ideatec®

PANEAUX POUR PLAFONDS ET REVÊTEMENTS

CEILING AND WALL PANELS

ACOUSTIC TEST REPORT

ISO 9001

BUREAU VERITAS Certification

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1. INTRODUCTION

This test report is presented for company TAOR and represents a summary of the configurations tried by this company, in the reverberant chamber of the E.P.S. Gandia by the group of Optical and Acoustical Devices and Systems (DISAO). The tests have been made according to norm UNE-EN 20354 during the month of 2005 July. The measures of the absorption coefficient, according to UNITES 20354, and the noise reduction criteria NRC, according the American norm ASTM C-423 are shown.

The technical characteristics of the used devices and instruments for the measurements are summarized in annexed number 1.

2. MEASUREMENTS

The measurements were made mounting the plates in two plenums, the first of 5 cm of height and second of 8 cm. Altogether each plenum lodged a total of 30 plates, mounting in 15 groups of 2, in whose the inner volume were changed the absorbents, as much in plenum 1 as in the 2. Those absorbent were attached to the perforated plate to measure, so and as they mount in the reality, with the exception of the wool of rock and the mineral wool, that by their characteristics were mounted in the inferior part of the plenum, in other words, leaving an air volume between the plate and the absorbent. The different measurement of each plate with its absorbent in both plenums was made, using for it 6 microphone positions, that were analyzed with the purpose of avoiding measures erroneous due to heterogeneous distributions of the sound in the chamber.

2.1 Measurement according UNE –EN ISO 354

The absorption coefficient is deduced from the measurements of the reverberation time, with and without sample inside this reverberant chamber. In the case of measuring without sample, measurements of this parameter are made inserting in the chamber the frame if the configuration included it, in order not to overestimate the absorption coefficient by edge effects. These measurements have been made in third octave bands, between 100 and 5000 Hertz, and in octave bands, between 125 and 4000 Hertz. The characteristics of the reverberant chamber and the conditions of measurement are the following ones:

- Volume: 238 m^3
- Total inner surface: 236 m^2
- Kind of signal: Pink noise
- Kind of analysis: Third octave bands and octave bands
- Temperature: 21-23º
- Relative humidity: ~ 40%

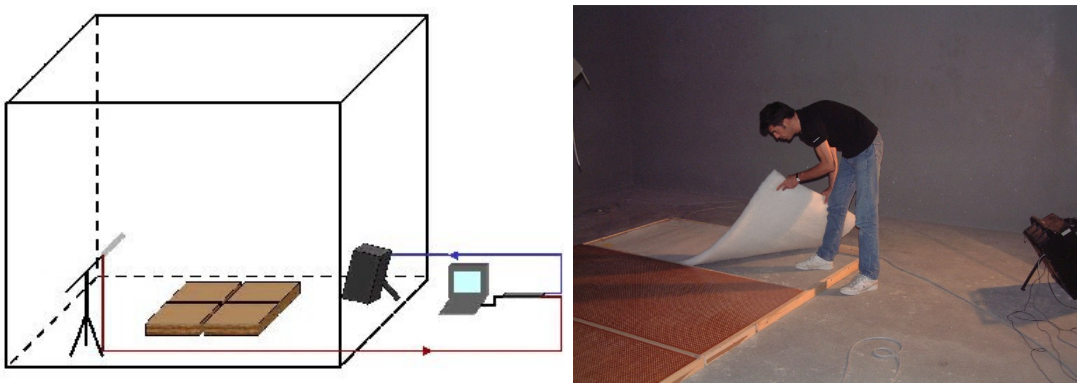


Figure 1. Disposition of the samples in the reverberant chamber: In the left picture schematic representation and in the right one photography of one of the tried configurations.

The equivalent acoustic absorption area, is square meters, is obtain according the norm UNE EN 20354, using the following expression:

$$A = \frac{55{,}3\,V}{c}\left(\frac{1}{T_2} - \frac{1}{T_1}\right) \quad (1.)$$

Where V is the volume of the chamber, T_2 is the reverberation time (in seconds) of the chamber with the simple inside of it, T_1 is the reverberation time (in seconds) of the empty chamber, and c is the speed of sound in air. Once determined the equivalent acoustic absorption area the absorption coefficient is obtain by means of the following equation:

$$\alpha = \frac{A}{S_{sample}} \qquad (2.)$$

Where S_{sample} is the surface occupied by the test sample.

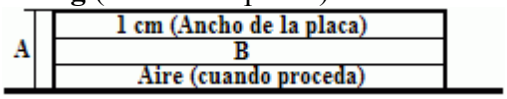
2.2. Noise reduction coefficient NRC (ASTM C-423)

Another well known parameter is the NRC (Noise Reduction Coefficient) that is defined as the average value of the absorption coefficients of the material at the frequencies of 250, 500, 1000 and 2000 Hertz. In addition, this average is expressed rounding in multiple of 0,05.

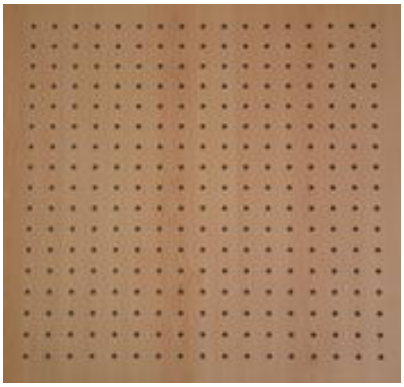
3 - TEST OF DIFERENT KIND OF PERFORATED TILES FOR CEILINGS OR WALL COVERING

3.1. TEST WITH ROCK WOOL

Kind of plate:
T32 Ø 8 mm (perforation 4,13%) (Plate 1)
Number of holes: 289
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 5 cm (Total height of the plenum 1)
B = 0 cm empty
4,0 cm With rock wool
2,5 cm With rock wool (*)



Plot plenum 1:

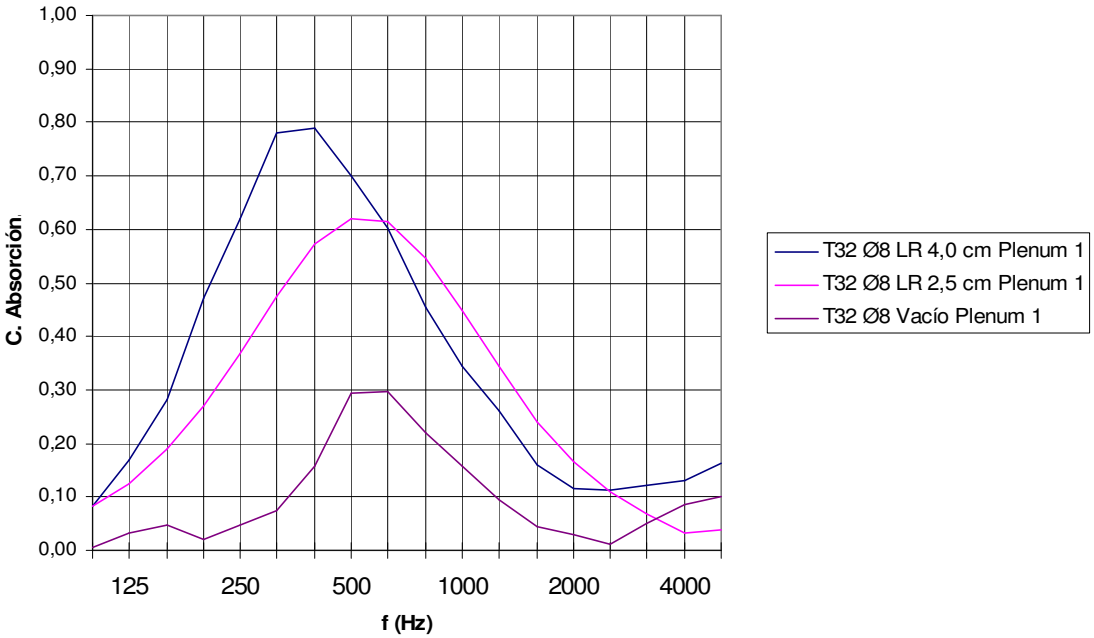


Table absorption plenum 1:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,01	0,03	0,05	0,02	0,05	0,08	0,16	0,30	0,30	0,22	0,16	0,10	0,05	0,03	0,01	0,05	0,09
$\alpha_{rock\ wool}$ 4 cm	0,08	0,17	0,28	0,47	0,62	0,78	0,79	0,70	0,60	0,45	0,35	0,26	0,16	0,12	0,11	0,12	0,13
$\alpha_{rock\ wool}$ 2,5 cm (*)	0,08	0,12	0,19	0,27	0,37	0,48	0,57	0,62	0,61	0,55	0,45	0,34	0,24	0,17	0,11	0,07	0,03

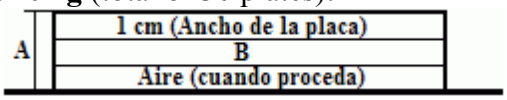
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 1:

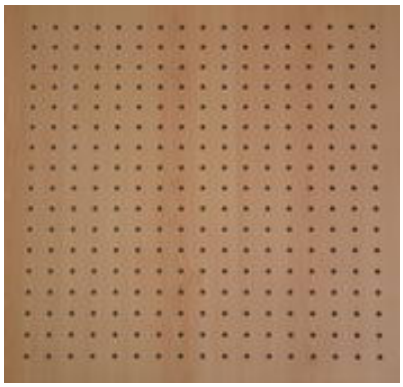
	Empty	Rock wool 4 cm	Rock wool 2,5 cm
NRC	0.15	0.45	0.40
α_m [1]	0.15	0.40	0.40

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
T32 Ø 8 mm (perforation 4,13%) (Plate 1)
Number of holes: 289
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 8 cm (Total height of the plenum 2)
B = 0 cm empty
4,0 cm With rock wool
2,5 cm With rock wool (*)



Plot plenum 2:

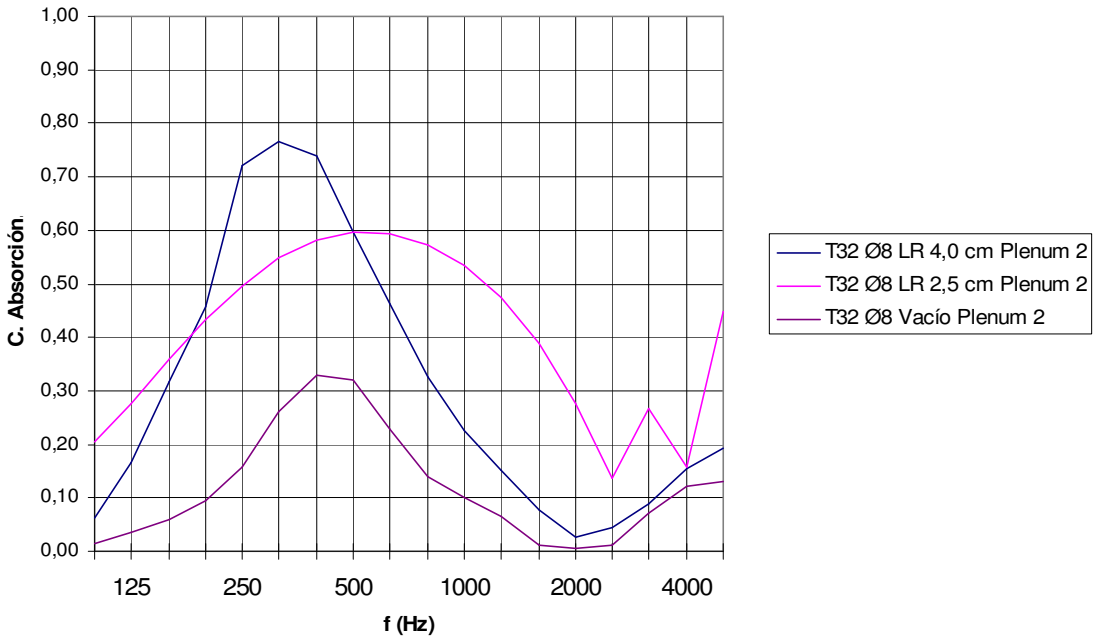


Table absorbing plenum 2:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,02	0,04	0,06	0,09	0,16	0,26	0,33	0,32	0,23	0,14	0,10	0,06	0,01	0,01	0,01	0,07	0,12
$\alpha_{rock\ wool}$ 4 cm	0,06	0,17	0,32	0,46	0,72	0,76	0,74	0,60	0,46	0,33	0,22	0,15	0,08	0,03	0,05	0,09	0,15
$\alpha_{rock\ wool}$ 2,5 cm (*)	0,21	0,28	0,36	0,43	0,50	0,55	0,58	0,60	0,59	0,57	0,53	0,48	0,39	0,28	0,14	0,27	0,16

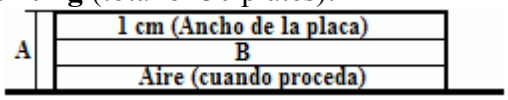
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 2:

	Empty	Rock wool 4 cm	Rock wool 2,5 cm
NRC	0.15	0.40	0.50
α_m [1]	0.15	0.30	0.45

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
2GT32 Ø 8 mm (perforation 1,94%) (Plate 2)
Number of holes: 136
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 5 cm (Total height of the plenum 1)
B = 0 cm empty
4,0 cm With rock wool
2,5 cm With rock wool (*)

Plot plenum 1:

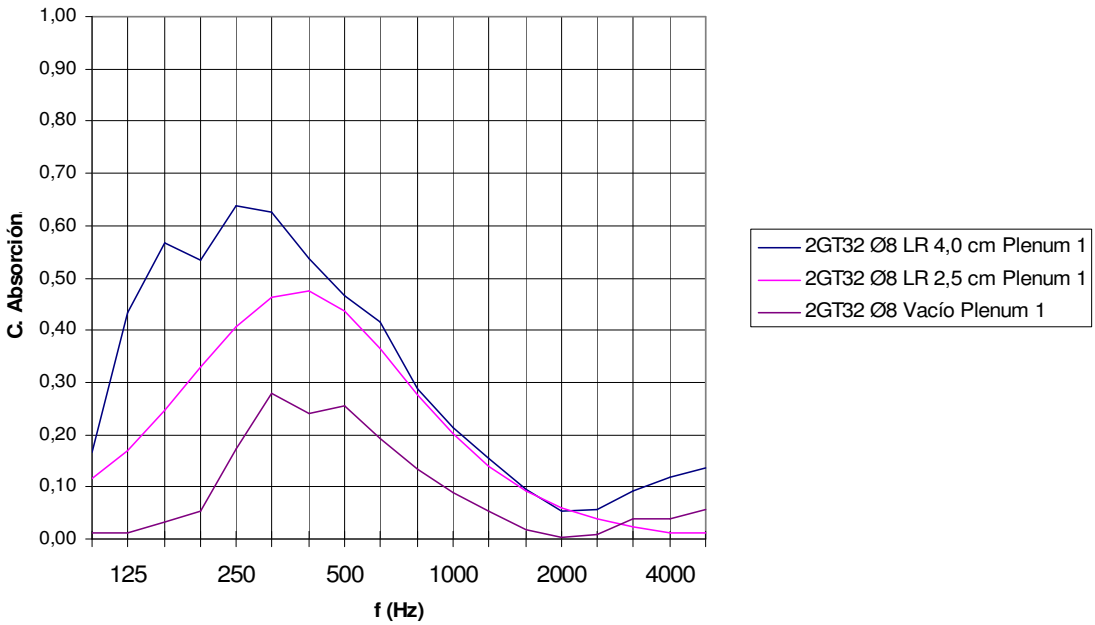


Table absorption plenum 1:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,01	0,01	0,03	0,05	0,17	0,28	0,24	0,25	0,19	0,13	0,09	0,05	0,02	0,00	0,01	0,04	0,04
$\alpha_{rock\ wool}$ 4 cm	0,17	0,43	0,57	0,53	0,64	0,63	0,54	0,47	0,42	0,29	0,21	0,15	0,09	0,05	0,06	0,09	0,12
$\alpha_{rock\ wool}$ 2,5 cm (*)	0,12	0,17	0,25	0,33	0,41	0,46	0,47	0,44	0,36	0,28	0,20	0,14	0,09	0,06	0,04	0,02	0,01

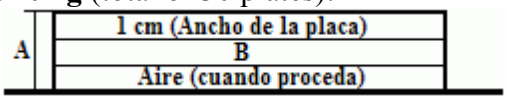
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 1:

	Empty	Rock wool 4 cm	Rock wool 2,5 cm
NRC	0.15	0.35	0.30
α_m [1]	0.10	0.25	0.25

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
2GT32 Ø 8 mm (perforation 1,94%) (Plate 2)
Number of holes: 136
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 8 cm (Total height of the plenum 2)
B = 0 cm empty
4,0 cm With rock wool
2,5 cm With rock wool (*)

Plot plenum 2:

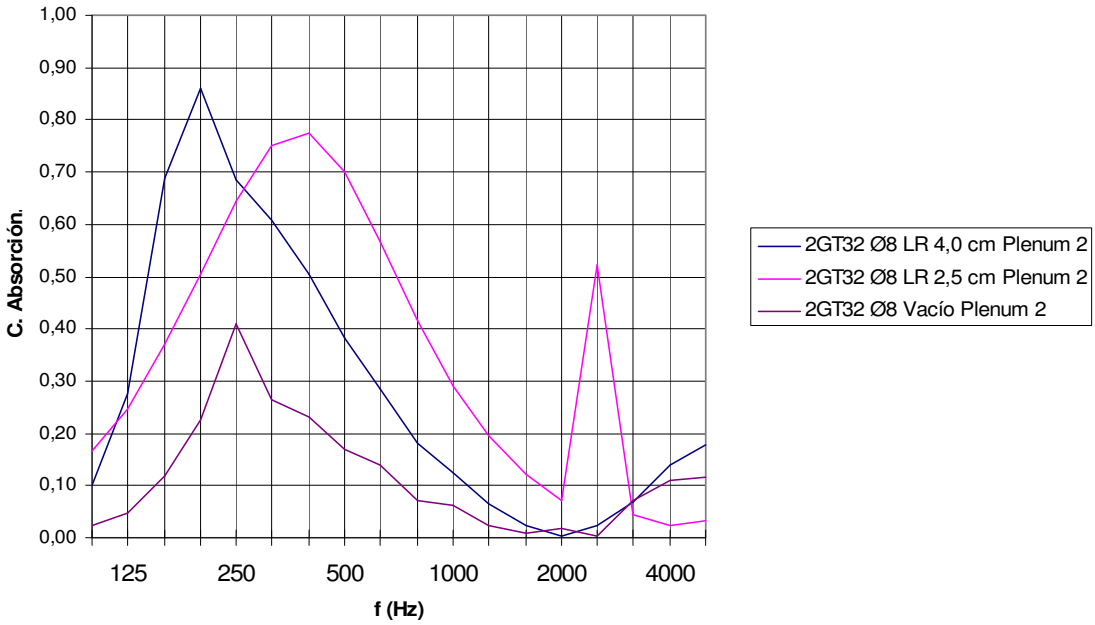


Table absorbing plenum 2:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,02	0,05	0,12	0,23	0,41	0,26	0,23	0,17	0,14	0,07	0,06	0,03	0,01	0,02	0,00	0,07	0,11
$\alpha_{rock\ wool}$ 4 cm	0,10	0,28	0,69	0,86	0,68	0,61	0,51	0,38	0,29	0,18	0,12	0,06	0,02	0,00	0,02	0,07	0,14
$\alpha_{rock\ wool}$ 2,5 cm (*)	0,17	0,25	0,37	0,51	0,64	0,75	0,77	0,70	0,57	0,42	0,29	0,20	0,12	0,07	0,52	0,04	0,02

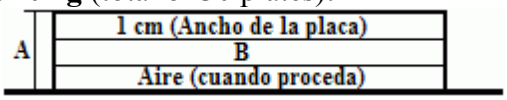
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 2:

	Empty	Rock wool 4 cm	Rock wool 2,5 cm
NRC	0.15	0.30	0.50
α_m [1]	0.10	0.15	0.40

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
T16 Ø 8 mm (perforation 7,79%) (Plate 3)
Number of holes: 545
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 5 cm (Total height of the plenum 1)
B = 0 cm empty
4,0 cm With rock wool
2,5 cm With rock wool (*)

Plot plenum 1:

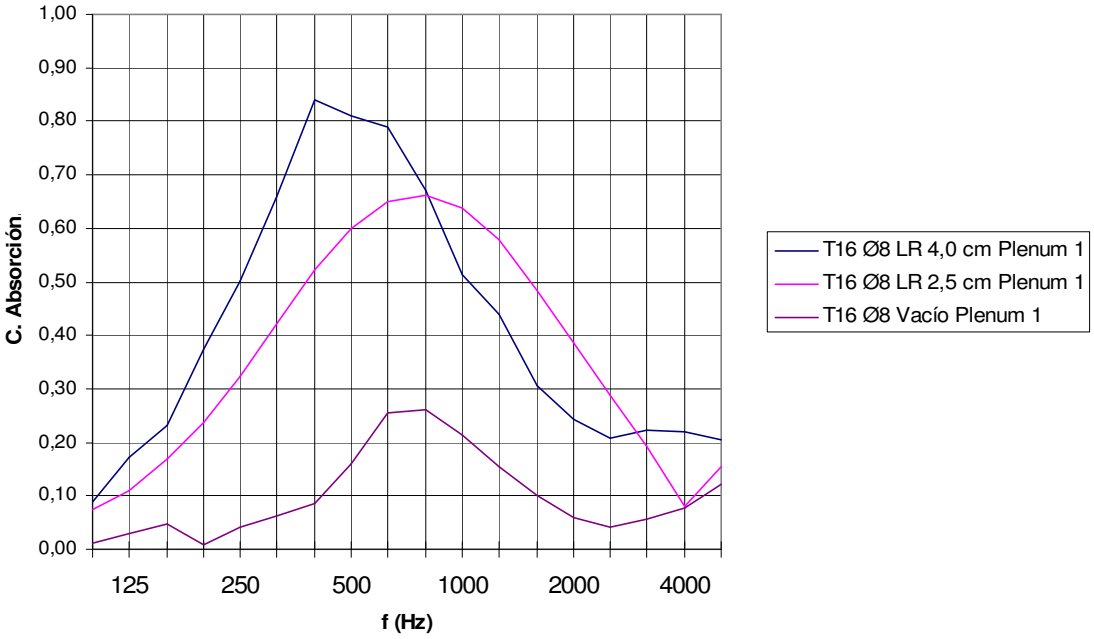


Table absorption plenum 1:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,01	0,03	0,05	0,01	0,04	0,06	0,09	0,16	0,26	0,26	0,21	0,15	0,10	0,06	0,04	0,06	0,08
$\alpha_{rock\ wool}$ 4 cm	0,09	0,17	0,23	0,37	0,50	0,66	0,84	0,81	0,79	0,67	0,51	0,44	0,30	0,24	0,21	0,22	0,22
$\alpha_{rock\ wool}$ 2,5 cm (*)	0,07	0,11	0,17	0,24	0,32	0,42	0,52	0,60	0,65	0,66	0,64	0,58	0,48	0,39	0,29	0,19	0,08

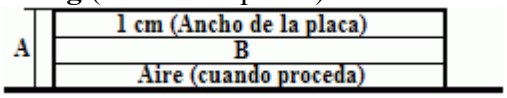
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 1:

	Empty	Rock wool 4 cm	Rock wool 2,5 cm
NRC	0.10	0.55	0.50
α_m [1]	0.15	0.55	0.55

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
T16 Ø 8 mm (perforation 7,79%) (Plate 3)
Number of holes: 545
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 8 cm (Total height of the plenum 2)
B = 0 cm empty
4,0 cm With rock wool
2,5 cm With rock wool (*)

Plot plenum 2:

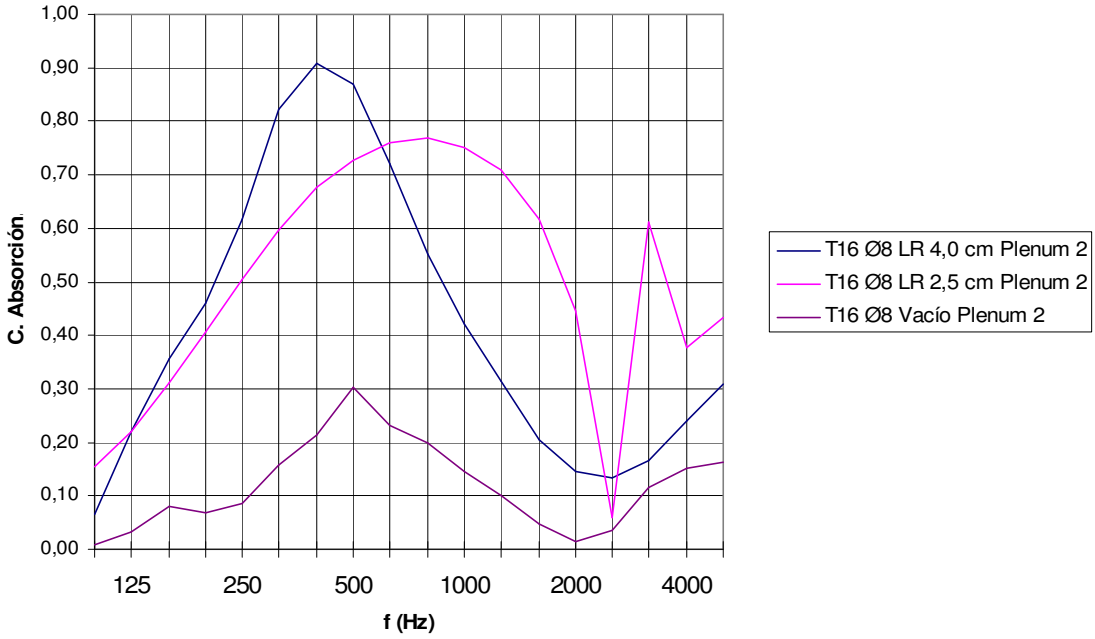


Table absorbing plenum 2:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,01	0,03	0,08	0,07	0,09	0,16	0,21	0,30	0,23	0,20	0,15	0,10	0,05	0,01	0,03	0,12	0,15
$\alpha_{rock\ wool}$ 4 cm	0,07	0,22	0,36	0,46	0,62	0,82	0,91	0,87	0,72	0,55	0,42	0,31	0,21	0,14	0,13	0,17	0,24
$\alpha_{rock\ wool}$ 2,5 cm (*)	0,16	0,22	0,31	0,41	0,50	0,60	0,68	0,73	0,76	0,77	0,75	0,71	0,62	0,45	0,06	0,61	0,38

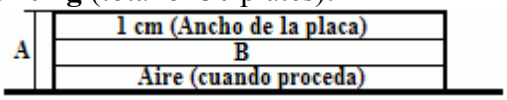
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 2:

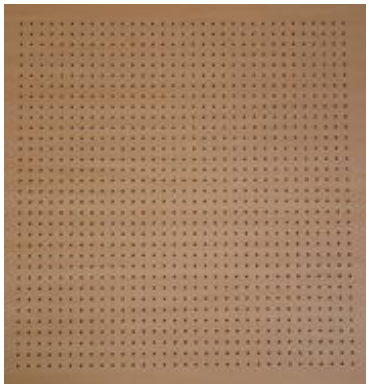
	Empty	Rock wool 4 cm	Rock wool 2,5 cm
NRC	0.15	0.55	0.60
α_m [1]	0.15	0.50	0.60

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
MI Ø 4 mm (perforation 3,89%) (Plate 4)
Number of holes: 1089
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 5 cm (Total height of the plenum 1)
B = 0 cm empty
4,0 cm With rock wool
2,5 cm With rock wool (*)



Plot plenum 1:

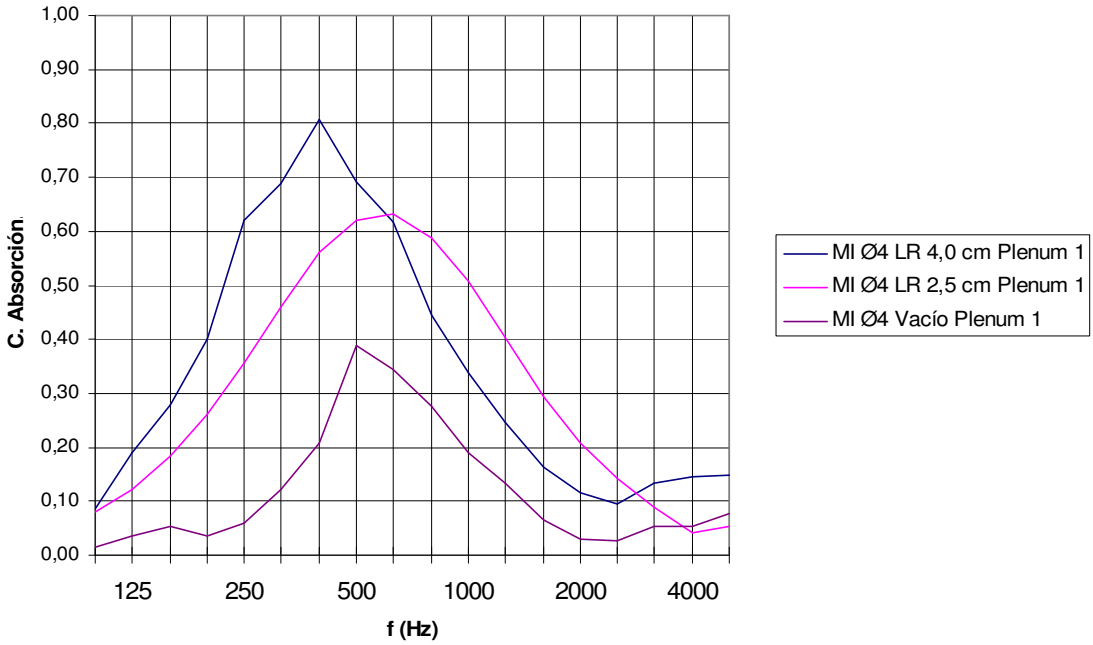


Table absorption plenum 1:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,01	0,03	0,05	0,03	0,06	0,12	0,21	0,39	0,35	0,28	0,19	0,13	0,07	0,03	0,03	0,05	0,05
$\alpha_{rock\ wool}$ 4 cm	0,09	0,19	0,28	0,40	0,62	0,69	0,81	0,69	0,62	0,44	0,34	0,25	0,16	0,12	0,10	0,13	0,14
$\alpha_{rock\ wool}$ 2,5 cm (*)	0,08	0,12	0,18	0,26	0,36	0,46	0,56	0,62	0,63	0,59	0,51	0,41	0,29	0,21	0,14	0,09	0,04

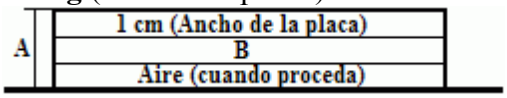
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 1:

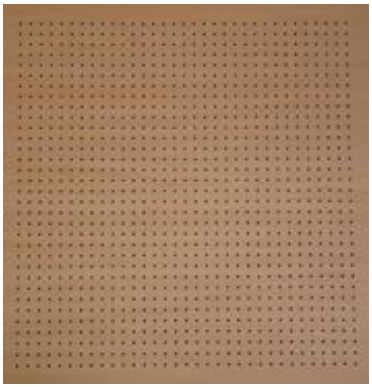
	Empty	Rock wool 4 cm	Rock wool 2,5 cm
NRC	0.15	0.45	0.40
α_m [1]	0.20	0.40	0.45

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
MI Ø 4 mm (perforation 3,89%) (Plate 4)
Number of holes: 1089
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 8 cm (Total height of the plenum 2)
B = 0 cm empty
4,0 cm With rock wool
2,5 cm With rock wool (*)



Plot plenum 2:

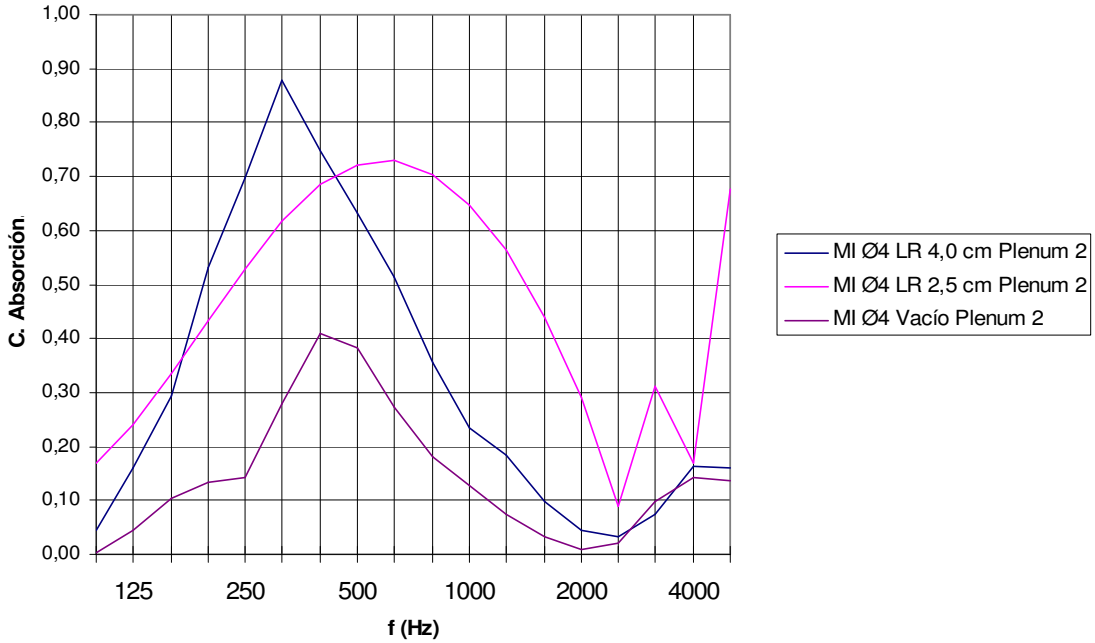


Table absorbing plenum 2:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,00	0,05	0,10	0,13	0,14	0,28	0,41	0,38	0,27	0,18	0,13	0,08	0,03	0,01	0,02	0,10	0,14
$\alpha_{rock\ wool}$ 4 cm	0,04	0,16	0,29	0,53	0,70	0,88	0,75	0,63	0,51	0,36	0,24	0,18	0,10	0,04	0,03	0,08	0,16
$\alpha_{rock\ wool}$ 2,5 cm (*)	0,17	0,24	0,34	0,43	0,53	0,62	0,69	0,72	0,73	0,70	0,65	0,56	0,44	0,29	0,09	0,31	0,17

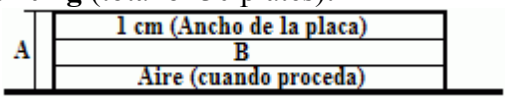
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 2:

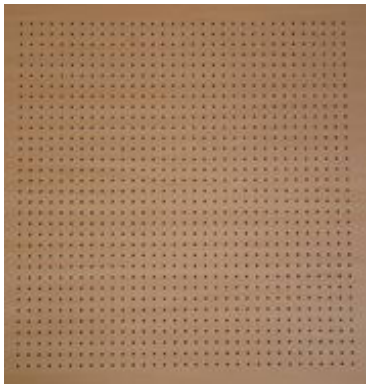
	Empty	Rock wool 4 cm	Rock wool 2,5 cm
NRC	0.20	0.40	0.55
α_m [1]	0.15	0.30	0.55

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
MI Ø 6 mm (perforation 8,76%) (Plate 5)
Number of holes: 1089
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 5 cm (Total height of the plenum 1)
B = 0 cm empty
4,0 cm With rock wool
2,5 cm With rock wool (*)



Plot plenum 1:

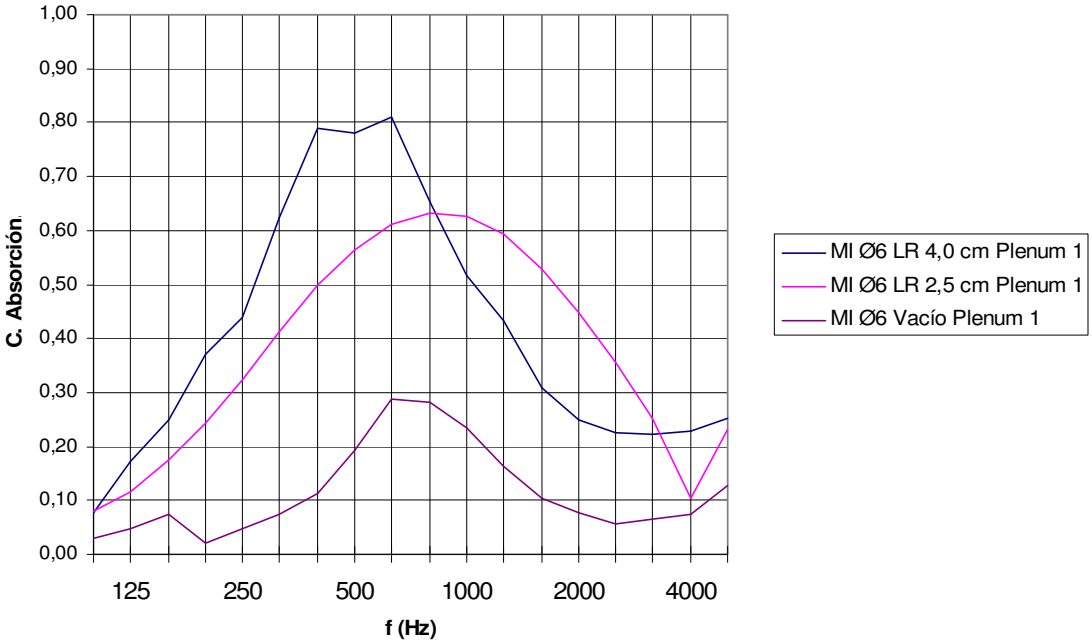


Table absorption plenum 1:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,03	0,05	0,07	0,02	0,05	0,07	0,11	0,19	0,29	0,28	0,23	0,16	0,10	0,08	0,06	0,06	0,08
$\alpha_{rock\ wool}$ 4 cm	0,08	0,17	0,25	0,37	0,44	0,62	0,79	0,78	0,81	0,65	0,52	0,43	0,31	0,25	0,22	0,22	0,23
$\alpha_{rock\ wool}$ 2,5 cm (*)	0,08	0,12	0,17	0,24	0,32	0,41	0,50	0,57	0,61	0,63	0,63	0,59	0,53	0,45	0,36	0,25	0,10

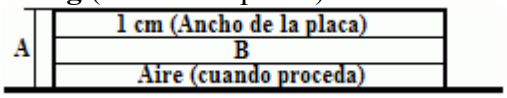
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 1:

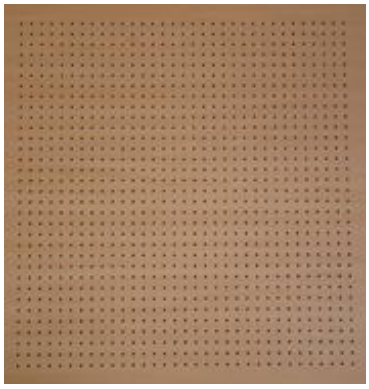
	Empty	Rock wool 4 cm	Rock wool 2,5 cm
NRC	0.15	0.45	0.40
α_m [1]	0.20	0.40	0.45

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
MI Ø 6 mm (perforation 8,76%) (Plate 5)
Number of holes: 1089
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 8 cm (Total height of the plenum 2)
B = 0 cm empty
4,0 cm With rock wool
2,5 cm With rock wool (*)



Plot plenum 2:

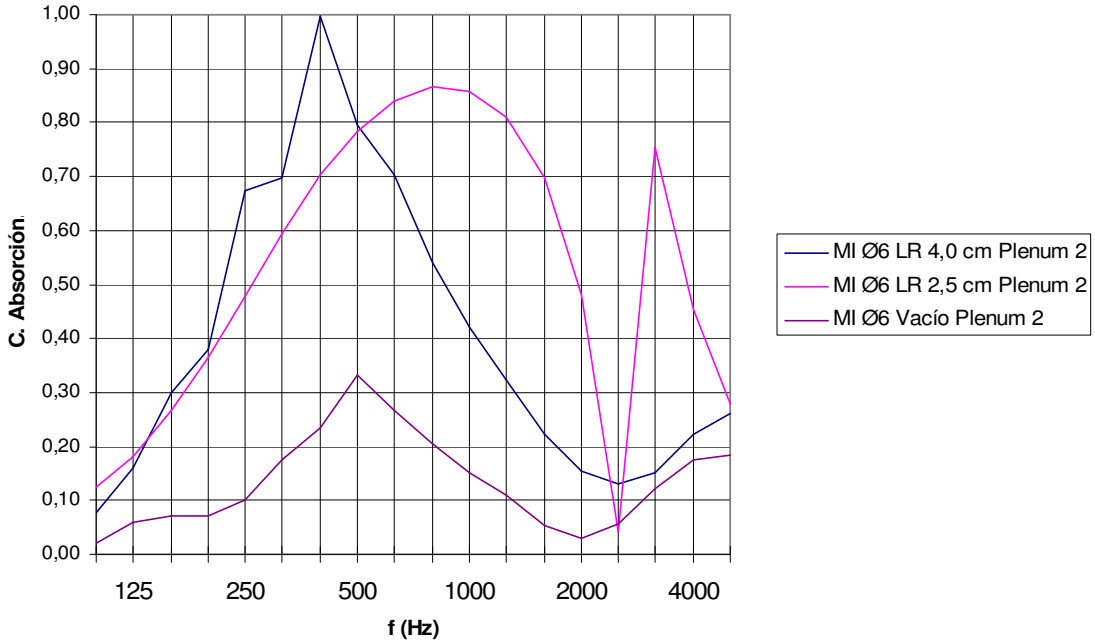


Table absorbing plenum 2:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,02	0,06	0,07	0,07	0,10	0,17	0,24	0,33	0,27	0,20	0,15	0,11	0,05	0,03	0,06	0,12	0,17
$\alpha_{rock\ wool}$ 4 cm	0,08	0,16	0,30	0,38	0,67	0,70	1,00	0,79	0,70	0,54	0,42	0,32	0,22	0,15	0,13	0,15	0,22
$\alpha_{rock\ wool}$ 2,5 cm (*)	0,12	0,18	0,27	0,37	0,48	0,59	0,70	0,78	0,84	0,87	0,86	0,81	0,70	0,48	0,04	0,75	0,45

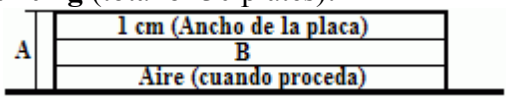
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 2:

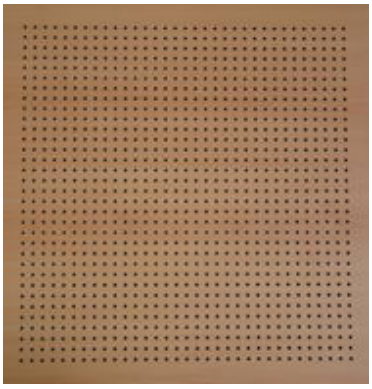
	Empty	Rock wool 4 cm	Rock wool 2,5 cm
NRC	0.15	0.50	0.65
α_m [1]	0.15	0.50	0.70

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
MI Ø 8 mm (perforation 15,57%) (Plate 6)
Number of holes: 1089
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 5 cm (Total height of the plenum 1)
B = 0 cm empty
4,0 cm With rock wool
2,5 cm With rock wool (*)



Plot plenum 1:

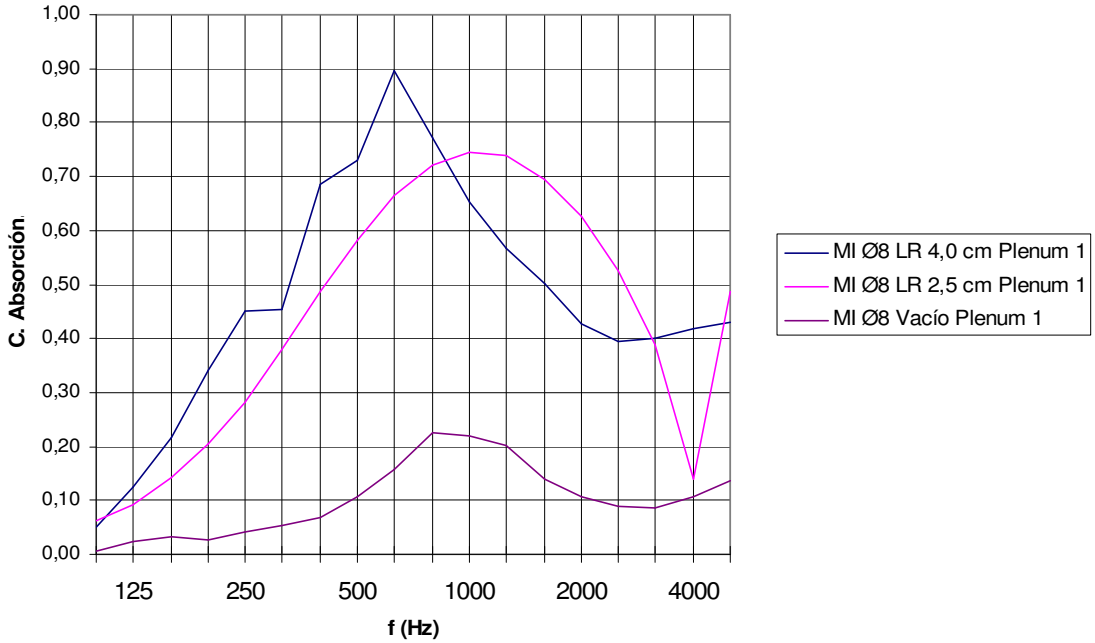


Table absorption plenum 1:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,00	0,02	0,03	0,03	0,04	0,05	0,07	0,11	0,16	0,23	0,22	0,20	0,14	0,11	0,09	0,08	0,11
$\alpha_{rock\ wool}$ 4 cm	0,05	0,12	0,22	0,34	0,45	0,45	0,69	0,73	0,90	0,77	0,65	0,57	0,50	0,43	0,39	0,40	0,42
$\alpha_{rock\ wool}$ 2,5 cm (*)	0,06	0,09	0,14	0,20	0,28	0,38	0,49	0,58	0,66	0,72	0,74	0,74	0,70	0,63	0,53	0,39	0,14

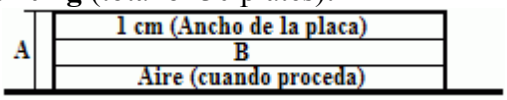
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 1:

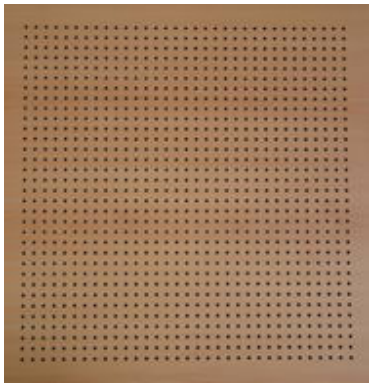
	Empty	Rock wool 4 cm	Rock wool 2,5 cm
NRC	0.10	0.55	0.55
α_m [1]	0.15	0.60	0.65

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
MI Ø 8 mm (perforation 15,57%) (Plate 6)
Number of holes: 1089
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 8 cm (Total height of the plenum 2)
B = 0 cm empty
4,0 cm With rock wool
2,5 cm With rock wool (*)



Plot plenum 2:

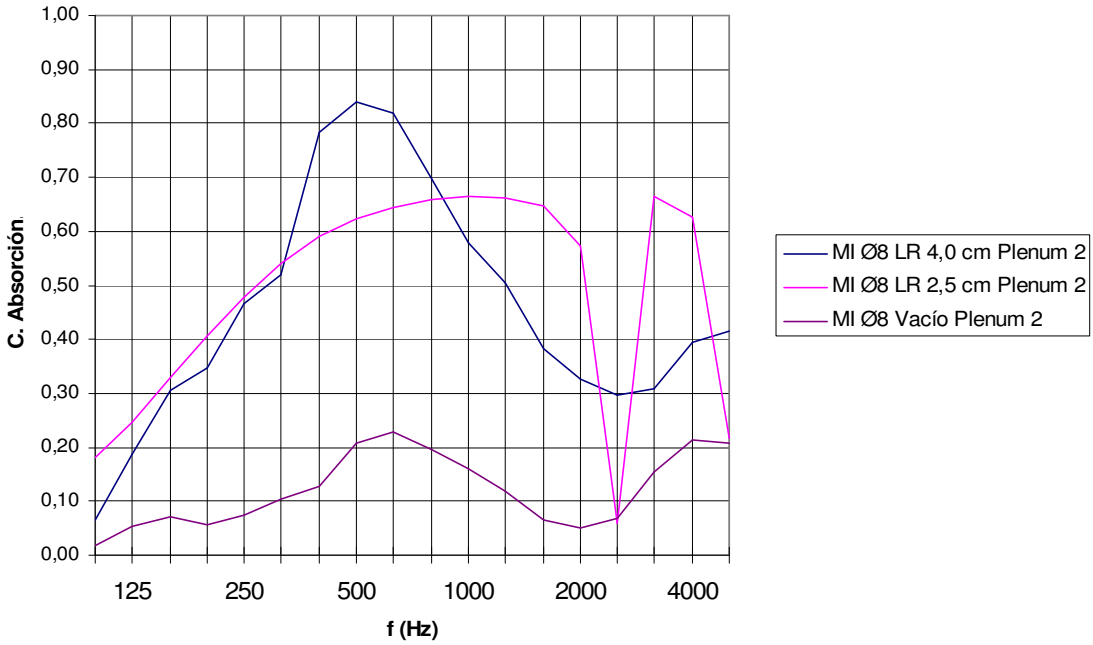


Table absorbing plenum 2:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,02	0,05	0,07	0,06	0,08	0,10	0,13	0,21	0,23	0,20	0,16	0,12	0,06	0,05	0,07	0,15	0,21
$\alpha_{rock\ wool}$ 4 cm	0,06	0,19	0,30	0,35	0,47	0,52	0,78	0,84	0,82	0,70	0,58	0,50	0,38	0,33	0,30	0,31	0,39
$\alpha_{rock\ wool}$ 2,5 cm (*)	0,18	0,25	0,33	0,41	0,48	0,54	0,59	0,62	0,65	0,66	0,66	0,66	0,65	0,57	0,06	0,66	0,63

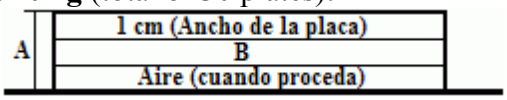
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 2:

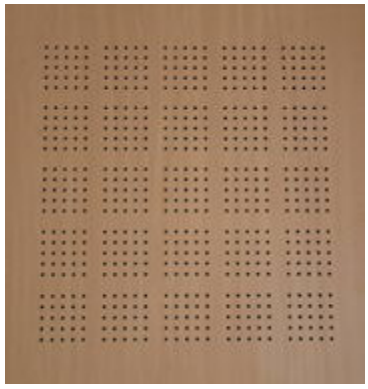
	Empty	Rock wool 4 cm	Rock wool 2,5 cm
NRC	0.15	0.55	0.55
α_m [1]	0.15	0.60	0.55

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
G5x5T16 Ø 6 mm (perf. 5,03%) (Plate 7)
Number of holes: 625
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 5 cm (Total height of the plenum 1)
B = 0 cm empty
4,0 cm With rock wool
2,5 cm With rock wool (*)



Plot plenum 1:

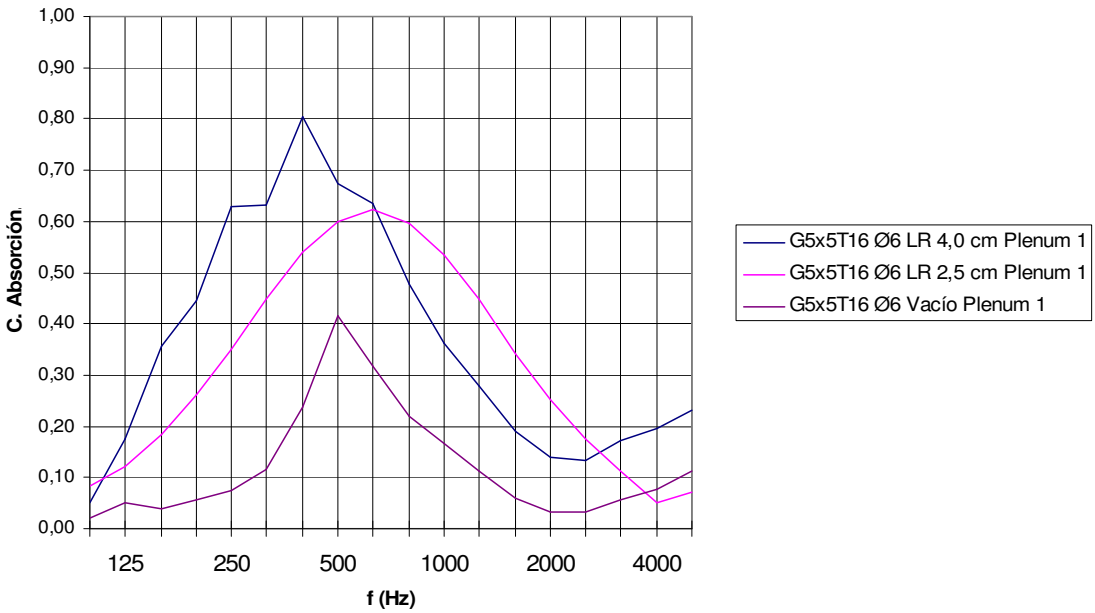


Table absorption plenum 1:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,02	0,05	0,04	0,06	0,07	0,12	0,24	0,42	0,32	0,22	0,17	0,11	0,06	0,03	0,03	0,06	0,08
$\alpha_{rock\ wool}$ 4 cm	0,05	0,17	0,35	0,44	0,63	0,63	0,80	0,67	0,63	0,48	0,36	0,28	0,19	0,14	0,13	0,17	0,20
$\alpha_{rock\ wool}$ 2,5 cm (*)	0,08	0,12	0,19	0,26	0,35	0,45	0,54	0,60	0,62	0,60	0,53	0,45	0,34	0,25	0,18	0,11	0,05

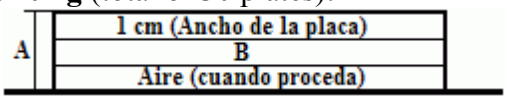
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 1:

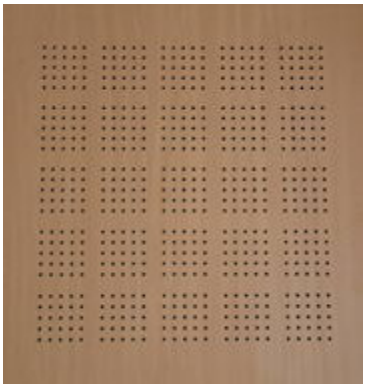
	Empty	Rock wool 4 cm	Rock wool 2,5 cm
NRC	0.15	0.45	0.45
α_m [1]	0.15	0.40	0.45

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
G5x5T16 Ø 6 mm (perf. 5,03%) (Plate 7)
Number of holes: 625
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 8 cm (Total height of the plenum 2)
B = 0 cm empty
4,0 cm With rock wool
2,5 cm With rock wool (*)



Plot plenum 2:

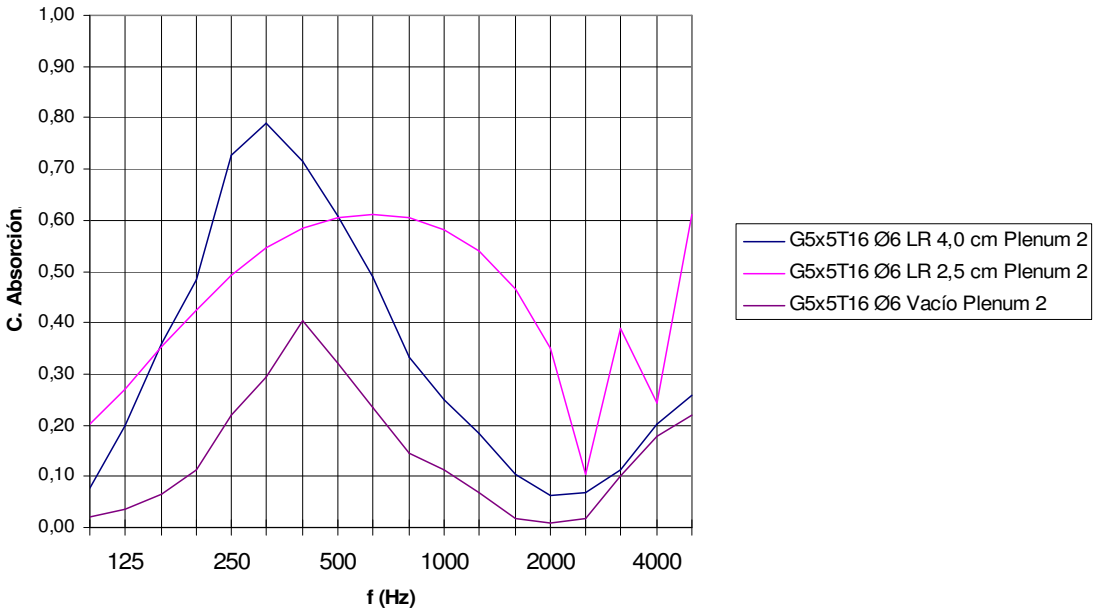


Table absorbing plenum 2:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,02	0,04	0,06	0,11	0,22	0,30	0,40	0,32	0,23	0,14	0,11	0,07	0,02	0,01	0,02	0,10	0,18
$\alpha_{rock\ wool}$ 4 cm	0,08	0,20	0,36	0,48	0,73	0,79	0,71	0,61	0,49	0,33	0,25	0,18	0,10	0,06	0,07	0,11	0,20
$\alpha_{rock\ wool}$ 2,5 cm (*)	0,20	0,27	0,35	0,43	0,49	0,55	0,58	0,60	0,61	0,60	0,58	0,54	0,47	0,35	0,10	0,39	0,24

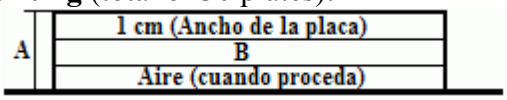
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 2:

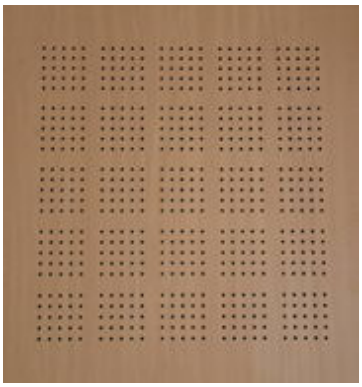
	Empty	Rock wool 4 cm	Rock wool 2,5 cm
NRC	0.15	0.40	0.50
α_m [1]	0.15	0.30	0.50

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
G5x5T16 Ø 8 mm (perf. 8,93%) (Plate 8)
Number of holes: 625
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 5 cm (Total height of the plenum 1)
B = 0 cm empty
4,0 cm With rock wool
2,5 cm With rock wool (*)



Plot plenum 1:

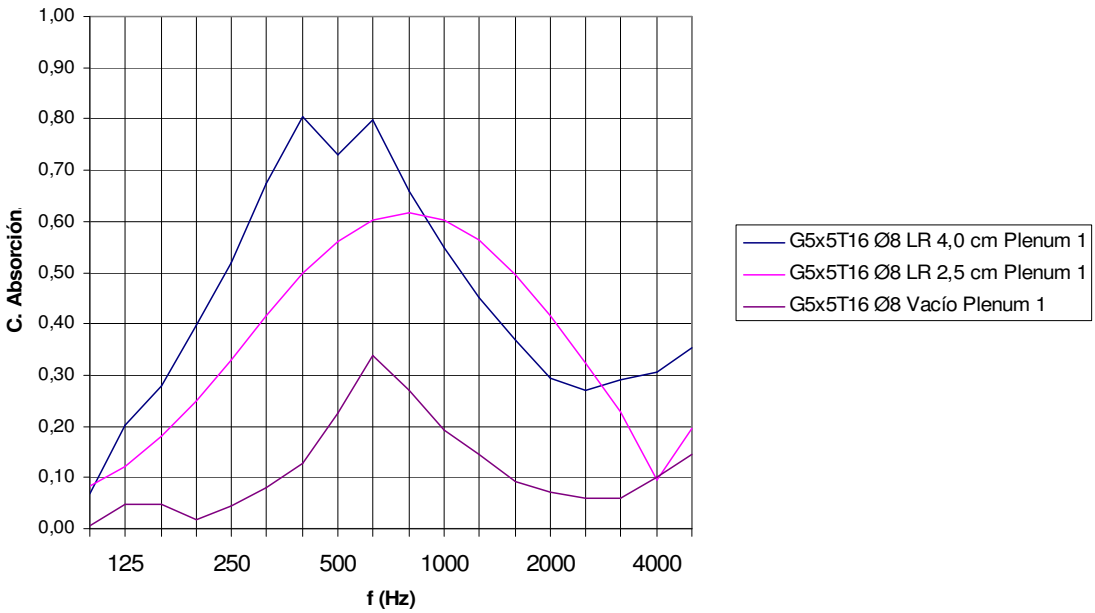


Table absorption plenum 1:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,01	0,05	0,05	0,02	0,05	0,08	0,13	0,23	0,34	0,27	0,19	0,15	0,09	0,07	0,06	0,06	0,10
$\alpha_{rock\ wool}$ 4 cm	0,07	0,20	0,28	0,40	0,52	0,67	0,80	0,73	0,80	0,66	0,55	0,45	0,37	0,29	0,27	0,29	0,30
$\alpha_{rock\ wool}$ 2,5 cm (*)	0,08	0,12	0,18	0,25	0,33	0,42	0,50	0,56	0,60	0,62	0,60	0,56	0,50	0,41	0,32	0,23	0,10

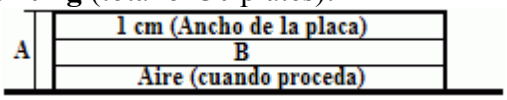
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 1:

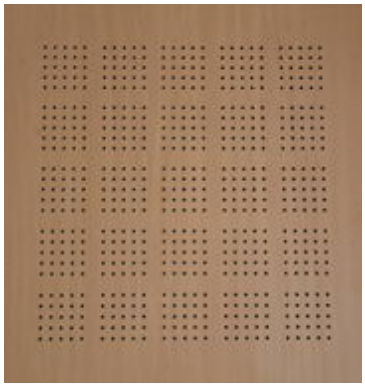
	Empty	Rock wool 4 cm	Rock wool 2,5 cm
NRC	0.15	0.55	0.50
α_m [1]	0.15	0.55	0.50

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
G5x5T16 Ø 8 mm (perf. 8,93%) (Plate 8)
Number of holes: 625
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 8 cm (Total height of the plenum 2)
B = 0 cm empty
4,0 cm With rock wool
2,5 cm With rock wool (*)



Plot plenum 2:

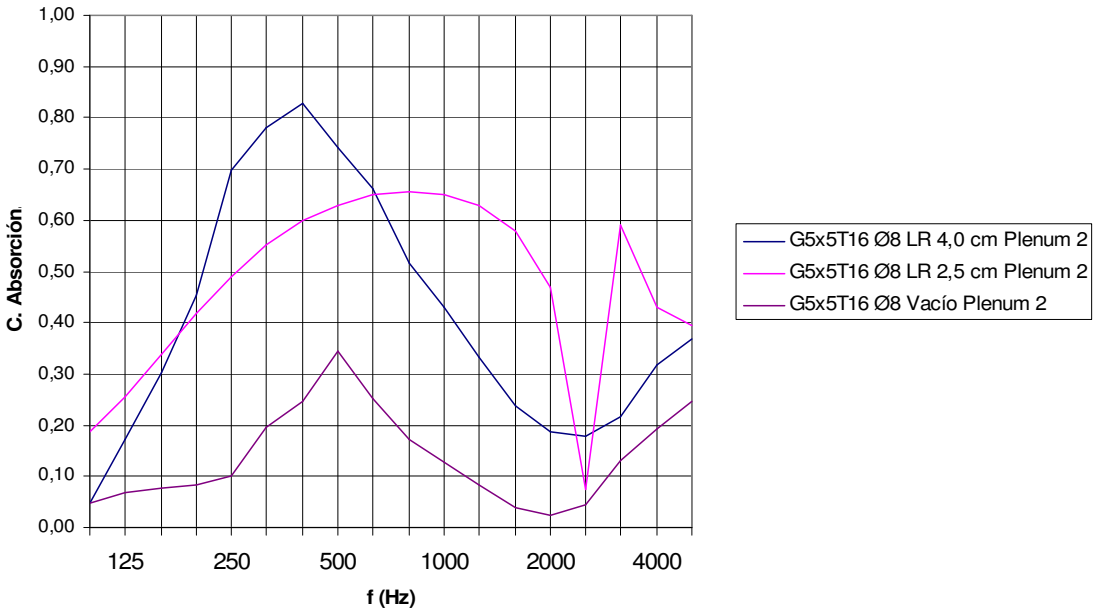


Table absorbing plenum 2:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,05	0,07	0,08	0,08	0,10	0,20	0,25	0,34	0,25	0,17	0,13	0,08	0,04	0,02	0,04	0,13	0,19
$\alpha_{rock\ wool}$ 4 cm	0,05	0,17	0,30	0,45	0,70	0,78	0,83	0,74	0,66	0,52	0,43	0,33	0,24	0,19	0,18	0,22	0,32
$\alpha_{rock\ wool}$ 2,5 cm (*)	0,19	0,25	0,34	0,42	0,49	0,55	0,60	0,63	0,65	0,65	0,65	0,63	0,58	0,47	0,07	0,59	0,43

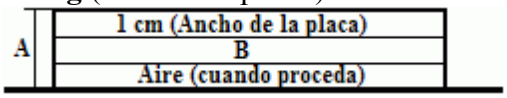
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 2:

	Empty	Rock wool 4 cm	Rock wool 2,5 cm
NRC	0.15	0.50	0.55
α_m [1]	0.15	0.45	0.55

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
R32 Slots 6 mm (perf. 10,39%) (Plate 9)
Number of Slots: 102
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 5 cm (Total height of the plenum 1)
B = 0 cm empty
4,0 cm With rock wool
2,5 cm With rock wool (*)

Plot plenum 1:

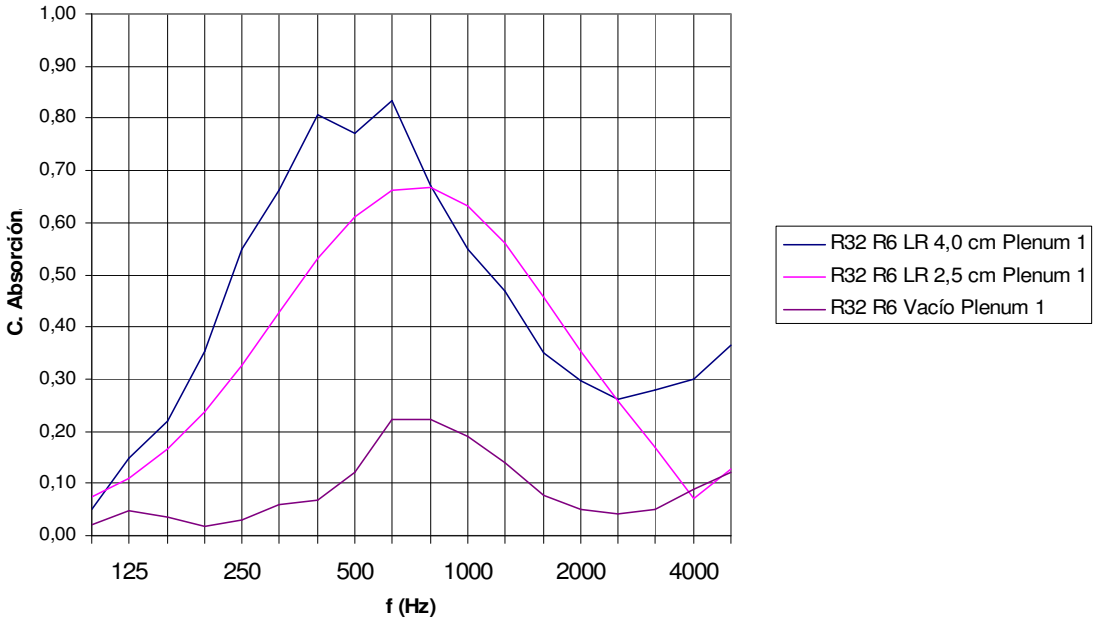


Table absorption plenum 1:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,02	0,05	0,04	0,02	0,03	0,06	0,07	0,12	0,22	0,22	0,19	0,14	0,08	0,05	0,04	0,05	0,09
$\alpha_{rock\ wool}$ 4 cm	0,05	0,15	0,22	0,35	0,55	0,66	0,81	0,77	0,83	0,67	0,55	0,47	0,35	0,30	0,26	0,28	0,30
$\alpha_{rock\ wool}$ 2,5 cm (*)	0,07	0,11	0,17	0,24	0,33	0,43	0,53	0,61	0,66	0,67	0,63	0,56	0,46	0,35	0,26	0,17	0,07

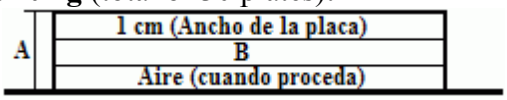
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 1:

	Empty	Rock wool 4 cm	Rock wool 2,5 cm
NRC	0.10	0.55	0.50
α_m [1]	0.15	0.55	0.50

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
R32 Slots 6 mm (perf. 10,39%) (Plate 9)
Number of Slots: 102
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 8 cm (Total height of the plenum 2)
B = 0 cm empty
4,0 cm With rock wool
2,5 cm With rock wool (*)

Plot plenum 2:

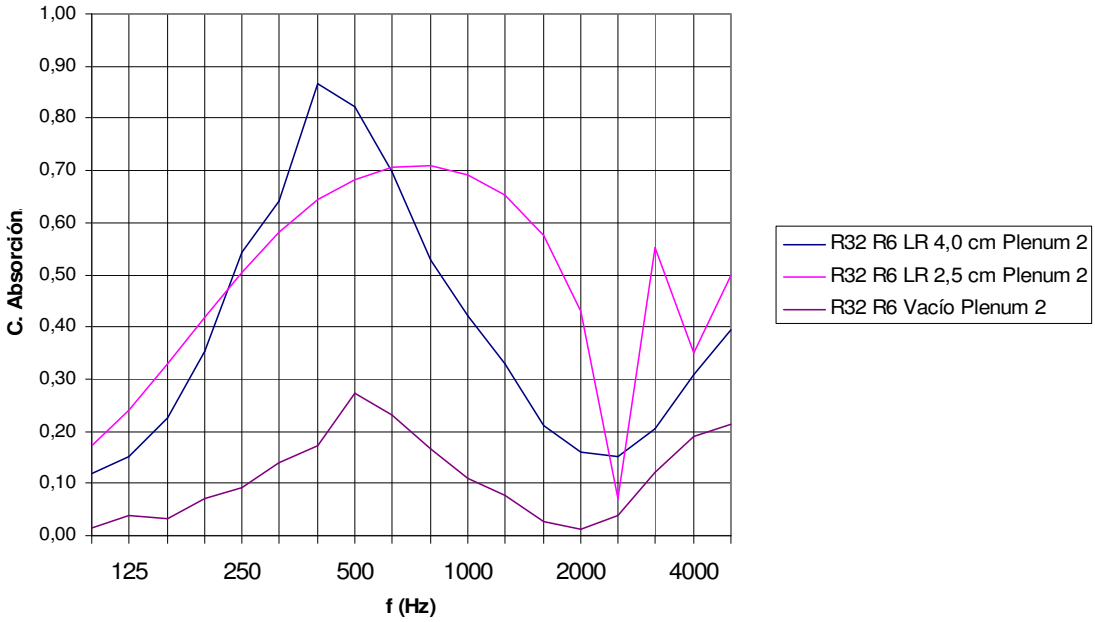


Table absorbing plenum 2:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,02	0,04	0,03	0,07	0,09	0,14	0,17	0,27	0,23	0,17	0,11	0,08	0,03	0,01	0,04	0,12	0,19
$\alpha_{rock\ wool}$ 4 cm	0,12	0,15	0,23	0,35	0,54	0,64	0,87	0,82	0,70	0,53	0,42	0,33	0,21	0,16	0,15	0,20	0,31
$\alpha_{rock\ wool}$ 2,5 cm (*)	0,17	0,24	0,33	0,42	0,50	0,58	0,64	0,68	0,70	0,71	0,69	0,65	0,57	0,43	0,07	0,55	0,35

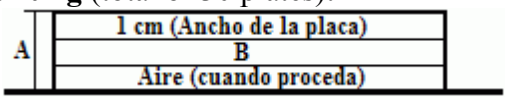
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 2:

	Empty	Rock wool 4 cm	Rock wool 2,5 cm
NRC	0.15	0.50	0.55
α_m [1]	0.15	0.45	0.60

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
R32 Slots 10 mm (per. 14,22%) (Plate 10)
Number of Slots: 102
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 5 cm (Total height of the plenum 1)
B = 0 cm empty
4,0 cm With rock wool
2,5 cm With rock wool (*)

Plot plenum 1:

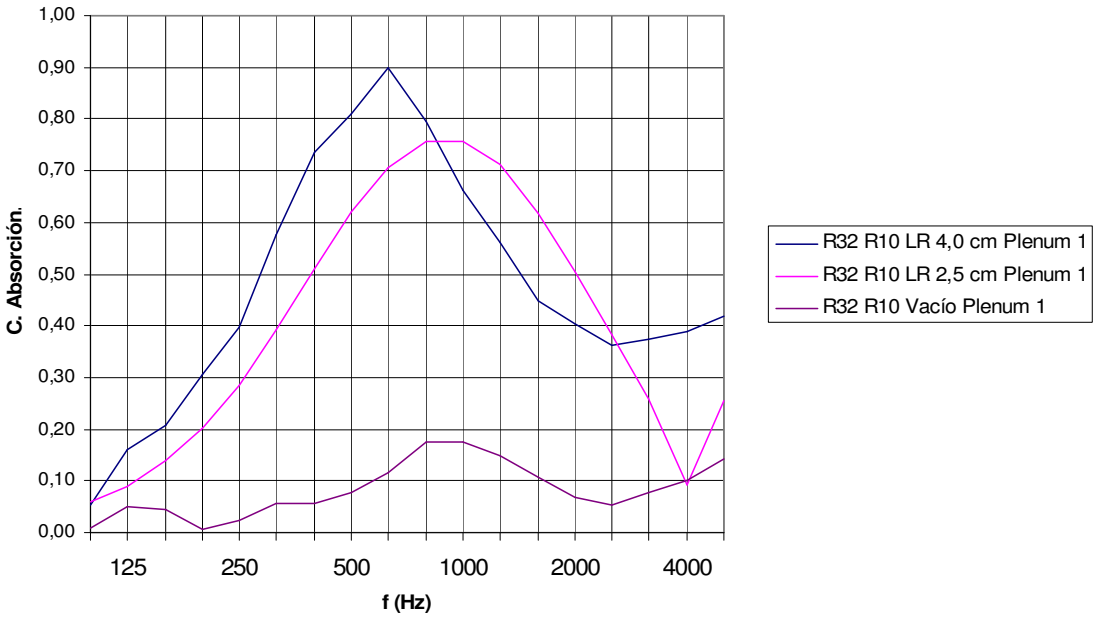


Table absorption plenum 1:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,01	0,05	0,05	0,00	0,02	0,06	0,06	0,08	0,11	0,17	0,17	0,15	0,11	0,07	0,05	0,08	0,10
$\alpha_{rock\ wool}$ 4 cm	0,05	0,16	0,21	0,30	0,40	0,57	0,74	0,81	0,90	0,80	0,66	0,56	0,45	0,40	0,36	0,37	0,39
$\alpha_{rock\ wool}$ 2,5 cm (*)	0,06	0,09	0,14	0,20	0,29	0,39	0,51	0,62	0,71	0,76	0,76	0,71	0,62	0,50	0,38	0,26	0,09

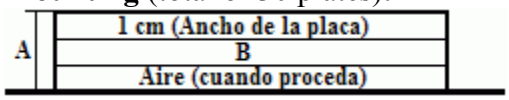
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 1:

	Empty	Rock wool 4 cm	Rock wool 2,5 cm
NRC	0.10	0.60	0.55
α_m [1]	0.10	0.60	0.60

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
R32 Slots 10 mm (perf. 14,22%) (Plate 10)
Number of Slots: 102
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 8 cm (Total height of the plenum 2)
B = 0 cm empty
4,0 cm With rock wool
2,5 cm With rock wool (*)

Plot plenum 2:

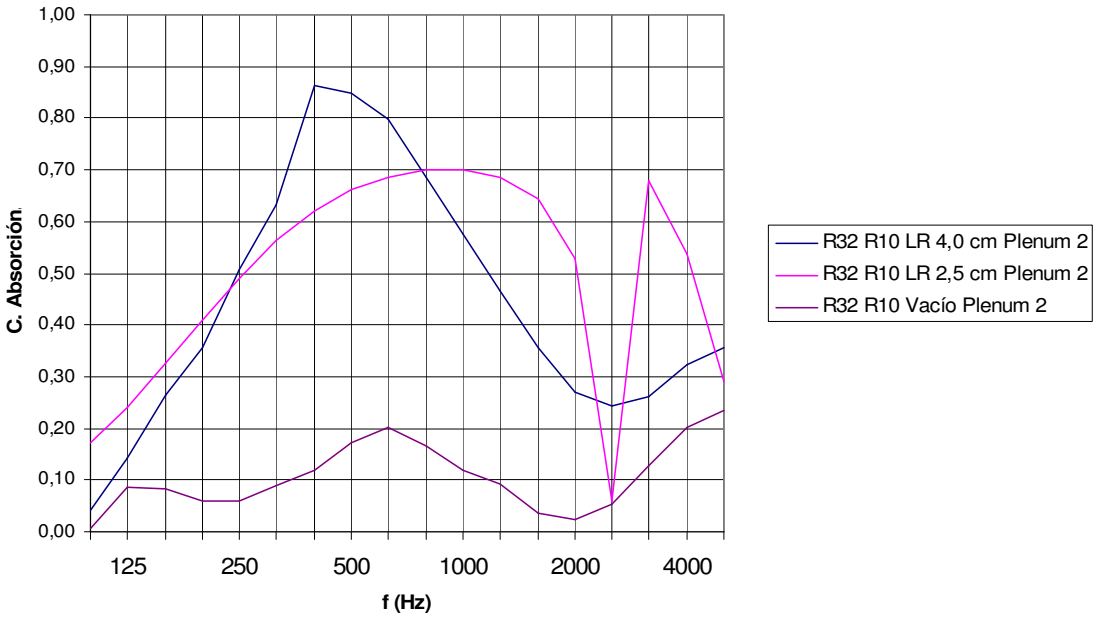


Table absorbing plenum 2:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,01	0,09	0,08	0,06	0,06	0,09	0,12	0,17	0,20	0,17	0,12	0,09	0,04	0,02	0,05	0,13	0,20
$\alpha_{rock\ wool}$ 4 cm	0,04	0,14	0,26	0,36	0,51	0,63	0,86	0,85	0,80	0,69	0,58	0,47	0,36	0,27	0,24	0,26	0,32
$\alpha_{rock\ wool}$ 2,5 cm (*)	0,17	0,24	0,33	0,41	0,49	0,56	0,62	0,66	0,69	0,70	0,70	0,69	0,64	0,53	0,06	0,68	0,54

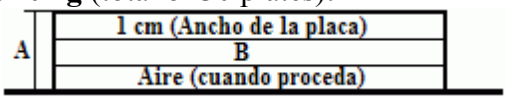
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 2:

	Empty	Rock wool 4 cm	Rock wool 2,5 cm
NRC	0.10	0.55	0.55
α_m [1]	0.10	0.60	0.60

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
R16 Slots 6 mm (perf. 20,17%) (Plate 11)
Number of Slots: 198
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 5 cm (Total height of the plenum 1)
B = 0 cm empty
4,0 cm With rock wool
2,5 cm With rock wool (*)

Plot plenum 1:

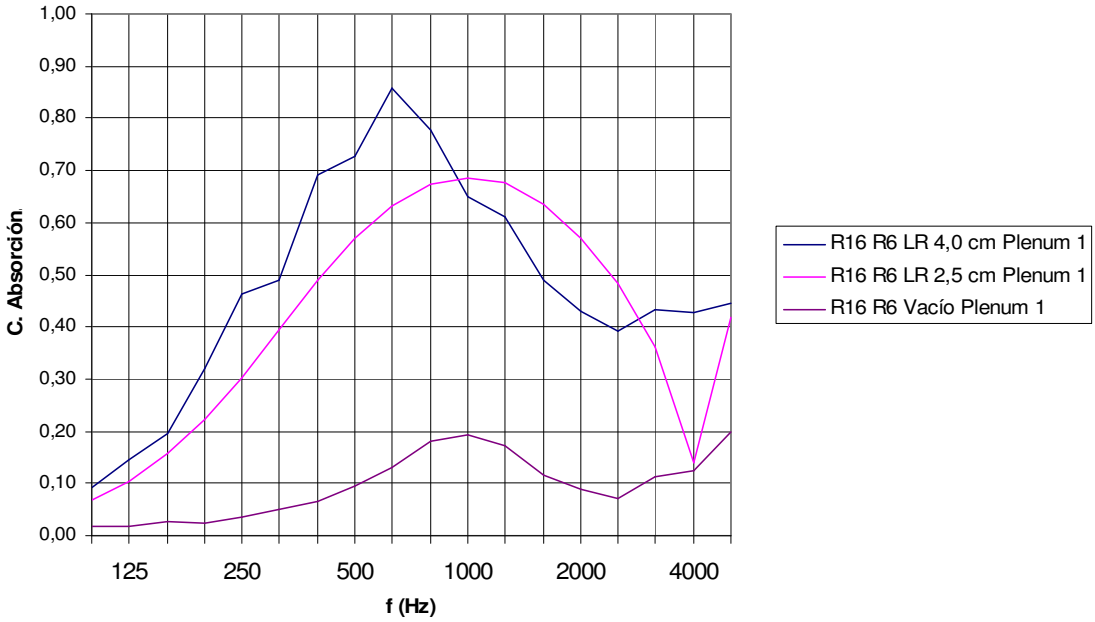


Table absorption plenum 1:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,02	0,02	0,03	0,02	0,04	0,05	0,06	0,09	0,13	0,18	0,19	0,17	0,12	0,09	0,07	0,11	0,12
$\alpha_{rock\ wool}$ 4 cm	0,09	0,14	0,19	0,32	0,46	0,49	0,69	0,73	0,86	0,78	0,65	0,61	0,49	0,43	0,39	0,43	0,43
$\alpha_{rock\ wool}$ 2,5 cm (*)	0,07	0,10	0,16	0,22	0,30	0,39	0,49	0,57	0,63	0,67	0,69	0,68	0,63	0,57	0,48	0,36	0,14

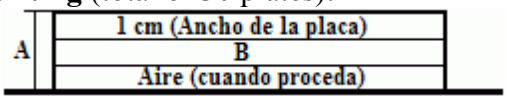
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 1:

	Empty	Rock wool 4 cm	Rock wool 2,5 cm
NRC	0.10	0.60	0.55
α_m [1]	0.15	0.65	0.60

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
R16 Slots 6 mm (perf. 20,17%) (Plate 11)
Number of Slots: 198
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 8 cm (Total height of the plenum 2)
B = 0 cm empty
4,0 cm With rock wool
2,5 cm With rock wool (*)

Plot plenum 2:

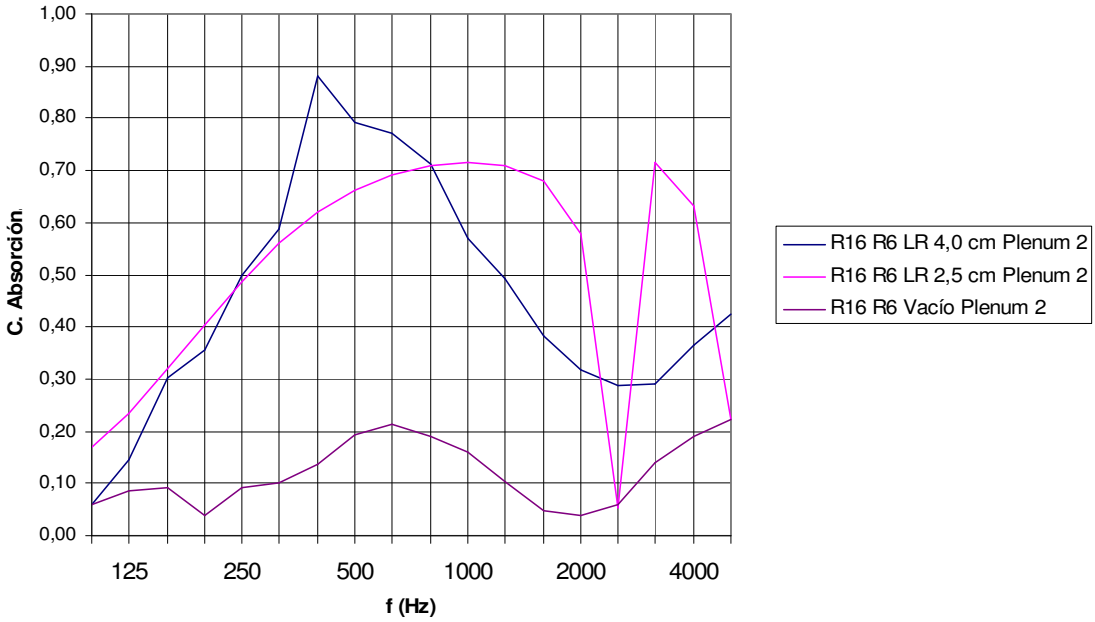


Table absorbing plenum 2:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,06	0,09	0,09	0,04	0,09	0,10	0,14	0,19	0,21	0,19	0,16	0,10	0,05	0,04	0,06	0,14	0,19
$\alpha_{rock\ wool}$ 4 cm	0,06	0,15	0,30	0,36	0,50	0,59	0,88	0,79	0,77	0,71	0,57	0,49	0,38	0,32	0,29	0,29	0,37
$\alpha_{rock\ wool}$ 2,5 cm (*)	0,17	0,23	0,32	0,40	0,49	0,56	0,62	0,66	0,69	0,71	0,72	0,71	0,68	0,58	0,05	0,71	0,63

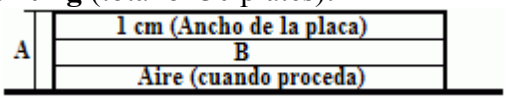
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 2:

	Empty	Rock wool 4 cm	Rock wool 2,5 cm
NRC	0.15	0.55	0.60
α_m [1]	0.15	0.60	0.60

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
G5R16 Slots 6 mm (perf. 16,50%) (Plate 12)
Number of Slots: 100
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 5 cm (Total height of the plenum 1)
B = 0 cm empty
4,0 cm With rock wool
2,5 cm With rock wool (*)

Plot plenum 1:

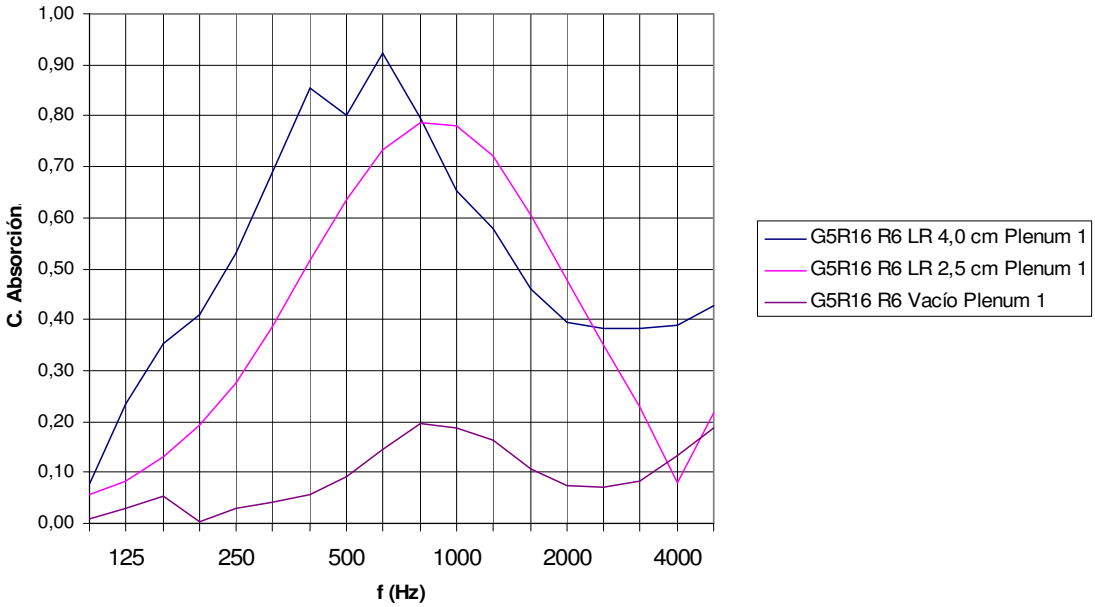


Table absorption plenum 1:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,01	0,03	0,05	0,00	0,03	0,04	0,06	0,09	0,15	0,20	0,19	0,16	0,11	0,07	0,07	0,08	0,13
$\alpha_{rock\ wool}$ 4 cm	0,08	0,24	0,35	0,41	0,53	0,69	0,85	0,80	0,92	0,79	0,65	0,58	0,46	0,40	0,38	0,38	0,39
$\alpha_{rock\ wool}$ 2,5 cm (*)	0,05	0,08	0,13	0,19	0,28	0,39	0,52	0,63	0,73	0,79	0,78	0,72	0,60	0,48	0,35	0,23	0,08

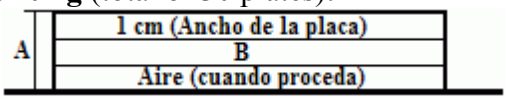
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 1:

	Empty	Rock wool 4 cm	Rock wool 2,5 cm
NRC	0.10	0.65	0.55
α_m [1]	0.15	0.65	0.65

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
G5R16 Slots 6 mm (perf. 16,50%) (Plate 12)
Number of Slots: 100
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 8 cm (Total height of the plenum 2)
B = 0 cm empty
4,0 cm With rock wool
2,5 cm With rock wool (*)

Plot plenum 2:

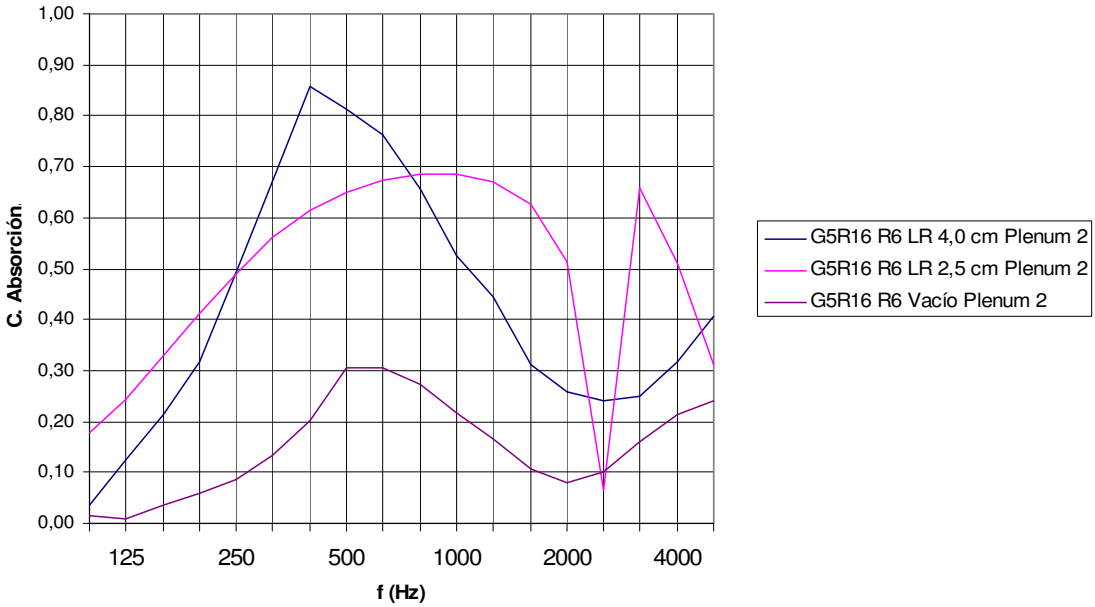


Table absorbing plenum 2:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,01	0,01	0,04	0,06	0,09	0,13	0,20	0,30	0,31	0,27	0,22	0,17	0,11	0,08	0,10	0,16	0,21
$\alpha_{rock\ wool}$ 4 cm	0,04	0,12	0,21	0,32	0,49	0,67	0,86	0,81	0,76	0,66	0,53	0,45	0,31	0,26	0,24	0,25	0,32
$\alpha_{rock\ wool}$ 2,5 cm (*)	0,18	0,24	0,33	0,41	0,49	0,56	0,61	0,65	0,67	0,69	0,68	0,67	0,63	0,51	0,06	0,66	0,51

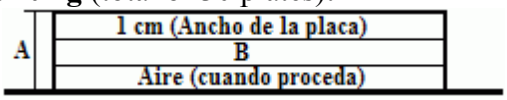
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 2:

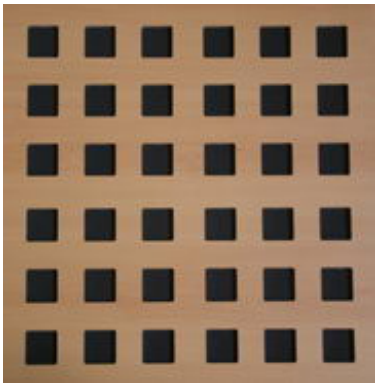
	Empty	Rock wool 4 cm	Rock wool 2,5 cm
NRC	0.15	0.55	0.55
α_m [1]	0.20	0.55	0.60

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
CU squares 50x50 mm (p. 25,59%) (Plate 13)
Number of squares: 36
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 5 cm (Total height of the plenum 1)
B = 0 cm empty
4,0 cm With rock wool
2,5 cm With rock wool (*)



Plot plenum 1:

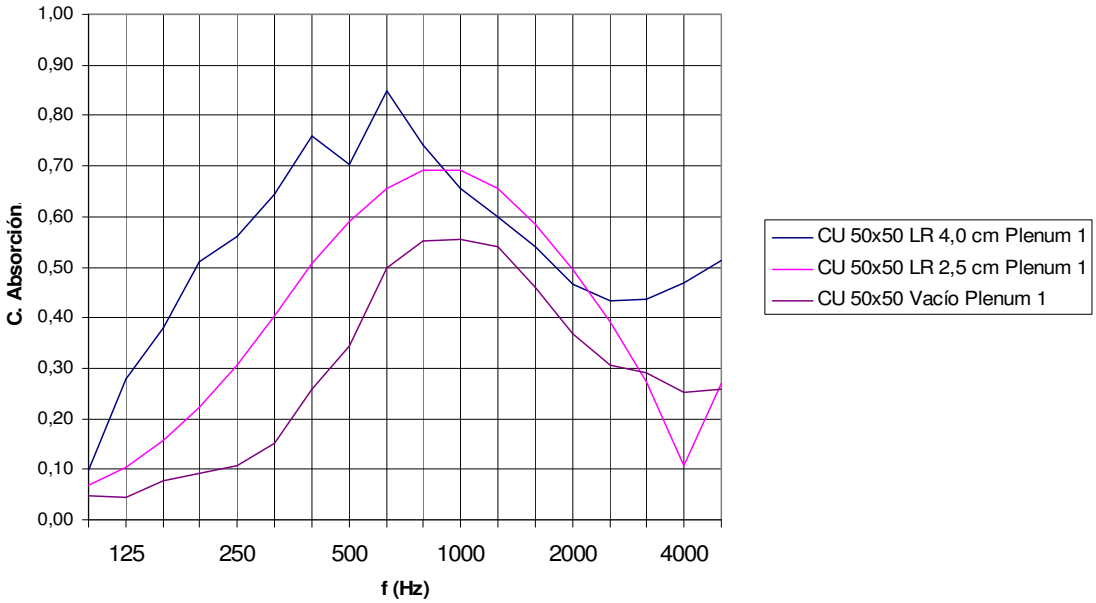


Table absorption plenum 1:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,05	0,04	0,08	0,09	0,11	0,15	0,26	0,35	0,50	0,55	0,56	0,54	0,46	0,37	0,31	0,29	0,25
$\alpha_{rock\ wool}$ 4 cm	0,10	0,28	0,38	0,51	0,56	0,64	0,76	0,70	0,85	0,74	0,66	0,60	0,54	0,47	0,43	0,44	0,47
$\alpha_{rock\ wool}$ 2,5 cm (*)	0,07	0,10	0,16	0,22	0,31	0,40	0,51	0,59	0,66	0,69	0,69	0,66	0,59	0,50	0,39	0,27	0,11

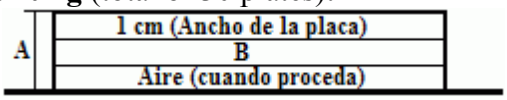
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 1:

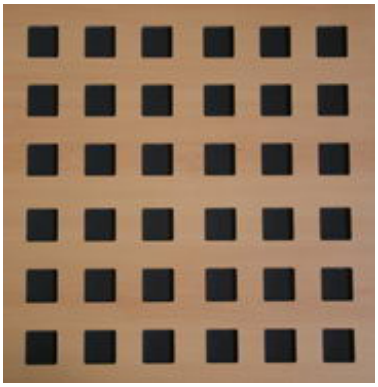
	Empty	Rock wool 4 cm	Rock wool 2,5 cm
NRC	0.35	0.60	0.55
α_m [1]	0.45	0.65	0.60

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
CU squares 50x50 mm (p. 25,59%) (Plate 13)
Number of squares: 36
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 8 cm (Total height of the plenum 2)
B = 0 cm empty
4,0 cm With rock wool
2,5 cm With rock wool (*)



Plot plenum 2:

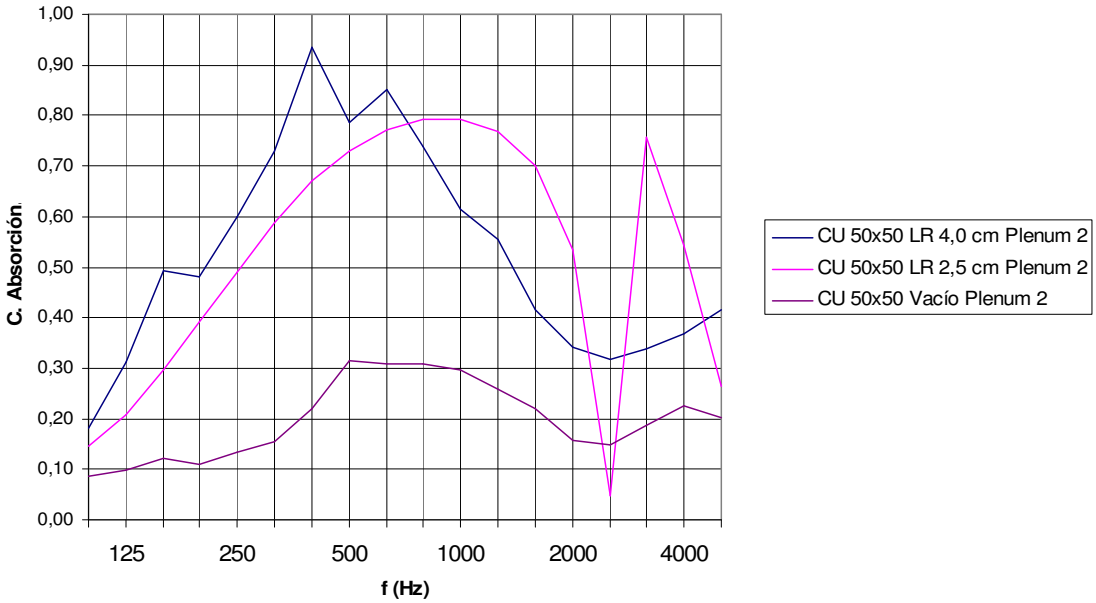


Table absorbing plenum 2:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,08	0,10	0,12	0,11	0,13	0,15	0,22	0,31	0,31	0,31	0,30	0,26	0,22	0,16	0,15	0,19	0,23
$\alpha_{rock\ wool}$ 4 cm	0,18	0,31	0,49	0,48	0,60	0,73	0,94	0,79	0,85	0,74	0,61	0,55	0,41	0,34	0,32	0,34	0,37
$\alpha_{rock\ wool}$ 2,5 cm (*)	0,15	0,21	0,30	0,39	0,49	0,59	0,67	0,73	0,77	0,79	0,79	0,77	0,70	0,53	0,05	0,76	0,54

(*) Curve obtained with software developed in collaboration with DISAO group

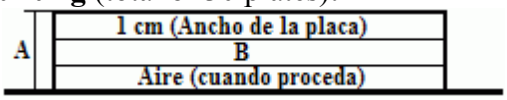
Supplementary data plenum 2:

	Empty	Rock wool 4 cm	Rock wool 2,5 cm
NRC	0.25	0.60	0.60
α_m [1]	0.25	0.60	0.65

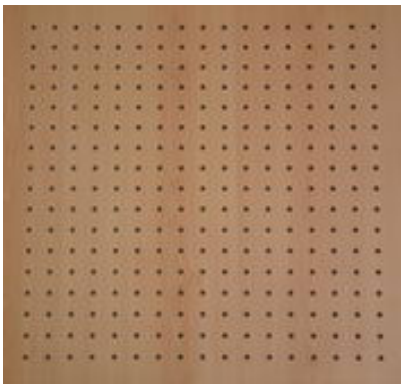
[1] average of value de 500, 1000 y 2000 Hz

3.2. TESTS WITH MINERAL WOOL

Kind of plate:
T32 Ø 8 mm (perforation 4,13%) (Plate 1)
Number of holes: 289
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 5 cm (Total height of the plenum 1)
B = 0 cm empty
4,0 cm con mineral wool (*)
2,5 cm con mineral wool



Plot plenum 1:

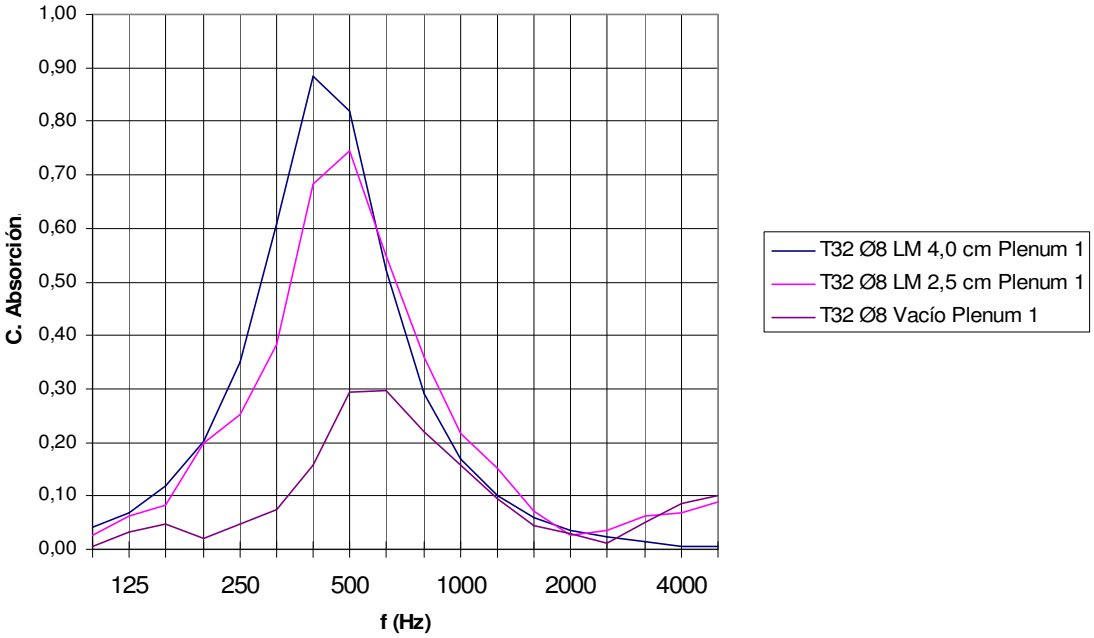


Table absorption plenum 1:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,01	0,03	0,05	0,02	0,05	0,08	0,16	0,30	0,30	0,22	0,16	0,10	0,05	0,03	0,01	0,05	0,09
$\alpha_{min\ wool.}$ 4 cm (*)	0,04	0,07	0,12	0,20	0,35	0,61	0,88	0,82	0,52	0,29	0,17	0,10	0,06	0,04	0,02	0,01	0,01
$\alpha_{min\ wool.}$ 2,5 cm	0,03	0,06	0,08	0,20	0,25	0,38	0,68	0,74	0,55	0,36	0,22	0,15	0,07	0,03	0,03	0,06	0,07

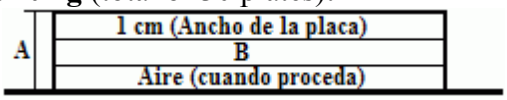
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 1:

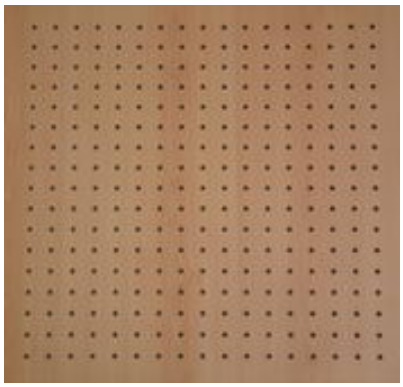
	Empty	Mineral wool 4 cm	Mineral wool 2,5 cm
NRC	0.15	0.35	0.30
α_m [1]	0.15	0.35	0.30

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
T32 Ø 8 mm (perforation 4,13%) (Plate 1)
Number of holes: 289
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 8 cm (Total height of the plenum 2)
B = 0 cm empty
4,0 cm con mineral wool (*)
2,5 cm con mineral wool



Plot plenum 2:

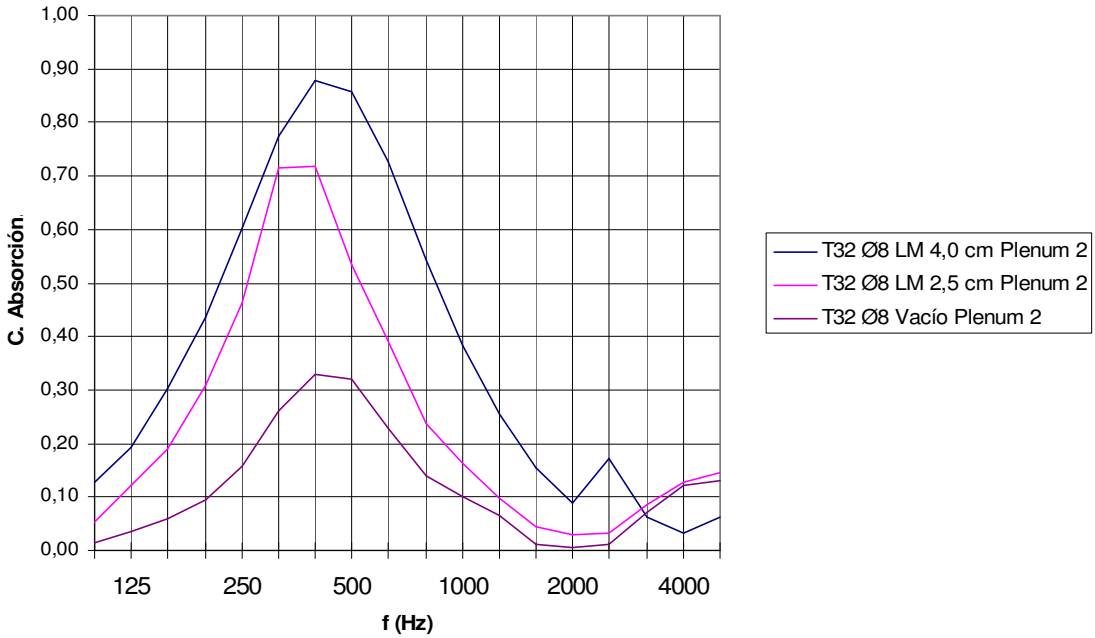


Table absorbing plenum 2:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,02	0,04	0,06	0,09	0,16	0,26	0,33	0,32	0,23	0,14	0,10	0,06	0,01	0,01	0,01	0,07	0,12
$\alpha_{min\ wool.}$ 4 cm (*)	0,13	0,19	0,30	0,44	0,60	0,77	0,88	0,86	0,73	0,54	0,38	0,26	0,16	0,09	0,17	0,06	0,03
$\alpha_{min\ wool.}$ 2,5 cm	0,05	0,12	0,19	0,31	0,46	0,71	0,72	0,53	0,39	0,24	0,16	0,10	0,04	0,03	0,03	0,09	0,13

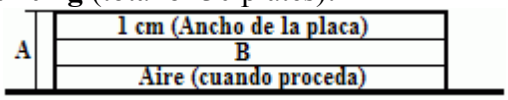
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 2:

	Empty	Mineral wool 4 cm	Mineral wool 2,5 cm
NRC	0.15	0.50	0.30
α_m [1]	0.15	0.45	0.25

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
2GT32 Ø 8 mm (perforation 1,94%) (Plate 2)
Number of holes: 136
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 5 cm (Total height of the plenum 1)
B = 0 cm empty
4,0 cm con mineral wool (*)
2,5 cm con mineral wool

Plot plenum 1:

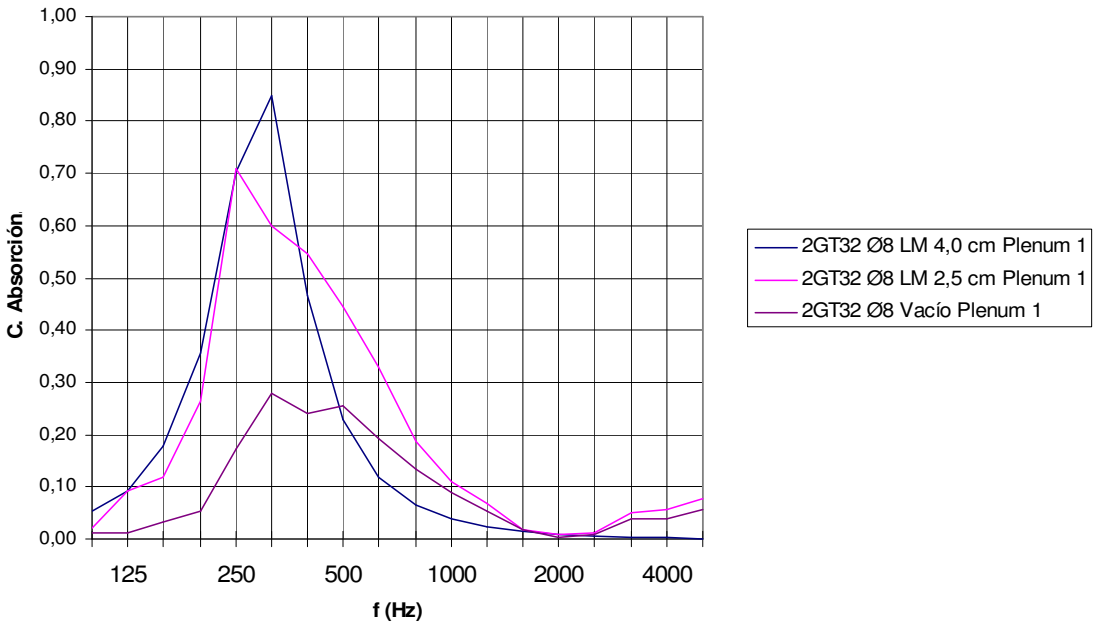


Table absorption plenum 1:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,01	0,01	0,03	0,05	0,17	0,28	0,24	0,25	0,19	0,13	0,09	0,05	0,02	0,00	0,01	0,04	0,04
$\alpha_{min\ wool.}$ 4 cm (*)	0,05	0,09	0,18	0,36	0,70	0,85	0,47	0,23	0,12	0,06	0,04	0,02	0,01	0,01	0,01	0,00	0,00
$\alpha_{min\ wool.}$ 2,5 cm	0,02	0,09	0,12	0,27	0,71	0,60	0,55	0,45	0,33	0,19	0,11	0,07	0,02	0,01	0,01	0,05	0,06

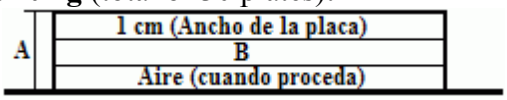
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 1:

	Empty	Mineral wool 4 cm	Mineral wool 2,5 cm
NRC	0.15	0.25	0.30
α_m [1]	0.10	0.10	0.20

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
2GT32 Ø 8 mm (perforation 1,94%) (Plate 2)
Number of holes: 136
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 8 cm (Total height of the plenum 2)
B = 0 cm empty
4,0 cm con mineral wool (*)
2,5 cm con mineral wool

Plot plenum 2:

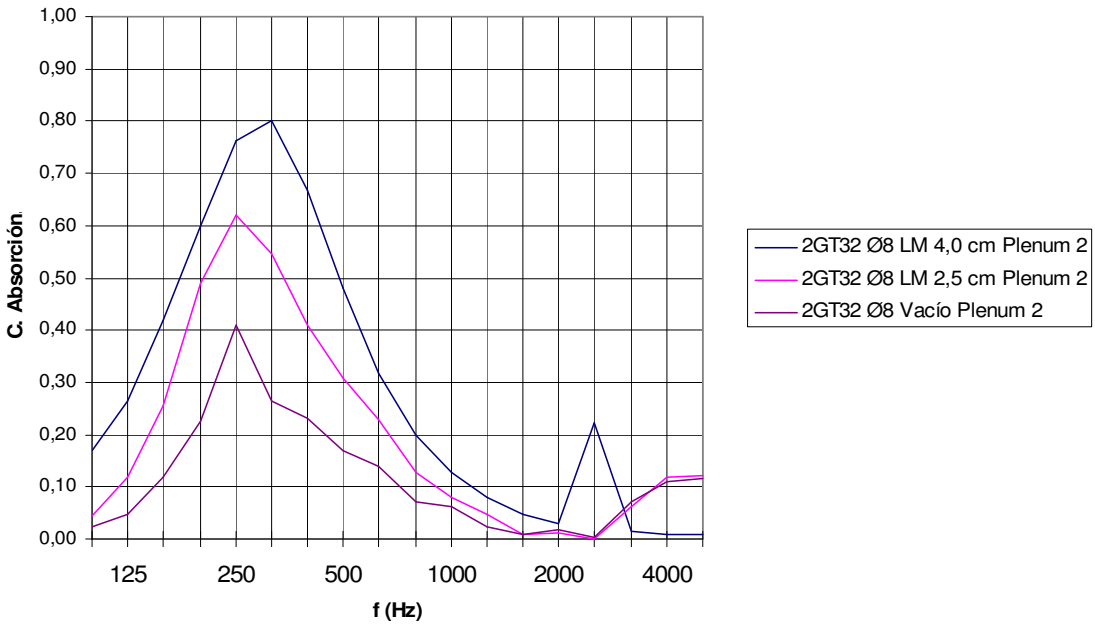


Table absorbing plenum 2:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,02	0,05	0,12	0,23	0,41	0,26	0,23	0,17	0,14	0,07	0,06	0,03	0,01	0,02	0,00	0,07	0,11
$\alpha_{min\ wool.}$ 4 cm (*)	0,17	0,26	0,42	0,60	0,76	0,80	0,67	0,48	0,32	0,20	0,13	0,08	0,05	0,03	0,22	0,01	0,01
$\alpha_{min\ wool.}$ 2,5 cm	0,04	0,12	0,25	0,49	0,62	0,55	0,41	0,31	0,23	0,13	0,08	0,05	0,01	0,01	0,00	0,06	0,12

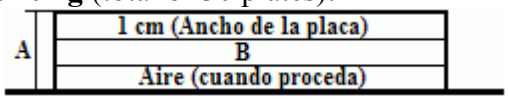
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 2:

	Empty	Mineral wool 4 cm	Mineral wool 2,5 cm
NRC	0.15	0.35	0.25
α_m [1]	0.10	0.25	0.15

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
T16 Ø 8 mm (perforation 7,79%) (Plate 3)
Number of holes: 545
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 5 cm (Total height of the plenum 1)
B = 0 cm empty
4,0 cm con mineral wool (*)
2,5 cm con mineral wool

Plot plenum 1:

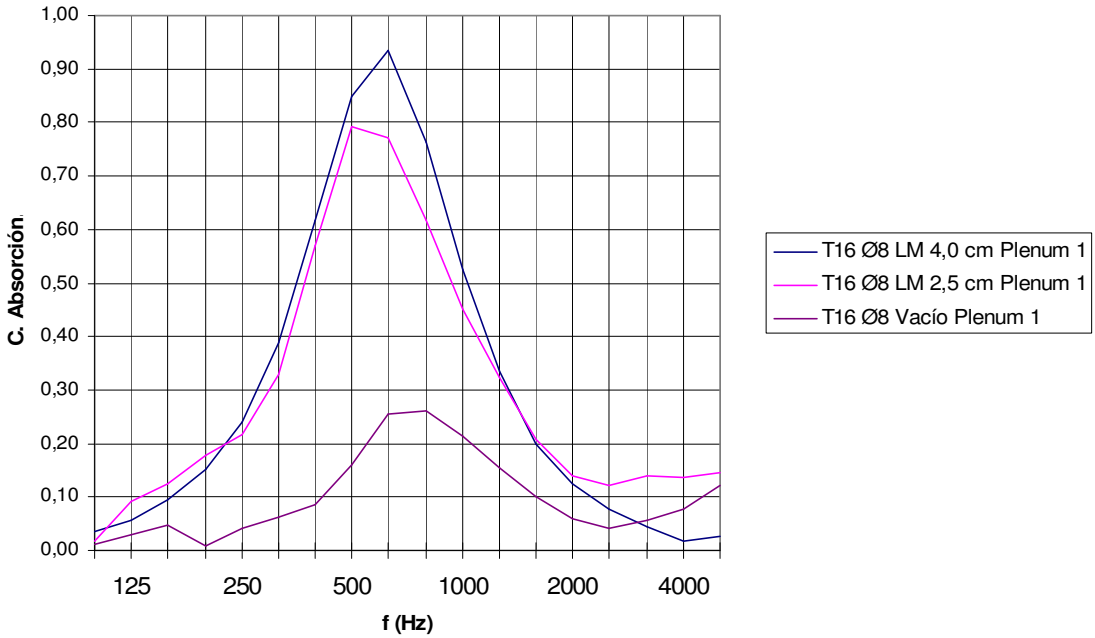


Table absorption plenum 1:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,01	0,03	0,05	0,01	0,04	0,06	0,09	0,16	0,26	0,26	0,21	0,15	0,10	0,06	0,04	0,06	0,08
$\alpha_{min\ wool.}$ 4 cm (*)	0,04	0,06	0,10	0,15	0,24	0,39	0,62	0,85	0,93	0,76	0,53	0,34	0,20	0,12	0,08	0,05	0,02
$\alpha_{min\ wool.}$ 2,5 cm	0,02	0,09	0,13	0,18	0,22	0,33	0,57	0,79	0,77	0,62	0,45	0,32	0,21	0,14	0,12	0,14	0,14

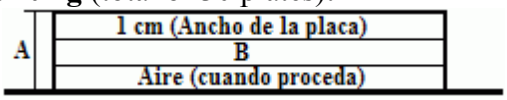
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 1:

	Empty	Mineral wool 4 cm	Mineral wool 2,5 cm
NRC	0.10	0.45	0.40
α_m [1]	0.15	0.50	0.45

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
T16 Ø 8 mm (perforation 7,79%) (Plate 3)
Number of holes: 545
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 8 cm (Total height of the plenum 2)
B = 0 cm empty
4,0 cm con mineral wool (*)
2,5 cm con mineral wool

Plot plenum 2:

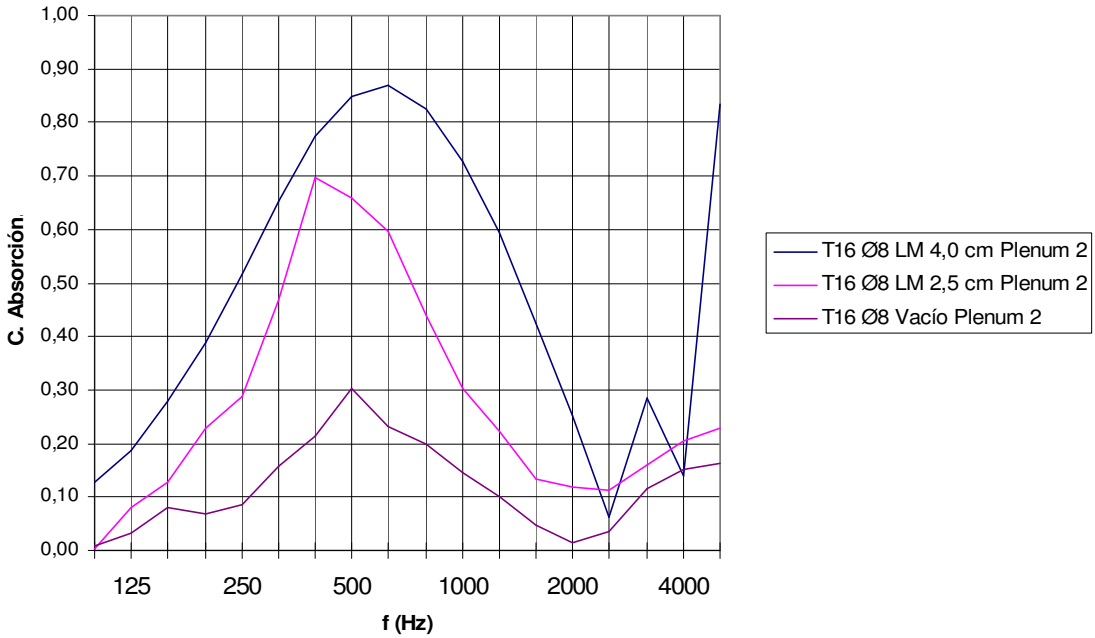


Table absorbing plenum 2:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,01	0,03	0,08	0,07	0,09	0,16	0,21	0,30	0,23	0,20	0,15	0,10	0,05	0,01	0,03	0,12	0,15
$\alpha_{min\ wool.}$ 4 cm (*)	0,13	0,19	0,28	0,39	0,52	0,65	0,77	0,85	0,87	0,82	0,73	0,59	0,42	0,25	0,06	0,28	0,14
$\alpha_{min\ wool.}$ 2,5 cm	0,00	0,08	0,13	0,23	0,29	0,47	0,70	0,66	0,60	0,44	0,30	0,22	0,13	0,12	0,11	0,16	0,21

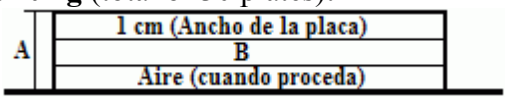
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 2:

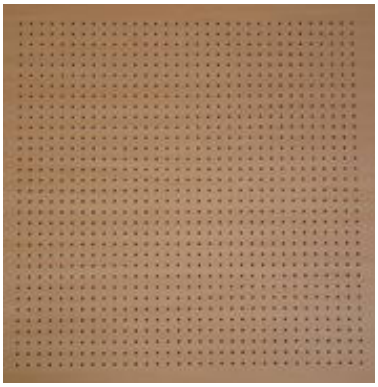
	Empty	Mineral wool 4 cm	Mineral wool 2,5 cm
NRC	0.15	0.60	0.35
α_m [1]	0.15	0.60	0.35

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
MI Ø 4 mm (perforation 3,89%) (Plate 4)
Number of holes: 1089
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 5 cm (Total height of the plenum 1)
B = 0 cm empty
4,0 cm con mineral wool (*)
2,5 cm con mineral wool



Plot plenum 1:

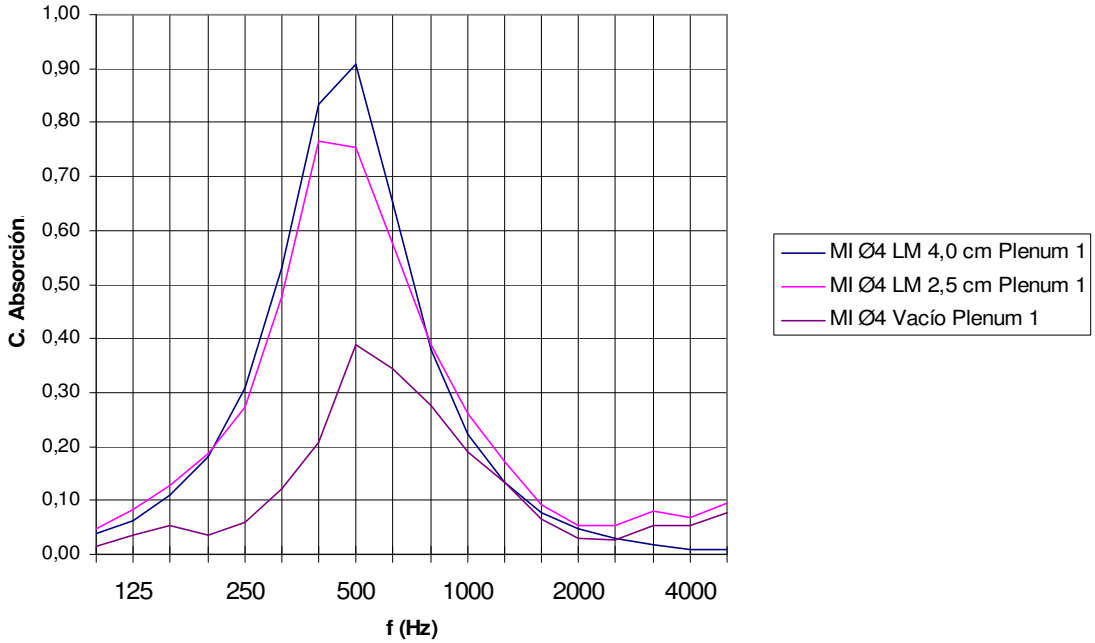


Table absorption plenum 1:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,01	0,03	0,05	0,03	0,06	0,12	0,21	0,39	0,35	0,28	0,19	0,13	0,07	0,03	0,03	0,05	0,05
$\alpha_{min\ wool.}$ 4 cm (*)	0,04	0,06	0,11	0,18	0,31	0,53	0,83	0,91	0,65	0,38	0,22	0,13	0,08	0,05	0,03	0,02	0,01
$\alpha_{min\ wool.}$ 2,5 cm	0,05	0,08	0,13	0,19	0,27	0,48	0,77	0,75	0,58	0,39	0,26	0,17	0,09	0,05	0,05	0,08	0,07

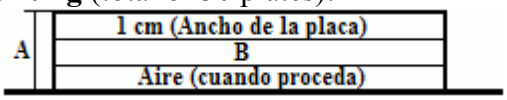
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 1:

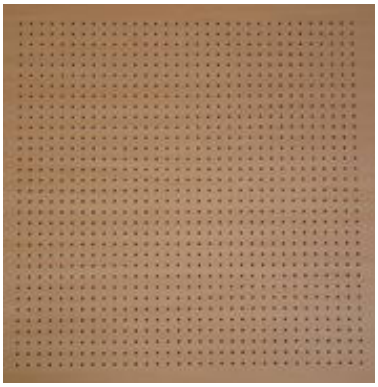
	Empty	Mineral wool 4 cm	Mineral wool 2,5 cm
NRC	0.15	0.35	0.35
α_m [1]	0.20	0.35	0.35

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
MI Ø 4 mm (perforation 3,89%) (Plate 4)
Number of holes: 1089
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 8 cm (Total height of the plenum 2)
B = 0 cm empty
4,0 cm con mineral wool (*)
2,5 cm con mineral wool



Plot plenum 2:

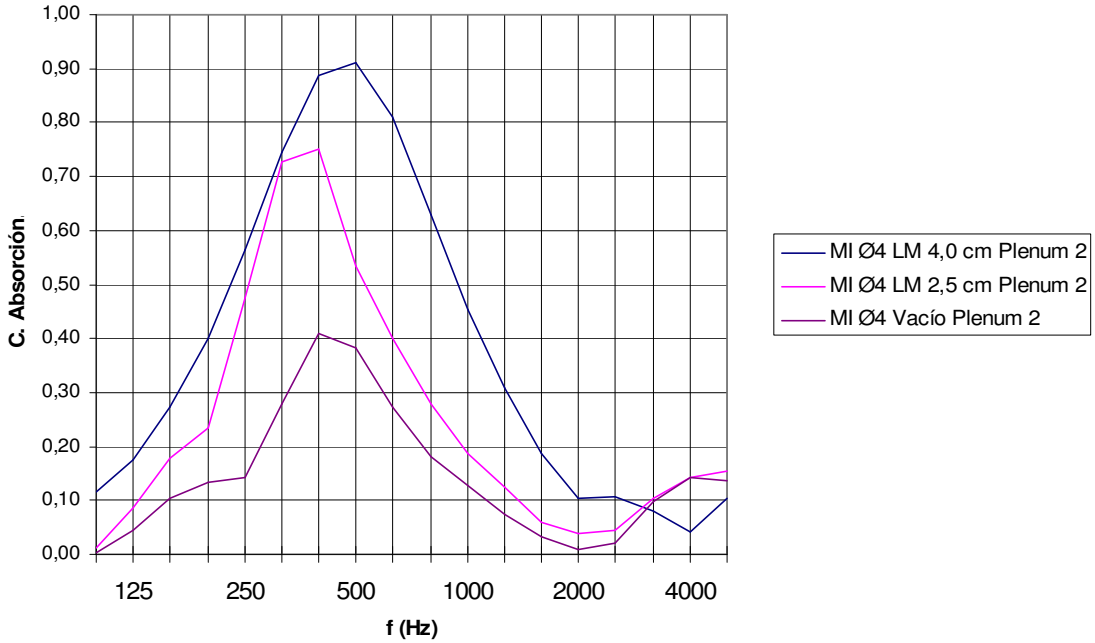


Table absorbing plenum 2:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,00	0,05	0,10	0,13	0,14	0,28	0,41	0,38	0,27	0,18	0,13	0,08	0,03	0,01	0,02	0,10	0,14
$\alpha_{min\ wool.}$ 4 cm (*)	0,11	0,17	0,27	0,40	0,56	0,74	0,89	0,91	0,81	0,63	0,45	0,31	0,19	0,11	0,11	0,08	0,04
$\alpha_{min\ wool.}$ 2,5 cm	0,01	0,08	0,18	0,24	0,47	0,73	0,75	0,53	0,40	0,28	0,19	0,12	0,06	0,04	0,04	0,10	0,14

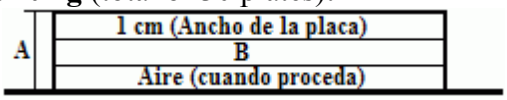
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 2:

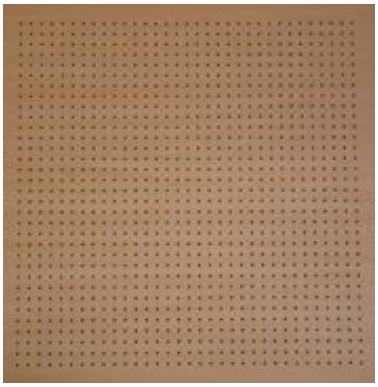
	Empty	Mineral wool 4 cm	Mineral wool 2,5 cm
NRC	0.20	0.50	0.35
α_m [1]	0.15	0.50	0.25

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
MI Ø 6 mm (perforation 8,76%) (Plate 5)
Number of holes: 1089
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 5 cm (Total height of the plenum 1)
B = 0 cm empty
4,0 cm con mineral wool (*)
2,5 cm con mineral wool



Plot plenum 1:

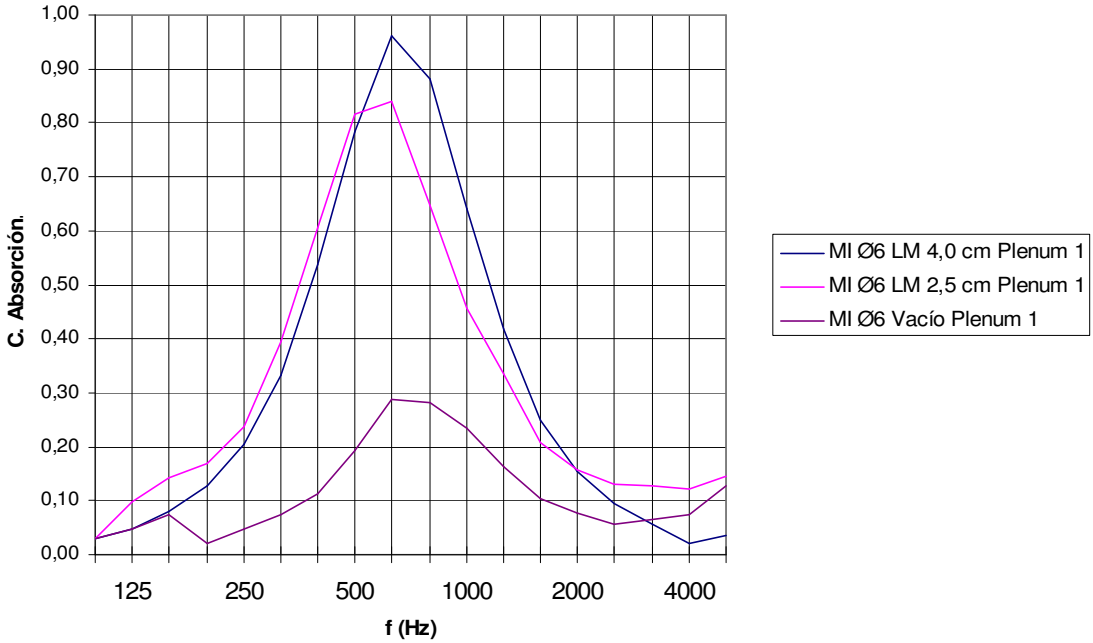


Table absorption plenum 1:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,03	0,05	0,07	0,02	0,05	0,07	0,11	0,19	0,29	0,28	0,23	0,16	0,10	0,08	0,06	0,06	0,08
$\alpha_{min\ wool.}$ 4 cm (*)	0,03	0,05	0,08	0,13	0,21	0,33	0,54	0,78	0,96	0,88	0,64	0,42	0,25	0,15	0,09	0,06	0,02
$\alpha_{min\ wool.}$ 2,5 cm	0,03	0,10	0,14	0,17	0,24	0,39	0,61	0,82	0,84	0,65	0,46	0,33	0,21	0,16	0,13	0,13	0,12

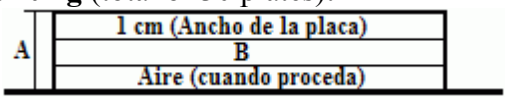
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 1:

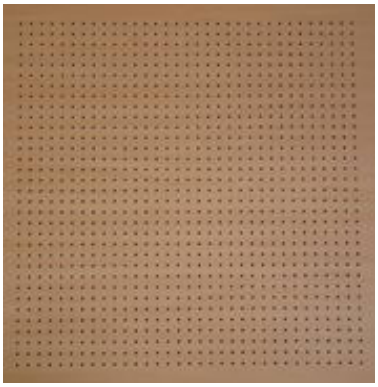
	Empty	Mineral wool 4 cm	Mineral wool 2,5 cm
NRC	0.15	0.45	0.40
α_m [1]	0.20	0.50	0.45

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
MI Ø 6 mm (perforation 8,76%) (Plate 5)
Number of holes: 1089
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 8 cm (Total height of the plenum 2)
B = 0 cm empty
4,0 cm con mineral wool (*)
2,5 cm con mineral wool



Plot plenum 2:

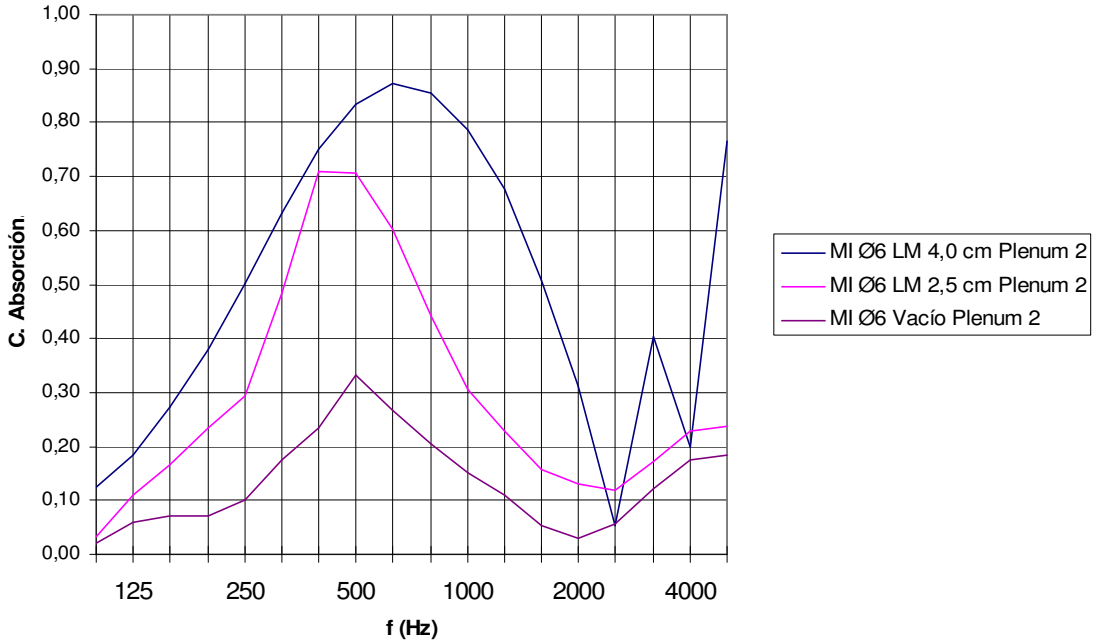


Table absorbing plenum 2:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,02	0,06	0,07	0,07	0,10	0,17	0,24	0,33	0,27	0,20	0,15	0,11	0,05	0,03	0,06	0,12	0,17
$\alpha_{min\ wool.}$ 4 cm (*)	0,12	0,18	0,27	0,38	0,50	0,63	0,75	0,83	0,87	0,85	0,79	0,68	0,51	0,31	0,05	0,40	0,20
$\alpha_{min\ wool.}$ 2,5 cm	0,03	0,11	0,17	0,24	0,29	0,48	0,71	0,71	0,60	0,44	0,31	0,23	0,16	0,13	0,12	0,17	0,23

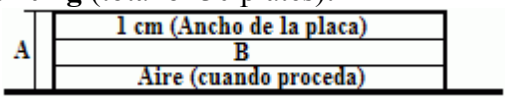
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 2:

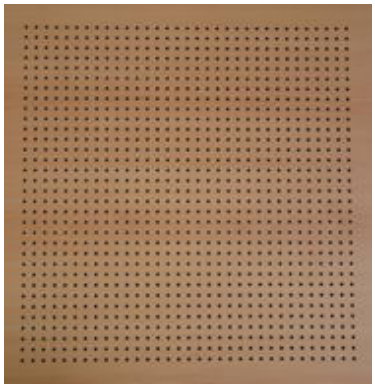
	Empty	Mineral wool 4 cm	Mineral wool 2,5 cm
NRC	0.15	0.60	0.40
α_m [1]	0.15	0.60	0.40

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
MI Ø 8 mm (perforation 15,57%) (Plate 6)
Number of holes: 1089
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 5 cm (Total height of the plenum 1)
B = 0 cm empty
4,0 cm con mineral wool (*)
2,5 cm con mineral wool



Plot plenum 1:

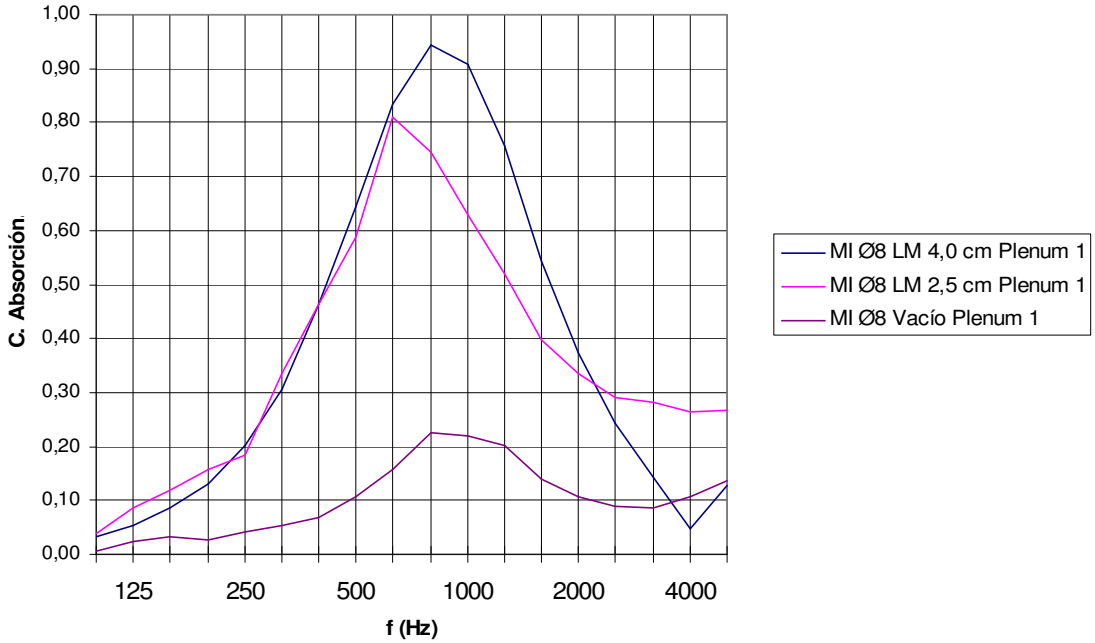


Table absorption plenum 1:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,00	0,02	0,03	0,03	0,04	0,05	0,07	0,11	0,16	0,23	0,22	0,20	0,14	0,11	0,09	0,08	0,11
$\alpha_{min\ wool.}$ 4 cm (*)	0,03	0,05	0,09	0,13	0,20	0,31	0,46	0,64	0,83	0,94	0,91	0,76	0,54	0,37	0,24	0,14	0,05
$\alpha_{min\ wool.}$ 2,5 cm	0,04	0,09	0,12	0,16	0,19	0,34	0,46	0,59	0,81	0,75	0,63	0,52	0,40	0,34	0,29	0,28	0,26

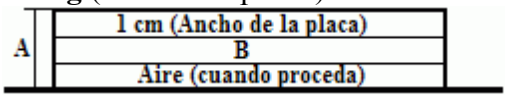
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 1:

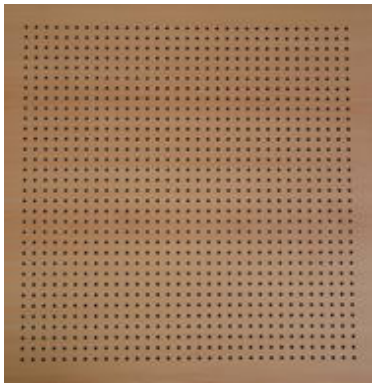
	Empty	Mineral wool 4 cm	Mineral wool 2,5 cm
NRC	0.10	0.55	0.45
α_m [1]	0.15	0.65	0.55

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
MI Ø 8 mm (perforation 15,57%) (Plate 6)
Number of holes: 1089
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 8 cm (Total height of the plenum 2)
B = 0 cm empty
4,0 cm con mineral wool (*)
2,5 cm con mineral wool



Plot plenum 2:

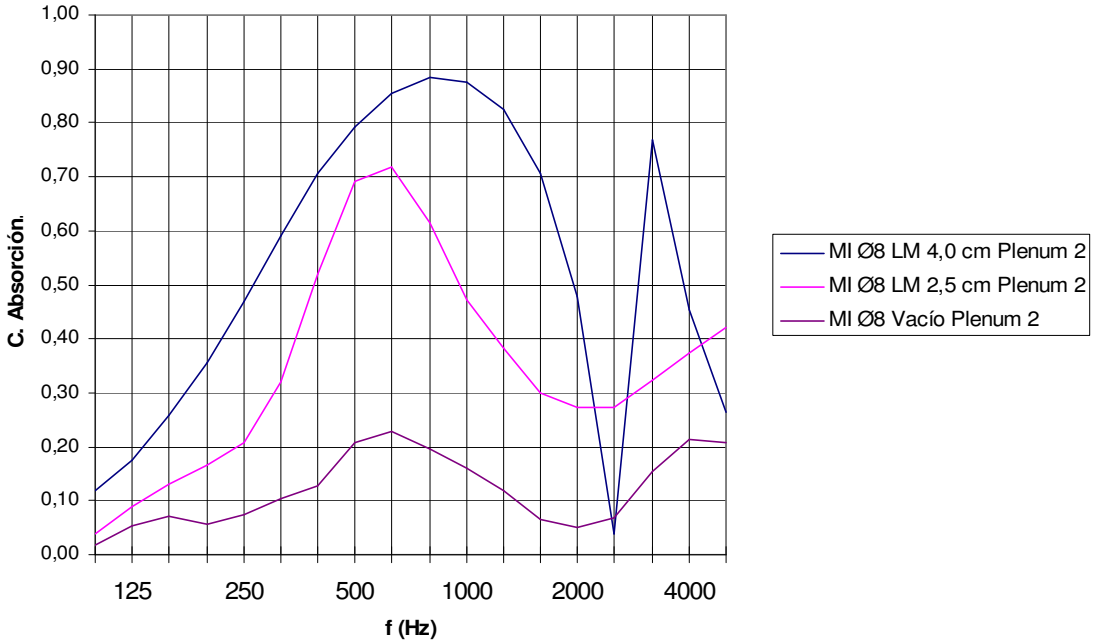


Table absorbing plenum 2:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,02	0,05	0,07	0,06	0,08	0,10	0,13	0,21	0,23	0,20	0,16	0,12	0,06	0,05	0,07	0,15	0,21
$\alpha_{min\ wool.}$ 4 cm (*)	0,12	0,17	0,26	0,36	0,47	0,59	0,71	0,79	0,86	0,88	0,87	0,83	0,71	0,48	0,04	0,77	0,46
$\alpha_{min\ wool.}$ 2,5 cm	0,04	0,09	0,13	0,17	0,21	0,32	0,52	0,69	0,72	0,61	0,47	0,38	0,30	0,27	0,27	0,32	0,37

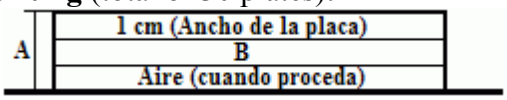
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 2:

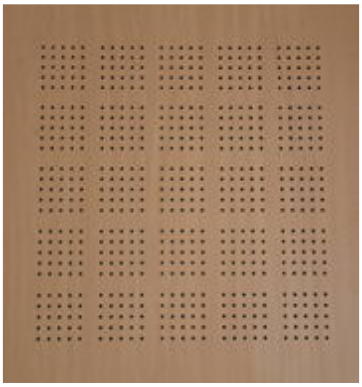
	Empty	Mineral wool 4 cm	Mineral wool 2,5 cm
NRC	0.15	0.65	0.45
α_m [1]	0.15	0.75	0.50

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
G5x5T16 Ø 6 mm (perf. 5,03%) (Plate 7)
Number of holes: 625
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 5 cm (Total height of the plenum 1)
B = 0 cm empty
4,0 cm con mineral wool (*)
2,5 cm con mineral wool



Plot plenum 1:

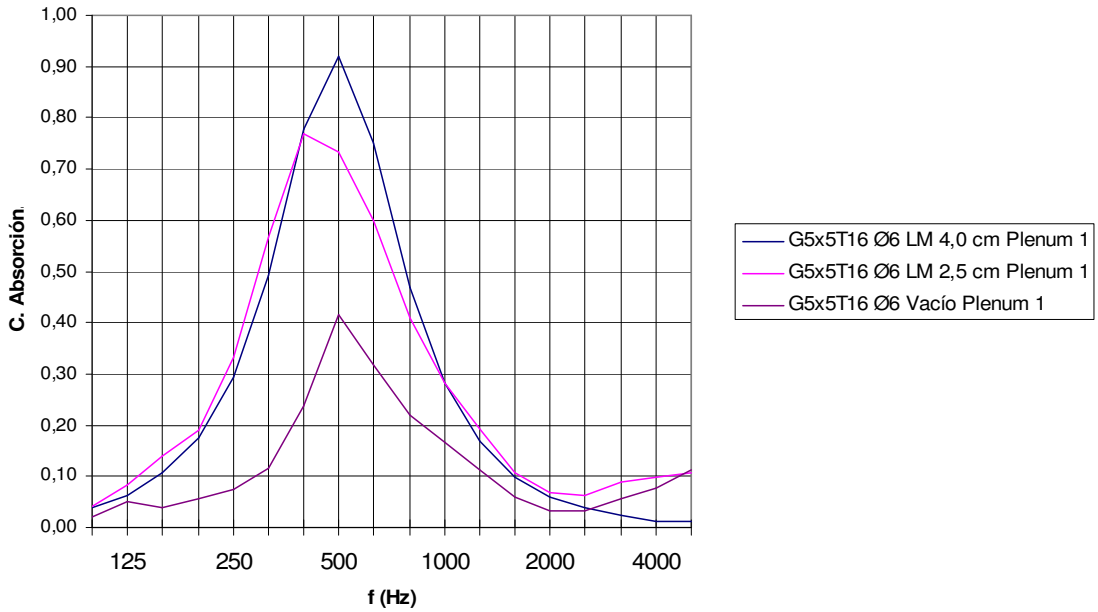


Table absorption plenum 1:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,02	0,05	0,04	0,06	0,07	0,12	0,24	0,42	0,32	0,22	0,17	0,11	0,06	0,03	0,03	0,06	0,08
$\alpha_{min\ wool.}$ 4 cm (*)	0,04	0,06	0,11	0,18	0,29	0,49	0,78	0,92	0,75	0,47	0,28	0,17	0,10	0,06	0,04	0,02	0,01
$\alpha_{min\ wool.}$ 2,5 cm	0,04	0,08	0,14	0,19	0,33	0,57	0,77	0,73	0,60	0,41	0,28	0,19	0,11	0,07	0,06	0,09	0,10

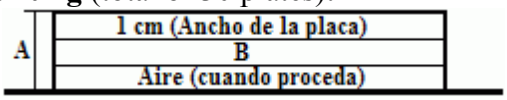
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 1:

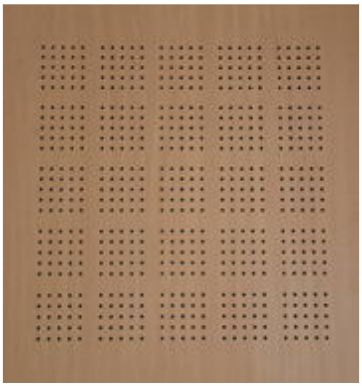
	Empty	Mineral wool 4 cm	Mineral wool 2,5 cm
NRC	0.15	0.35	0.35
α_m [1]	0.15	0.40	0.35

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
G5x5T16 Ø 6 mm (perf. 5,03%) (Plate 7)
Number of holes: 625
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 8 cm (Total height of the plenum 2)
B = 0 cm empty
4,0 cm con mineral wool (*)
2,5 cm con mineral wool



Plot plenum 2:

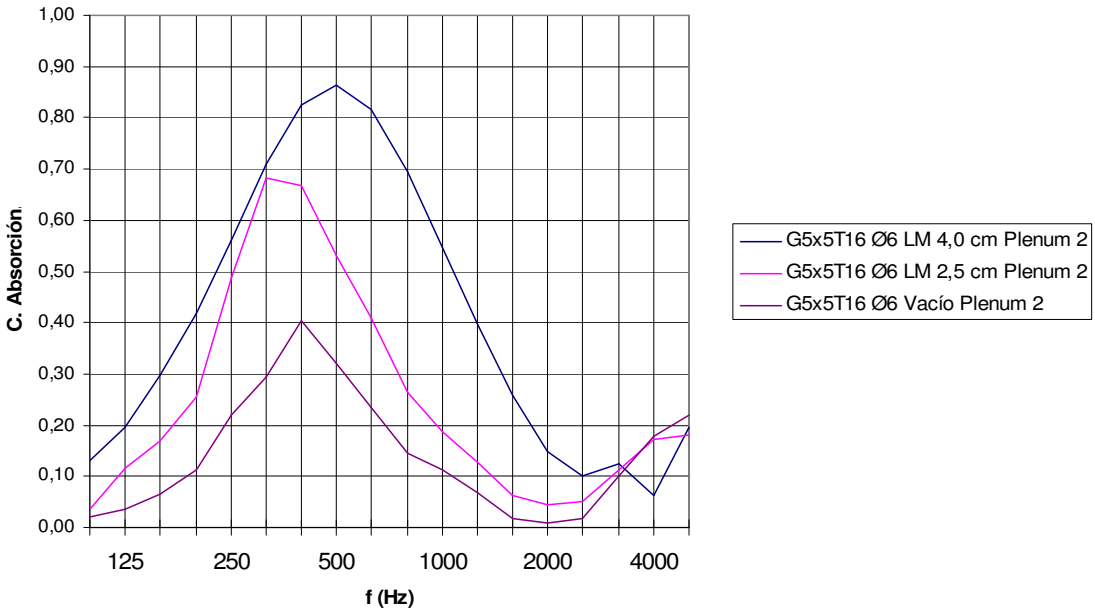


Table absorbing plenum 2:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,02	0,04	0,06	0,11	0,22	0,30	0,40	0,32	0,23	0,14	0,11	0,07	0,02	0,01	0,02	0,10	0,18
$\alpha_{min\ wool.}$ 4 cm (*)	0,13	0,20	0,30	0,42	0,56	0,71	0,82	0,86	0,82	0,69	0,55	0,40	0,26	0,15	0,10	0,12	0,06
$\alpha_{min\ wool.}$ 2,5 cm	0,04	0,12	0,17	0,25	0,49	0,68	0,67	0,53	0,41	0,26	0,19	0,13	0,06	0,04	0,05	0,11	0,17

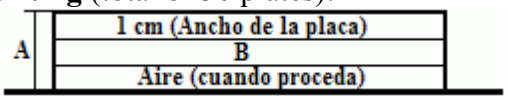
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 2:

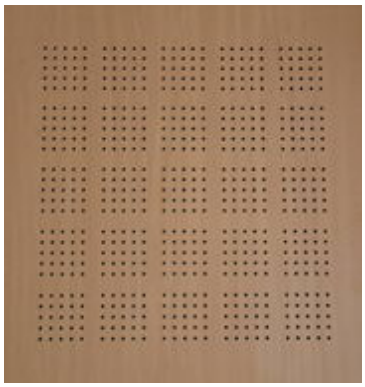
	Empty	Mineral wool 4 cm	Mineral wool 2,5 cm
NRC	0.15	0.55	0.30
α_m [1]	0.15	0.50	0.25

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
G5x5T16 Ø 8 mm (perf. 8,93%) (Plate 8)
Number of holes: 625
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 5 cm (Total height of the plenum 1)
B = 0 cm empty
4,0 cm con mineral wool (*)
2,5 cm con mineral wool



Plot plenum 1:

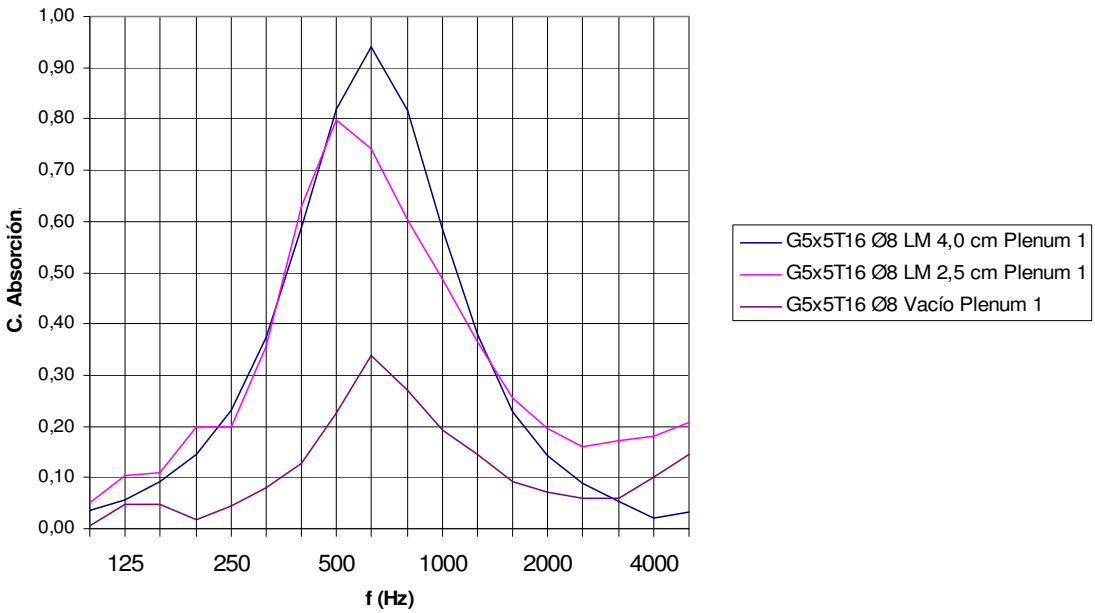


Table absorption plenum 1:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,01	0,05	0,05	0,02	0,05	0,08	0,13	0,23	0,34	0,27	0,19	0,15	0,09	0,07	0,06	0,06	0,10
$\alpha_{min\ wool.}$ 4 cm (*)	0,04	0,06	0,09	0,15	0,23	0,37	0,59	0,82	0,94	0,82	0,58	0,38	0,23	0,14	0,09	0,05	0,02
$\alpha_{min\ wool.}$ 2,5 cm	0,05	0,10	0,11	0,20	0,20	0,36	0,63	0,80	0,74	0,60	0,49	0,36	0,26	0,20	0,16	0,17	0,18

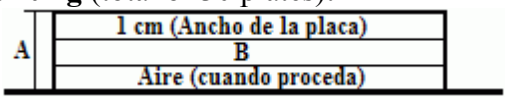
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 1:

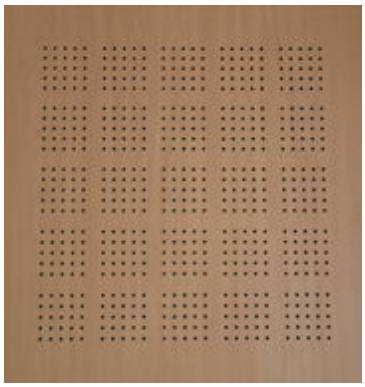
	Empty	Mineral wool 4 cm	Mineral wool 2,5 cm
NRC	0.15	0.45	0.40
α_m [1]	0.15	0.50	0.45

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
G5x5T16 Ø 8 mm (perf. 8,93%) (Plate 8)
Number of holes: 625
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 8 cm (Total height of the plenum 2)
B = 0 cm empty
4,0 cm con mineral wool (*)
2,5 cm con mineral wool



Plot plenum 2:

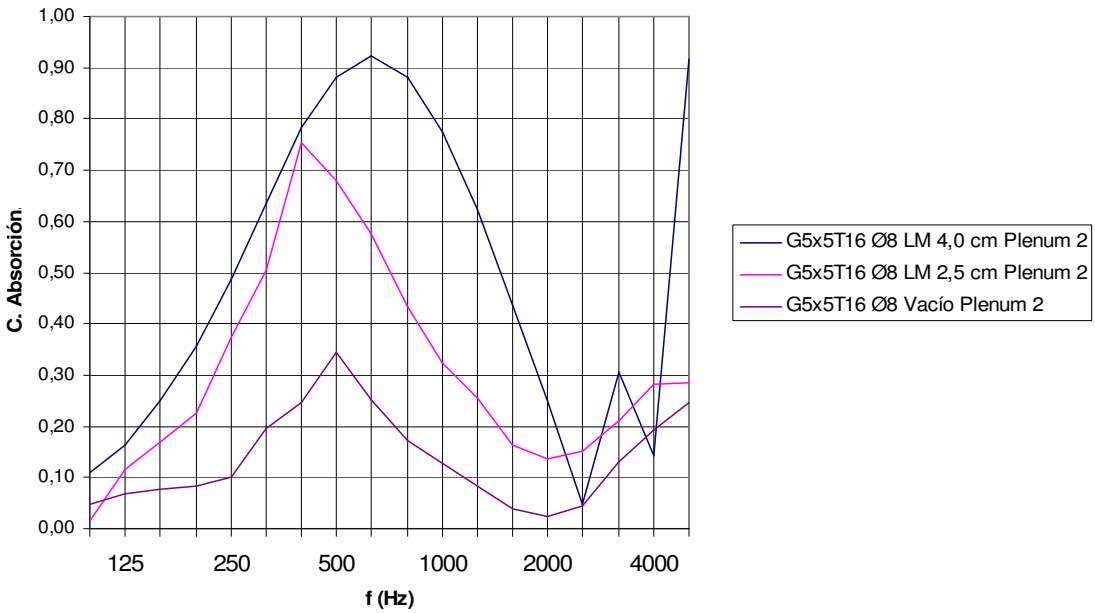


Table absorbing plenum 2:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,05	0,07	0,08	0,08	0,10	0,20	0,25	0,34	0,25	0,17	0,13	0,08	0,04	0,02	0,04	0,13	0,19
$\alpha_{min\ wool.}$ 4 cm (*)	0,11	0,16	0,25	0,35	0,49	0,64	0,78	0,88	0,92	0,88	0,77	0,62	0,44	0,25	0,05	0,30	0,14
$\alpha_{min\ wool.}$ 2,5 cm	0,01	0,11	0,17	0,23	0,37	0,50	0,75	0,68	0,58	0,43	0,32	0,26	0,16	0,14	0,15	0,21	0,28

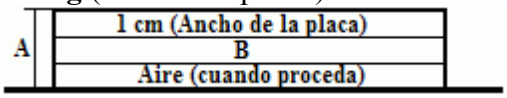
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 2:

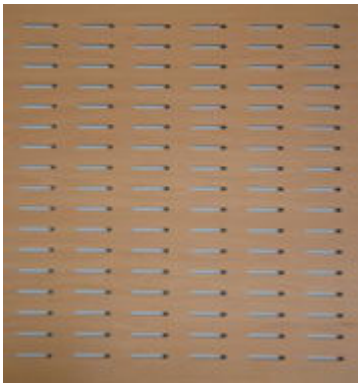
	Empty	Mineral wool 4 cm	Mineral wool 2,5 cm
NRC	0.15	0.60	0.40
α_m [1]	0.15	0.60	0.40

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
R32 Slots 6 mm (perf. 10,39%) (Plate 9)
Number of Slots: 102
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 5 cm (Total height of the plenum 1)
B = 0 cm empty
4,0 cm con mineral wool (*)
2,5 cm con mineral wool



Plot plenum 1:

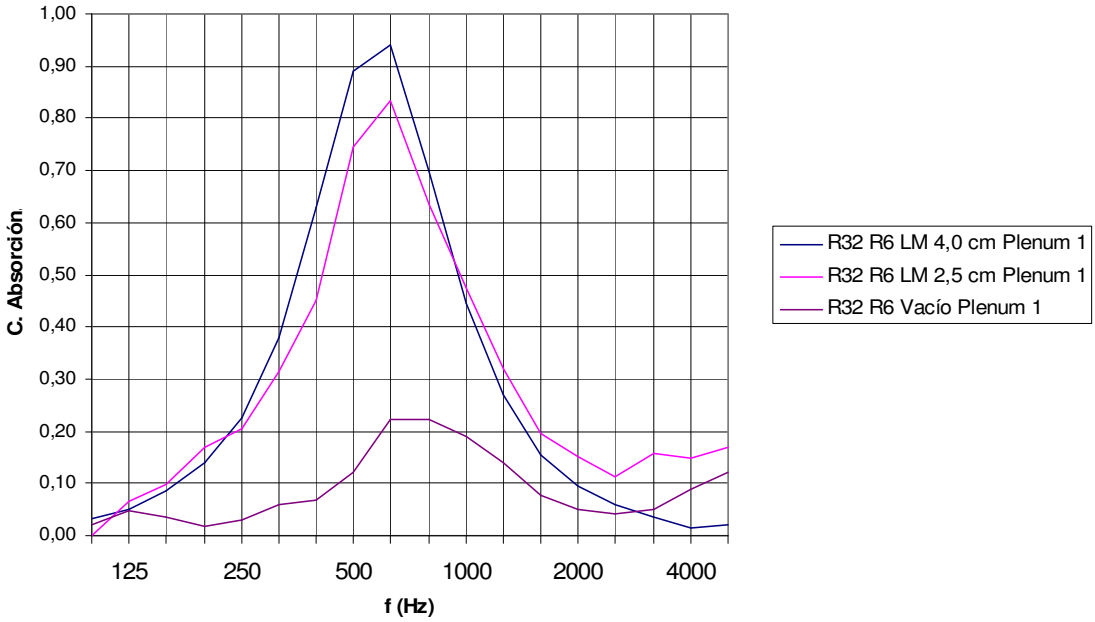


Table absorption plenum 1:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,02	0,05	0,04	0,02	0,03	0,06	0,07	0,12	0,22	0,22	0,19	0,14	0,08	0,05	0,04	0,05	0,09
$\alpha_{min\ wool.}$ 4 cm (*)	0,03	0,05	0,09	0,14	0,23	0,38	0,63	0,89	0,94	0,70	0,44	0,27	0,16	0,10	0,06	0,03	0,01
$\alpha_{min\ wool.}$ 2,5 cm	0,00	0,07	0,10	0,17	0,20	0,32	0,45	0,74	0,83	0,64	0,48	0,32	0,20	0,15	0,11	0,16	0,15

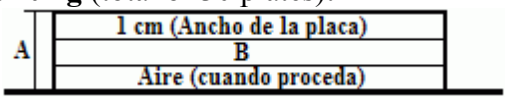
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 1:

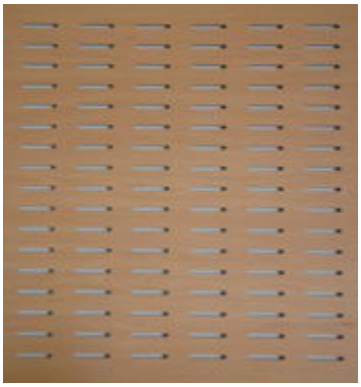
	Empty	Mineral wool 4 cm	Mineral wool 2,5 cm
NRC	0.10	0.40	0.40
α_m [1]	0.15	0.45	0.45

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
R32 Slots 6 mm (perf. 10,39%) (Plate 9)
Number of Slots: 102
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 8 cm (Total height of the plenum 2)
B = 0 cm empty
4,0 cm con mineral wool (*)
2,5 cm con mineral wool



Plot plenum 2:

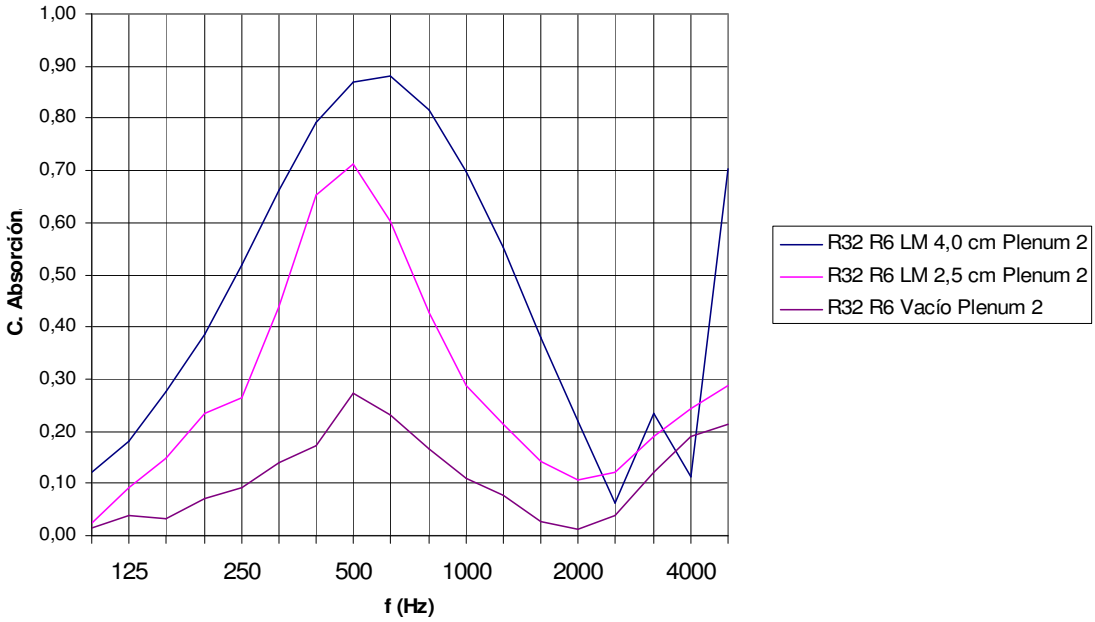


Table absorbing plenum 2:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,02	0,04	0,03	0,07	0,09	0,14	0,17	0,27	0,23	0,17	0,11	0,08	0,03	0,01	0,04	0,12	0,19
$\alpha_{min\ wool.}$ 4 cm (*)	0,12	0,18	0,28	0,39	0,52	0,66	0,79	0,87	0,88	0,82	0,70	0,55	0,38	0,22	0,06	0,23	0,11
$\alpha_{min\ wool.}$ 2,5 cm	0,02	0,09	0,15	0,23	0,26	0,44	0,65	0,71	0,60	0,43	0,29	0,21	0,14	0,11	0,12	0,19	0,24

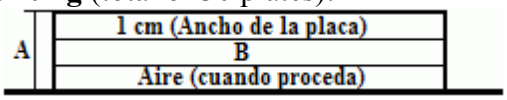
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 2:

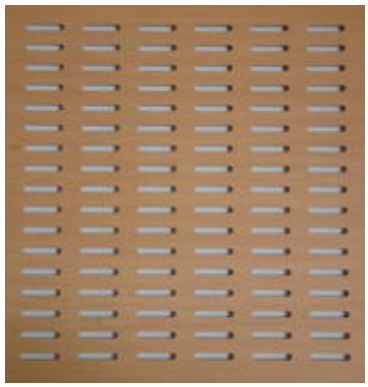
	Empty	Mineral wool 4 cm	Mineral wool 2,5 cm
NRC	0.15	0.55	0.35
α_m [1]	0.15	0.60	0.35

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
R32 Slots 10 mm (perf. 14,22%) (Plate 10)
Number of Slots: 102
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 5 cm (Total height of the plenum 1)
B = 0 cm empty
4,0 cm con mineral wool (*)
2,5 cm con mineral wool



Plot plenum 1:

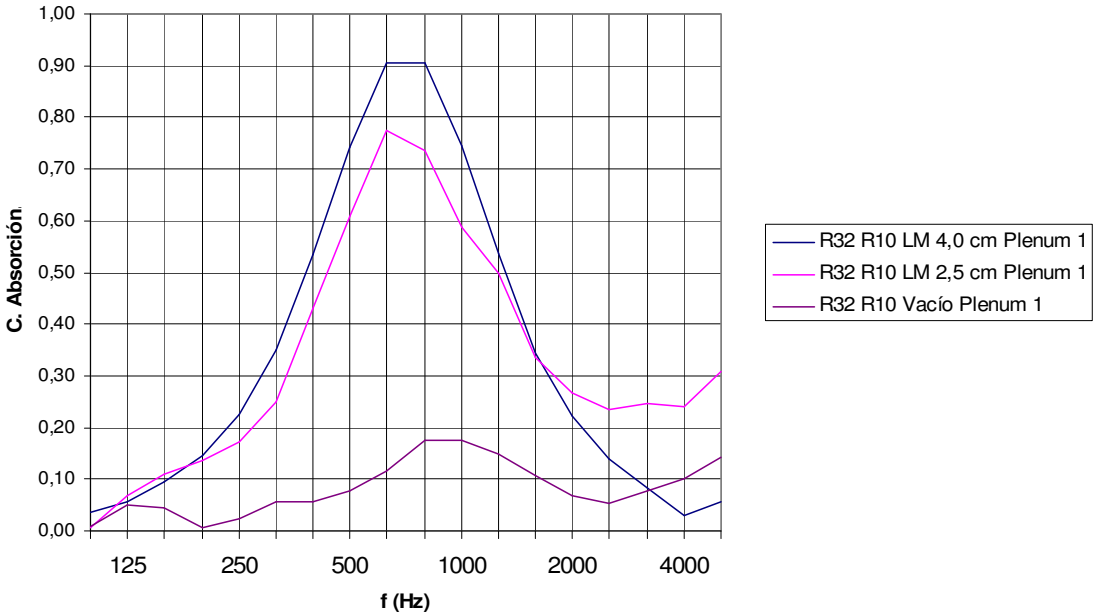


Table absorption plenum 1:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,01	0,05	0,05	0,00	0,02	0,06	0,06	0,08	0,11	0,17	0,17	0,15	0,11	0,07	0,05	0,08	0,10
$\alpha_{min\ wool.}$ 4 cm (*)	0,04	0,06	0,09	0,15	0,23	0,35	0,54	0,74	0,91	0,91	0,74	0,54	0,35	0,22	0,14	0,08	0,03
$\alpha_{min\ wool.}$ 2,5 cm	0,01	0,07	0,11	0,14	0,17	0,25	0,43	0,61	0,77	0,74	0,59	0,50	0,33	0,27	0,24	0,25	0,24

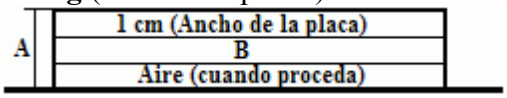
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 1:

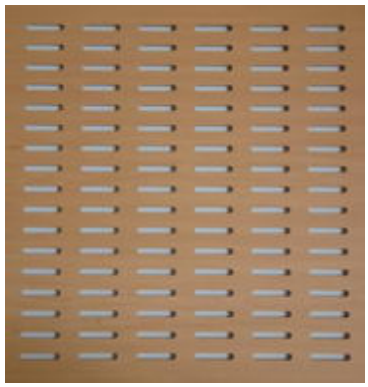
	Empty	Mineral wool 4 cm	Mineral wool 2,5 cm
NRC	0.10	0.50	0.45
α_m [1]	0.10	0.60	0.50

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
R32 Slots 10 mm (perf. 14,22%) (Plate 10)
Number of Slots: 102
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 8 cm (Total height of the plenum 2)
B = 0 cm empty
4,0 cm con mineral wool (*)
2,5 cm con mineral wool



Plot plenum 2:

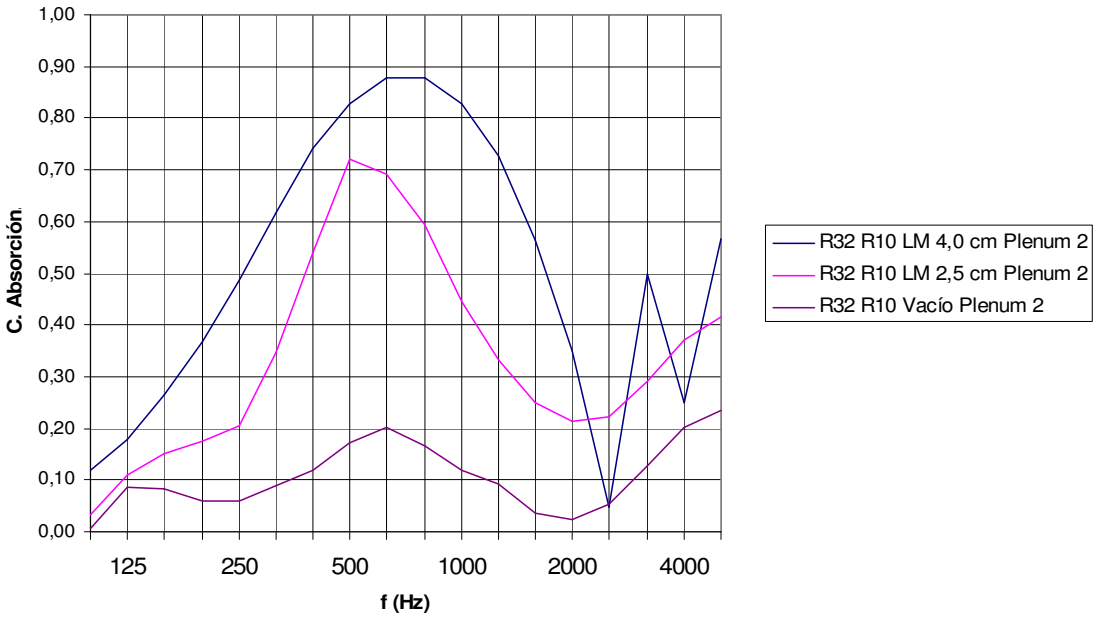


Table absorbing plenum 2:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,01	0,09	0,08	0,06	0,06	0,09	0,12	0,17	0,20	0,17	0,12	0,09	0,04	0,02	0,05	0,13	0,20
$\alpha_{min\ wool.}$ 4 cm (*)	0,12	0,18	0,27	0,37	0,49	0,62	0,74	0,83	0,88	0,88	0,83	0,73	0,56	0,35	0,05	0,50	0,25
$\alpha_{min\ wool.}$ 2,5 cm	0,03	0,11	0,15	0,17	0,20	0,35	0,54	0,72	0,69	0,59	0,45	0,33	0,25	0,21	0,22	0,29	0,37

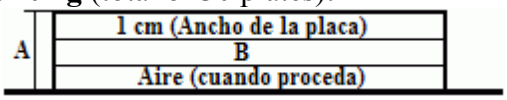
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 2:

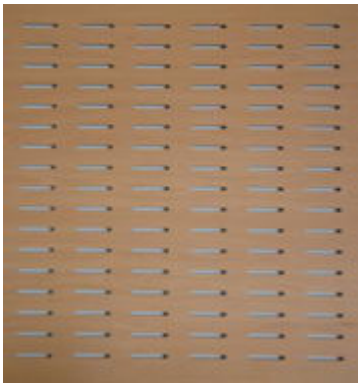
	Empty	Mineral wool 4 cm	Mineral wool 2,5 cm
NRC	0.10	0.60	0.40
α_m [1]	0.10	0.65	0.45

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
R16 Slots 6 mm (perf. 20,17%) (Plate 11)
Number of Slots: 198
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 5 cm (Total height of the plenum 1)
B = 0 cm empty
4,0 cm con mineral wool (*)
2,5 cm con mineral wool



Plot plenum 1:

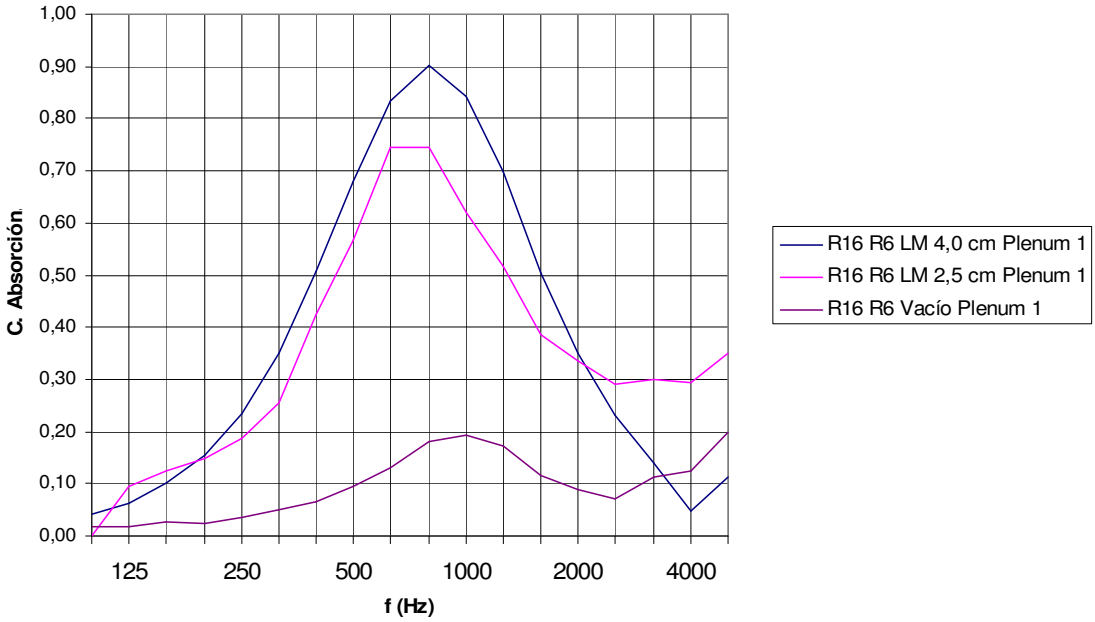


Table absorption plenum 1:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,02	0,02	0,03	0,02	0,04	0,05	0,06	0,09	0,13	0,18	0,19	0,17	0,12	0,09	0,07	0,11	0,12
$\alpha_{min\ wool.}$ 4 cm (*)	0,04	0,06	0,10	0,15	0,23	0,35	0,51	0,68	0,83	0,90	0,84	0,70	0,50	0,35	0,23	0,14	0,05
$\alpha_{min\ wool.}$ 2,5 cm	0,00	0,09	0,12	0,15	0,19	0,25	0,42	0,57	0,75	0,75	0,62	0,52	0,39	0,34	0,29	0,30	0,29

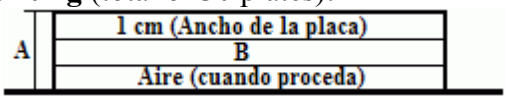
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 1:

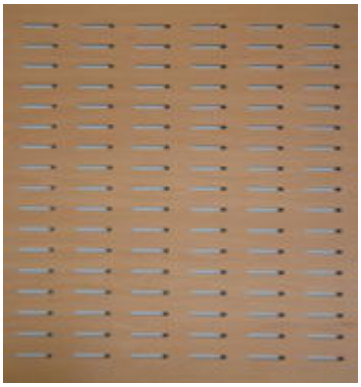
	Empty	Mineral wool 4 cm	Mineral wool 2,5 cm
NRC	0.10	0.50	0.45
α_m [1]	0.15	0.60	0.55

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
R16 Slots 6 mm (perf. 20,17%) (Plate 11)
Number of Slots: 198
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 8 cm (Total height of the plenum 2)
B = 0 cm empty
4,0 cm con mineral wool (*)
2,5 cm con mineral wool



Plot plenum 2:

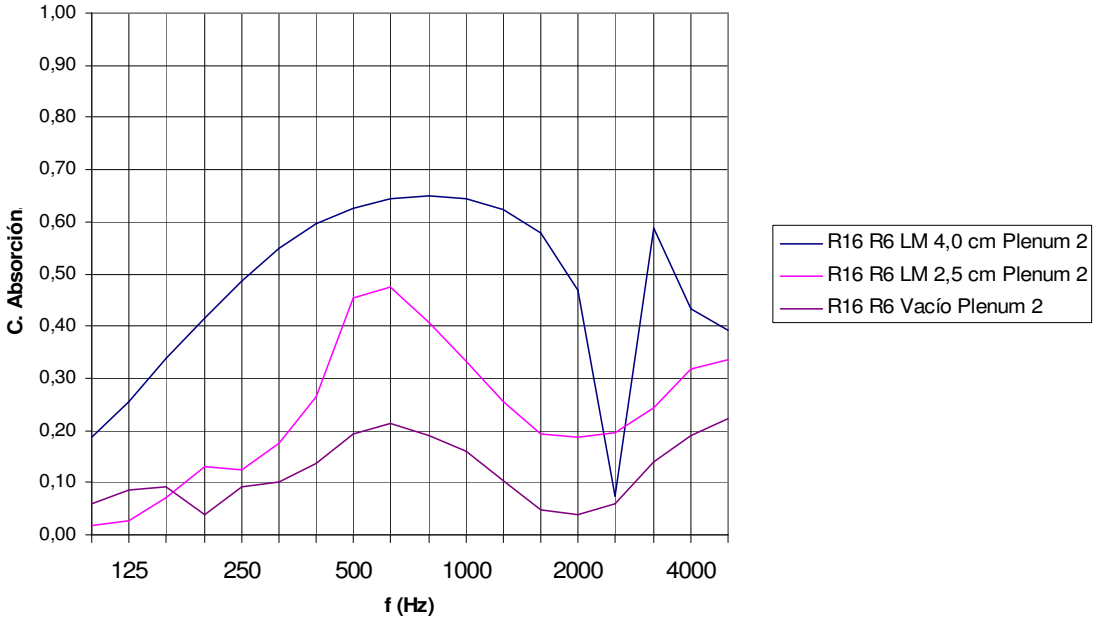


Table absorbing plenum 2:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,06	0,09	0,09	0,04	0,09	0,10	0,14	0,19	0,21	0,19	0,16	0,10	0,05	0,04	0,06	0,14	0,19
$\alpha_{min\ wool.}$ 4 cm (*)	0,19	0,26	0,34	0,42	0,49	0,55	0,60	0,63	0,64	0,65	0,64	0,62	0,58	0,47	0,07	0,59	0,43
$\alpha_{min\ wool.}$ 2,5 cm	0,02	0,03	0,07	0,13	0,12	0,18	0,27	0,45	0,48	0,41	0,33	0,26	0,19	0,19	0,20	0,24	0,32

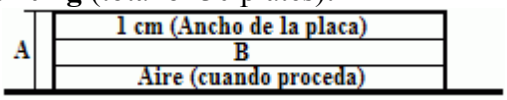
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 2:

	Empty	Mineral wool 4 cm	Mineral wool 2,5 cm
NRC	0.15	0.55	0.30
α_m [1]	0.15	0.55	0.30

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
G5R16 Slots 6 mm (perf. 16,50%) (Plate 12)
Number of Slots: 100
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 5 cm (Total height of the plenum 1)
B = 0 cm empty
4,0 cm con mineral wool (*)
2,5 cm con mineral wool

Plot plenum 1:

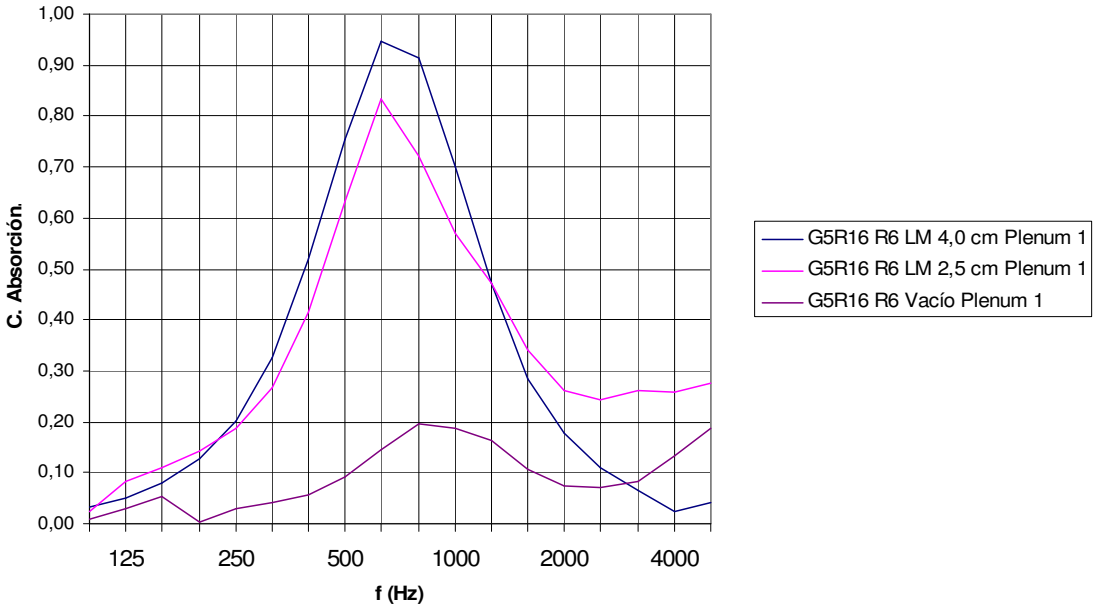


Table absorption plenum 1:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,01	0,03	0,05	0,00	0,03	0,04	0,06	0,09	0,15	0,20	0,19	0,16	0,11	0,07	0,07	0,08	0,13
$\alpha_{min\ wool.}$ 4 cm (*)	0,03	0,05	0,08	0,13	0,20	0,33	0,52	0,75	0,95	0,91	0,70	0,47	0,29	0,18	0,11	0,06	0,02
$\alpha_{min\ wool.}$ 2,5 cm	0,02	0,08	0,11	0,14	0,19	0,27	0,41	0,63	0,83	0,72	0,57	0,47	0,34	0,26	0,24	0,26	0,26

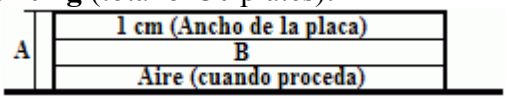
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 1:

	Empty	Mineral wool 4 cm	Mineral wool 2,5 cm
NRC	0.10	0.45	0.45
α_m [1]	0.15	0.55	0.50

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
G5R16 Slots 6 mm (perf. 16,50%) (Plate 12)
Number of Slots: 100
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 8 cm (Total height of the plenum 2)
B = 0 cm empty
4,0 cm con mineral wool (*)
2,5 cm con mineral wool

Plot plenum 2:

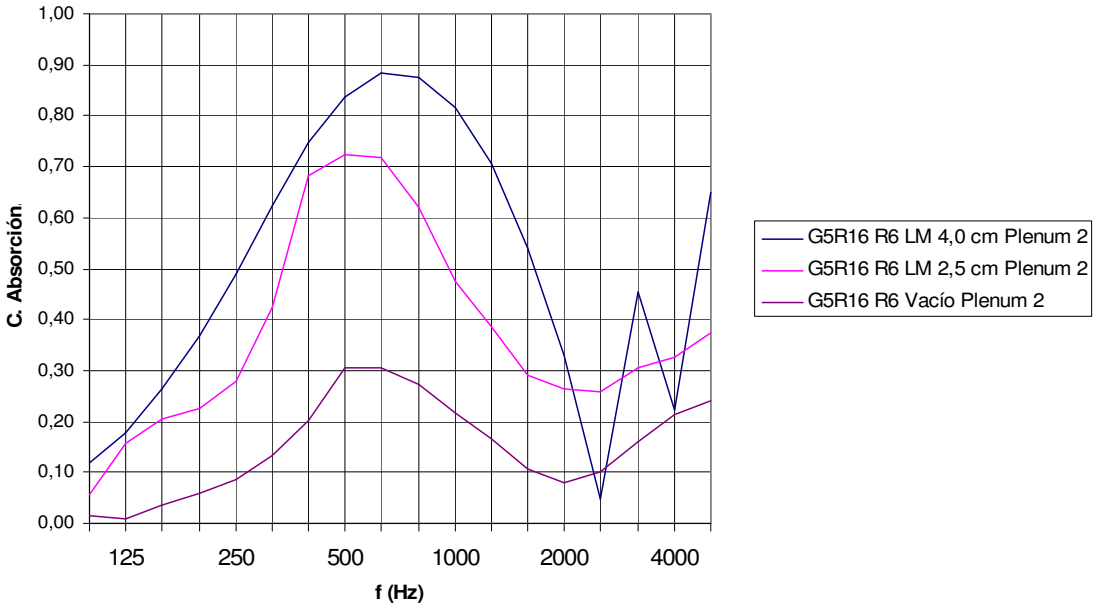


Table absorbing plenum 2:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,01	0,01	0,04	0,06	0,09	0,13	0,20	0,30	0,31	0,27	0,22	0,17	0,11	0,08	0,10	0,16	0,21
$\alpha_{min\ wool.}$ 4 cm (*)	0,12	0,18	0,26	0,37	0,49	0,62	0,75	0,84	0,88	0,88	0,82	0,71	0,54	0,33	0,05	0,45	0,22
$\alpha_{min\ wool.}$ 2,5 cm	0,06	0,16	0,21	0,23	0,28	0,43	0,68	0,73	0,72	0,62	0,48	0,39	0,29	0,26	0,26	0,31	0,32

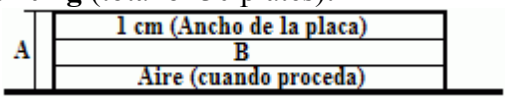
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 2:

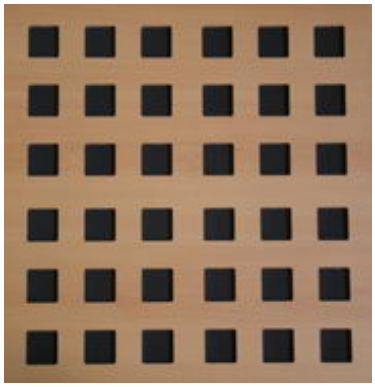
	Empty	Mineral wool 4 cm	Mineral wool 2,5 cm
NRC	0.15	0.60	0.45
α_m [1]	0.20	0.65	0.50

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
CU squares 50x50 mm (p. 25,59%) (Plate 13)
Number of squares: 36
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 5 cm (Total height of the plenum 1)
B = 0 cm empty
4,0 cm con mineral wool (*)
2,5 cm con mineral wool



Plot plenum 1:

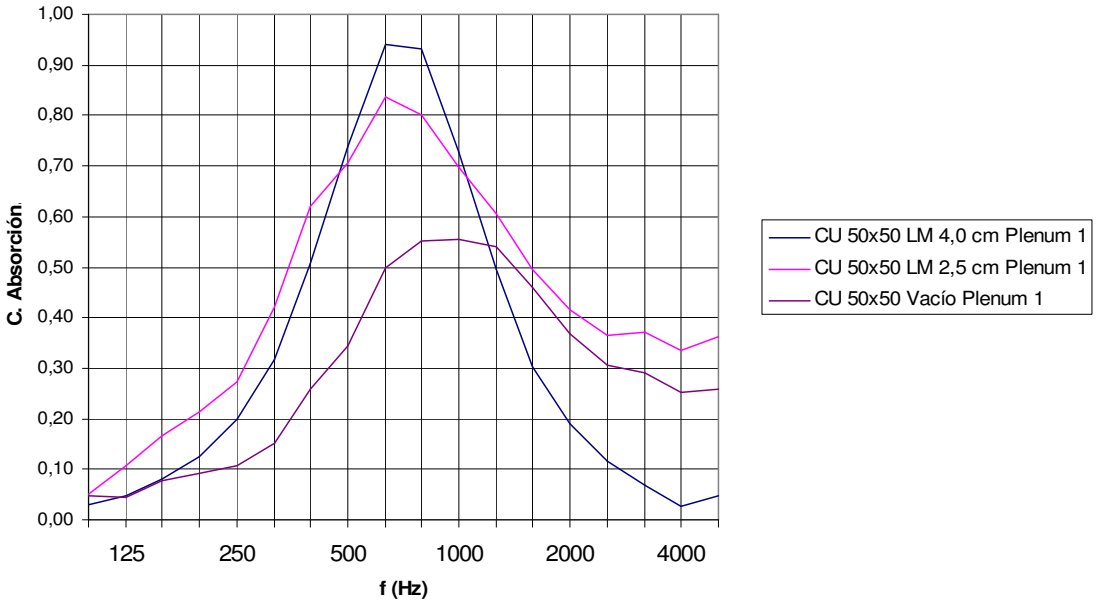


Table absorption plenum 1:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,05	0,04	0,08	0,09	0,11	0,15	0,26	0,35	0,50	0,55	0,56	0,54	0,46	0,37	0,31	0,29	0,25
$\alpha_{min\ wool.}$ 4 cm (*)	0,03	0,05	0,08	0,13	0,20	0,32	0,51	0,74	0,94	0,93	0,73	0,50	0,30	0,19	0,12	0,07	0,03
$\alpha_{min\ wool.}$ 2,5 cm	0,05	0,11	0,16	0,22	0,27	0,42	0,62	0,71	0,84	0,80	0,70	0,60	0,50	0,42	0,36	0,37	0,34

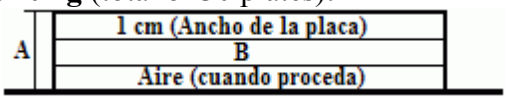
(*) Curve obtained with software developed in collaboration with DISAO group

Supplementary data plenum 1:

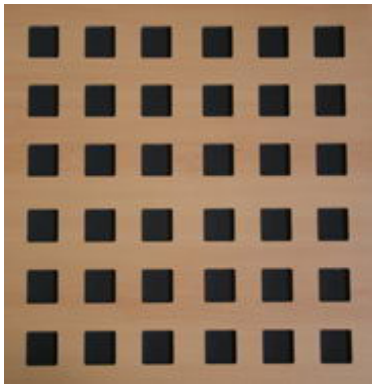
	Empty	Mineral wool 4 cm	Mineral wool 2,5 cm
NRC	0.35	0.45	0.55
α_m [1]	0.45	0.55	0.60

[1] average of value de 500, 1000 y 2000 Hz

Kind of plate:
CU squares 50x50 mm (p. 25,59%) (Plate 13)
Number of squares: 36
(Measurement according norm UNE 20354)
Mounting (total of 30 plates)**:**



A= 8 cm (Total height of the plenum 2)
B = 0 cm empty
4,0 cm con mineral wool (*)
2,5 cm con mineral wool



Plot plenum 2:

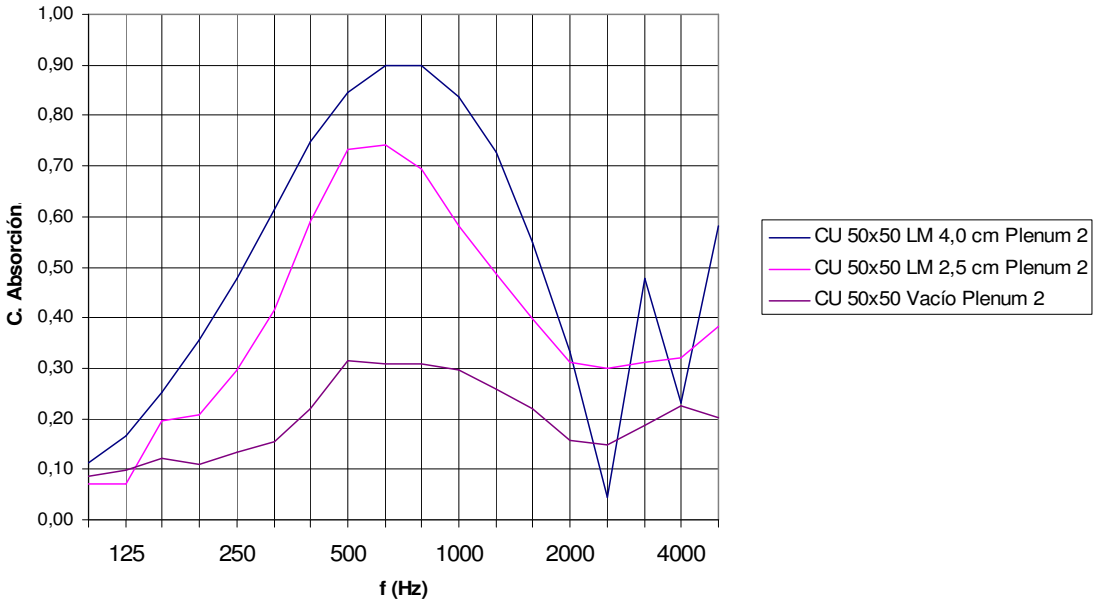


Table absorbing plenum 2:

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
α_{empty}	0,08	0,10	0,12	0,11	0,13	0,15	0,22	0,31	0,31	0,31	0,30	0,26	0,22	0,16	0,15	0,19	0,23
$\alpha_{min\ wool.}$ 4 cm (*)	0,11	0,17	0,25	0,36	0,48	0,61	0,75	0,84	0,90	0,90	0,84	0,73	0,55	0,33	0,04	0,48	0,23
$\alpha_{min\ wool.}$ 2,5 cm	0,07	0,07	0,19	0,21	0,30	0,42	0,59	0,73	0,74	0,69	0,58	0,49	0,40	0,31	0,30	0,31	0,32

(*) Curve obtained with software developed in collaboration with DISAO group

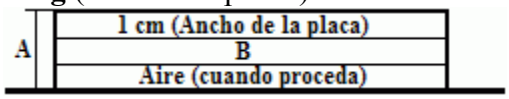
Supplementary data plenum 2:

	Empty	Mineral wool 4 cm	Mineral wool 2,5 cm
NRC	0.25	0.60	0.50
α_m [1]	0.25	0.65	0.55

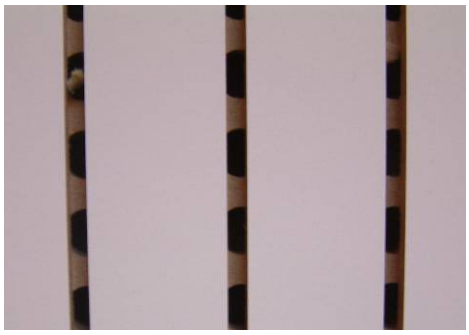
[1] average of value de 500, 1000 y 2000 Hz

4. IDEACUSTIC TEST REPORT

Kind of plate (ref.: plate 1)**:**
IDEACUSTIC SLATES- 32/4
(Measurement according norm UNE 20354)
Mounting (total of 16 plates)**:**



A= 5 cm (Total height of the plenum 1)
B = 0 cm en empty
4 cm With rock wool
4 cm With rock wool (*)



Plot plenum 1:

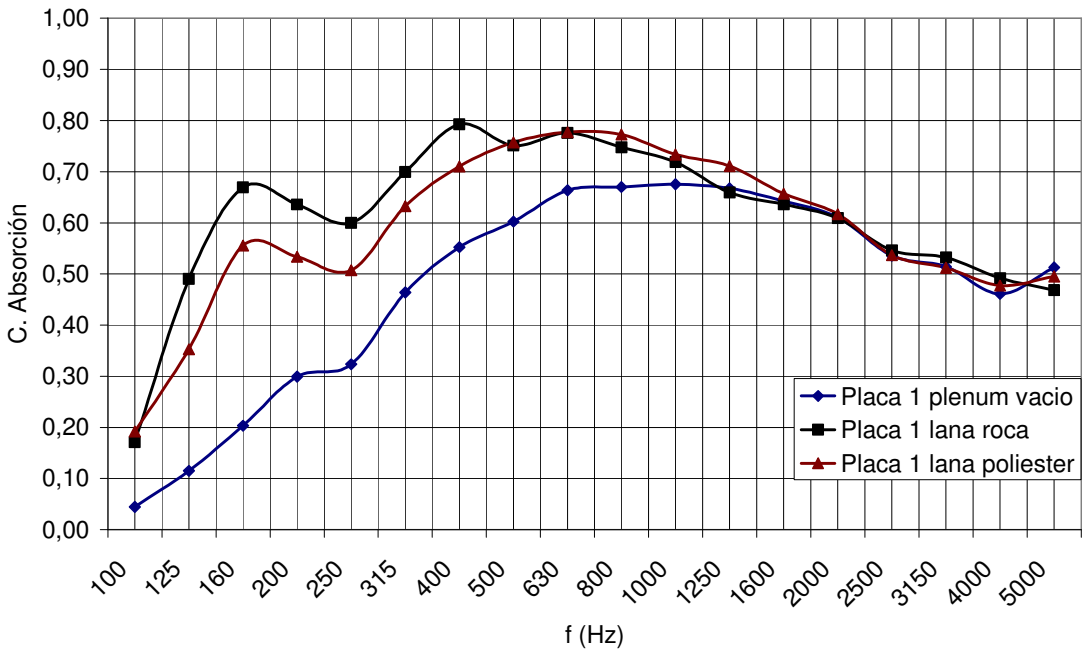


Table absorption plenum 1:

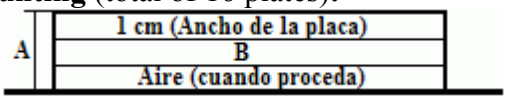
f (Hz)	125	250	500	1000	2000	4000
α_{empty}	0,12	0,36	0,61	0,67	0,60	0,50
$\alpha_{rock\ wool}$ 4 cm	0,44	0,65	0,77	0,71	0,60	0,50
$\alpha_{rock\ wool}$ 2,5 cm (*)	0,37	0,56	0,75	0,74	0,60	0,49

Supplementary data plenum 1:

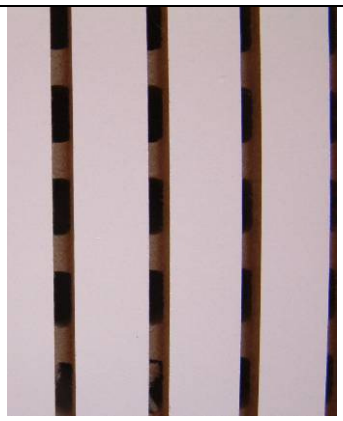
	Empty	Rock wool 4 cm	Rock wool 2,5 cm
α_{ω}[1]	0,60	0,70	0,70
Clase[1]	C	C	C
NRC[2]	0,55	0,65	0,65

[1] **según norma ISO 11654.**
[2] **según normativa americana ASTM C-423.**

Kind of plate (ref.: plate 2)**:**
IDEACUSTIC SLATES - 16/3
(Measurement according norm UNE 20354)
Mounting (total of 16 plates)**:**



A= 5 cm (Total height of the plenum 1)
B = 0 cm en empty
4 cm With rock wool
4 cm With rock wool (*)



Plot plenum 1:

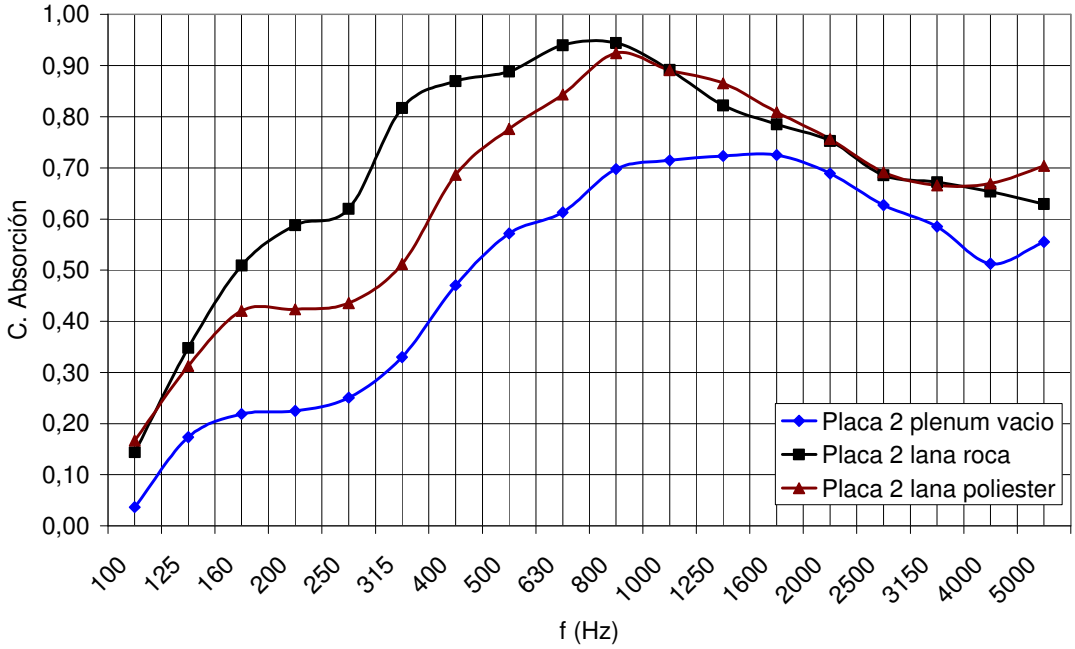


Table absorption plenum 1:

f (Hz)	125	250	500	1000	2000	4000
α_{empty}	0,14	0,27	0,55	0,71	0,68	0,55
$\alpha_{rock\ wool}$ 4 cm	0,33	0,67	0,90	0,89	0,74	0,65
$\alpha_{rock\ wool}$ 2,5 cm (*)	0,30	0,46	0,77	0,89	0,75	0,68

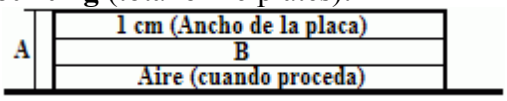
Supplementary data plenum 1:

	Empty	Rock wool 4 cm	Rock wool 2,5 cm
α_w[1]	0,65	0,85	0,80
Clase[1]	C	B	B
NRC[2]	0,55	0,80	0,70

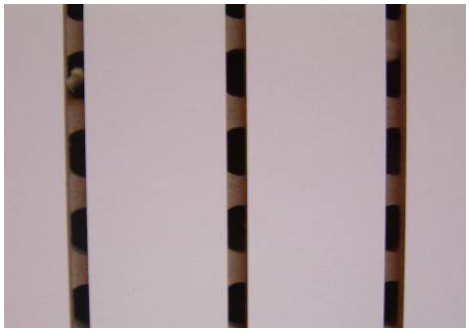
[1] **según norma ISO 11654.**
[2] **según normativa americana ASTM C-423.**

Kind of plate (ref.: plate 1)**:**

IDEACUSTIC SLATES - 32/4
(Measurement according norm UNE 20354)
Mounting (total of 16 plates)**:**



A= 21 cm (Total height of the plenum 2)
B = 0 cm en empty
4 cm With rock wool
4 cm With rock wool (*)



Plot plenum 2:

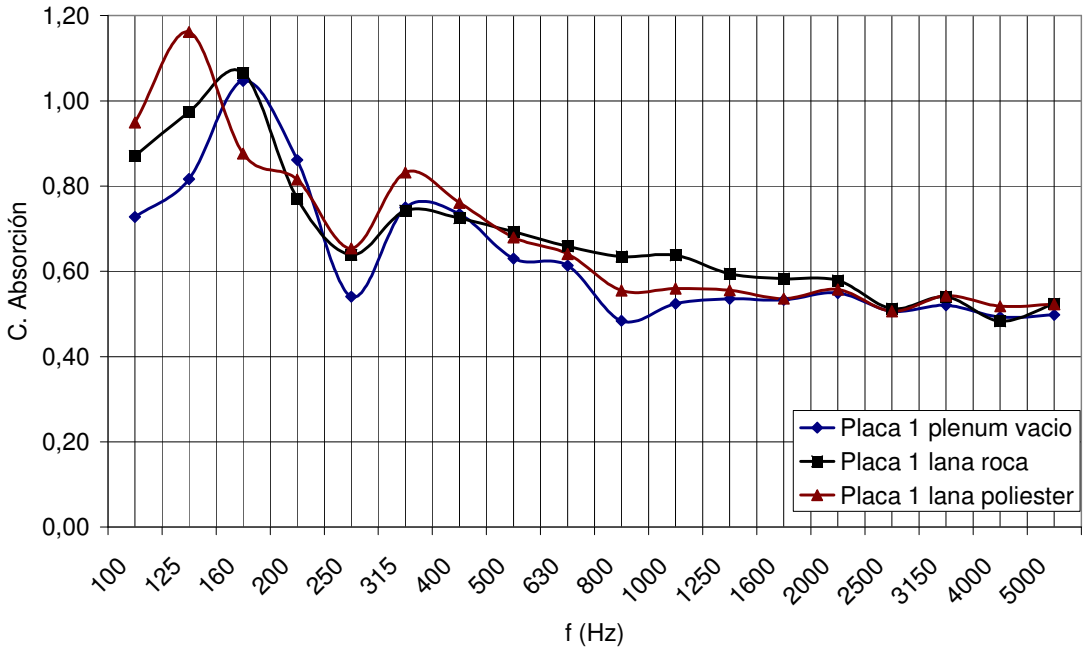


Table absorption plenum 2:

f (Hz)	125	250	500	1000	2000	4000
α_{empty}	0,86	0,72	0,66	0,51	0,53	0,50
$\alpha_{rock\ wool}$ 4 cm	0,97	0,72	0,69	0,62	0,56	0,52
$\alpha_{rock\ wool}$ 2,5 cm (*)	1,00	0,77	0,69	0,56	0,53	0,53

Supplementary data plenum 2:

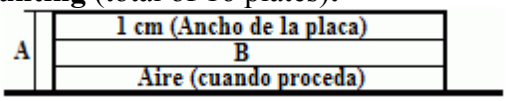
	Empty	Rock wool 4 cm	Rock wool 2,5 cm
α_{ω}[1]	0,65	0,70	0,70
Clase[1]	C	C	C
NRC[2]	0,60	0,65	0,65

[1] **según norma ISO 11654.**
[2] **según normativa americana ASTM C-423.**

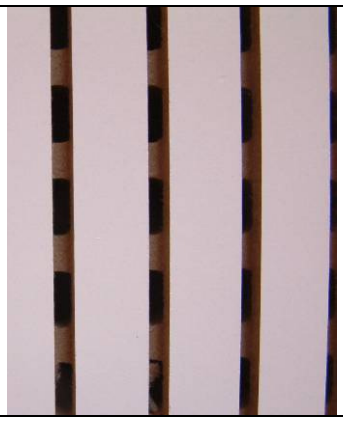
Kind of plate (ref.: plate 2)**:**
IDEACUSTIC SLATES - 16/3

(Measurement according norm UNE 20354)

Mounting (total of 16 plates)**:**



A= 21 cm (Total height of the plenum 2)
B = 0 cm en empty
4 cm With rock wool
4 cm With rock wool (*)



Plot plenum 2:

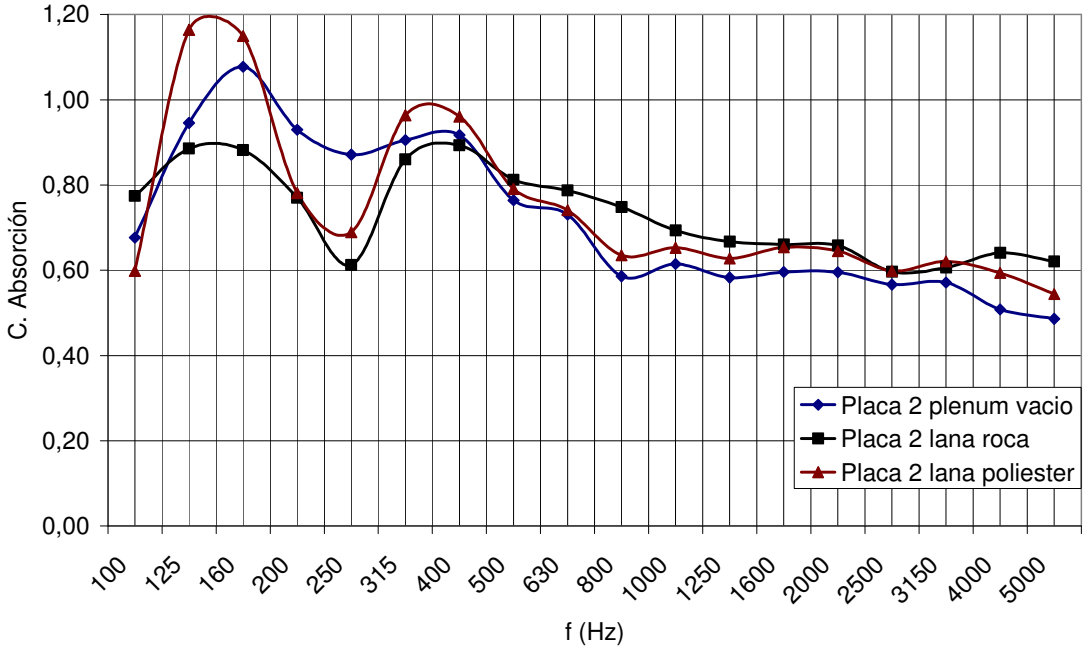


Table absorption plenum 2:

f (Hz)	125	250	500	1000	2000	4000
α_{empty}	0,90	0,90	0,80	0,59	0,59	0,52
$\alpha_{rock\ wool}$ 4 cm	0,85	0,75	0,83	0,70	0,64	0,62
$\alpha_{rock\ wool}$ 2,5 cm (*)	0,97	0,81	0,83	0,64	0,63	0,59

Supplementary data plenum 2:

	Empty	Rock wool 4 cm	Rock wool 2,5 cm
α_{ω}[1]	0,75	0,80	0,80
Clase[1]	C	B	B
NRC[2]	0,75	0,75	0,75

[1] **según norma ISO 11654.**
[2] **según normativa americana ASTM C-423.**

5. APLICATIONS EXEMPLES OF IDEATEC PANELS.

Following we made 3 applications examples of Ideatec panels. For those examples we use the parameter established in the new building technical code. The principal parameter that we use is the reverberation time (RT), definite by the time go by the emitter stops and the moment when the sound goes 60dB down his initial.

EXAMPLE 1 – MEETING ROOM

In this case we simulate a meeting room, who by the way of the new building technical code must have to get a maximum RT of 0.7seconds. Our room is rectangular, with a volume of 216 m^3, with 6 m wide, 12 m long and 3 m high. In the room we cover the two lateral walls and the back wall and in the roof we made a square of 3x9 m with IDEATEC panels.

The covering made with IDEATEC panels R32(slotted32) of 6 mm, rock wool of 4cm and a plenum of 5 cm. For this calcule we use the average value "α_m" which is value is 0,55.
The square of the roof is made with IDEATEC panels mechanising with CU (Squares) of 50x50 mm, mineral wool of 2,5 cm and with plenum of 8 cm. In this case the value of the "α_m" is 0,60.

The calculs to realise are.

$$RT = 0{,}161 \cdot \frac{V}{A_{tot}} \text{ in seconds}$$

Where

V = volume of the room (m^3)
A_{tot} = Total absorption of the room (definite following)

$$A_{tot} = \alpha_1 S_1 + \alpha_2 S_2 + \ldots\ldots + \alpha_n S_n$$

Where:

α = correspond to the value α_m of each IDEATEC panels
S = surface of each kind of IDEATEC panel, in Sqm

In our case we have 3 walls covered with IDEATEC wall panels mechanising with slots R32:

$$\mathbf{A_{walls}} = 2 \cdot \alpha_{R32} \cdot S_1 + \alpha_{R32} \cdot S_2 = 2 \cdot 0{,}55 \cdot 12 \cdot 3 + 0{,}55 \cdot 6 \cdot 3 = \mathbf{49{,}5}$$

For the roof we use the IDEATEC panels mechanising with CU(squares), so we have this calcul:

$$\mathbf{A_{roof}} = \alpha_{CU} \cdot S_3 = 0{,}60 \cdot 3 \cdot 9 = \mathbf{16{,}2}$$

So: $\mathbf{A_{tot}} = A_{walls} + A_{roof} = 49{,}5 + 16{,}2 = \mathbf{65.7}$

And with this calcul we can obtain the RT value of the room with Ideatec wall panels covering.

$$RT = 0.161 \cdot \frac{250}{65.7} = 0.61 \text{ seconds}$$

Now we can check that the RT value is lower than 0.7 seconds like the normative tell us that had to be, so using the IDEATEC panels we obtain a meeting room with a reverberation time lower than the maximum limit established by the normative

EXAMPLE 2 – RESTAURANT

In this case we simulate a restaurant, who by the way of the new building technical code must have to got a maximum RT of 0.9seconds. Our restaurant got a volume of 960 m^3, with 12 m wide, 20 m long and 4 m high. In the restaurant we cover the four lateral walls until half high (2m) and the entire roof with IDEATEC panels.
So the surfaces to cover are:

- 2 walls of 12 m with 2 m tall, so a total of 48 Sqm (S_1)
- 2 walls of 20 m with 2 m tall, so a total of 80 Sqm (S_2)
- 1 roof of 20 m with 12 m, so a total of 240 Sqm (S_3)

The covering will be made with IDEATEC panels mechanising with T16 of 8mm of diameter, with rock wool of 4 cm, Plenum of 5 cm and a value of "α_m" of 0.55.
The roof Hill made with IDEATEC panels mechanising with G5x5T16 de 8 mm of diameter, with rock wool of 4 cm, Plenum of 5 cm and a value "α_m" of 0.55.

With all this information we calcule the RT that we obtain with the offer we realise:

$$\mathbf{A_{wall}} = 2 \cdot \alpha_{T16} \cdot S_1 + 2 \cdot \alpha_{T16} \cdot S_2 = 0{,}55 \cdot 48 + 0{,}55 \cdot 80 = \mathbf{70{,}4}$$
$$\mathbf{A_{roof}} = \alpha_{G5x5T16} \cdot S_3 = 0{,}55 \cdot 240 = \mathbf{132}$$

$$\mathbf{A_{total}} = A_{walls} + A_{roof} = 70{,}4 + 132 = \mathbf{202{,}4}$$

So the RT will be:

$$RT = 0{,}161 \cdot \frac{V}{A_{tot}} = 0{,}161 \cdot \frac{960}{202{,}4} = 0{,}76 \text{ seconds}$$

Now we can check that the RT value is lower than 0.76 seconds like the normative tell us that had to be, so using the IDEATEC panels we obtain a restaurant with a reverberation time lower than the maximum limit established by the normative

EXAMPLE 3 – OFFICIES

In this case we realise the stud for offices, with a volume very smaller. Per example an office of 37.5 m^3, with dimensions of 3 m wide, 5 m long y 2,5 m high. In this case we simulate an office with a volume very small and the new building technical code doesn't give any limit value, but we consider a maximum RT of 0.4 seconds. We cover the walls of the office with IDEATEC.
So the surfaces to cover are:

- 2 walls of 5 m per 2,5 m high, with a total of 25 Sqm (S_1)
- 2 walls of 3 m per 2,5 m high, with a total of 15 Sqm (S_2)

The covering chooses in this case are IDEATEC panels mechanising with R32 (SLOT 32) of 6mm, mineral wool of 2.5, plenum of 5cm and a value "α_m" of 0.45. So the value RT was the following:

$$\mathbf{A_{total}} = \mathbf{A_{walls}} = \alpha_{R32} \cdot S_1 + \alpha_{R32} \cdot S_2 = 0{,}45 \cdot 25 + 0{,}45 \cdot 15 = \mathbf{20{,}25}$$

$$RT = 0{,}161 \cdot \frac{V}{A_{tot}} = 0{,}161 \cdot \frac{37{,}5}{20{,}25} = 0{,}3 \text{ seconds}$$

Now we can check that the RT value is lower than 0.3 seconds than the 0.4 seconds we consider appropriate in this case

ANNEX I

The experimental equipment used for the measurements is listed below:

- Sound Calibrator: Portable Brüel & Kjaer calibrator. Model 4231 with 94 dB SPL-1000 Hz. Serial number 1800567. IEC 942, 1988 Class 1 & ANSI S 1.40-1984

- Brüel & Kjaer Soundlevelmeter model 2144, Serial number 1875142.

- Conderser's microphone and preamplifiers (Bruël & Kjaer)

Model	Serial number	Class
Microphone 4189 (Channel 1)	2146140	Class 1
Microphone 4192 (Channel 2)	2148495	Class 1
Preamplifier 2669	1865626	Class 1
Preamplifier 2669	2148495	Class 1

- Multichannel analyzer 01dB. Model Symphonie, Serial number: 00282. Class 1.