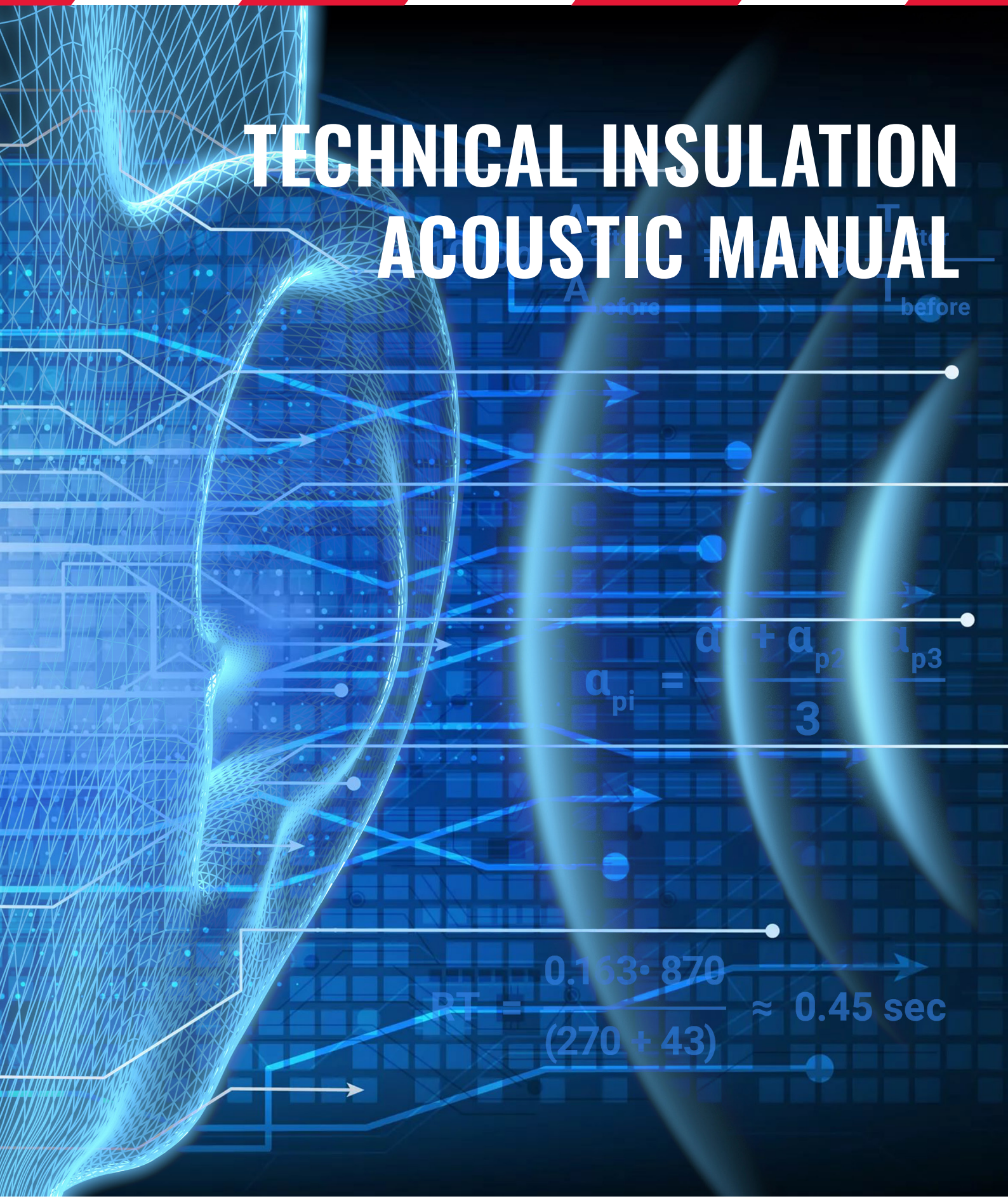
TECHNICAL INSULATION ACOUSTIC MANUAL



OWENS CORNING® PAROC®

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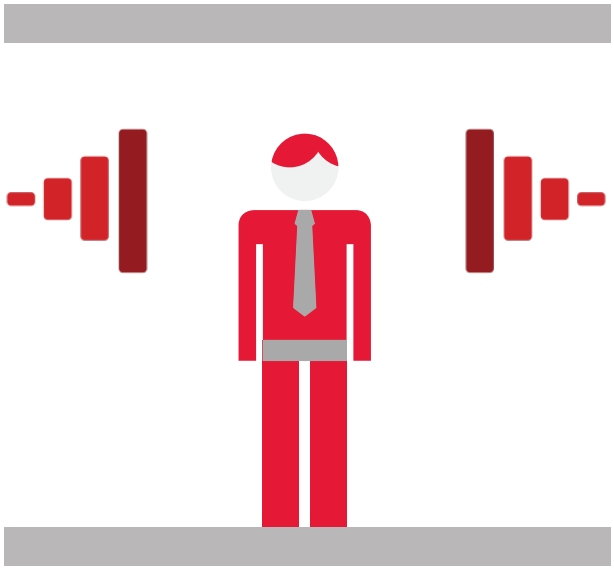
SOUND ABSORPTION

A material's sound absorbing properties are expressed by the sound absorption coefficient, α, (alpha), as a function of the frequency. α ranges from 0 (total reflection) to 1.00 (total absorption).

The sound absorption coefficient is normally measured by the room method. The measurements are done in a large room, reverberation room, which is designed to create a diffuse or random incidence sound field (i.e. one with a uniform distribution of acoustic energy and random direction of sound incidence over a short time period).

The measuring method follows an international standard designated EN ISO 354. Sound absorbing properties are classified according to EN ISO 11654.



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EXPLANATION OF DEFINITIONS

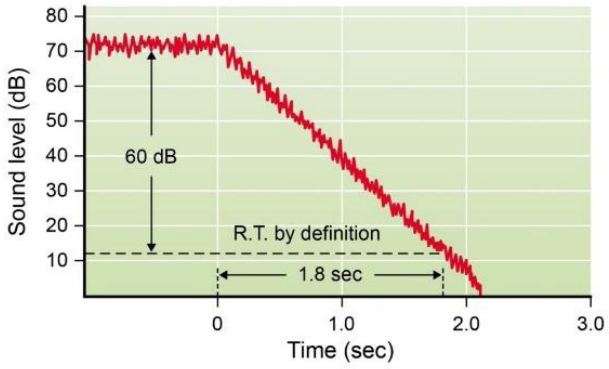
Reverberation time

The reverberation time is defined as the time it takes for the sound energy to decrease 60 dB after the sound source has been switched off. A relationship between the reverberant time, the volume and the total sound absorbent area of a room was developed by Sabine.

The Sabine formula:

$$RT = \frac{0.163V}{A}$$

RT = Reveberation time, sec
V = Room volume m^3
S = Surface area for the different parts of the room
α = Sound absorption coefficient. Material constant which indicates the ability to absorb sound. Varies between 0 (total reflection) to 1 (total absorption) and is frequency dependent.
A = α·S for the areas in the room



Following formula is used when performing the measurements of the absorption coefficient.

You Measuring the reverberation time in the empty room and then place the test sample in the room and measure the time again. The measurement is performed in 1/3-octave band.

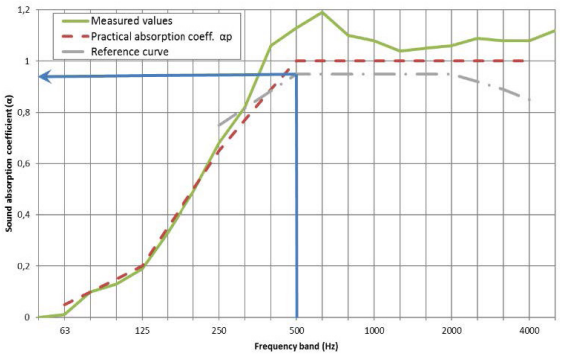
$$\alpha = \frac{0.163V}{S}\left(\frac{1}{T_s} - \frac{1}{T_e}\right)$$

Practical and weighted sound absorption coefficient

The practical absorption coefficient α_p is the average value of the three 1/3 -octave band values in one octave band. The practical absorption coefficient cannot exceed one, see the red dotted line.

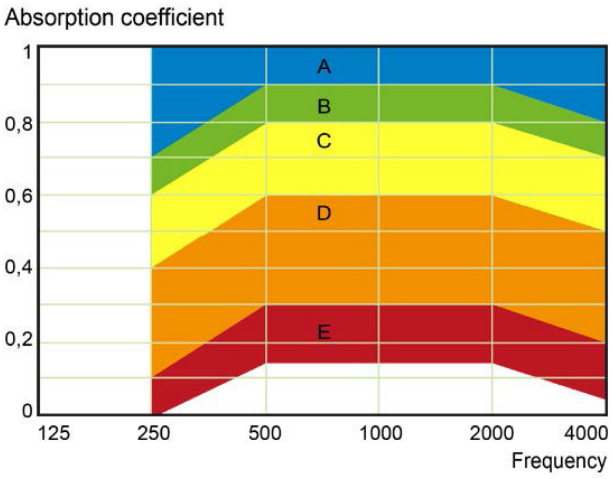
$$\alpha_{pi} = \frac{\alpha_{p1} + \alpha_{p2} + \alpha_{p3}}{3}$$

The weighted sound absorption coefficient (α_w) is a result from comparison between the practical sound absorption coefficient values at standard frequencies and a reference curve (grey) in accordance with ISO 11654.



Sound absorption class

EN ISO 11654 is also used to classify the sound absorption materials based on the measured absorption curves, α_p, to categories from A to E. Class A with a practical absorption coefficient in the blue area, has the best ability to absorb sound, and E has the weakest.



NRC, Noise reduction coefficient

NRC is an average value of absorption at four octave frequencies 250, 500, 1000 and 2000 Hertz. Materials with the same NRC rating can 'sound' very different!

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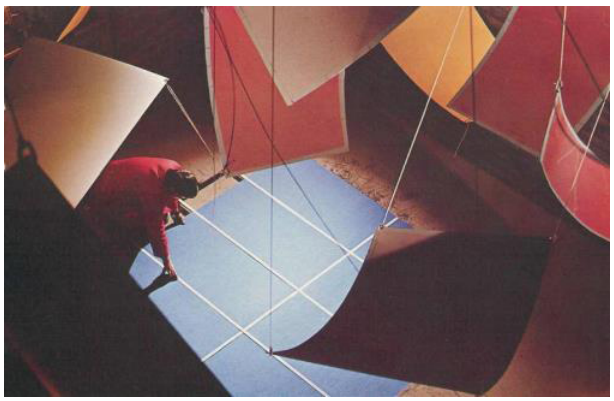
Measurements

The measurements are performed according to the reverberation room method EN ISO 354:2003 and evaluated according EN ISO 11654:1997.

The test objects have been placed directly on the floor in the room.

For products with aluminum foil as coating all visible joints are taped except for wired mats.



Test sample in a reverberation room.

Absorption coefficients of some common materials

Following table shows the absorption coefficient of some common materials. It has to be seen as a guidance.

Material	Frequency Hz					
	125	250	500	1000	2000	4000
Concrete	0,02	0,02	0,02	0,04	0,05	0,05
Gypsum board, solid backing	0,03	0,03	0,02	0,03	0,04	0,05
Gypsum board, on studs	0,3	0,15	0,1	0,05	0,04	0,05
Curtains	0,10	0,15	0,40	0,55	0,60	0,60
Carpet, Haircord on felt	0,10	0,15	0,25	0,30	0,30	0,30
Mineral wool, 50 mm	0,20	0,65	1,00	1,00	1,00	1,00

Sometimes it is necessary to provide a porous absorbent such as mineral wool with a protective surface layer. Under certain conditions this may occur without affecting the absorber. Plastic film up to 0.03 mm or 0.01 mm Al-foil has negligible impact. A perforated steel sheet also has little effect if the perforation is greater than 20%. Thicker or denser surface layers reduce the sound absorption at higher frequencies and may increase at lower frequencies. Painting the absorbent layer has an effect similar to applying a surface coating. A thick layer of coating color can completely destroy the absorption.

The great majority of sound absorbing materials are of the porous and/or fibrous type. Factors that affect the absorption include porosity, tortuosity or airflow resistance and can be used in theoretical models to predict the sound absorption. These calculations do not replace measurements of actual products in a laboratory The airflow resistance is the resistance experienced by air as it passes through a material. This property is directly related to the capacity of the material to absorb sound energy.

EXAMPLE

We will acoustically regulate a small workshop room. The desired reverberation time should be no more than 0.6 seconds at 500 Hz. We have measured the current reverberation time to be 3.3 seconds.

Input data:

Dimensions of the room: length 20 m, width 15 m and height 2,9 m.

This gives the volume of the room: 870 m^3

Using Sabine formula (page 5) we can calculate the existing absorption area:

$$\mathbf{RT = \frac{0.163V}{A}\ gives\ the\ absorption\ area}$$

$$\mathbf{A = \frac{0.163 \cdot 870}{3{,}3} = 43\ m^2\ Sabine}$$

Using the same formula, we also get the needed absorption area to be 236 m^2 Sabine.

Suppose we choose to fix the ceiling with an absorbent with absorption factor 0.9 at 500 Hz.

Area of the roof is 300 m^2 and this gives an added absorption area of $0.9 \cdot 300 = 270\ m^2$

$$\mathbf{RT = \frac{0.163 \cdot 870}{(270 + 43)} \approx 0.45\ sec}$$

(normally the absorption from the existing roof should be counted).

What can be noted is that the absorption factor in combination with the amount of absorbent is what determines the result.

Sound level reduction

Sound level reduction differs in different parts of the sound field. Close to the sound source is the direct field. The sound level in the direct field is not affected by actions in the room. Outside this field we find ourselves in the reverberation field and the sound absorption plays a big role. The sound level reduction in the reverberation field is determined as follows:

$$\mathbf{L_{after} = 10\ log\ \frac{A_{after}}{A_{before}} = 10\ log\ \frac{T_{after}}{T_{before}}}$$

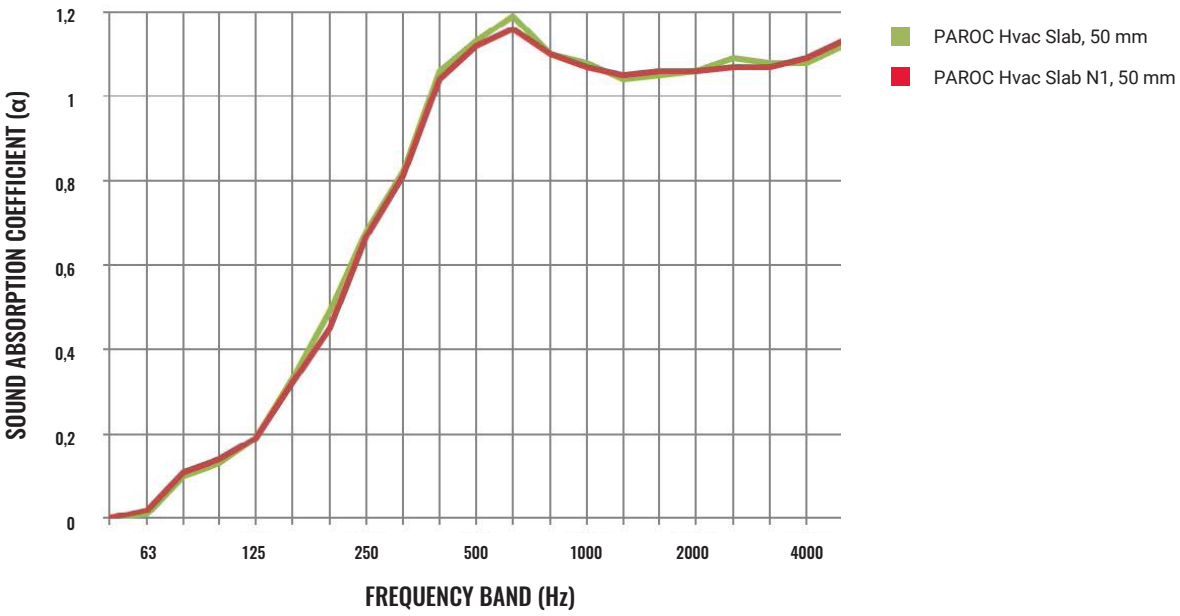
$\mathbf{L_{after}}$ = Sound level reduction
A = Absorption area
T = Reverberation time

In our example then:

$$\mathbf{L_{after} = 10\ log\ \frac{A_{after}}{A_{before}} = 10\ log\ \frac{270 + 43}{43} = 8\ dB}$$

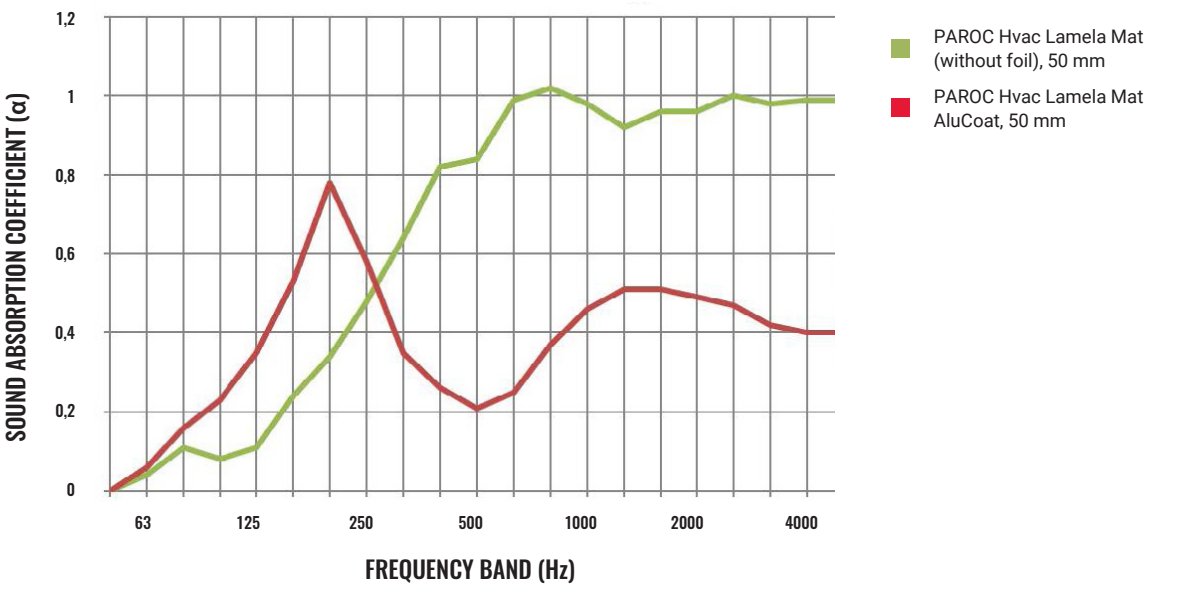
INFLUENCE OF FACINGS

Influence of facing



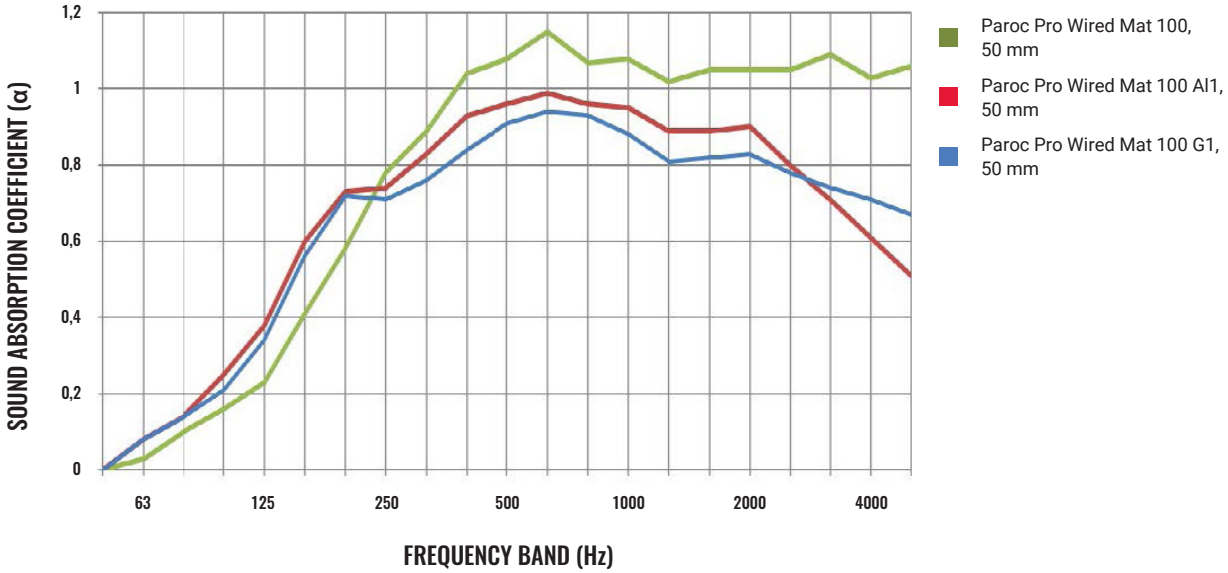
A permeable surface layer does not affect sound absorption

Influence of facing



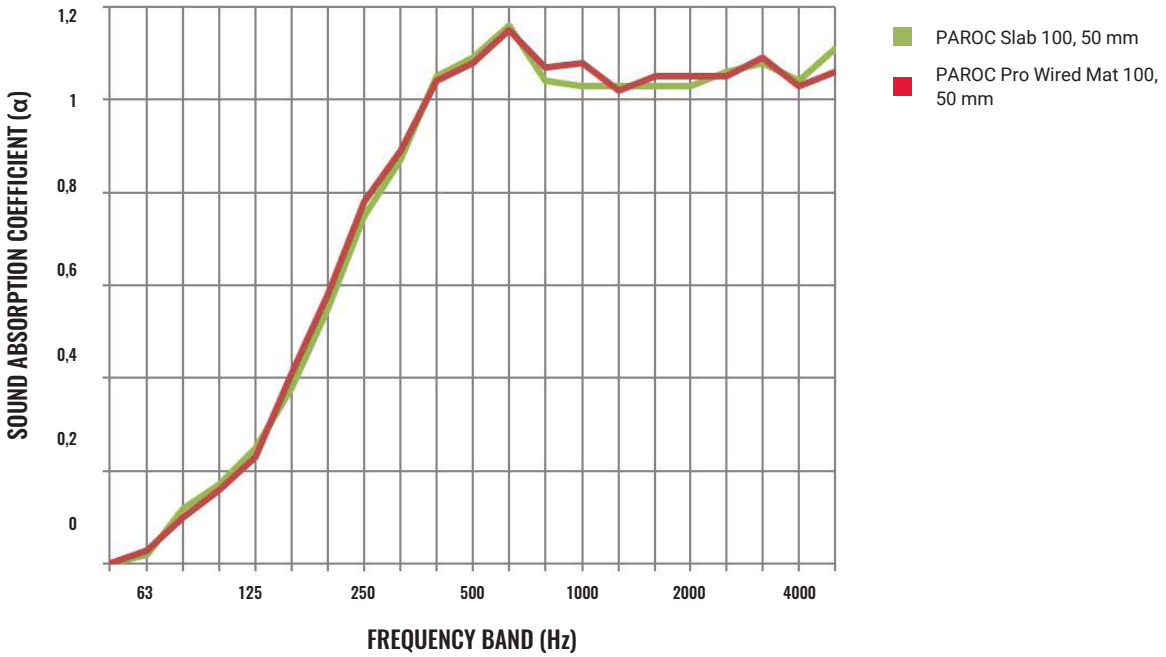
A slightly heavier surface layer affects the sound absorption. You can see that it gives a resonance phenomenon at 200 Hz.

Influence of facing



INFLUENCE OF PRODUCT TYPE

Different product type with same density



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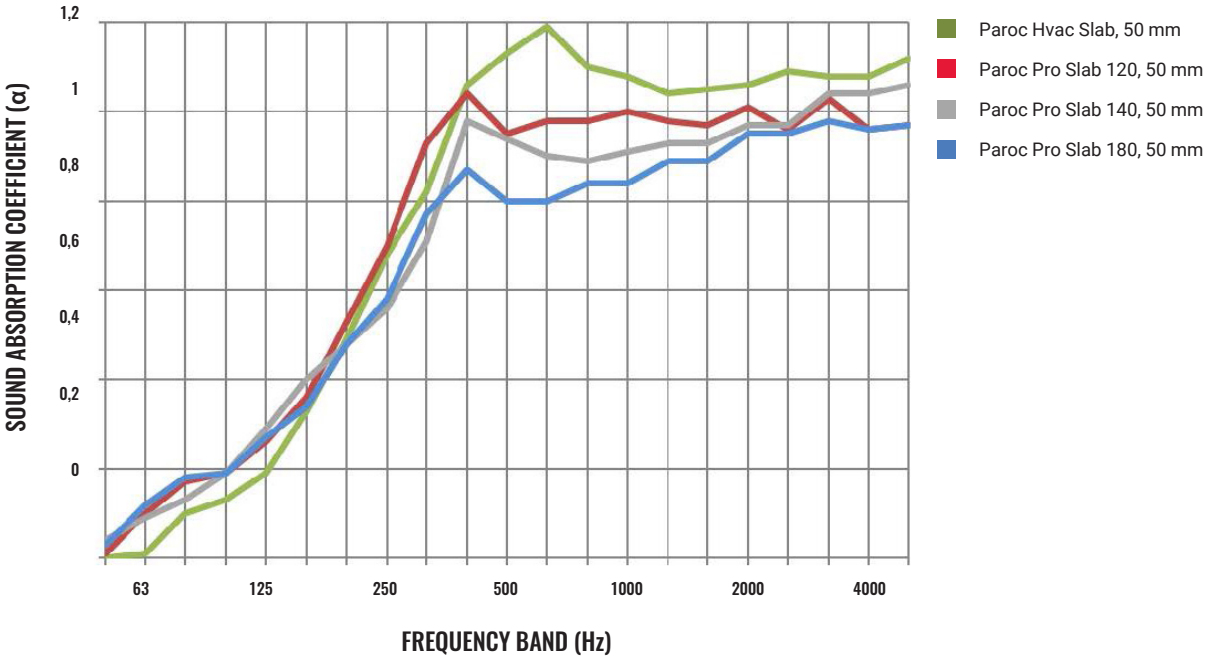
INFLUENCE OF DENSITY

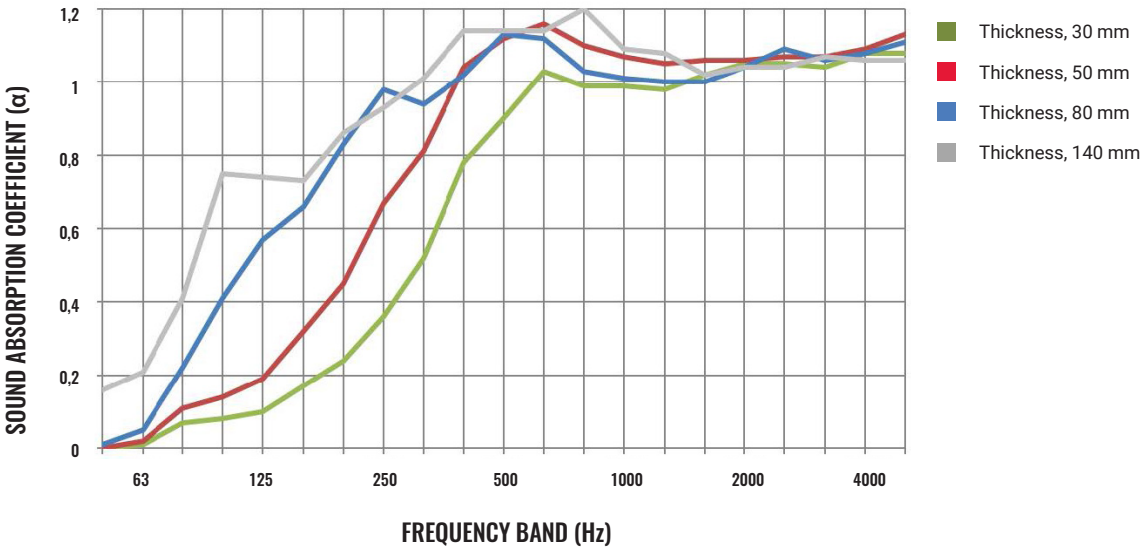
Influence of density



The figure shows that optimum density for sound absorption is around 60-70 kg / m³ (PAROC Hvac Slab). At higher densities, sound absorption decreases.

INFLUENCE OF THICKNESS

Influence of thickness, PAROC Hvac Slab

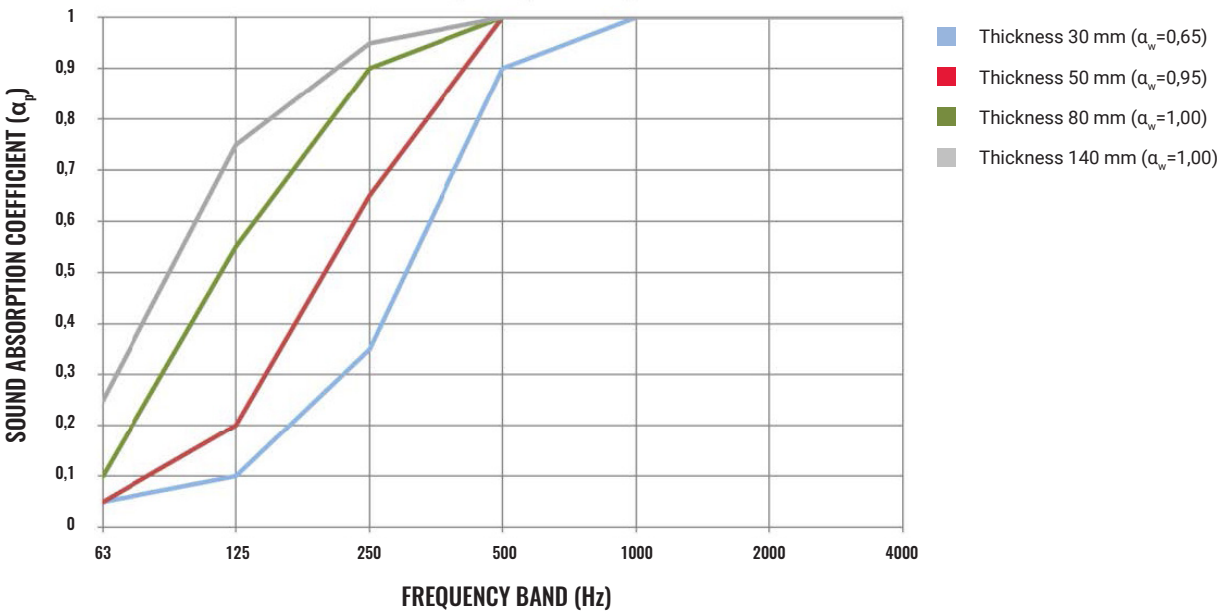


Thicker insulation provides better sound absorption in the lower frequency range. You can also increase the sound absorption at low frequencies by mounting the absorbent at a distance to the backed surface

Product	Density, kg/m³	Thickness, mm	α_w	Diagram
PAROC Hvac Slab	60	30, 50, 80, 140	0,65 0,95 1,00 1,00	H1
PAROC Hvac Slab N1	60	30, 50, 80, 140	0,65 0,95 1,00 1,00	H2
PAROC InVent 40 G9	40	50, 100	0,95 1,00	H3
PAROC InVent 45 G5/N1	Ca 45	20, 30, 50, 100	0,45 0,60 1,00 1,00	H4
PAROC InVent 60 N8	60	50, 100	0,95 1,00	H5
PAROC InVent 60 G9	60	50, 100	1,00 1,00	H6
PAROC InVent 80 N8	80	50, 100	1,00 1,00	H7
PAROC InVent 80 G9	80	20, 30, 50, 80	0,50 0,65 1,00 1,00	H8
PAROC Slab 45	45	50, 100	0,85 1,00	H9
PAROC Slab 100	100	50, 70, 100	1,00 1,00 1,00	H10
PAROC Hvac Lamella Mat AluCoat	35	30, 50, 100	0,30 0,35 0,30	H11
PAROC Hvac Fire Slab EI30	80	30, 50, 100	0,60 1,00 1,00	H12
PAROC Hvac Fire Slab EI30 AluCoat	80	30, 50, 100	0,35 0,45 0,45	H13
PAROC Hvac Fire Slab EI60	120	30, 50, 100	0,65 1,00 1,00	H14
PAROC Hvac Fire Slab EI60 AluCoat	120	30, 50, 100	0,35 0,30 0,25	H15
PAROC Hvac Fire Slab EI90	140	30, 50, 100	0,65 0,90 0,85	H16
PAROC Hvac Fire Slab EI90 AluCoat	140	30, 50, 100	0,25 0,25 0,20	H17
PAROC Hvac Fire Slab EI120	180	30, 50, 100	0,80 0,85 0,80	H18
PAROC Hvac Fire Slab EI120 AluCoat	180	30, 50, 100	0,20 0,15 0,15	H19
PAROC Hvac Fire Mat Comfort	80	30, 50, 80, 100	0,80 1,00 1,00 1,00	H20
PAROC Hvac Fire Mat AluCoat	80	30, 50, 80, 100	0,85 0,85 0,85 0,85	H21

DIAGRAM H1.

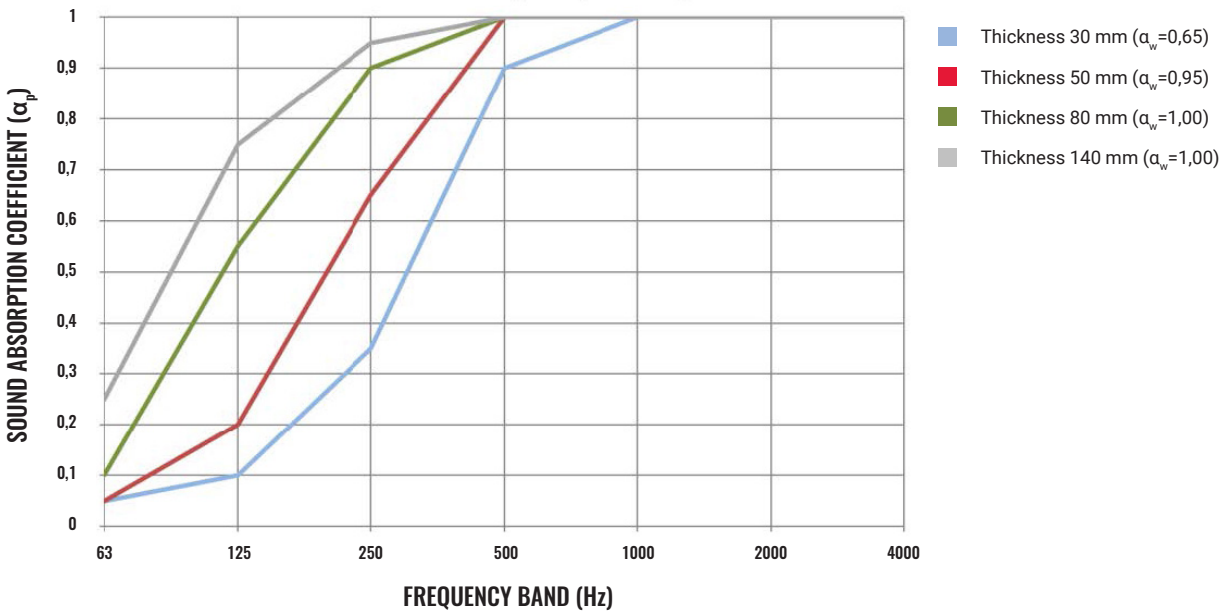
PAROC Hvac Slab (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
30	0,05	0,10	0,35	0,90	1,00	1,00	1,00	0,65	C	0,80
50	0,05	0,20	0,65	1,00	1,00	1,00	1,00	0,95	A	0,90
80	0,10	0,55	0,90	1,00	1,00	1,00	1,00	1,00	A	1,00
140	0,25	0,75	0,95	1,00	1,00	1,00	1,00	1,00	A	1,00

DIAGRAM H2

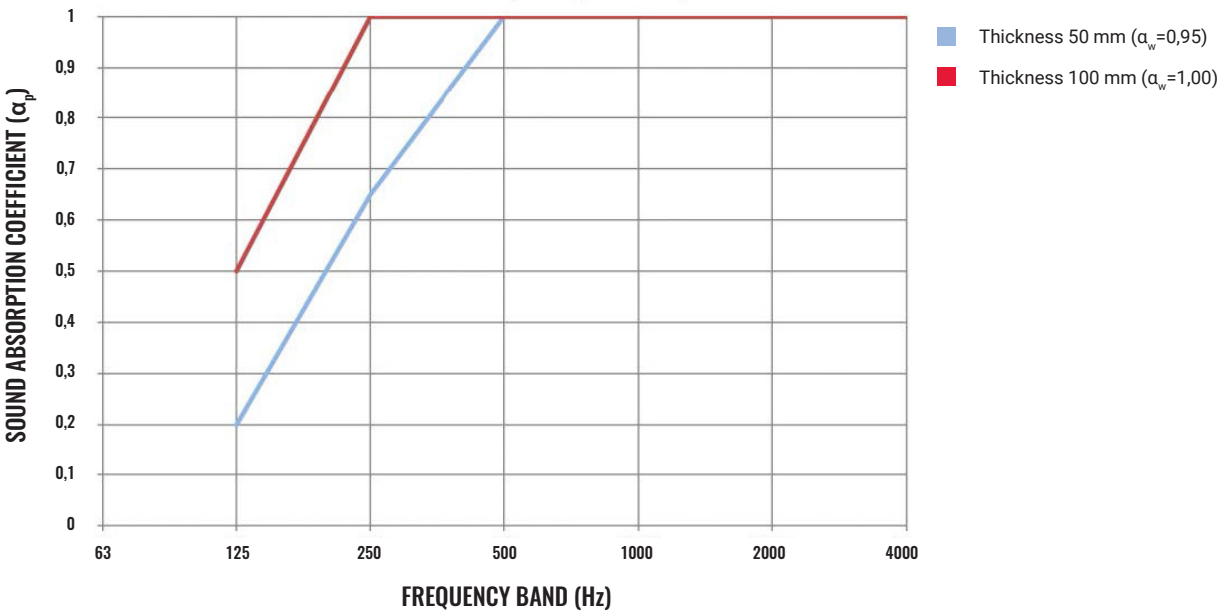
PAROC Hvac Slab N1 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
30	0,05	0,10	0,35	0,90	1,00	1,00	1,00	0,65	C	0,80
50	0,05	0,20	0,65	1,00	1,00	1,00	1,00	0,95	A	0,90
80	0,10	0,55	0,90	1,00	1,00	1,00	1,00	1,00	A	1,00
140	0,25	0,75	0,95	1,00	1,00	1,00	1,00	1,00	A	1,00

DIAGRAM H3

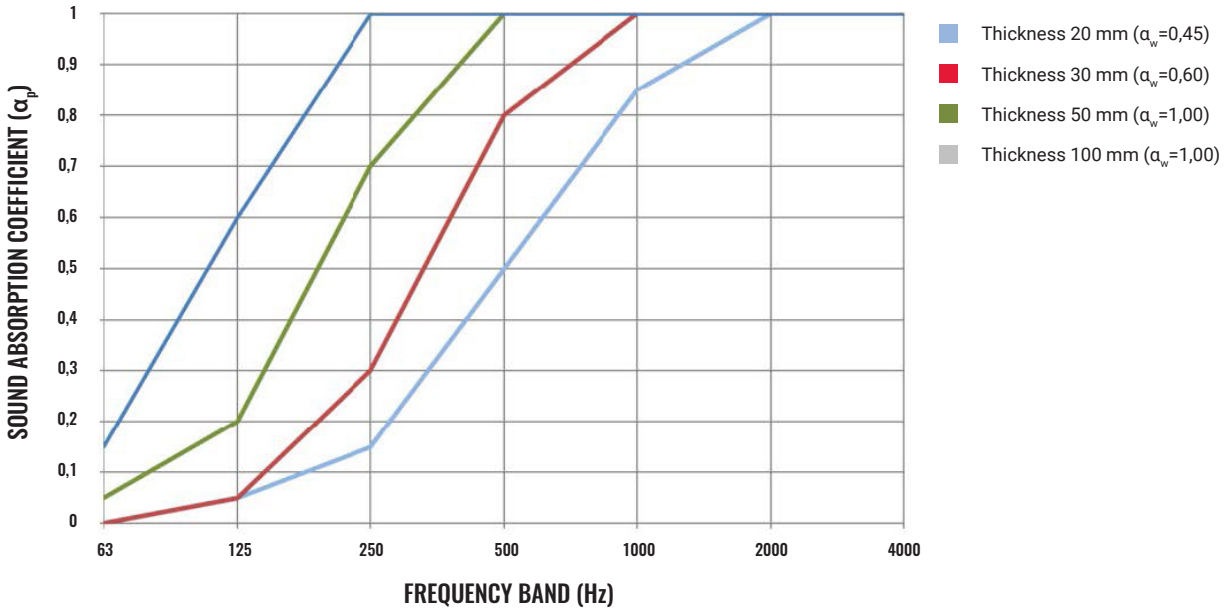
PAROC InVent 40 G9 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
50	-	0,20	0,65	1,00	1,00	1,00	1,00	0,95	A	0,90
100	-	0,50	1,00	1,00	1,00	1,00	1,00	1,00	A	1,00

DIAGRAM H4

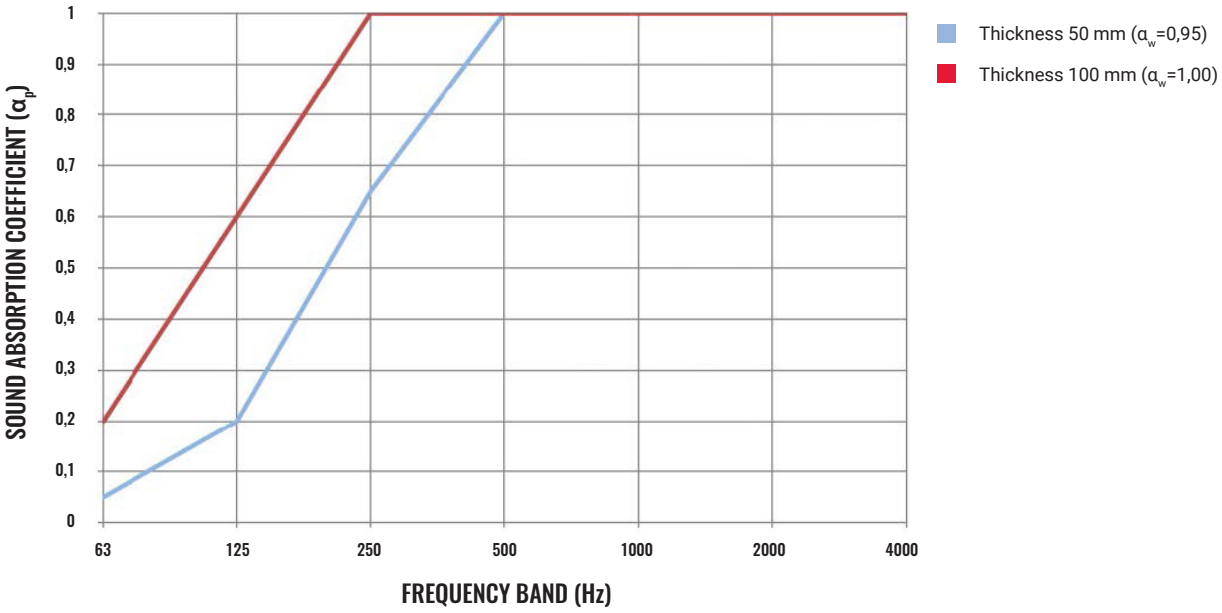
PAROC InVent 45 G5/N1 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
20	0,00	0,05	0,15	0,50	0,85	1,00	1,00	0,45	D	0,65
30	0,00	0,05	0,30	0,80	1,00	1,00	1,00	0,60	C	0,80
50	0,05	0,20	0,70	1,00	1,00	1,00	1,00	1,00	A	0,95
100	0,15	0,60	1,00	1,00	1,00	1,00	1,00	1,00	A	1,00

DIAGRAM H5

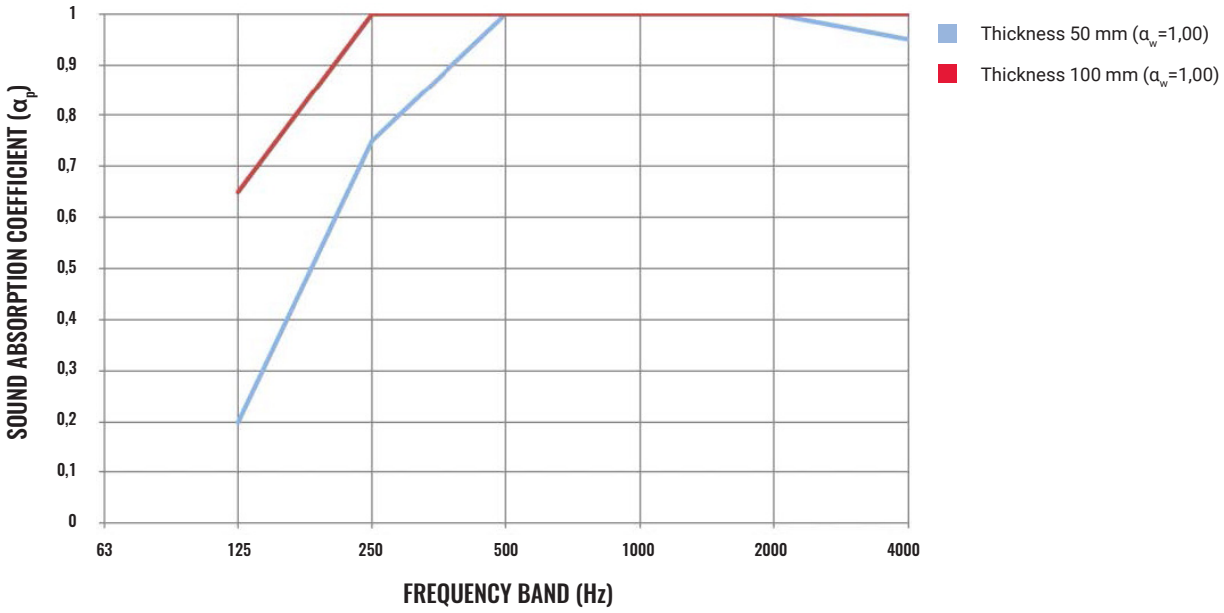
PAROC InVent 60 N8 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
50	0,05	0,20	0,65	1,00	1,00	1,00	1,00	0,95	A	0,90
100	0,20	0,60	1,00	1,00	1,00	1,00	1,00	1,00	A	1,00

DIAGRAM H6

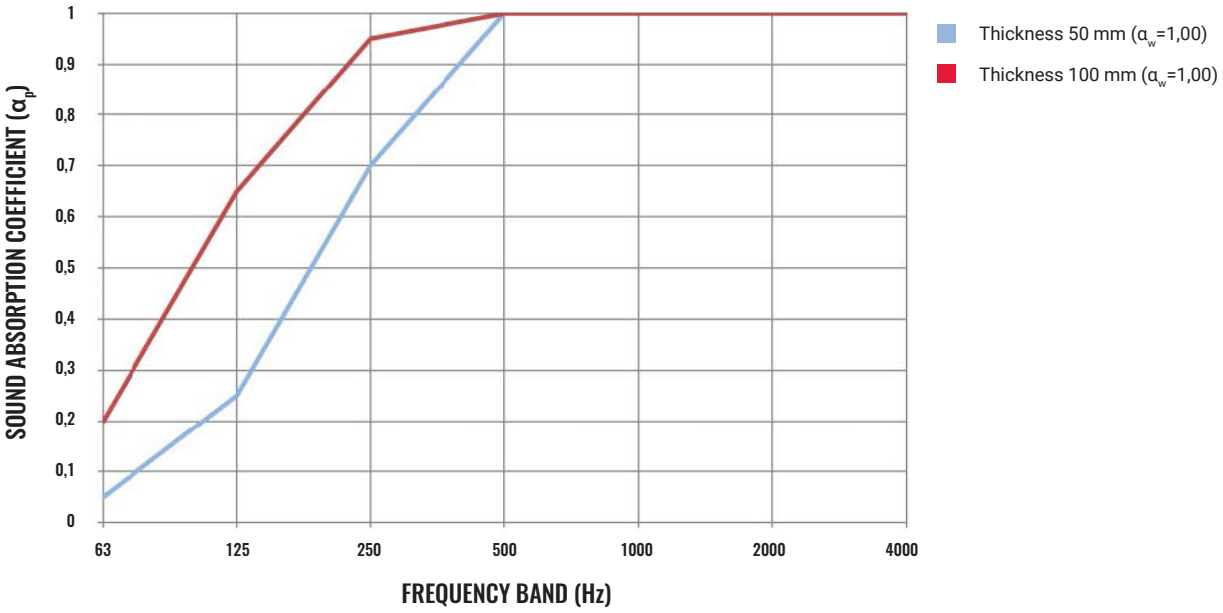
PAROC InVent 60 G9 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
50	-	0,20	0,75	1,00	1,00	1,00	1,00	1,00	A	0,95
100	-	0,65	1,00	1,00	1,00	1,00	1,00	1,00	A	1,00

DIAGRAM H7

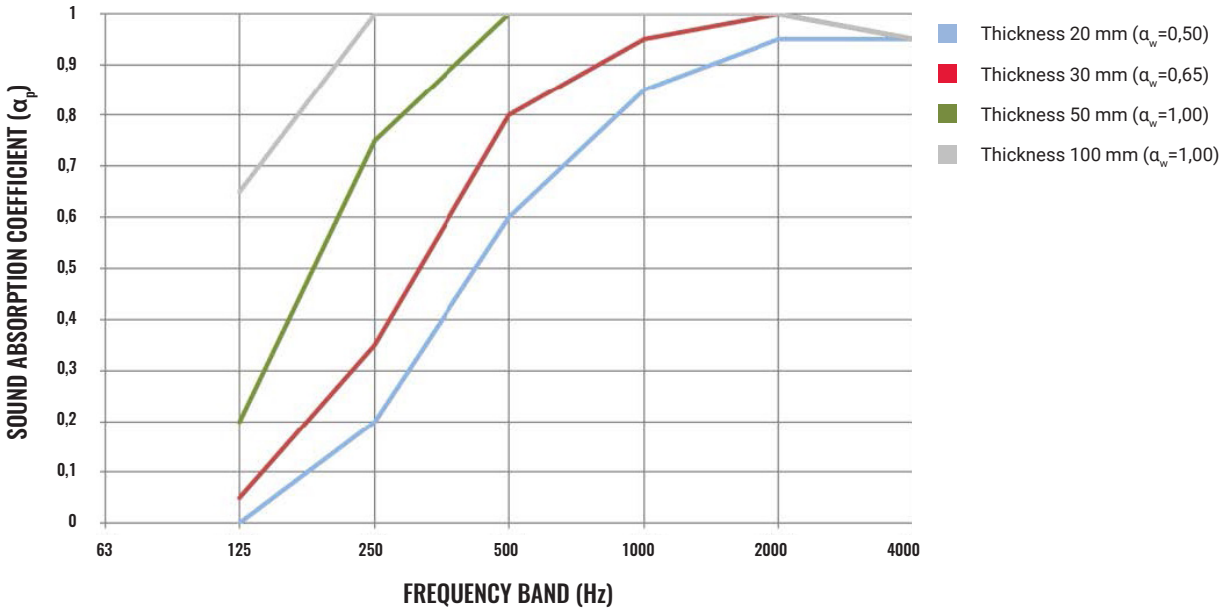
PAROC InVent 80 N8 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
50	0,05	0,25	0,70	1,00	1,00	1,00	1,00	1,00	A	0,95
100	0,20	0,65	0,95	1,00	1,00	1,00	1,00	1,00	A	1,00

DIAGRAM H8

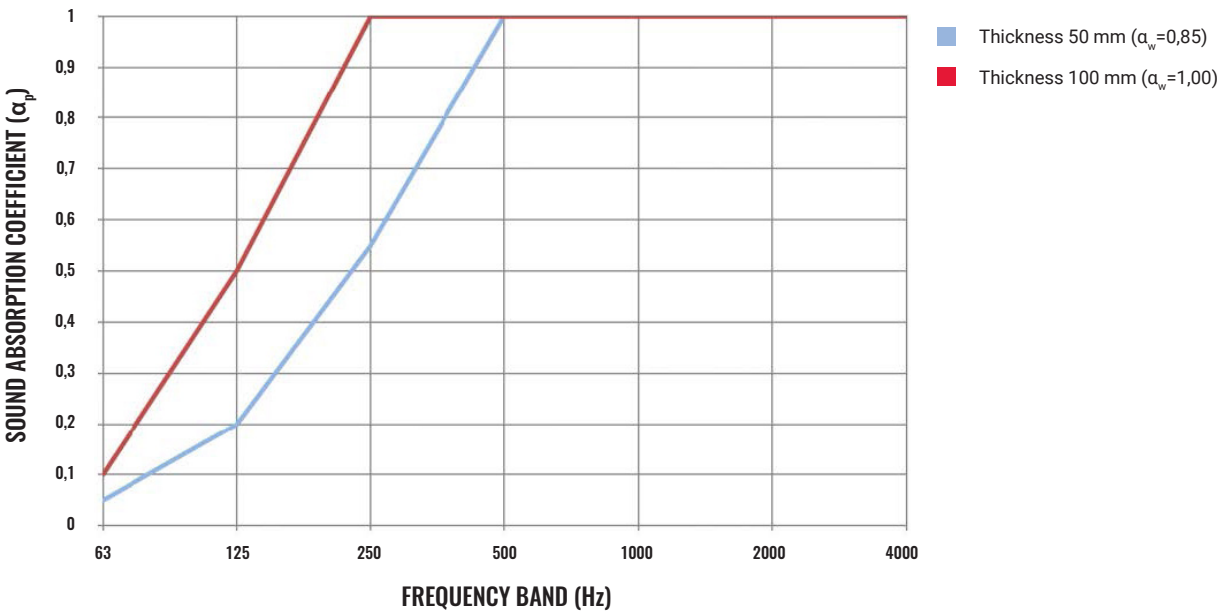
PAROC InVent 80 G9 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
20	-	0	0,20	0,60	0,85	0,95	0,95	0,50	D	0,65
30	-	0,05	0,35	0,80	0,95	1,00	0,95	0,65	C	0,80
50	-	0,20	0,75	1,00	1,00	1,00	0,95	1,00	A	0,95
80	-	0,65	1,00	1,00	1,00	1,00	1,00	1,00	A	1,00

DIAGRAM H9

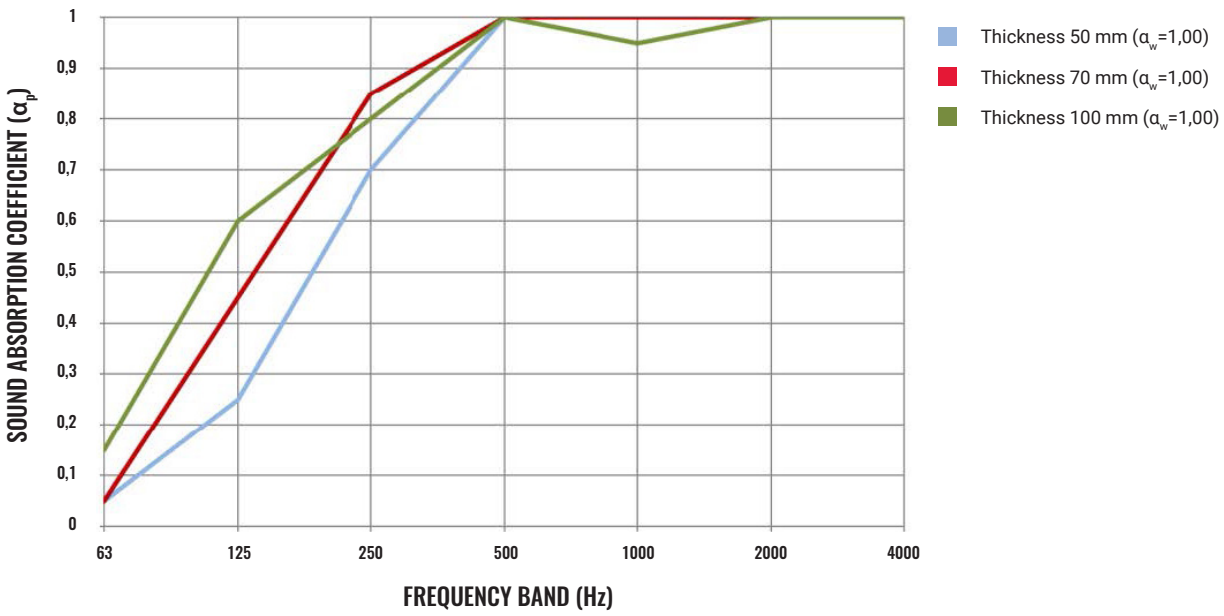
PAROC Slab 45 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
50	0,05	0,20	0,55	1,00	1,00	1,00	1,00	0,85	B	0,90
100	0,10	0,50	1,00	1,00	1,00	1,00	1,00	1,00	A	1,00

DIAGRAM H10

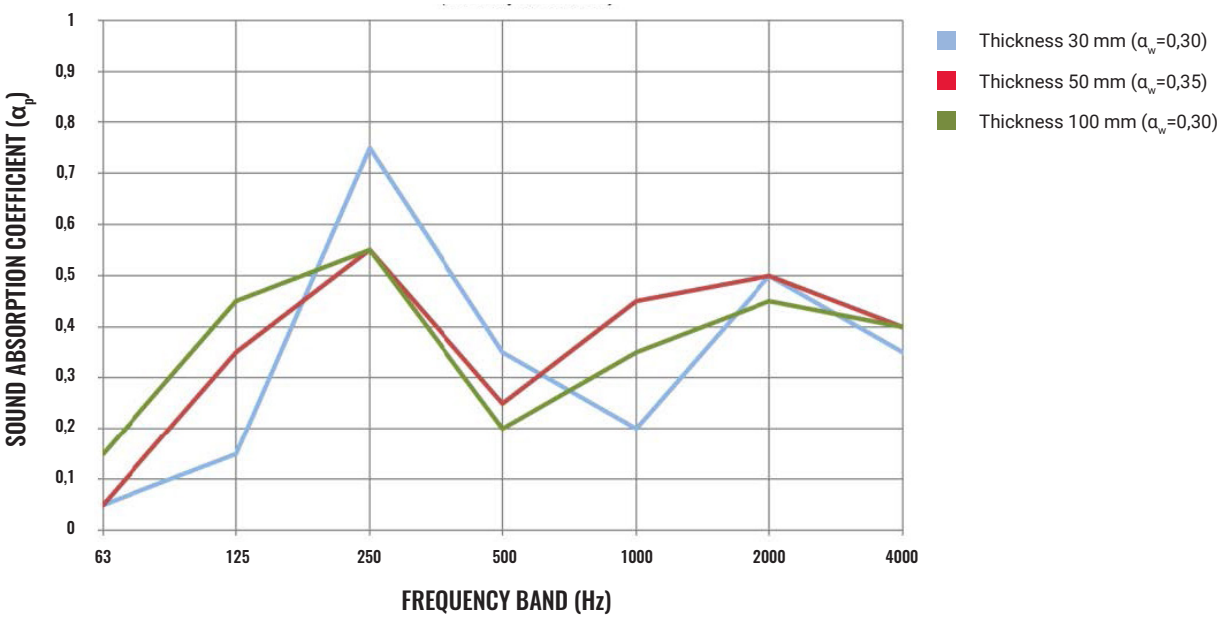
PAROC Slab 100 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
50	0,05	0,25	0,70	1,00	1,00	1,00	1,00	1,00	A	0,95
70	0,05	0,45	0,85	1,00	1,00	1,00	1,00	1,00	A	1,00
100	0,15	0,6	0,8	1,00	0,95	1,00	1,00	1,00	A	0,95

DIAGRAM H11

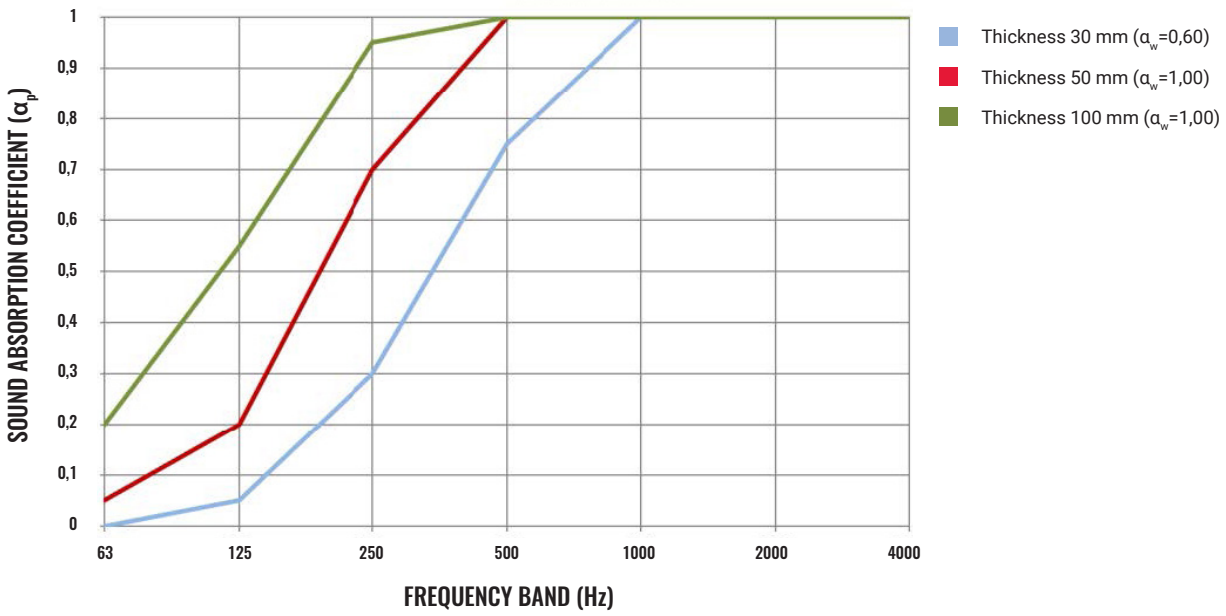
PAROC Hvac Lamela Mat AluCoat (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
30	0,05	0,15	0,75	0,35	0,20	0,50	0,35	0,30	D	0,45
50	0,05	0,35	0,55	0,25	0,45	0,50	0,40	0,35	D	0,45
100	0,15	0,45	0,55	0,20	0,35	0,45	0,40	0,30	D	0,40

DIAGRAM H12

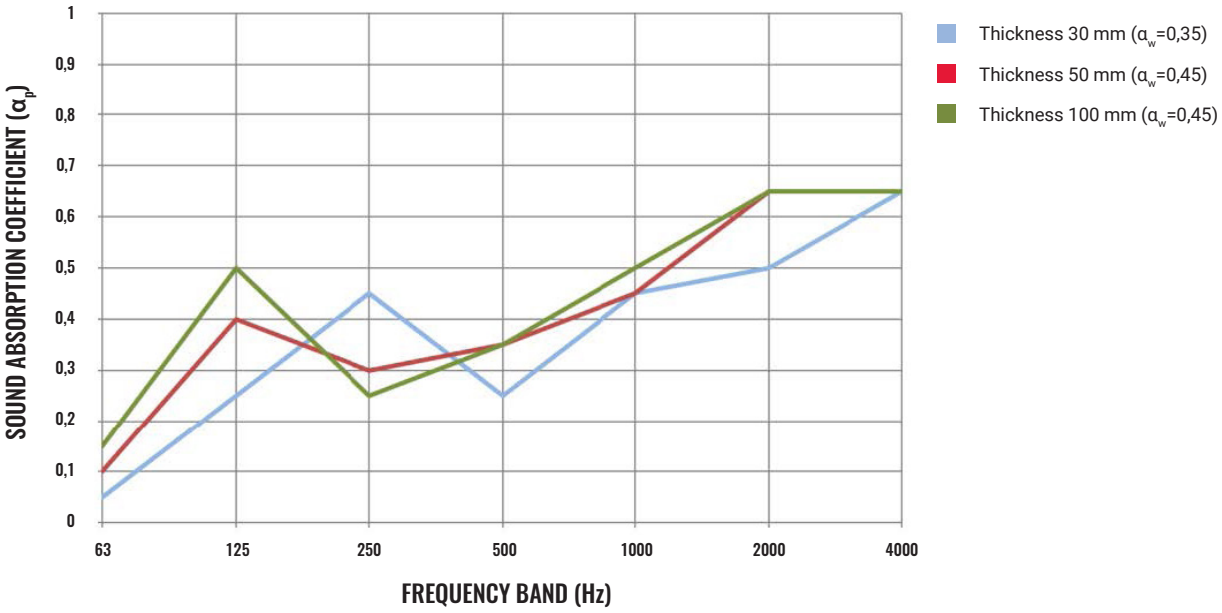
PAROC Hvac Fire Slab EI30 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
30	0	0,05	0,30	0,75	1,00	1,00	1,00	0,60	C	0,75
50	0,05	0,20	0,70	1,00	1,00	1,00	1,00	1,00	A	0,95
100	0,20	0,55	0,95	1,00	1,00	1,00	1,00	1,00	A	1,00

DIAGRAM H13

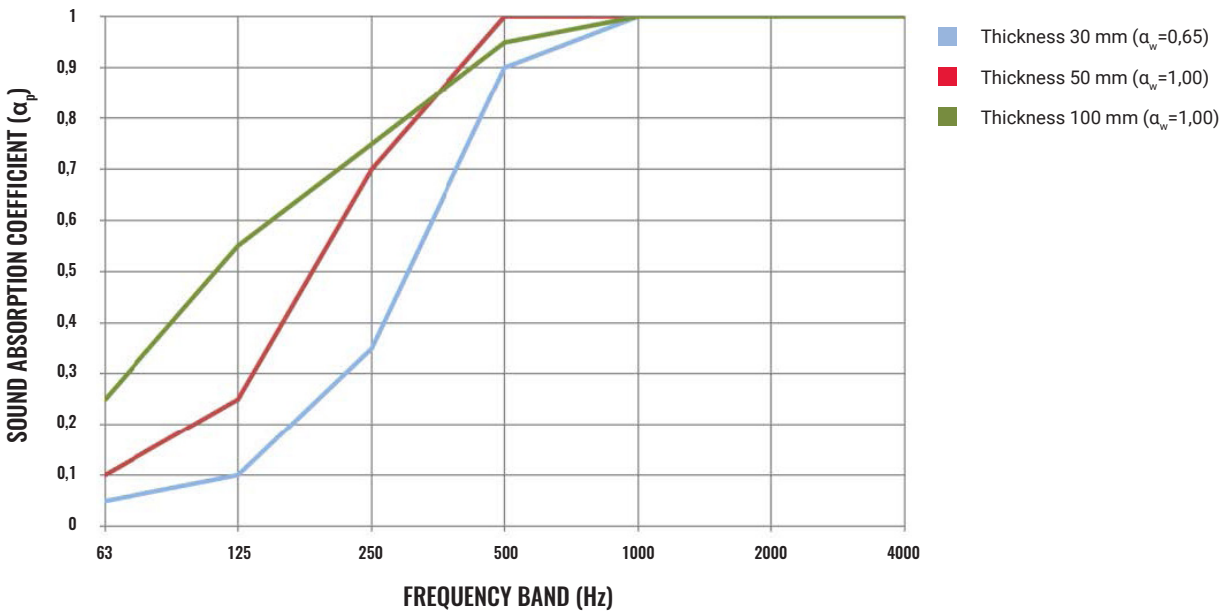
PAROC Hvac Fire Slab EI30 AluCoat (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
30	0,05	0,25	0,45	0,25	0,45	0,50	0,65	0,35	D	0,40
50	0,10	0,40	0,30	0,35	0,45	0,65	0,65	0,45	D	0,45
100	0,15	0,50	0,25	0,35	0,50	0,65	0,65	0,45	D	0,45

DIAGRAM H14

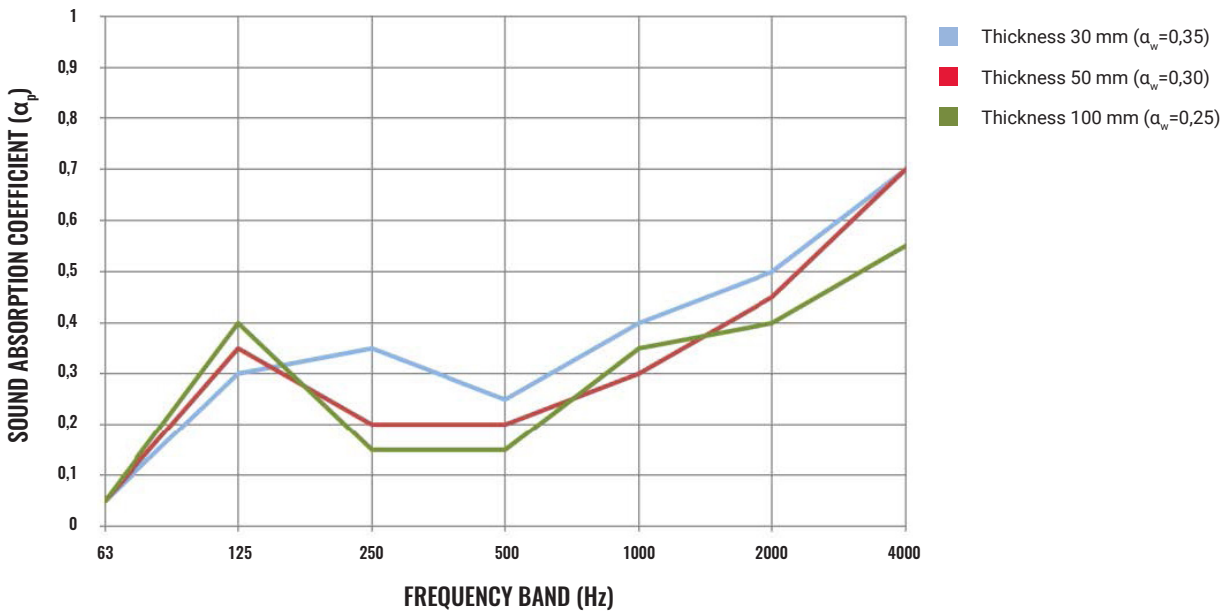
PAROC Hvac Fire Slab EI60 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
30	0,05	0,10	0,35	0,90	1,00	1,00	1,00	0,65	C	0,80
50	0,10	0,25	0,70	1,00	1,00	1,00	1,00	1,00	A	0,95
100	0,25	0,55	0,75	0,95	1,00	1,00	1,00	1,00	A	0,95

DIAGRAM H15

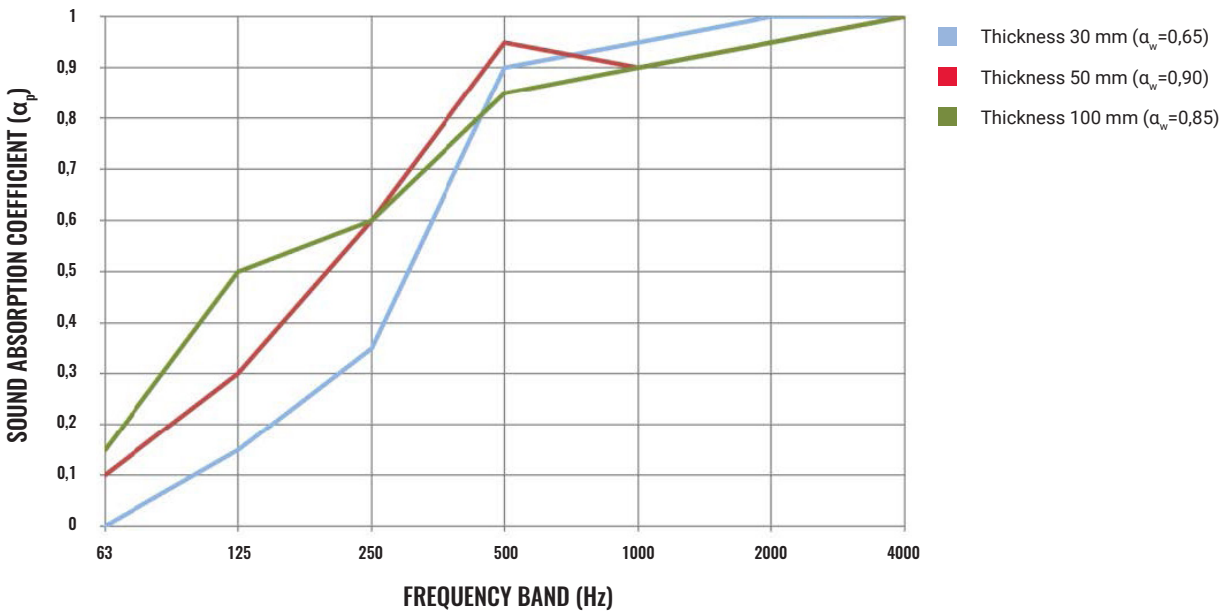
PAROC Hvac Fire Slab EI60 AluCoat (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
30	0,05	0,30	0,35	0,25	0,40	0,50	0,70	0,35	D	0,40
50	0,05	0,35	0,20	0,20	0,30	0,45	0,70	0,30	D	0,30
100	0,05	0,40	0,15	0,15	0,35	0,40	0,55	0,25	E	0,25

DIAGRAM H16

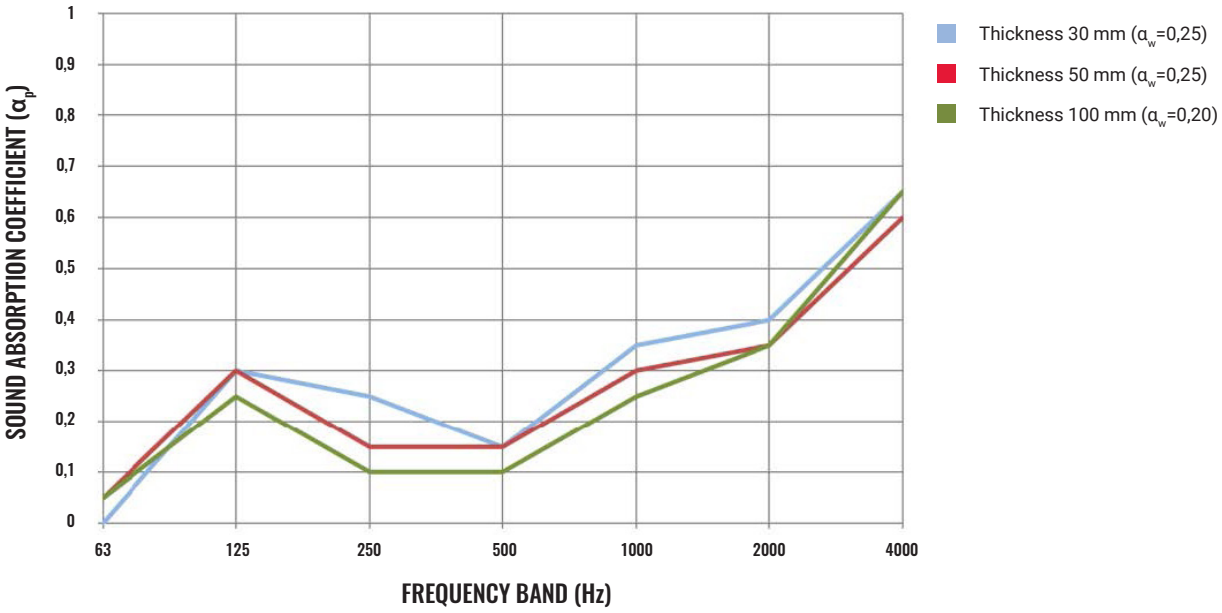
PAROC Hvac Fire Slab EI90 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
30	0,00	0,15	0,35	0,90	0,95	1,00	1,00	0,65	C	0,80
50	0,10	0,30	0,60	0,95	0,90	0,95	1,00	0,90	A	0,85
100	0,15	0,50	0,60	0,85	0,90	0,95	1,00	0,85	B	0,85

DIAGRAM H17

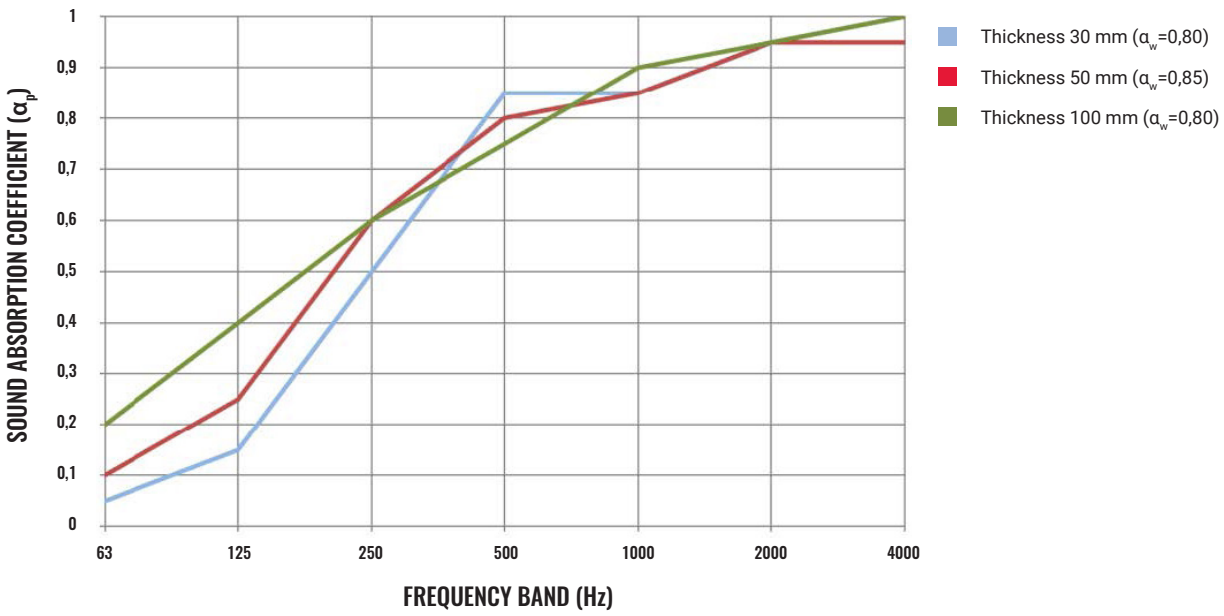
PAROC Hvac Fire Slab EI90 AluCoat (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
30	0,00	0,30	0,25	0,15	0,35	0,40	0,65	0,25	E	0,30
50	0,05	0,30	0,15	0,15	0,30	0,35	0,60	0,25	E	0,25
100	0,05	0,25	0,10	0,10	0,25	0,35	0,65	0,20	E	0,20

DIAGRAM H18

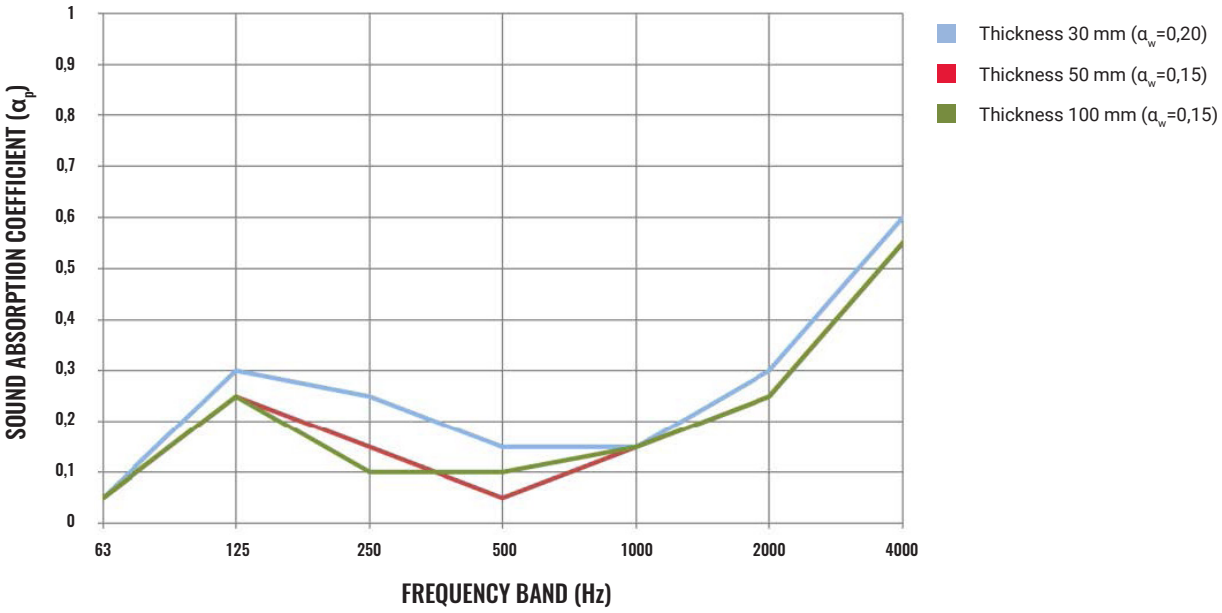
PAROC Hvac Fire Slab EI120 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
30	0,05	0,15	0,50	0,85	0,85	0,95	1,00	0,80	B	0,80
50	0,10	0,25	0,60	0,80	0,85	0,95	0,95	0,85	B	0,80
100	0,20	0,40	0,60	0,75	0,90	0,95	1,00	0,80	B	0,80

DIAGRAM H19

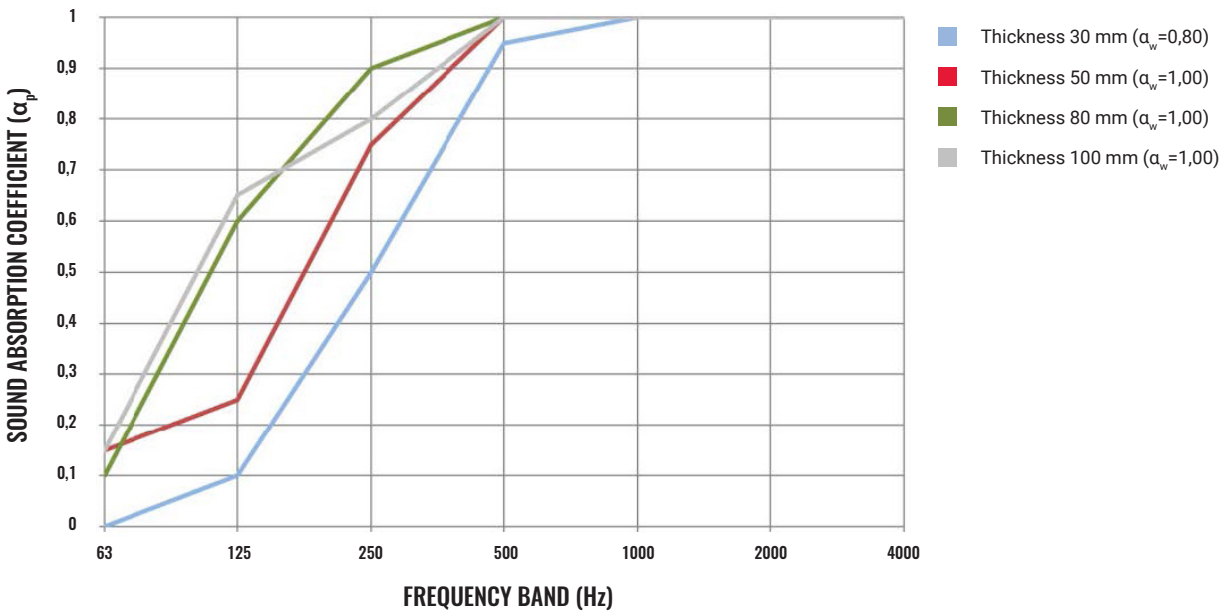
PAROC Hvac Fire Slab EI120 AluCoat (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
30	0,05	0,30	0,25	0,15	0,15	0,30	0,60	0,20	E	0,20
50	0,05	0,25	0,15	0,05	0,15	0,25	0,55	0,15	E	0,15
100	0,05	0,25	0,10	0,10	0,15	0,25	0,55	0,15	E	0,15

DIAGRAM H20

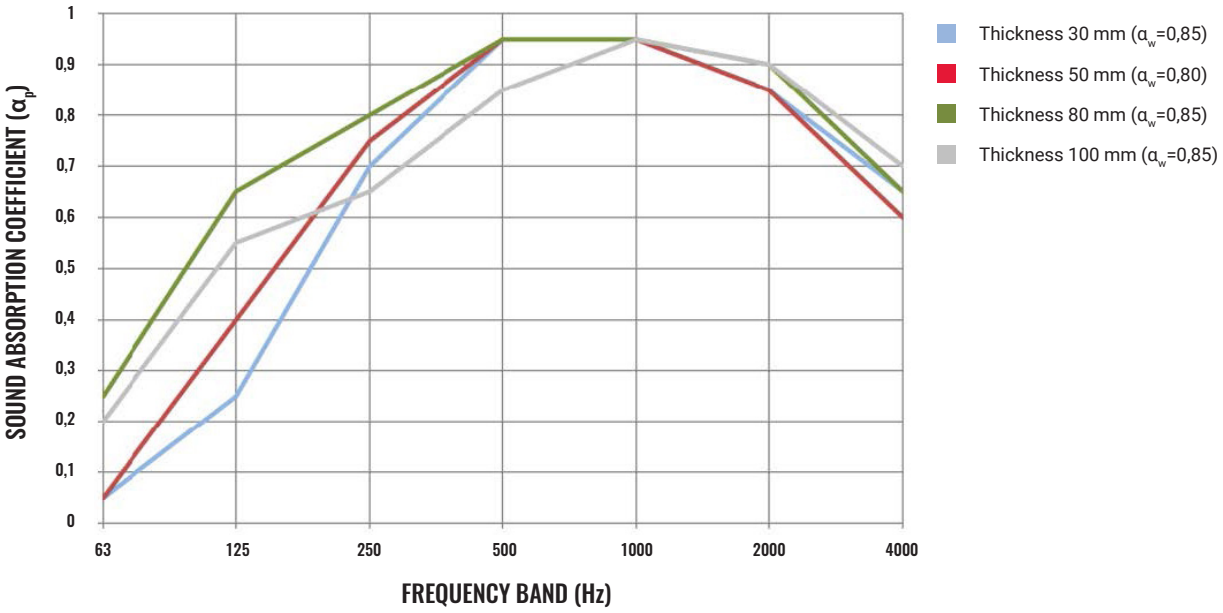
PAROC Hvac Fire Mat Comfort (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
30	0,00	0,10	0,50	0,95	1,00	1,00	1,00	0,80	B	0,85
50	0,15	0,25	0,75	1,00	1,00	1,00	1,00	1,00	A	0,95
80	0,10	0,60	0,90	1,00	1,00	1,00	1,00	1,00	A	1,00
100	0,15	0,65	0,80	1,00	1,00	1,00	1,00	1,00	A	0,95

DIAGRAM H21

PAROC Hvac Fire Mat AluCoat (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
30	0,05	0,35	0,70	0,95	0,85	0,85	0,65	0,85	B	0,85
50	0,05	0,40	0,75	0,95	0,85	0,85	0,60	0,80	B	0,90
80	0,25	0,65	0,80	0,95	0,95	0,90	0,65	0,85	B	0,90
100	0,20	0,55	0,65	0,85	0,95	0,90	0,70	0,85	B	0,85

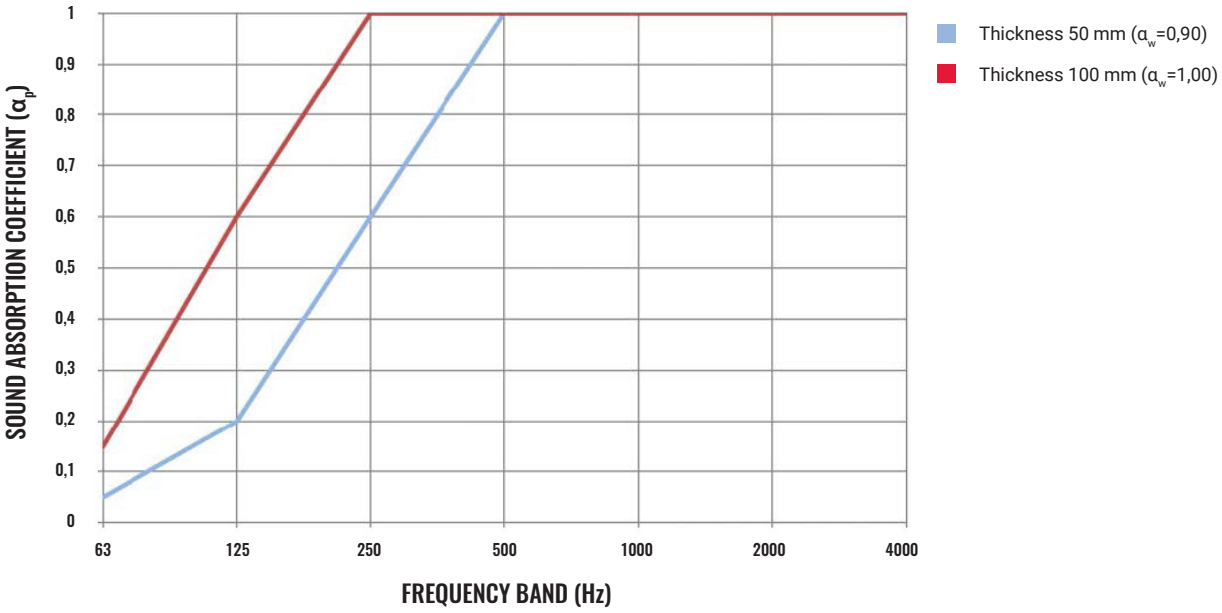
SOUND ABSORPTION DATA INDUSTRY PRODUCTS

Click on the line with product name to go directly to the diagram

Product	Density, kg/m³	Thickness, mm	α_w	Diagram
PAROC Pro Slab 60	60	50, 100	0,90 1,00	I1
PAROC Pro Slab 80	80	30, 50, 100	0,60 1,00 1,00	I2
PAROC Pro Slab 120	120	30, 50, 100	0,65 1,00 1,00	I3
PAROC Pro Slab 120 AluCoat	120	30, 50, 100	0,35 0,30 0,25	I4
PAROC Pro Slab 140	140	30, 50, 100	0,65 0,90 0,85	I5
PAROC Pro Slab 140 AluCoat	140	30, 50, 100	0,25 0,25 0,20	I6
PAROC Pro Slab 180	180	30, 50, 100	0,80 0,85 0,80	I7
PAROC Pro Slab 180 AluCoat	180	30, 50, 100	0,20 0,15 0,15	I8
PAROC Pro Roof Slab 20 kPa	100	25, 50, 75, 100	0,55 1,00 1,00 1,00	I9
PAROC Pro Roof Slab 30 kPa	100	25, 50, 75, 100	0,55 1,00 1,00 1,00	I10
PAROC Pro Roof Slab 50 kPa	140	30, 50, 100	0,65 0,90 0,85	I11
PAROC Pro Roof Slab 80 kPa	180	30, 50, 100	0,80 0,85 0,80	I12
PAROC Pro Wired Mat 100	100	30, 50, 80, 100	0,80 1,00 1,00 1,00	I13
PAROC Pro Wired Mat 100 AL1	100	30, 50, 80, 100	0,85 0,80 0,85 0,85	I14

DIAGRAM I1

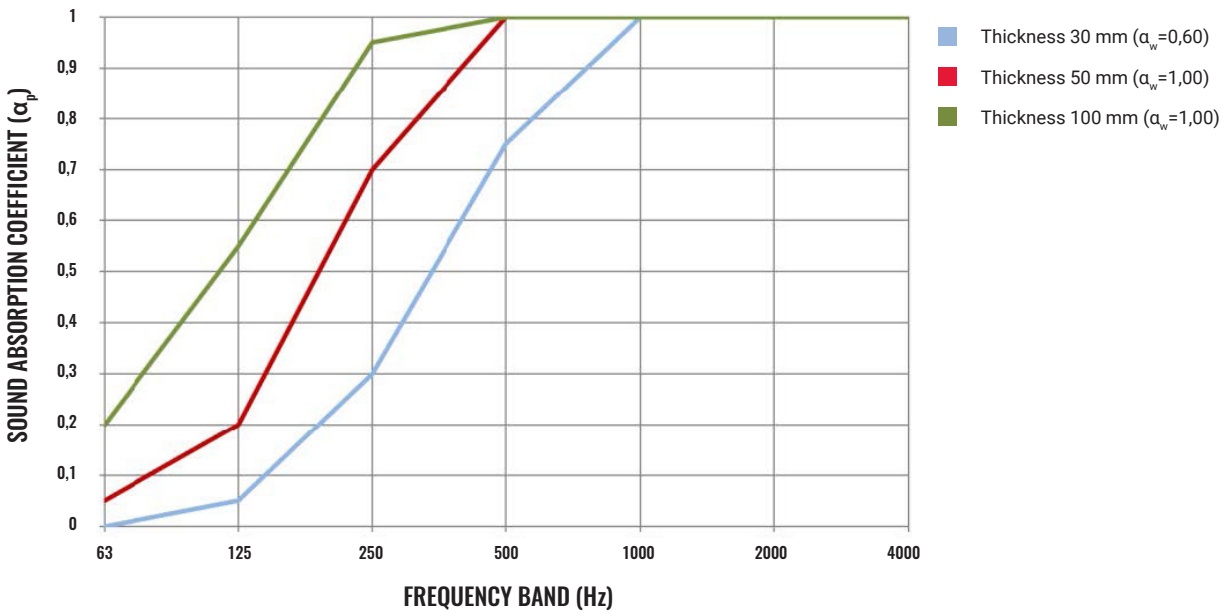
PAROC Pro Slab 60 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
50	0,05	0,20	0,60	1,00	1,00	1,00	1,00	0,90	A	0,90
100	0,15	0,60	1,00	1,00	1,00	1,00	1,00	1,00	A	1,00

DIAGRAM I2

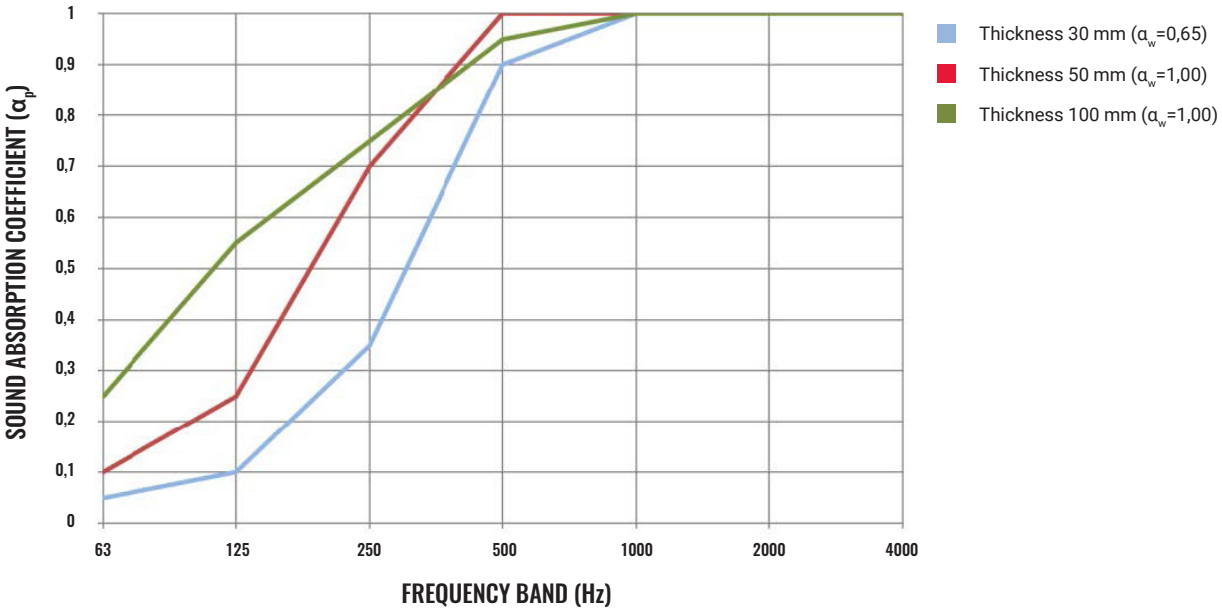
PAROC Pro Slab 80 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
30	0	0,05	0,30	0,75	1,00	1,00	1,00	0,60	C	0,75
50	0,05	0,20	0,70	1,00	1,00	1,00	1,00	1,00	A	0,95
100	0,20	0,55	0,95	1,00	1,00	1,00	1,00	1,00	A	1,00

DIAGRAM I3

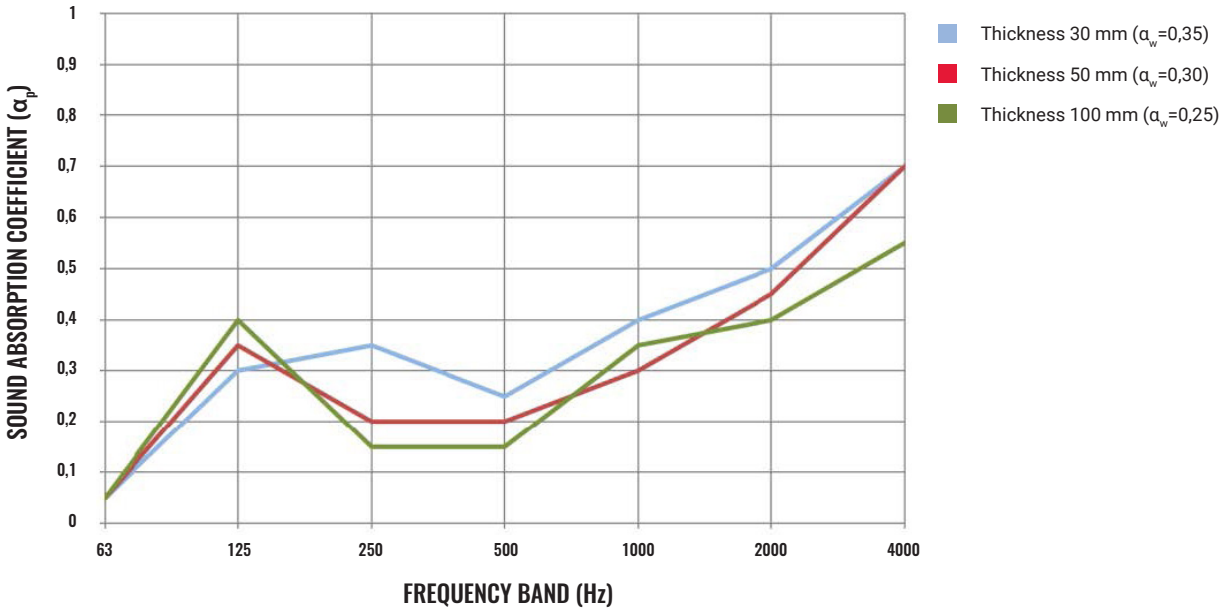
PAROC Pro Slab 120 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
30	0,05	0,10	0,35	0,90	1,00	1,00	1,00	0,65	C	0,80
50	0,10	0,25	0,70	1,00	1,00	1,00	1,00	1,00	A	0,95
100	0,25	0,55	0,75	0,95	1,00	1,00	1,00	1,00	A	0,95

DIAGRAM I4

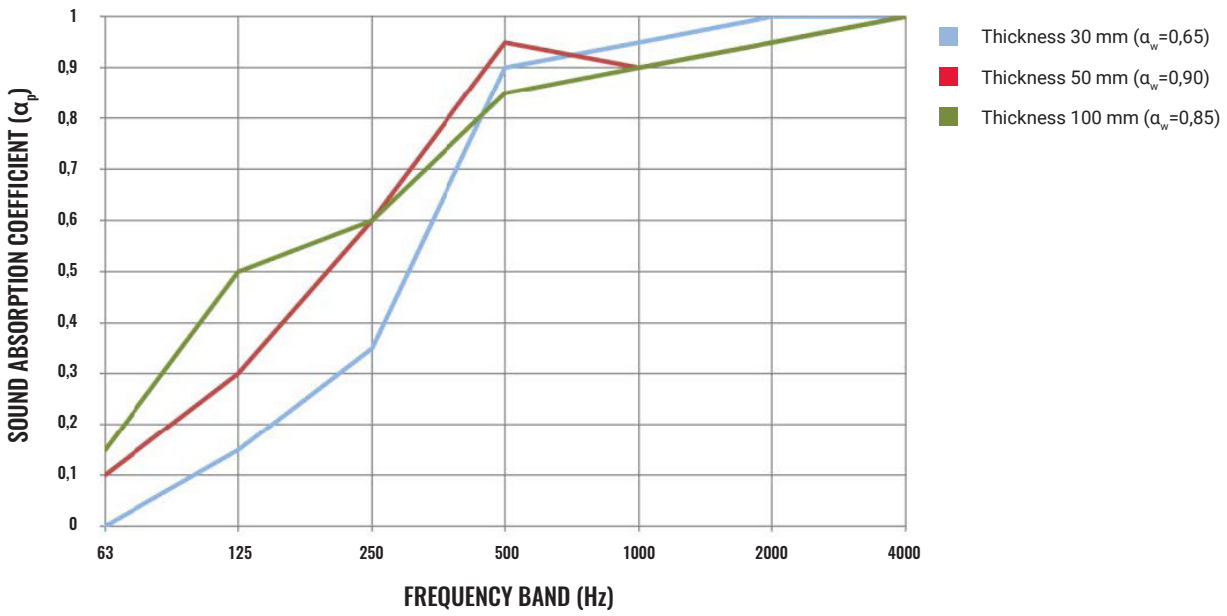
PAROC Pro Slab 120 AluCoat (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
30	0,05	0,30	0,35	0,25	0,40	0,50	0,70	0,35	D	0,40
50	0,05	0,35	0,20	0,20	0,30	0,45	0,70	0,30	D	0,30
100	0,05	0,40	0,15	0,15	0,35	0,40	0,55	0,25	F	0,25

DIAGRAM I5

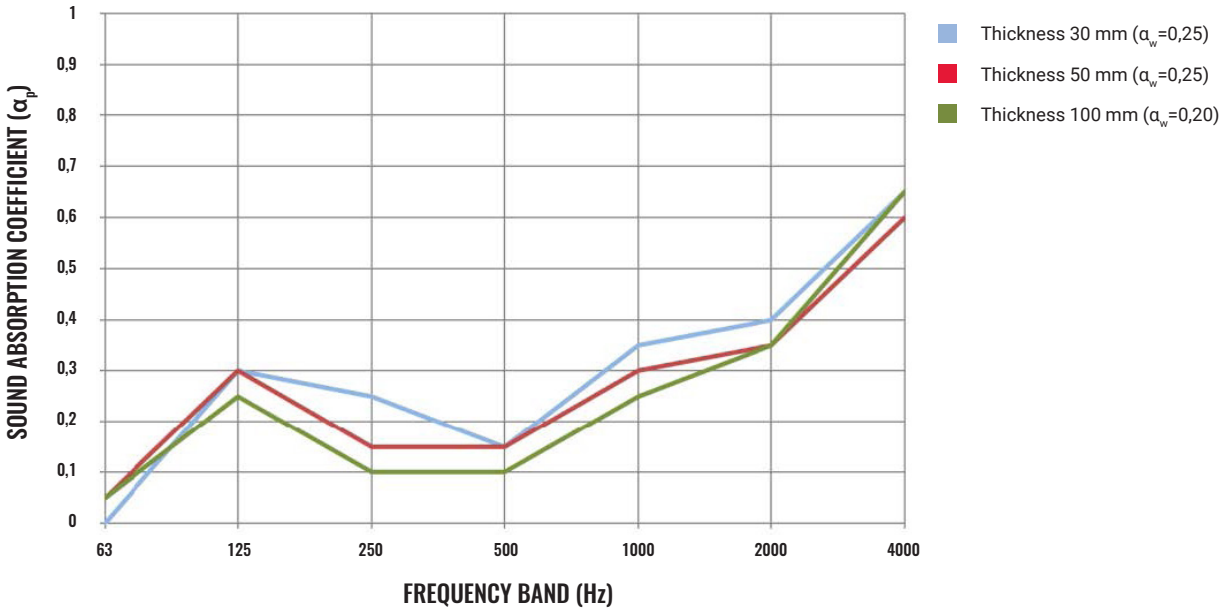
PAROC Pro Slab 140 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
30	0,00	0,15	0,35	0,90	0,95	1,00	1,00	0,65	C	0,80
50	0,10	0,30	0,60	0,95	0,90	0,95	1,00	0,90	A	0,85
100	0,15	0,50	0,60	0,85	0,90	0,95	1,00	0,85	B	0,85

DIAGRAM I6

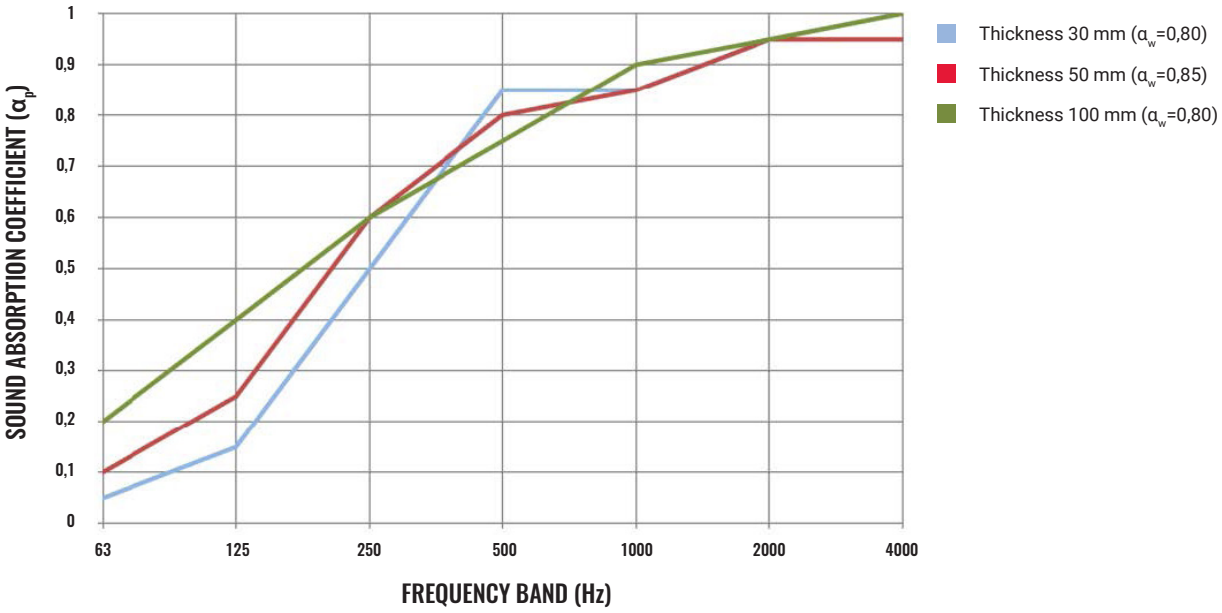
PAROC Pro Slab 140 AluCoat (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
30	0,00	0,30	0,25	0,15	0,35	0,40	0,65	0,25	E	0,30
50	0,05	0,30	0,15	0,15	0,30	0,35	0,60	0,25	E	0,25
100	0,05	0,25	0,10	0,15	0,25	0,35	0,65	0,20	E	0,20

DIAGRAM I7

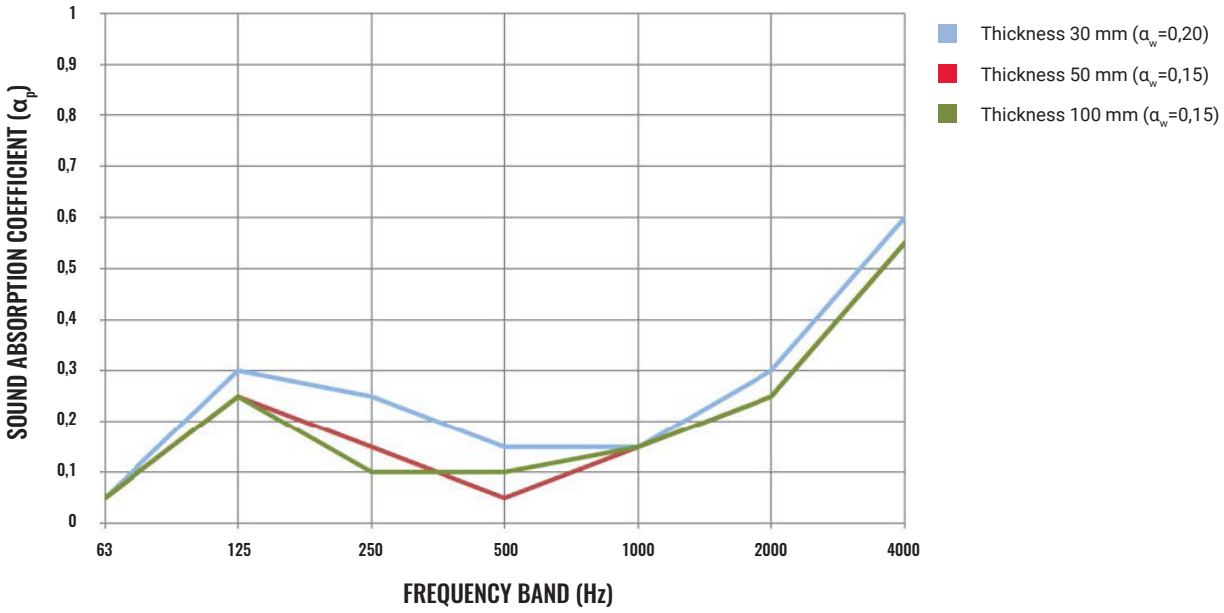
PAROC Pro Slab 180 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
30	0,05	0,15	0,50	0,85	0,85	0,95	1,00	0,80	B	0,80
50	0,10	0,25	0,60	0,80	0,85	0,95	0,95	0,85	B	0,80
100	0,20	0,40	0,60	0,75	0,90	0,95	1,00	0,80	B	0,80

DIAGRAM I8

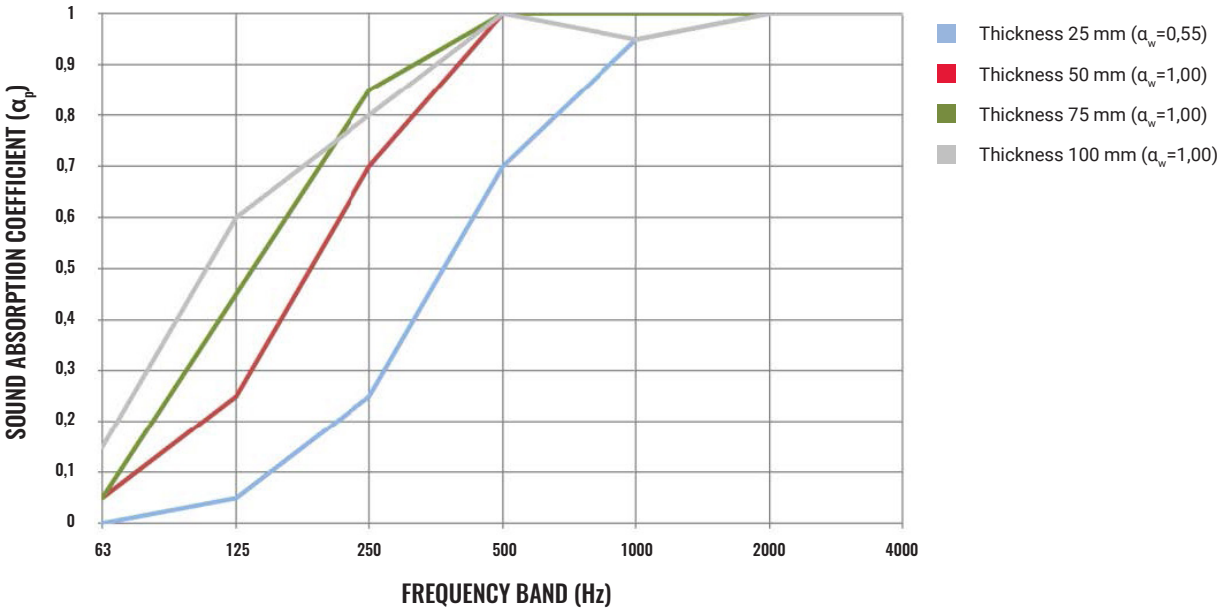
PAROC Pro Slab 180 AluCoat (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
30	0,05	0,30	0,25	0,15	0,15	0,30	0,60	0,20	E	0,20
50	0,05	0,25	0,15	0,05	0,15	0,25	0,55	0,15	E	0,15
100	0,05	0,25	0,10	0,10	0,15	0,25	0,55	0,15	E	0,15

DIAGRAM I9

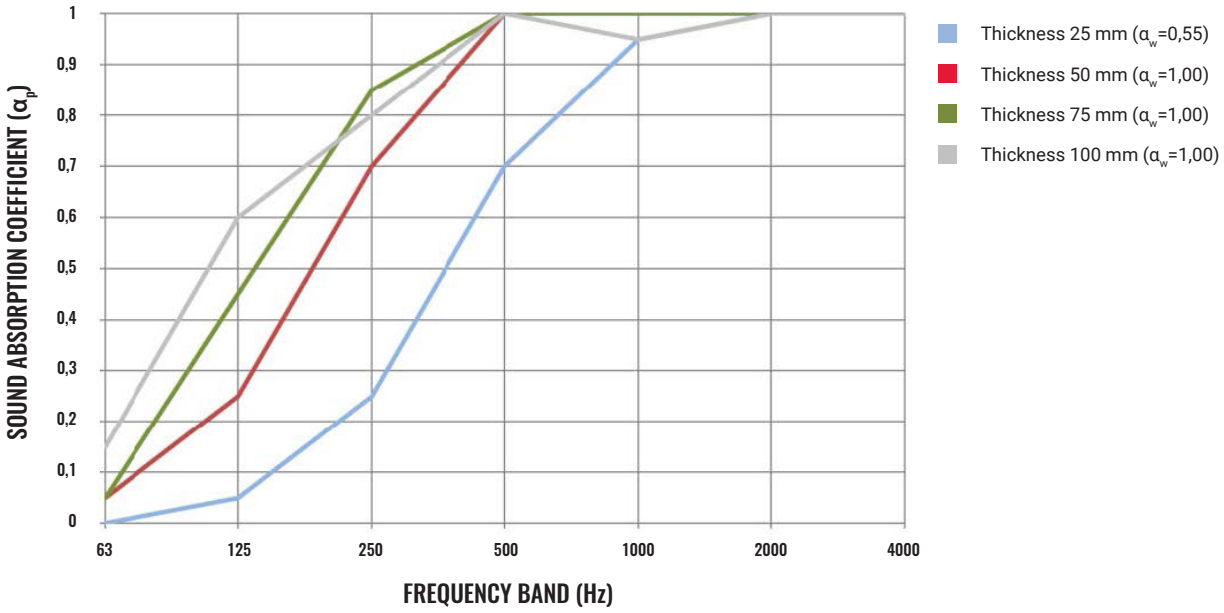
PAROC Pro Roof Slab 20 kPa (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
25	0,00	0,05	0,25	0,70	0,95	1,00	1,00	0,55	D	0,75
50	0,05	0,25	0,70	1,00	1,00	1,00	1,00	1,00	A	0,95
75	0,05	0,45	0,85	1,00	1,00	1,00	1,00	1,00	A	0,95
100	0,15	0,60	0,80	1,00	0,95	1,00	1,00	1,00	A	0,95

DIAGRAM I10

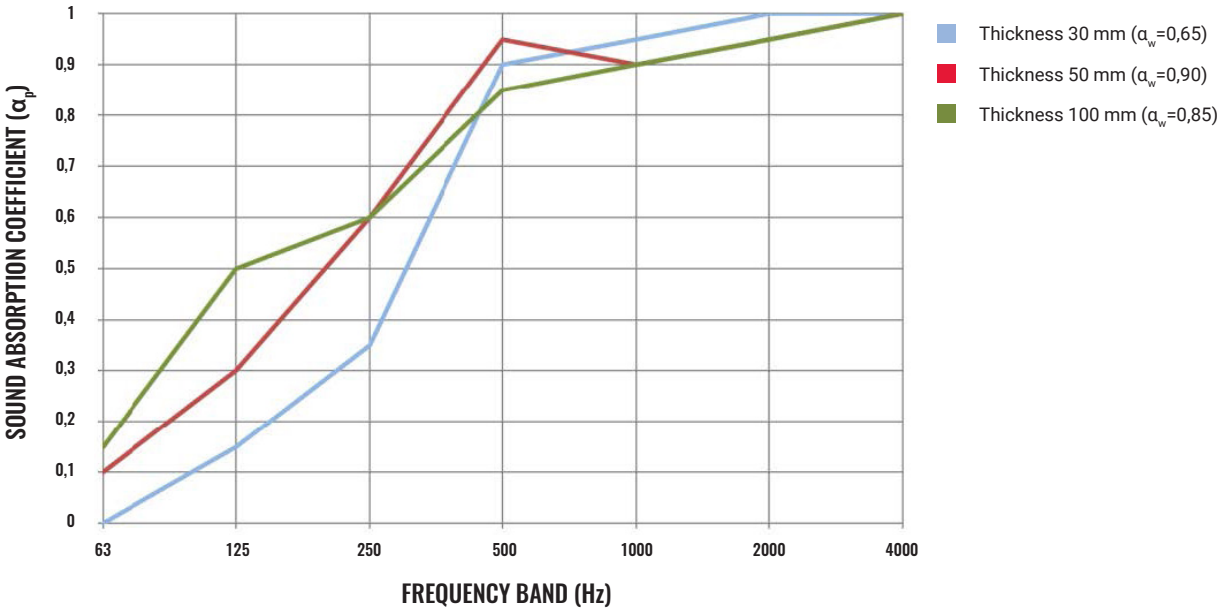
PAROC Pro Roof Slab 30 kPa (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
25	0,00	0,05	0,25	0,70	0,95	1,00	1,00	0,55	D	0,75
50	0,05	0,25	0,70	1,00	1,00	1,00	1,00	1,00	A	0,95
75	0,05	0,45	0,85	1,00	1,00	1,00	1,00	1,00	A	0,95
100	0,15	0,60	0,80	1,00	0,95	1,00	1,00	1,00	A	0,95

DIAGRAM I11

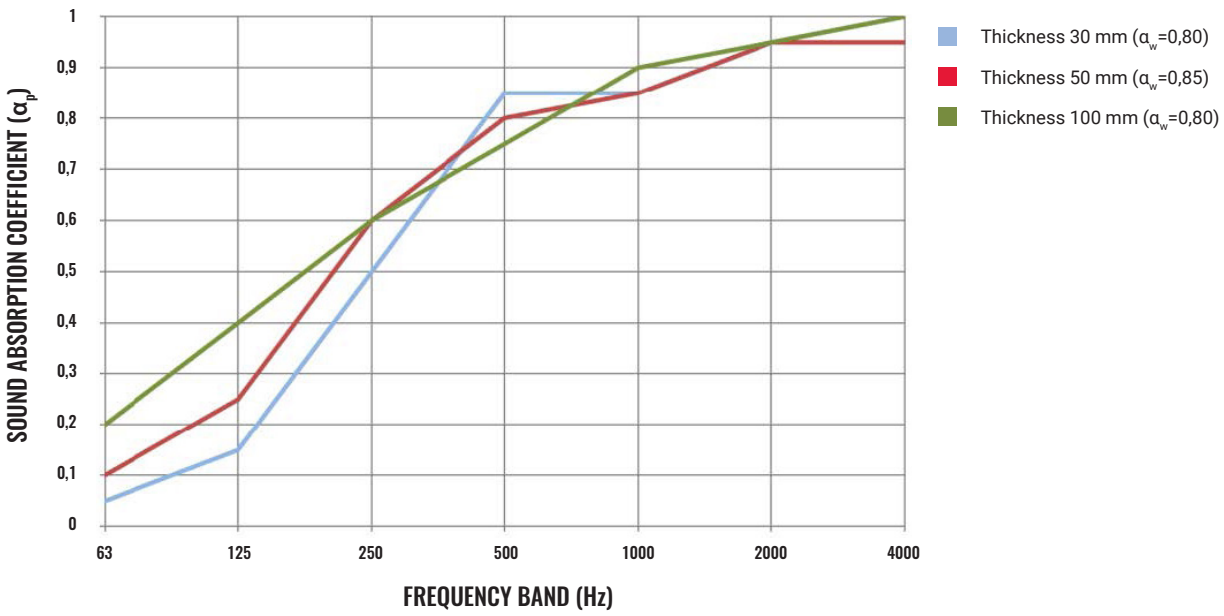
PAROC Pro Roof Slab 50 kPa (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
30	0,00	0,15	0,35	0,90	0,95	1,00	1,00	0,65	C	0,80
50	0,10	0,30	0,60	0,95	0,90	0,95	1,00	0,90	A	0,85
100	0,15	0,50	0,60	0,85	0,90	0,95	1,00	0,85	B	0,85

DIAGRAM I12

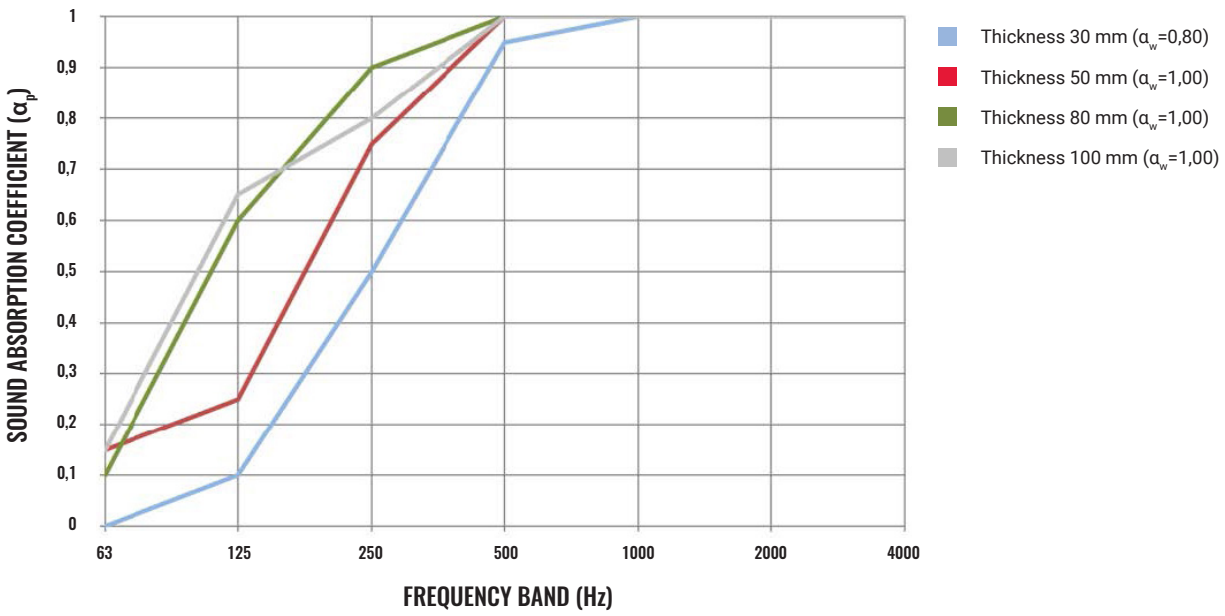
PAROC Pro Roof Slab 80 kPa (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
30	0,05	0,15	0,50	0,85	0,85	0,95	1,00	0,80	B	0,80
50	0,10	0,25	0,60	0,80	0,85	0,95	0,95	0,85	B	0,80
100	0,20	0,40	0,60	0,75	0,90	0,95	1,00	0,80	B	0,80

DIAGRAM I13

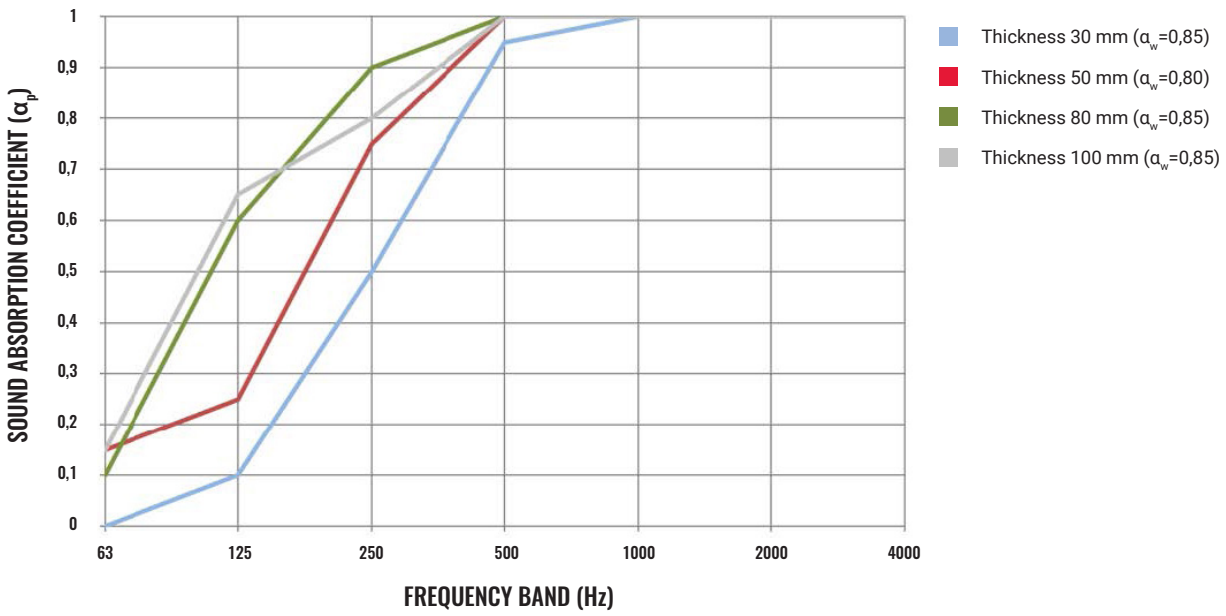
PAROC Pro Wired Mat 100 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
30	0,00	0,10	0,50	0,95	1,00	1,00	1,00	0,80	B	0,85
50	0,15	0,25	0,75	1,00	1,00	1,00	1,00	1,00	A	0,95
80	0,10	0,60	0,90	1,00	1,00	1,00	1,00	1,00	A	1,00
100	0,15	0,65	0,80	1,00	1,00	1,00	1,00	1,00	A	0,95

DIAGRAM I14

PAROC Pro Wired Mat 100 Al1 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
30	0,05	0,35	0,70	0,95	0,95	0,85	0,65	0,85	B	0,85
50	0,05	0,40	0,75	0,95	0,95	0,85	0,60	0,80	B	0,90
80	0,25	0,65	0,80	0,95	0,95	0,90	0,65	0,85	B	0,90
100	0,20	0,55	0,65	0,95	0,95	0,90	0,70	0,85	B	0,85

SOUND ABSORPTION DATA MARINE PRODUCTS

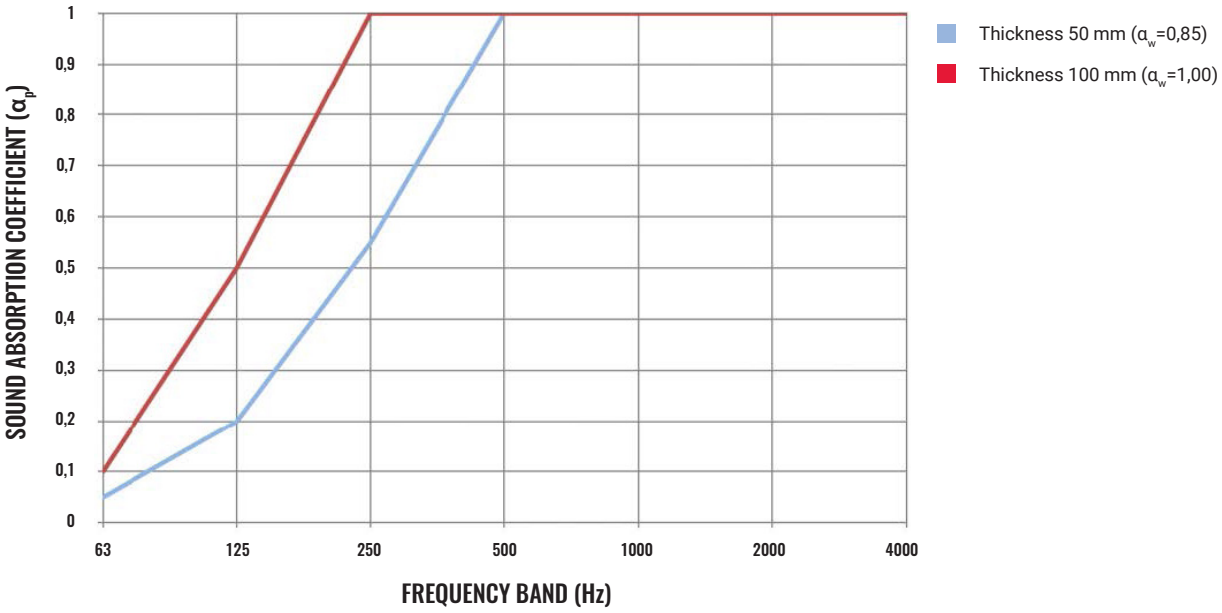
Click on the line with product name to go directly to the diagram

Product	Density, kg/m³	Thickness, mm	α_w	Diagram
PAROC Marine Slab 40	40	50, 100	0,85 1,00	M1
PAROC Marine Slab 40 AluCoat	40	30, 50, 100	0,65 0,75 0,75	M2
PAROC Marine Navis Slab 60	60	30, 40, 50, 60	0,65 0,75 0,95 1,00	M3
PAROC Marine Navis Slab 60	60	70, 80, 140	1,00 1,00 1,00	M4
PAROC Marine Navis Slab 60 G1	60	30, 40, 50	0,65 0,55 0,70	M5
PAROC Marine Navis Slab 60 G1	60	60, 70, 100	0,55 0,45 0,50	M6
PAROC Marine Navis Slab 60 AluCoat	60	50	0,75	M7
PAROC Marine Navis Slab 60 G3	60	50	0,95	M8
PAROC Marine Navis Slab 60 G4	60	50	0,30	M9
PAROC Marine Navis Slab 60 G7	60	50	0,30	M10
PAROC Marine Fire Slab 100	100	25, 50, 75, 100	0,55 1,00 1,00 1,00	M11
PAROC Marine Fire Slab 100 G1	100	25, 50, 75, 100	0,75 0,75 0,70 0,70	M12
PAROC Marine Floor Slab 140	140	50	0,90	M13
PAROC Marine Fire Slab 220 N5	220	15	0,50	M14
PAROC Marine Navis Mat 60	60	60	1,00	M15
PAROC Marine Navis Mat 90	90	60, 70	1,00 1,00	M16
PAROC Marine Navis Mat 90 AluCoat	90	60, 70	0,65 1,00	M17
PAROC Marine Navis Wired Mat 60	60	50	0,80	M18
PAROC Marine Navis Wired Mat 60 AluCoat	60	50	0,85	M19
PAROC Marine Navis Wired Mat 60 G1	60	30, 40, 50	0,75 0,75 0,75	M20
PAROC Marine Navis Wired Mat 60 G1	60	60, 70	0,75 0,75	M21

Product	Density, kg/m³	Thickness, mm	α_w	Diagram
PAROC Marine Navis Wired Mat 60 G4	60	50	0,50	M22
PAROC Marine Navis Wired Mat 60 G7	60	50	0,50	M23
PAROC Marine Navis Wired Mat 90	90	60, 70	1,00 1,00	M24
PAROC Marine Navis Wired Mat 90 AluCoat	90	60, 70	0,90 0,90	M25
PAROC Marine Navis Wired Mat 90 G1	90	60, 70	0,65 0,65	M26
PAROC Marine Navis Wired Mat 90 G4	90	60, 70	0,55 0,55	M27
PAROC Marine Navis Wired Mat 90 G7	90	60, 70	0,55 0,55	M28
PAROC Marine Wired Mat 100	100	30, 50, 80, 100	0,80 1,00 1,00 1,00	M29
PAROC Marine Wired Mat 100 G1	100	30, 50, 80, 100	0,80 0,85 0,85 0,80	M30

DIAGRAM M1

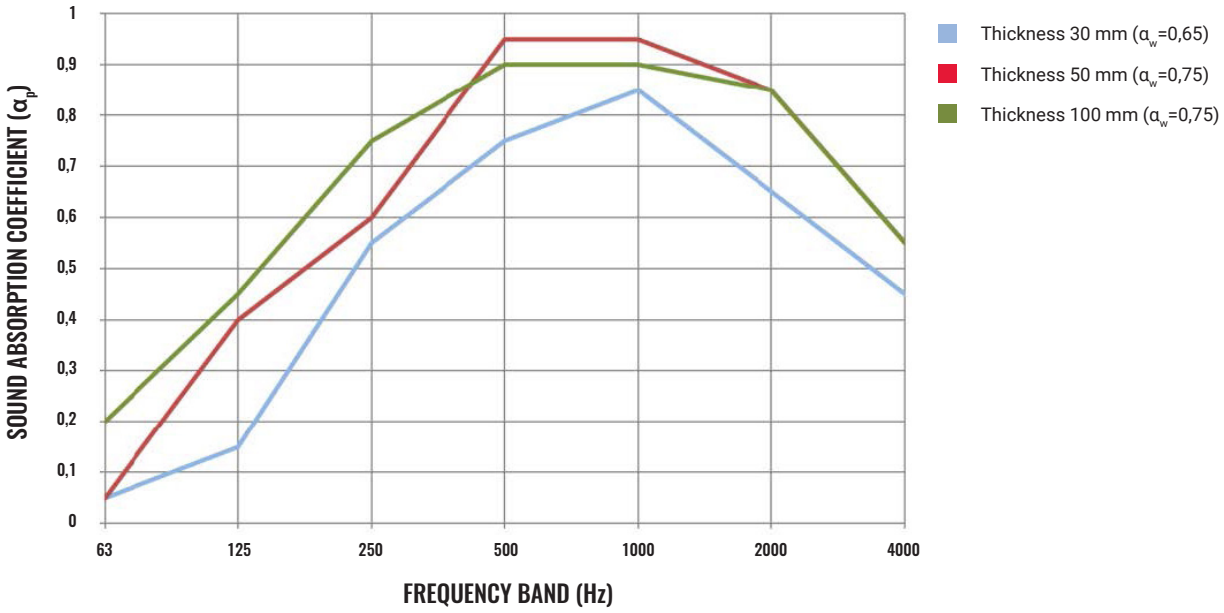
PAROC Marine Slab 40 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
50	0,05	0,20	0,55	1,00	1,00	1,00	1,00	0,85	B	0,90
100	0,10	0,50	1,00	1,00	1,00	1,00	1,00	1,00	A	1,00

DIAGRAM M2

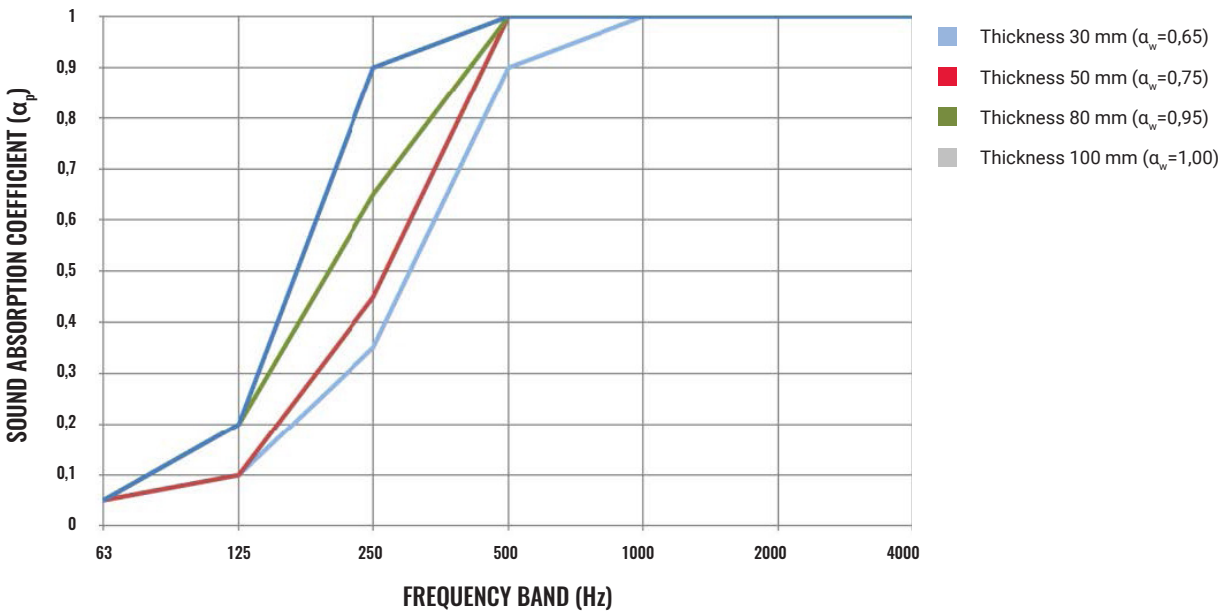
PAROC Marine Slab 40 AluCoat (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
30	0,05	0,15	0,55	0,75	0,85	0,65	0,45	0,65	C	0,70
50	0,05	0,40	0,60	0,95	0,95	0,85	0,85	0,75	C	0,85
100	0,20	0,45	0,75	0,90	0,90	0,85	0,85	0,75	C	0,85

DIAGRAM M3

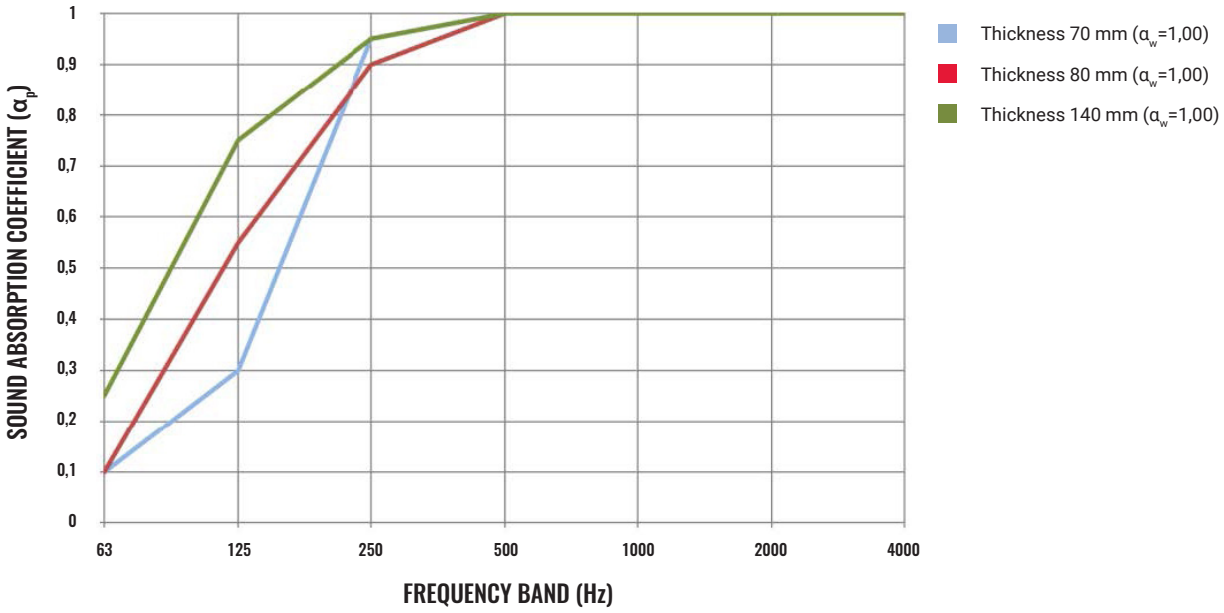
PAROC Marine Navis Slab 60 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
30	0,05	0,10	0,35	0,90	1,00	1,00	1,00	0,65	C	0,80
40	0,05	0,10	0,45	1,00	1,00	1,00	1,00	0,75	C	0,85
50	0,05	0,20	0,65	1,00	1,00	1,00	1,00	0,95	A	0,90
60	0,05	0,20	0,90	1,00	1,00	1,00	1,00	1,00	A	1,00

DIAGRAM M4

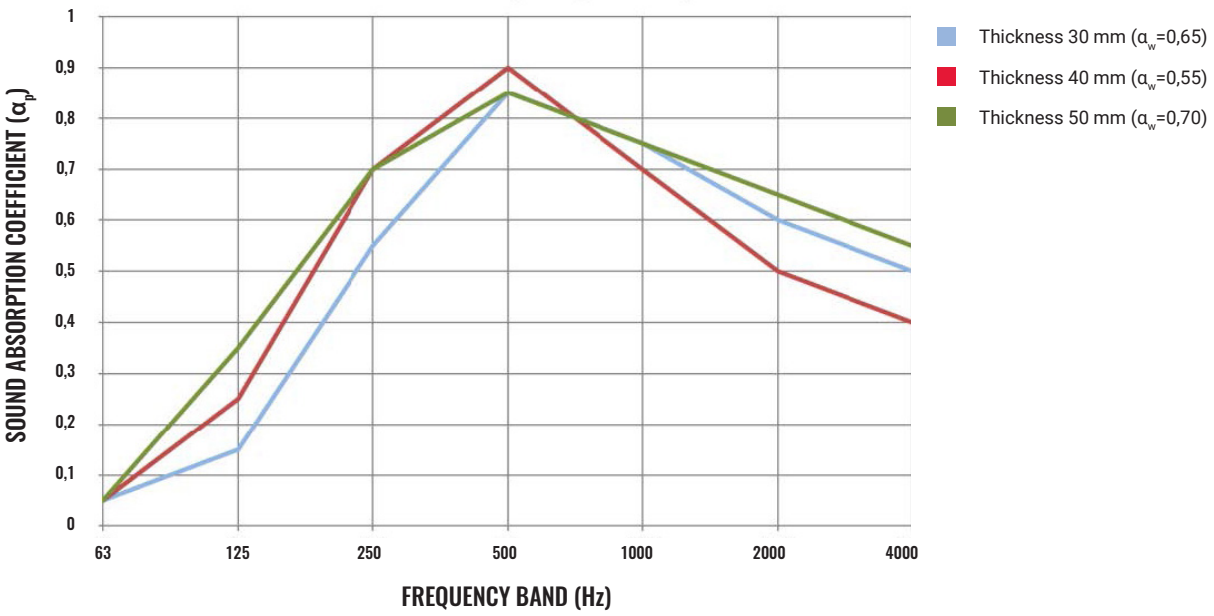
PAROC Marine Navis Slab 60 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
70	0,10	0,30	0,95	1,00	1,00	1,00	1,00	1,00	A	1,00
80	0,10	0,55	0,90	1,00	1,00	1,00	1,00	1,00	A	1,00
140	0,25	0,75	0,95	1,00	1,00	1,00	1,00	1,00	A	1,00

DIAGRAM M5

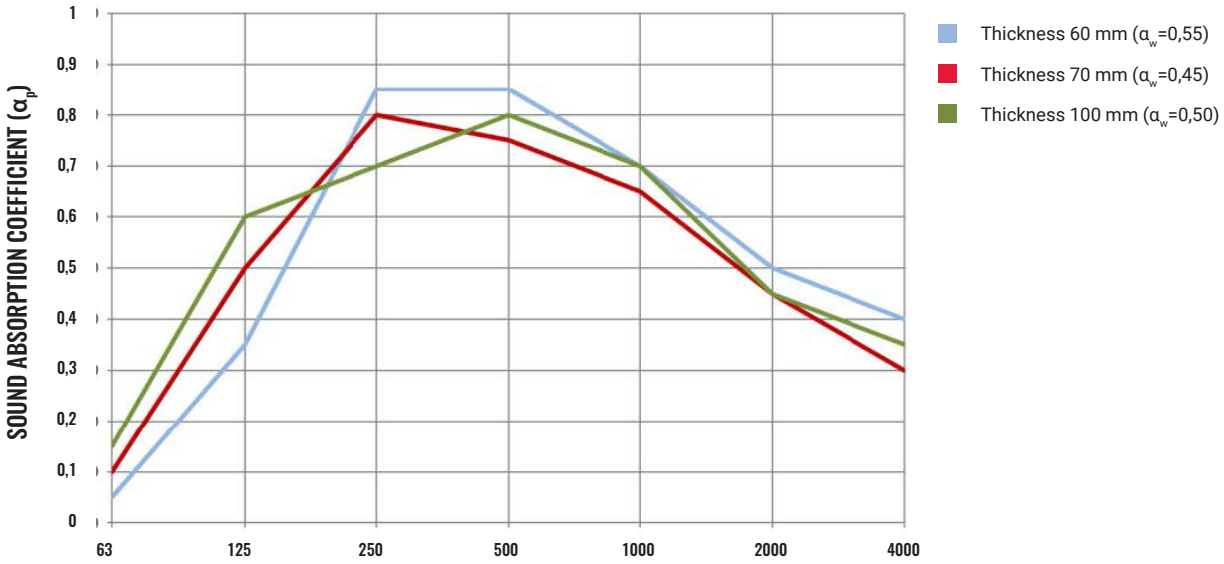
Paroc Marine Navis Slab 60 G1 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
30	0,05	0,15	0,55	0,85	0,75	0,60	0,50	0,65	C	0,70
50	0,05	0,25	0,70	0,90	0,70	0,50	0,40	0,55	D	0,70
100	0,05	0,35	0,70	0,85	0,75	0,65	0,55	0,70	C	0,75

DIAGRAM M6

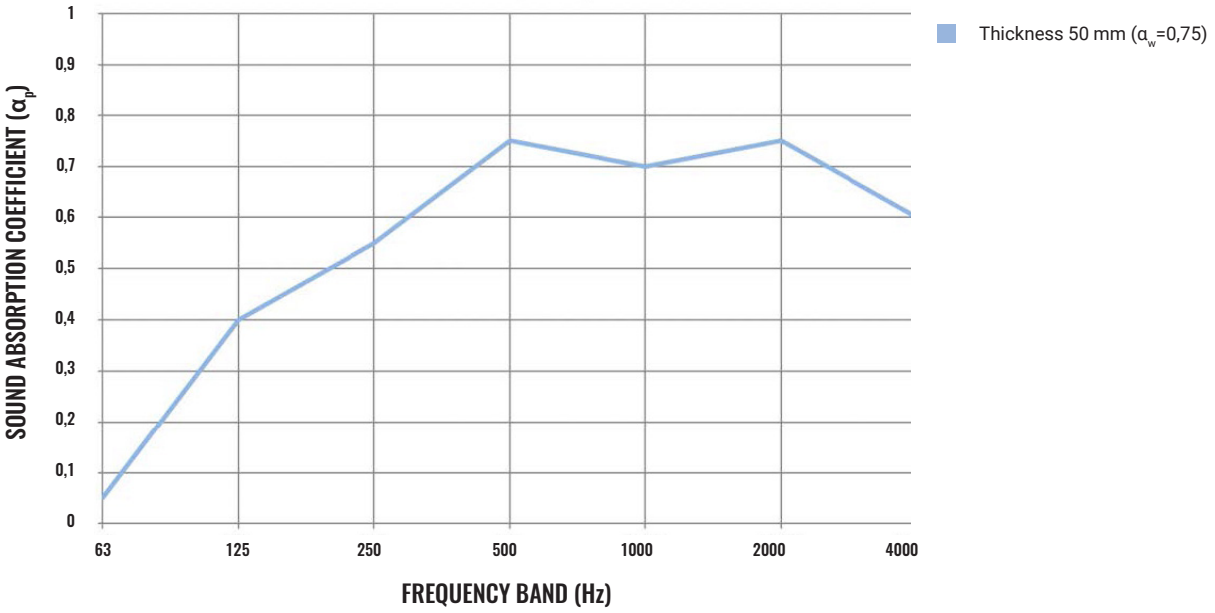
PAROC Marine Navis Slab 60 G1 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
60	0,05	0,35	0,85	0,85	0,70	0,50	0,40	0,55	D	0,75
70	0,10	0,50	0,80	0,75	0,65	0,45	0,30	0,45	D	0,65
100	0,15	0,60	0,70	0,80	0,70	0,45	0,35	0,50	D	0,65

DIAGRAM M7

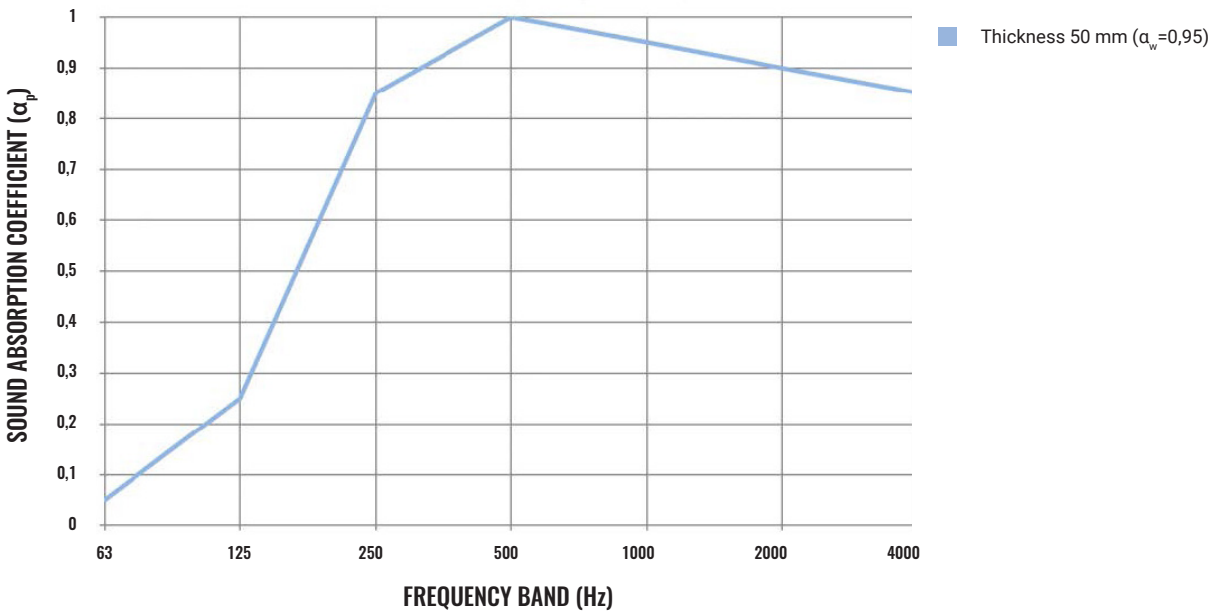
PAROC Marine Navis Slab 60 AluCoat (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
50	0,05	0,40	0,55	0,75	0,70	0,75	0,60	0,75	C	0,70

DIAGRAM M8

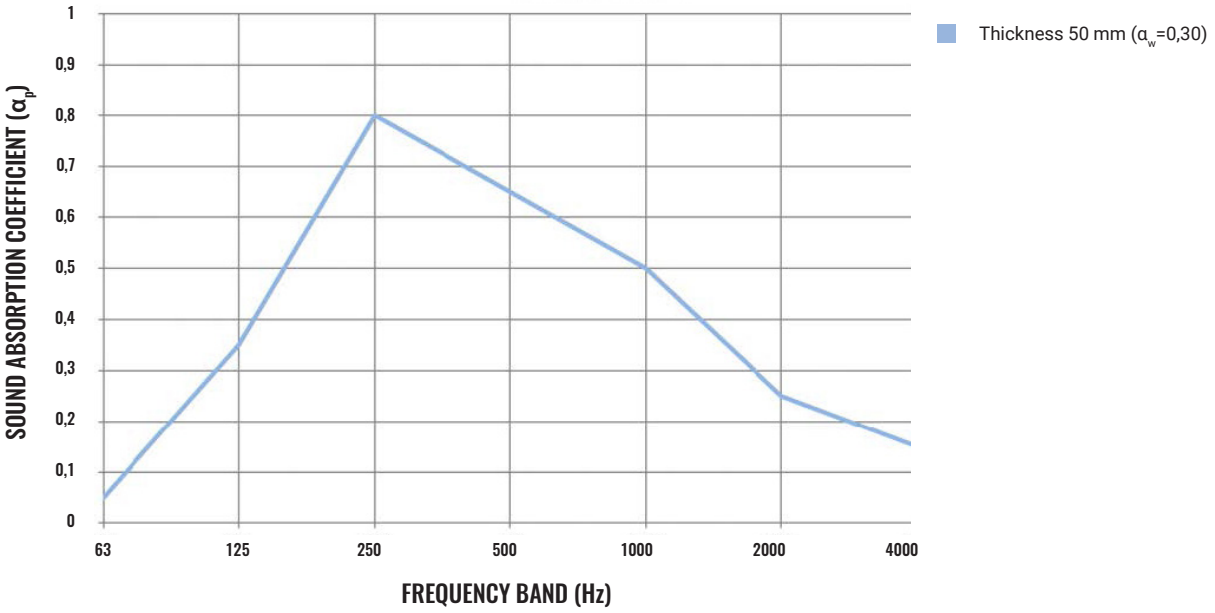
PAROC Marine Navis Slab 60 G3 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
50	0,05	0,25	0,85	1,00	0,95	0,90	0,85	0,95	A	0,95

DIAGRAM M9

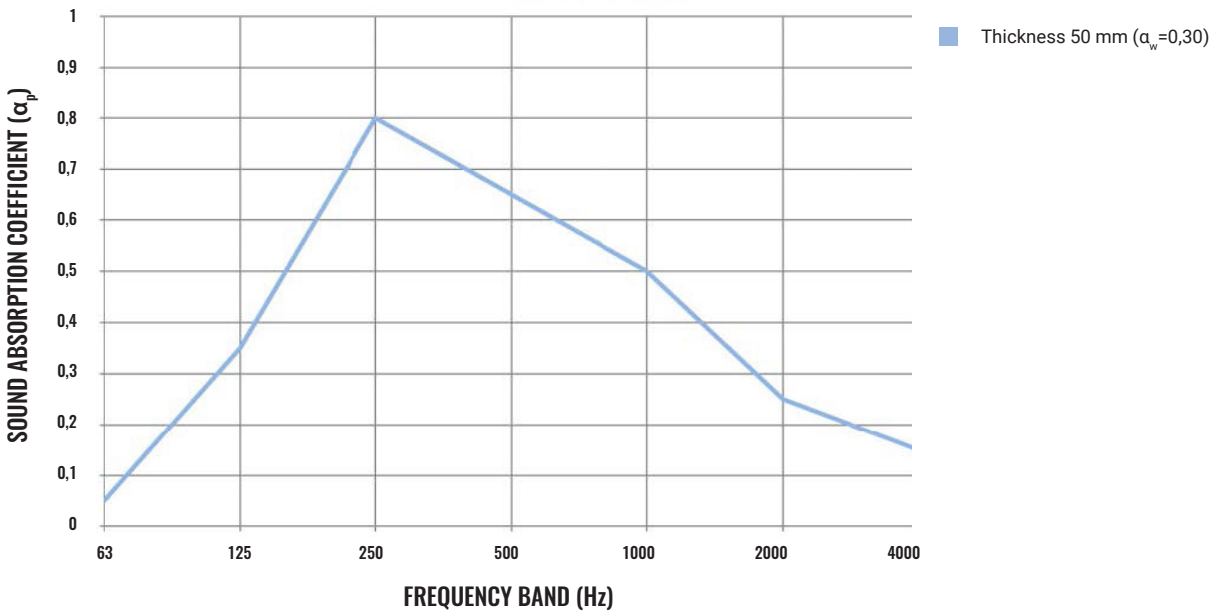
PAROC Marine Navis Slab 60 G4 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
50	0,05	0,35	0,80	0,65	0,50	0,25	0,15	0,30	D	0,55

DIAGRAM M10

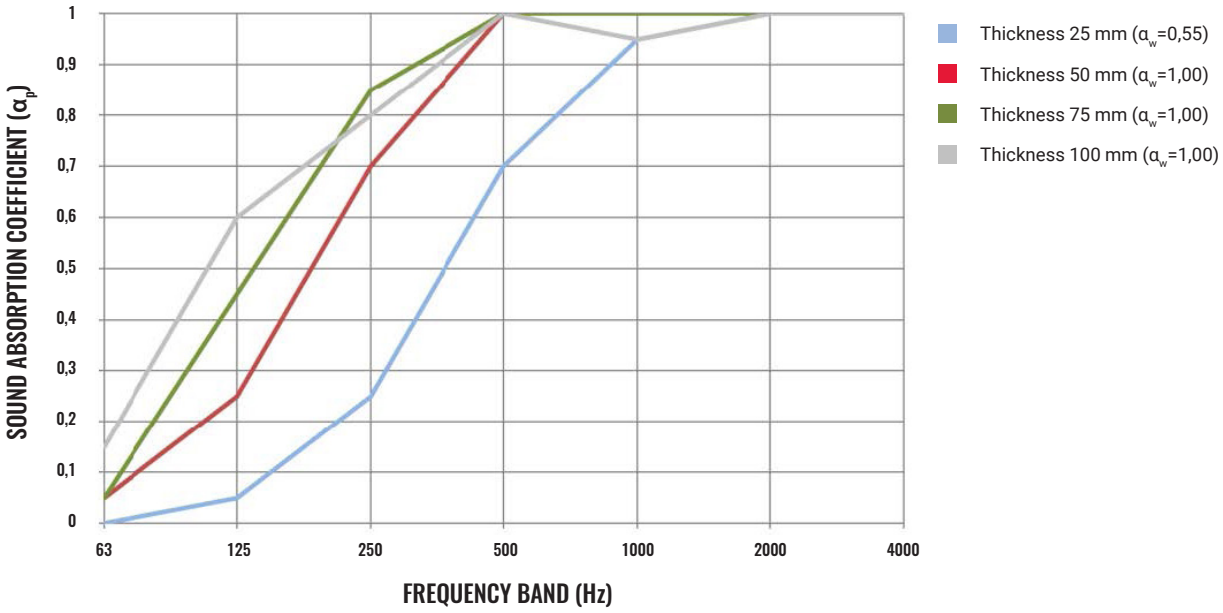
PAROC Marine Navis Slab 60 G7 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
50	0,05	0,35	0,80	0,65	0,50	0,25	0,15	0,30	D	0,55

DIAGRAM M11

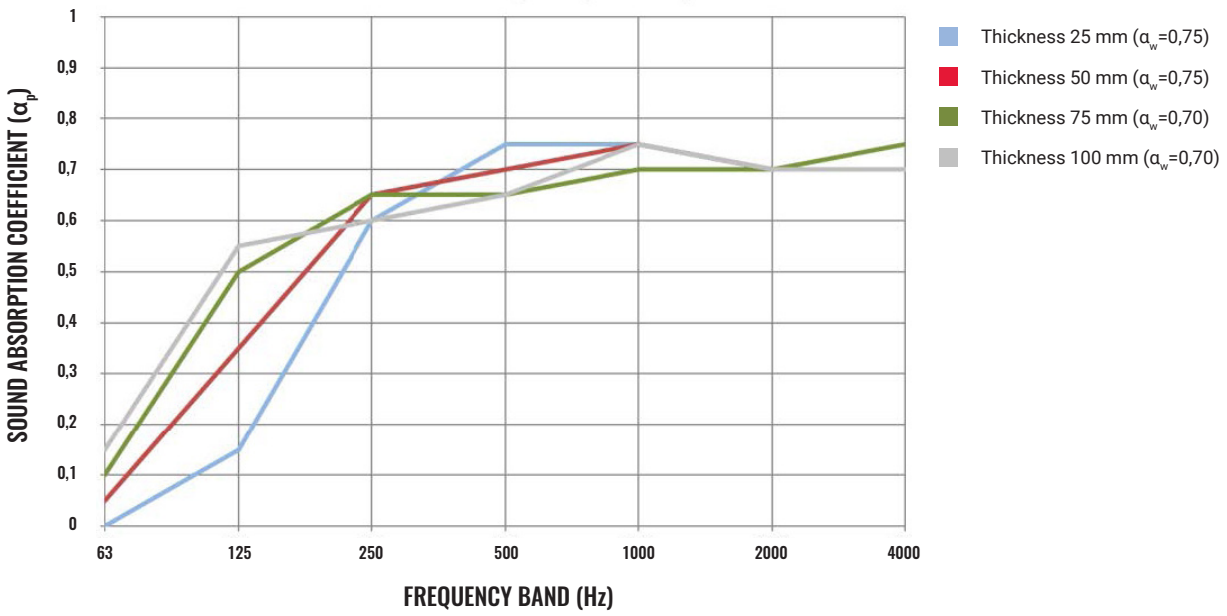
PAROC Marine Fire Slab 100 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
25	0,00	0,05	0,25	0,70	0,95	1,00	1,00	0,55	D	0,75
50	0,05	0,25	0,70	1,00	1,00	1,00	1,00	1,00	A	0,95
75	0,05	0,45	0,85	1,00	1,00	1,00	1,00	1,00	A	0,95
100	0,15	0,60	0,80	1,00	0,95	1,00	1,00	1,00	A	0,95

DIAGRAM M12

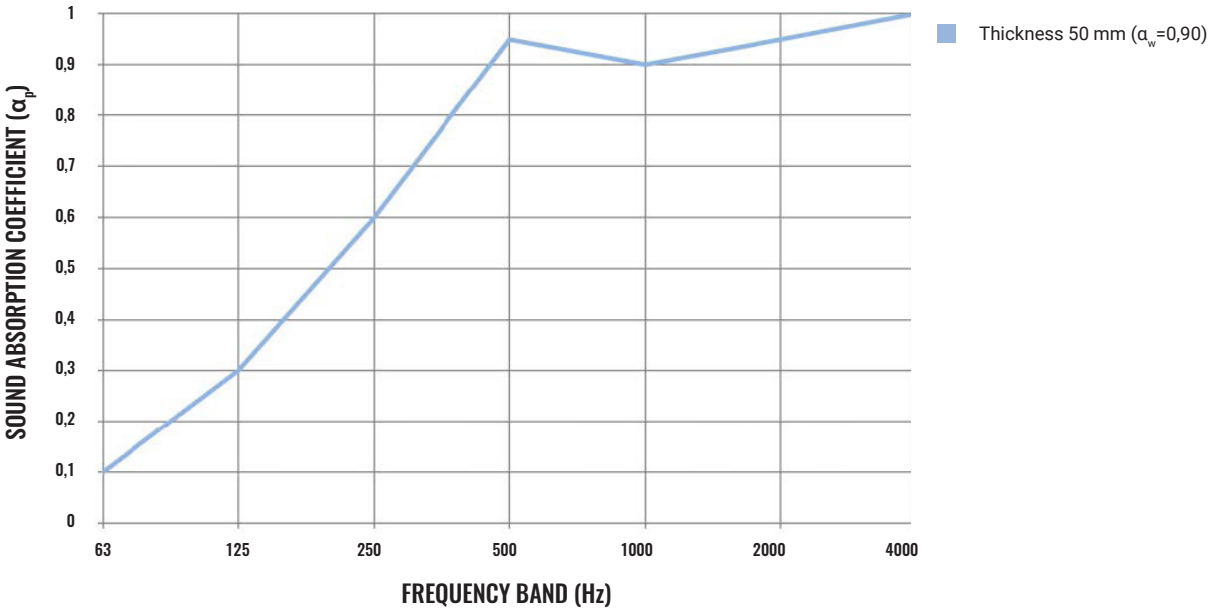
PAROC Marine Fire Slab 100 G1 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
25	0,00	0,16	0,60	0,75	0,75	0,70	0,70	0,75	C	0,70
50	0,05	0,35	0,65	0,70	0,75	0,70	0,70	0,75	C	0,70
75	0,10	0,55	0,60	0,65	0,75	0,70	0,70	0,70	C	0,70
100	0,15	0,55	0,60	0,65	0,75	0,70	0,70	0,70	C	0,70

DIAGRAM M13

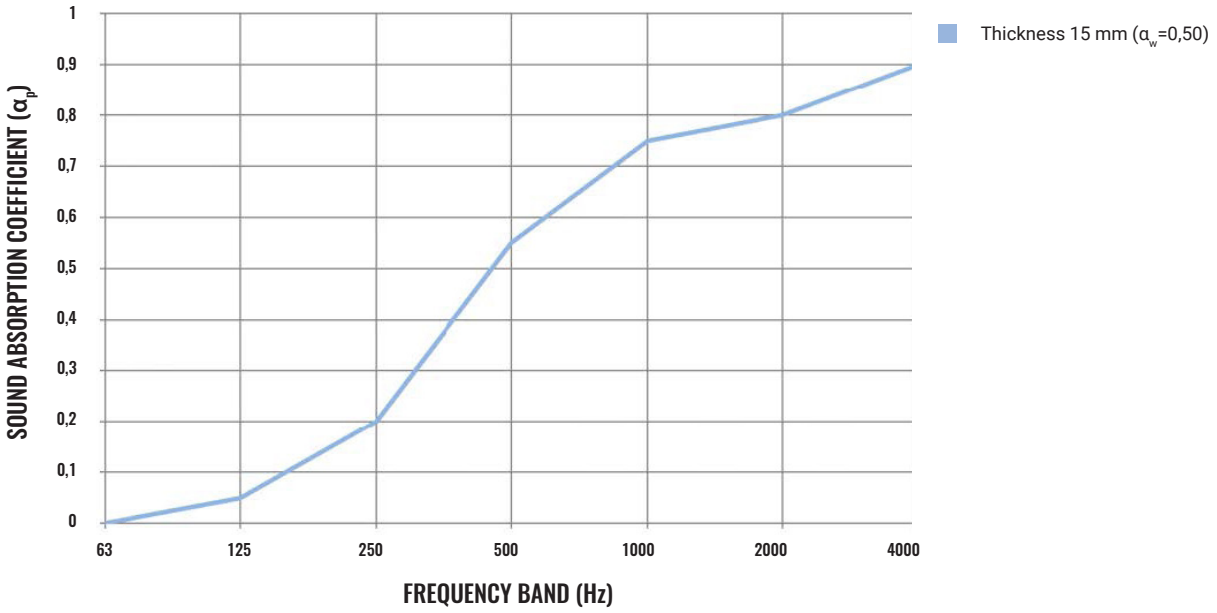
PAROC Marine Floor Slab 140 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
50	0,10	0,30	0,60	0,95	0,90	0,95	1,00	0,90	A	0,85

DIAGRAM M14

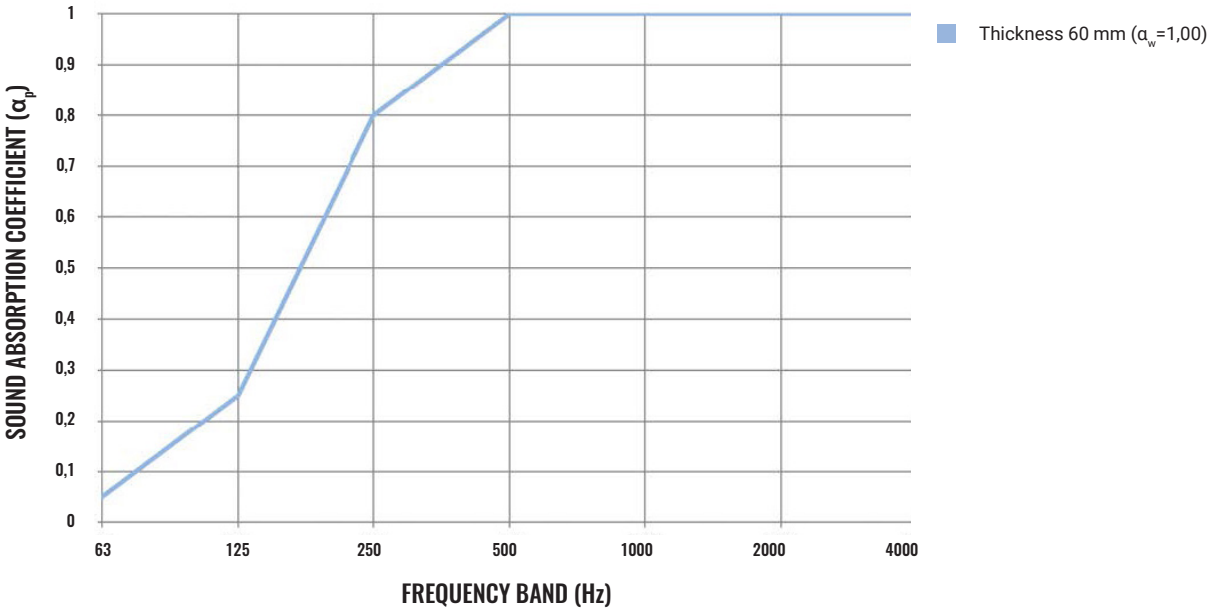
PAROC Marine Slab 220 N5 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
15	0,00	0,05	0,20	0,55	0,75	0,80	0,90	0,50	D	0,60

DIAGRAM M15

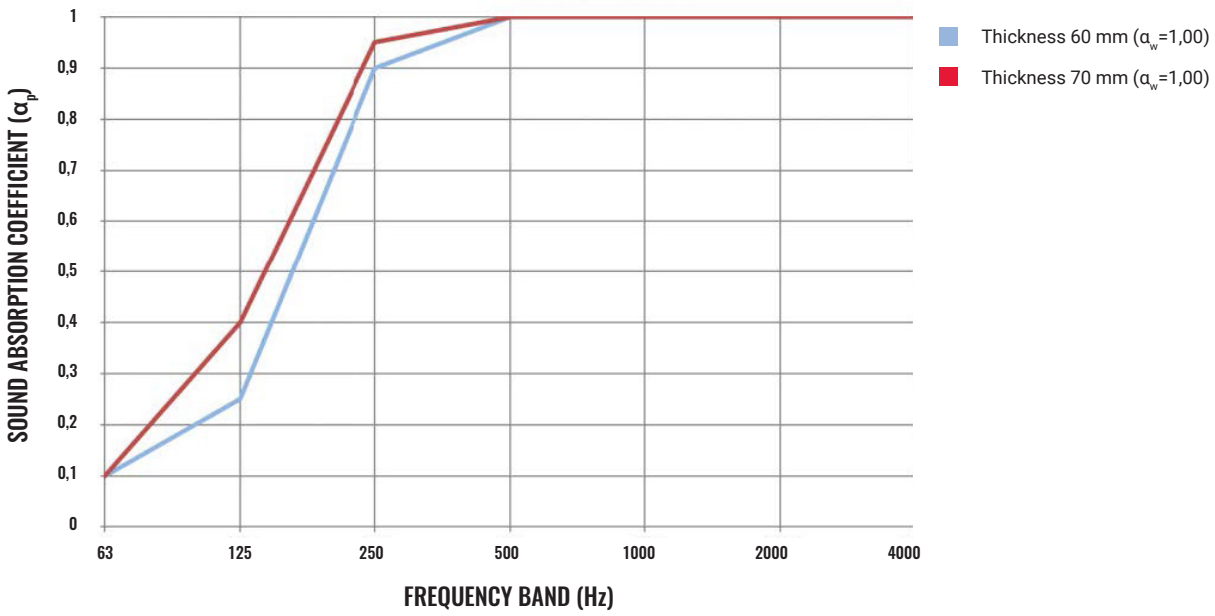
PAROC Marine Navis Mat 60 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
60	0,05	0,25	0,80	1,00	1,00	1,00	1,00	1,00	A	0,95

DIAGRAM M16

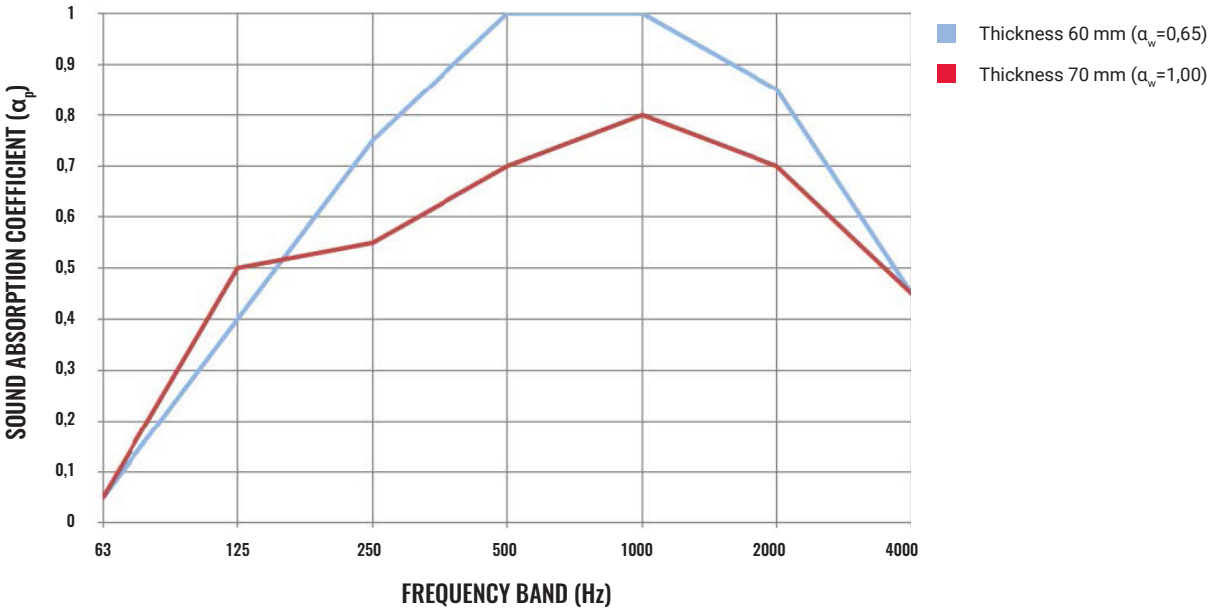
PAROC Marine Navis Mat 90 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
60	0,10	0,25	0,90	1,00	1,00	1,00	1,00	1,00	A	1,00
70	0,10	0,40	0,95	1,00	1,00	1,00	1,00	1,00	A	1,00

DIAGRAM M17

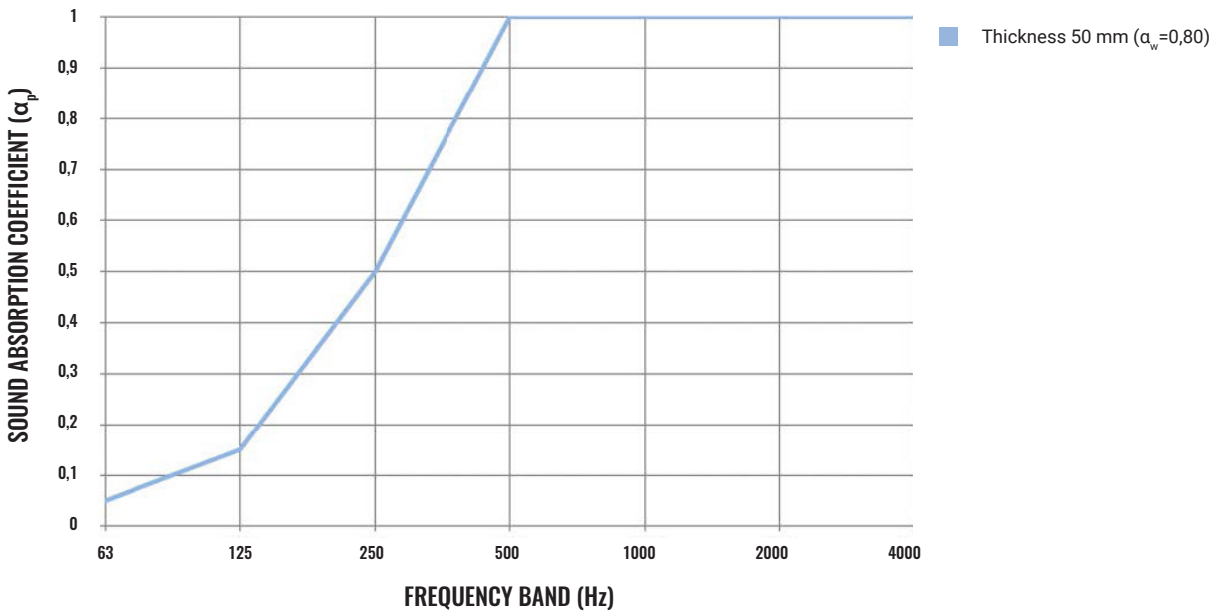
PAROC Marine Navis Mat 90 AluCoat (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
60	0,05	0,40	0,75	1,00	1,00	0,85	0,45	0,65	C	0,90
70	0,05	0,50	0,55	0,70	0,80	0,70	0,45	0,65	C	0,75

DIAGRAM M18

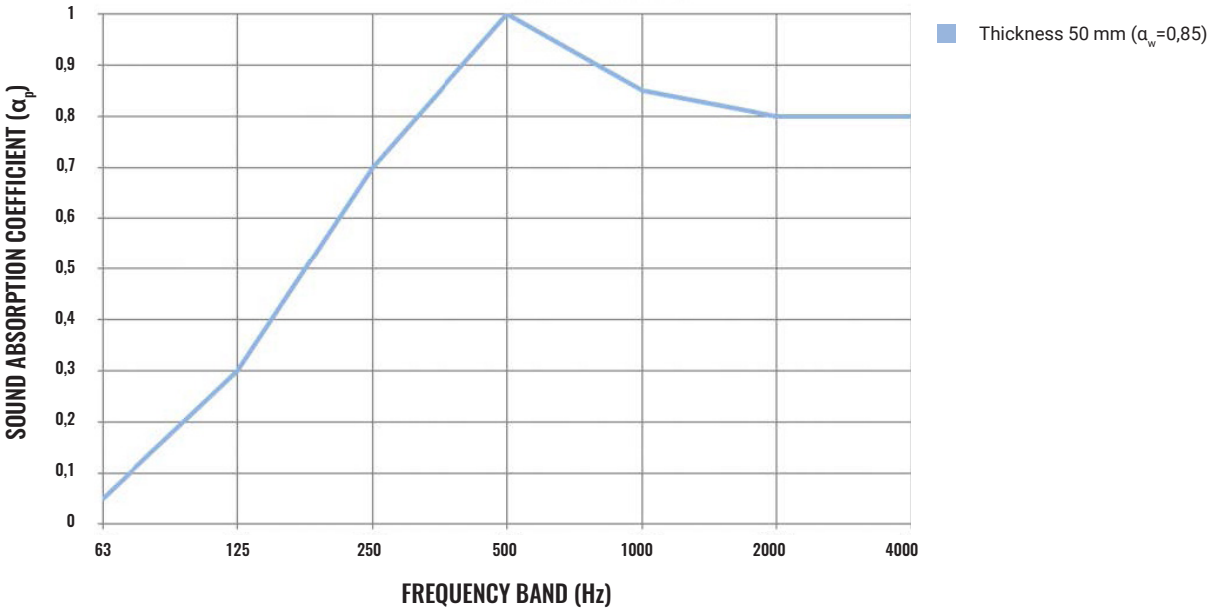
PAROC Marine Navis Wired Mat 60 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
50	0,05	0,15	0,50	1,00	1,00	1,00	1,00	0,80	B	0,90

DIAGRAM M19

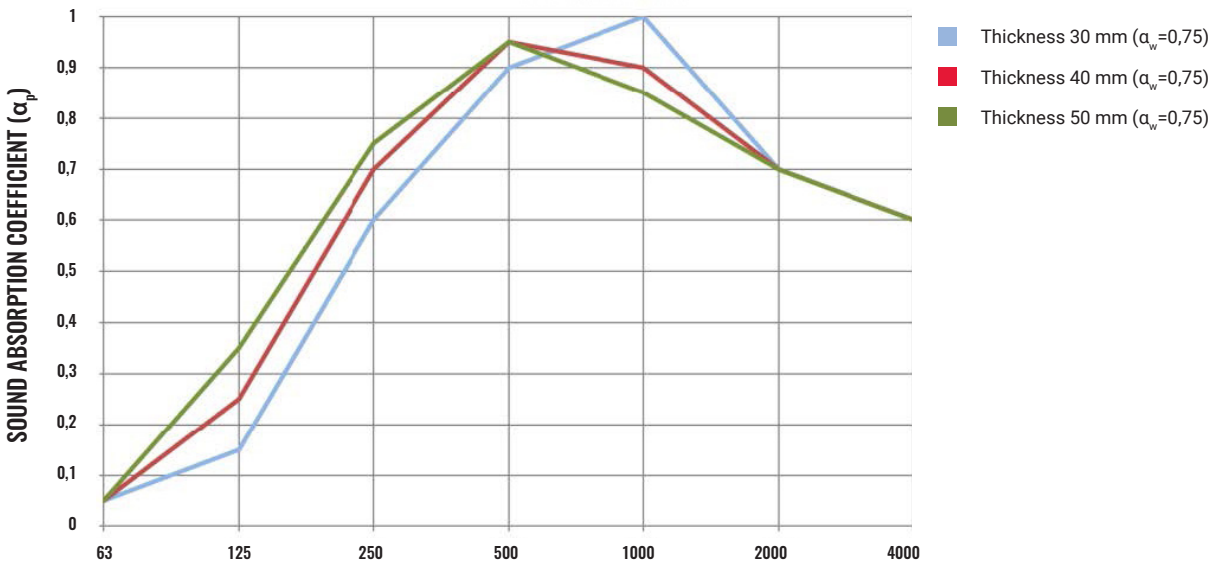
PAROC Marine Navis Wired Mat 60 AluCoat (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
50	0,05	0,30	0,70	1,00	0,85	0,80	0,80	0,85	B	0,85

DIAGRAM M20

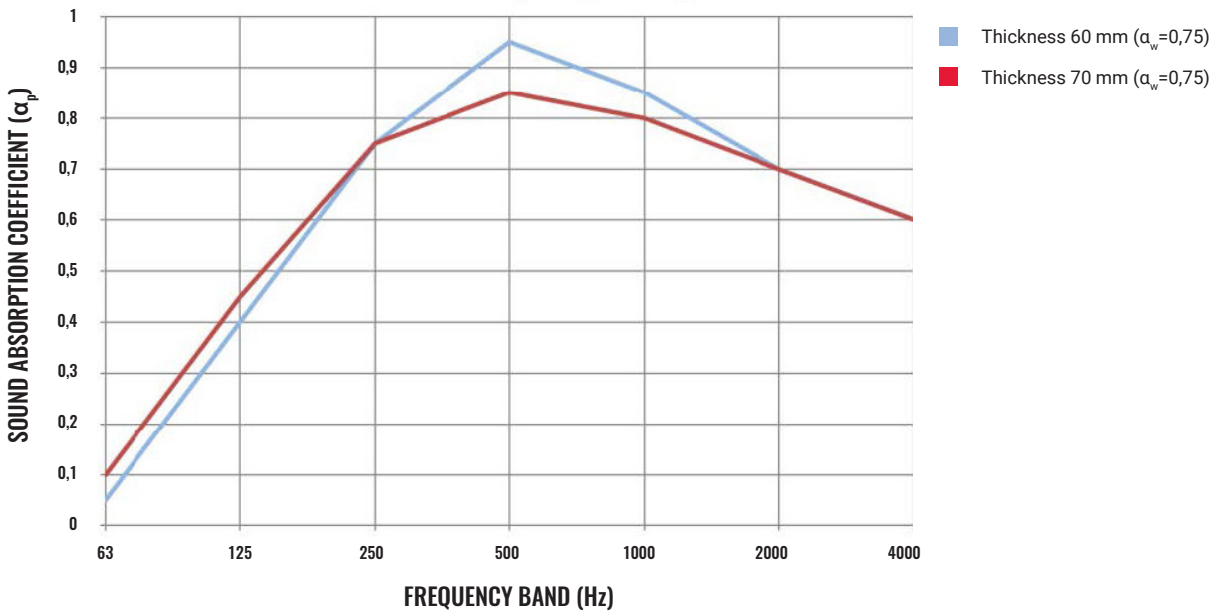
PAROC Marine Navis Wired Mat 60 G1 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
30	0,05	0,15	0,60	0,90	1,00	0,70	0,60	0,75	C	0,80
40	0,05	0,25	0,70	0,95	0,90	0,70	0,60	0,75	C	0,80
50	0,05	0,35	0,75	0,95	0,85	0,70	0,60	0,75	C	0,80

DIAGRAM M21

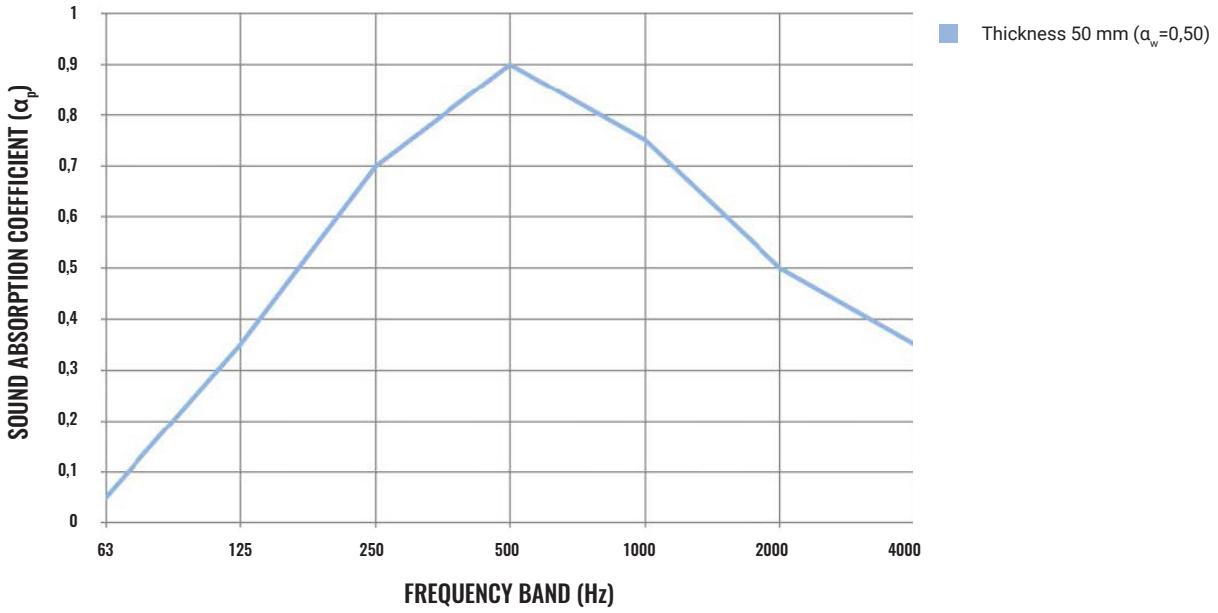
PAROC Marine Navis Wired Mat 60 G1 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
60	0,05	0,40	0,75	0,95	0,85	0,70	0,60	0,75	C	0,80
70	0,10	0,45	0,75	0,85	0,80	0,70	0,60	0,75	C	0,80

DIAGRAM M22

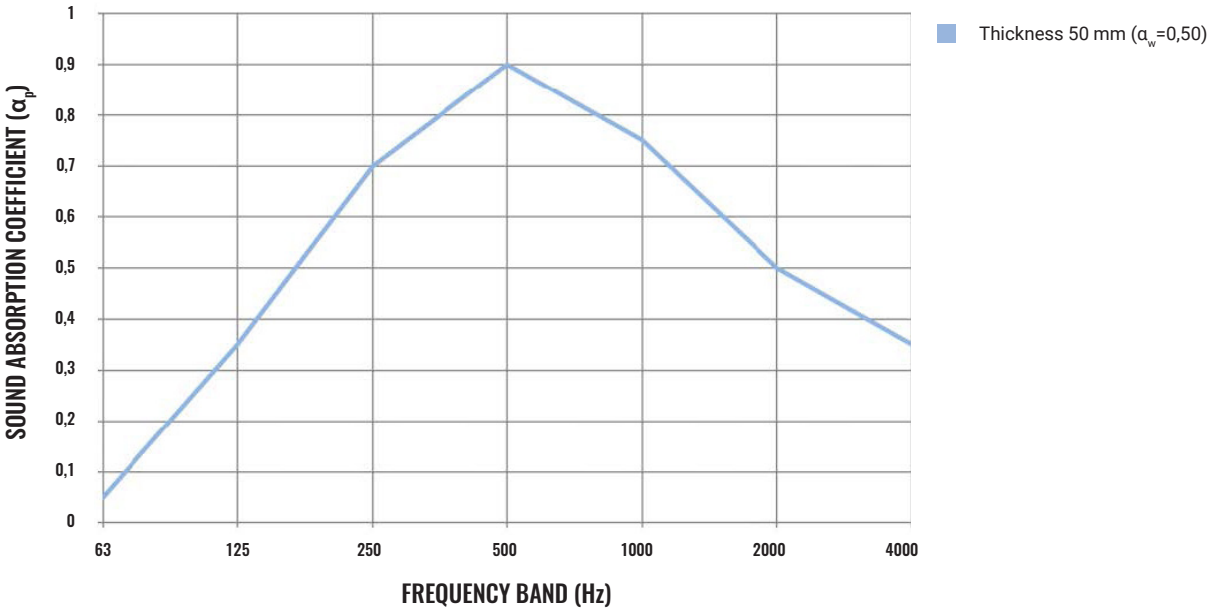
PAROC Marine Navis Wired Mat 60 G4 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
50	0,05	0,35	0,70	0,90	0,75	0,50	0,35	0,50	D	0,70

DIAGRAM M23

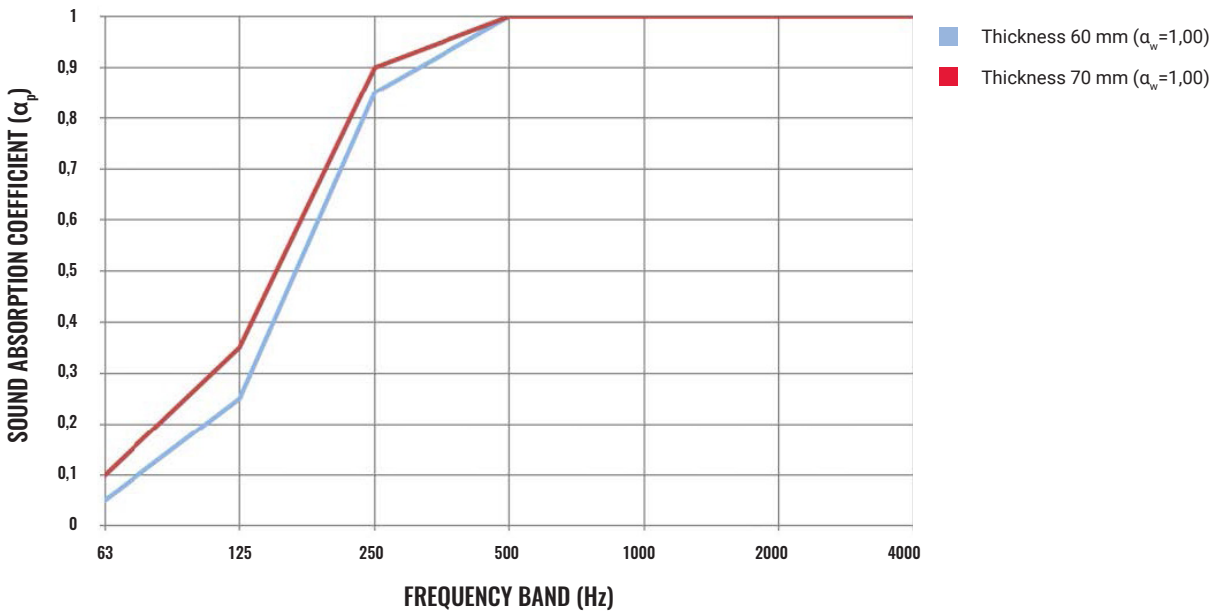
PAROC Marine Navis Wired Mat 60 G7 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
50	0,05	0,35	0,70	0,90	0,75	0,50	0,35	0,50	D	0,70

DIAGRAM M24

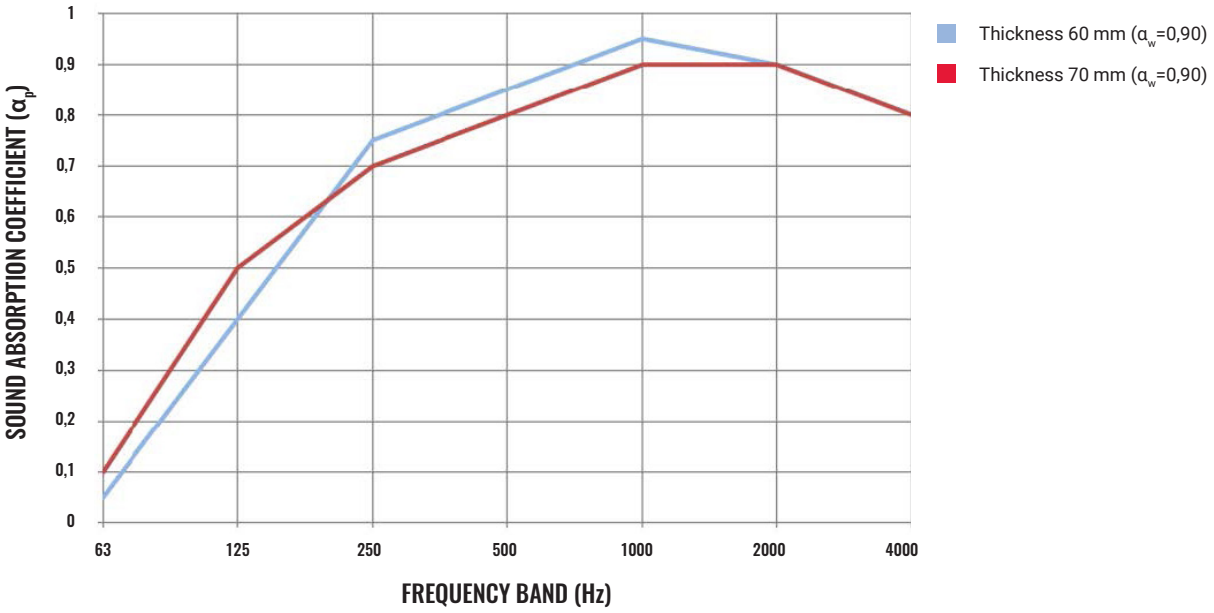
PAROC Marine Navis Wired Mat 90 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
60	0,05	0,25	0,85	1,00	1,00	1,00	1,00	1,00	A	0,95
70	0,10	0,35	0,90	1,00	1,00	1,00	1,00	1,00	A	1,00

DIAGRAM M25

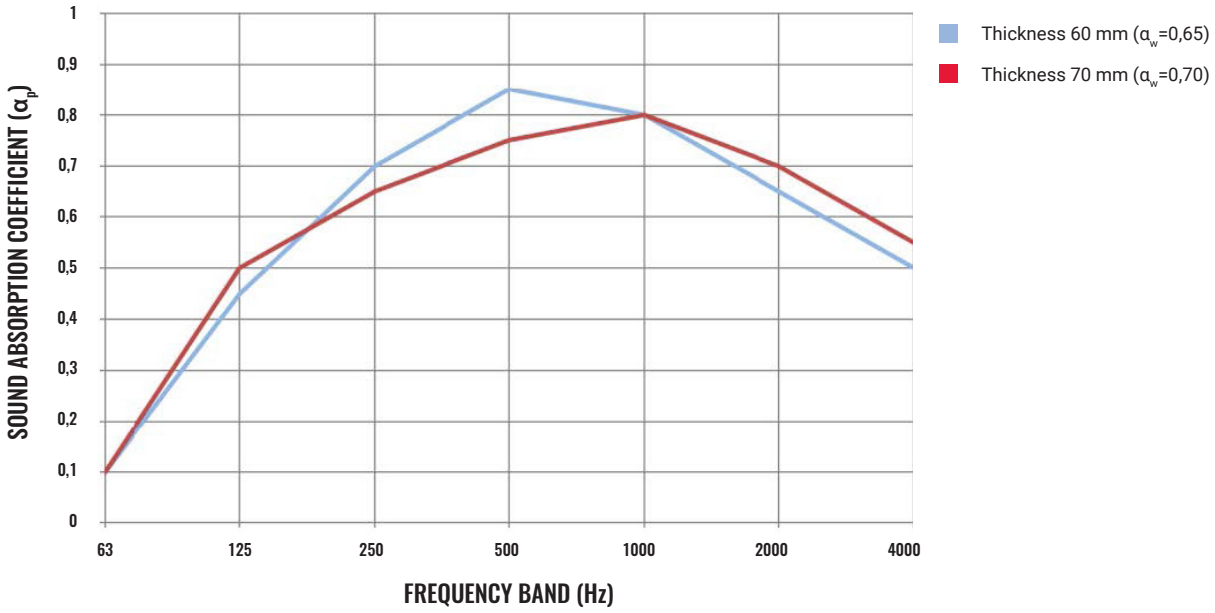
PAROC Marine Navis Wired Mat 90 AluCoat (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
60	0,05	0,40	0,75	0,85	0,95	0,90	0,80	0,90	A	0,85
70	0,10	0,50	0,70	0,80	0,90	0,90	0,80	0,90	A	0,85

DIAGRAM M26

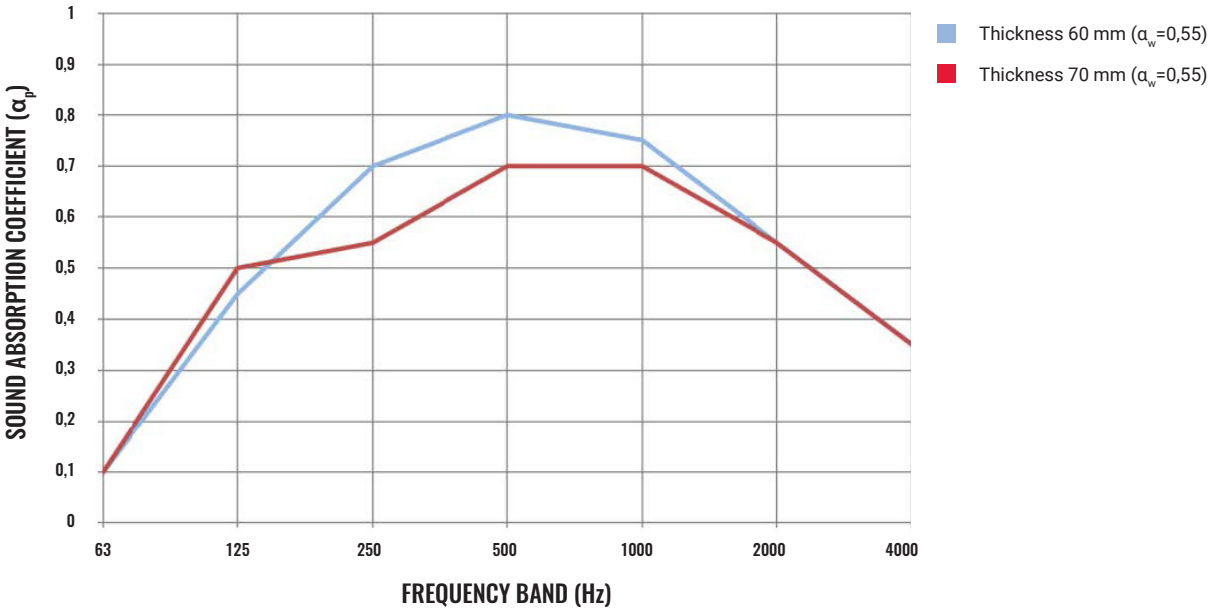
PAROC Marine Navis Wired Mat 90 G1 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
60	0,10	0,45	0,70	0,85	0,80	0,65	0,50	0,65	C	0,75
70	0,10	0,50	0,65	0,75	0,80	0,70	0,55	0,70	C	0,80

DIAGRAM M27

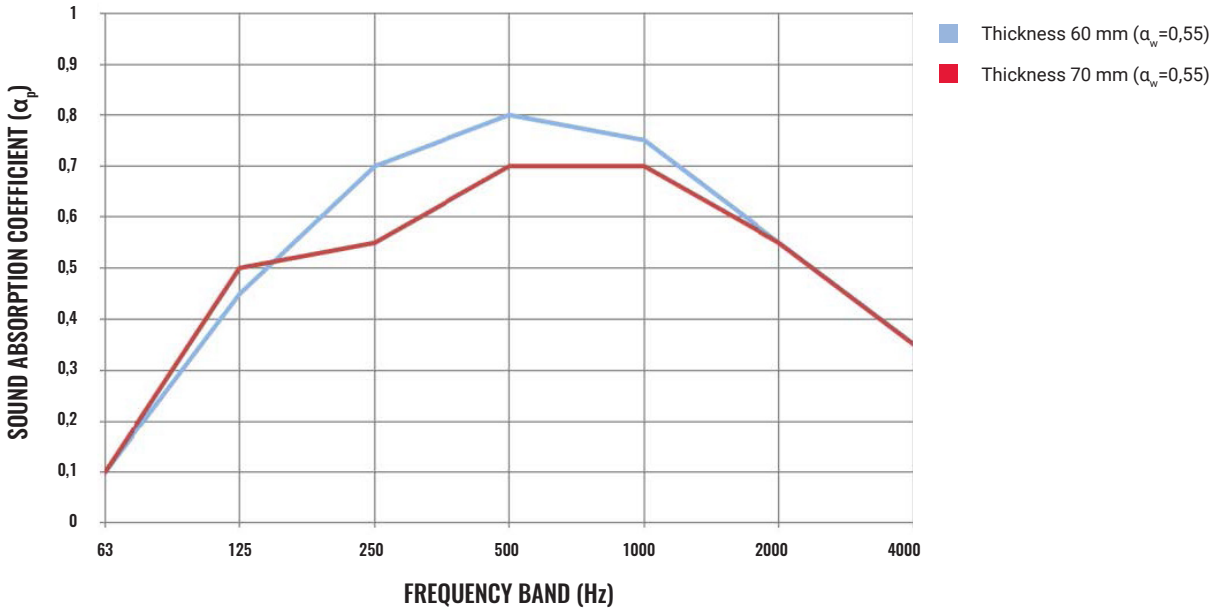
PAROC Marine Navis Wired Mat 90 G4 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
60	0,10	0,45	0,70	0,80	0,75	0,55	0,35	0,55	D	0,70
70	0,10	0,50	0,55	0,70	0,70	0,55	0,35	0,55	D	0,65

DIAGRAM M28

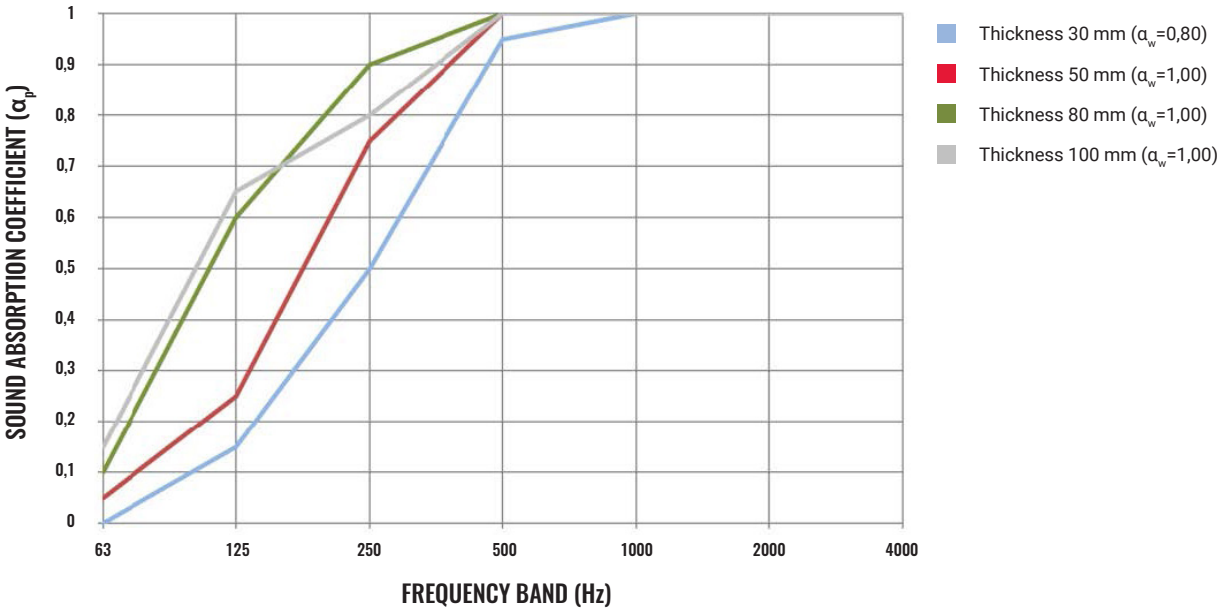
PAROC Marine Navis Wired Mat 90 G7 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
60	0,10	0,45	0,70	0,80	0,75	0,55	0,35	0,55	D	0,70
70	0,10	0,50	0,55	0,70	0,70	0,55	0,35	0,55	D	0,65

DIAGRAM M29

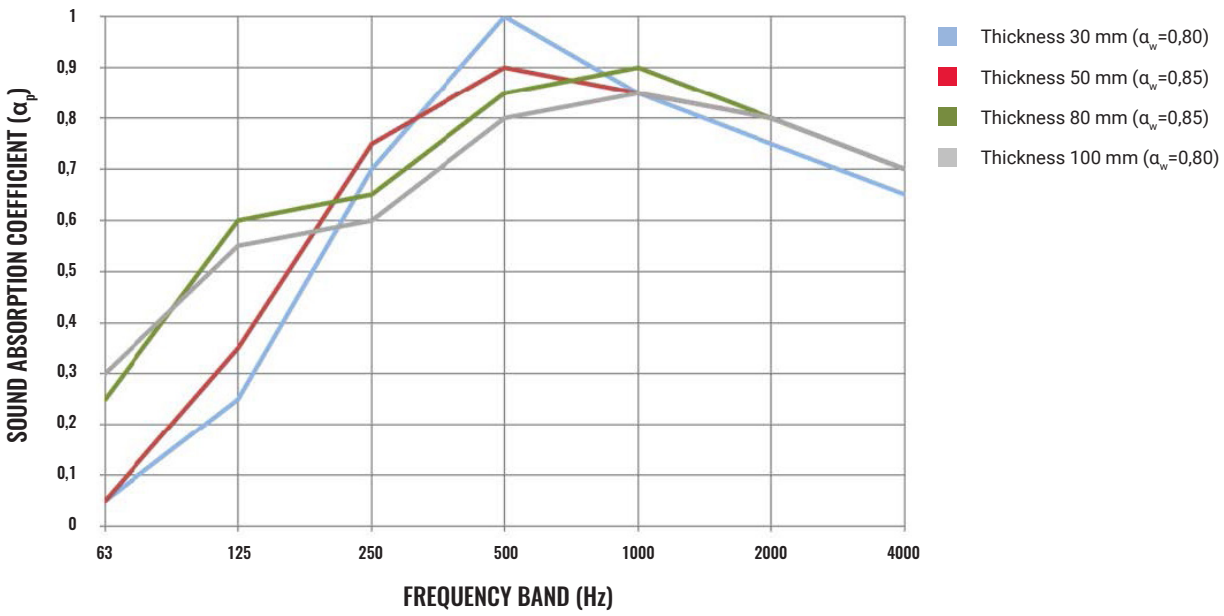
PAROC Marine Wired Mat 100 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
30	0,00	0,10	0,50	0,95	1,00	1,00	1,00	0,80	B	0,85
50	0,15	0,25	0,75	1,00	1,00	1,00	1,00	1,00	A	0,95
80	0,10	0,60	0,90	1,00	1,00	1,00	1,00	1,00	A	1,00
100	0,15	0,65	0,80	1,00	1,00	1,00	1,00	1,00	A	0,95

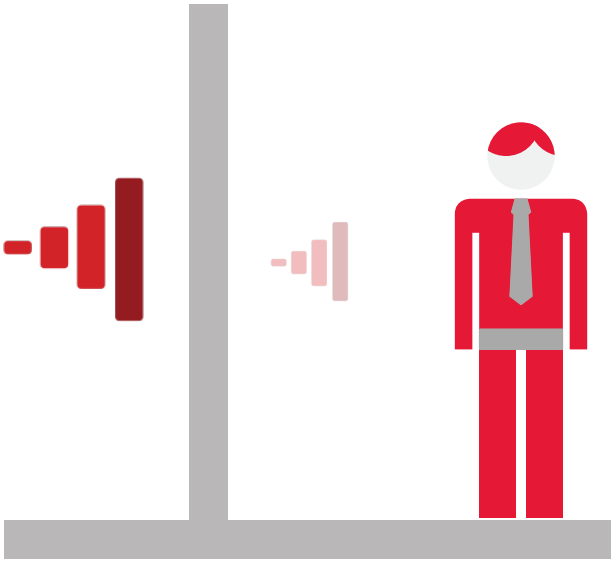
DIAGRAM M30

PAROC Marine Wired Mat 100 G1 (directly mounted)



Thickness,mm	Frequency Hz							α_w	Abs. class	NRC
	63	125	250	500	1000	2000	4000			
30	0,05	0,25	0,70	1,00	0,85	0,75	0,65	0,80	C	0,85
50	0,05	0,35	0,75	0,90	0,85	0,80	0,70	0,85	C	0,85
80	0,25	0,60	0,65	0,85	0,90	0,80	0,70	0,85	C	0,80
100	0,30	0,55	0,60	0,80	0,85	0,80	0,70	0,80	C	0,75

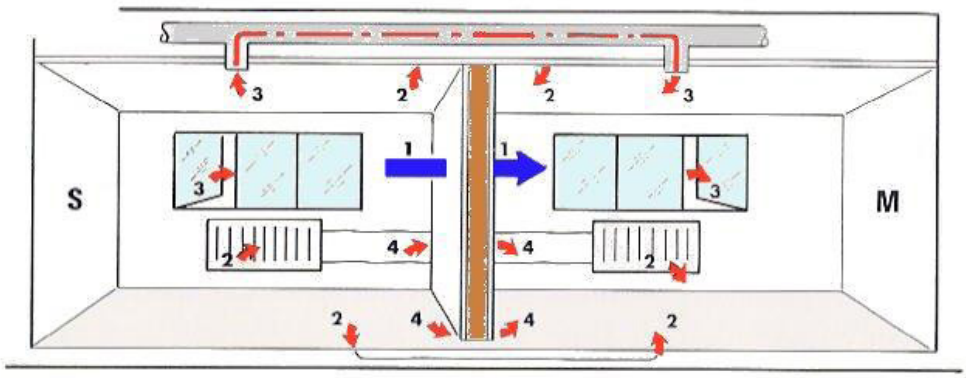
SOUND REDUCTION



EXPLANATION OF DEFINITIONS

Introduction

When airborne sound is generated in a room it can be transmitted to adjacent rooms via a number of transmission parts as walls, floors and building framework. The net reduction of sound energy is called airborne sound insulation.



Sound Reduction Index

The basic measure of sound insulation of a partition is named Sound Reduction Index or Sound Transmission Loss. The Sound Reduction Index is the number of decibels which the sound power is reduced through a partition. To compare sound insulation properties, you need to consider the area of the dividing partition/wall, as well as the volume and sound absorption properties of the receiving room.

The Sound Reduction Index is measured normally from 50 to 5000 Hz in 1/3 octave band. If the measurements are performed in situ (in a real building) the values are denoted R'. The difference between laboratory and field values can be a significant number of dB depending on the construction details and workmanship. The standard test procedure is defined in EN ISO 140, where standard methods are given for both laboratory and field measurements.

$$R = L_1 - L_2 + 10 \log (S/A)\ dB$$

where:

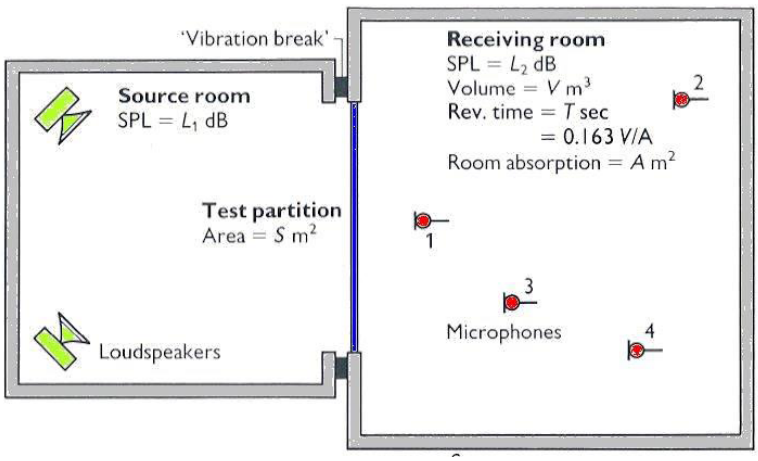
L_1: average sound pressure level in the source room

L_2: average sound pressure level in the receiving room

S: area of the test specimen (m^2)

A: equivalent sound absorption area of the receiving room (Sabine formula)

If the measurements are performed in situ the values are denoted R'.



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Rw- value

Weighted Sound Reduction Index Rw

When specifying the acoustic performance of a partition in a more general manner, it can be useful to describe the sound insulation by a single number. The weighted sound reduction index, Rw, is a rating given in EN ISO 717-1. This standard fits a standard reference curve to the measured sound reduction index curve.

In EN ISO 717-1, a rating method is also given where the Rw value is completed by two C-terms which are applied to two models of the noise spectra for various types of noise. These two terms, $\mathbf{R_{w+C}}$ and $\mathbf{R_{w+Ctr}}$, also include the frequency range 100 – 3150 Hz but can be extended to 50 – 5000 Hz. As industrial and traffic noise often have high sound levels which are also below 100 Hz, it is recommended that the extended frequency area is used.

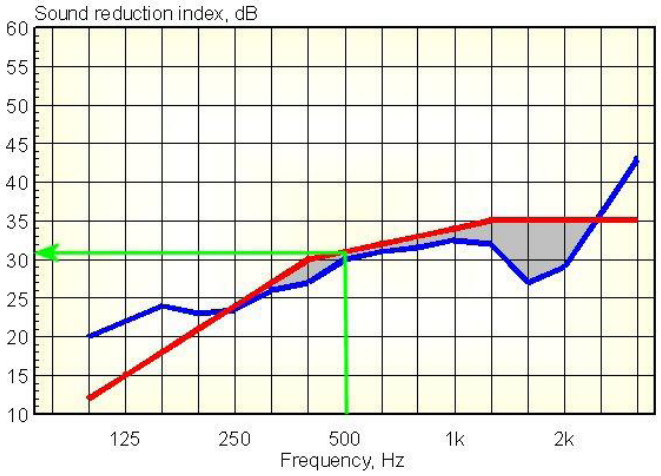
The summary value, $\mathbf{R_w}$ + **C**, gives the reduction value in dBA for a spectrum with a level which is equally high in all third-octave bands. This can be used for:

- Living activities (talking, music, radio, TV)
- Railway traffic at medium and high speed
- Highway road traffic travelling at speeds in excess of 80 km/h
- Jet aircraft at a short distance
- Factories emitting mainly medium and high frequency noise

The summary value $\mathbf{R_{w+}C_{tr}}$ also gives the reduction value in dBA, spectrum with low-frequency dominance such as:

Urban road traffic

- Railway traffic at low speeds
- Disco music
- Factories emitting mainly low and medium frequency noise



Compare measured values with a standardized reference curve between 100 – 3150 Hz. The reference curve (red) is moved upwards in steps of 1 dB until the difference is less than 32 dB (grey shaded area) between the measured values and the reference curve values.. The $\mathbf{R_w}$ value is then defined as the value the reference curve has at 500 Hz.

The $\mathbf{R_{w-}}$ value is then given as $\mathbf{R_w}$ (C, Ctr) = 47 (-2;-6). This means that the $\mathbf{R_{w-}}$ value is 47 dB, the $\mathbf{R_{W,C}}$ is 45 dBA and the $\mathbf{R_{W,\,Ctr}}$ is 41 dBA.

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The table below shows how the R_w values are perceived.

R' W dB	Normal office equipment	Normal conversation	Talks loudly	Shout	TV, radio, stereo, moderate level	Disco
25						
30						
35						
40						
44						
48						
52						
56						
60						

= Is heard = Can be heard = Is not heard

EXAMPLE

In the example on page 6 a production hall is next to the small workshop room. The side facing the production hall is 15 x 2.9 m. The sound reduction index for the wall structure is 40 dB in the actual frequency band. The overall sound level in the production hall will be 80 dB. Calculate the sound level in the dining room.

R = LS – LR + 10 log (S/A) dB

The absorption area, A, from page 8 with the insulated ceiling is 313 m^2 Sabine.

The area of the wall, S, is 43.5 m^2.

The sound level in the receiving room will be:

LR = 80 – 40 +10log (43.5/313) = 31.5 dB

Overall Sound Reduction Index

If a partition consists of different kinds of elements I, for example a wall with doors and windows which have different sound transmission characteristics, the overall sound reduction index for must be calculated.

$$RT_{total} = 10\log\left(\frac{S_1+S_2+\cdots+S_n}{S_1 10^{-R1/10}+\cdots S_n 10^{-R1/10}}\right)$$

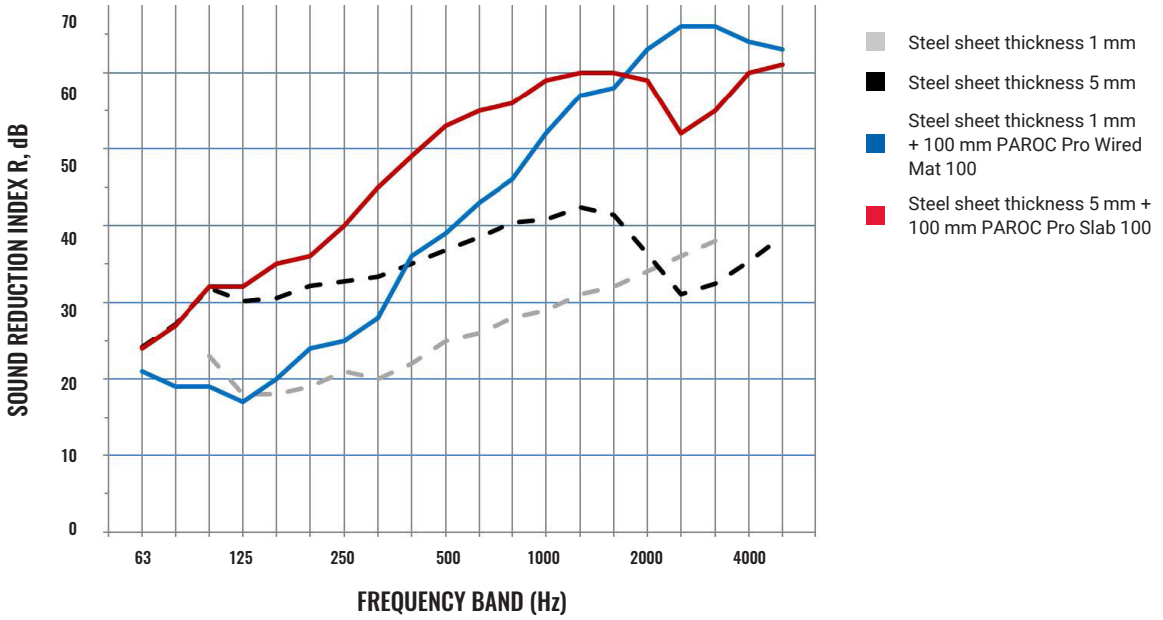
If a door (1 x 2 m) is mounted in the wall to the production hall with a sound reduction index of 25 dB the total sound reduction index will be:

$$RT_{total}=10\log\left(\frac{43.5+2}{43.5 \cdot 10^{-40/10}+\cdots+2 \cdot 10^{-25/10}}\right)=36\ dB$$

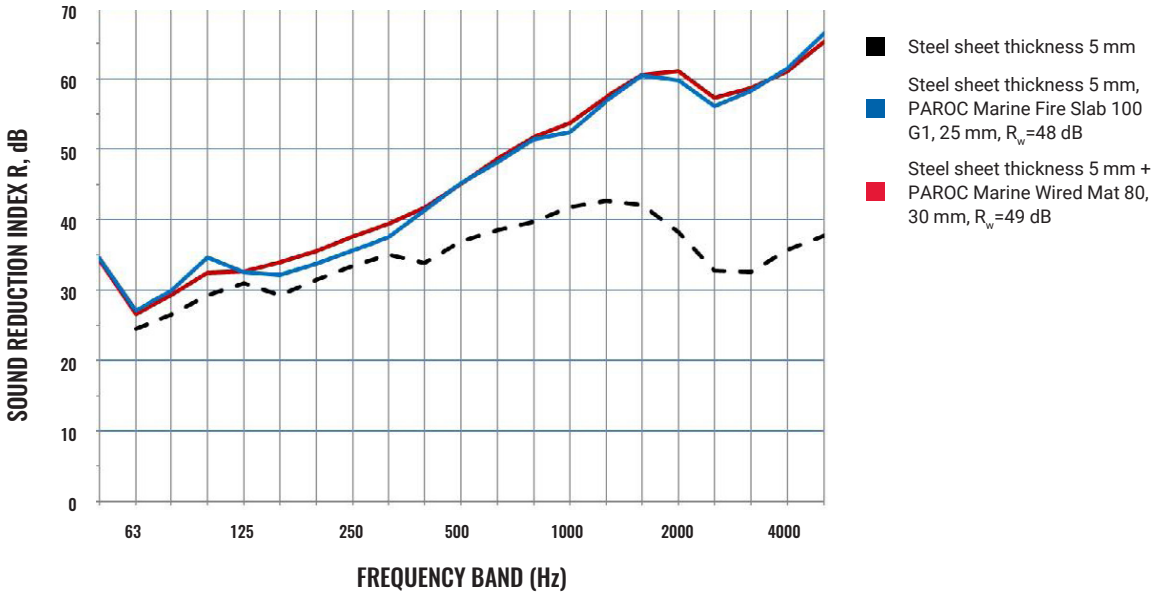
So 2 m^2 with 15 dB lower sound reduction index in a 43 m^2 wall will reduce the sound reduction with 4dB.

SOUND REDUCTION STEEL AND ALUMINIUM SHEET STRUCTURES

Influence of insulation on different steel sheets



Comparision slab vs wired mat



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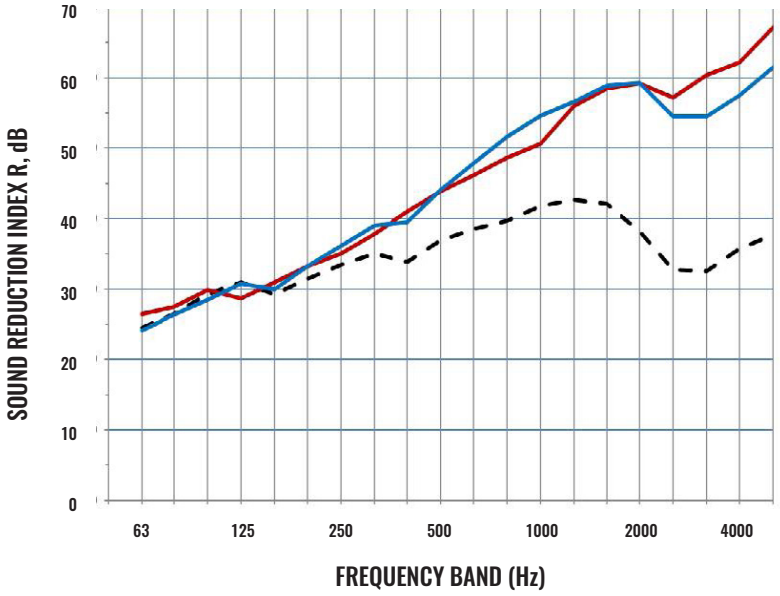
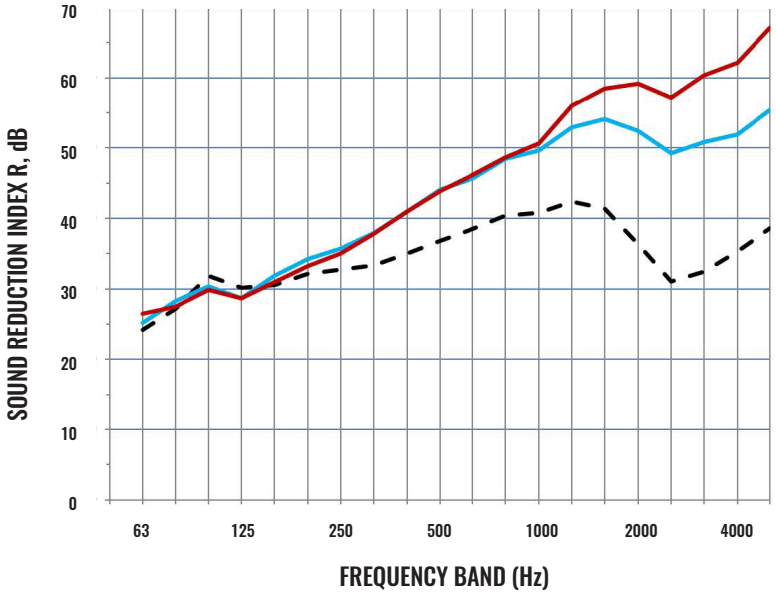
Comparision slab with different density



- 5 mm steel with stiffener, R_W 38dB
- PAROC Navis Slab 60, 50 mm, Stiffener 30 mm, R_w=47dB
- PAROC Marine Fire Slab 100, 50 mm, Stiffener 25 mm, R_w=47dB

PAROC Marine Fire Slab 100



- 5 mm steel with stiffener
- PAROC Marine Fire Slab 100, 50 mm R_w= 47dB
- PAROC Marine Fire Slab 100, 50 mm, Stiffener 25 mm PAROC Marine Fire Slab 100 G1 R_W=47dB

The image shows the effect of insulated stiffeners. The improvement occurs at the higher frequencies but have no effect on the ***R_w*** *-value.*

SOUND REDUCTION MARINE STEEL BULKHEAD, STEEL DECK AND OTHER STEEL STRUCTURES

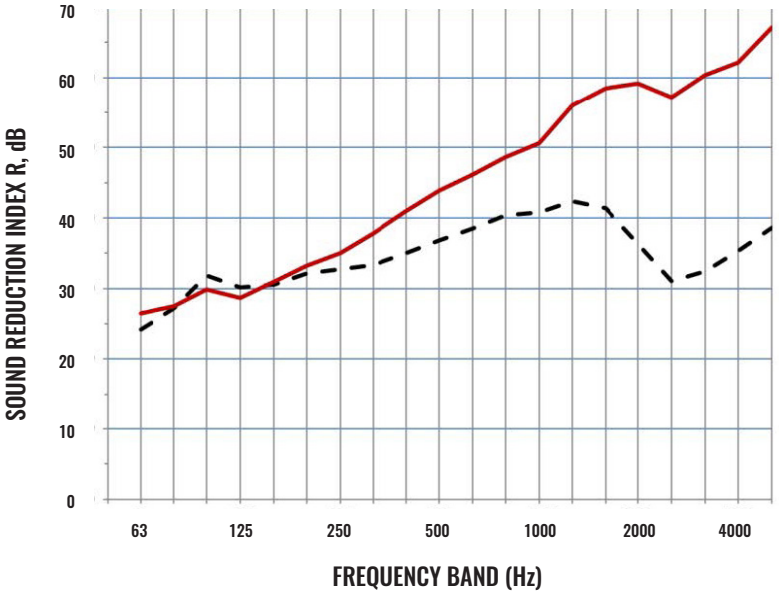
Click on the line with product name to go directly to the diagram

Solution	Product	Tickness, mm Level/stiffener	Rw (C, Ctr)	Diagram
Steel desk				
A60 Steel deck	PAROC Marine Fire Slab 100	50/25	47 (-2;-6)	R1
A30 Steel deck	PAROC Marine Fire Slab 100	25/25	46 (-2;-6)	R3
A30 Steel deck	PAROC Marine Fire Slab 80	40/40	45 (-1;-4)	R6
A15 Steel deck	PAROC Marine Fire Slab 80	40/0	45 (-1;-4)	R5
A60 Steel deck	PAROC Marine Navis Slab 60	40/30	47 (-2;-6)	R8
A30 Steel deck	PAROC Marine Navis Slab 60	30/30	46 (-2;-6)	R7
A60 Steel deck	PAROC Marine Wired Mat 100	40/40	48 (-1;-6)	-
A30 Steel deck	PAROC Marine Wired Mat 80	30/30	47 (-2;-6)	R13
A60 Steel deck	PAROC Marine Floor Slab 140	50	45 (-2;-7)	R14
A60 Steel deck	PAROC Marine Floor Slab 140+ 3 mm steel sheet on top	50	52 (-3;-8)	R15
Steel bukhead				
A60 Steel bulkhead	PAROC Marine Fire Slab 100	75/25	49 (-1;-6)	R2
A30 Steel bulkhead	PAROC Marine Fire Slab 100	50/25	47 (-2;-6)	R1
A15 Steel bulkhead	PAROC Marine Fire Slab 80	40/0	45 (-1;-4)	R5
A60 Steel bulkhead	PAROC Marine Navis Slab 60	70/30	47 (-1;-6)	R10
A30 Steel bulkhead	PAROC Marine Navis Slab 60	50/30	47 (-1;-6)	R9
A60 Steel bulkhead	PAROC Marine Wired Mat 100	80/30	49 (-2;-6)	R12
A30 Steel bulkhead	PAROC Marine Wired Mat 100	50/30	48 (-1;-6)	R11

Solution	Product	Tickness, mm Level/stiffener	Rw (C, Ctr)	Diagram
Other structures				
Container steel sheet, 2mm	PAROC Pro Slab 140	30 mm	34	R16
3 mm steel sheet	PAROC Pro Wired Mat 100 + insulation + 1 mm Aluminium sheet	100, 200	50, 58	R17
Aluminium deck, 4 mm				
N/A	PAROC Marine Navis Mat 90	60/0	39 (-2;-7)	R18
A60 Aluminium deck	PAROC Marine Navis Mat 90	60/60	39 (-2;-7)	R19
Aluminium bulkhead, 4 mm				
A60 Aluminium bulkhead	PAROC Marine Navis Mat 90	70/70 on both sides	41 (-3;-8)	R20
Aluminium deck, 6 mm				
A60 Aluminium deck	PAROC Marine Navis Mat 60	60/60	41 (-2;-7)	R21
Aluminium bulkhead, 6 mm				
A60 Aluminium bulkhead	PAROC Marine Navis Mat 60	60/60 on both sides	43 (-3;-8)	R22
A60 Aluminium bulkhead Restricted	PAROC Marine Navis Mat 60	60/60	41 (-2;-7)	R21

DIAGRAM R1

PAROC Marine Fire Slab 100

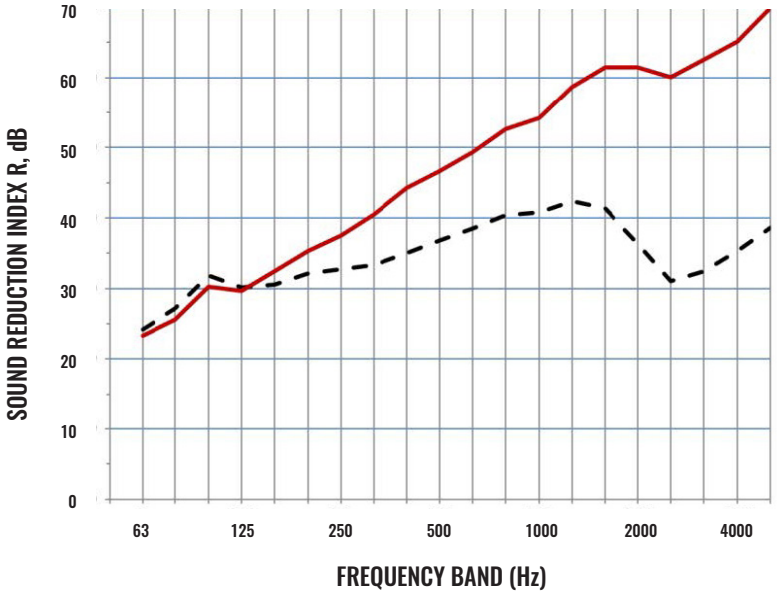


5 mm steel with stiffener

PAROC Marine Fire Slab 100, 50 mm, Stiffener 25 mm
PAROC Marine Fire Slab 100, R_W=47dB

DIAGRAM R2

PAROC Marine Fire Slab 100

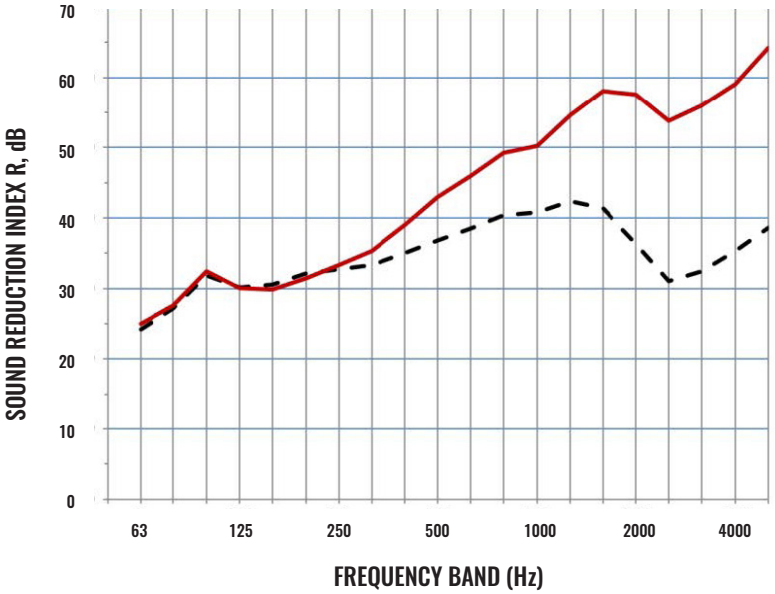


5 mm steel with stiffener

PAROC Marine Fire Slab 100, 75 mm, Stiffener 25 mm
PAROC Marine Fire Slab 100, R_w=49dB

DIAGRAM R3

PAROC Marine Fire Slab 100



5 mm steel with stiffener

PAROC Marine Fire Slab 100, 25 mm, Stiffener 25 mm
PAROC Marine Fire Slab 100, R_w=46dB

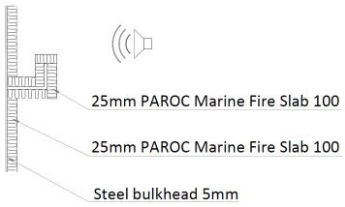
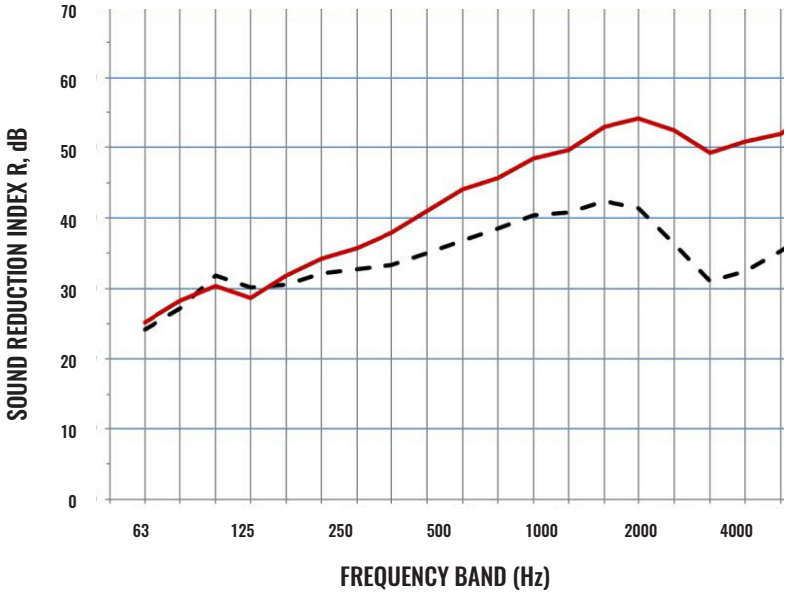


DIAGRAM R4

PAROC Marine Fire Slab 100

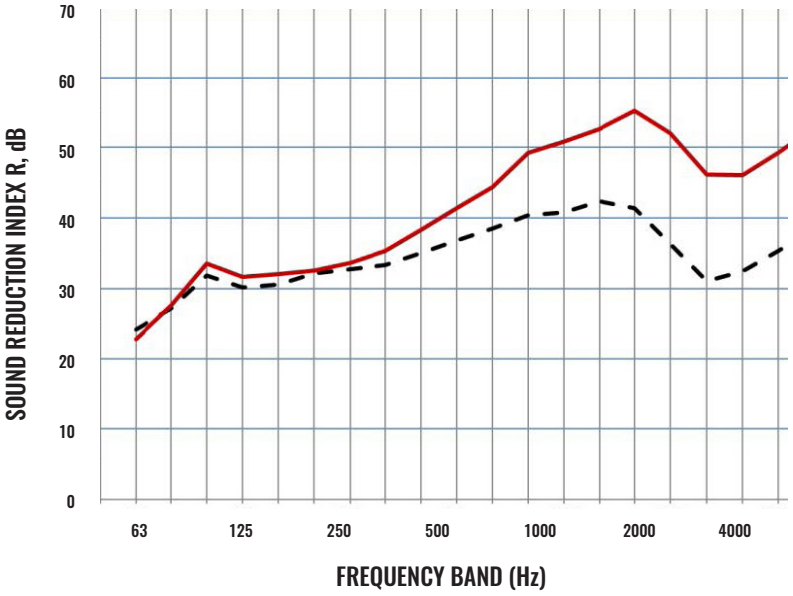


5 mm steel with stiffener

PAROC Marine Fire Slab 100, 50 mm R_w=47dB

DIAGRAM R5

PAROC Marine Fire Slab 80

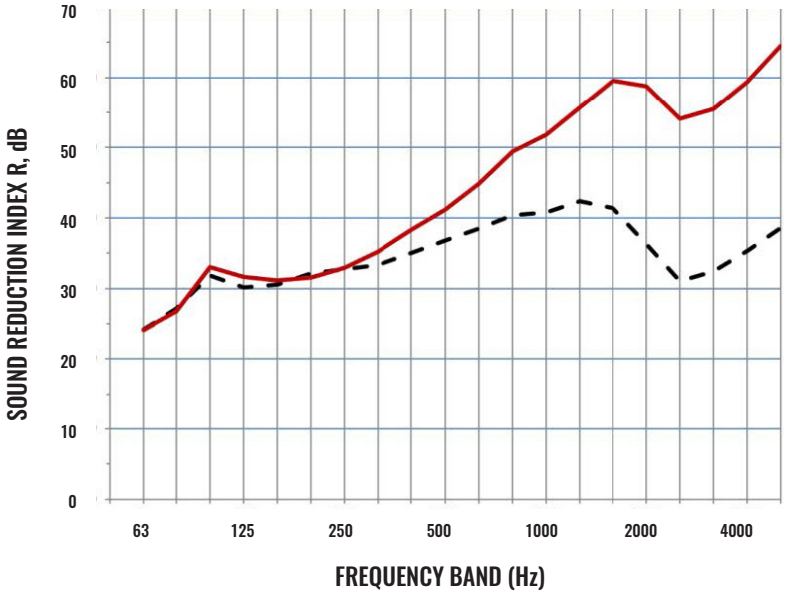


5 mm steel with stiffener, RW=38dB

PAROC Marine Fire Slab 80, 40 mm, R_w=45dB

DIAGRAM R6

PAROC Marine Fire Slab 80



5 mm steel with stiffener

PAROC Marine Fire Slab 80, 40 mm, stiffener 40 mm

PAROC Marine Fire Slab 80, R_w=45dB

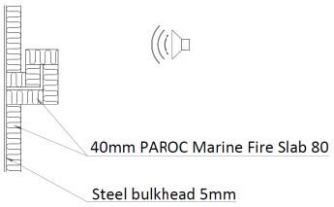
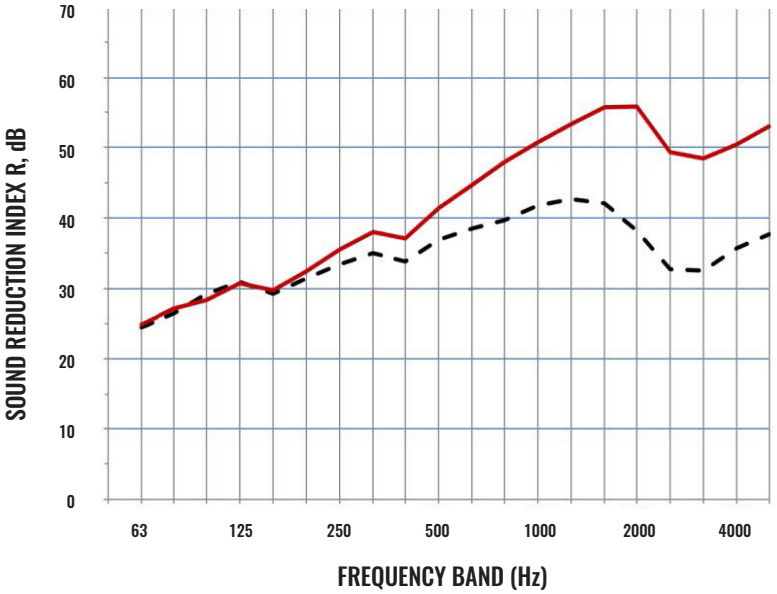


DIAGRAM R7

PAROC Navis Slab 60

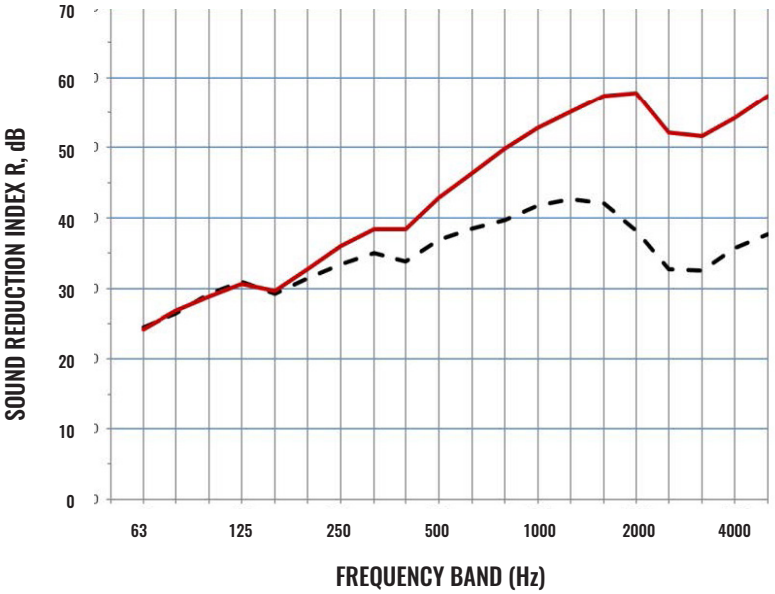


5 mm steel with stiffener, R_W=38dB

PAROC Navis Slab 60, 30 mm, Stiffener 30 mm, R_W=46dB

DIAGRAM R8

PAROC Navis Slab 60

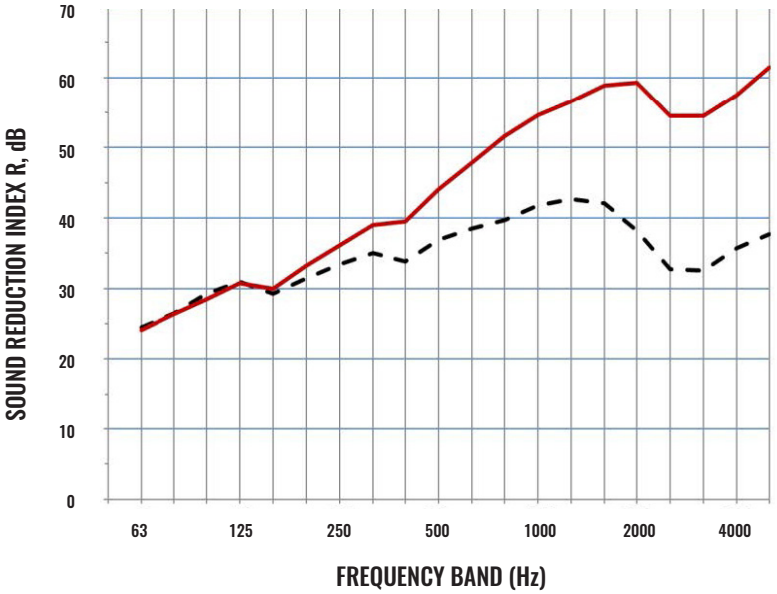


5 mm steel with stiffener, R_w=38dB

PAROC Navis Slab 60, 40 mm, stiffener 30 mm, R_w=47dB

DIAGRAM R9

PAROC Navis Slab 60

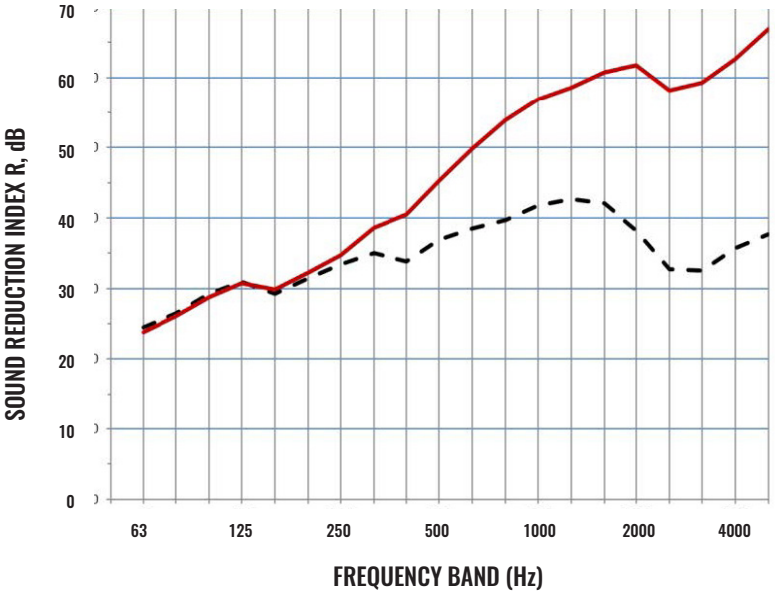


5 mm steel with stiffener, R_W=38dB

PAROC Navis Slab 60, 50 mm, Stiffener 30 mm, R_W=47dB

DIAGRAM R10

PAROC Navis Slab 60

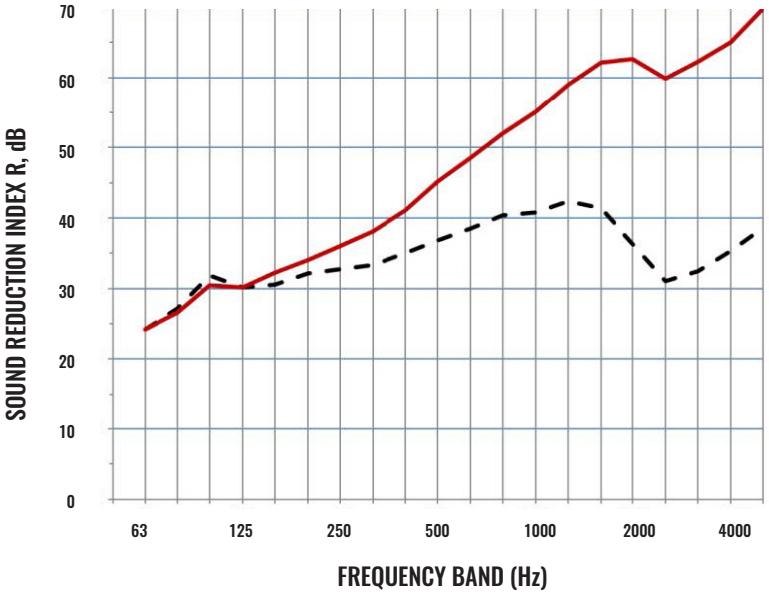


5 mm steel with stiffener, R_w=38dB

PAROC Navis Slab 60, 70 mm, stiffener 30 mm, R_w=47dB

DIAGRAM R11

PAROC Marine Wired Mat 100

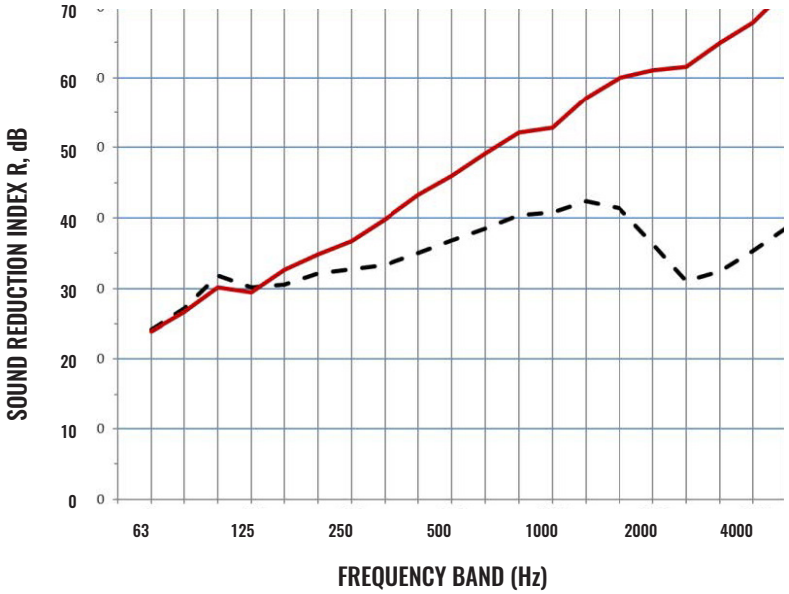


5 mm steel with stiffener

PAROC Marine Wired Mat 100, 50 mm, Stiffener 30 mm, Marine Wired Mat 100 R_w=48dB

DIAGRAM R12

PAROC Marine Wired Mat 100

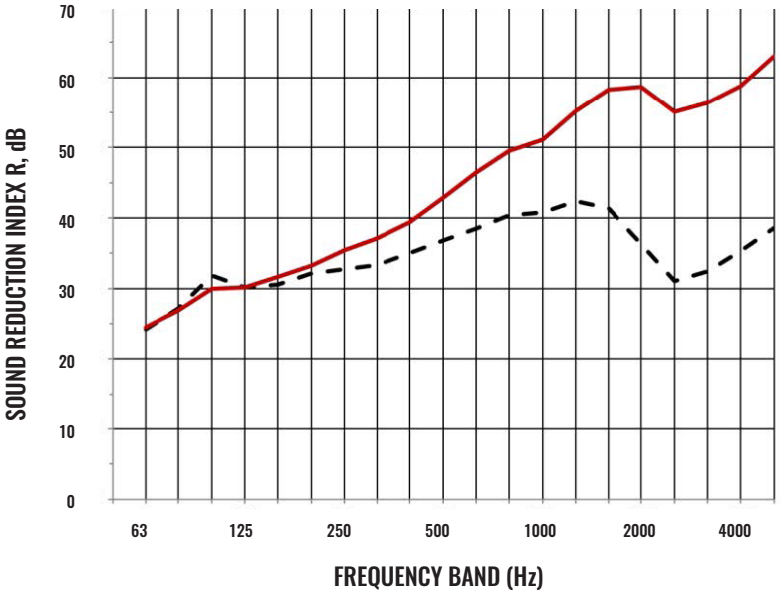


5 mm steel with stiffener

PAROC Marine Wired Mat 100, 80 mm, stiffener 30 mm, Marine Wired Mat 100 R_w=49dB

DIAGRAM R13

PAROC Marine Wired Mat 80



5 mm steel with stiffener

PAROC Marine Wired Mat 80, 30 mm, stiffener 30 mm, Marine Wired Mat 100
R_W=47dB

DIAGRAM R14

PAROC Floor Slab 140

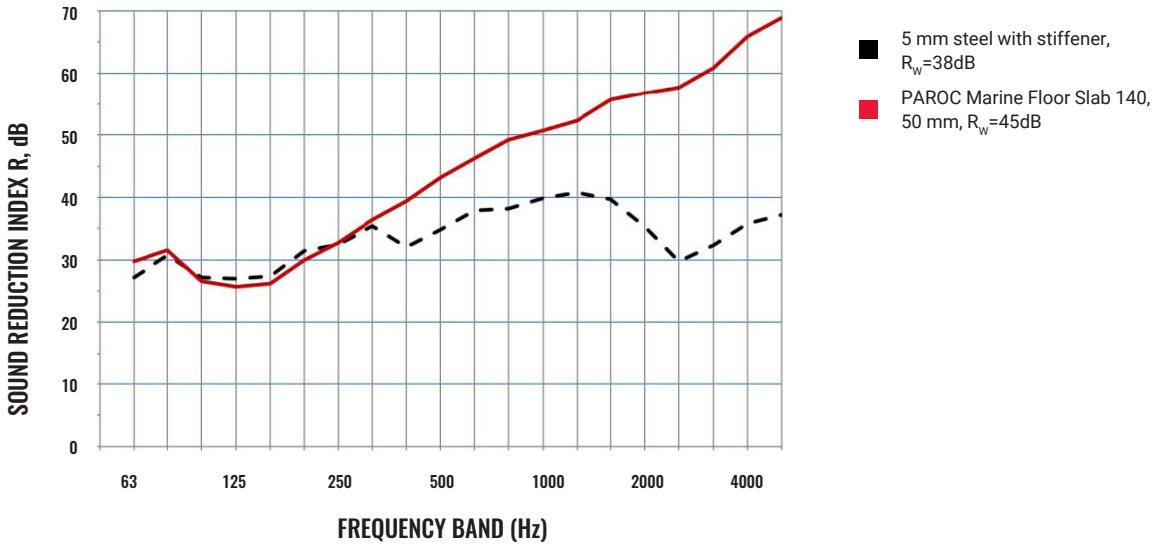
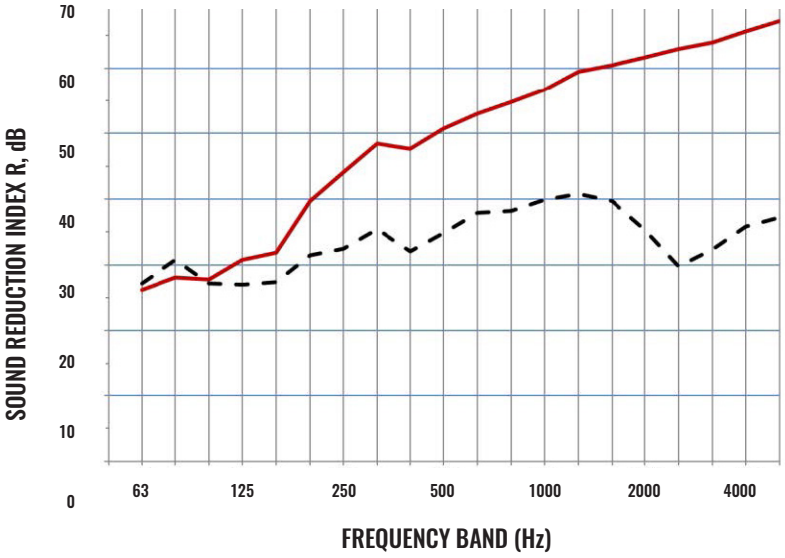


DIAGRAM R15

PAROC Floor Slab 140

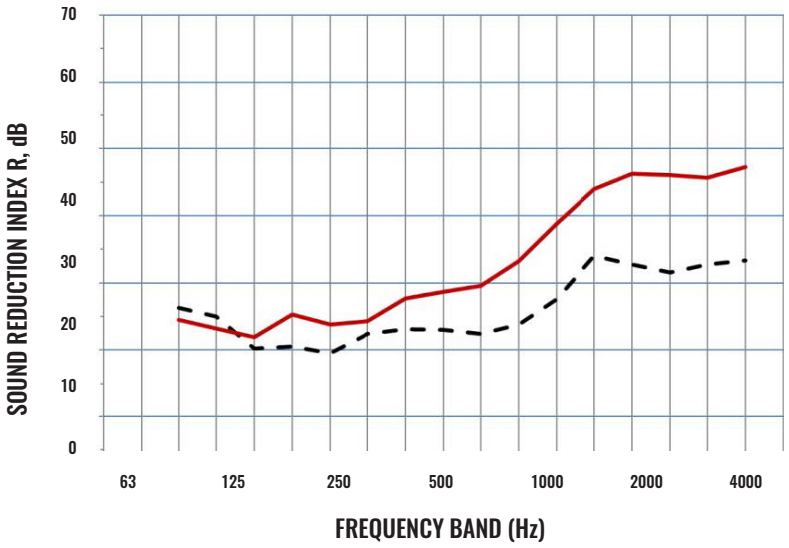


5 mm steel with stiffener, R_W=38dB

PAROC Marine Floor Slab 140, 50 mm + 3 mm steel sheet, R_W=52dB

DIAGRAM R16

PAROC Pro Slab 140



2 mm profiled steel sheet, R_W=28dB

PAROC Pro Slab 140, 30 mm, R_W=34dB

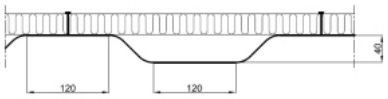
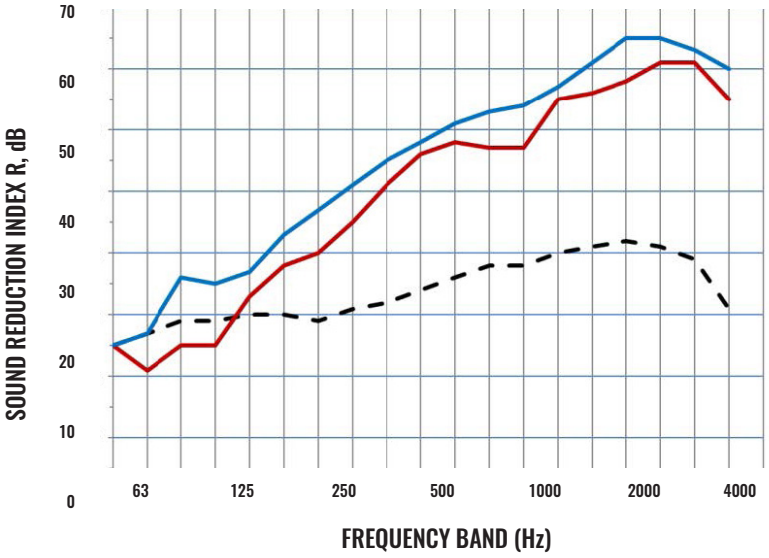


DIAGRAM R17

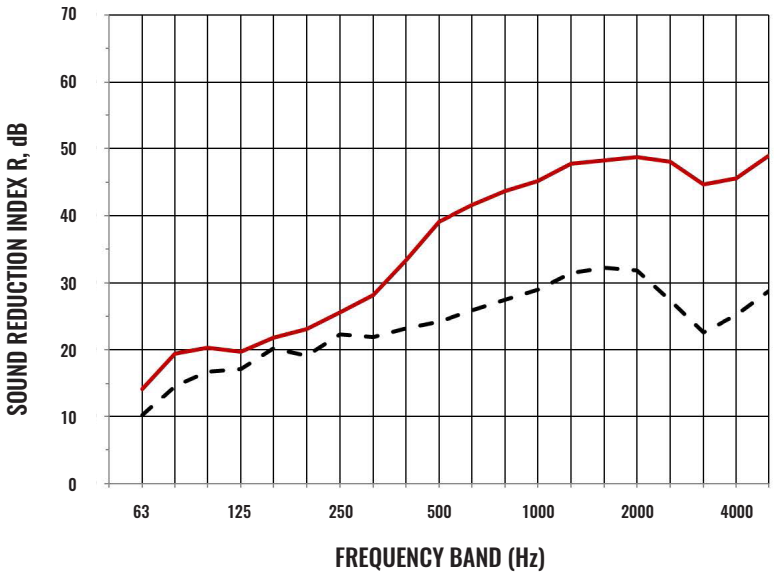
PAROC Pro Wired Mat 100



- 3 mm steel sheet, R_w=38dB
- PAROC Pro Wired Mat 100, 100 mm + 1 mm Aluminium sheet, R_w=50dB
- PAROC Pro Wired Mat 100, 200 mm + 1 mm Aluminium sheet, R_w=58dB

DIAGRAM R18

PAROC Marine Navis Mat 90



4 mm aluminium with stiffener, R_w=27dB

PAROC Marine Navis Mat 90, 60 mm, R_w=39dB

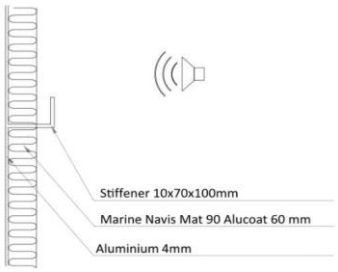
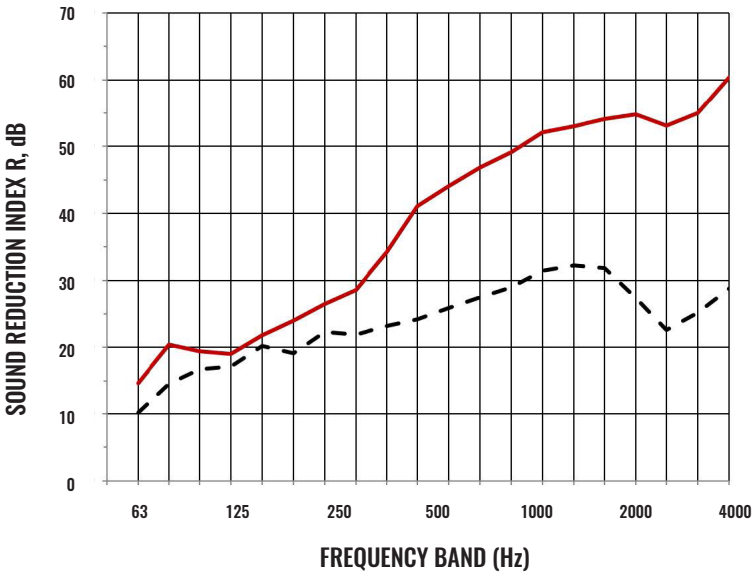


DIAGRAM R19

PAROC Marine Navis Mat 90



4 mm aluminium with stiffener, R_w=27dB

PAROC Marine Navis Mat 90, 60 mm, Stiffener 60 mm
Marine Navis Mat 90 R_w=39dB

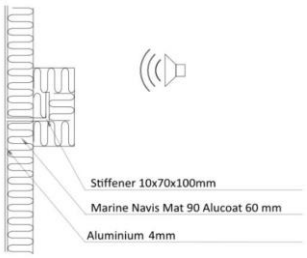
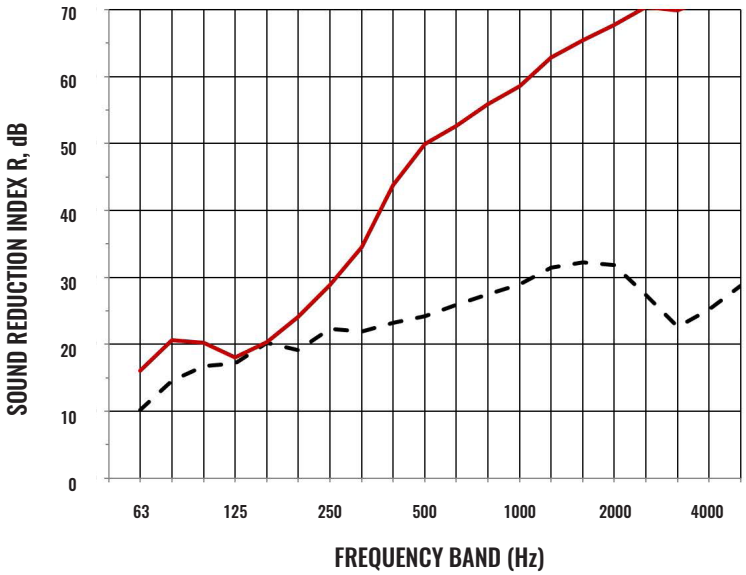


DIAGRAM R20

PAROC Marine Navis Mat 90



4 mm aluminium with stiffener, R_w=27dB

PAROC Marine Navis Mat 90, 70 mm, Stiffener 70 mm Marine Navis Mat 90 R_w=41dB

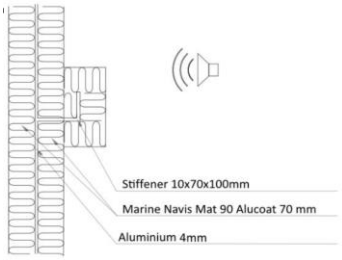
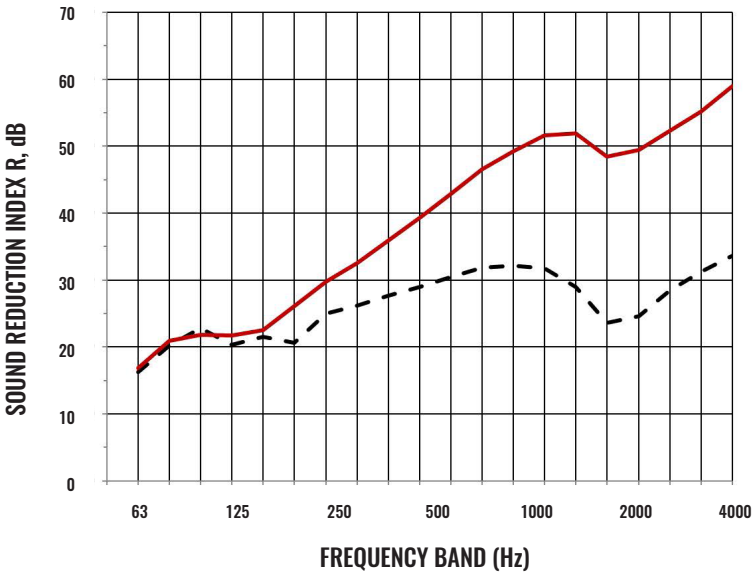


DIAGRAM R21

PAROC Marine Navis Mat 60



6 mm aluminium with stiffener, R_w=29dB

PAROC Marine Navis Mat 60, 60 mm, Stiffener 60 mm Marine Navis Mat 60 R_w=41dB

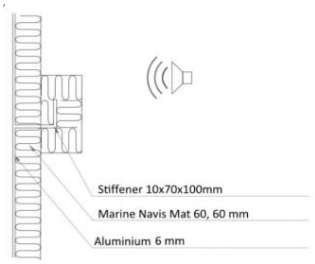
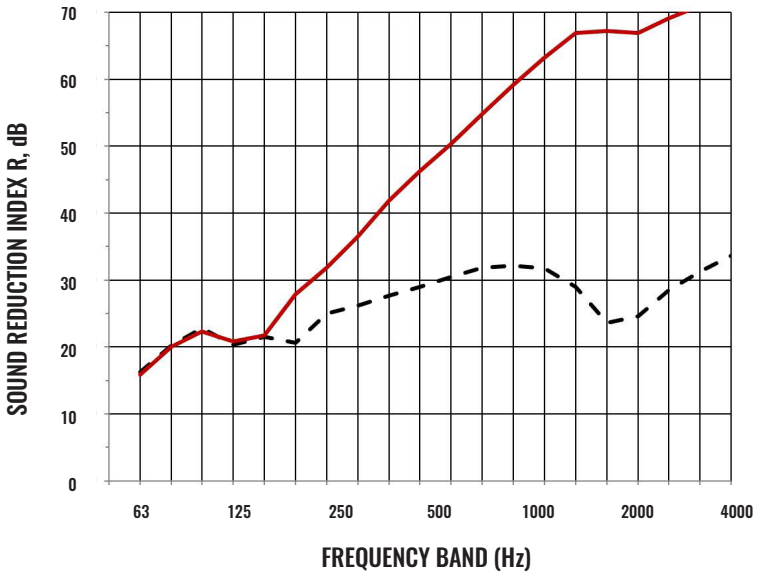


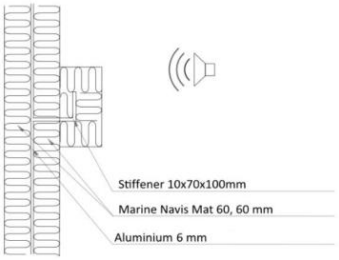
DIAGRAM R22

PAROC Navis Mat 60



6 mm aluminium with stiffener, R_w=29dB

PAROC Marine Navis Mat 60, 60 mm, Stiffener 60 mm
Marine Navis Mat 60 R_w=41dB

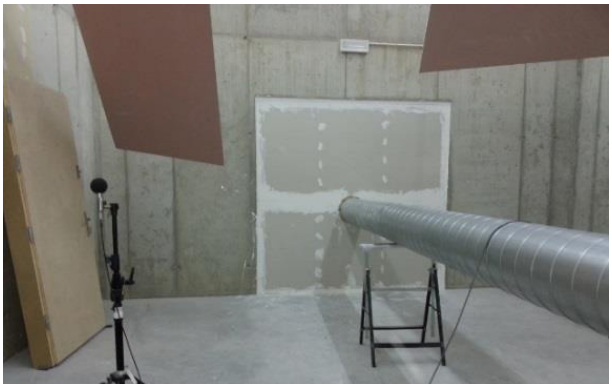


INSERTION LOSS FOR DUCTS AND PIPES

INSERTION LOSS

The insertion loss is the difference, in decibels, in the sound power radiated from a noise source before and after the application of the acoustic insulation.

The test method used is ISO 15665:2003 Acoustics - Acoustic insulation for pipes, valves and flanges.



CLASSES OF ACOUSTIC INSULATION.

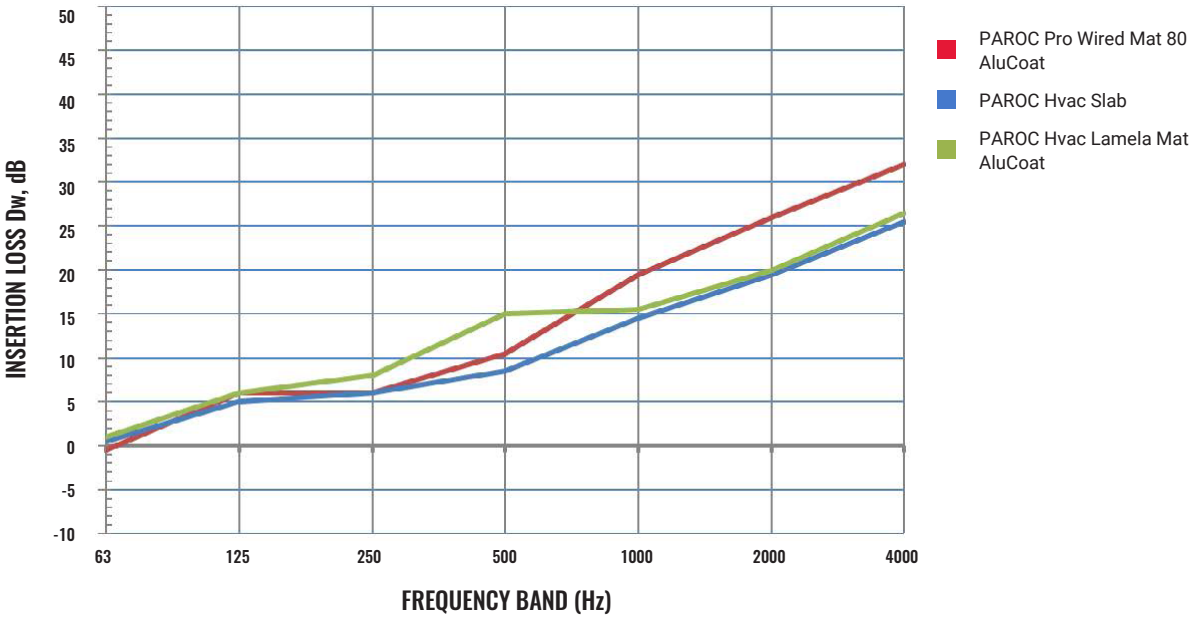
In the standard there is a classifying system for pipes with a certain diameter and thickness. There are three classes of acoustic insulation denoted A, B and C, in terms of requirements for minimum insertion loss. The insertion loss is also related to the diameter of the pipe on which it is applied, see table below.
Classification table

Table: Minimum insertion loss required for each class acc. ISO 15665:2003

Class	Nominal pipe diameter D mm		Octave band centre frequency, Hz						
			125	250	500	1000	2000	4000	8000
	lower limit	upper limit	Minimum insertion loss, dB						
A1		< 300	- 4	- 4	2	9	16	22	29
A2	≥ 300	< 650	- 4	- 4	2	9	16	22	29
A3	≥ 650	< 1000	- 4	2	7	13	19	24	30
B1		< 300	- 9	- 3	3	11	19	27	35
B2	≥ 300	< 650	- 9	- 3	6	15	24	33	42
B3	≥ 650	< 1000	- 7	2	11	20	29	36	42
C1		< 300	- 5	- 1	11	23	34	38	42
C2	≥ 300	< 650	- 7	4	14	24	34	38	42
C3	≥ 650	< 1000	1	9	17	26	34	38	42

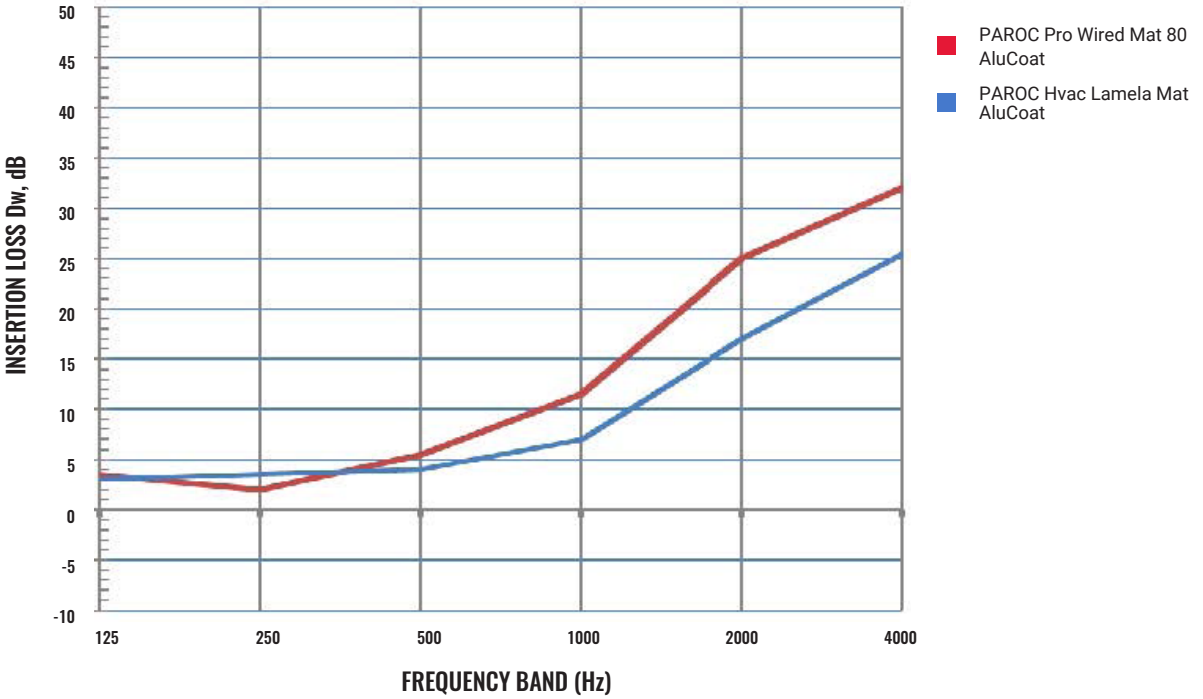
COMPARISION OF SOME RESULTS

Rectangular duct 400x400 mm, insulation thickness 60 mm

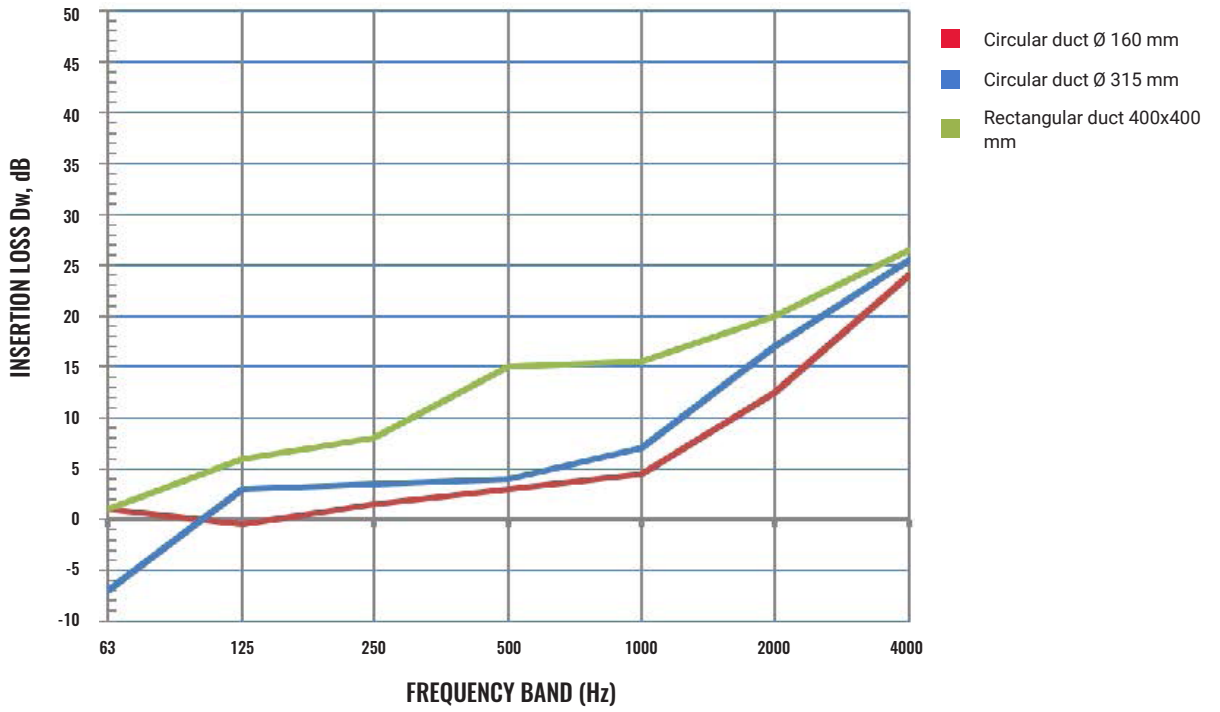


The diagram shows that higher density gives a higher insertion loss

Circular duct Ø 315 mm, insulation thickness 60 mm

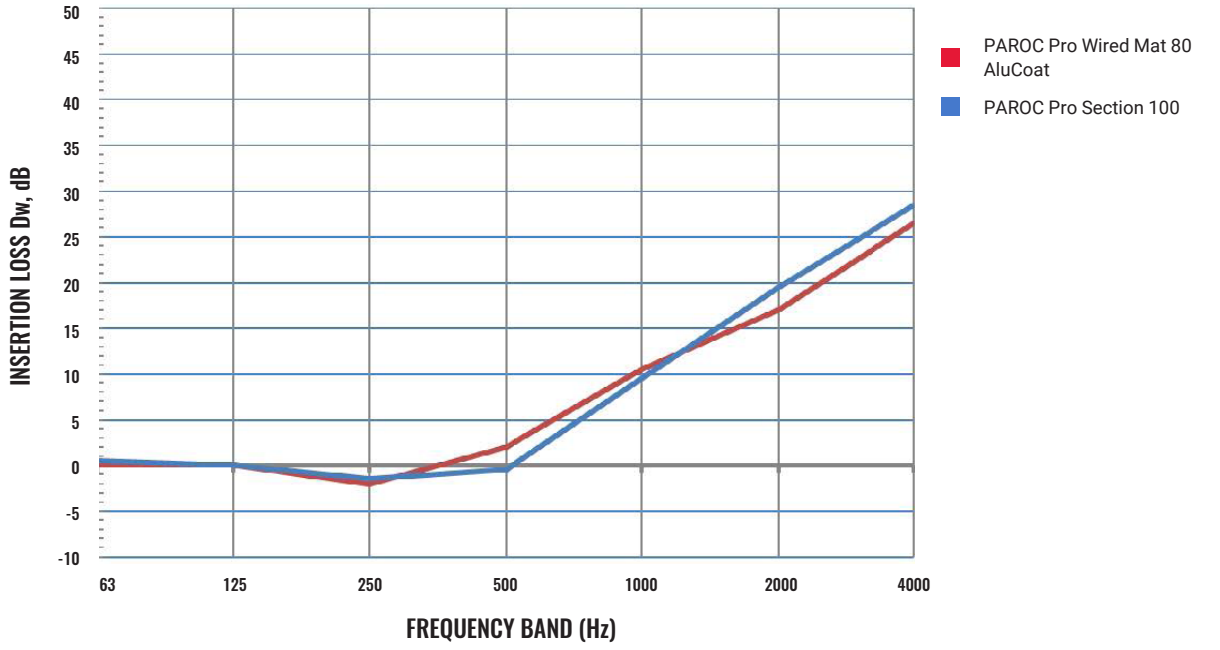


PAROC Hvac Lamela Mat AluCoat thickness 60 mm



The size and shape of the duct has an effect on the insertion loss

Iron pipe Ø 159 mm, insulation thickness 60 mm



Comparision between Wired Mat and a Pipe Section

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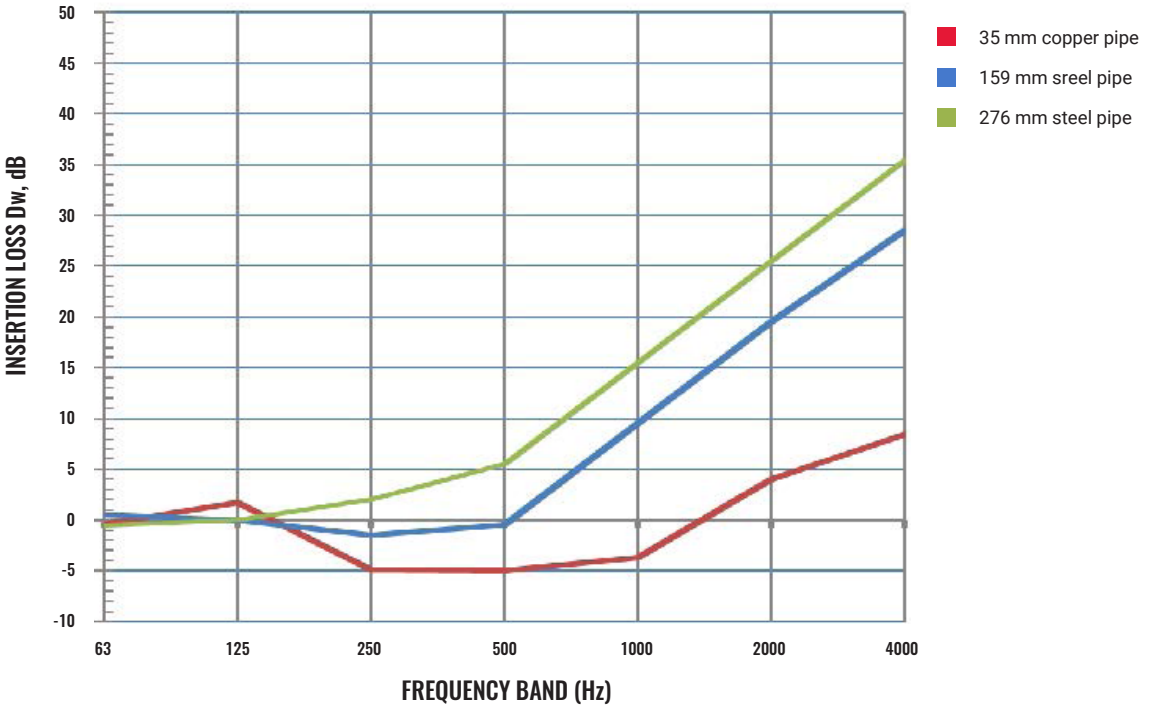
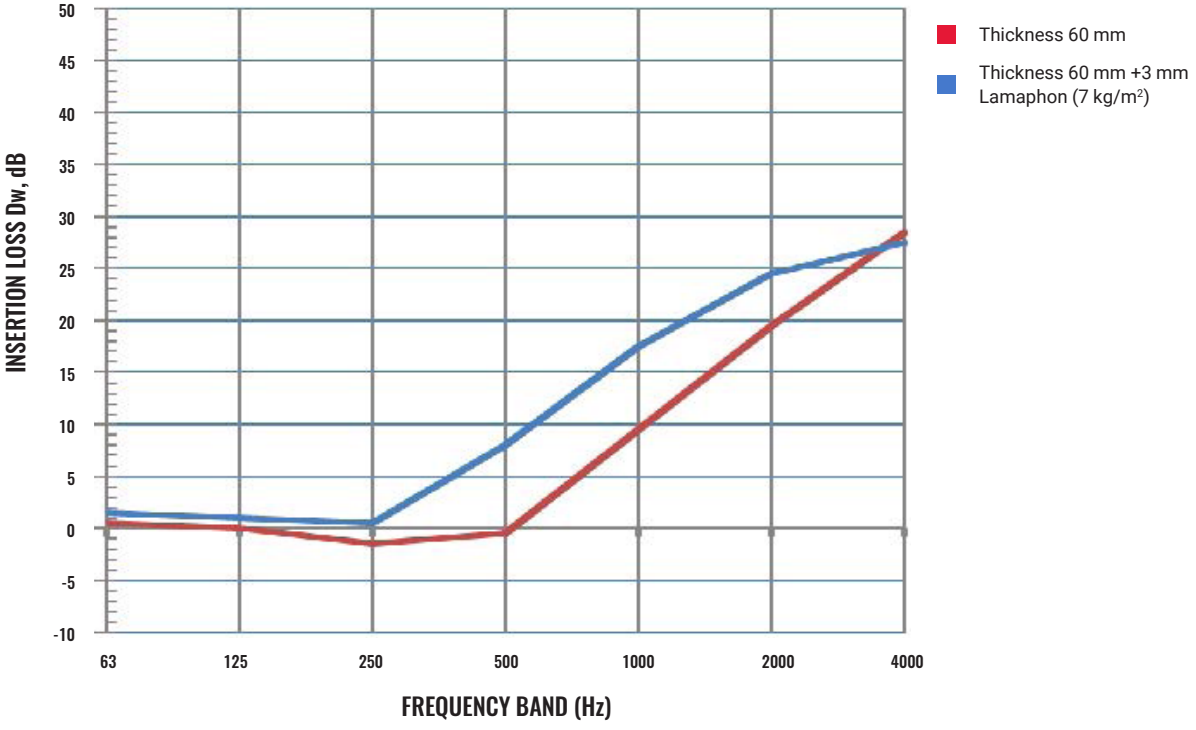
PAROC Pro Section 100



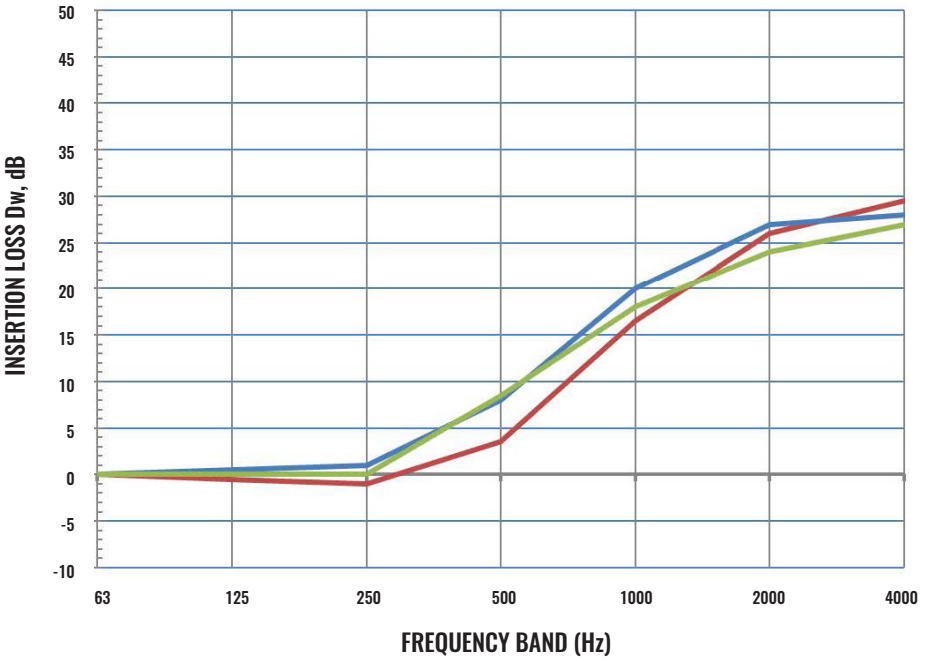
The diameter of the pipe plays an important role

Iron pipe Ø 159 mm, Paroc Pro Section 100

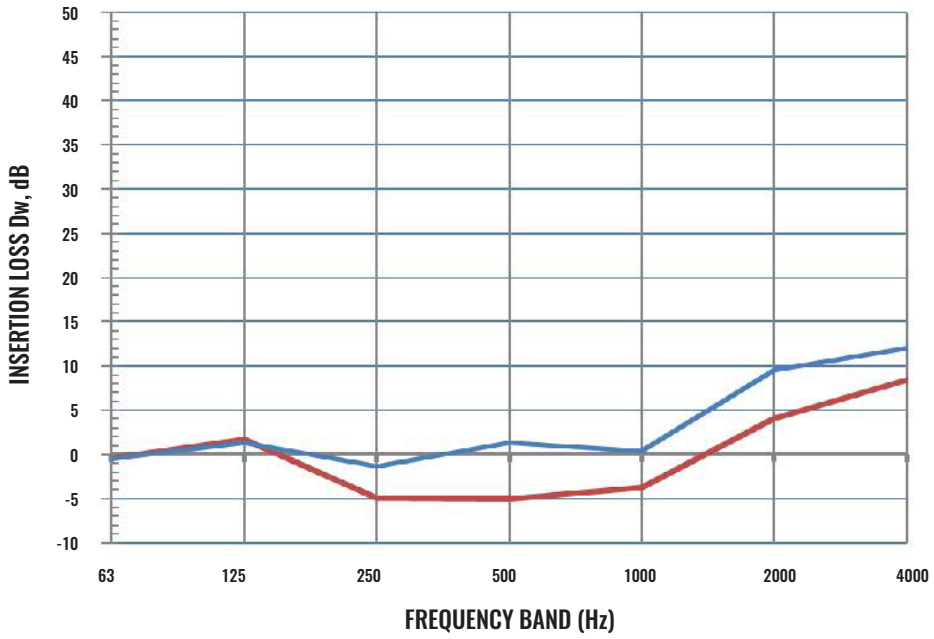


A heavier surface layer provides an improvement

Iron pipe Ø 159 mm Paroc Pro Section 100

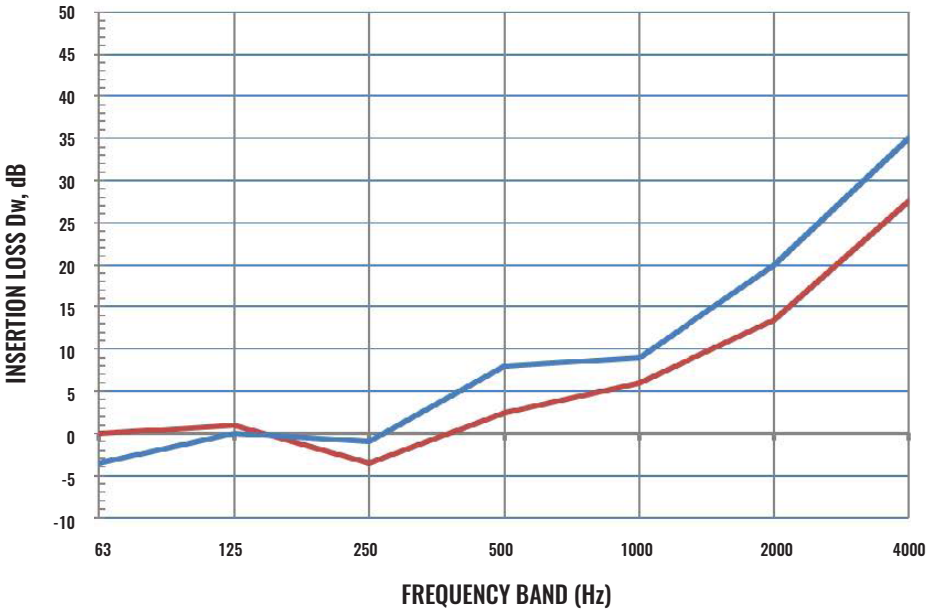


Copper pipe Ø 35 mm, PAROC Hvac Section AluCoat T



Spacing rings between the pipe and the pipe section provide an improvement in the insertion loss with retained outer diameter of the insulation.

Plastic sewer pipe Ø 110 mm, PAROC Hvac Section AluCoat T



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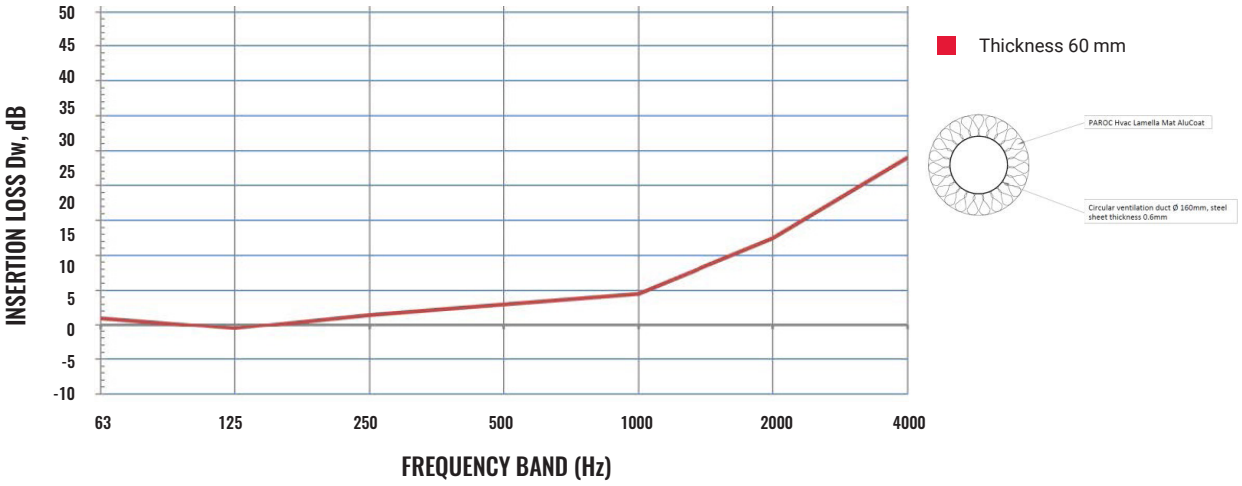
INSERTION LOSS FOR DUCTS

Click on the line with product name to go directly to the diagram

Solution	Product	Thickness, mm	Diagram
Circular duct ø 160 mm	PAROC Hvac Lamella Mat AluCoat	60	D1
Circular duct ø 315 mm	PAROC Hvac Lamella Mat AluCoat	60, 120	D2
Circular duct ø 315 mm	PAROC Pro Wired Mat 80 AluCoat	60, 120	D3
Rectangular duct 400 x 400 mm	PAROC Pro Wired Mat 80 AluCoat	60, 120	D4
Rectangular duct 400 x 400 mm	PAROC Hvac Lamella Mat AluCoat	60, 120	D5
Rectangular duct 400 x 400 mm	PAROC Hvac Slab AluCoat	60, 120	D6
Rectangular duct 400 x 400 mm	PAROC Hvac Fire Slab EI60 AluCoat	60	D7
Rectangular duct 400 x 400 mm	PAROC Hvac Fire Slab EI120 AluCoat	60	D8

DIAGRAM D1

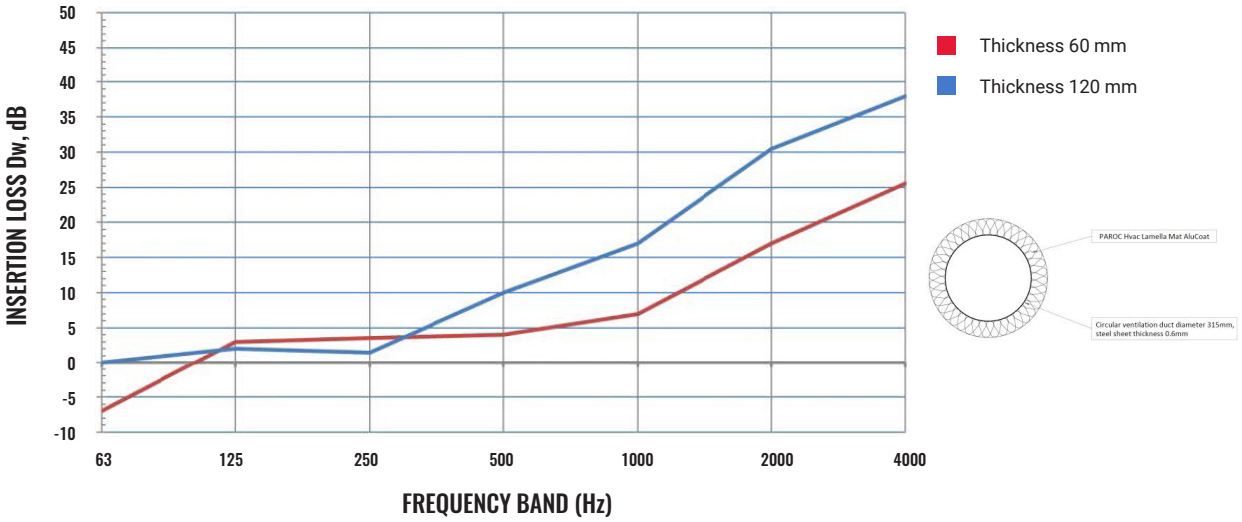
PAROC Hvac Lamela Mat AluCoat, circular duct Ø 160 mm



Thickness,mm	Frequency Hz						
	63	125	250	500	1000	2000	4000
60	1	-0,5	1,5	3	4,5	12,5	24

DIAGRAM D2

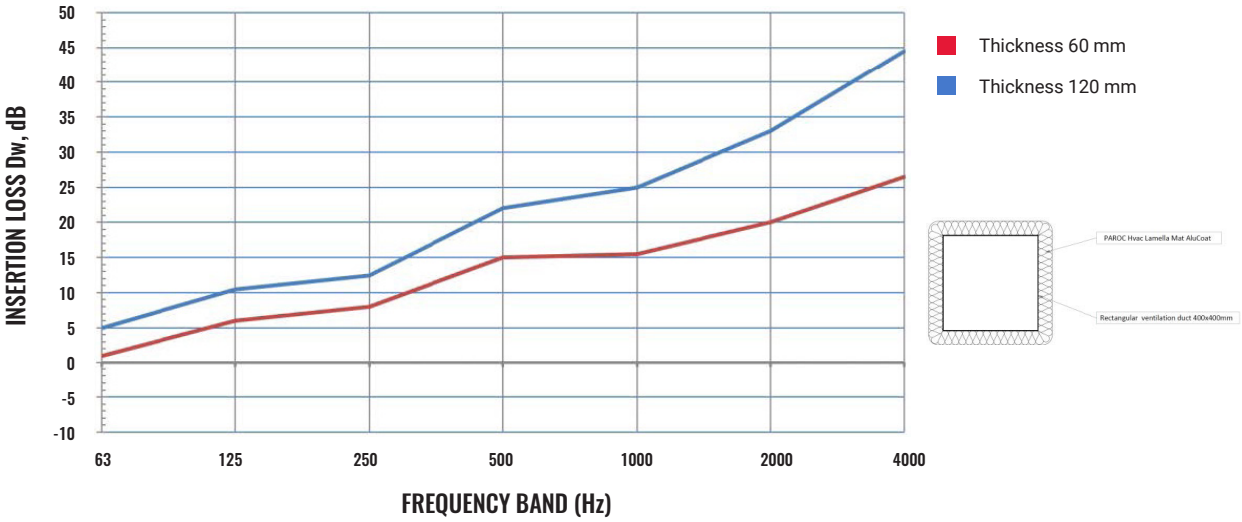
PAROC Hvac Lamela Mat AluCoat, circular duct Ø 315 mm



Thickness,mm	Frequency Hz						
	63	125	250	500	1000	2000	4000
60	-7	3	3,5	4	7	17	25,5
120	0	2	1,5	10	17	30,5	38

DIAGRAM D3

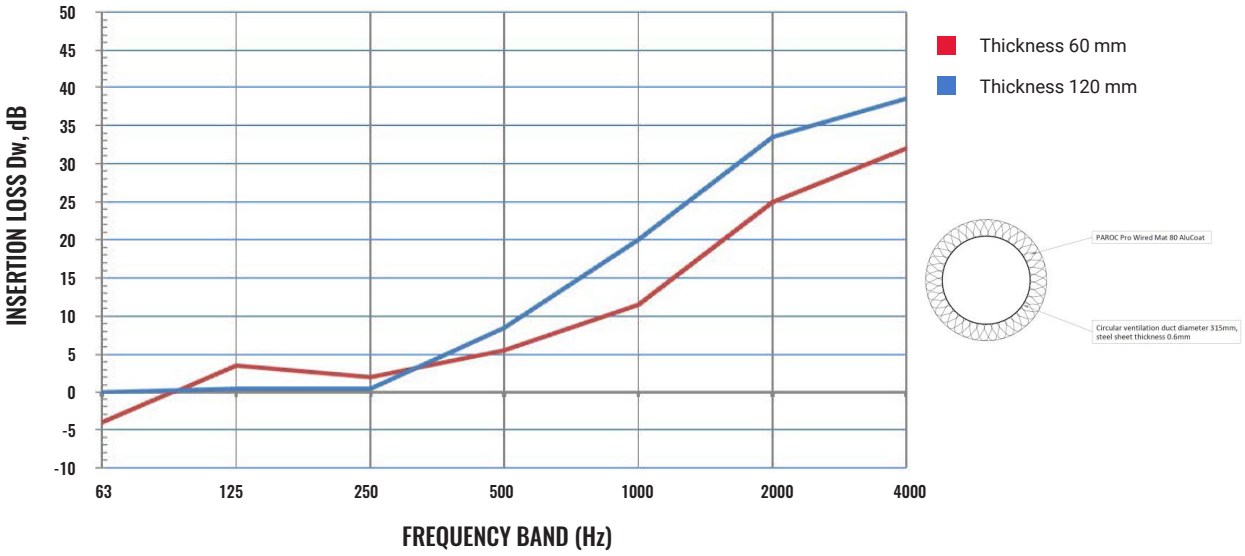
PAROC Hvac Lamella Mat AluCoat, rectangular duct 400x400 mm



Thickness,mm	Frequency Hz						
	63	125	250	500	1000	2000	4000
60	1	6	8	15	15,5	20	26,5
120	5	10,5	12,5	22	25	33	44,5

DIAGRAM D4

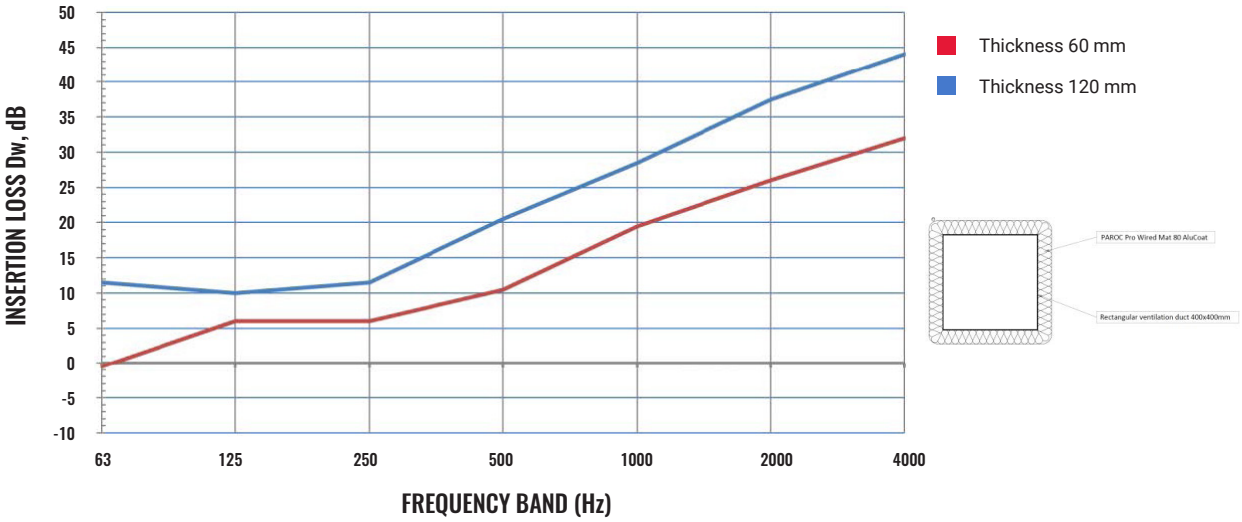
PAROC Pro Wired Mat 80 AluCoat, circular duct Ø 315 mm



Thickness,mm	Frequency Hz						
	63	125	250	500	1000	2000	4000
60	-4	3,5	2	5,5	11,5	25	32
120	0	0,5	0,5	8,5	20	33,5	38,5

DIAGRAM D5

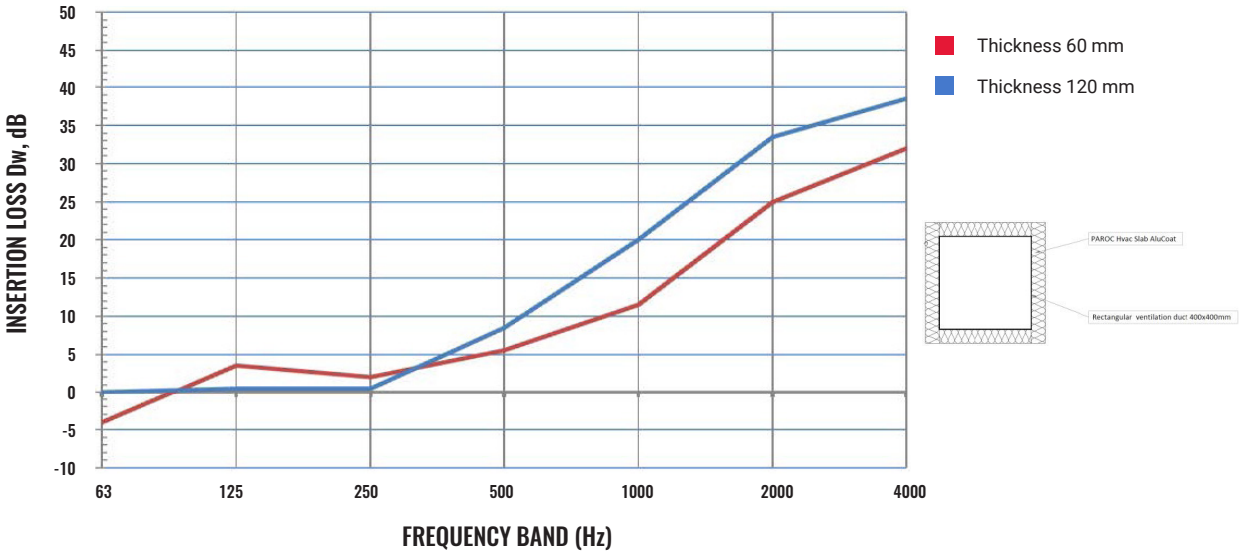
PAROC Pro Wired Mat 80 AluCoat rectangular duct 400x400 mm



Thickness,mm	Frequency Hz						
	63	125	250	500	1000	2000	4000
60	-0,5	6	6	10,5	19,5	26	32
120	11,5	10	11,5	20,5	28,5	37,5	44

DIAGRAM D6

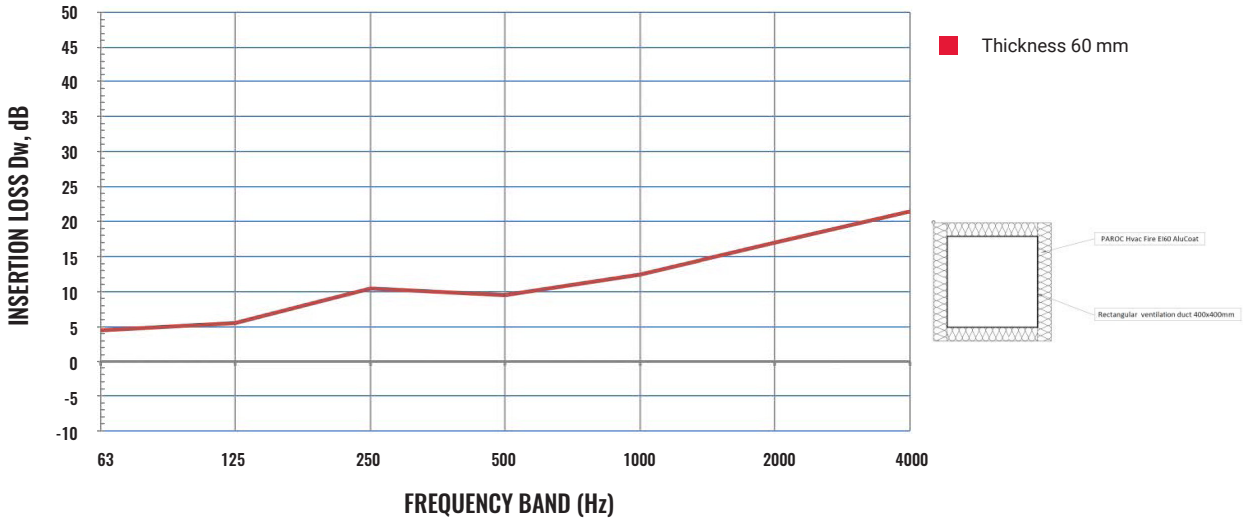
PAROC Hvac Slab AluCoat, rectangular duct 400x400 mm



Thickness,mm	Frequency Hz						
	63	125	250	500	1000	2000	4000
60	0,5	5	6	8,5	14,5	19,5	25,5
120	-1	8	12,5	18,5	26	34	44

DIAGRAM D7

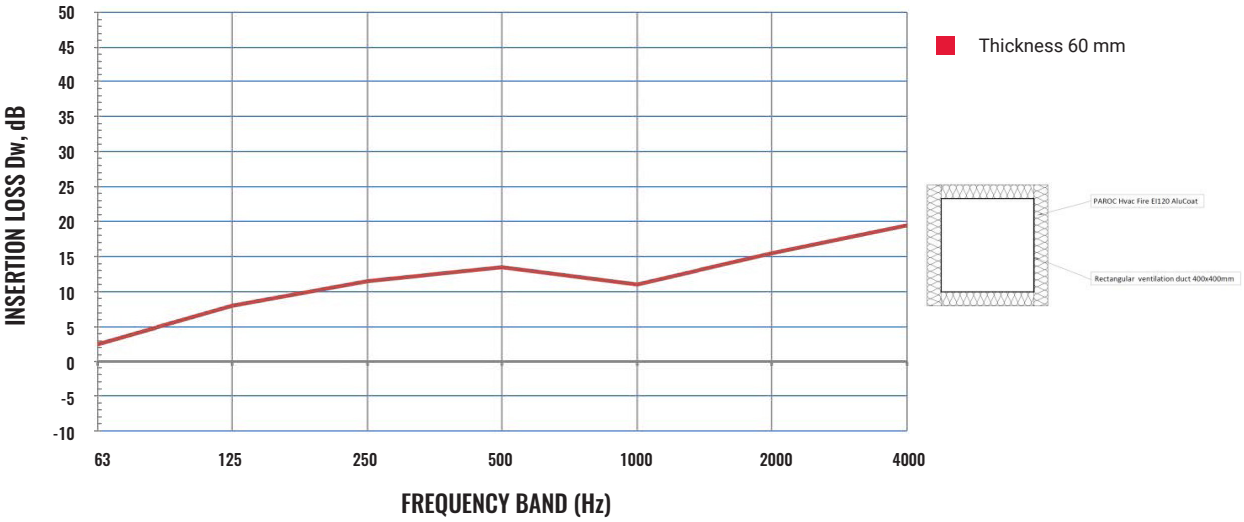
PAROC Hvac Fire Slab EI60 AluCoat, rectangular duct 400x400 mm



Thickness,mm	Frequency Hz						
	63	125	250	500	1000	2000	4000
60	4,5	5,5	10,5	9,5	12,5	17	21,5

DIAGRAM D8

PAROC Hvac Fire Slab EI120 AluCoat, rectangular duct 400x400 mm



Thickness,mm	Frequency Hz						
	63	125	250	500	1000	2000	4000
60	2,5	8	11,5	13,5	11	15,5	19,5

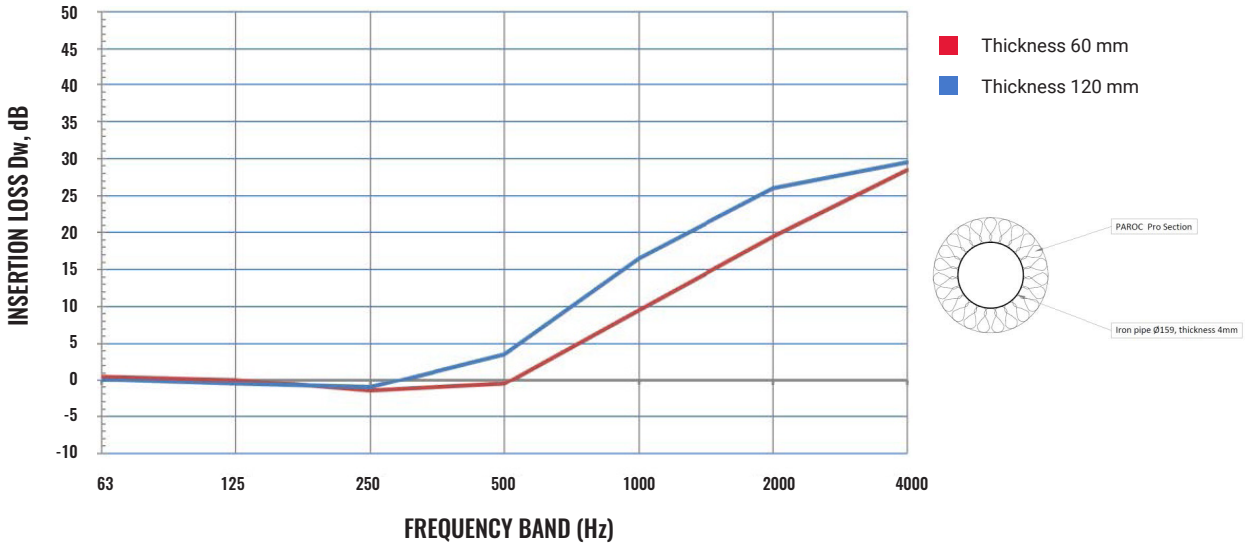
INSERTION LOSS FOR PIPES

Click on the line with product name to go directly to the diagram

Solution	Product	Thickness, mm	Class	Diagram
Iron pipe ø 159 mm thickness 4 mm	PAROC Pro Section 100	60, 120	N/A, A1	P1
Iron pipe ø 159 mm thickness 4 mm	PAROC Pro Section 100 + 3 mm Lamaphon (7 kg/m^2)	60, 120	A1, A1	P3
Iron pipe ø 159 mm thickness 4 mm	PAROC Pro Section 100 + 3 mm Lamaphon (7 kg/m^2)+ PAROC Pro Section 100	120	A1	P4
Iron pipe ø 159 mm thickness 4 mm	PAROC Pro Wired Mat 80 AluCoat	60, 120	A1, A1	P5
Iron pipe ø 275 mm thickness 5 mm	PAROC Pro Section 100	30, 60, 100	A1, B1, B1	P2
Plastic sewer pipe ø 110 mm	PAROC Hvac Section AluCoat T	50	N/A	P6
Copper pipe ø 35 mm	PAROC Hvac Section AluCoat T	60	N/A	P7

DIAGRAM P1

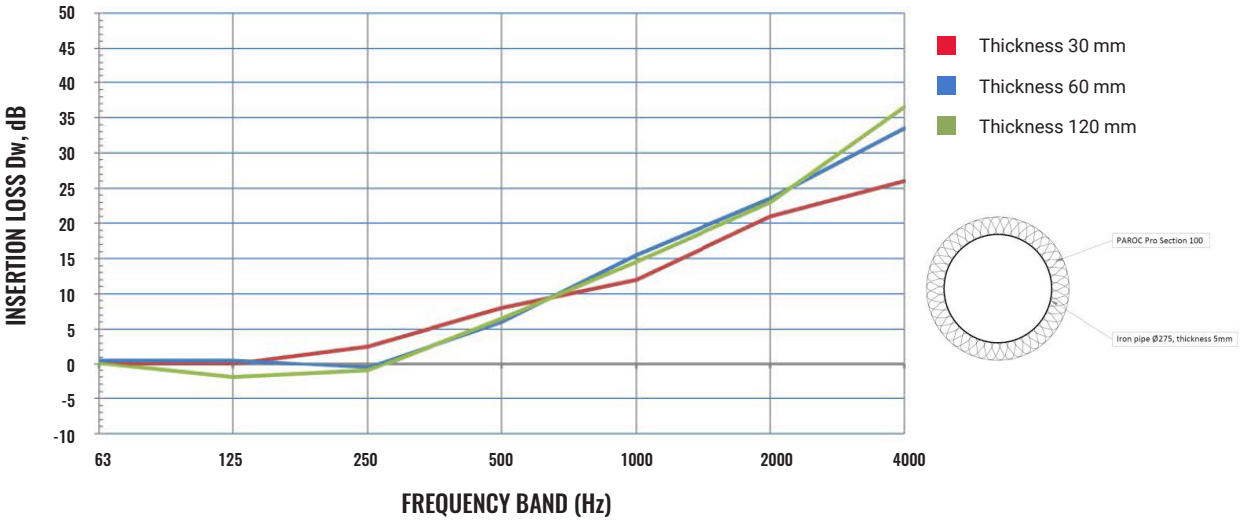
PAROC Pro Section 100, Iron Pipe Ø159 mm



Thickness,mm	Frequency Hz						
	63	125	250	500	1000	2000	4000
60	0,5	0	-1,5	-0,5	9,5	19,5	28,5
120	0	-0,5	-1	3,5	16,5	26	29,5

DIAGRAM P2

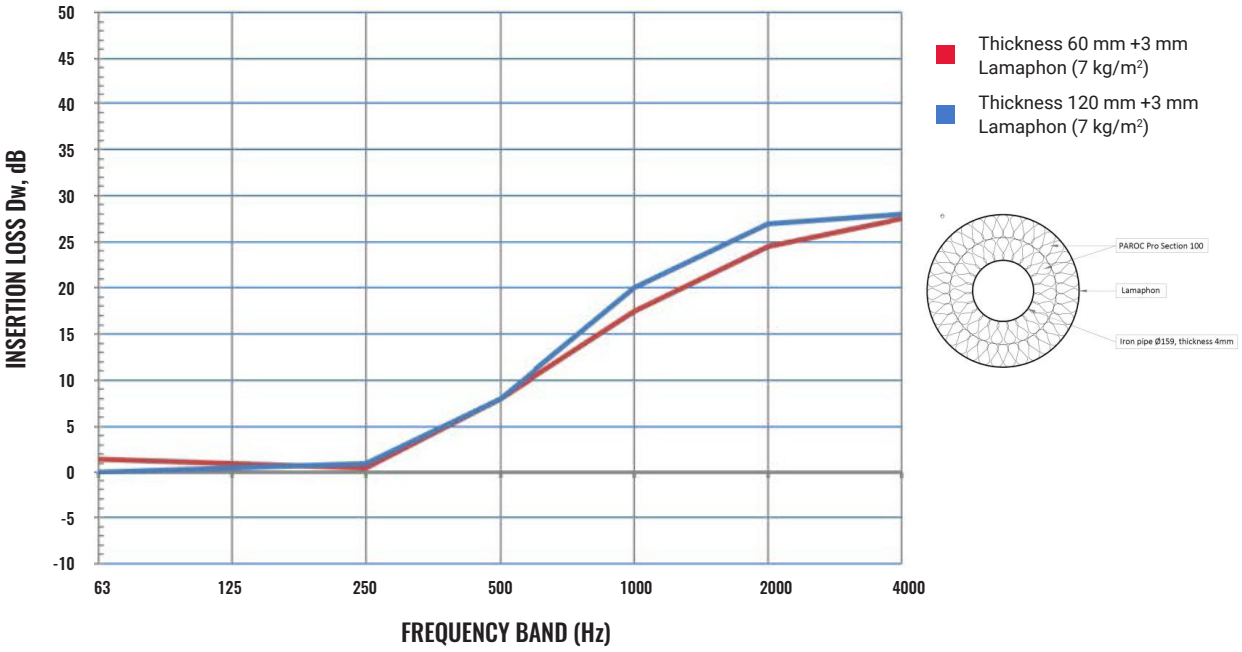
PAROC Pro Section 100, Iron Pipe Ø275 mm



Thickness,mm	Frequency Hz						
	63	125	250	500	1000	2000	4000
30	0	0	2,5	8	12	21	26
60	0,5	0,5	-0,5	6	15,5	23,5	33,5
100	0	-2	-1	6,5	14,5	23	36,5

DIAGRAM P3

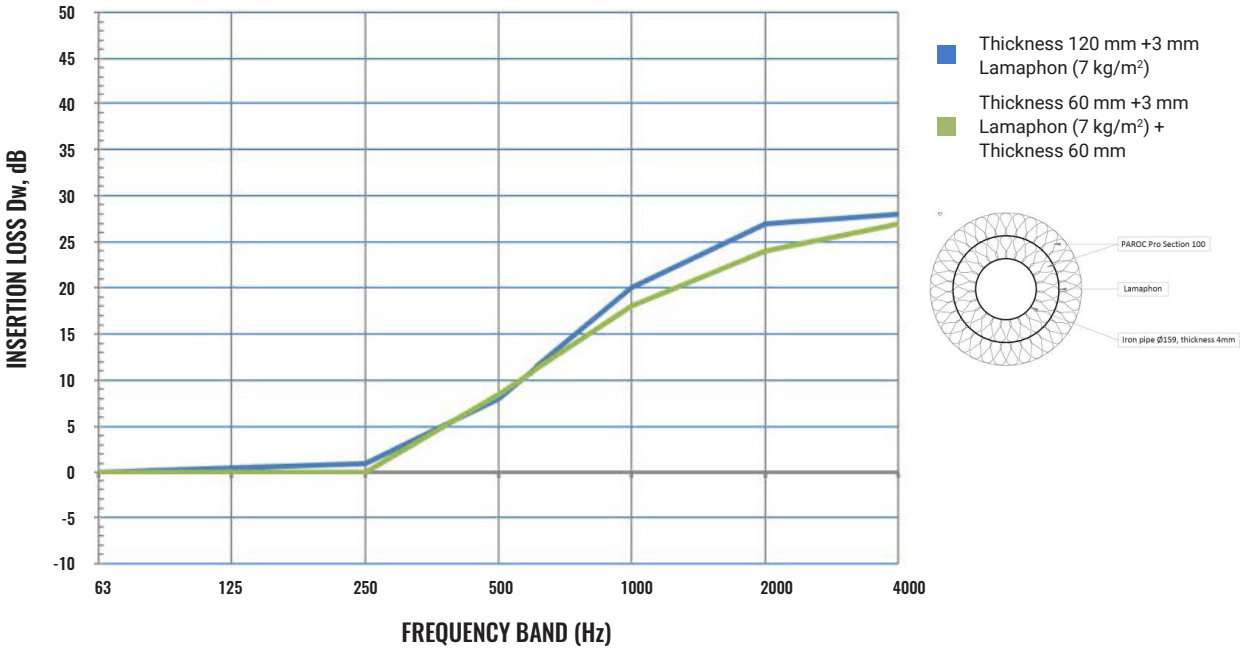
PAROC Pro Section 100, Iron Pipe Ø159 x 4 mm



Thickness,mm	Frequency Hz						
	63	125	250	500	1000	2000	4000
Thickness 60 mm+3 mm Lamaphon (7 kg/m²)	1,5	1	0,5	8	17,5	24,5	27,5
Thickness 120 mm+3 mm Lamaphon (7 kg/m²)	0	0,5	1	8	20	27	28

DIAGRAM P4

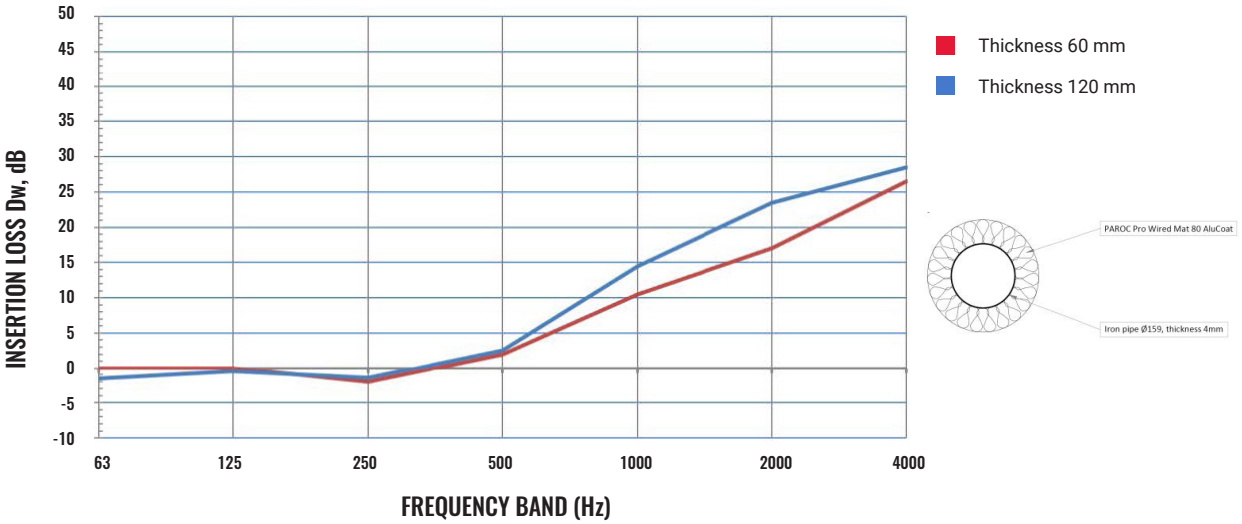
PAROC Pro Section 100, Iron Pipe Ø159 x 4 mm



Thickness,mm	Frequency Hz						
	63	125	250	500	1000	2000	4000
Thickness 120 mm+3 mm Lamaphon (7 kg/m²)	0	0,5	1	8	20	27	28
Thickness 60 mm+3 mm Lamaphon (7 kg/m²) + Thickness 60 mm	0	0	0	8,5	18	24	27

DIAGRAM P5

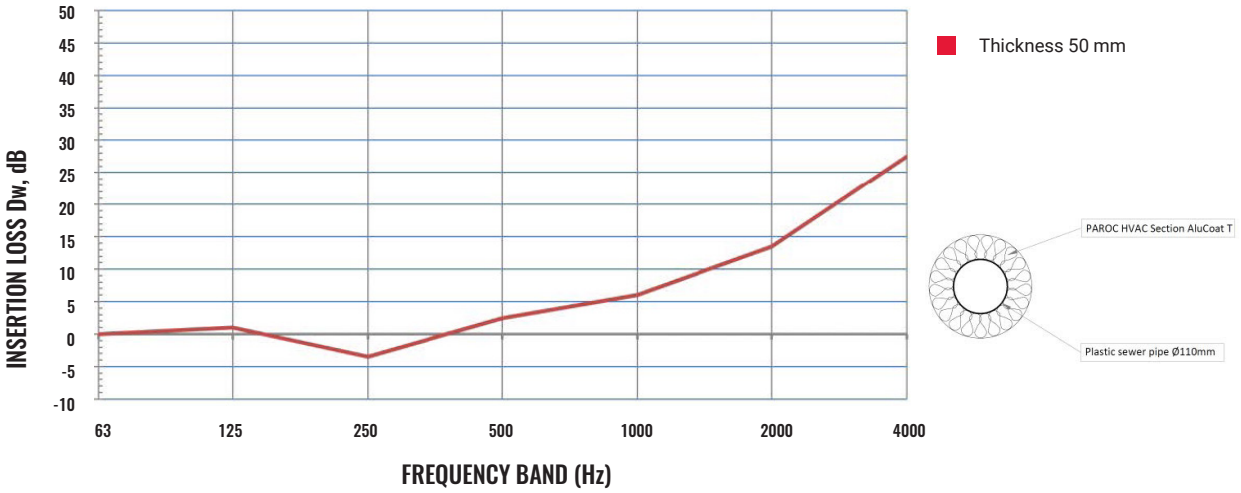
PAROC Pro Wired Mat 80 AluCoat, Iron Pipe Ø159x4 mm



Thickness,mm	Frequency Hz						
	63	125	250	500	1000	2000	4000
60	0	0	-2	2	10,5	17	26,5
120	-1,5	-0,5	-1,5	2,5	14,5	23,5	28,5

DIAGRAM P6

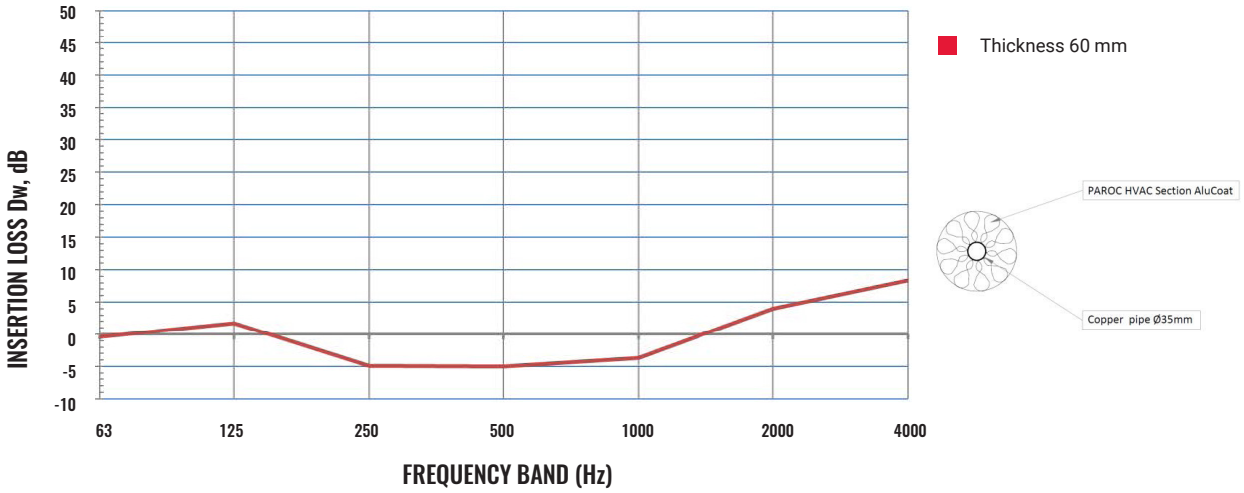
PAROC Hvac Section AluCoat T, Plastic sewer Pipe Ø110 mm



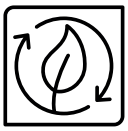
Thickness,mm	Frequency Hz						
	63	125	250	500	1000	2000	4000
60	0	1	-3,5	2,5	6	13,5	27,5

DIAGRAM P7

PAROC Hvac Section AluCoat T, Copper Pipe Ø35 mm

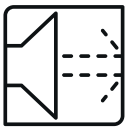


Thickness,mm	Frequency Hz						
	63	125	250	500	1000	2000	4000
60	-0,5	2	-5	-5	-4	4	8,5



DURABLE

REUSABLE



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