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Industrieweg 114H
B-9032 Wondelgem
Belgium
BTW nr.: BE 0887 763 992

N° 0451-TEST
NBN EN ISO 17025:2005

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NOISE LAB
REPORT Number A-2017_ES_160-1-42975_E

Customer : Le Tissage d'Arcade (2TEC2)
Boulevard Industriel 98
B-7700 Moeskroen
Belgium

Contacts : **Client :** Wesley Declerck
Noise lab : Volker Spessart

Tests : Measurement of sound absorption in the reverberation room

Product name : **2tec2 comfort backing**

Normative references:

NBN EN ISO 354:2003	**Acoustics - Measurement of sound absorption in a reverberation room**
NBN EN ISO 11654:1997	Acoustics - Sound absorbers for use in buildings - Rating of sound absorption
NBN ISO 9613-1:1996	Acoustics - Attenuation of sound during propagation outdoors - part 1 : Calculation of the absorption of sound by the atmosphere

To perform the above measurements, the laboratory of eco-scan is accredited by BELAC "The Belgian Accreditation Body"
BELAC is a signatory of all existing MLAs (multilateral agreements) and MRAs (multilateral recognition agreements) of EA (European co-operation for Accreditation), ILAC (International Laboratory Accreditation Cooperation) and IAF (International Accreditation Forum).
In this way, reports and certificates issued by BELAC accredited bodies are internationally accredited.

Date and reference of the request:	24/08/2017	2017_ES_160
Date of receipt of the specimen(s):	28/08/2017	1
Date of construction:	28/08/2017	
Date of tests:	28/08/2017	
Date of preparation of the report:	28/08/2017	

This test report together with its annexes contains : 10 pages and must be multiplied only in its entirety

Technical Manager,

Volker Spessart

Laboratory Engineer,

Karolien Benoit

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MEASURING EQUIPMENT

Signal
Brüel & Kjaer - 4292 : Omni Power Sound Source

Microphone system:
Brüel & Kjaer - 4189-L-001 : 1/2" free field microphone prepolarized, inclusive 2669L TEDS
Brüel & Kjaer - 4189 : 1/2" free field microphone, 6Hz to 20kHz, prepolarized
Brüel & Kjaer - 2669 : 1/2" microphone preamplifier
Brüel & Kjaer - 4231 : Sound calibrator 94&114dB SPL-1000Hz, Fulfils IEC 60942(2003)Class1

Number of source positions:	2	Different sound source positions at least 3m apart
Number of microphone positions for each source position:	8	The measurements shall be made with different microphone positions
Number of measured decays curves:	3	which are at least 1,5m apart, 2m from any sound source and 1m from
Number of decays curves for each microphone position:	48	any room surface and the test specimen.

Signal processing
Brüel & Kjaer - 2716C : Power amplifier
Brüel & Kjaer - 3050-A-6/0: Signal generator, 6-ch. Inputmodule LAN-XI
Brüel & Kjaer - 3160-A-042: Signal generator, 4/2-ch. Input/output module LAN-XI
Brüel & Kjaer : PULSE Labshop Version 13.5
A PC with all necessary software

Reverberation room

Dimensions of the room:	Volume :	296.9	m^3
	Length:	9.99	m
	Width	4.97	m
	Height	5.98	m
	Volume :	297	m^3
	Total area:	278	m^2

$l_{max} = 12{,}65\ m < 1{,}9\ V^{1/3}$

In order to improve the diffusivity, the use of diffusers is necessary
The test specimen shall have a maximum area of 15,62 m^2, which depends on the room volume

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TEST METHOD

The tests were conducted in accordance with the provisions of the test method EN ISO354:2003. A detailed description of the test set up has been given in the figures of annex 1 of this report.
The measurement method can be simply descibed as follows:

Essence of the test is in measuring of the reverberation time in the empty reflecting room and in the same room with the test sample inside it. The sound-absorption properties of a material depend on how the material is mounted during the test. Annex B of ISO 354:2003 specifies several different standard mountings that shall be used during a test for sound absorption. Normally a test specimen is tested using only one of the specified mountings.

From these reverberation times, the equivalent sound absorption area of the test specimen, is calculated by using Sabine's equation. Measurement is carried out in ranges of 1/3 octave and interval from 100Hz to 5000Hz.

The equivalent sound absorption area of the empty reverberation room, A1, in square metres, shall be calculated using the formula (1) :

$$A_1 = 55{,}3\ V / (c_1 T_1) - 4Vm_1 \quad [m^2] \quad (1)$$

The equivalent sound absorption area of the reverberation room containing a test specimen, A2, in square metres, shall be calculated using the formula (2) :

$$A_2 = 55{,}3\ V / (c_2 T_2) - 4Vm_2 \quad [m^2] \quad (2)$$

The equivalent sound absorption area of the test specimen, AT, in square metres, shall be calculated using the formula (3) :

$$A_T = A_2 - A_1 = 55{,}3\ V\ (1/c_2T_2 - 1/c_1T_1) - 4V(m_2 - m_1) \quad [m^2] \quad (3)$$

The sound absorption coefficient of a plane absorber or a specified array of test objects shall be calculated using the formula (4):

$$\alpha_S = A_T / S \quad (4)$$

whereas:

A1	=	*The equivalent sound absorption area of the empty reverberation room in square metres*	
A2	=	*The equivalent sound absorption area of the reverberation room containing a test specimen in square metres*	
V	=	volume , in cubic metres, of the empty reverberation room [m³]	
c1,c2	=	the propagation speed of sound in air, in [m/s], calculated using the formula (in function of the temperature in the room during the test)	
		c=331 + 0,6 t	with t= the air temperature in degrees Celsius for temperatures in the range of 15°C to 30°C
T1	=	*the reverberation time, in seconds, of the empty reverberation room*	
T2	=	*the reverberation time, in seconds, of the reverberation room after the test specimen has been introduced*	
m1,m2	=	*the power attenuation coefficient, in reciprocal metres, calculated according to ISO 9613-1:1993*	
AT	=	*The equivalent sound absorption area of the test specimen in square metres*	
S	=	*the area, in square metres, covered by the test specimen*	
αs	=	*the sound absorption coefficient*	

SPECIAL MEASUREMENT CONDITIONS

-
-
-
-
-

n/a

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RATING OF SOUND ABSORPTION

α_p PRACTICAL SOUND ABSORPTION COEFFICIENT

Frequency-dependent value of the sound absorption coefficient which is based on measurements on one-third-octave bands in accordance with ISO 354 and which is calculated in octave bands in accordance with the standard ISO 11654:1997.
The practical sound absorption coefficient, api, for each octave band i, is calculated from the arithmetic mean value of the three one-third octave sound absorption coefficients within the octave. The mean value is calculated to the second decimal and rounded in steps of 0,05 and maximized to 1,00 for rounded mean values > 1,00

α_w WEIGHTED SOUND ABSORPTION COEFFICIENT

The weighted sound absorption coefficient is determined as a single number value from the practical sound absorption coefficients from 250 Hz to 4000 Hz. The practical sound absorption coefficient is calculated according to ISO 11654:1997.
Single-number frequency-independent value which equals the value of the reference curve at 500 Hz after shifting is as specified in the standard ISO 11654:1997.

SHAPE INDICATORS, L,M,H

Whenever a practical sound absorption coefficient api exceeds the value of the shifted reference curve by 0,25 or more, one or more shape indicators shall be added, in parantheses, to the aw value.
If the excess absorption occurs at 250 Hz, use the notation L.
If the excess absorption occurs at 500 Hz or 1000 Hz, use the notation M.
If the excess absorption occurs at 2000 Hz or 4000 Hz, use the notation H.

NRC NOISE REDUCTION COEFFICIENT

The NRC is a single-number index determined in a lab test and used for rating how absorptive a particular material is. This industry standard ranges from zero (perfectly reflective) to 1 (perfectly absorptive). It is simply the average of the mid-frequency sound absorption coefficients (250, 500, 1000 and 2000 Hertz) rounded to the nearest 5%.

SAA SOUND ABSORPTION AVERAGE

NRC is being replaced by the Sound Absorption Average (SAA), which is described in the current ASTM C423-09a. The SAA is a single-number rating of sound absorption properties of a material similar to NRC, except that the sound absorption values employed in the averaging are taken at the twelve one-third octave bands from 200 Hz to 2500 Hz, inclusive, and rounding is to the nearest multiple of 0.01.

The NRC and SAA results are not within the scope of the accreditation.

Test results related to tested object only. The test results should not be considered as material constants, the absorption depends not only on the material itself. The method of construction, the size of the material surface and its place in the room, affect the sound absorption characteristics of the test element.

ACCURACY

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

The relative standard deviation of the reverberation time T20, evaluated over a 20dB decay range, can be estimated by the following formula (see 8.2.2. van ISO 354:2003)
These relative standard deviations of the reverberation time T20 were calculated and illustrated in annex 1.

The reproducibility of absorption coefficient measurement is still under investigation

The specific value of uncertainty is available on request

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α_s SOUND ABSORPTION COEFFICIENT

EN ISO 354:2003 Acoustics - Measurement of sound absorption in a reverberation room
EN ISO 11654:1997 Acoustics - Sound absorbers for use in buildings - Rating of sound absorption

Identification number of test element: 1 **Test date:** 28/08/2017

Reverberation room: V = 296.9 m³ S_{tot} = 278.2 m²

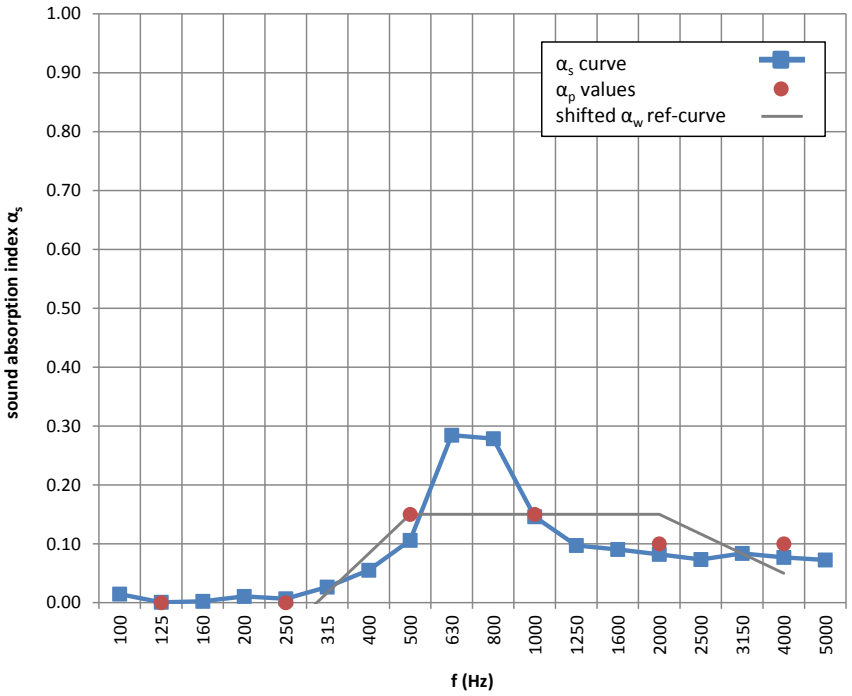
Room conditions during measurements:		Empty room	With testelement	
Temperature:	T =	21.4	21.3	°C
Atmospheric pressure:	p =	101.6	101.6	kPa
Relative humidity :	h_r =	72	72	%

Type of test element: **Plane absorber**
Construction characteristics:

* using plane absorber:	Area of test element:	10.50 m²
	Total thickness:	-
	Number of layers,including air spaces:	-
	Connection of layers:	-
* using baffles (Type J mounting):	Dimensions (L x W x H):	-
	Distance between baffle rows:	-
* using discrete objects:	Number of tested objects:	-

f(Hz)	T1 (s)	T2 (s)	α_s
50			
63			
80			
100	12.76	12.26	0.01
125	**11.28**	**11.27**	**0.00**
160	8.97	8.93	0.00
200	9.58	9.37	0.01
250	**9.40**	**9.27**	**0.01**
315	9.44	8.95	0.03
400	9.03	8.14	0.06
500	**8.99**	**7.44**	**0.11**
630	9.59	6.00	0.28
800	9.43	5.98	0.28
1000	**9.16**	**7.08**	**0.15**
1250	8.46	7.17	0.10
1600	7.62	6.62	0.09
2000	**6.84**	**6.09**	**0.08**
2500	5.89	5.38	0.07
3150	5.02	4.60	0.08
4000	**4.11**	**3.84**	**0.08**
5000	3.36	3.18	0.07

f(Hz)	α_p
125	0.00
250	0.00
500	0.15
1000	0.15
2000	0.10
4000	0.10



α_w = 0.15 ( ) *
acoustical absorption class: E

NRC = 0.1 **
SAA = 0.10 **

* It is strongly recommended to use this single-number rating in combination with the complete sound absorption coefficient curve
** These results are not within the scope of the accreditation

Requested by: Le Tissage d'Arcade (2TEC2),Boulevard Industriel 98,B-7700 Moeskroen
TESTELEMENT: (product name, for details see Annex 2)
2tec2 comfort backing

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ANNEX 1 : PRECISION

The relative standard deviation of the reverberation time T20

f	T_1 (s)	ε_{20} (s)	T_2 (s)	ε_{20} (s)
50	0	0	0	0
63	0	0	0	0
80	0	0	0	0
100	12.76	0.56	12.26	0.55
125	11.28	0.47	11.27	0.47
160	8.97	0.37	8.93	0.37
200	9.58	0.35	9.37	0.34
250	9.40	0.31	9.27	0.30
315	9.44	0.27	8.95	0.27
400	9.03	0.24	8.14	0.23
500	8.99	0.21	7.44	0.19
630	9.59	0.19	6.00	0.15
800	9.43	0.17	5.98	0.14
1000	9.16	0.15	7.08	0.13
1250	8.46	0.13	7.17	0.12
1600	7.62	0.11	6.62	0.10
2000	6.84	0.09	6.09	0.09
2500	5.89	0.08	5.38	0.07
3150	5.02	0.06	4.60	0.06
4000	4.11	0.05	3.84	0.05
5000	3.36	0.04	3.18	0.04

ε_{20} = The relative standard deviation of the reverberation time T20, evaluated over a 20dB decay range, can be estimated by the following formula (see 8.2.2. van ISO 354:2003)

$$\varepsilon_{20}(T) = T * \sqrt{\frac{2.42 + 3.59 / N}{fT}}$$

T_1 (s) = reverberation time of the empty room
T_2 (s) = reverberation time of the reverberation room after with the test specimen
f (Hz) = centre frequency of the one-third-octave band
N = number of decay curves evaluated

The relative standard deviation of the sound absorption coefficient

f	αs	ε_α	δ_{95} (α)
50	0.00	0.00	0.00
63	0.00	0.00	0.00
80	0.00	0.00	0.00
100	0.01	0.02	0.01
125	0.00	0.02	0.01
160	0.00	0.03	0.01
200	0.01	0.02	0.01
250	0.01	0.02	0.01
315	0.03	0.02	0.01
400	0.06	0.02	0.01
500	0.11	0.02	0.01
630	0.28	0.02	0.01
800	0.28	0.02	0.01
1000	0.15	0.01	0.00
1250	0.10	0.01	0.00
1600	0.09	0.01	0.00
2000	0.08	0.01	0.00
2500	0.07	0.02	0.00
3150	0.08	0.02	0.00
4000	0.08	0.02	0.01
5000	0.07	0.02	0.01

$\varepsilon(\alpha)$ = The relative standard deviation of the sound absorption coefficient

$$\varepsilon(\alpha) \cong \frac{55,3V}{cS}\sqrt{\left(\frac{\varepsilon_{20}(T_2)}{T_2^2}\right)^2 + \left(\frac{\varepsilon_{20}(T_1)}{T_1^2}\right)^2}$$

δ_{95} (α) = 95% confidence interval

$$\delta_{95}(\alpha) = \frac{1,96\ \varepsilon(\alpha)}{\sqrt{N}}$$

T_1 (s) = reverberation time of the empty room
T_2 (s) = reverberation time of the reverberation room after with the test specimen
V = Volume of the reverberation room
c = the propagation speed of sound in air

S = number of decay curves evaluated
N = the area, in square metres, covered by the test specimen

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ANNEX 2: Description test items by manufacturer

The test sample description given by manufacturer is checked visually as good as possible by the laboratory.
The correspondence between the test element and the commercialized product is the sole responsibility of the manufacturer

2tec2 comfort backing (Woven vinyl flooring with integrated acoustic backing layer)

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ANNEX 3: Technical datasheet

The test sample description given by manufacturer is checked visually as good as possible by the laboratory.
The correspondence between the test element and the commercialized product is the sole responsibility of the manufacturer

Please request at supplier.

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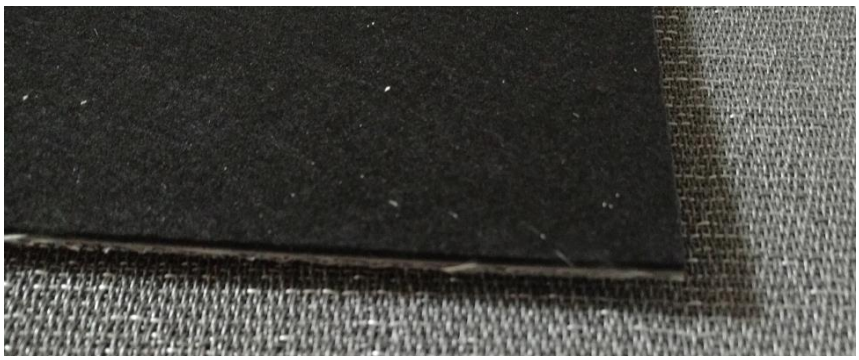
ANNEX 4: photographs of the test element or the test arrangement

Description of the assembly or drawing or photo

The floorcovering tiles were put straight onto the floor of the reverberation room.



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ANNEX 5: Sketch of the test room

The test room was built and finnished according ISO 354.