

REPORT N. 088-2019-CR ENG

UNI EN ISO 354:2003

ACOUSTIC ABSORPTION MEASUREMENT IN REVERBERATION ROOM

Issue place and date: Cerea (VR), date 05/10/2019

Committee: SLALOM s.r.l.

Address committee: Via E. Rossi, 69, 20862 Arcore (MB)

Sample delivery date: 04/29/2019

Sample provenance: SLALOM s.r.l.

Sample installation date: 05/02/2019

Sample installed in laboratory by: Z Lab S.r.l. (sampling made by the committee)

Test date: 05/02/2019

Test location: Z Lab S.r.l. – Via Pisa, 7 – 37053 Cerea (VR) - Italia

Sampling denomination: The test sample is denominated "ECObooth"]

Mounting Type: Discrete Objects



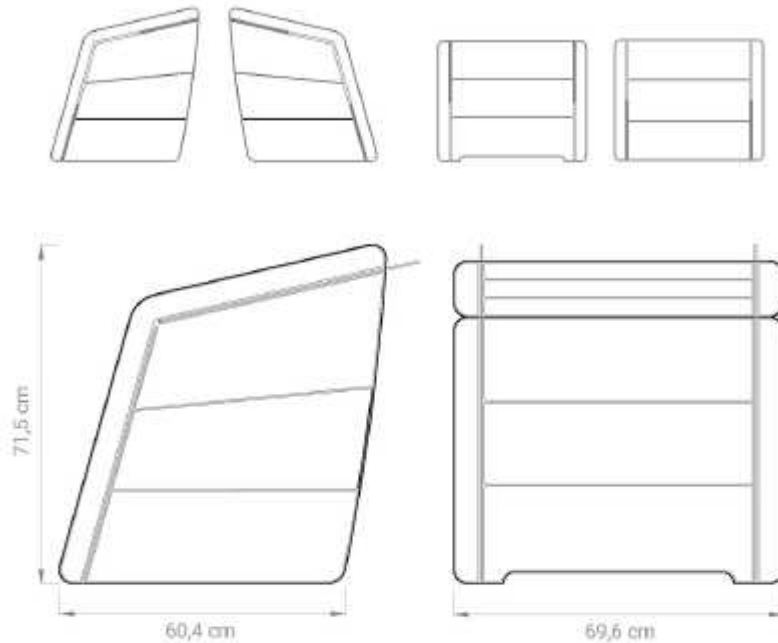
LAB N° 1416

PREPARED	VERIFIED	APPROVED
Antonio Scofano	Antonio Scofano	Antonio Scofano

Sample description

The test sample is composed of is a " thermoformed sound-absorbing nesting cabin named "ECObooth, made of 100% polyester fiber.

In next section there are the technical data of the product: (*)



DIMENSIONI:

• L 69,6 x H 71,5 x P 60,4 cm – Pannelli: SP 3,5 cm

NOTE: *I pannelli potranno avere differenze di spessore dovute alla tipologia del materiale*

PESO:

4,8 kg

Figure 1_ Sample technical data (*)

(*) nominal data provided by the sample manufacturer

Mounting conditions

Three samples placed in 3 different locations were installed inside the test chamber. The distance provided by the regulations has been maintained: 2 meters between the three positions in the room and 1 meter from each test surface and microphone position.

The test sample characteristics are listed below:

<i>n° test objects</i>
3



Figure 2_ Sample detail (*)

(*) nominal data provided by the sample manufacturer

Test sample illustrations



Figure 2_ Reverberation Room Empty



Figure 3_ Reverberation Room with test objects

The test has been made as soon as the sample installation was completed.

Standards references

UNI EN ISO 354:2003	<i>Acoustic - Absorption measurement in reverberation room</i>
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Test environment description

The test structure is made of reinforced concrete, completely insulated from the floor of the laboratory with anti-vibration supports. It is made up of a reverberating room of irregular shape and free of partition parallel to each other.

The dimensional data are listed below:

Average reverberation room dimensions (L x W x H)	700 X 560 X 370 cm
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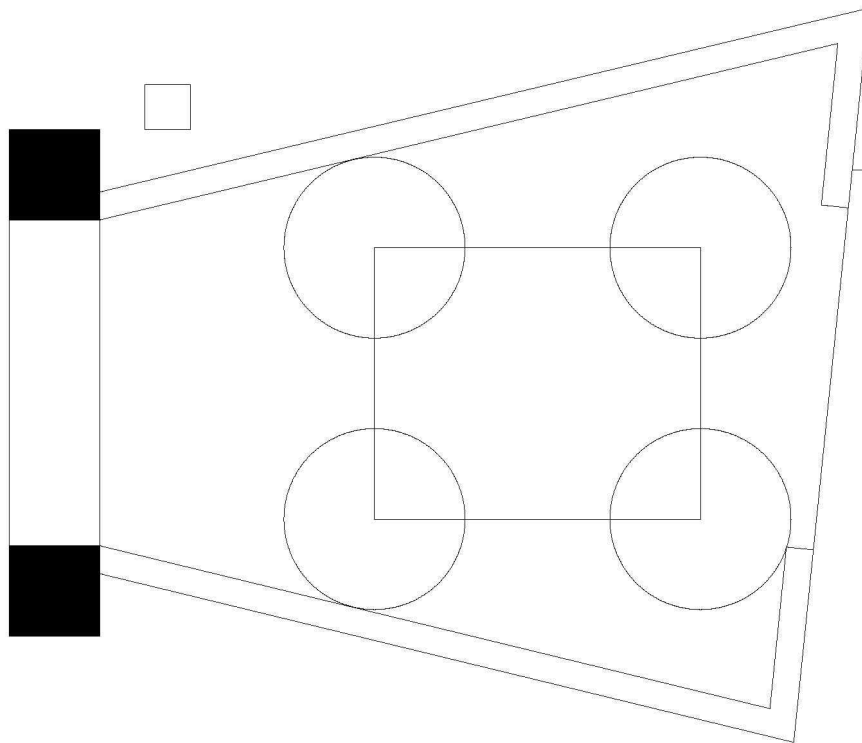


Figure 4_ Reverberation Room Scheme

Test equipment and instruments

Instrument	Model	Serial number
Sound Level Meter	Larson & Davis LD2900B	1080 CH1
Microphone	GRAS 40AQ	204027
Preamplifier	Larson & Davis PRM900C	1267
Calibrator	Larson & Davis CAL200	3852
Omnidirectional source	Bruel & Kjaer 2719 + 4292	2571776 + 14012
Termohygrometer	DeltaOHM HD 2301.0	9020599
Temperature and humidity sensor	DeltaOHM HP472AC R	9028736
Tape	Stanley 33 - 442	13/946

Environmental data during the test

	Reverberation room
Volume	161.3 m ³
Total surface	188.5 m ²
Average temperature during T ₁	19.0 ± 1.0 °C
Average relative humidity during T ₁	54.0 ± 2.0 %
Average temperature during T ₂	19.2 ± 1.0 °C
Average relative humidity during T ₂	54.6 ± 2.0 %

Where:

- T₁: Empty room reverberation time
- T₂: Room reverberation time with sample

Measurement method

The measurement of the sound absorption in the reverberation room is based on the principle of the difference between the reverberation times measured in the reverberation room in the presence of the material to be tested and in the empty reverberation room. The acoustic source, which produces pink noise, has been operated within the source room in 3 different positions, while the microphone is located in 4 different positions, both in the source room and in the receiving room. Three measurements for each source-microphone combination have been performed, for a total of 36 measurements in the empty room and 36 measurements in the sample room. The integration time, for each measure, has been at least 10 s.

After the measurements, the reverberation time of both rooms is calculated in any frequency band by evaluating the arithmetic average of the total number of measured reverberation times. The average reverberation time for the empty room and for the sample room, respectively T_1 and T_2 , is expressed with two significant digits.

The sample equivalent absorption area, A_T is then calculated using the formula:

$$A_T = A_2 - A_1 = 55,3 \cdot V \cdot \left(\frac{1}{c_2 T_2} - \frac{1}{c_1 T_1} \right) - 4 \cdot V \cdot (m_2 - m_1)$$

Where:

c_1 : is the sound speed in air at temperature t_1 , in m/s;

c_2 : is the sound speed in air at temperature t_2 , in m/s;

V : is the empty room volume, in m^3 ;

T_1 e T_2 : are the reverberation times for both the rooms;

m_1 e m_2 : are attenuation coefficients, depending on climate rooms conditions during the test.

When the test specimen comprises several identical objects, the equivalent sound absorption area A_{obj} of an individual object is found by dividing A_T by the number of objects, n :

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

Where:

A_T : equivalent sound absorption area in m^2 ;

n : number of test objects .

Measured values

f [Hz]	T ₁ [s]	T ₂ [s]	A _T [m ²]
<i>Frequency</i>	<i>Empty room reverberation time</i>	<i>Sample room reverberation time</i>	<i>Equivalent absorption area</i>
100	4.31	3.18	2.16
125	4.20	2.84	2.97
160	5.72	3.49	2.91
200	6.38	3.37	3.64
250	6.15	3.58	3.04
315	5.93	3.30	3.49
400	5.55	3.09	3.74
500	5.19	2.78	4.36
630	5.46	2.80	4.51
800	5.07	2.52	5.21
1000	4.57	2.27	5.78
1250	4.37	2.20	5.88
1600	4.51	2.27	5.69
2000	4.30	2.24	5.58
2500	3.82	2.13	5.41
3150	3.16	1.97	4.99
4000	2.68	1.78	4.93
5000	2.11	1.53	4.68

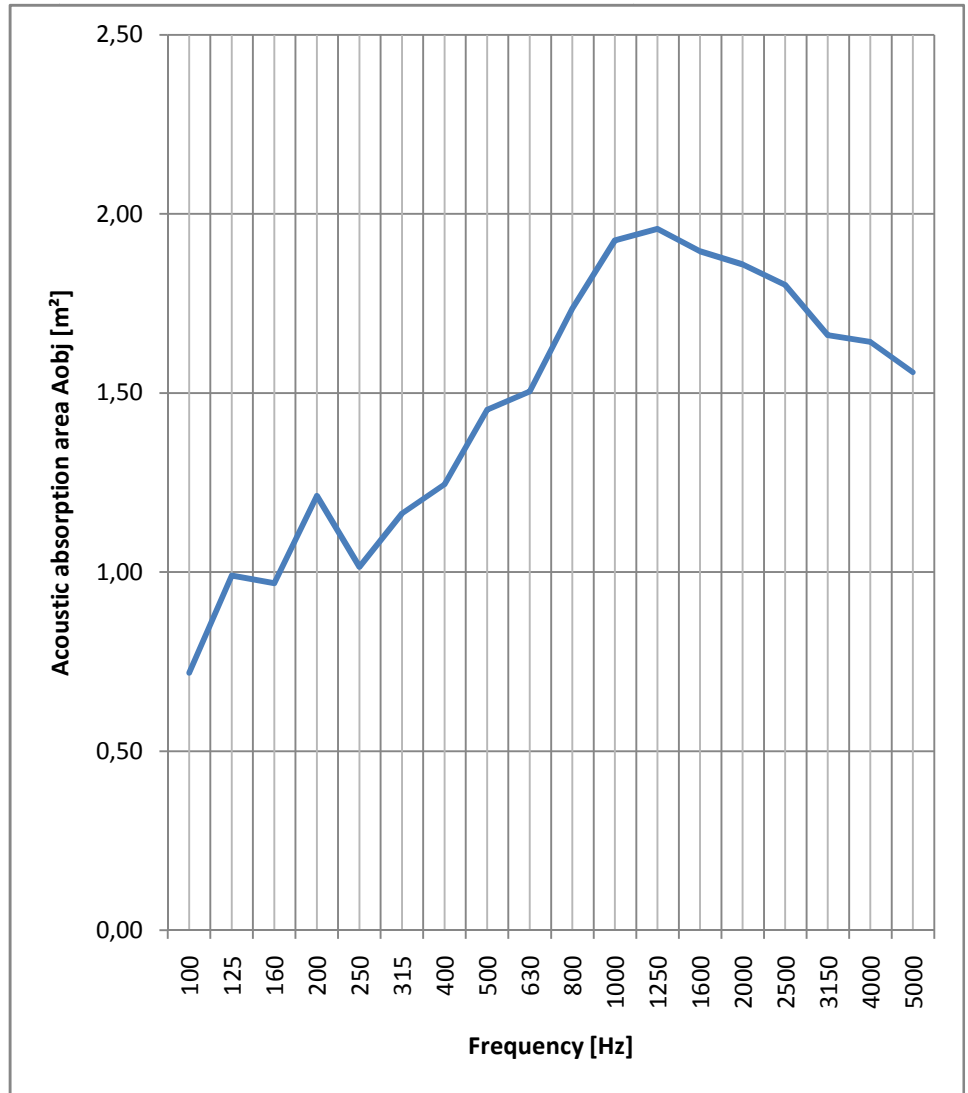
Equivalent Sound Absorption of an individual object Aobj calculation in reverberation room according to UNI EN ISO 354

Sample description: ECObooth

Mounting Type: [Type]

Reverberation room volume: 161.3 m³

f [Hz]	Aobj[m ²]
	<i>Equivalent sound absorption of an individual object values</i>
Frequency	
100	0.72
125	0.99
160	0.97
200	1.21
250	1.01
315	1.16
400	1.25
500	1.45
630	1.50
800	1.74
1000	1.93
1250	1.96
1600	1.90
2000	1.86
2500	1.80
3150	1.66
4000	1.64
5000	1.56



Evaluation based on laboratory measurement results by means of a technical method.

Laboratory Manager, Ing. Antonio Scofano