SOUND ABSORPTION REPORT IN REVERBERATION ROOM

FOR

BOVER

15th December 2022

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Date of the completion of the report: 12-12-2022

Date of the last revision of the report: 15-12-2022

1. GENERAL DATA

This report is made on request of Mr. David Florensa, from BOVER's technical office. This report, provides more information, the products are adapted and some additional calculations are made respect to the report carried out on 29 September 2022. The measurements done of the equivalent sound absorption per element of the BOVER luminaires are detailed below:

	VERTICAL NOREN S/72	CIRCULAR NOREN S/100
Num. of strings	2	2
Distance to ceiling	VARIABLE	VARIABLE
Dimensions (mm)	1200x700	R=1000
Material "Body"	BASOTEK BASF	BASOTEK BASF
Material "Shade"	CREVIN MOOS	CREVIN MOOS
		

The acoustic tests are carried out in the reverberation room at the Higher Polytechnic School of Gandia, Polytechnic University of Valencia (Spain) on September 22nd 2022.

In addition, based on the tests, the sound absorption is interpolated for the following elements: : NOREN S/85, NOREN S/123.2, NOREN S/151.2, NOREN S/123, y NOREN S/151.

The considered regulations needed to develop the following report are:

- *UNE-EN ISO 354:2004 Acoustics - Measurement of sound absorption in a reverberation room. (ISO 354:2003). (New version of UNE-EN 20354:1994, reviewed in 1998)*

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

- *ASTM C423 - 22 Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method (American Regulation of Measurement and Classification).*

In the annex 1 the supporting sheets of the acoustic test are given. In the annex 2, the periodic verification certificates of measurement equipment are given. In the annex 3, the Higher Polytechnic School of Gandia reverberation chamber characteristics are detailed, and the annex 4 contains the supporting sheets of 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 m^2 of the material sample) is determined using the equation 1 included in the UNE-EN ISO 26:1998 regulation:

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

where:
$_2$ refers to reverberation room data with the material inside,
$_1$ refers to reverberation room data with empty room,
V = reverberation room volume (m^3),
T_i = reverberation time (s),
c_i = speed of sound (m/s) in air, and
m_i = sound attenuation coefficient, obtained using the climate conditions of the reverberation room during the measurement, under the ISO 9613-1:1993 regulation. It can be calculated by the attenuation coefficient α using the equation 2:

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

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:

$$c = 331 + 0{,}6t \tag{3.}$$

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.

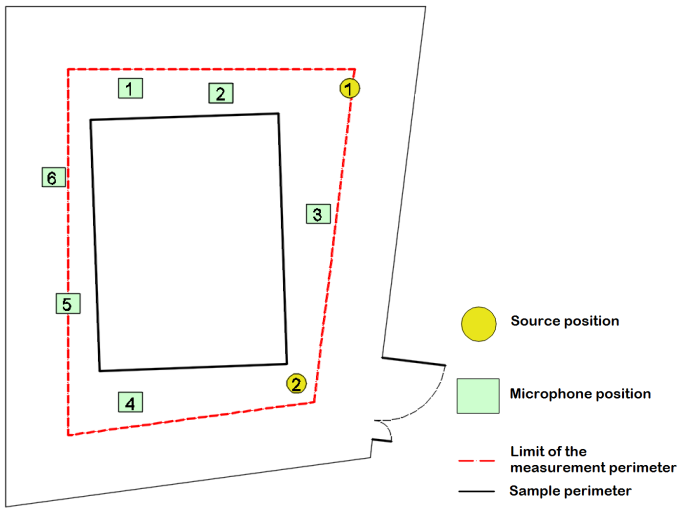


Figure 1. Source and microphone positions during reverberation room measurements.

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 are 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

They have measured with the procedures described in the section 3 the luminaires also described in the section 1. They have made 3 tests:

- Test of NOREN S/72 (3 units)
- Test of NOREN S/100 (3 units)

The samples install in the ceiling of the reverberation room of the Higher Polytechnic School of Gandia simulating terms of use, and with the end to guarantee the maximum diffusivity.

Figure 3 shows the test configuration of de NOREN S/72 model.



Figure 2. NOREN S/72. Test configuration

Figure 3 shows the test configuration of de NOREN S/100 model.



Figure 3. NOREN S/100. Test configuration

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 (CLASS A) with the suitable surface, under the UNE-EN ISO 11654:1998 and the acoustic absorption under the ASTM C423 - 22American regulation.

From point 5.3 onwards, the interpolations of the following luminaires are shown: : NOREN S/85, NOREN S/123.2, NOREN S/151.2, NOREN S/123, y NOREN S/151. The interpolation sheets are added in Annex 4.

5.1. NOREN S/72 Results.

To continuation, show the data of the Equivalent Sound Absorption Area, Aeq (m^2) by element obtained for the NOREN S/72 model.

f (Hz)	Aeq (m^2)
80	0,01
100	0,07
125	0,26
160	0,48
200	0,73
250	0,68
315	0,91
400	1,28
500	1,56
630	1,83
800	1,90
1000	1,92
1250	1,81
1600	1,88
2000	1,87
2500	1,80
3150	1,79
4000	1,75
5000	1,80

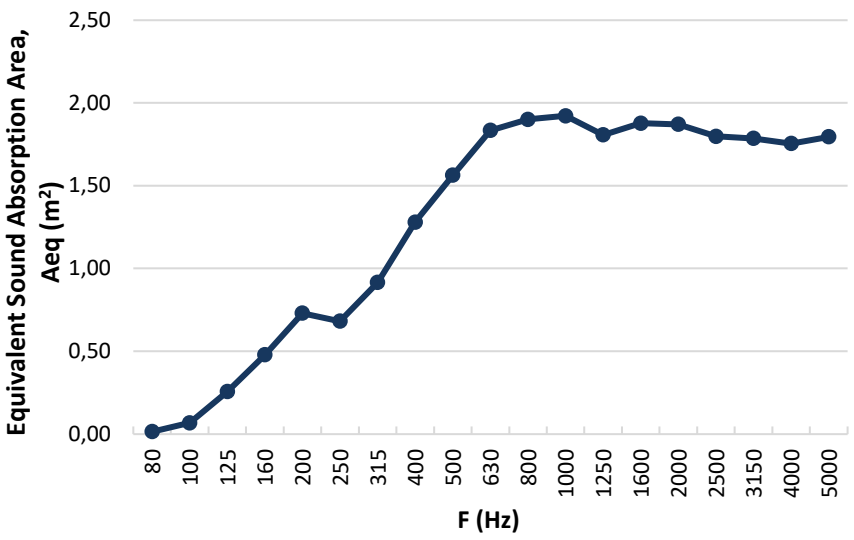


Figure. 3. The Equivalent Sound Absorption Area, Aeq in one-third octave bands between 80 Hz and 5 kHz for the NOREN S/72

To continuation, show the data test 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	9,20	8,84	0,17
100	9,42	8,73	0,32
125	6,51	5,50	1,08
160	5,95	4,78	1,56
200	6,37	4,56	2,37
250	6,93	4,78	2,46
315	7,47	4,75	2,92
400	7,43	4,47	3,39
500	7,56	4,24	3,94
630	7,42	3,74	5,04
800	7,16	3,50	5,55
1000	6,86	3,41	5,59
1250	6,32	3,28	5,55
1600	5,87	3,11	5,76
2000	5,42	2,94	5,93
2500	4,74	2,76	5,73
3150	4,16	2,55	5,73
4000	3,50	2,33	5,44
5000	2,94	2,03	5,77

Table 2. Reverberation times and equivalent sound absorption area for test NOREN S/72

It calculates also, on request of the company, the surface of distribution from which these elements obtains a "CLASS A" under the UNE-EN ISO 11654:1998. For NOREN S/72 produces in the case to distribute an element each 1,3 m^2, or equivalent to install 8 elements in 10 m^2. In this concrete case the data obtained are:

Absorption coefficients by octave bands

f (Hz)	α_s	Data for DB-HR	
125	0,19		
250	0,58		
500	1,19	1,20	$\alpha_{average}$
1000	1,42	1,40	**1,33**
2000	1,42	1,40	
4000	1,38		

Classification under European regulation

ISO 11654:1997	
α_w	0,90
CLASS	A

Classification under American regulation

ASTM C423 - 22	
NRC	1,15
SAA	1,51

5.2. NOREN S/100. Results

To continuation, show the data of the Equivalent Sound Absorption Area, Aeq (m^2) by element obtained for the NOREN S/100 model.

f (Hz)	Aeq (m^2)
80	0,01
100	0,07
125	0,25
160	0,48
200	0,73
250	0,68
315	0,91
400	1,28
500	1,56
630	1,83
800	1,90
1000	1,92
1250	1,81
1600	1,88
2000	1,87
2500	1,80
3150	1,78
4000	1,75
5000	1,79

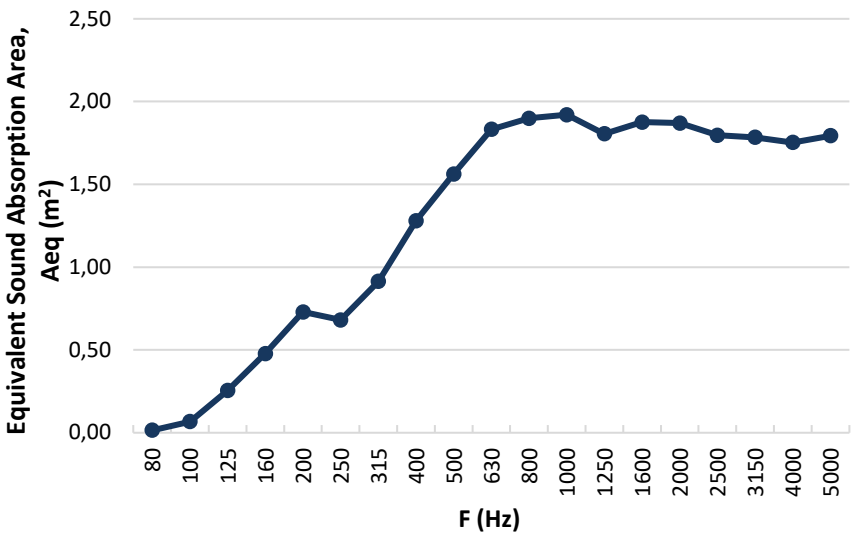


Figure 6. The Equivalent Sound Absorption Area, Aeq in one-third octave bands between 80 Hz and 5 kHz for the NOREN S/100

To continuation, show the data test 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	9,20	9,10	0,04
100	9,42	8,97	0,20
125	6,51	5,76	0,76
160	5,95	4,86	1,43
200	6,37	4,66	2,19
250	6,93	5,05	2,04
315	7,47	4,85	2,74
400	7,43	4,24	3,84
500	7,56	3,91	4,69
630	7,42	3,58	5,50
800	7,16	3,45	5,70
1000	6,86	3,36	5,76
1250	6,32	3,32	5,42

1600	5,87	3,14	5,63
2000	5,42	3,01	5,61
2500	4,74	2,83	5,39
3150	4,16	2,62	5,35
4000	3,50	2,36	5,26
5000	2,94	2,07	5,38

Table 3. Reverberation times and equivalent sound absorption area for test NOREN S/100

It calculates also, on request of the company, the surface of distribution from which these elements obtains a "CLASS A" under the UNE-EN ISO 11654:1998. For NOREN S/100 produces in the case to distribute an element each 1,3 m^2, or equivalent to install 8 elements in 10 m^2. In this concrete case the data obtained are:

Absorption coefficients by octave bands

f (Hz)	α_s	Data for DB-HR	
125	0,19		
250	0,58		
500	1,19	1,20	$\alpha_{average}$
1000	1,42	1,40	**1,13**
2000	1,42	1,40	
4000	1,38		

Classification under European regulation

ISO 11654:1997	
α_w	0,90
CLASS	A

Classification under American regulation

ASTM C423 - 22	
NRC	1,15
SAA	1,51

5.3. NOREN S/85. Results.

To continuation, show the data of the Equivalent Sound Absorption Area, Aeq (m^2) by element obtained for the CIRCULAR NOREN 800 model.

f (Hz)	Aeq (m^2)
80	0,01
100	0,04
125	0,16
160	0,31
200	0,47
250	0,44
315	0,58
400	0,82
500	1,00
630	1,17
800	1,22
1000	1,23
1250	1,16
1600	1,20
2000	1,20
2500	1,15
3150	1,14
4000	1,12
5000	1,15

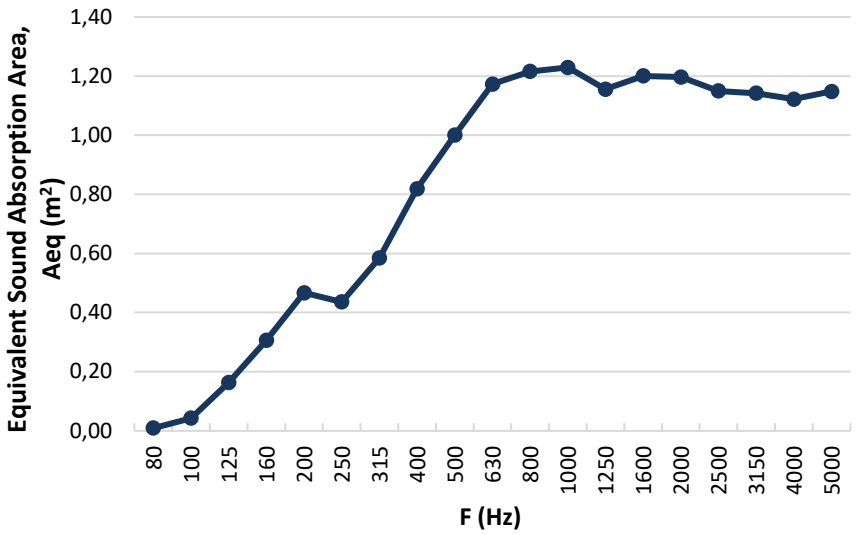


Figure 7. The Equivalent Sound Absorption Area, Aeq in one-third octave bands between 80 Hz and 5 kHz for the NOREN S/85

It calculates also, on request of the company, the surface of distribution from which these elements obtains a "CLASS A" under the UNE-EN ISO 11654:1998. For NOREN S/85 produces in the case to distribute an element each 0,86 m^2, or equivalent to install 12 elements in 10 m^2. In this concrete case the data obtained are:

Absorption coefficients by octave bands

f (Hz)	α_s	Data for DB-HR	
125	0,17		
250	0,58		
500	1,16	1,15	$\alpha_{average}$
1000	1,40	1,40	**1,32**
2000	1,40	1,40	
4000	1,34		

Classification under European regulation

ISO 11654:1997	
α_w	0,90
CLASS	A

Classification under American regulation

ASTM C423 - 22	
NRC	1,15
SAA	0,97

5.4. NOREN S/123.2 Results

To continuation, show the data of the Equivalent Sound Absorption Area, Aeq (m^2) by element obtained for the NOREN S/123.2 model.

f (Hz)	Aeq (m^2)
80	0,01
100	0,07
125	0,26
160	0,48
200	0,73
250	0,68
315	0,91
400	1,28
500	1,56
630	1,83
800	1,90
1000	1,92
1250	1,81
1600	1,88
2000	1,87
2500	1,80
3150	1,79
4000	1,75
5000	1,80

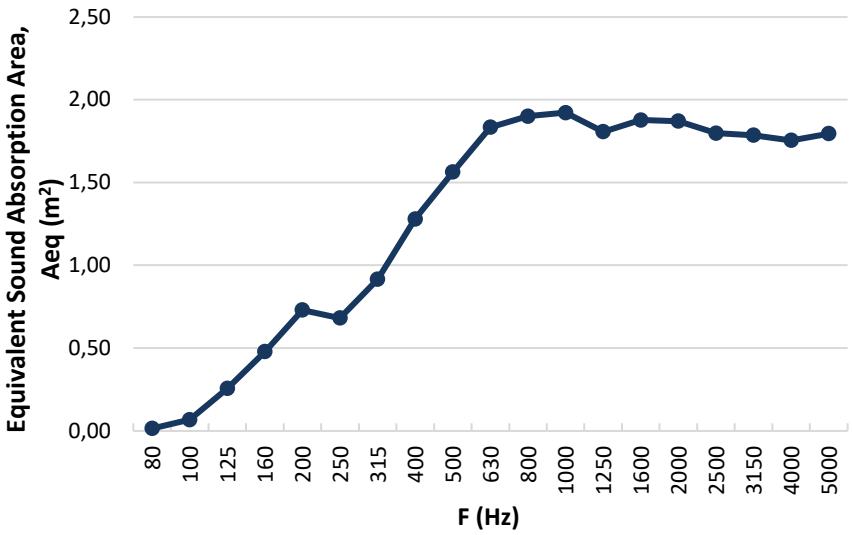


Figure. 4. The Equivalent Sound Absorption Area, Aeq in one-third octave bands between 80 Hz and 5 kHz for the NOREN S/123.2

It calculates also, on request of the company, the surface of distribution from which these elements obtains a "CLASS A" under the UNE-EN ISO 11654:1998. For NOREN S/123.2 produces in the case to distribute an element each 1,3 m^2, or equivalent to install 8 elements in 10 m^2. In this concrete case the data obtained are:

Absorption coefficients by octave bands

f (Hz)	α_s	Data for DB-HR	
125	0,19		
250	0,58		
500	1,19	1,20	$\alpha_{average}$
1000	1,42	1,40	**1,33**
2000	1,42	1,40	
4000	1,38		

Classification under European regulation

ISO 11654:1997	
α_w	0,90
CLASS	A

Classification under American regulation

ASTM C423 - 22	
NRC	1,15
SAA	1,51

5.5. NOREN S/151.2 Resutls

To continuation, show the data of the Equivalent Sound Absorption Area, Aeq (m^2) by element obtained for the NOREN S/151.2 model.

f (Hz)	Aeq (m^2)
80	0,02
100	0,08
125	0,31
160	0,58
200	0,89
250	0,83
315	1,11
400	1,56
500	1,90
630	2,23
800	2,31
1000	2,34
1250	2,20
1600	2,28
2000	2,27
2500	2,18
3150	2,17
4000	2,13
5000	2,18

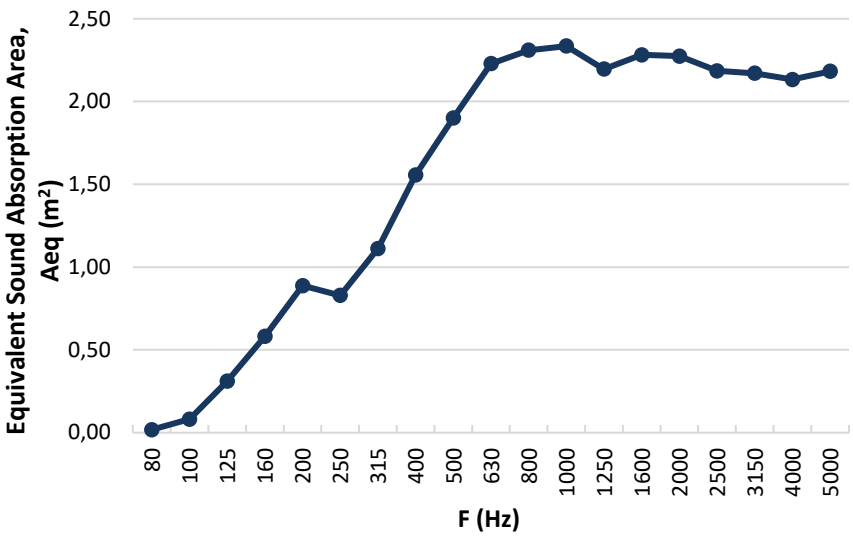


Figure. 5. The Equivalent Sound Absorption Area, Aeq in one-third octave bands between 80 Hz and 5 kHz for the NOREN S/151.2

It calculates also, on request of the company, the surface of distribution from which these elements obtains a "CLASS A" under the UNE-EN ISO 11654:1998. For HORIZONTAL NOREN 1500x700 produces in the case to distribute an element each 1,3 m^2, or equivalent to install 8 elements in 10 m^2. In this concrete case the data obtained are:

Absorption coefficients by octave bands

f (Hz)	α_s	Data for DB-HR	
125	0,18		
250	0,58		
500	1,15	1,15	$\alpha_{average}$
1000	1,39	1,40	**1,33**
2000	1,36	1,35	
4000	1,30		

Classification under European regulation

ISO 11654:1997	
α_w	0,90
CLASS	A

Classification under American regulation

ASTM C423 - 22	
NRC	1,10
SAA	1,84

5.6. NOREN S/123 Results

To continuation, show the data of the Equivalent Sound Absorption Area, Aeq (m^2) by element obtained for the NOREN S/123 model.

f (Hz)	Aeq (m^2)
80	0,02
100	0,08
125	0,31
160	0,58
200	0,89
250	0,83
315	1,11
400	1,56
500	1,90
630	2,23
800	2,31
1000	2,34
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1600	2,28
2000	2,27
2500	2,18
3150	2,17
4000	2,13
5000	2,18

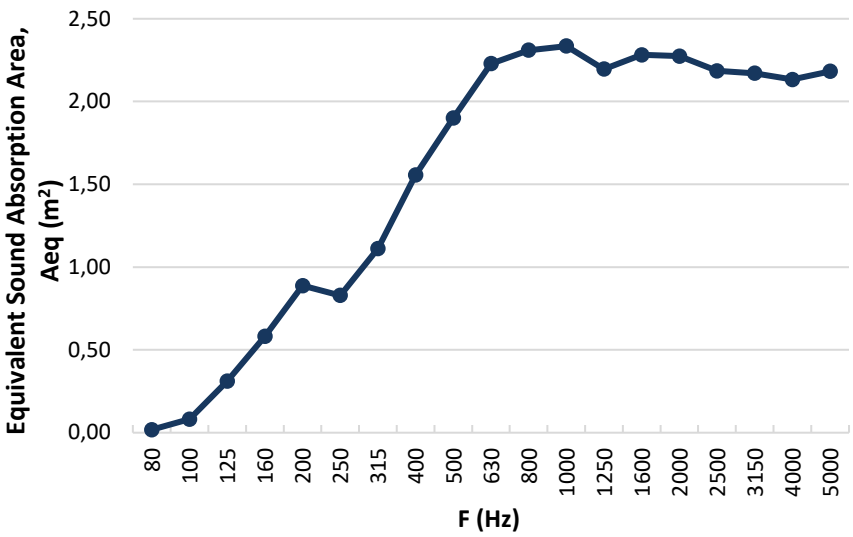


Figure. 6. The Equivalent Sound Absorption Area, Aeq in one-third octave bands between 80 Hz and 5 kHz for the NOREN S/123

It calculates also, on request of the company, the surface of distribution from which these elements obtains a "CLASS A" under the UNE-EN ISO 11654:1998. For NOREN S/123 produces in the case to distribute an element each 1,3 m^2, or equivalent to install 8 elements in 10 m^2. In this concrete case the data obtained are:

Absorption coefficients by octave bands

f (Hz)	α_s	Data for DB-HR	
125	0,22		
250	0,58		
500	1,16	1,15	$\alpha_{average}$
1000	1,38	1,40	**1,33**
2000	1,30	1,30	
4000	1,30		

Classification under European regulation

ISO 11654:1997	
α_w	0,90
CLASS	A

Classification under American regulation

ASTM C423 - 22	
NRC	1,10
SAA	0,76

5.7. NOREN S/151 Results

To continuation, show the data of the Equivalent Sound Absorption Area, Aeq (m^2) by element obtained for the NOREN S/151 model.

f (Hz)	Aeq (m^2)
80	0,01
100	0,04
125	0,16
160	0,29
200	0,44
250	0,41
315	0,56
400	0,78
500	0,95
630	1,11
800	1,15
1000	1,17
1250	1,10
1600	1,14
2000	1,14
2500	1,09
3150	1,09
4000	1,07
5000	1,09

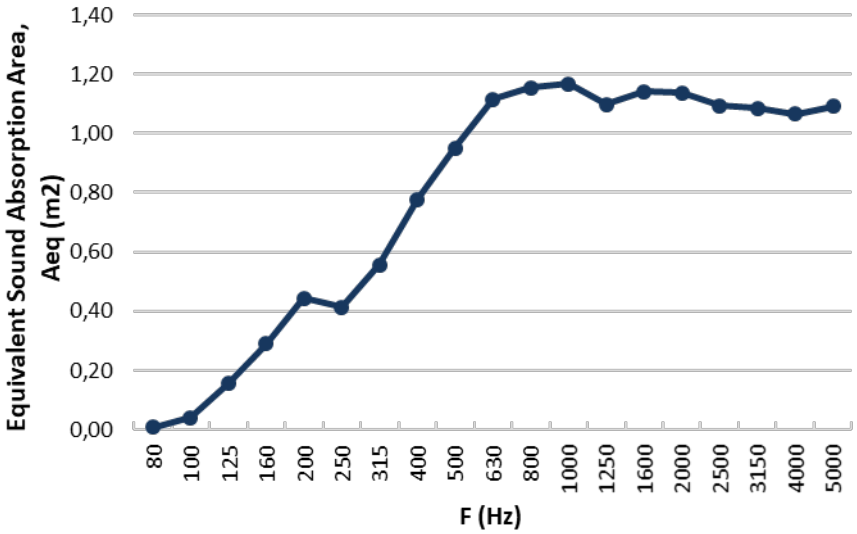


Figure. 7. The Equivalent Sound Absorption Area, Aeq in one-third octave bands between 80 Hz and 5 kHz for the NOREN S/151

It calculates also, on request of the company, the surface of distribution from which these elements obtains a "CLASS A" under the UNE-EN ISO 11654:1998. For NOREN S/151 produces in the case to distribute an element each 0.78 m^2, or equivalent to install 13 elements in 10 m^2. In this concrete case the data obtained are:

Absorption coefficients by octave bands

f (Hz)	α_s	Data for DB-HR	
125	0,19		
250	0,58		
500	1,22	1,20	$\alpha_{average}$
1000	1,47	1,45	**1,35**
2000	1,41	1,40	
4000	1,41		

Classification under European regulation

ISO 11654:1997	
α_w	0,90
CLASS	A

Classification under American regulation

ASTM C423 - 22	
NRC	1,15
SAA	0,92

6. SUMMARY OF DATA

The number of necessary elements to achieve in 10 m^2 a Sound Absorption Class A (máximum) is obtained according to UNE-EN ISO 11654:98 for all the models tested and/or interpolated. The following table summarises the data.

MODEL TARIFF	Units (10 m2)
NOREN S/100	8
NOREN S/85	12
NOREN S/72	8
NOREN S/123.2	8
NOREN S/151.2	6
NOREN S/151	13
NOREN S/123	14

Gandia, 15th December 2022

JESUS|ALBA|FERNANDEZ

Firmado digitalmente por JESUS|ALBA|FERNANDEZ
Fecha: 2022.12.15 09:44:13 +01'00'

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

Annex 1.

Supporting sheets

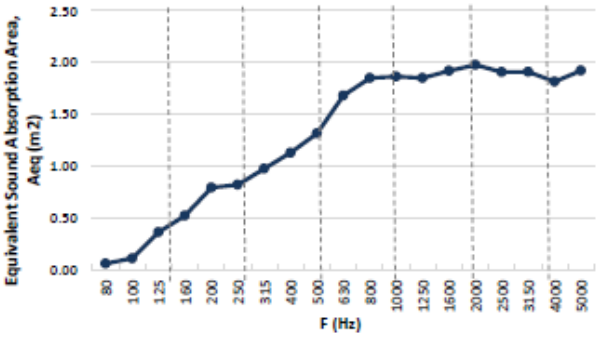
Reverberation room of Higher Polytechnic College of Gandia
Acoustic absorption measurements according to UNE-EN ISO 354:2004
Equivalent Sound Absorption Area, Aeq (m2), one element

Requester: BOVER
Test Sample: NOREN S/72

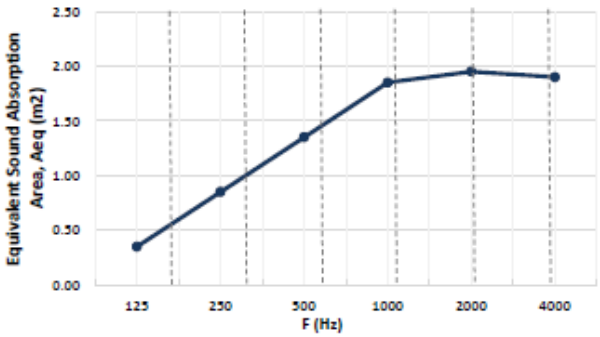


Dimensions:		Indoor Enviroment Conditions:	
Room volume (m^3)	238	$T_{empty\ Room}$	26 °C
Room surface (m^2)	236	$HR_{empty\ Room}$	69 %
Surface of the test sample (m2)	3	$T_{Room\ with\ sample}$	26 °C
		$HR_{Room\ with\ sample}$	68 %
Date of Measurements:	22/9/2022	**Date of Report:**	14/12/2022

f (Hz)	Aeq (m^2)
80	0.06
100	0.11
125	0.36
160	0.52
200	0.79
250	0.82
315	0.97
400	1.13
500	1.31
630	1.68
800	1.85
1000	1.86
1250	1.85
1600	1.92
2000	1.98
2500	1.91
3150	1.91
4000	1.81
5000	1.92



f (Hz)	Aeq (m^2)
125	0.35
250	0.85
500	1.35
1000	1.85
2000	1.95
4000	1.90



Additional data

The higher classification produces distributing 1 element in the following surface (m2): 1.728
Number of elements in 10 m2 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	0.19		
250	0.50		
500	0.80	0.80	$\alpha_{average}$
1000	1.07	1.05	0.98
2000	1.12	1.10	
4000	1.09		

Classification under European regulation

UNE-EN ISO 11654:1998	
α_w	0.80
CLASS	B

Classification under American regulation

ASTM C423 - 22	
NRC	0.85
SAA	1.51

UNIVERSITAT POLITÈCNICA DE VALÈNCIA
CAMPUS DE GANDIA

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Polytechnic University of Valencia (www.upv.es)
C/Paraninmf 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 (m2), one element

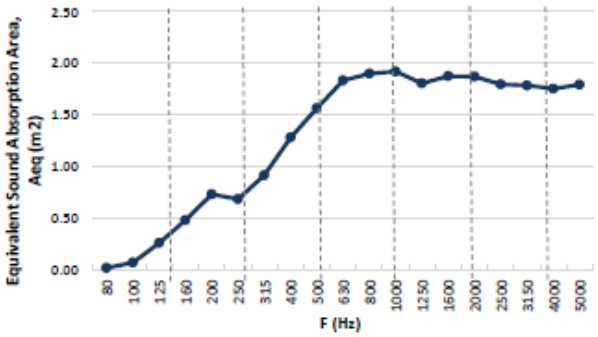
Requester: BOVER
Test Sample: NOREN S/100

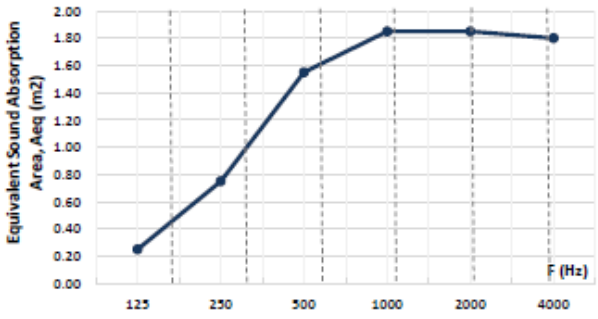


Dimensions:		Indoor Enviroment Conditions:	
Room volume (m^3)	238	$T_{empty\ Room}$	26 °C
Room surface (m^2)	236	$HR_{empty\ Room}$	69 %
Surface of the test sample (m2)	3	$T_{Room\ with\ sample}$	26 °C
		$HR_{Room\ with\ sample}$	69 %
Date of Measurements:	22/9/2022	**Date of Report:**	14/12/2022

f (Hz)	Aeq (m^2)
80	0.01
100	0.07
125	0.25
160	0.48
200	0.73
250	0.68
315	0.91
400	1.28
500	1.56
630	1.83
800	1.90
1000	1.92
1250	1.81
1600	1.88
2000	1.87
2500	1.80
3150	1.78
4000	1.75
5000	1.79

f (Hz)	Aeq (m^2)
125	0.25
250	0.75
500	1.55
1000	1.85
2000	1.85
4000	1.80





Additional data

The higher classification produces distributing 1 element in the following surface (m2): 1.5708
Number of elements in 10 m2 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	0.17		
250	0.49		
500	0.99	1.00	$\alpha_{average}$
1000	1.19	1.20	1.13
2000	1.18	1.20	
4000	1.13		

Classification under European regulation

UNE-EN ISO 11654:1998	
α_w	0.80
CLASE	B

Classification under American regulation

ASTM C423 - 22	
NRC	0.95
SAA	1.51

UNIVERSITAT POLITÈCNICA DE VALÈNCIA
CAMPUS DE GANDIA

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Telephone: (+34)962849300. Ext 43140. e-mail: jesalba@fis.upv.es

Annex 2.

Periodic verification certificates of used equipment

BOLETÍN IDENTIFICATIVO

INSTRUMENTOS DE MEDIDA DE SONIDO AUDIBLE Y CALIBRADORES ACÚSTICOS

TITULAR DEL INSTRUMENTO			
Nombre o razón social:			
Dirección:			
CP:	Localidad:	Provincia:	Tfno:
Persona de contacto:	Fax:	e-mail:	

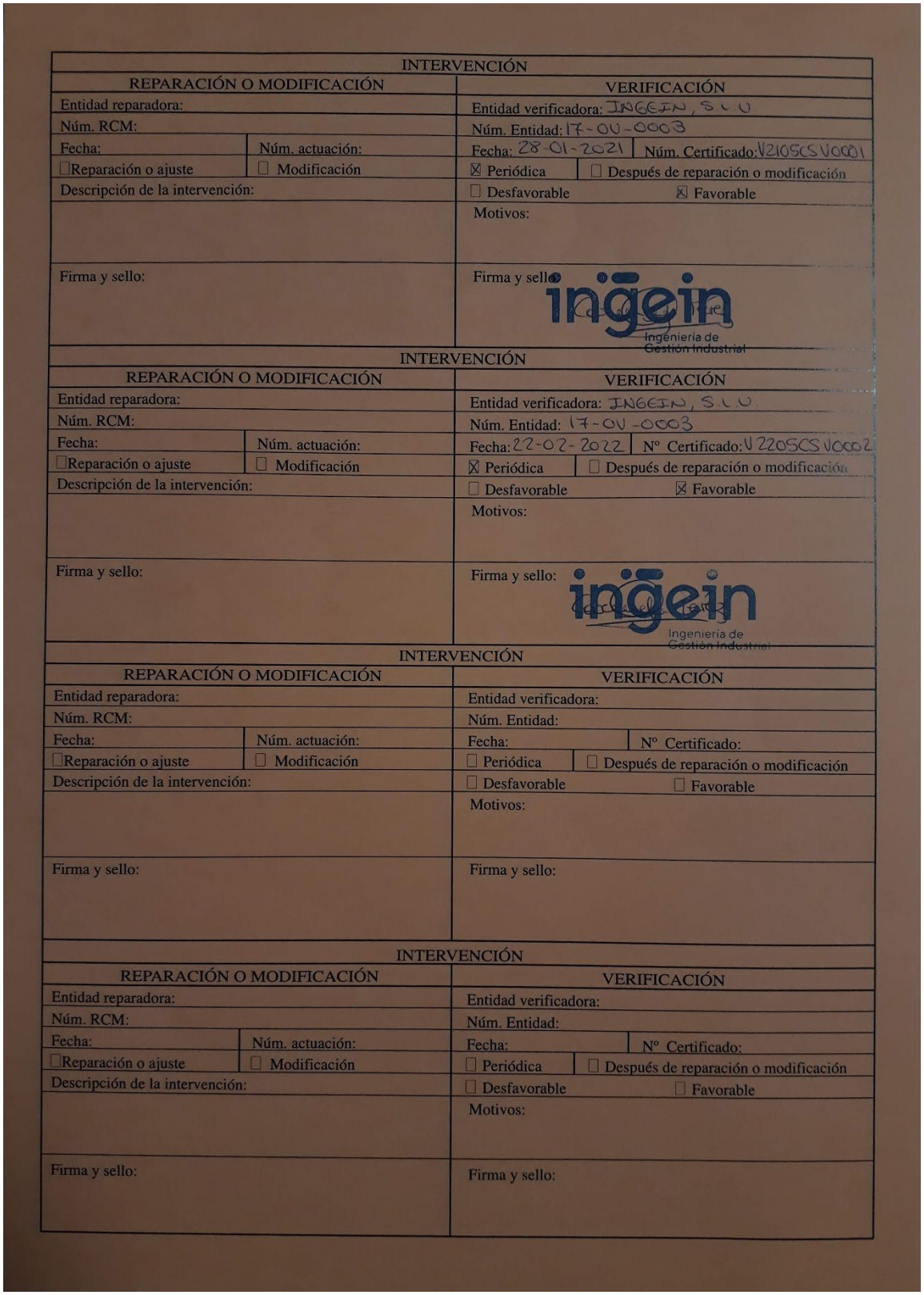
DATOS IDENTIFICATIVOS DEL INSTRUMENTO		
Fabricante: **BRÜEL & KJAER**	Marca: **BRÜEL & KJAER**	
Modelo: **2270 (G4)**	Nº de serie: **3011089**	**Canal 1**
Micrófono: **B&K 4189**	Nº de serie: **3180898**	
Preamplificador: **ZC 0032**	Nº de serie: **28138**	
Lugar de instalación:	Tipo de Instrumento: **SONÓMETRO**	
Fecha de puesta en servicio (1):		
Nº Aprobación de modelo (2):		
Fecha de verificación primitiva (2):		
Certificado examen de modelo nº: **131127003**	Módulo: **B**	Fecha: **01/12/2015**
Organismo de control nº: **00-OC-1000**		
Certificado de conformidad nº: **19LAC18099F01**	Módulo: **F**	Fecha: 14/01/2019
Organismo de control nº: **16-OC-1002**		



REPARACIÓN O MODIFICACIÓN		CONTROL METROLÓGICO	
Entidad reparadora nº:		Organismo Verificador nº: 17-OV-0003 / INGEIN, S.L.U.	
		Fecha: 08-01-2020	Nº de certificado: V200508V0001
Fecha:	Núm. actuación:	☒ Periódica	☐ Después de reparación o modificación
Descripción de la intervención:		☐ Desfavorable	☒ Favorable
		Motivos:	
Firma y sello:		Firma y sello: Ingein, Catherine Ferro, INGENIERÍA DE GESTIÓN INDUSTRIAL	

REPARACIÓN O MODIFICACIÓN		CONTROL METROLÓGICO	
Entidad reparadora nº:		Organismo Verificador nº: 17-OV-0003 / INGEIN, S.L.U.	
		Fecha: 28-01-2021	Nº de certificado: V210508V0001
Fecha:	Núm. actuación:	☒ Periódica	☐ Después de reparación o modificación
Descripción de la intervención:		☐ Desfavorable	☒ Favorable
		Motivos:	
Firma y sello:		Firma y sello: ingein, Catherine Ferro, Ingeniería de Gestión Industrial	

(1) Sólo para dosímetros en servicio antes de la entrada en vigor de la Orden ITC/2845/2007. (2) Para instrumentos puestos en servicio en cumplimiento de la Orden de 16 de diciembre de 1998.



INTERVENCIÓN			
REPARACIÓN O MODIFICACIÓN		VERIFICACIÓN	
Entidad reparadora:		Entidad verificadora: INGEIN, S.L.U	
Núm. RCM:		Núm. Entidad: 17-OU-0003	
Fecha:	Núm. actuación:	Fecha: 28-01-2021	Núm. Certificado: V210SCSV0001
☐ Reparación o ajuste	☐ Modificación	☒ Periódica	☐ Después de reparación o modificación
Descripción de la intervención:		☐ Desfavorable	☒ Favorable
		Motivos:	
Firma y sello:		Firma y sello: ingein Ingeniería de Gestión Industrial	

INTERVENCIÓN			
REPARACIÓN O MODIFICACIÓN		VERIFICACIÓN	
Entidad reparadora:		Entidad verificadora: INGEIN, S.L.U	
Núm. RCM:		Núm. Entidad: 17-OU-0003	
Fecha:	Núm. actuación:	Fecha: 22-02-2022	Nº Certificado: V220SCSV0002
☐ Reparación o ajuste	☐ Modificación	☒ Periódica	☐ Después de reparación o modificación
Descripción de la intervención:		☐ Desfavorable	☒ Favorable
		Motivos:	
Firma y sello:		Firma y sello: ingein Ingeniería de Gestión Industrial	

INTERVENCIÓN			
REPARACIÓN O MODIFICACIÓN		VERIFICACIÓN	
Entidad reparadora:		Entidad verificadora:	
Núm. RCM:		Núm. Entidad:	
Fecha:	Núm. actuación:	Fecha:	Nº Certificado:
☐ Reparación o ajuste	☐ Modificación	☐ Periódica	☐ Después de reparación o modificación
Descripción de la intervención:		☐ Desfavorable	☐ Favorable
		Motivos:	
Firma y sello:		Firma y sello:	

INTERVENCIÓN			
REPARACIÓN O MODIFICACIÓN		VERIFICACIÓN	
Entidad reparadora:		Entidad verificadora:	
Núm. RCM:		Núm. Entidad:	
Fecha:	Núm. actuación:	Fecha:	Nº Certificado:
☐ Reparación o ajuste	☐ Modificación	☐ Periódica	☐ Después de reparación o modificación
Descripción de la intervención:		☐ Desfavorable	☐ Favorable
		Motivos:	
Firma y sello:		Firma y sello:	

BOLETÍN IDENTIFICATIVO

DATOS DEL INSTRUMENTO			
Nombre de la entidad titular del instrumento: **Escuela Politécnica Superior de Gandia**			
Dirección: **Paranimf, 1**			
Localidad: **46730 Gandia (Valencia)**			Teléfono:
Ubicación del instrumento:			
Fabricante: **BRUEL & KJÆR**			
Tipo de instrumento: **CALIBRADOR**			Canal:
Marca: **BRUEL & KJÆR**	Modelo: **4231**		Num. de serie: **3019977**
Marca del micrófono:	Modelo:		Num. de serie:
Fecha de puesta en servicio:			
Aprobación del modelo número: **02-001-B-26/10-R Rev. 0**			
Fecha de aprobación de modelo: **28-jul-2010**		Fecha de verificación primitiva:	**5-dic-2017**
Autoridad de control de la verificación primitiva: **02-OC-1002**			
Placa de características:			Número de precintos: **2**
Croquis de la localización de la placa de características, etiqueta de verificación y precintos:			



INTERVENCIÓN			
REPARACIÓN O MODIFICACIÓN		VERIFICACIÓN	
Entidad reparadora:		Entidad verificadora: INGEIN, S.L.U.	
Núm. RCM:		Núm. Entidad: 17-OV-0003	
Fecha:	Núm. actuación:	Fecha: 15-01-2019	Nº Certificado: V1905CSV0001
☐ Reparación o ajuste	☐ Modificación	☒ Periódica	☐ Después de reparación o modificación
Descripción de la intervención:		☐ Desfavorable	☒ Favorable
		Motivos:	
Firma y sello:		Firma y sello: Ingein INGENIERÍA DE GESTIÓN INDUSTRIAL	

INTERVENCIÓN			
REPARACIÓN O MODIFICACIÓN		VERIFICACIÓN	
Entidad reparadora:		Entidad verificadora: INGEIN, S.L.U.	
Núm. RCM:		Núm. Entidad: 17-OV-0003	
Fecha:	Núm. actuación:	Fecha: 10-01-2020	Nº Certificado: V2005CSV0001
☐ Reparación o ajuste	☐ Modificación	☒ Periódica	☐ Después de reparación o modificación
Descripción de la intervención:		☐ Desfavorable	☒ Favorable
		Motivos:	
Firma y sello:		Firma y sello: Ingein INGENIERÍA DE GESTIÓN INDUSTRIAL	

HBK HOTTINGER BRÜEL & KJÆR

Certificate of Conformance

Escuela Politécnica Superior de Gandía
C/ Paranimf, 1
Departamento de Física Aplicad
46730 Grao de Gandia
VALENCIA

Reference number:	Service request:	Date:
Pedido: PQ000214560	CAS-561850-J9G2B7	16 Feb 2022

We hereby declare that

-2270--D01- 2270-G4 Handheld Analyzer Serial Number: 3011089

has been tested and passed all test.

The instrument has been tested according to published specifications at the date of the test.
All tests have been performed using calibrated equipment, traceable to National or International Standards or by ratio measurements.

Certificate issued
16-Feb-2022

Torben Bjørn

Vice President - Operations
For and behalf of Hottinger Brüel & Kjær HQ

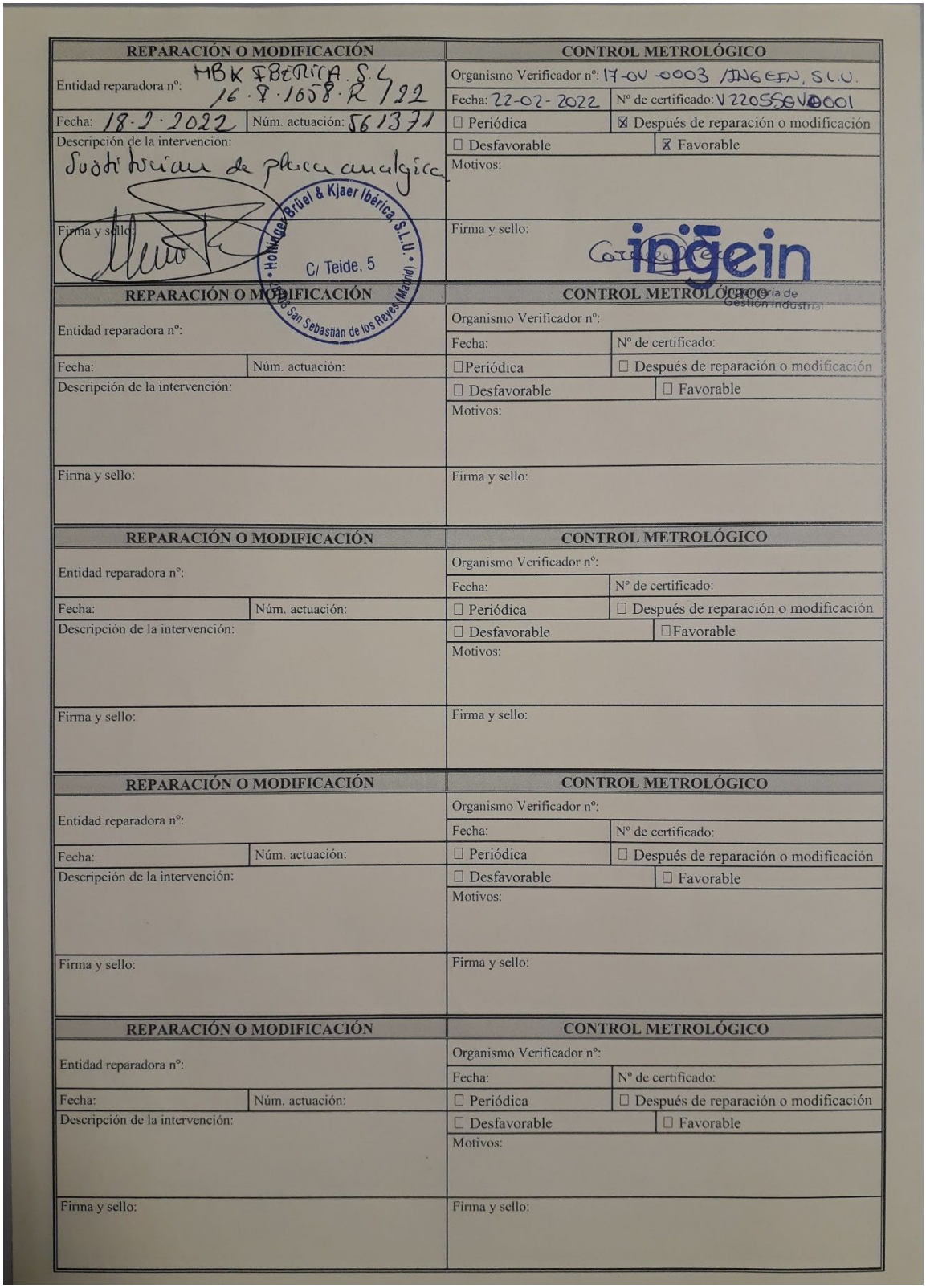
Recommended date for next check: Feb-2023

Hottinger Brüel & Kjær is certified under ISO 9001:2008, assuring that all calibration data is retained on file and is available for inspection upon request

Note:
Although this certificate states that your instrument complied with all specifications at the time of the test, this is not a calibration certificate.

Hottinger Brüel & Kjær A/S
Teknikerbyen 28-40 • DK-2830 Virum • Denmark
Tel: +45 45 80 05 00
E-mail: info@hbkworld.com
Website: www.hbkworld.com • www.hbm.com • www.bksv.com

CVR nr. 23 95 84 14 • VAT. nr. DK 11948456
Danske Bank: Account no. 3100-3015081260, SWIFT DABADKKK
IBANS: (DKK) DK 75 3000 3015081260 • (EUR) DK 25 3000 3001963589
(USD) DK 26 3000 4451045504



REPARACIÓN O MODIFICACIÓN		CONTROL METROLÓGICO	
Entidad reparadora nº: MBK IBERICA S.L. 16.8.1058.R/22		Organismo Verificador nº: 17-OV-0003 / INGEIN, S.L.U.	
Fecha: 18-1-2022	Núm. actuación: 561371	Fecha: 22-02-2022	Nº de certificado: V220556V0001
Descripción de la intervención: Sustitución de placa analógica		☐ Periódica	☒ Después de reparación o modificación
		☐ Desfavorable	☒ Favorable
		Motivos:	
Firma y sello: Hottinger Brüel & Kjaer Ibérica, S.L.U. C/ Teide, 5 28703 San Sebastián de los Reyes (Madrid)		Firma y sello: ingein Ingeniería de Gestión Industrial	

REPARACIÓN O MODIFICACIÓN		CONTROL METROLÓGICO	
Entidad reparadora nº:		Organismo Verificador nº:	
		Fecha:	Nº de certificado:
Fecha:	Núm. actuación:	☐ Periódica	☐ Después de reparación o modificación
Descripción de la intervención:		☐ Desfavorable	☐ Favorable
		Motivos:	
Firma y sello:		Firma y sello:	

REPARACIÓN O MODIFICACIÓN		CONTROL METROLÓGICO	
Entidad reparadora nº:		Organismo Verificador nº:	
		Fecha:	Nº de certificado:
Fecha:	Núm. actuación:	☐ Periódica	☐ Después de reparación o modificación
Descripción de la intervención:		☐ Desfavorable	☐ Favorable
		Motivos:	
Firma y sello:		Firma y sello:	

REPARACIÓN O MODIFICACIÓN		CONTROL METROLÓGICO	
Entidad reparadora nº:		Organismo Verificador nº:	
		Fecha:	Nº de certificado:
Fecha:	Núm. actuación:	☐ Periódica	☐ Después de reparación o modificación
Descripción de la intervención:		☐ Desfavorable	☐ Favorable
		Motivos:	
Firma y sello:		Firma y sello:	

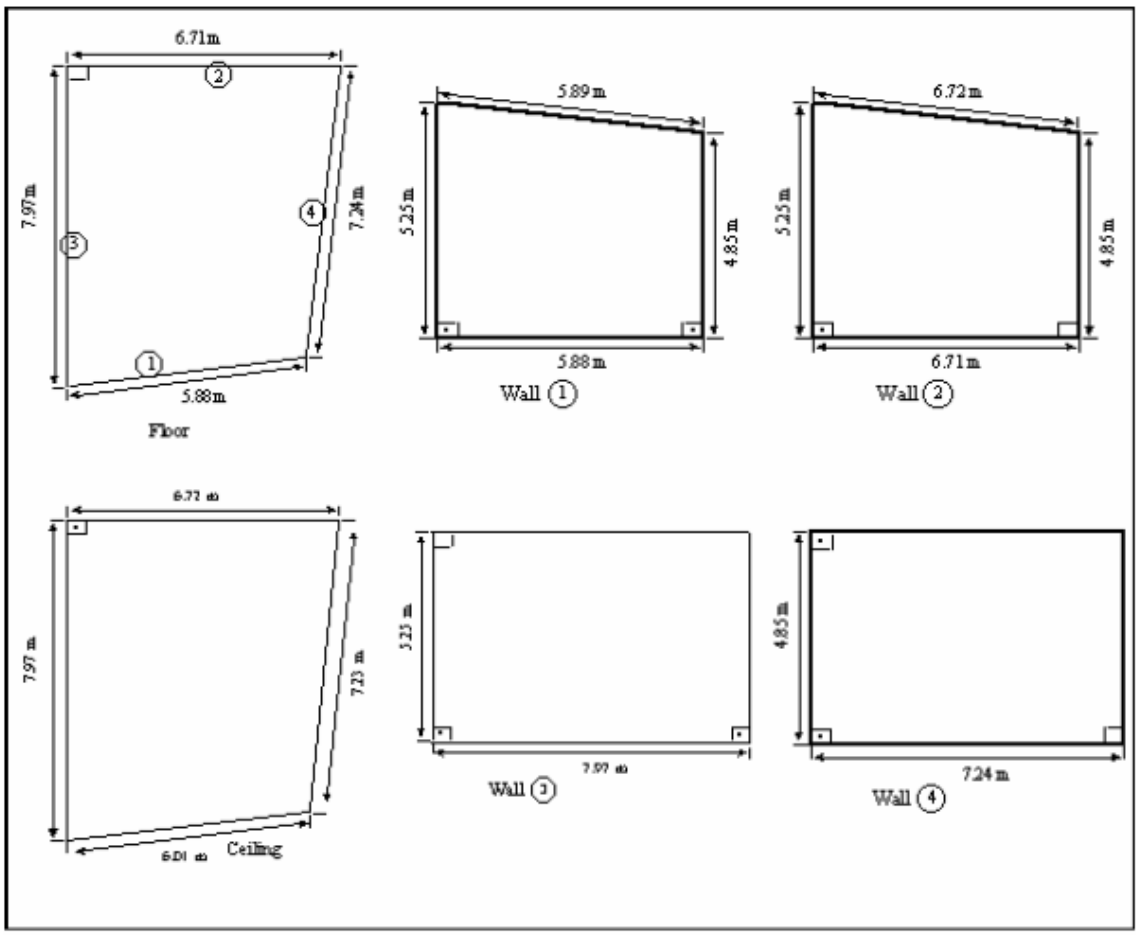
REPARACIÓN O MODIFICACIÓN		CONTROL METROLÓGICO	
Entidad reparadora nº:		Organismo Verificador nº:	
		Fecha:	Nº de certificado:
Fecha:	Núm. actuación:	☐ Periódica	☐ Después de reparación o modificación
Descripción de la intervención:		☐ Desfavorable	☐ Favorable
		Motivos:	
Firma y sello:		Firma y sello:	

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
  -

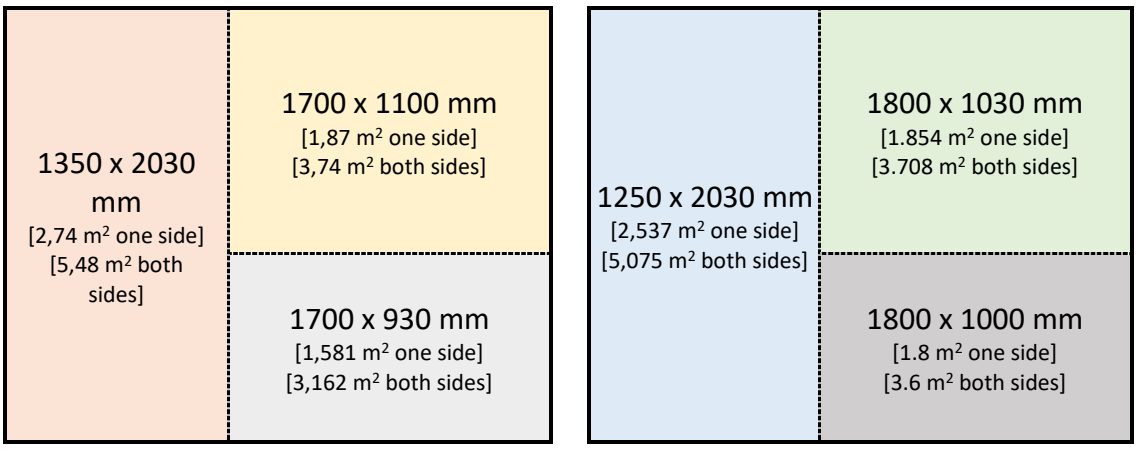


Absorption characteristics:

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]
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 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]	
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.



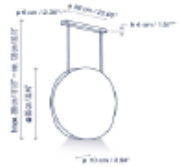


Annex 4.

Interpolation supporting sheets

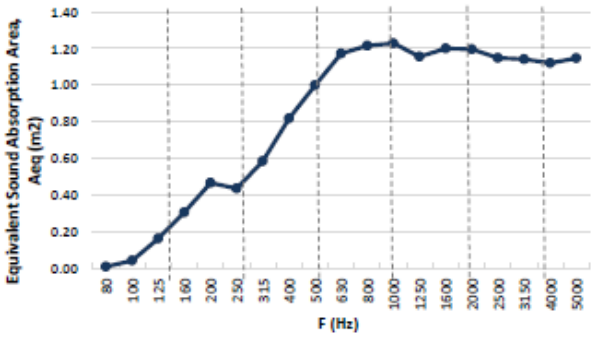
Reverberation room of Higher Polytechnic College of Gandia
Acoustic absorption measurements according to UNE-EN ISO 354:2004
Equivalent Sound Absorption Area, Aeq (m2), one element

Requester: BOVER
Test Sample: NOREN S/85

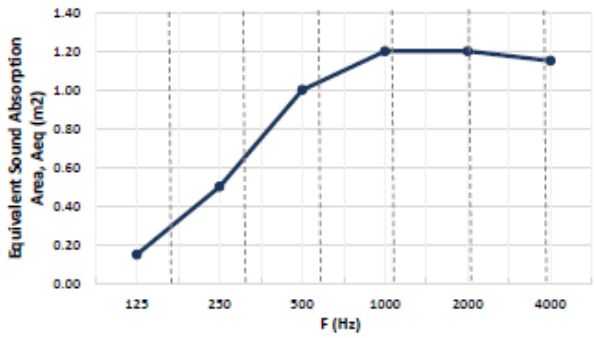


Reference			
NOREN S/85			
Element factor	0.64		
Group factor	1.07		
Estimated elements:	5		
Calculation date:	22/9/2022	**Date of Report:**	14/12/2022

f (Hz)	Aeq (m²)
80	0.01
100	0.04
125	0.16
160	0.31
200	0.47
250	0.44
315	0.58
400	0.82
500	1.00
630	1.17
800	1.22
1000	1.23
1250	1.16
1600	1.20
2000	1.20
2500	1.15
3150	1.14
4000	1.12
5000	1.15



f (Hz)	Aeq (m²)
125	0.15
250	0.50
500	1.00
1000	1.20
2000	1.20
4000	1.15



Additional data

The higher classification produces distributing 1 element in the following surface (m2): 0.86
Number of elements in 10 m2 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	0.17		
250	0.58		
500	1.16	1.15	$\alpha_{average}$
1000	1.40	1.40	1.32
2000	1.40	1.40	
4000	1.34		

Classification under European regulation

UNE-EN ISO 11654:1998	
α_w	0.90
CLASS	A

Classification under American regulation

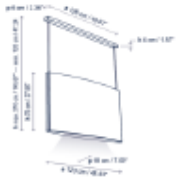
ASTM C423 - 22	
NRC	1.15
SAA	0.97

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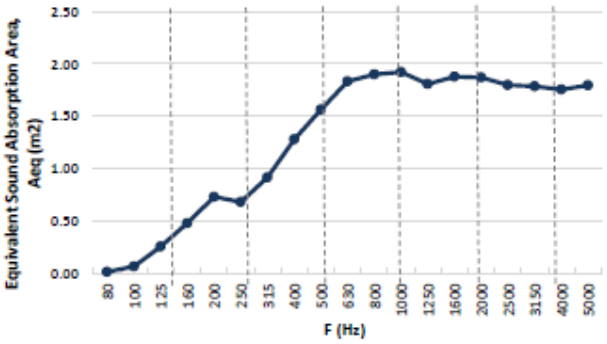
Reverberation room of Higher Polytechnic College of Gandia
Acoustic absorption measurements according to UNE-EN ISO 354:2004
Equivalent Sound Absorption Area, Aeq (m2), one element

Requester: BOVER
Test Sample: NOREN S/123.2

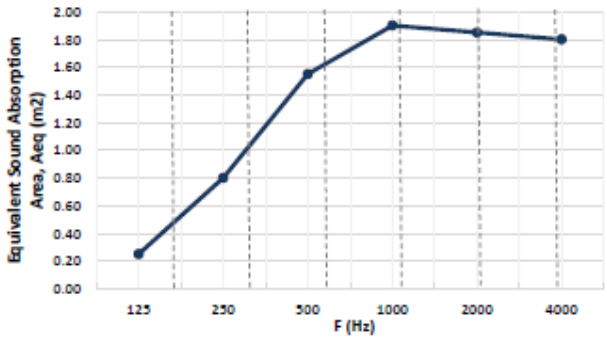


Reference			
NOREN S/123.2			
Element factor	1.00		
Group factor	1.00		
Estimated elements:	3		
Calculation date:	22/9/2022	**Date of Report:**	14/12/2022

f (Hz)	Aeq (m^2)
80	0.01
100	0.07
125	0.26
160	0.48
200	0.73
250	0.68
315	0.91
400	1.28
500	1.56
630	1.83
800	1.90
1000	1.92
1250	1.81
1600	1.88
2000	1.87
2500	1.80
3150	1.79
4000	1.75
5000	1.80



f (Hz)	Aeq (m^2)
125	0.25
250	0.80
500	1.55
1000	1.90
2000	1.85
4000	1.80



Additional data

The higher classification produces distributing 1 element in the following surface (m2): 1.30
Number of elements in 10 m2 8

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

Absorption coefficients by octave bands

f (Hz)	α_s	Data for DB-HR	
125	0.19		
250	0.62		
500	1.19	1.20	$\alpha_{average}$
1000	1.46	1.45	1.35
2000	1.42	1.40	
4000	1.38		

Classification under European regulation

UNE-EN ISO 11654:1998	
α_w	0.90
CLASS	A

Classification under American regulation

ASTM C423 - 22	
NRC	1.15
SAA	1.51

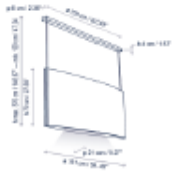
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Reverberation room of Higher Polytechnic College of Gandia
Acoustic absorption measurements according to UNE-EN ISO 354:2004
Equivalent Sound Absorption Area, Aeq (m2), one element

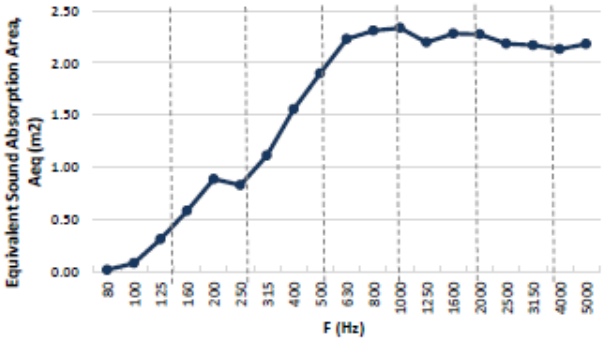
Requester: BOVER

Test Sample: NOREN S/151.2

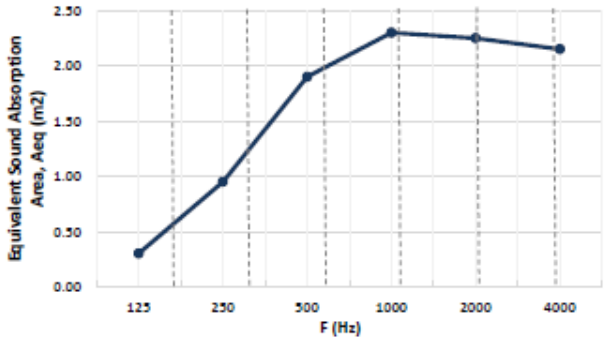


Reference			
NOREN S/151.2			
Element factor	1.22		
Group factor	0.41		
Estimated elements:	2		
Calculation date:	22/9/2022	**Date of Report:**	14/12/2022

f (Hz)	Aeq (m^2)
80	0.02
100	0.08
125	0.31
160	0.58
200	0.89
250	0.83
315	1.11
400	1.56
500	1.90
630	2.23
800	2.31
1000	2.34
1250	2.20
1600	2.28
2000	2.27
2500	2.18
3150	2.17
4000	2.13
5000	2.18



f (Hz)	Aeq (m^2)
125	0.30
250	0.95
500	1.90
1000	2.30
2000	2.25
4000	2.15



Additional data

The higher classification produces distributing 1 element in the following surface (m2): 1.65

Number of elements in 10 m2 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	0.18		
250	0.58		
500	1.15	1.15	$\alpha_{average}$
1000	1.39	1.40	1.30
2000	1.36	1.35	
4000	1.30		

Classification under European regulation

UNE-EN ISO 11654:1998	
α_w	0.90
CLASS	A

Classification under American regulation

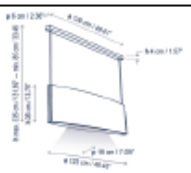
ASTM C423 - 22	
NRC	1.10
SAA	1.84

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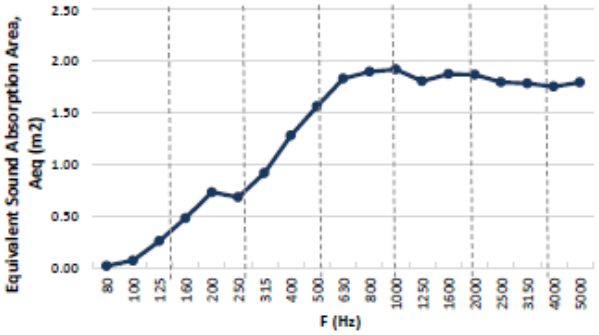
Reverberation room of Higher Polytechnic College of Gandia
Acoustic absorption measurements according to UNE-EN ISO 354:2004
Equivalent Sound Absorption Area, Aeq (m2), one element

Requester: BOVER
Test Sample: NOREN S/123

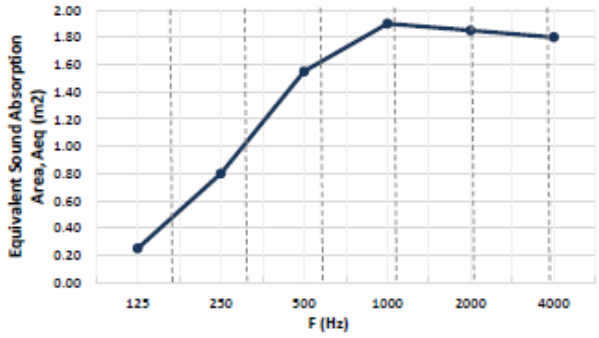


Dimensions:		Indoor Enviroment Conditions:	
Room volume (m^3)	238	$T_{empty\ Room}$	26 °C
Room surface (m^2)	236	$HR_{empty\ Room}$	69 %
Surface of the test sample (m2)	3	$T_{Room\ with\ sample}$	26 °C
		$HR_{Room\ with\ sample}$	68 %
Date of Measurements:	22/9/2022	**Date of Report:**	14/12/2022

f (Hz)	Aeq (m^2)
80	0.01
100	0.07
125	0.26
160	0.48
200	0.73
250	0.68
315	0.91
400	1.28
500	1.56
630	1.83
800	1.90
1000	1.92
1250	1.81
1600	1.88
2000	1.87
2500	1.80
3150	1.79
4000	1.75
5000	1.80



f (Hz)	Aeq (m^2)
125	0.25
250	0.80
500	1.55
1000	1.90
2000	1.85
4000	1.80



Additional data

The higher classification produces distributing 1 element in the following surface (m2): 1.3
Number of elements in 10 m2 8

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

Absorption coefficients by octave bands

f (Hz)	α_s	Data for DB-HR	
125	0.19		
250	0.62		
500	1.19	1.20	$\alpha_{average}$
1000	1.46	1.45	1.35
2000	1.42	1.40	
4000	1.38		

Classification under European regulation

UNE-EN ISO 11654:1998	
α_w	0.90
CLASS	A

Classification under American regulation

ASTM C423 - 22	
NRC	1.15
SAA	1.51

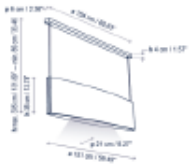
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Acoustic absorption measurements according to UNE-EN ISO 354:2004
Equivalent Sound Absorption Area, Aeq (m2), one element

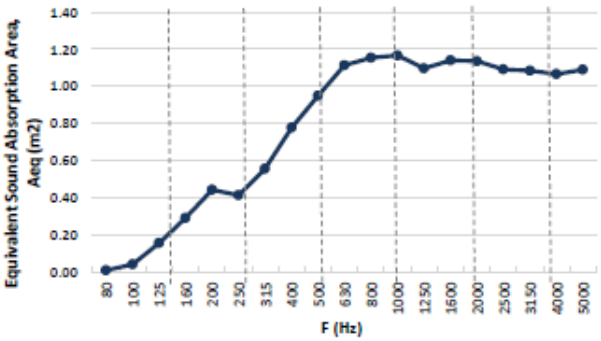
Requester: BOVER

Test Sample: NOREN S/151

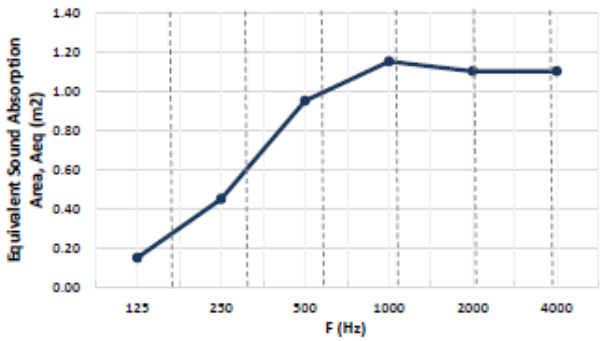


Reference			
NOREN S/151			
Element factor	0.61		
Group factor	1.01		
Estimated elements:	5		
Calculation date:	22/9/2022	**Date of Report:**	14/12/2022

f (Hz)	Aeq (m^2)
80	0.01
100	0.04
125	0.16
160	0.29
200	0.44
250	0.41
315	0.56
400	0.78
500	0.95
630	1.11
800	1.15
1000	1.17
1250	1.10
1600	1.14
2000	1.14
2500	1.09
3150	1.09
4000	1.07
5000	1.09



f (Hz)	Aeq (m^2)
125	0.15
250	0.45
500	0.95
1000	1.15
2000	1.10
4000	1.10



Additional data

The higher classification produces distributing 1 element in the following surface (m2): 0.78

Number of elements in 10 m2 13

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

Absorption coefficients by octave bands

f (Hz)	α_s	Data for DB-HR	
125	0.19		
250	0.58		
500	1.22	1.20	$\alpha_{average}$
1000	1.47	1.45	1.35
2000	1.41	1.40	
4000	1.41		

Classification under European regulation

UNE-EN ISO 11654:1998	
α_w	0.90
CLASS	A

Classification under American regulation

ASTM C423 - 22	
NRC	1.15
SAA	0.92

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