TEST REPORT No. 110259-6

CLIENT:	**ISINAC ACOUSTIC WORLD, S.L.** Av. de Ramón Nieto, 125-Bajo 36205 VIGO
AIM:	**Measurement of sound absorption in laboratory**
STANDARD:	**EN ISO 354:2003**
TEST SPECIMEN:	***ISINAC CURTAIN ILUCS 2 layers curtain*, with folded arrangement and 200 mm of distance to the wall**
ISSUE DATE:	**08/03/2024**

Technical Consultant
Susana Lopez de Aretxaga

LAB_SERVICES

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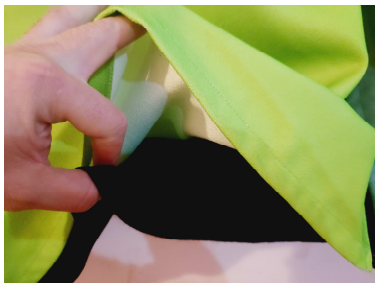
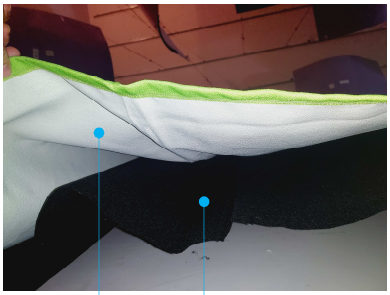
Facilities where the measurements are carried out belong to the Acoustics Area of the Building Quality Control Laboratory of the Basque Government, located in Agirrelanda, 10, 01013 VITORIA-GASTEIZ (Spain) operated by TECNALIA.

1. TEST SPECIMEN DESCRIPTION

The test specimen consists of a folded curtain separated from the wall, with the following description and test arrangement, according to the information provided by the client:

Description of the curtain:





a. ILUCS FABRIC
100% Polyester Trevira CS
(~1 mm thick & 265 gr/m^2)

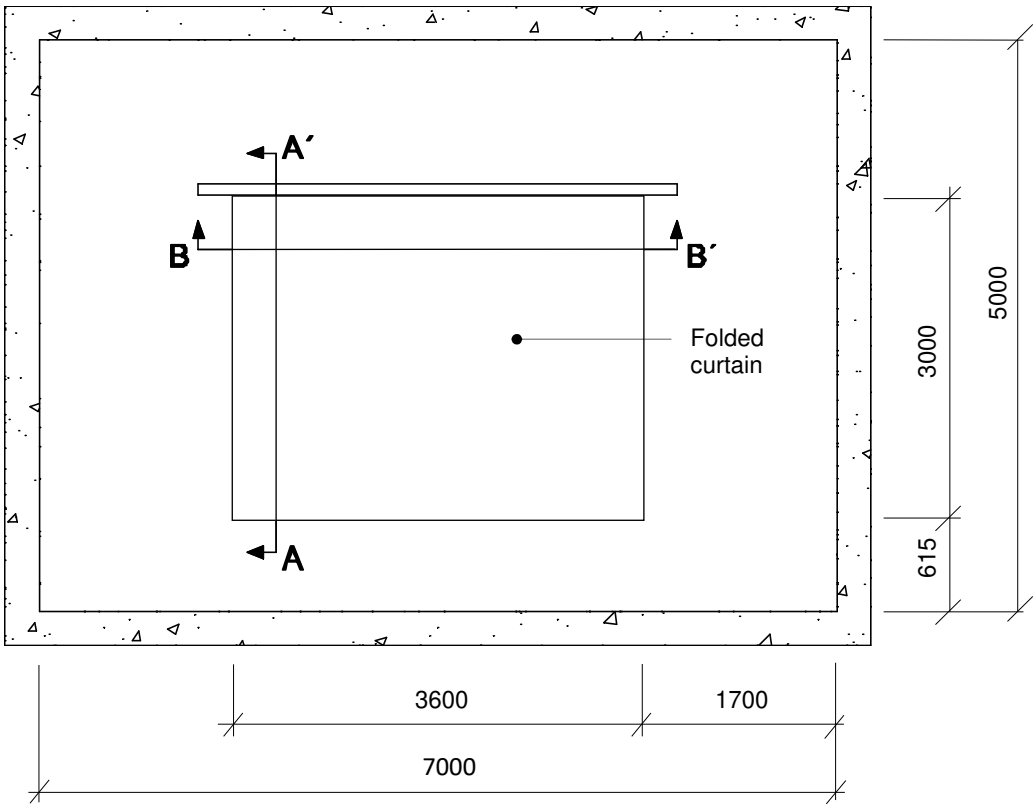
b. PX210 FABRIC
100% CARBON FIBER
(~3 mm thick & 210 gr/m^2)

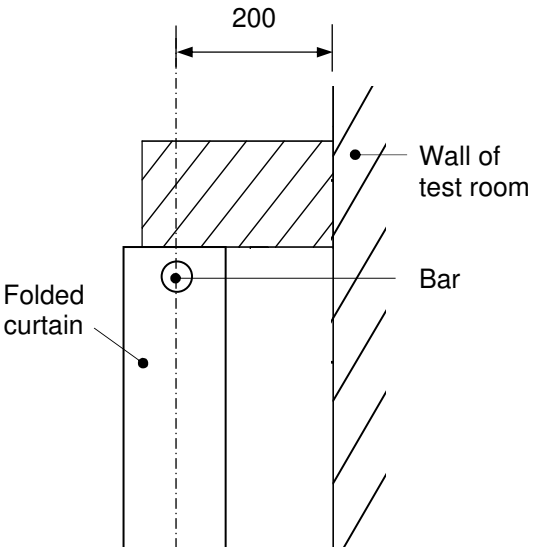
Each curtain panel is formed by 2 layers (a+b) joined together by the sides and top.

Test specimen thickness: ~4 mm.

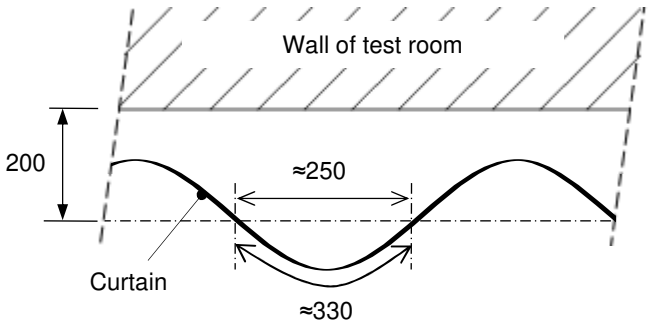
Arrangement of the test specimen:

- Folded arrangement.
- Dimensions: 3600 mm wide x 3000 mm high = 10,8 m^2
- Test specimen made of 3 panels of 1610, 1570 and 1580 mm wide and 3000 mm high each one, joined by zipper, which form a curtain of exterior dimensions of 4760x3000 mm, which folding covers an area of 3600x3000 mm.
- Test specimen mounted parallel to a wall of the reverberation room, with a distance between curtain and wall of 200 mm, without lateral frame. Mounting type G-200 according to Annex B of EN ISO 354:2003.
- The curtain was hanged from a wooden bar of Ø40 mm, fixed to a wooden beam of 230 mm wide x 100 mm high.





Section AA'



Section BB'

Arrangement of test specimen (110259-6). Cotes in mm

Photos of test specimen

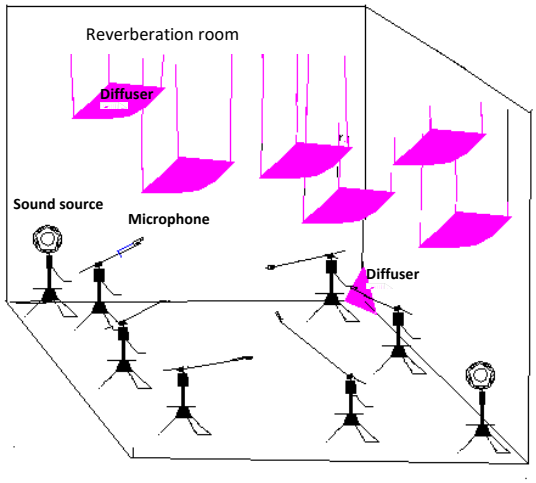
Manufacturer od curtain: Client

Curtain selected and delivered by: Client

Mounting performed by: Tecnalia and Construcciones J.L. Iglesias

2. LABORATORY TEST FACILITY

The test is performed in the reverberation room. This room is a regular parallelepiped of 7x6x5 meters with a total surface area of 211,8 m^2 (walls, floor and ceiling). The sound field diffusivity of the room is obtained by means of twenty diffusers (between 1 and 1,2 m^2) suspended from the ceiling of the room and eight edged diffusers. The room complies with the requirements of EN ISO 354:2003.



Sketch of reverberation room

3. EQUIPMENT AND TEST CONDITIONS

Equipment

Microphones	Brüel&Kjær 4943; Serial No. 3188436	Brüel&Kjær 4943; Serial No. 3188435
Preamplifiers	Brüel&Kjær 2669; Serial No. 1948764	Brüel&Kjær 2669; Serial No. 2025844
Analyzer	Nor850-MF1; Serial No. 8501186	
Sound source	Brüel&Kjær 4296; Serial No. 2071428	
Amplifier	LAB 300; Serial No. 970-967	
Equalizer	Sony, SRP-E100; Serial No. 400238	
Calibrator	Brüel & Kjær 4231; Serial No. 2061476	
Environmental conditions meter	Rotronic BL-1D; Serial No. A21050028	

Environmental conditions:	Empty room	Room with test specimen	Uncertainty
Air temperature (ºC)	16,9	16,9	±0,5
Relative humidity (%)	53	54	±4
Static pressure (mbar)	959	955	±2

4. TEST PROCEDURE AND EVALUATION

The sound absorption coefficient, α_s, is calculated for the one-third-octave frequency band from 100 Hz to 5 kHz according to standard EN ISO 354:2003, using the following formula:

$$\alpha_s = A_T/S$$

A_T: Equivalent sound absorption area of test specimen (m^2)

S: Area covered by test specimen (m^2)

The equivalent sound absorption area of test specimen, A_T, is calculated according to the formula:

$$A_T = 55{,}3 \cdot V \cdot \left(\frac{1}{c_2 \cdot T_2} - \frac{1}{c_1 \cdot T_1} \right) - 4 \cdot V (m_2 - m_1)$$

V: Volume of empty reverberation room (m^3)

C_1: Propagation speed of sound in air in empty reverberation room (m/s)

C_2: Propagation speed of sound in air in reverberation room with test specimen (m/s)

T_1: Reverberation time of empty reverberation room (s)

T_2: Reverberation time of reverberation room with test specimen (s)

m_1; m_2: Power attenuation coefficients, in reciprocal metres, calculated according to ISO 9613-1, using the climatic conditions in the reverberation room

Reverberation time measurement is performed using the interrupted noise method and is obtained by arithmetic average of measurements at 2 source positions and 6 fixed microphone positions for each source position.

Measuring chain is verified just before and after the execution of the test.

The guidelines indicated in the applicable internal procedures have been followed:

- PE.MC-AA-63-E: “Procedure to determine the sound absorption in a reverberation room, according to standard EN ISO 354”.
- PE.MC-AA-06-M: “Procedure to manage the test specimens for acoustic tests in laboratory”.

5. RESULTS

The following results are featured for the test specimen:

- Sound absorption coefficient, α_S, per one-third octave frequency bands from 100 to 5000 Hz.
- The following parameters obtained according to standard EN ISO 11654:1997, from the sound absorption coefficient α_S:
  - Practical sound absorption coefficient, α_p, in octave frequency bands from 125 to 4000 Hz
  - Weighted sound absorption coefficient, α_w
  - Shape indicators: L.M.H.

The intermediate data obtained in the test are:

f (Hz)	T_1	T_2	A_T
100	9,65	8,16	0,6
125	8,07	5,20	2,3
160	8,48	4,95	2,9
200	9,53	4,00	4,9
250	9,02	3,45	6,1
315	8,15	2,96	7,3
400	8,07	2,58	9,0
500	8,51	2,61	9,0
630	8,19	2,63	8,8

f (Hz)	T_1	T_2	A_T
800	7,46	2,61	8,4
1000	7,00	2,53	8,6
1250	6,32	2,40	8,8
1600	5,67	2,32	8,7
2000	4,97	2,14	9,1
2500	4,19	1,92	9,6
3150	3,30	1,67	10,1
4000	2,62	1,44	10,8
5000	1,93	1,20	10,9

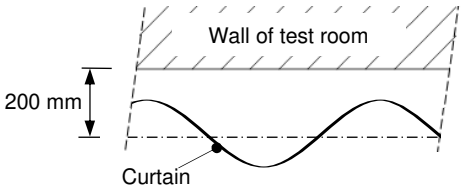
Sound Absorption according to EN ISO 354:2003
Laboratory measurements

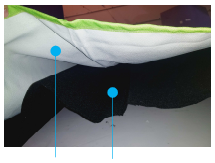
CLIENT: **ISINAC ACOUSTIC WORLD, S.L.**

TEST DATE: 29/02/2024

RESULT No.: 110259-6

TEST SPECIMEN: ***ISINAC CURTAIN ILUCS 2 layers*** **curtain, with folded arrangement and 200 mm of distance to the wall**





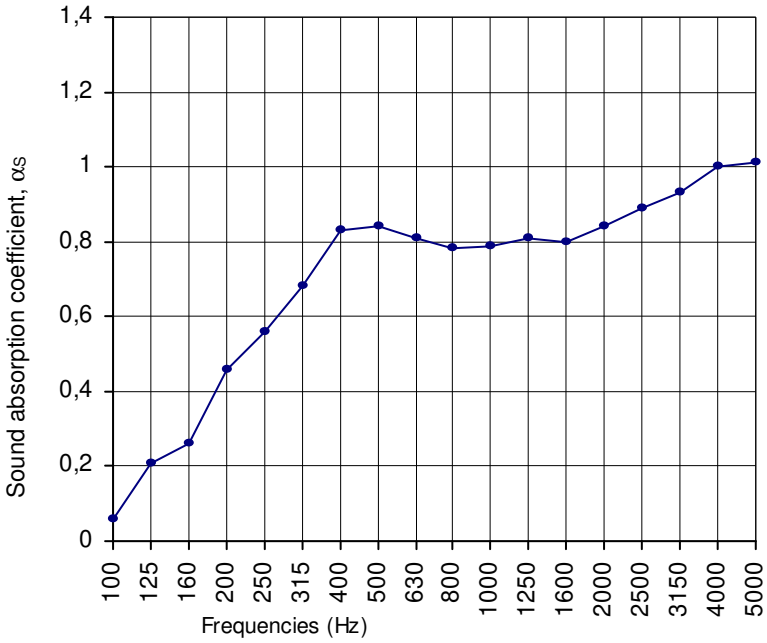
a. ILUCS FABRIC
100% POLYESTER TREVIRA CS 265 gr/m²

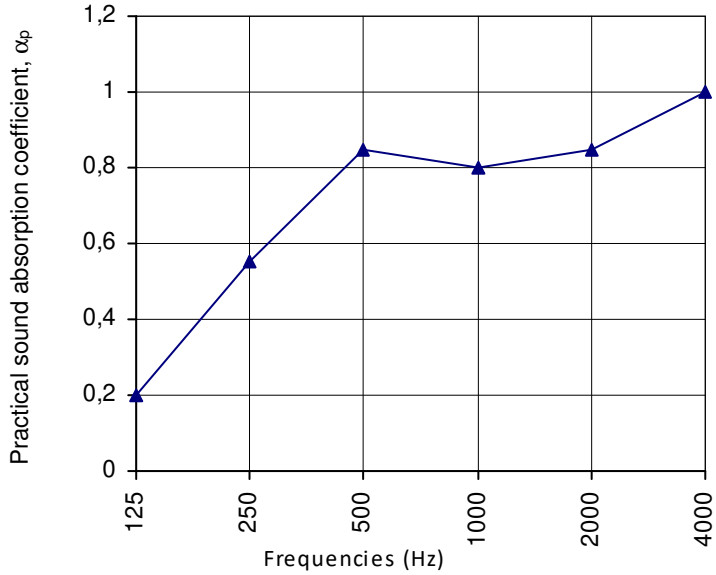
b. PX210 FABRIC
100% CARBON FIBER 210 gr/m²

Area, S, test: 10,8 m²
Reverberation room volume: 209,6 m³

f (Hz)	α_s	α_p
100	0,06	0,20
125	0,21	
160	0,26	
200	0,46	0,55
250	0,56	
315	0,68	
400	0,83	0,85
500	0,84	
630	0,81	
800	0,78	0,80
1000	0,79	
1250	0,81	
1600	0,80	0,85
2000	0,84	
2500	0,89	
3150	0,93	1,00
4000	1,00	
5000	1,01	

Weighted sound absorption coefficient according to EN ISO 11654:1997
α_w = 0,80 (H)





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