

REPORT N. 147-2019-CR Eng rev.1

UNI EN ISO 354:2003

ACOUSTIC ABSORPTION MEASUREMENT IN REVERBERATION ROOM

Issue place and date: Cerea (VR), 10/30/2019

Committee: Abitex S.r.l.

Address committee: Via E.Fermi 9/11, 35010 Cadoneghe (PD) Italy

Sample delivery date: 09/09/2019

Sample provenance: Manufacturing plant : Castello di Godego (TV)

Sample installation date: 09/09/2019

Sample installed in laboratory by: Committee (sampling made by the committee)

Test date: 09/09/2019

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

Sampling denomination: The test sample is denominatated “Terawall Gold”

Mounting Type: Mounting A



LAB N° 1416

PREPARED	VERIFIED	APPROVED
Sabato Di Filippo	Antonio Scofano	Antonio Scofano

Sample description

The test sample is sound-absorbing panel named "Terawall Gold" having the following characteristics:

The panel is striped tufted, sandwich fabrics, and is composed of a first layer made of ALU, siliceous fiber in the core and a Carbon Fiber layer; total thickness (variable): from 15 mm to 40 mm; mass per unit area: 1,2 kg/m².



Figure 1_Sample "Terawall Gold"

Mounting conditions

The mounting type is A in accordance with Annex B.2 of UNI EN ISO 354.

The outer perimeter of the specimen has been sealed with adhesive tap.

The test sample characteristics are listed below (*):

Sample length** (mm)	Sample Width** (mm)	Sample thickness* (mm)
3470	3100	15÷40

(*) nominal data provided by the sample manufacturer

(**) data measured by test element sampling

Test sample illustrations



Figure 2_ Reverberation Room Empty

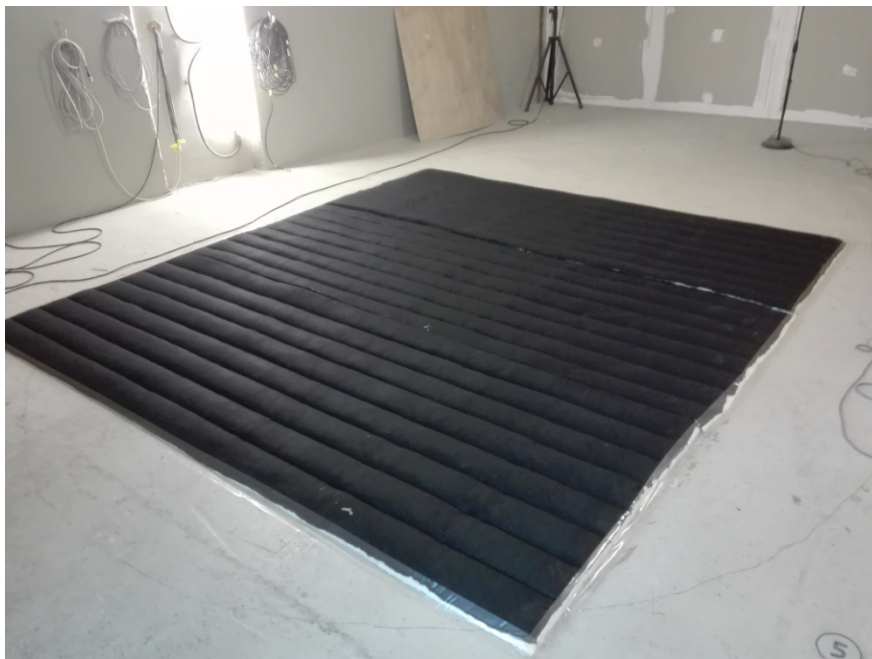


Figure 3_ Reverberation Room With Sample

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>
UNI EN ISO 11654:1998	<i>Acoustics - acoustic absorbers for buildings - Rating of sound absorption.</i>

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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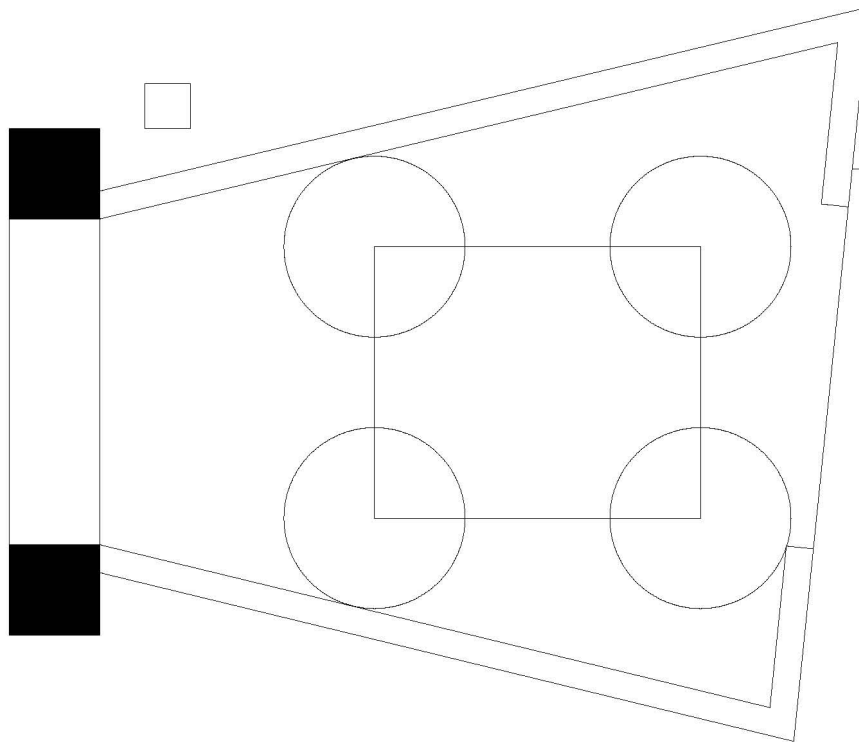


Figure 4_ Reverberation Room Scheme

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 HD35ED1NTV	16037651
Temperature and humidity sensor	DeltaOHM HD35ED1NTV	16037652
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	25.4 ± 1.0 °C
Average relative humidity during T ₁	42.3 ± 2.0 %
Average temperature during T ₂	25.4 ± 1.0 °C
Average relative humidity during T ₂	42.3 ± 2.0 %
Sample surface	10.76 m ²

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. 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.

The acoustic absorption coefficient, α_s , of flat absorbers or of a set of objects is evaluated with the formula:

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

where:

S : is the sample area, in m^2 .

According to UNI EN ISO 11654, is then possible to evaluate the practical absorption coefficient, α_{pi} , for any octave band "T", through arithmetic average of the three absorption coefficients for any one-third octave band in the octave band of interest:

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

The mean value is calculated to the second decimal digit, rounded by 0.05 steps, and limited to $\alpha_{pi} = 1.00$ for rounded average values > 1.00 .

The α_{pi} values are used to calculate the a_w weighted acoustic absorption coefficient starting from the reference curve which is translated at steps of 0.05 to the measured value until the sum of unfavorable deviations is less than or equal to 0.10. The a_w weighted acoustic absorption coefficient is defined as the value of the reference curve transposed at 500 Hz.

If a practical acoustic absorption coefficient α_{pi} exceeds the value of the referenced reference curve of 0.25 or more, add one or more shape gauges to the a_w value by bringing them back into parentheses. If the excess absorption occurs at 250 Hz, the notion L is reported, if the excess occurs at 500 Hz or 1000 Hz, the indicator M is used, and if the excess occurs at 2000 Hz or 4000 Hz the notion H.

Measured values

f [Hz]	T₁ [s]	T₂ [s]	A_T [m²]
<i>Frequency</i>	<i>Empty room reverberation time</i>	<i>Sample room reverberation time</i>	<i>Equivalent absorption area</i>
100	3,88	3,34	1,07
125	4,98	3,66	1,87
160	6,04	3,86	2,41
200	6,70	3,52	3,47
250	6,92	3,33	4,02
315	6,53	2,76	5,38
400	5,72	2,15	7,50
500	5,15	2,05	7,54
630	5,44	1,92	8,70
800	4,95	1,74	9,58
1000	4,40	1,63	9,95
1250	4,18	1,56	10,40
1600	4,35	1,65	9,65
2000	4,25	1,61	9,93
2500	3,76	1,60	9,27
3150	3,15	1,53	8,66
4000	2,72	1,41	8,76
5000	2,09	1,36	6,68

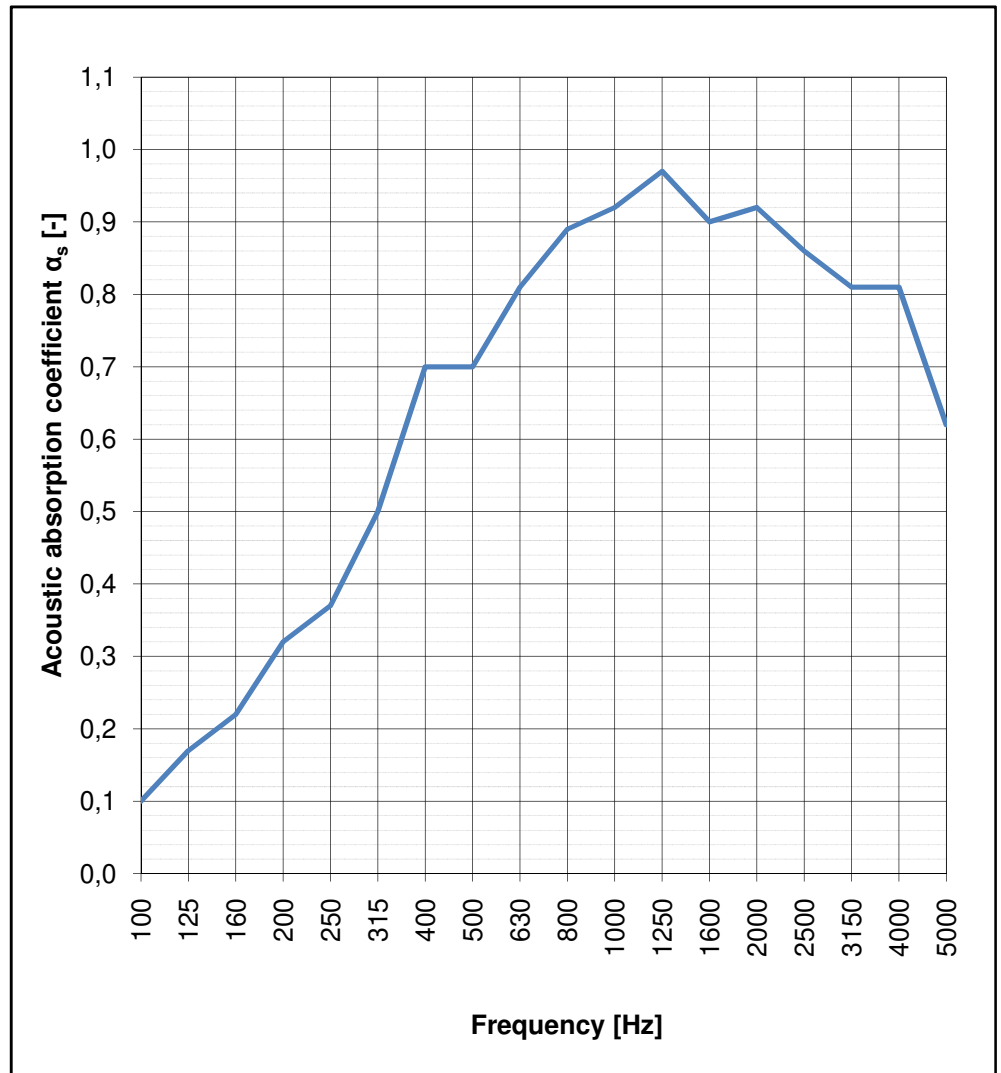
Acoustic absorption calculation in reverberation room according to UNI EN ISO 354:2003

Sample description: Panel "Terawall Gold"

Mounting Type: Mounting A

Sample area: 10.76 m²
Reverberation room volume: 161.3 m³

f [Hz]	α_s [-]
Frequency	Acoustic absorption coefficient values
100	0,10
125	0,17
160	0,22
200	0,32
250	0,37
315	0,50
400	0,70
500	0,70
630	0,81
800	0,89
1000	0,92
1250	0,97
1600	0,90
2000	0,92
2500	0,86
3150	0,81
4000	0,81
5000	0,62



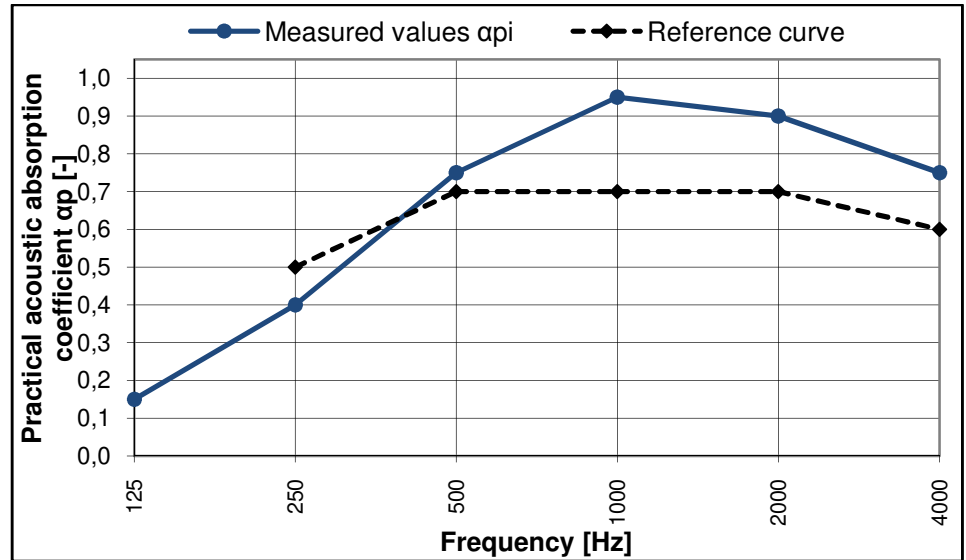
Evaluation based on laboratory measurement results by means of a technical method.

Acoustic absorption calculation in reverberation room according to UNI EN ISO 11654:1998

Sample description: Panel "Terawall Gold"
 Mounting Type: Mounting A

Sample area: 10.76 m²
 Reverberation room volume: 161.3 m³

f [Hz]	α_p [-]
Frequency	Practical acoustic absorption coefficient values
125	0,15
250	0,40
500	0,75
1000	0,95
2000	0,90
4000	0,75



STANDARD EVALUATION INDEX:

α_w	0.70 CLASS C	Weighted acoustic sound absorption coefficient Sound Absorption Class**	UNI EN ISO 11654:1998
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Evaluation based on laboratory measurement results by means of a technical method.

** Classification of acoustic absorbers: The unique α_w evaluation index is used to calculate the absorption class according to the following table:

CLASS	α_w
A	0.9 - 0.95 - 1.00
B	0.8 - 0.85
C	0.6 - 0.65 - 0.7 - 0.75
D	da 0.3 a 0.55
E	0.15 - 0.2 - 0.25
NC	0.00 - 0.05 - 0.1

Laboratory Manager, Ing. Antonio Scofano