- Test centre : B-1342 Limelette, Avenue P. Holoffe 21   Tel : (32) 2 655 77 11   Fax : (32) 2 653 07 29
- Offices : B-1932 Sint-Stevens-Woluwe, Lozenberg 7   Tel : (32) 2 716 42 11   Fax : (32) 2 725 32 12
- Head office : B-1000 Brussels, Rue du Lombard 42   Tel : (32) 2 502 66 90   Fax : (32) 2 502 81 80

VAT n°: BE 407.695.057   www.bbri.be   Page 1 / 6

LABORATORY OF ACOUSTICS
TESTREPORT Nr. AC5695

Requested by: Indetex
Torkonjestraat 21/C
B-8510 Kortrijk-Marke

Contacts:	**Company:**	**BBRI - WTCB - CSTC - WTB**
	O. Debie	D. Wuyts

Test carried out: Measurement of the sound absorption coefficient in the reverberation room

Product tested: Cosy

References

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

Date and reference of the order:	01-06-13	Nr. DE631xB201
Receipt of the test element:	18-06-13	Nr. Test element: 2013-028-025/8
Date of the test:	18-06-13	
Drafting date of the report:	29-08-13	

This report contains (all annexes included) 6 pages. It may only be reproduced in its entirety. Each page of the original report has been stamped (in red) by the laboratory and initialised by the head of laboratory. The results and findings are only valid for the tested samples.

☐   No sample
☐   Sample(s) submitted to a destructive test
☒   Sample(s) to be removed from our laboratories 10 calendar days after sending of the report, unless a written request is received by the demander of the test
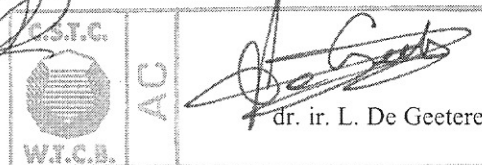
Responsable in charge of the test,   Responsable engineer in charge of the test,   The deputy head of division,

P. Huart   D. Wuyts   dr. ir. L. De Geetere

Technical assistant : M. Dubois

THE PRECISION OF THE MEASUREMENTS

1 THE PRECISION OF THE MEASUREMENTS

Repeatability of measured reverberation times and calculated absorption coefficients

The standard deviation of the reverberation time T20 evaluated over a 20 dB decay range, can be estimated by the following formula (ISO 354:2003 - point 8.2.2.):

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

T = the measured reverberation time

f = the centre frequency of one-third-octave band

N = the number of decay curves evaluated

The standard deviations are given in annex 2 of this test report.

Reproducibility of reverberation times and calculated absorption coefficients

The reproducibility of absorption coefficient measurement is not known yet and still subject of international research

2 TEST EQUIPMENT

Signal

- Interrupted pink noise generated by two modules (non-correlated signals) Norsonic N850-MF1 belonging tot the measurement system Norsonic NOR850 v.1.5
- 4 omni-directional tetrahedron shaped loudspeakers, each with 4 membranes BEYMA 6P200Fe, amplified by 2 amplifiers QSC RMX 2450
- The emitted broad-band noise has a spectrum such that the resulting sound pressure levels in the room differ less then 6 dB in adjacent one-third-octave bands.

Microphones and recording system

- Bruël & Kjaer - 4190 : 2 microphones
- Bruël & Kjaer - 2669L : 2 preamplifiers for microphones
- Bruël & Kjaer - 2829 : 2 current supplies for microphone
- Norsonic NOR850 v.1.5 : Measurement system
- Number of source pair configurations : 2 ; distances between the different source positions are at least 3 m
- The number of measurement positions per source configuration : 12 ; distances between the different measurement positions at least 1.5 m,at least distanced 2 m from the sound source and at least 1m from anay reflecting surface and of the test specimen
- The total number of measurements : 24

Signal analysis

- Norsonic NOR850 v. 1.5: Measurement system
- Possibility to intervene by a graphical visual software to determine the reverberation time from the decay curves

Reverberation room

- Volume of the reverberation room : 264.3 m³
- I_{max} = 12.10 m < $1.9V^{1/3}$ (=12.19 m)
- S_t 0266.5 m²
- Diffusors are present (± 34 m²)
- $(V/200m^3)^{2/3}$ = Volume multiplication factor for spaces bigger than 200 m³ = 1.20
- Maximum surface for testelements in function of the volume = 14.45 m²
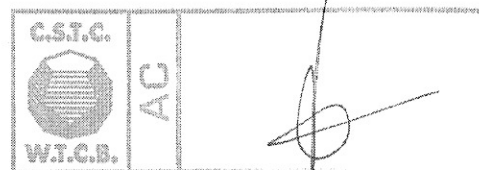
ANNEX 1: MEASUREMENT METHOD AND SINGLE VALUE RATINGS

1. MEASUREMENT METHOD

The determination of the sound absorption coefficient follows the standard EN ISO 354:2003 "Acoustics – Measurement of sound absorption in a reverberation room (ISO 354:2003)". A detailed description of the measurement procedure can be found in this standard.

The measurement principle is as follows: The sound absorption coefficient of a test specimen can be derived from measurements of the reverberation time in a reverberation room. The reverberation time for a specified frequency band is defined as the time needed to decay 60 dB after switching off a sound source. First the reverberation time of the empty room is measured. This leads to a reverberation time spectrum T1. Then the product is fitted into the reverberation room over a sufficient area, closely following the mounting prescriptions of the supplier. The reverberation times for this new situation lead to a second spectrum T2. According to the standard, the "Sabine" sound absorption coefficients for each frequency band can be obtained using the following formula:

$$A_T = A_2 - A_1 = 55.3V \left(\frac{1}{c_2 T_2} - \frac{1}{c_1 T_1} \right) - 4V(m_2 - m_1)$$

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

A_2, A_1 = the equivalent sound absorption area of the empty and the fitted room respectively

V = the volume of the reverberation room

c_1, c_2 = the speed of sound in the empty and the fitted room respectively

T_1, T_2 = the reverberation time in the empty and the fitted room respectively

m_1, m_2 = the power attenuation coefficient, in reciprocal metres, calculated according to ISO 9613-1

A_T = the equivalent sound absorption area of the test specimen

S = the area of the test specimen

α_s = the sound absorption coefficient of the specimen

2. α_P PRACTICAL SOUND ABSORPTION COEFFICIENT

This is the sound absorption coefficient per octave band, deduced from third-octave band measurements by taking the arithmetic average of the sound absorption coefficients of the three third-octave bands within the octave band. The numbers need to be rounded to two digits after the period, according to the prescriptions in the standard EN ISO 11654.

3. α_W SINGLE RATING

The single number rating (indicated by the subscript "w") procedure is explained in ISO 11654: "Acoustics - Sound absorbers for use in buildings - Rating of sound absorption". The calculation is based on the practical sound absorption coefficients, and is too complex to describe in a few lines here. We refer to the cited standard. More information can also be found on the following website: http://www.normen.be

4. FORM INDICATORS L, M, H

Each time a practical sound absorption coefficient exceeds the shifted reference curve by 0.25 or more, one or more form indicators (L, M, H) need to be added to the weighted sound absorption coefficient.

- if the excess happens in the 250 Hz band, the indicator "L" is added
- if the excess happens in the 500 Hz or 1000 Hz band, the indicator "M" is added
- if the excess happens in the 2000 Hz or 4000 Hz band, the indicator "H" is added

The form indicators indicate that, in one or more octave bands, the practical sound absorption coefficient is considerably higher than the value of the shifted reference curve. The interested parties are invited to study the absorption curve in detail.
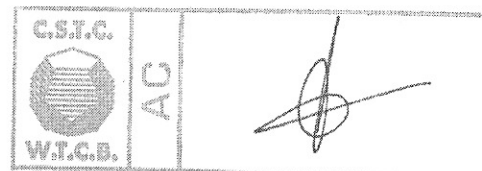
ANNEX 2: MEASUREMENT PRECISION

Accuracy of the measured reverberation times

f (Hz)	T_1 (s)	ε_{20} (s)	T_2 (s)	ε_{20} (s)
50	7.0	0.60	6.6	0.58
63	6.4	0.51	6.1	0.50
80	7.0	0.47	6.1	0.44
100	6.1	0.40	5.0	0.36
125	5.7	0.34	4.4	0.30
160	5.5	0.30	4.1	0.26
200	5.7	0.27	3.5	0.21
250	6.0	0.25	3.3	0.18
315	6.1	0.22	2.9	0.15
400	6.2	0.20	2.6	0.13
500	6.2	0.18	2.5	0.11
630	6.2	0.16	2.4	0.10
800	6.0	0.14	2.5	0.09
1000	5.9	0.12	2.4	0.08
1250	5.9	0.11	2.4	0.07
1600	5.6	0.09	2.3	0.06
2000	5.0	0.08	2.2	0.05
2500	4.4	0.07	2.1	0.05
3150	3.7	0.06	1.9	0.04
4000	3.0	0.04	1.7	0.03
5000	2.4	0.04	1.5	0.03

$\varepsilon_{20} =$ The standard deviation of the reverberation time T20 evaluated over a 20 dB decay range, can be estimated by the following formula (ISO 354:2003 - point 8.2.2.):

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

$T_1 =$ the reverberation time in the empty room
$T_2 =$ the reverberation time in the fitted room
$f =$ the centre frequency of one-third-octave band
$N =$ the number of decay curves evaluated

Accuracy of the measured sound absorption coefficients

f (Hz)	α	$\varepsilon(\alpha)$	$\delta_{95}(\alpha)$
50	0.04	0.07	0.03
63	0.03	0.07	0.03
80	0.09	0.06	0.03
100	0.14	0.07	0.03
125	0.21	0.08	0.03
160	0.26	0.07	0.03
200	0.43	0.08	0.03
250	0.57	0.07	0.03
315	0.72	0.08	0.03
400	0.90	0.08	0.03
500	0.99	0.08	0.03
630	1.02	0.07	0.03
800	0.98	0.06	0.02
1000	1.00	0.06	0.02
1250	1.01	0.05	0.02
1600	1.01	0.05	0.02
2000	1.00	0.05	0.02
2500	0.99	0.05	0.02
3150	0.99	0.05	0.02
4000	0.97	0.05	0.02
5000	0.99	0.06	0.02

$\varepsilon(\alpha) =$ standard deviation of the measured sound absorption coefficients

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

$T_1 =$ the reverberation time in the empty room
$T_2 =$ the reverberation time in the fitted room
$V =$ the volume of the reverberation room
$c =$ average speed of sound for the empty and the fitted reverberation room

$S =$ the area of the test specimen

$\delta_{95}(\alpha) =$ 95% confidence limit on the measurement of the average sound absorption coefficient (=1.96 times the "standard error" or 1.96 times the "standard deviation of the mean"). If the same measurement would be repeated, the difference with the actual measurement would be smaller than this limit in 95% of the cases.
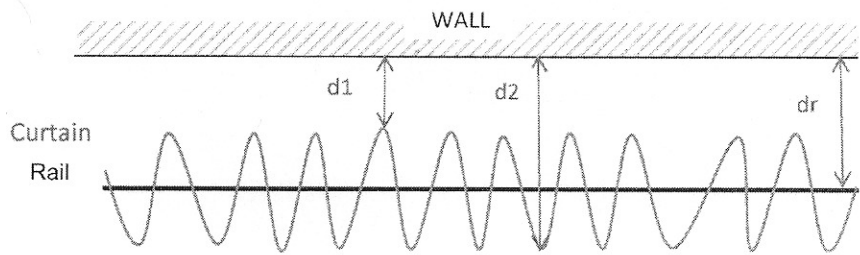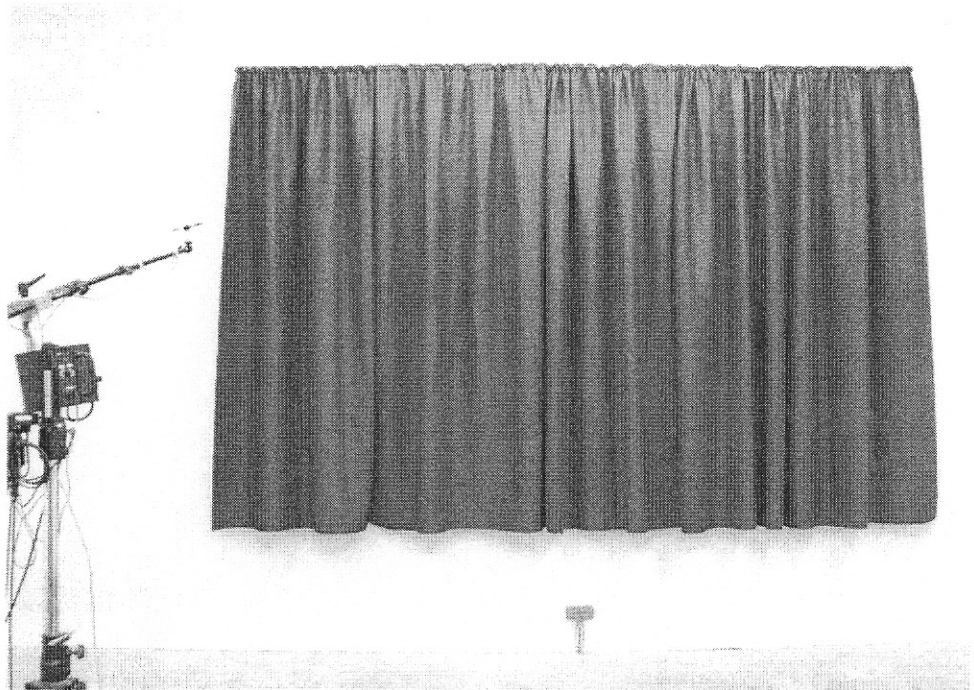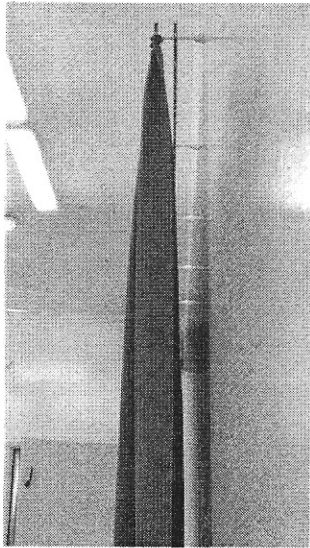
$$\delta_{95}(\alpha) = \frac{1,96\,\varepsilon(\alpha)}{\sqrt{N}}$$

$N =$ the number of decay curves evaluated

N° 042 – TEST
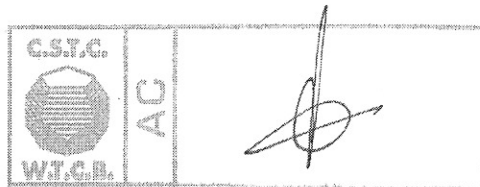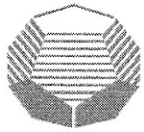
ANNEX 3: DESCRIPTION OF THE TEST ARRANGEMENT

WALL

Curtain Rail

d1   d2   dr

Cosy			
	"mounted"	m²	10.4
	"unfolded"	m²	23.33
Dimensions	height	m	2.7
	width (folded)	m	3.85
	widh (unfolded)	m	8.64
	folds	number	15
Distance to wall	rail (dr)	mm	180
	Min. average (d1)	mm	80
	Max. average (d2)	mm	250

B E L A C
N° 042 – TEST
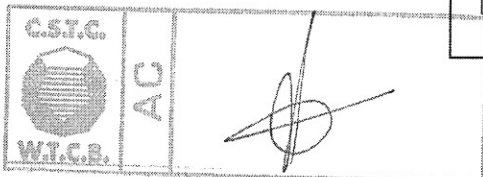
α_S SOUND ABSORPTION COEFFICIENT - GELUIDABSORPTIECOEFFIENT
COEFFICIENT D'ABSORPTION ACOUSTIQUE - SCHALLABSORPTIONCOEFFICIENT

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

Date / Datum: 18/06/2013

Reverberation room / Nagalmruimte / Salle réverbérante / Hallraum:	Alpha K2 :	V = 264.3 m³	S_t = 266.5 m²		
Empty space /Lege ruimte / salle vide / Lege Hallraum:	h_{r1} %H₂O = 45.4 %	T_1 = 20.4 °C	p_{a1} = 103.0 kPa		
With testelement / Met testelement / Avec l'élément d'essai / Mit Testelementes:	h_{r2} %H₂O = 44.1 %	T_2 = 20.4°C	p_{a2} = 103.0 kPa		

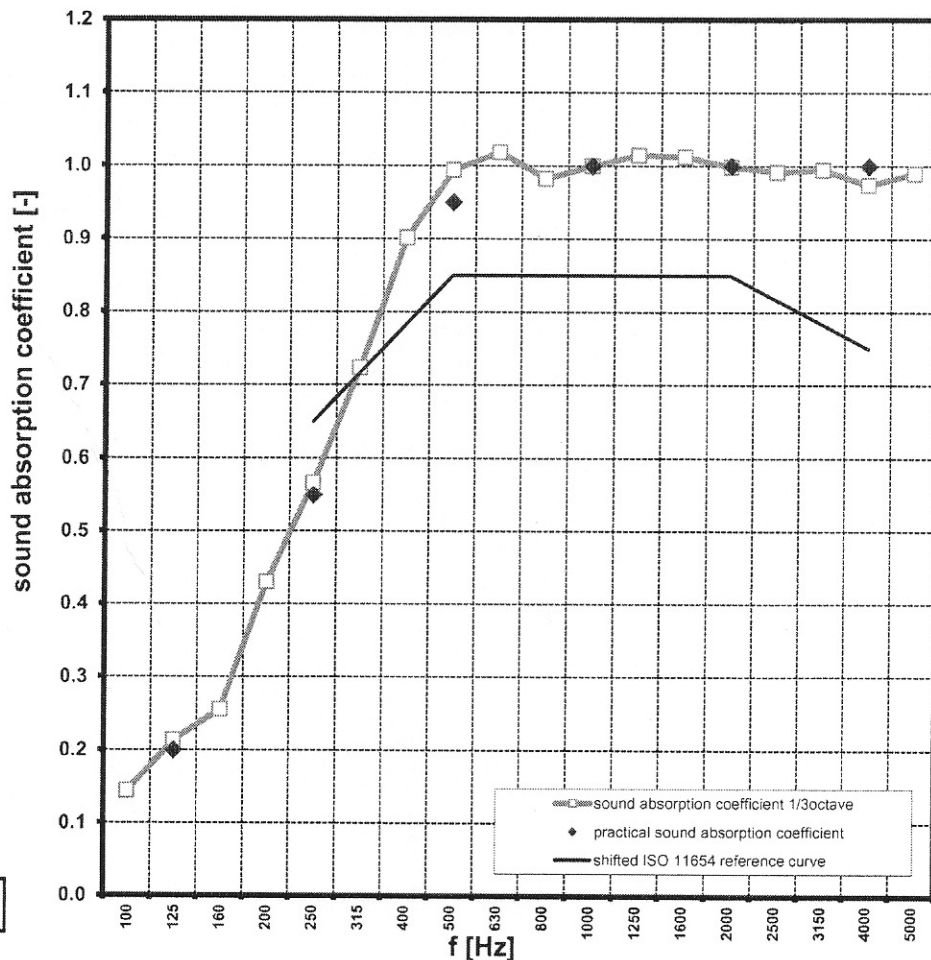N° test sample / N° testelement / N° de l'élément d'essai / Nr. Testelementes: 2013-028-025/8

Area of test element / Opp. testelement / Surf. de l'élément d'essai / Fläche des Testelementes: S = 10.40 m²

f [Hz]	T_1 [s]	T_2 [s]	α_S
50	7.04	6.59	0.04
63	6.40	6.14	0.03
80	6.96	6.06	0.09
100	6.12	5.03	0.14
125	5.69	4.39	0.21
160	5.48	4.08	0.26
200	5.65	3.55	0.43
250	6.04	3.29	0.57
315	6.13	2.94	0.72
400	6.19	2.62	0.90
500	6.18	2.47	0.99
630	6.21	2.44	1.02
800	6.03	2.46	0.98
1000	5.93	2.42	1.00
1250	5.89	2.39	1.01
1600	5.60	2.35	1.01
2000	5.00	2.25	1.00
2500	4.37	2.12	0.99
3150	3.73	1.95	0.99
4000	3.02	1.74	0.97
5000	2.39	1.50	0.99

f [Hz]	α_p
125	0.20
250	0.55
500	0.95
1000	1.00
2000	1.00
4000	1.00

α_w =	0.85	(H)
acoustical absorption class:	B	

Legend:
- sound absorption coefficient 1/3octave
- practical sound absorption coefficient
- shifted ISO 11654 reference curve

REQUESTED BY / AANVRAGER / DEMANDEUR / ANTRAGSTELLER:

2013-028-025/7, Indetex, Torkonjestraat 21/C, B-8510 Kortrijk-Marke

TEST ELEMENT / PROEFELEMENT / ELEMENT D'ESSAI / PRÜFMUSTER:

NL: Geen nederlandse beschrijving beschikbaar

FR: Pas de description en Français disponible

GB: 100% Fire retardant dim-out curtain.
Article Cosy : 100% polyester fire resistant - 150 cm wide - 325 g/m².
(see Annex 3 for detailed description of the mounting).

D: Keine Deutsche Beschreibung verfügbar