm***

	sound absorption coefficient α_s	
record nr.	**#145**	
figure nr.	**4**	
frequency [Hz]	**1/3 oct.**	**1/1 oct.**
100	0,43	
125	0,69	0,61
160	0,72	
200	0,75	
250	0,86	0,83
315	0,87	
400	0,93	
500	0,93	0,93
630	0,94	
800	0,95	
1000	0,95	0,96
1250	0,98	
1600	0,96	
2000	0,97	0,97
2500	0,99	
3150	1,00	
4000	0,98	0,98
5000	0,96	
α_w	0,95	
NRC	0,95	

The sound absorption coefficient of a material is not a material property. It should be taken into account that the sound absorption of a construction depends on the dimensions, the way of mounting of the material and its position in the room.

Mook,

Th. Scheers
Laboratory Supervisor

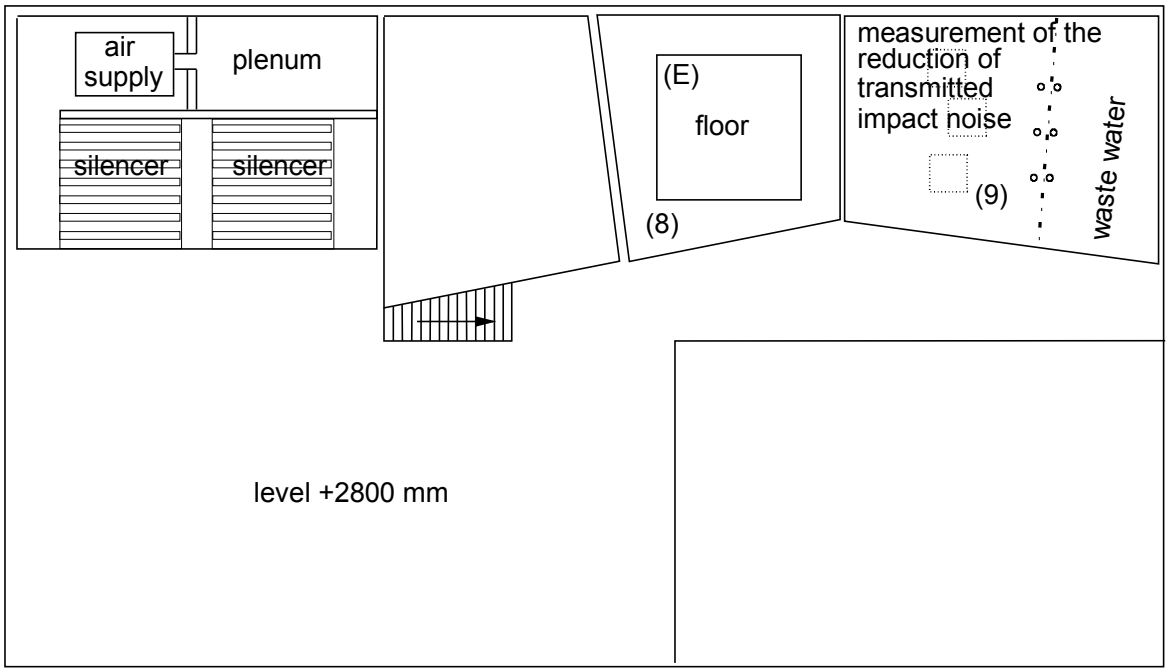
dr. ir. M.L.S Vercammen
Manager

This report contains 10 pages and 4 figures.

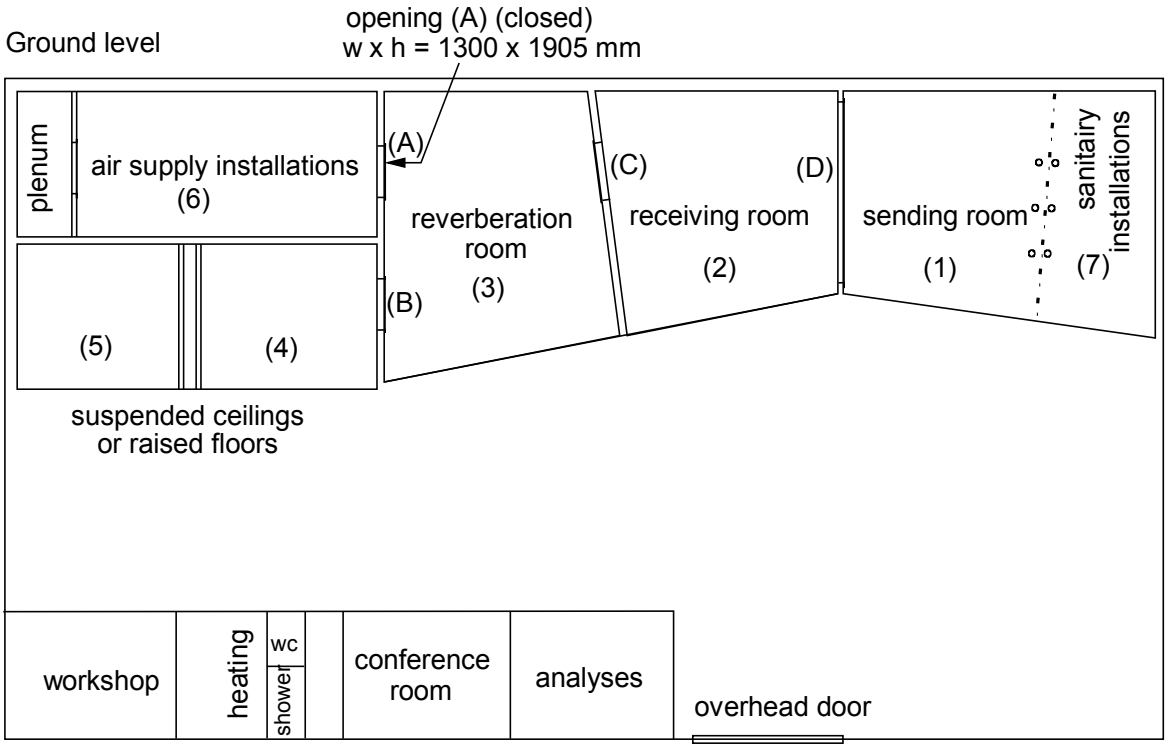
PEUTZ bv
Lindenlaan 41, NL-6584 AC MOLENHOEK (LB), THE NETHERLANDS

OVERVIEW

Story



Ground level



TEST OPENINGS (w x h in mm)
(B) 1000 x 2200
(C) 1500 x 1250
(D) 4300 x 2800
(E) 4000 x 4000

0 1 2 3 4 5 m
scale

PEUTZ bv
Lindenlaan 41, 6584 AC MOLENHOEK (LB), THE NETHERLANDS

REVERBERATION ROOM

The reverberation room meets the requirements of ISO 354:2003.

additional data:

volume : 214 m^3

total area S_t (walls, floor and ceiling) : 219 m^2

diffusion: by the shape of the room and by adding 6 curved and 2 flat reflecting elements with a total area of approx. 13 m^2 a sufficient diffusion has been gained.

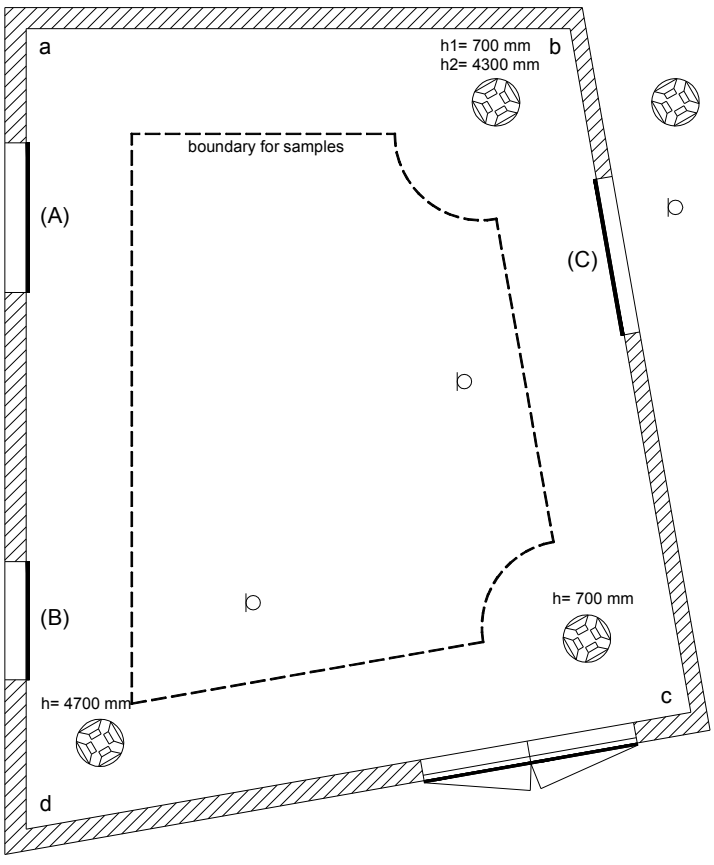
reverberation time of the empty reverberation room during measurements of 28-01-2014

frequency (1/1 oct.)	125	250	500	1000	2000	4000	Hz
Reverberation time	9,85	7,96	7,67	6,33	4,43	2,75	sec.

repeatibility r (1/1 oct.) c.f. ISO 354:1985 annex C (see chapter 5.2 of this report).

r at high α	0,13	0,04	0,04	0,02	0,02	0,08	-
r at low α	0,09	0,02	0,01	0,02	0,02	0,04	-

plan

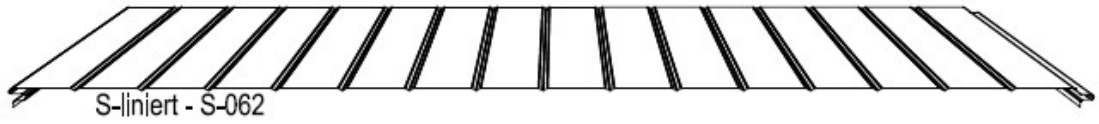


(closed) testopenings
(width x height in mm)
(A): 1300 x 1800
(B): 1000 x 2200
(C): 1500 x 1250

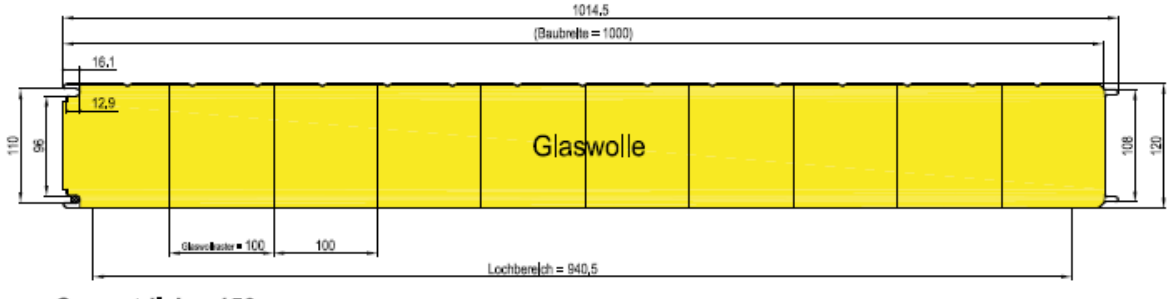
height at:
a: 5573 mm
b: 5102 mm
c: 5000 mm
d: 5580 mm

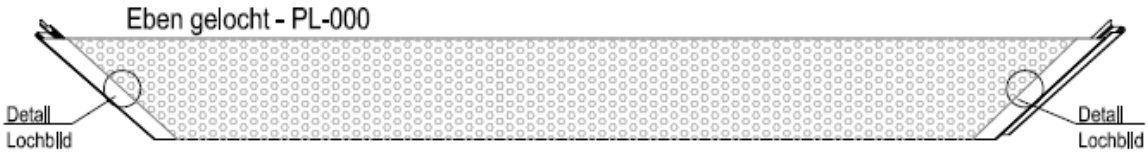
0 1 2 m

Absorb, versie 5.7.2 mode 7, PM: RA, file: a2651 E#:3-38 T_1 = 15,6 °C p_1 = 99,7 kPa h_1 = 54,5 %

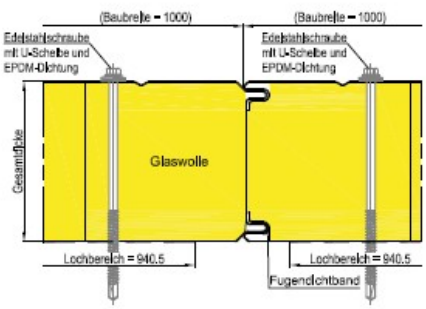


Gesamtdicke: 120

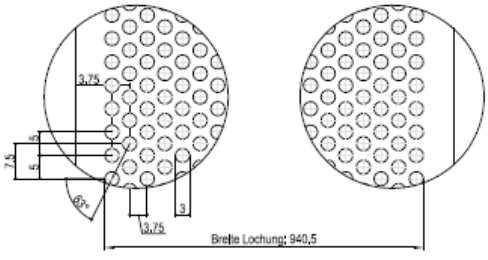




Detail



Detail Lochbild



MEASUREMENT OF SOUND ABSORPTION IN A REVERBERATION ROOM ACCORDING TO ISO 354:2003

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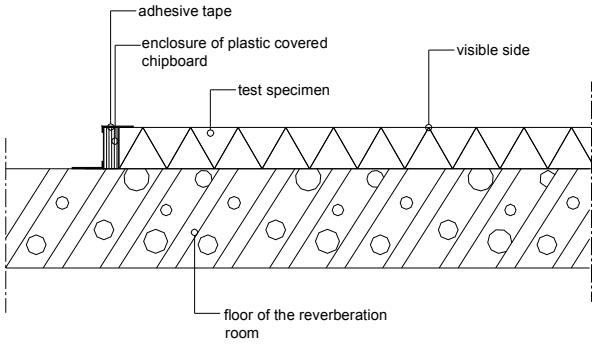
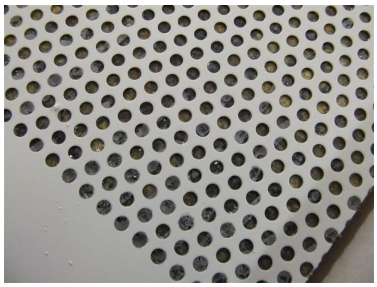
principal: Metecno Bausysteme GmbH

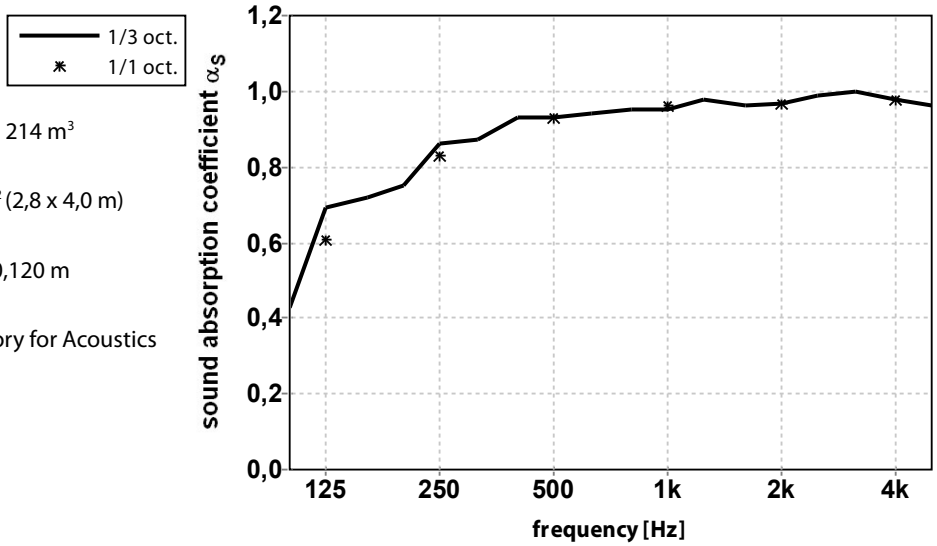
Construction; facade type **Metfiber *ECO* Wall Sound 120 mm** manufactured by Metecno Bausysteme GmbH

Sandwich construction, mass approximately 15,4 kg/m^2;

- perforated metal sheet thickness 0,6 mm, perforation rate 32,7 %
  (triangle pattern, hole diameter 3,0 mm, c.t.c. 5,0 mm)
- glass wool thickness 120 mm, density about 55 kg/m^3
- (closed) metal sheet thickness 0,6 mm







volume reverberation room: 214 m^3

surface area sample: 11,2 m^2 (2,8 x 4,0 m)

heigth of the construction: 0,120 m

measured at: Peutz Laboratory for Acoustics

signal: broad-band noise

bandwidth: 1/3 octave

			0,43	0,75	0,93	0,95	0,96	1,00
α_w (ISO 11654) = 0,95	1/3 oct.		0,69	0,86	0,93	0,95	0,97	0,98
			0,72	0,87	0,94	0,98	0,99	0,96
NRC (ASTM - C423) = 0,95	**1/1 oct.**		**0,61**	**0,83**	**0,93**	**0,96**	**0,97**	**0,98**

Mook, 28-01-2014

Absorb, versie 5.7.2 mode 7, PM: RA, file: a2651 E#:3-38 F#:109-144 A#:145 T_1 = 15,6 °C T_2 = 16,4 °C p_1 = 99,7 kPa p_2 = 99,8 kPa h_1 = 54,5 % h_2 = 54,8 %

A 2651-3E-RA-001 (25715)2E1 THEO