

Bellaterra: 7th of October, 2013
Report Number: 13/7294-3158
Petitioner Reference: **INDUSTRIAS KOLMER, S.A.**
C/ Loja, Parc. 111-112, Pol. Ind. Juncaril
18220 Albolote (Granada)

TEST REPORT

REQUESTED TEST: Measurement of the sound absorption in a reverberation room, in conformity with the standard UNE-EN ISO 354:2004, of a specimen of projected cork **SUBER BY KOLMER** approximately 3 mm thick.

DATE OF TEST: 29th of July, 2013

TEST CARRIED OUT BY: Xavier Molins (Acoustics Laboratory – LGAI Technological Center)

Xavier Costa
Manager of Acoustics
LGAI Technological Center S.A.

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1.- SCOPE OF THE TEST

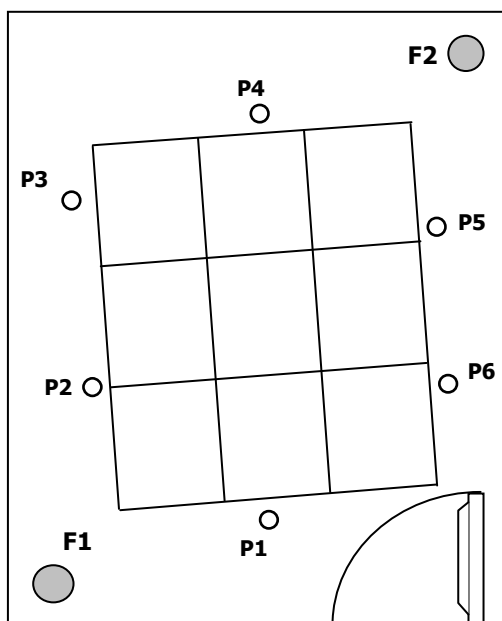
The scope of this test is to determinate the sound absorption, in conformity with the standard UNE-EN ISO 354:2004, of a specimen of projected cork with commercial reference **SUBER BY KOLMER** approximately 3 mm thick.

2.- MEASUREMENT EQUIPMENT

The equipment used in the test is the following:

- Spectrum analyser id. num.: 103099 (Bruel&Kjaer mod. Pulse)
- Microphone calibrator id. num.: 103032 (Bruel&Kjaer mod. 4231)
- Diffuse field microphones id. num.: 103128, 103131, 170093 and 170108 (Bruel&Kjaer mod. 4943) and 170374 and 170375 (G.R.A.S. mod. 40AR)
- Sound sources id. num.: 103098 (AVM mod. DO12) and 103124 (CESVA mod. BP012)
- Noise generator id. num.: 103195 (Bruel&Kjaer mod. 1049)
- Power amplifier id. num.: 103097 (INTER mod. M700)
- Thermo-hygrometer id. num.: 103021 (Oregon Scientific mod. BA116)
- Tape measurer id. num.: 103095 (Stanley mod. Powerlock)

3.- TEST PROCEDURE



Test carried out in conformity with LGAI Technological Center procedure C521 0198 based on the European standard UNE-EN ISO 354:2004; reverberation times of the room with and without the test specimen are compared. The evaluation and rating is done in conformity with the European standard UNE-EN ISO 11654:1998.

Around the room 6 microphones are positioned in P1, P2, P3, P4, P5 and P6. The measurements are done with the sound sources in positions F1 and F2. The test is carried out exciting the room with pink noise. The measured reverberation times are used as specified in part 5.3.

4.- TEST ELEMENT DESCRIPTION

The test specimen, provided by the test petitioner and received within Applus Laboratories – LGAI Technological Center on 26th of July, 2013, is a set of panels with approximately 3 mm thick of projected cork **SUBER BY KOLMER**.

In the Appendix 1 the data sheet of the product with its main characteristics is attached (provided by the test petitioner).

To facilitate the test specimen assembling into the reverberation room, the product to test is projected on a non-porous base (MDF wooden panels 16 mm nominal thickness, with dimensions 1000 x 1200 mm).



Images 1 and 2 Projected cork SUBER BY KOLMER

The test specimen is composed of 9 panels (3 wide x 3 long). To avoid cavities below them, they are screwed on a plane MDF wooden base 19 mm thick that occupies the whole test element surface. The perimeter of the sample is 3 x 3.6 m; therefore the test specimen surface is 10.8 m².



Images 3 and 4 Installation of the test specimen into de reverberant room

The junctions between the different panels are sealed with neutral silicone to avoid the sound penetration through them. Due to the test specimen nature, it is considered unnecessary to seal its perimeter.



Images 5 and 6 Sealing between panels

The following image shows the test specimen and the necessary equipment prepared for the test performance.

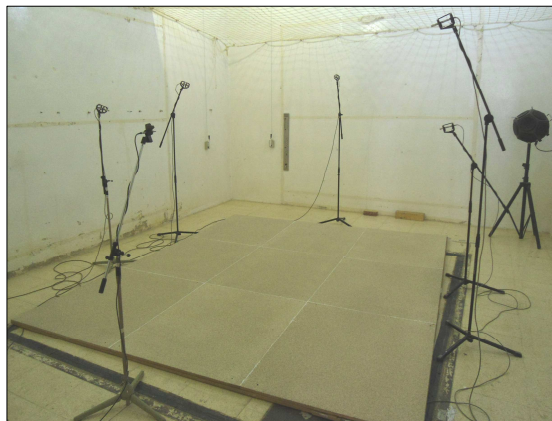


Image 7 Test specimen into the reverberation room

5.- DEFINITIONS AND CLASSIFICATION

5.1. **Reverberation time.** Time, in seconds, that would be required for the sound pressure level to decrease by 60 dB after the sound source has stopped.

5.2. **Equivalent sound absorption area of a room.** Hypothetical area of a totally absorbing surface without diffraction effects which, if it were the only absorbing element in the room, would give the same reverberation time as the room under consideration.

5.3. **Equivalent sound absorption area of the test specimen.** Difference between the equivalent sound absorption area of the reverberation room with and without the test specimen. To calculate this parameter the average reverberation time in the reverberation room is measured with and without the test specimen. From these reverberation times the equivalent sound absorption area, A_T , shall be calculated using the Sabine formula:

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

where:

- c_1 and c_2 are the propagation speed of sound in air temperatures t_1 and t_2 ,
- V is the volume, in cubic metres, of the empty reverberation room,
- T_1 is the reverberation time, in seconds, of the empty reverberation room,
- T_2 is the reverberation time, in seconds, of the empty reverberation room after the test specimen has been introduced,
- m_1 and m_2 are the power attenuation coefficients, in reciprocal metres, of the empty reverberation room and with the test specimen, respectively. The value of m is calculated according to the International Standard ISO 9613-1 using the climatic conditions that have been present during the measurement.

The value of m can be calculated from the attenuation coefficient, α , which is used in International Standard ISO 9613-1 according to the formula:

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

5.4. Sound Absorption Coefficient. The sound absorption coefficient, α_s , of a plane absorber (or an array of identical objects), shall be calculated using the formula:

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

where:

- A_T is the equivalent sound absorption area of the test specimen, in square meters,
- S is the area, in square meters, of the test specimen.

For discrete absorbers, the result should be expressed as equivalent sound absorption area per object, which is determined by dividing A_T by the number of objects tested, n :

$$A_{obj} = \frac{A_T}{n}$$

5.5. Practical sound absorption coefficient, α_p . Value of sound absorption coefficient depending of frequency, based upon measurements of sound absorption according standard ISO 354, and calculated using the formula:

$$\alpha_{pi} = \frac{\alpha_{i1} + \alpha_{i2} + \alpha_{i3}}{3}$$

where:

- α_{pi} is the practical sound absorption coefficient for the i^{th} octave band,
- α_{i1} , α_{i2} and α_{i3} , are the sound absorption coefficients of the corresponding third-octave band within the i^{th} octave band.

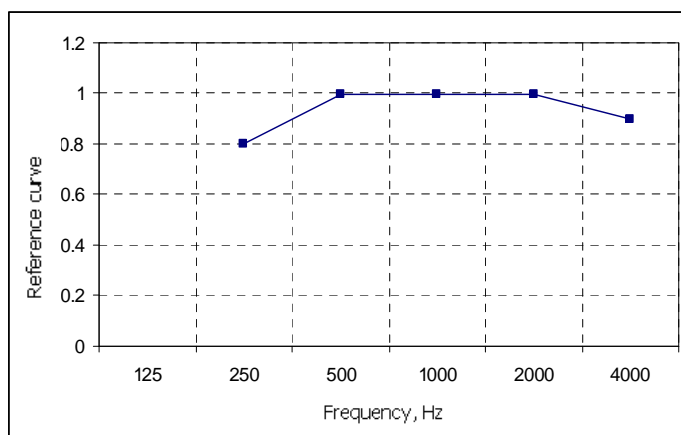
Values are given with 2 decimal and rounded in steps of 0.05 until a maximum value of $\alpha_{pi} = 1.00$ in case of rounded average values > 1.00 .

5.6. Weighted sound absorption coefficient, α_w . Single-number defined as the value of the reference curve, at the frequency of 500 Hz, after shifting it according to the method laid down.

To evaluate the results of a measurement, the reference curve is shifted in steps of 0.05 towards the curve of practical sound absorption, α_p , until the sum of the unfavourable deviations is as large as possible but no more than 0.10. An unfavourable deviation at a particular frequency occurs when the result of measurement is less than the reference curve.

The set of reference values used for comparison with measurement results (reference curve) is specified in table below:

Frequency (Hz)	Reference curve value
250	0.80
500	1.00
1000	1.00
2000	1.00
4000	0.90



5.7. Shape indicators, L. M. H. If a practical sound absorption coefficient, α_{pi} , exceeds the shifted reference curve value on 0.25 or more, a shape indicator will be added.

When excess happens at 250 Hz, indicator L is used. For 500 and 1000 Hz octave bands, indicator M is used. For 2000 Hz and 4000 Hz octave bands, indicator H is used.

5.8. Absorption Classes. Absorption classes A to E are another classification method described in the International Standard ISO 11654 and it is used in wide band applications. The single-number, α_w , is compared with values given in the table below:

Absorption class	α_w
A	0.90; 0.95; 1.00
B	0.80; 0.85
C	0.60; 0.65; 0.70; 0.75
D	0.30; 0.35; 0.40; 0.45; 0.50; 0.55
E	0.15; 0.20; 0.25
Not classified	0.00; 0.05; 0.10

6.- TEST CONDITIONS

Reverberation room characteristics			
Shape:	Parallelepiped	Total area (A_T):	238.2 m ²
Dimensions:	7.84 × 4.96 × 6.27 m	Number of diffusers:	14
Volume (V):	243.6 m ³	Size of diffuser:	1.5 m ²

Environmental conditions of reverberation room		
Room state:	Empty	With specimen
Temperature:	26.0 °C	26.0 °C
Humidity:	50 %	50 %
Atmospheric Pressure:	1007 hPa	1007 hPa

7.- UNCERTAINTY OF TEST

The uncertainty associated to the test has been calculated and is available to the petitioner.

8.- REVERBERATION TIMES AND EQUIVALENT SOUND ABSORPTION AREA

In the following table the reverberation time values of the test room with and without the test element are given, as well as the calculated equivalent sound absorption areas.

Frequency (Hz)	Reverberation time of the empty room, T_1 (s)	Reverberation time of the room with the test specimen, T_2 (s)	Equivalent sound absorption area, A_T (m ²)
100	15.11	13.42	0.32
125	11.08	9.56	0.56
160	11.52	9.58	0.68
200	11.80	9.63	0.74
250	11.96	8.95	1.09
315	11.18	8.10	1.33
400	10.29	7.18	1.63
500	9.91	7.29	1.41
630	9.21	6.94	1.39
800	8.49	6.45	1.45
1000	8.03	6.16	1.48
1250	7.19	5.51	1.65
1600	6.29	4.95	1.68
2000	5.53	4.41	1.80
2500	4.85	3.85	2.09
3150	4.17	3.33	2.37
4000	3.31	2.68	2.80
5000	2.62	2.13	3.42

9.- RESULTS

Sound absorption according to UNE-EN ISO 354:2004



INDUSTRIAS KOLMER, S.A.

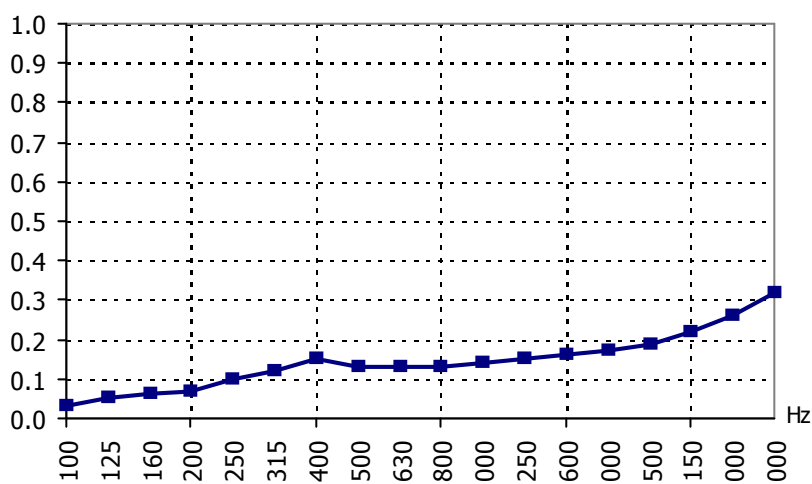
Test specimen:

Projected cork referenced **SUBER BY KOLMER** approximately 3 mm thick. Projected on a wooden MDF 16 mm thick base.

Date of test: 29th of July, 2013



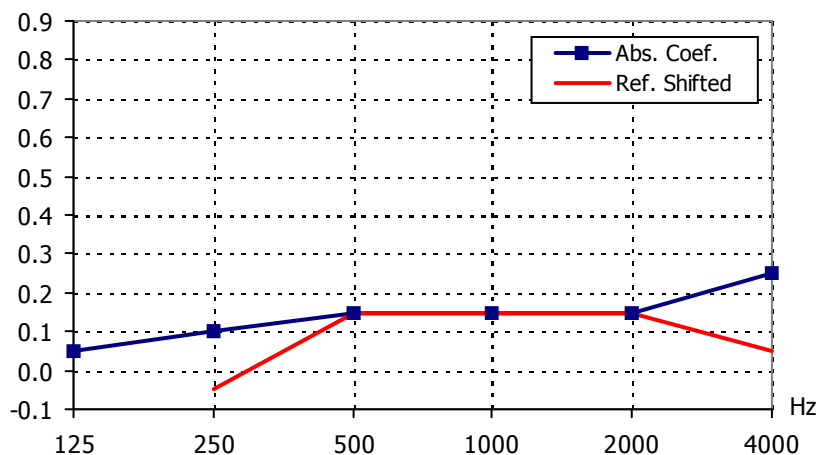
Sound absorption coefficient, α_s



Sound abs. coefficient, α_s

Freq. (Hz)	α_s
100	0.03
125	0.05
160	0.06
200	0.07
250	0.10
315	0.12
400	0.15
500	0.13
630	0.13
800	0.13
1000	0.14
1250	0.15
1600	0.16
2000	0.17
2500	0.19
3150	0.22
4000	0.26
5000	0.32

Practical sound absorption coefficient, α_p



Practical sound absorption coef., α_p

Freq. (Hz)	α_p
125	0.05
250	0.10
500	0.15
1000	0.15
2000	0.15
4000	0.25

Weighted sound absorption coefficient, $\alpha_w = 0.15$ (--)

Absorption class: **E**

It is highly recommended to use the single number "weighted sound absorption coefficient (α_w)" together with frequency-dependent values of sound absorption coefficient.

The results reported in this document relate only to the sample, product or item delivered to LGAI Technological Center the appointed day having been tested under the conditions established in this document.

APPENDIX 1 – DATA SHEET PROVIDED BY THE TEST PETITIONER




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SUBER PROJECTED CORK BY KOLMER

CARACTERÍSTICAS-CARACTERÍSTICAS-FEATURES-CARACTÉRISTIQUES-CARATTERISTICHE

<p>LIQUID PRODUCT Storage: up to 12 months. Specific weight: 0.91 g / cc. Solids content: 45%</p>	<p>DRY FILM Theoretical yield: 2.5 kg/m2 Dry to the touch after: 1 hour Rough, warm finish. Waterproof and vapour and CO2 permeable</p>
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ESPECIFICACIONES-ESPECIFICAÇÕES-SPECIFICATIONS-CARACTÉRISTIQUES-SPECIFICHE

Dry to the touch depending on support and humidity after: 1 - 2 hours
Total drying time depending on support and humidity: 8 to 24 hours.
Minimum/maximum application temperature: +7°C / +30°C
Performance: From 1.5 to 2.5 kgs./m2, depending on the surface and thickness of application. The estimated energy savings are between 20 and 40%.

MODO DE EMPLEO-INSTRUÇÕES-INSTRUCTIONS-DIRECTIONS-ISTRUZIONE

Supports must be in good, clean and consistent condition. On metallic surfaces, add the KOLMAN ANTIOXIDANT ADDITIVE to the coating, and then mix. For the first and successive coats, apply SUBER by Kolmer diluted by up to 10% with water, leaving the surface smooth. It is imperative that the first coat is completely dry before applying new layers. This product is applied by spray with the correct nozzle, which is to be cleaned with water immediately after. This coating allows for slight movement. To improve movement, it is recommended to add KOLMAN MOVEABLE ADDITIVE, finishing it off with layers of the water-based KOLMAN NATURA HARDWOOD VARNISH.

PRINCIPALES PROPIEDADES-PRINCIPAIS PROPRIEDADES-MAIN PROPERTIES PRINCIPALES PROPRIÉTÉS-PRINCIPALI PROPRIETÀ

There are no limits for the application of this product due to the features that make it ideal for insulation and protection, both indoors and outdoors. Its main advantages: Excellent insulation. Waterproof. Good elasticity. High resistance. Good performance. Great washability. Easy to apply. Non-toxic. Not flammable. High resistance to aging. Good resistance to alkalinity. It is manufactured in K-P and K-TR bases. With KOLINTINE dyes, many colors can be achieved, there is a basic chart of 50 colors.

Contains max. VOC: 19 g/l
EU limit value of the product (cat.A/c): 40 g/l(2010)

FORMATOS-FORMATOS-FORMATS-FORMATS-FORMATI

It comes in packs of 12 kilos



CARACTERÍSTICAS TÉCNICAS-ESPECIFICAÇÕES TÉCNICAS TECHNICAL FEATURES-CARACTERISTIQUES TECHNIQUES CARATTERISTICHE TECNICHE

- RECOMMENDATIONS -

Stir the contents of the package in order to homogenize the product before applying. The surfaces must be clean and dry. Seal problematic surfaces with ANTICARBONATION PRIMER. The duration and effectiveness of SUBER by Kolmer is dependent on the thickness of the applied product.

- RECORDS AND ACCREDITATION -

BUREAU CERTIFIED PRODUCT
VERITAS CERTIFICATION

THIS DATA SHEET SUPERCEDES ALL PREVIOUS VERSIONS. Please check the "GUIDE TO PROBLEMS WITH APPLICATION AND FINALISATION" of these products.

* Range of the numerical data: 20%

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