SOUND ABSORPTION REPORT IN REVERBERATION ROOM

FOR

BOVER

(MEI FAMILY)

8rd May 2024

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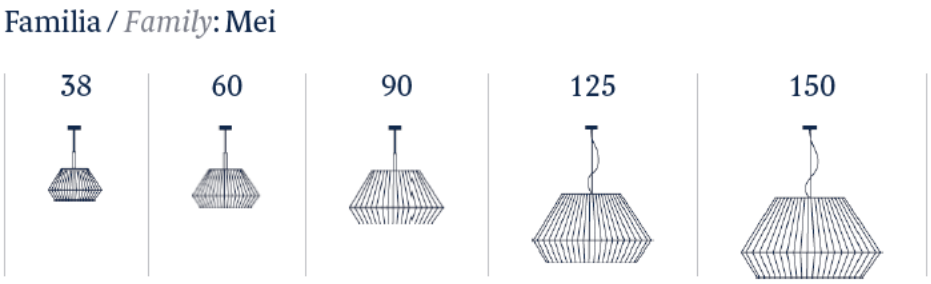
Date of the completion of the report: 3-05-2024

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1. GENERAL DATA

This report is being conducted at the request of Mr. David Florensa, from the technical office of the company BOVER. Measurements of the equivalent sound absorption per element of the BOVER MEI 150 are being carried out in the reverberation chamber of the School of Engineering of Gandia, Polytechnic University of Valencia, on May 26, 2024.

Additionally, based on the tests, an interpolation and expansion of the sound absorption is performed for the following elements: MEI 38, MEI 60, MEI 90, and MEI 125.



The regulations to consider for the development of this report are:

- UNE-EN ISO 354:2004 Acoustics. Measurement of sound absorption in a reverberation room. (ISO 354:2003). (Measurement standard)
- UNE-EN ISO 11654:1998 Acoustics. Sound absorbers for use in buildings. Rating of sound absorption. (ISO 11654:1997) (Classification standard).
- ASTM C423 - 22 Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method (American measurement and classification standard).

Annex 1 provides the justification sheet for the test. Annex 2 contains the certification data of the measurement equipment. Annex 3 includes information about the reverberation chamber of the School of Engineering of Gandia. Annex 4 contains the justification sheets for the interpolations.

2. INSTRUMENTATION

The equipment used to make the sound measurements was this:

- Sonometer Brüel & Kjær Type 2250. S/N: 3011089
- Microphone ½" Type 4189 Brüel & Kjær. S/N: 3180898
- Acoustic calibrator Type 4231 Brüel & Kjær. S/N: 3019977
- Sound source Omni Power 4296 Brüel & Kjær. S/N: 2498653
- Power stage Brüel & Kjær Type 2716. S/N: 2551039

3. DESCRIPTION OF THE APPLIED REGULATION

Here the applied regulation related to this report is summarized.

The **UNE-EN ISO 354:2004** regulation determines the steps to make the proper measurements and obtain the sound absorption coefficient of the material in diffuse sound field.

The **UNE-EN ISO 11654:1998** sets the process to obtain a parameter (α_w, weighted sound absorption coefficient) to evaluate the given sound absorption of a specific material.

The American regulation **ASTM C423 - 22**(last version in 2022), as in UNE EN ISO 354:2004, describes a method to obtain the sound absorption in reverberation room but increasing the measurements to the 80Hz one-third octave band. Moreover, two other parameters are included, the Sound Absorption Average (SAA) and the Noise Reduction Coefficient (NRC).

3.1. UNE-EN ISO 354:2004 Acoustics - Measurement of sound absorption in a reverberation room. (ISO 354:2003).

The UNE-EN ISO 354:2004 regulation establishes the process to get the sound absorption coefficient in diffuse sound field. This coefficient is obtained by the reverberation time measurements results, inside a reverberation room and with and without the material. The measurements are made in one-third octave bands between 100 and 5000 Hz, and in octave bands between 125 and 4000 Hz, as said in UNE-EN ISO 266:1998.
The equivalent sound absorption area, A, in square meters of the sample, is calculated according to the standard, using the following expression:

$$A = 55{,}3V\left(\frac{1}{c_2T_2} - \frac{1}{c_1T_1}\right) - 4V(m_2 - m_1) \quad (1.)$$

Where V is the volume of the reverberation chamber. The subscript 2 indicates data with the sample inside the chamber, and the subscript 1 indicates data with the chamber empty. T_i is the reverberation time (in seconds), c_i is the speed of sound propagation in air, and mi is the sound attenuation coefficient according to ISO 9613-1:1993 obtained using the climatic conditions of the reverberation chamber during the measurement.
It can be calculated by the attenuation coefficient α using the equation 2:

$$m = \frac{\alpha}{10\log(e)} \quad (2.)$$

Also it is possible to obtain the speed of sound in air, c, in the temperature range between 15 °C a 30 °C using the equation 3:

$$c = 331 + 0{,}6t \quad (3.)$$

where t is the air temperature in degrees Celsius.

The norm UNE-EN ISO 354:2004 in his section 6.2 refers to test samples. Can distinguish in his point 6.2.1 to "plane absorbers", where these have to have a surface among 10 and 12 m^2. In his point 6.2.2. It refers to "discrete sound absorbers". Inside this point, in 6.2.2.2. It describes the test of unitary elements, that is the case that occupies in this report. In the 6.2.2.3 it indicates that it has to be a sufficient number of objects (in general, at least three), providing a change in the measure of the Equivalent Sound Absorption Area elder of 1 m^2 and without exceeding the 12 m^2. These unitary elements will have an Equivalent Sound Absorption Area Aeq, in square metres, that obtains of the Equivalent Sound Absorption Area, divided among the number of elements.

Once determined the equivalent sound absorption area of the sample, it can be acquired the sound absorption coefficient, α, applying the formula:

$$\alpha = \frac{A}{S_{muestra}} \tag{4.}$$

where S_{sample} is the sample occupied area. In case of flat absorbing material, the sample must have a surface between 10 and 12 m^2. If the room volume is bigger than 200 m^3, the highest limit of the assay sample surface is to be raised by $(V/200)^{2/3}$ m^3. In the case of discrete sound absorbers, the calculation of the sound absorption coefficient, α, depends of the spaced of the elements in the surface where distribute.

Different microphone positions must be taken in order to conduct the assay, with a separation between them of 1,5 m at least, 2 m of any sound source and 1 m of any room surface or sample. Concerning the source positions, they must be separated 3 m at least. At least 12 different decay curves are needed, with at least three microphone positions and two source positions. For further details the regulation has to be consulted.

Figure 1 below shows the required source and microphone positions to do the measurements. Around the sample there have been established 6 microphone positions at points 1, 2, 3, 4, 5 and 6. Another two source positions have been established at points 1 and 2. The pink noise is the room excitation signal used in the assay.

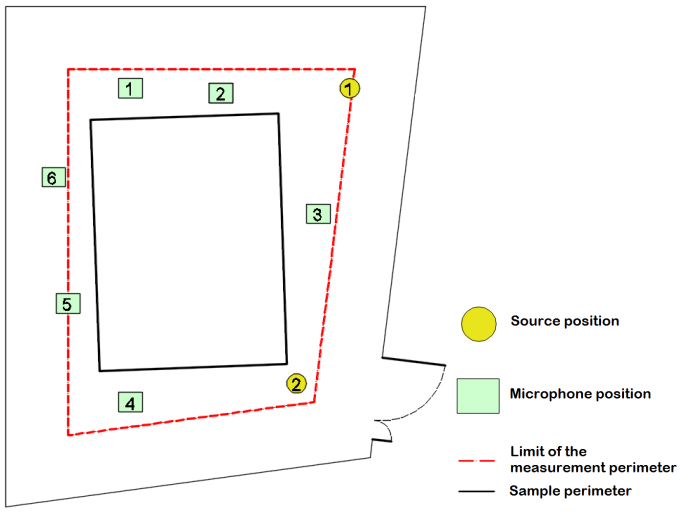


Figure 1. Source and microphone positions during reverberation room measurements.

3.2. UNE-EN ISO 11654:1998 Acoustics. Sound absorbers for use in buildings. Rating of sound absorption. (ISO 11654:1997)

The UNE-EN ISO 11654:1998 regulation determines a process to obtain one parameter (α_w, weighted sound absorption coefficient) to evaluate the given sound absorption of a specific material.
The first step consists on transform the results of the sound absorption coefficient α in one-third octave bands to values for each octave band between 250 and 4000 Hz, which according to the UNE-EN ISO 354:2004 regulation is named as α_p (practical sound absorption coefficient). To this end, the arithmetic mean of the three one-third octave bands of each octave band is done. For example, to obtain the α_p at 250 Hz it is necessary to add the α values of 200, 250 and 315 Hz and divide them by three. The next step is to round these values in steps of 0,05. Finally, the values have to be weighted according to the reference curve defined in the regulation, thus getting the weighted sound absorption coefficient (α_w).

It can be that for some octave bands the α_p curve exceeds in more than 0,20 the reference curve. In that case, an indicator of in which frequency range is being produced that excess has to be added to the parameter α_w. The indicators are letters, the “L” for the 250 Hz frequency band, “M” for the 500 and 1000 Hz bands and “H” for the 2000 and 4000 Hz bands. It is to be noted that if necessary two or more letters can be used to indicate that the reference curve is exceeded by more than 0,20 in more than a single frequency band. For example, if the curve is exceeded in 0,25 at 250 Hz and 0,3 at 1000 Hz, the “LM” indicators will be used.

Lastly, it is pointed out that the indicator α_w allows obtaining the acoustic absorption *class* given by the material as it is shown in Table 1.

Acoustic Absorption Class	α_w
A	0,90 or higher
B	between 0,8 and 0,85
C	between 0,6 and 0,75
D	between 0,3 and 0,55
E	between 0,15 and 0,25
Not classified	0,10 or lower

Table 1. Acoustic Absorption Class according to UNE – EN ISO 11654: 1998

3.3. ASTM C423 - 22 Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method

The American regulation ASTM C423 - 22(last version in 2022), as in UNE EN ISO 354:2004, describes a method to obtain the sound absorption in reverberation room. In this case, the formula used to obtain the sound propagation speed in the air, *c*, is the equation 5:

$$c = 20.047\sqrt{273.15 + t} \tag{5.}$$

where *t* is the air temperature in degrees Celsius. This formula allows a wider setting range.
In this regulation, the measurements are taken as usual in one-third octave bands, between 80 and 5000 Hz, that is to say, increasing the one-third octave band of 80 Hz from the determined in UNE-EN ISO 354:2004.

In addition, it has to be noted in this regulation the two new parameters that don not appear in UNE-EN ISO 354:2004.

The first is the Sound Absorption Average (SAA). This parameter is the mean of the one-third octave bands between 200 and 2500 Hz, rounding the values to 0,01 multiples.

The second one is the Noise Reduction Coefficient (NRC), defined as the average value of the absorption coefficients of the material at the 250, 500, 1000 and 2000 Hz frequencies. Moreover, this average is rounded to the closest multiple of 0,05.

4. DESCRIPTION OF THE TEST SAMPLES

The luminaire described in section 1 has also been measured using the procedures described in section 1. One test has been conducted:

- Test of MEI 150, with 4 units.

The samples are installed on the ceiling of the reverberation chamber of the School of Engineering of Gandia, simulating conditions of use, and to ensure maximum diffusivity.

Figure 2 shows a detail of the tested configuration for the MEI 150 model.



Figure 2. MEI 150 Detailed.

5. RESULTS

Then, there are the results obtained according to the UNE-EN ISO 354:2004 regulation, in graphical and tabular form. The complete data obtained evaluating the Equivalent Sound Absorption Area, Aeq (m^2), is presented in the Annex 1–Supporting sheets of this report. Besides, they show the sound absorption coefficient that can obtain in conditions of maximum classification with the suitable surface, under the UNE-EN ISO 11654:1998 and the acoustic absorption under the ASTM C423 - 22American regulation.

From point 5.2 onwards, the interpolations of the following luminaires are shown: MEI 125, MEI 90, MEI 60, MEI 38. The interpolation sheets are added in Annex 4.

5.1. MEI 150 results.

To continuation, show the data of the Equivalent Sound Absorption Area, Aeq (m^2) by element obtained for the MEI 150 model.

f (Hz)	Aeq (m^2)
80	0,50
100	0,60
125	0,55
160	0,71
200	0,82
250	1,00
315	1,06
400	1,25
500	1,40
630	1,71
800	1,89
1000	2,04
1250	2,23
1600	2,35
2000	2,54
2500	2,71
3150	2,86
4000	2,96
5000	3,08

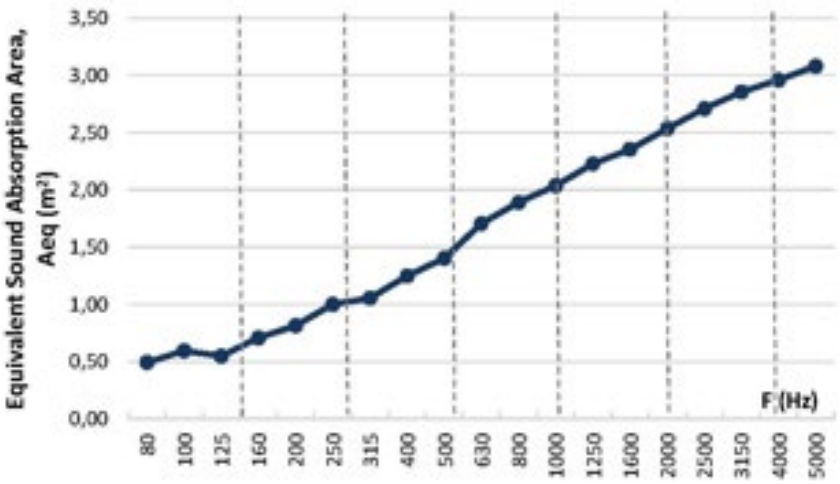


Figure. 3. The Equivalent Sound Absorption Area, Aeq in one-third octave bands between 80 Hz and 5 kHz for the MEI 150

Below are the test data obtained for the set of the 3 elements:

f (Hz)	Reverberation time for empty room, T_1 (s)	Reverberation time with the sample, T_2 (s)	Equivalent sound absorption area, A_T (m^2)
80	9,59	6,42	1,98
100	9,08	5,81	2,38
125	6,16	4,56	2,19
160	5,79	4,06	2,83
200	6,00	3,98	3,26
250	6,66	3,93	4,00
315	7,08	3,98	4,22
400	7,16	3,71	5,00
500	7,23	3,51	5,62
630	7,23	3,16	6,83
800	7,13	2,96	7,57
1000	6,80	2,78	8,15
1250	6,48	2,59	8,91
1600	5,94	2,42	9,42
2000	5,31	2,21	10,15
2500	4,69	2,02	10,84
3150	3,96	1,82	11,42
4000	3,26	1,63	11,83
5000	2,59	1,42	12,33

Table 2. Reverberation times and equivalent sound absorption area for test MEI 150

The number of elements needed to achieve the highest CLASS according to the UNE-EN ISO 11654:1998 standard is calculated. For MEI 150 and 4 elements distributed over 9 m^2, the following results are obtained:

Absorption coefficients by octave bands

f (Hz)	α_s	Data for DB-HR	
125	0,27		
250	0,43		
500	0,65	0,65	$\alpha_{average}$
1000	0,91	0,90	**0,9**
2000	1,13	1,15	
4000	1,32		

Classification under European regulation

ISO 11654:1997	
α_w	0,70
CLASS	C

Classification under American regulation

ASTM C423 - 22	
NRC	0,80
SAA	0.78

5.2. MEI 125 results

To continuation, show the data of the Equivalent Sound Absorption Area, Aeq (m^2) by element obtained for the MEI 125 model.

f (Hz)	Aeq (m^2)
80	0,34
100	0,41
125	0,38
160	0,49
200	0,57
250	0,70
315	0,73
400	0,87
500	0,98
630	1,19
800	1,31
1000	1,42
1250	1,55
1600	1,64
2000	1,76
2500	1,88
3150	1,98
4000	2,05
5000	2,14

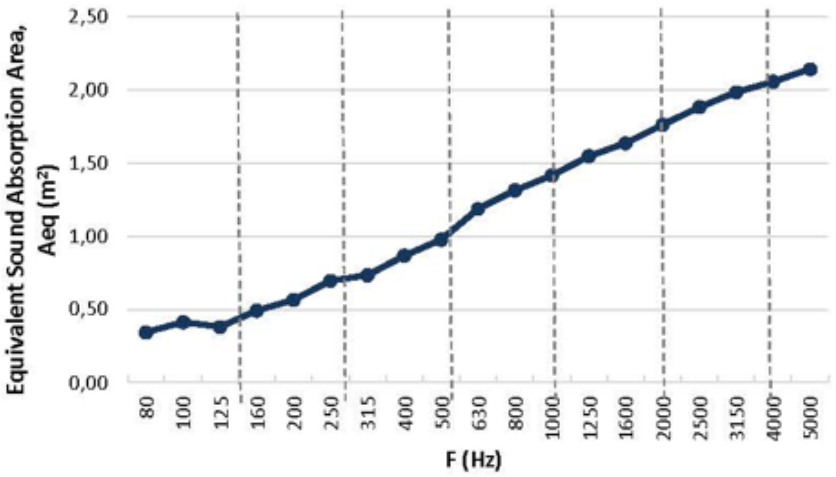


Figure 6. The Equivalent Sound Absorption Area, Aeq in one-third octave bands between 80 Hz and 5 kHz for the MEI 125

The number of elements needed to achieve the maximum CLASS according to the UNE-EN ISO 11654:1998 standard is calculated. For MEI 125, and 6 elements distributed over 10 m^2, the following results are obtained:

Absorption coefficients by octave bands

f (Hz)	α_s	Data for DB-HR	
125	0,29		
250	0,42		
500	0,64	0,65	$\alpha_{average}$
1000	0,93	0,95	**0,9**
2000	1,12	1,10	
4000	1,31		

Classification under European regulation

ISO 11654:1997	
α_w	0,70
CLASS	C

Classification under American regulation

ASTM C423 - 22	
NRC	0,80
SAA	0,78

5.3. MEI 90 Results.

To continuation, show the data of the Equivalent Sound Absorption Area, Aeq (m^2) by element obtained for the MEI 90 model.

f (Hz)	Aeq (m^2)
80	0,18
100	0,21
125	0,20
160	0,25
200	0,29
250	0,36
315	0,38
400	0,45
500	0,51
630	0,62
800	0,68
1000	0,73
1250	0,80
1600	0,85
2000	0,91
2500	0,98
3150	1,03
4000	1,07
5000	1,11

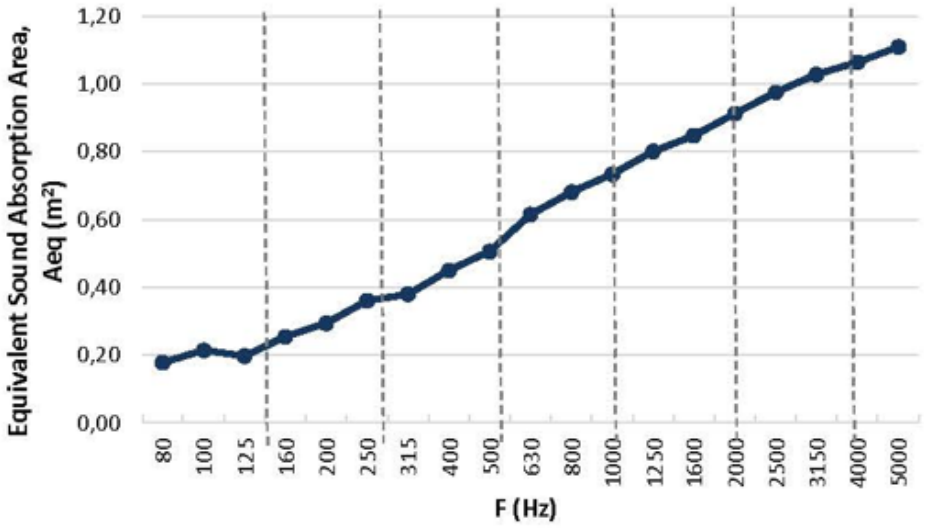


Figure 7. The Equivalent Sound Absorption Area, Aeq in one-third octave bands between 80 Hz and 5 kHz for the MEI 90

The number of elements needed to achieve the maximum CLASS according to the UNE-EN ISO 11654:1998 standard is calculated. For MEI 90, and 12 elements distributed over 10 m^2, the following results are obtained:

Absorption coefficients by octave bands

f (Hz)	α_s	Data for DB-HR	
125	0,25		
250	0,43		
500	0,62	0,60	$\alpha_{average}$
1000	0,93	0,95	**0.88**
2000	1,11	1,10	
4000	1,30		

Classification under European regulation

ISO 11654:1997	
α_w	0,70
CLASS	C

Classification under American regulation

ASTM C423 - 22	
NRC	0.75
SAA	0,78

5.4. MEI 60 Results

To continuation, show the data of the Equivalent Sound Absorption Area, Aeq (m^2) by element obtained for the MEI 60 model.

f (Hz)	Aeq (m^2)
80	0,08
100	0,10
125	0,09
160	0,11
200	0,13
250	0,16
315	0,17
400	0,20
500	0,22
630	0,27
800	0,30
1000	0,33
1250	0,36
1600	0,38
2000	0,41
2500	0,43
3150	0,46
4000	0,47
5000	0,49

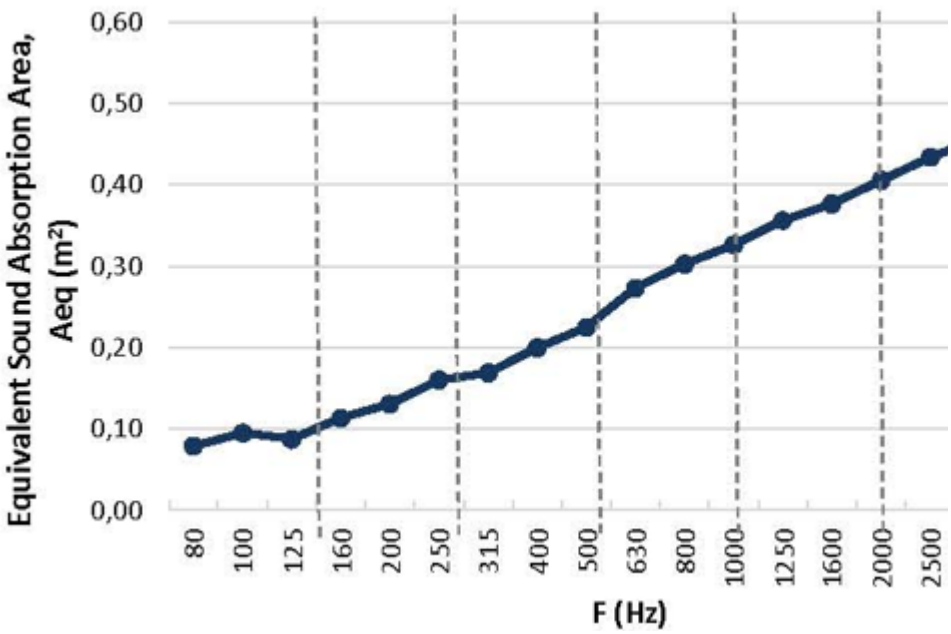


Figure. 4. The Equivalent Sound Absorption Area, Aeq in one-third octave bands between 80 Hz and 5 kHz for the MEI 60

The number of elements needed to achieve the maximum CLASS according to the UNE-EN ISO 11654:1998 standard is calculated. For MEI 60, and 28 elements distributed over 10 m^2, the following results are obtained:

Absorption coefficients by octave bands

f (Hz)	α_s	Data for DB-HR	
125	0,28		
250	0,42		
500	0,69	0,70	$\alpha_{average}$
1000	0,97	0,95	**0.92**
2000	1,11	1,10	
4000	1,25		

Classification under European regulation

ISO 11654:1997	
α_w	0,70
CLASS	C

Classification under American regulation

ASTM C423 - 22	
NRC	0.80
SAA	0.78

5.5. MEI 38 Results

To continuation, show the data of the Equivalent Sound Absorption Area, Aeq (m^2) by element obtained for the MEI 38 model.

f (Hz)	Aeq (m^2)
80	0,03
100	0,04
125	0,04
160	0,05
200	0,05
250	0,06
315	0,07
400	0,08
500	0,09
630	0,11
800	0,12
1000	0,13
1250	0,14
1600	0,15
2000	0,16
2500	0,17
3150	0,18
4000	0,19
5000	0,20

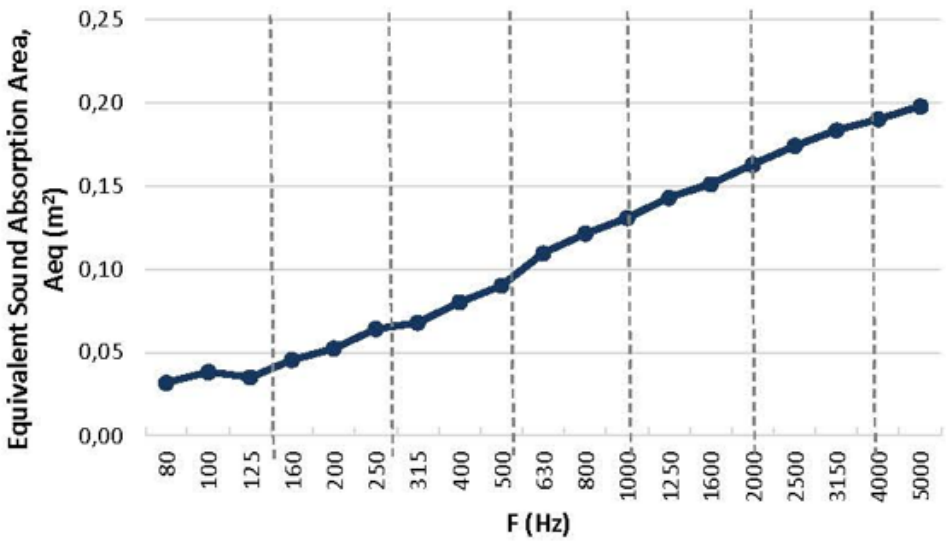


Figure. 5. The Equivalent Sound Absorption Area, Aeq in one-third octave bands between 80 Hz and 5 kHz for the MEI 38

The number of elements needed to achieve the maximum CLASS according to the UNE-EN ISO 11654:1998 standard is calculated. For MEI 38, and 69 elements distributed over 10 m^2, the following results are obtained:

Absorption coefficients by octave bands

f (Hz)	α_s	Data for DB-HR	
125	0,35		
250	0,35		
500	0,69	0,70	$\alpha_{average}$
1000	1,04	1,05	**0.93**
2000	1,04	1,05	
4000	1,39		

Classification under European regulation

ISO 11654:1997	
α_w	0,70
CLASS	C

Classification under American regulation

ASTM C423 – 22	
NRC	0.80
SAA	0.78

6. SUMMARY OF DATA

For all the tested and/or interpolated models, the number of elements required to achieve a maximum Acoustic Absorption Class value for that model in 10 m^2 has been obtained according to UNE-EN ISO 11654:98. The data is summarized in the table below.

The achieved classification is C, primarily conditioned by the values at very low frequencies.

MODEL	Units (10 m^2)
MEI 125	6
MEI 90	12
MEI 60	28
MEI 38	69

Gandia, 8th May 2024

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Jesús Alba Fernández

Professor
Physical technologies Center: Acoustics, materials and Astrophysics
Department of applied physics (www.fisgan.upv.es)
Polytechnic School of Gandia (www.gandia.upv.es)
Polytechnic University of València (www.upv.es)
C/ Paranimf nº1 46730 Grao de Gandia (Valencia) Spain
Telephone: (+34)962849300, Ext. 43140. e-mail: jesalba@fis.upv.es.

Annex 1.

Supporting sheets

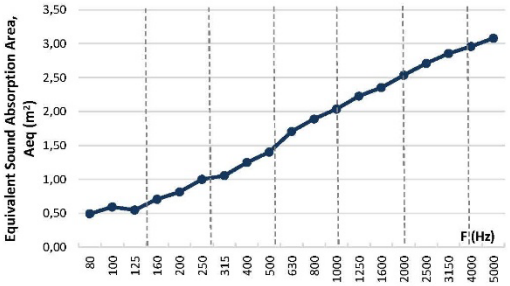
Reverberation room of Higher Polytechnic College of Gandia
Acoustic absorption measurements according to UNE-EN ISO 354:2004
Equivalent Sound Absorption Area, Aeq (m^2), one element

Requester: BOVER
Test Sample: MEI 150

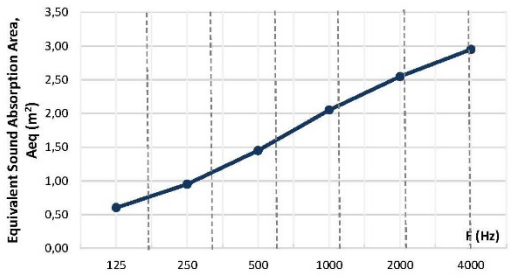


Dimensions:		Indoor Environment Conditions:	
Room volume (m^3)	238	T empty Room:	20,3 °C
Room surface (m^2)	236	HR empty Room:	57,9 %
Surface of the test sample (m^2)	4	T room with sample:	20,0 °C
		HR room with sample:	59,5 %
Date of Measurements:	26/04/2024	Date of Report:	03/05/2024

f (Hz)	Aeq (m^2)
80	0,50
100	0,60
125	0,55
160	0,71
200	0,82
250	1,00
315	1,06
400	1,25
500	1,40
630	1,71
800	1,89
1000	2,04
1250	2,23
1600	2,35
2000	2,54
2500	2,71
3150	2,86
4000	2,96
5000	3,08



f (Hz)	Aeq (m^2)
125	0,60
250	0,95
500	1,45
1000	2,05
2000	2,55
4000	2,95



Additional data

The higher classification produces distributing 1 element in the following surface: (m^2) 2,3
Number of elements in 10 m^2 4

Classification according to European norm (higher) for the anterior surface

Absorption coefficients by octave bands

f (Hz)	α_s	Data for DB-HR	
125	0,27		
250	0,43		
500	0,65	0,65	$\alpha_{average}$
1000	0,91	0,90	**0,90**
2000	1,13	1,15	
4000	1,32		

Classification under European regulation

ISO 11654:1997	
α_w	0,70
CLASS	C

Classification under American regulation

ASTM C423 - 09a	
NRC	0,80
SAA	0,78

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CAMPUS DE GANDIA

Polytechnic School of Gandia (www.gandia.upv.es)
Polytechnic University of València (www.upv.es)
C/ Paranimf nº1 46730. Grao de Gandia (Valencia) Spain
Telephone: (+34)962849300, Ext. 43140. e-mail: jesalba@fis.upv.es.

Annex 2.

Periodic verification certificates of used equipment

ingein

INGENIERIA DE GESTION INDUSTRIAL S.L. (Unipersonal)

ORGANISMO AUTORIZADO DE VERIFICACIÓN METROLÓGICA. PE-35. RCM Nº:17-OV-0003.
ORGANISME AUTORITZAT DE VERIFICACIÓ METROLÓGICA. PE-35. RCM Nº:17-OV-0003.

UNIDAD TÉCNICA RESPONSABLE/UNITAT TÈCNICA RESPONSABLE:
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CERTIFICADO DE VERIFICACIÓN DE SONÓMETRO
CERTIFICAT DE VERIFICACIÓ DE SONÒMETRE

[X] Periódica/Periòdica
[ ] Después de reparación/Després de reparació
[ ] Después de modificación/Després de modificació

N.º : **V461_03807_24**

Reglamentación reguladora/Reglamentació reguladora
ORDEN ICT/155/2020, de 7 de febrero, por la que se regula el control metrológico del Estado de determinados instrumentos de medida.
ORDRE ICT /155/2020, de 7 de febrer, per la qual es regula el control metrològic de l'Estat de determinats instruments de mesura

• ***TITULAR:*** ***249284*** ***249284***

Entitat **UNIVERSIDAD POLITECNICA VALENCIA**
Entidad

UNIVERSIDAD POLITECNICA VALENCIA Campus Gandia
C/ Paranimf, 1
46730 GANDIA
VALENCIA

NIF/CIF:
Q4618002B

• ***Lugar de realización de ensayos / lloc de realització dels assaigs***

Laboratorio INGEIN Picanya

• ***INSTRUMENTO/INSTRUMENT***

• ***SONÓMETRO/SONÒMETRE***

Marca:
Brüel & Kjaer
Modelo/Model:
2270 (G-4)
Nº Serie/Nº Sèrie:
3011089
Clase/Classe:
1

• ***MICRÓFONO/MICRÒFON***

Marca:
Brüel & Kjaer
Modelo/Model:
4189
Nº Serie/Nº Sèrie:
3180898

• *FECHA DE VERIFICACIÓN/DATA DE VERIFICACIÓ:* 05 abril 2024 / 5 abril 2024
• *RESULTADO DE LA VERIFICACIÓN / RESULTAT DE LA VERIFICACIÓ:* CONFORME

Firmado por JAVIER IRANZO CASTILLO
Fecha: 08/04/2024 09:36:00 CEST

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ORGANISMO AUTORIZADO DE VERIFICACIÓN METROLÓGICA. PE-35. RCM Nº:17-OV-0003.
ORGANISME AUTORITZAT DE VERIFICACIÓ METROLÓGICA. PE-35. RCM Nº:17-OV-0003.

UNIDAD TÉCNICA RESPONSABLE/UNITAT TÈCNICA RESPONSABLE:
Dissabtes, 2-A - Planta 1 - Polig. Alquería de Moret 46210-PICANYA (VALENCIA) Tfno.:963134077 email:valencia@ingein.es

CERTIFICADO DE VERIFICACIÓN DE SONÓMETRO
CERTIFICAT DE VERIFICACIÓ DE SONÒMETRE

[X] Periódica/Periòdica
[ ] Después de reparación/Després de reparació
[ ] Después de modificación/Després de modificació

N.º : **V461_03807_24**

Reglamentación reguladora/Reglamentació reguladora
ORDEN ICT/155/2020, de 7 de febrero, por la que se regula el control metrológico del Estado de determinados instrumentos de medida.
ORDRE ICT /155/2020, de 7 de febrer, per la qual es regula el control metrològic de l'Estat de determinats instruments de mesura

- ***TITULAR:*** *249284* *249284*

Entitat **UNIVERSIDAD POLITECNICA VALENCIA**
Entidad

UNIVERSIDAD POLITECNICA VALENCIA Campus Gandia
C/ Paranimf, 1
46730 GANDIA
VALENCIA

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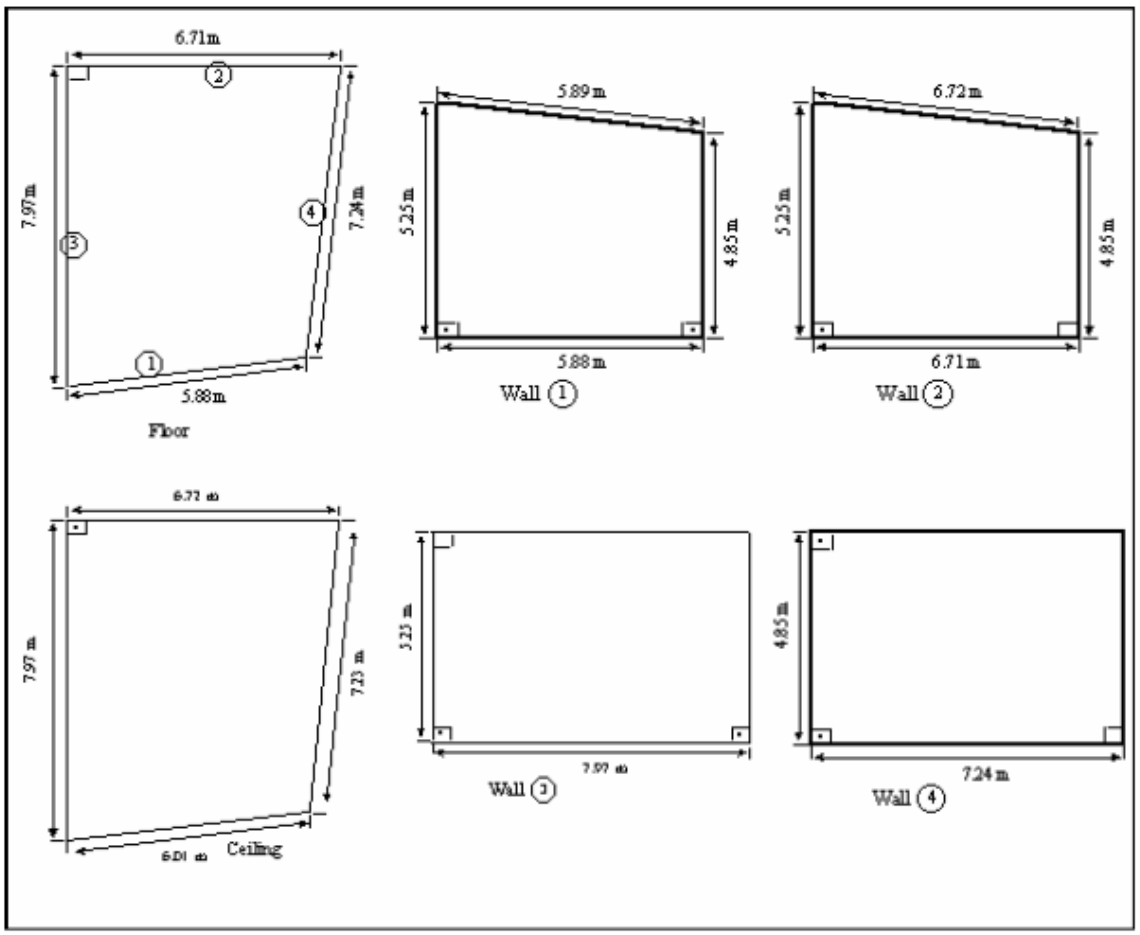
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Annex 3.

Reverberation room characteristics where the measurements were taken

- Description and qualification of the reverberation room
  - Volume $238\ m^3$
  - Total surface $236\ m^2$

  Verifies the following conditions:
  - $1.9V^{1/3} > D$
  - $S_{Total} \approx 6V^{2/3}$ $(236\ m^2 \approx 230\ m^2)$
  - $T_{60} \geq \frac{V}{S} = 1.01$
  - Dimensions
  -

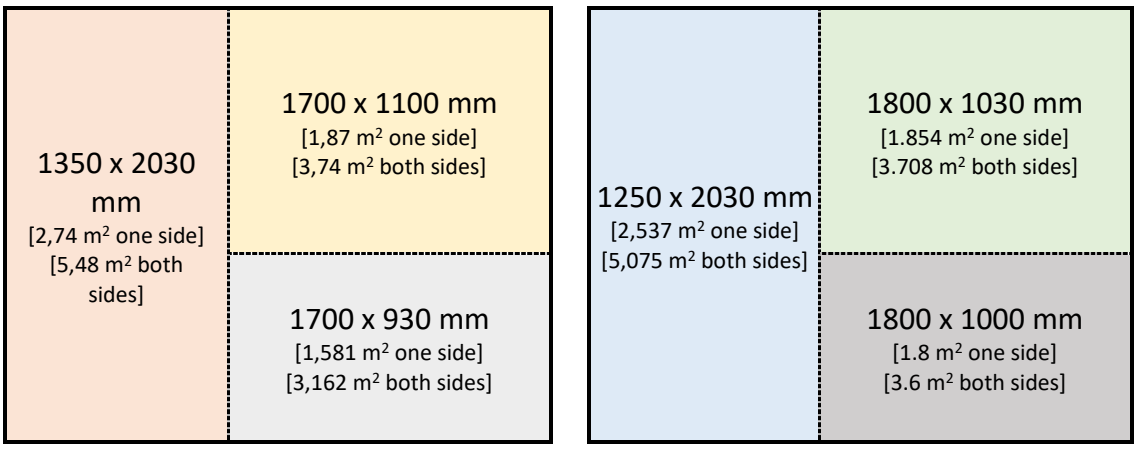


Absorption characteristics:

Frequency (Hz)	Tr of the room (s)	Background noise (dB)	Room absorption (m²)
100	10,6	35	3,60
125	7,2	21	5,28
160	6,6	17	5,78
200	7,0	18	5,45
250	7,5	16	5,11
315	8,3	17	4,58
400	8,6	15	4,44
500	8,8	14	4,35
630	8,8	12	4,33
800	8,7	8	4,38
1000	8,4	7	4,53
1250	7,9	8	4,86
1600	7,0	8	5,49
2000	6,0	6	6,35
2500	5,1	7	7,57
3150	4,0	7	9,58
4000	3,1	8	12,23
5000	2,4	9	16,27

Diffuser panels

Six methacrylate panels are hung from the ceiling with these dimensions:



Nine methacrylate panels are disposed on walls and the floor with these dimensions:

550 x 1000 mm [0,55 m^2 one side] [1,1 m^2 both sides]	2500 x 1000 mm [2,5 m^2 one side] [5 m^2 both sides]	1050 x 1100 mm [1,15 m^2 one side] [2,3 m^2 both sides]	2000 x 1100 mm [2.2 m^2 one side] [4.4 m^2 both sides]	
550 x 1030 mm [0,567 m^2 one side] [1,133 m^2 both sides]	2500 x 1030 mm [2,575 m^2 one side] [5,150 m^2 both sides]	1050 x 930 mm [0,977 m^2 one side] [1,953 m^2 both sides]	1000 x 930 mm [0,93 m^2 one side] [1,86 m^2 both sides]	1050 x 930 mm [0,977 m^2 one side] [1,953 m^2 both sides]

The following images show details of the reverberation room.





Annex 4.

Interpolation supporting sheets

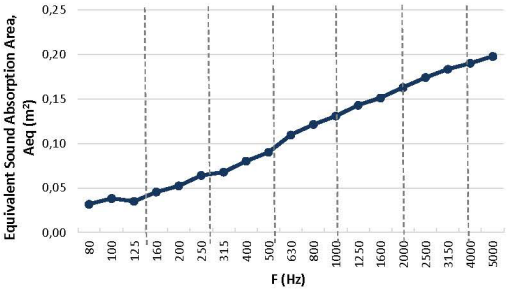
Reverberation room of Higher Polytechnic College of Gandia
Acoustic absorption measurements according to UNE-EN ISO 354:2004
Equivalent Sound Absorption Area, Aeq (m^2), one element

Requester: BOVER
Estimated sample: MEI38

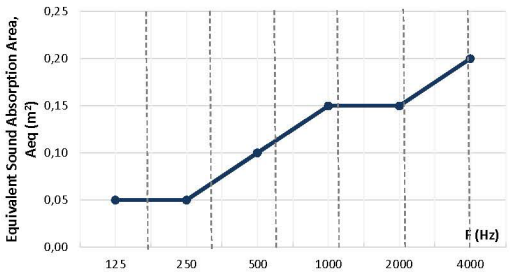


Reference:	
MEI 150	
Element factor:	0,06
Groupal factor:	0,06
Estimated elements:	62
Date of estimation:	26/04/2024
Date of Report:	03/05/2024

f (Hz)	Aeq (m^2)
80	0,03
100	0,04
125	0,04
160	0,05
200	0,05
250	0,06
315	0,07
400	0,08
500	0,09
630	0,11
800	0,12
1000	0,13
1250	0,14
1600	0,15
2000	0,16
2500	0,17
3150	0,18
4000	0,19
5000	0,20



f (Hz)	Aeq (m^2)
125	0,05
250	0,05
500	0,10
1000	0,15
2000	0,15
4000	0,20



Additional data

The higher classification produces distributing 1 element in the following surface: (m2) 0,14
Number of elements in 10 m^2 69

Classification according to European norm (higher) for the anterior surface

Absorption coefficients by octave bands

f (Hz)	α_s	Data for DB-HR	
125	0,35		
250	0,35		
500	0,69	0,70	$\alpha_{average}$
1000	1,04	1,05	**0,93**
2000	1,04	1,05	
4000	1,39		

Classification under European regulation

UNE-EN ISO 11654:1998	
α_w	0,70
CLASS	C

Classification under American regulation

ASTM C423 - 22	
NRC	0,80
SAA	0,78

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Polytechnic University of València (www.upv.es)
C/ Paranimf nº1 46730. Grao de Gandia (Valencia) Spain
Telephone: (+34)962849300, Ext. 43140. e-mail: jesalba@fis.upv.es.

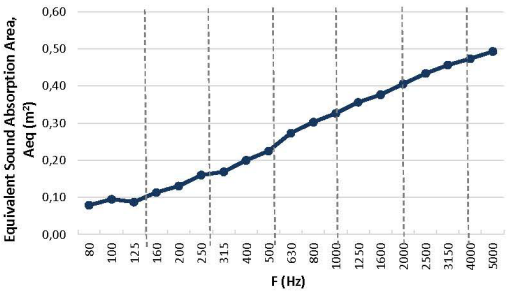
Reverberation room of Higher Polytechnic College of Gandia
Acoustic absorption measurements according to UNE-EN ISO 354:2004
Equivalent Sound Absorption Area, Aeq (m^2), one element

Requester: BOVER
Estimated sample: MEI60

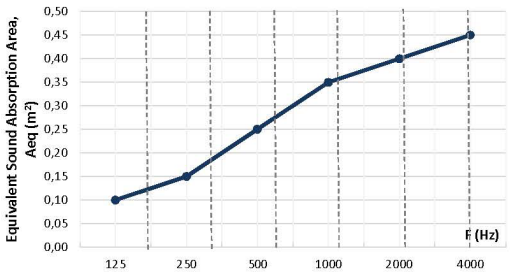


Reference:	
MEI 150	
Element factor:	0,16
Groupal factor:	0,16
Estimated elements:	25
Date of estimation:	26/04/2024
Date of Report:	03/05/2024

f (Hz)	Aeq (m^2)
80	0,08
100	0,10
125	0,09
160	0,11
200	0,13
250	0,16
315	0,17
400	0,20
500	0,22
630	0,27
800	0,30
1000	0,33
1250	0,36
1600	0,38
2000	0,41
2500	0,43
3150	0,46
4000	0,47
5000	0,49



f (Hz)	Aeq (m^2)
125	0,10
250	0,15
500	0,25
1000	0,35
2000	0,40
4000	0,45



Additional data

The higher classification produces distributing 1 element in the following surface: (m2) 0,36
Number of elements in 10 m^2 28

Classification according to European norm (higher) for the anterior surface

Absorption coefficients by octave bands

f (Hz)	α_s	Data for DB-HR	
125	0,28		
250	0,42		
500	0,69	0,70	$\alpha_{average}$
1000	0,97	0,95	**0,92**
2000	1,11	1,10	
4000	1,25		

Classification under European regulation

UNE-EN ISO 11654:1998	
α_w	0,70
CLASS	C

Classification under American regulation

ASTM C423 - 22	
NRC	0,80
SAA	0,78

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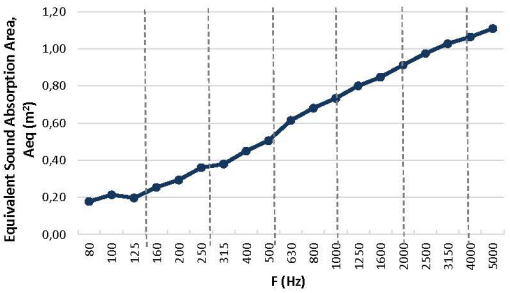
Reverberation room of Higher Polytechnic College of Gandia
Acoustic absorption measurements according to UNE-EN ISO 354:2004
Equivalent Sound Absorption Area, Aeq (m^2), one element

Requester: BOVER
Estimated sample: MEI90

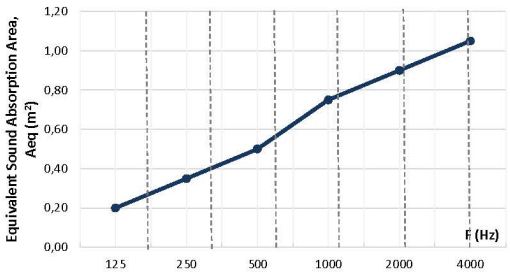


Reference:	
MEI 150	
Element factor:	0,36
Groupal factor:	0,36
Estimated elements:	11
Date of estimation:	26/04/2024
Date of Report:	03/05/2024

f (Hz)	Aeq (m^2)
80	0,18
100	0,21
125	0,20
160	0,25
200	0,29
250	0,36
315	0,38
400	0,45
500	0,51
630	0,62
800	0,68
1000	0,73
1250	0,80
1600	0,85
2000	0,91
2500	0,98
3150	1,03
4000	1,07
5000	1,11



f (Hz)	Aeq (m^2)
125	0,20
250	0,35
500	0,50
1000	0,75
2000	0,90
4000	1,05



Additional data

The higher classification produces distributing 1 element in the following surface: (m2) 0,81
Number of elements in 10 m^2 12

Classification according to European norm (higher) for the anterior surface

Absorption coefficients by octave bands

f (Hz)	α_s	Data for DB-HR	
125	0,25		
250	0,43		
500	0,62	0,60	$\alpha_{average}$
1000	0,93	0,95	**0,88**
2000	1,11	1,10	
4000	1,30		

Classification under European regulation

UNE-EN ISO 11654:1998	
α_w	0,70
CLASS	C

Classification under American regulation

ASTM C423 - 22	
NRC	0,75
SAA	0,78

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Polytechnic University of València (www.upv.es)
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Reverberation room of Higher Polytechnic College of Gandia
Acoustic absorption measurements according to UNE-EN ISO 354:2004
Equivalent Sound Absorption Area, Aeq (m^2), one element

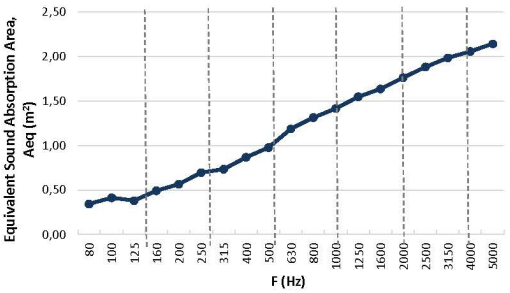
Requester: BOVER
Estimated sample: MEI 125

125

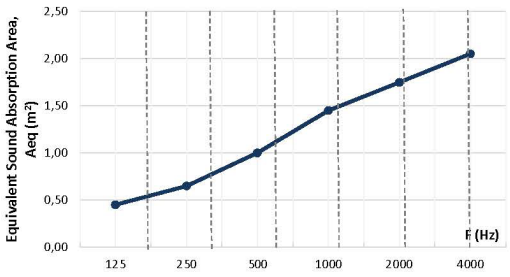


Reference:			
MEI 150			
Element factor:	0,69		
Groupal factor:	0,69		
Estimated elements:	6		
Date of estimation:	26/04/2024	**Date of Report:**	03/05/2024

f (Hz)	Aeq (m^2)
80	0,34
100	0,41
125	0,38
160	0,49
200	0,57
250	0,70
315	0,73
400	0,87
500	0,98
630	1,19
800	1,31
1000	1,42
1250	1,55
1600	1,64
2000	1,76
2500	1,88
3150	1,98
4000	2,05
5000	2,14



f (Hz)	Aeq (m^2)
125	0,45
250	0,65
500	1,00
1000	1,45
2000	1,75
4000	2,05



Additional data

The higher classification produces distributing 1 element in the following surface: (m2) 1,56
Number of elements in 10 m^2 6

Classification according to European norm (higher) for the anterior surface

Absorption coefficients by octave bands

f (Hz)	α_s	Data for DB-HR	
125	0,29		
250	0,42		
500	0,64	0,65	$\alpha_{average}$
1000	0,93	0,95	**0,90**
2000	1,12	1,10	
4000	1,31		

Classification under European regulation

UNE-EN ISO 11654:1998	
α_w	0,70
CLASS	C

Classification under American regulation

ASTM C423 - 22	
NRC	0,80
SAA	0,78

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