ISOVER
SAINT-GOBAIN

DESIGNING ACOUSTICS IN INDUSTRY

SAINT-GOBAIN

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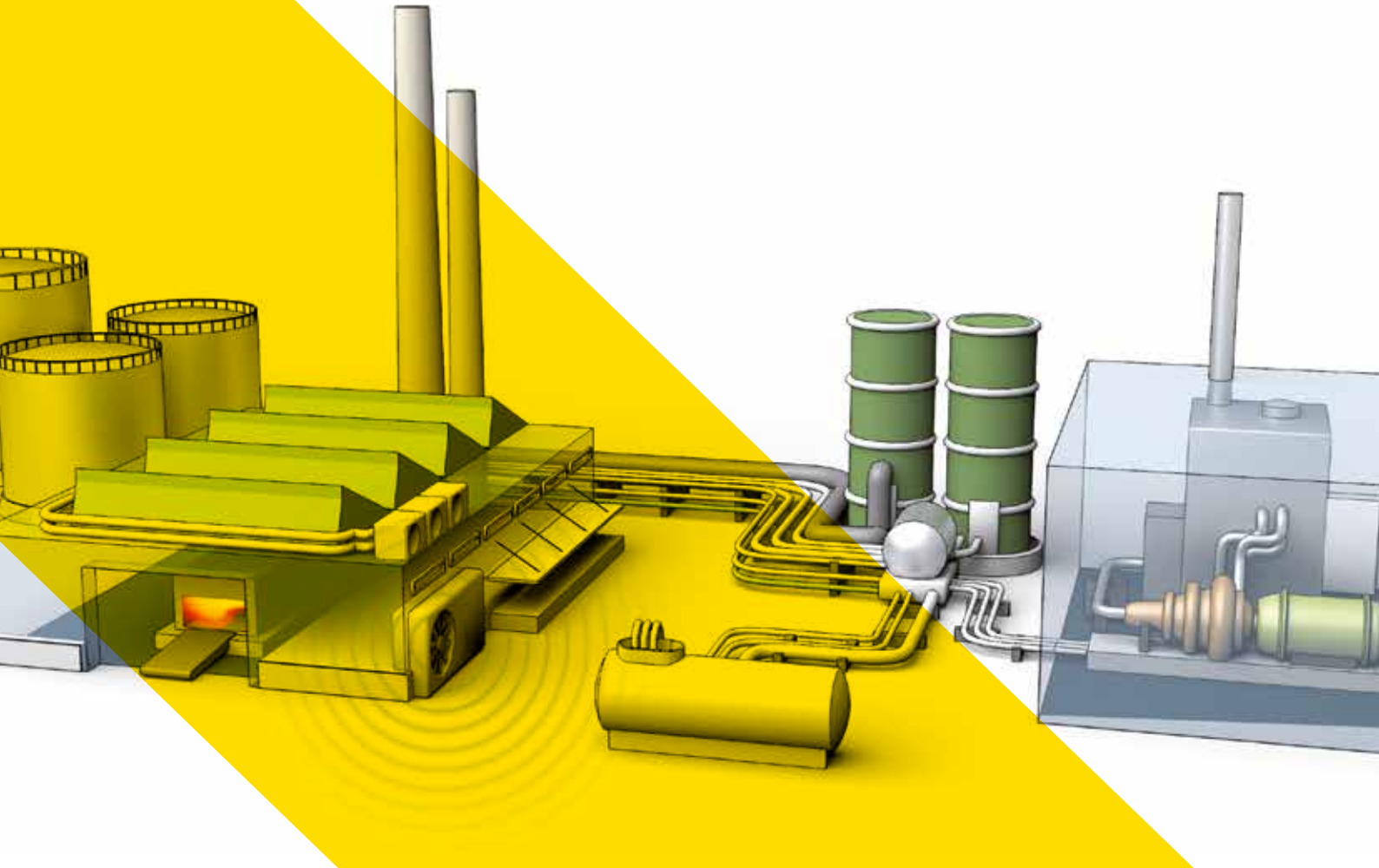


Ensure effective noise
PROTECTION AT THE WORKPLACE

Whenever people are working alongside machines or motors, effective noise protection solutions are needed. Noise protection in industry requires noise protection concepts for the protection of the health of employees, to minimize absenteeism, to improve the working climate and to remain in compliance with the directives and regulations in force.

Not only do machines, powertrains or engines increase noise pollution in industrial halls, factories and workshops, but reflective surfaces also amplify noise and degrade acoustics in industrial operations. In the long run, noise levels in the workplace can contribute to poor concentration, loss of performance and increased absenteeism.

On the contrary, targeted noise protection measures help improve the quality of people's work and the long-term working atmosphere by significantly lowering the noise level.

INSULATION PLAYS A KEY ROLE IN CREATING AN OPTIMAL ACOUSTIC ENVIRONMENT

In industrial acoustics, the noise source occupies a central place, and one must try to nip annoying noises in the bud.

With the help of acoustic barriers, absorbent panels, acoustic cabins and other high quality noise protection solutions, the sound pressure level emitted by machines is reduced, so that it cannot spread further in the production hall or factory.

Add value to
YOUR INDUSTRIAL SITES

Invest in the right sound insulation to create comfortable working environments.

AS A PLANT OPERATOR

› Improve working conditions in your sites
› Protect the health of your employees
› Comply with the directives and regulations in force

AS A SPECIFIER

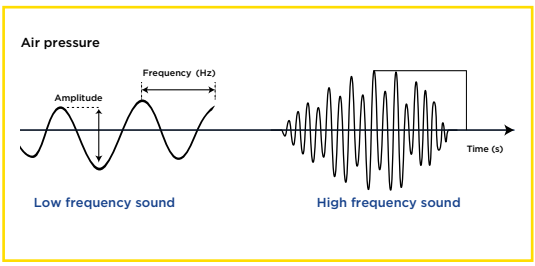
› Design high-performance industrial sites for your customers
› Bring key benefits to your customers
› Demonstrate your capacity to innovate
› Meet strict acoustic regulations

UNDERSTANDING SOUND AND NOISE

Refresh your knowledge
by remembering some basic
acoustics principles,
such as frequency and sound pressure.

A bit of ACOUSTICS THEORY

What is frequency?



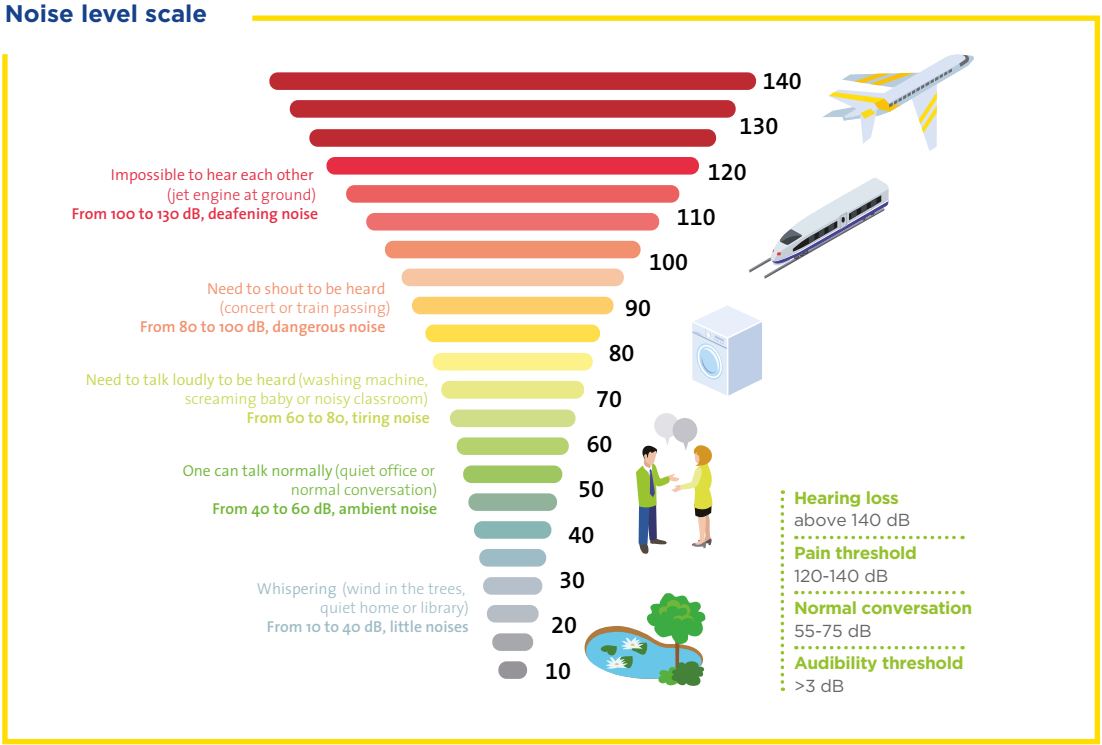
The frequency of a sound is the number of pressure variations per second and is expressed in hertz (Hz). A frequency of 1 Hz refers to one wave cycle per second, while 20 Hz refers to 20 wave cycles per second. The number of pressure variations gives a sound its distinctive tone: a low frequency produces a low-pitch sound; a high frequency will give a high-pitch sound.

The audio spectrum is the frequency range that is audible to humans.
This generally spans from 20 to 20,000 Hz.

What is sound pressure?

The sound pressure level terms the amplitude of a sound. A weak amplitude produces a quiet sound, a large amplitude a loud sound. The scale of sound pressure is expressed in decibels (dB).

Noise level scale



How to calculate the total sound pressure level?

In acoustics, huge changes in measurable physical parameters (pressure, power, frequency) correspond to relatively small changes in perceived properties (volume, height). The human ear is able to hear sounds over a very wide range of amplitudes. Typically, the largest numbers in the data are hundreds or even thousands of times greater than the smallest numbers. This is why a logarithmic scale is used to display numeric data over a very wide range of values in a compact way.

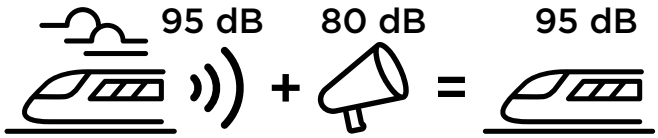
Calculating the total sound pressure level of combined noise sources requires the use of logarithmic sums. They cannot be added or subtracted in the usual arithmetical way.
If the difference in sound levels is more than 10 dB, the louder noise drowns out the weaker noise.

For instance, if one source emits a sound level of 95 dB and a second source emits a sound level of 80 dB, the resulting sound level is 95 dB, not 175 dB.

Difference between two sound levels (in dB)	0	1	2	3	4	5	6	7	8	9
Value to be added at the highest level (in dB)	3.0	2.6	2.1	1.8	1.5	1.2	1.0	0.8	0.6	0.5

83dB + 83 dB ≠ **166 dB would be 86 dB**

83dB + 87 dB ≠ **170 dB would be 88.5 dB**

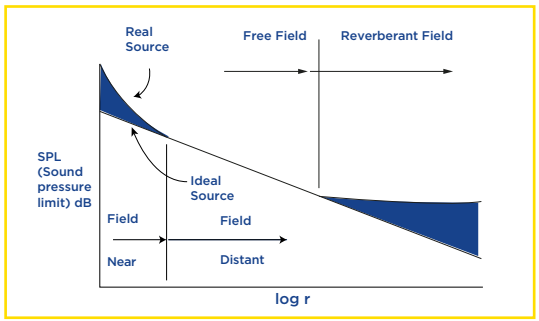


How is sound propagated?

We can distinguish two different types of sound sources:

- **Point sound source:** Where wave fronts propagate in all possible directions in the same way. In most real cases sound sources are similar to this type of source. The sound level decreases by 6 dB when the distance from the sound source is doubled.
- **Linear sound source:** In one dimension, it has larger magnitudes than in the rest. Its wave front will not propagate in a spherical form but in a cylindrical one according to the environment. In this case the sound level decreases by 3 dB when the distance from the sound source is doubled.

When a source is in an enclosed space, sound waves are reflected by the surfaces that make up the room. This is called a **reverberant field.**



The reverberant field is that part of the sound field that has undergone at least one reflection from the boundary surfaces of the room containing the sound source.

DID YOU KNOW?

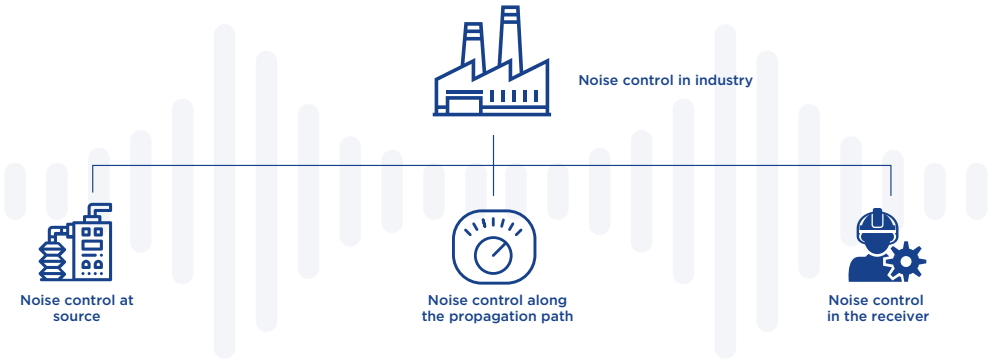
The speed at which sound waves travel in an elastic medium is called sound propagation speed. This velocity depends on the mass and elasticity of the medium in which it is propagated. In air, sound reaches a speed of 340 m/s, at a temperature of 20°C and at 1 atm of pressure.

KEEP THE NOISE DOWN

Find out about the different sources of noise in an industrial site, how noise is spread, and the different levers you have to reduce it.

How to
CONTROL NOISE

When designing an industrial plant, you need to consider the appropriate solutions for noise reduction. Effective insulation will help you control noise at the source, along the path, and in the receiver.



- Low-noise work processes
- Low-noise machinery

Airborne noise

- Location of the source
- Enclosures
- Silencers
- Absorption treatments
- Acoustic screens
- Partitions, etc.

Structural noise

- Vibration insulation
- Floating floors
- Joints in construction elements

- Personal protection cabins
- Acoustic screens
- Personal protective equipment
- Limitation to exposure

Controlling noise at the source

Noise control actions at source aim to reduce the noise generated by processes and machines in operation: reduce the noise of existing machines, develop low noise production processes and technologies, or replace machine parts. These solutions are best implemented at the design stage because retroactive measures can affect operations and are generally more expensive.

Controlling noise along the propagation path

The most effective solutions for the reduction of noise emitted by machinery, installations, pipes, etc., as well as noise control systems in the propagation path, include absorbent treatments, acoustic enclosures, silencers, acoustic screens, vibration insulation systems, and active control systems.

Controlling noise in the receiver

In order to carry out noise control actions in the receiver, it is first necessary to know the noise exposure limits in the area concerned and promote actions such as the installation of acoustic enclosures (personal protection cabins) or the use of hearing protection.

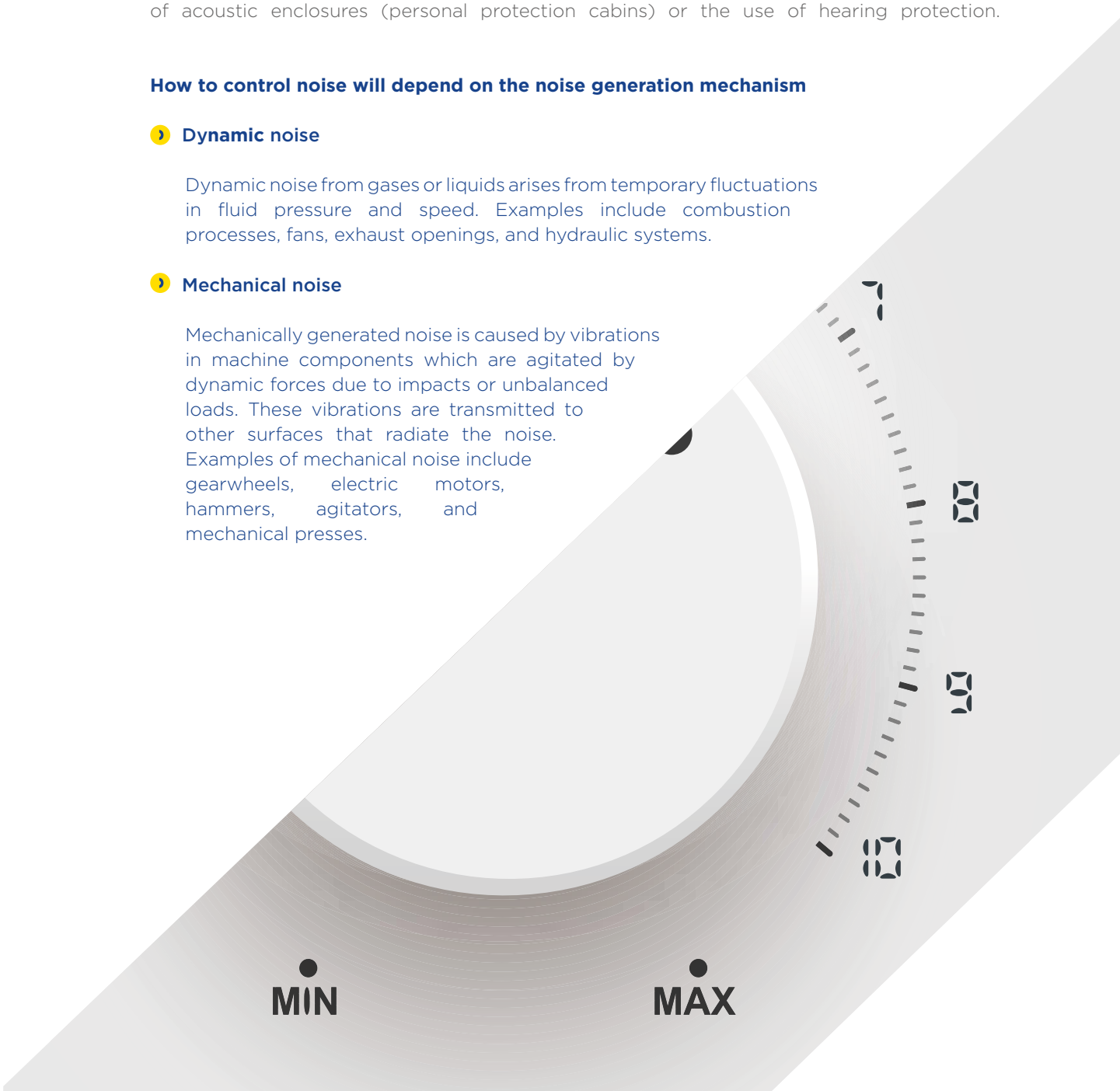
How to control noise will depend on the noise generation mechanism

- **Dynamic noise**

  Dynamic noise from gases or liquids arises from temporary fluctuations in fluid pressure and speed. Examples include combustion processes, fans, exhaust openings, and hydraulic systems.

- **Mechanical noise**

  Mechanically generated noise is caused by vibrations in machine components which are agitated by dynamic forces due to impacts or unbalanced loads. These vibrations are transmitted to other surfaces that radiate the noise. Examples of mechanical noise include gearwheels, electric motors, hammers, agitators, and mechanical presses.



Our INDUSTRY MANUAL contains a comprehensive chapter on industrial noise control to go deeper into the subject. You can access it from our website.

ACOUSTIC PROPERTIES OF MINERAL WOOLS

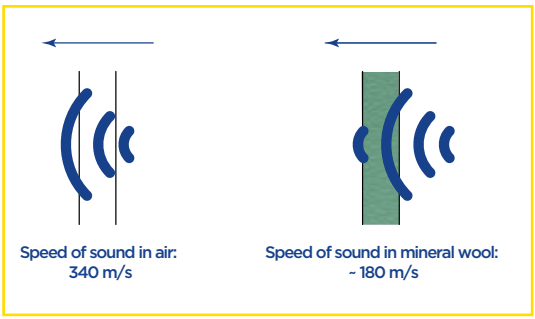
Learn how airflow resistivity, dynamic stiffness and sound absorption characterise the acoustic behavior of mineral wools.

ACOUSTIC PROPERTIES OF MINERAL WOOLS

When choosing the best acoustic insulation solution for your projects, you should mainly consider the following parameters:

- **Air flow resistivity, r (KPa •s/m²)**
- **Dynamic stiffness, s' (MN/m³)**
- **Sound absorption, α_s (dimensionless)**

Air flow resistivity

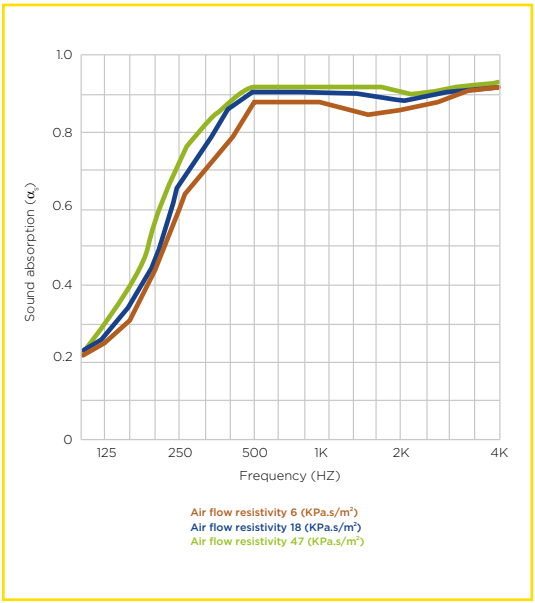


The air flow resistivity is an intrinsic property of all absorbent materials. It determines their ability to reduce the transmitted acoustic energy, by reducing the speed of sound.

The air flow resistivity is the result of friction between the mineral wool fibres and the air particles they enclose. This property depends mainly on the length and diameter of the mineral wool fibres.

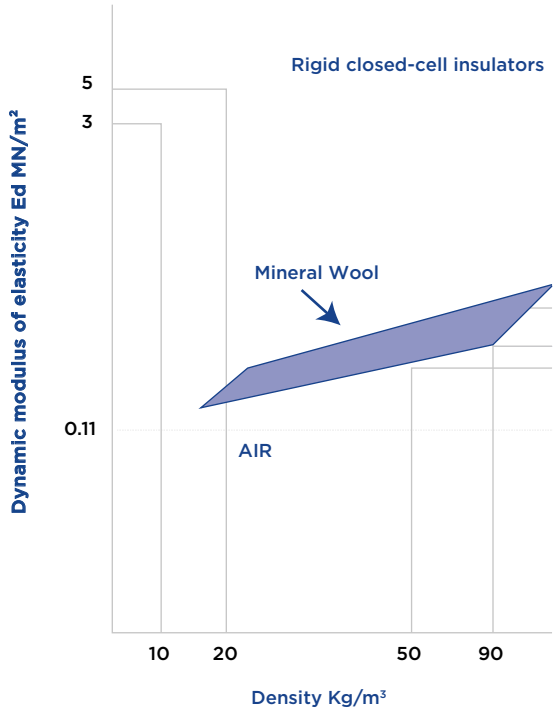
The air flow resistivity should ideally be between 5 - 50 kPa s/m² (the acoustic behaviour at equal thickness is similar); below 5 kPa s/m² the insulation will not provide sufficient sound absorption, and above 50 kPa s/m² the transmission of noise will be predominantly structure-borne because it would be an excessively rigid material.

The air flow resistivity, r, is determined by the test carried out according to the EN 29053 standard, required for materials used in acoustic applications.



Dynamic stiffness

This is the quality of mineral wool, which acts as a cushion to dampen noise and vibrations.

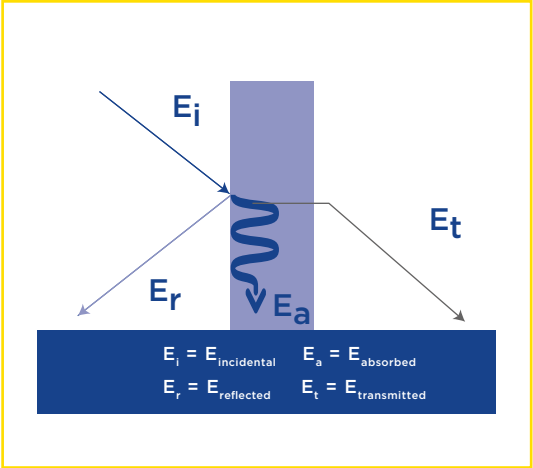


$$s' = \frac{Ed}{d}$$

s': Dynamic material stiffness (MN/m³)
Ed: Dynamic modulus of elasticity (MN/m²)
d: Material thickness (m)

The dynamic stiffness, s', is determined by the test carried out according to the EN 29052-1 standard.

Sound absorption



Sound absorption means that part of the acoustic energy that hits a surface is absorbed and transformed into heat.

When a wave front reaches a vertical wall that separates two enclosures, part of the incident energy is reflected by the wall, another part of this energy is absorbed by it, and finally, the remaining energy passes through the wall.

The incident sound energy, Ei, is described by the following energy equation (principle of energy conservation): $E_i = E_a + E_r + E_t$

Breaking this down, the above expression for Ei is as follows: $1 = \alpha + \rho + \tau$

Where:
$\alpha = E_a / E_i$ is the **sound absorption coefficient** (dimensionless)
$\rho = E_r / E_i$ is the **acoustic reflection coefficient** (dimensional)
$\tau = E_t / E_i$ is the **coefficient of acoustic transmission or transmissibility** (non-dimensional)

The **sound absorption coefficient** α of a material is characterised by the amount of incident energy that the material is capable of absorbing; it varies according to several parameters:

- Air flow resistivity
- Sound frequency
- Porosity (air volume/total volume)
- Tortuosity (geometry of the material structure)
- Thickness

The sound absorption coefficient of an insulation material is typically measured in a reverberation chamber in accordance with the EN-ISO 354 standard for measurement and is called the "Sabine" absorption coefficient α o α_s.

The sound absorption coefficient is between 0 and 1.

DID YOU KNOW?

Mineral wools have very high absorption coefficients and are characterised by the way their surface allows sound energy to penetrate through the material's pores.

WHICH SOUND INSULATION SOLUTION FOR WHICH APPLICATION?

Find out which noise control solutions are best suited for your process and equipment.

Solutions for all industrial
ACOUSTIC APPLICATIONS

Fans, compressors, chimney exhaust systems and large motors are important causes of noise problems in industry. To treat them, there is a range of effective noise control solutions designed to work seamlessly with your process and equipment, including silencers, enclosures and cabins, barriers or insulation systems for pipework.

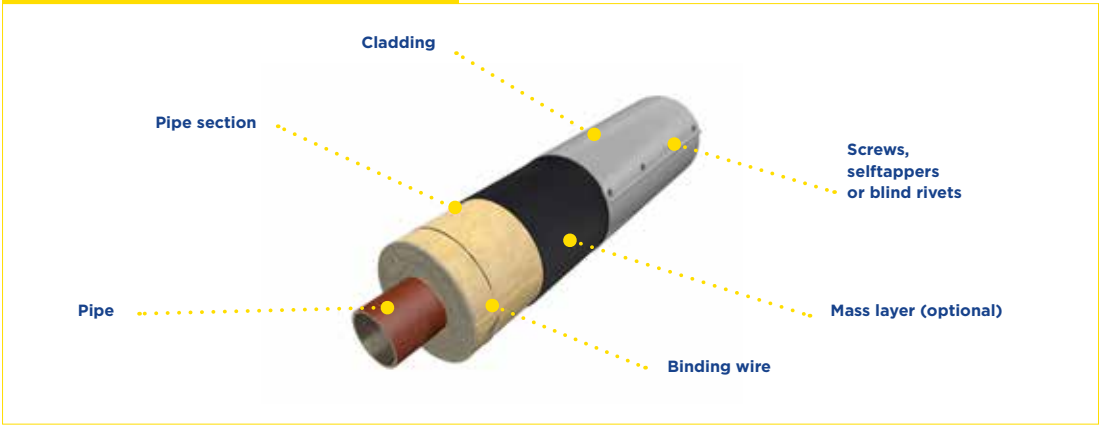
PIPEWORK

Large industrial sites can be characterized by the presence of kilometres of pipelines which can represent a major source of noise. Noise can arise from the turbulent flow of compressible fluids, changes in pipe diameters, termination of piping at a header or vessel, and noise induced by equipment.

The noise radiated by the wall of a pipe is usually generated by equipment connected to the pipe, such as compressors, pumps, valves or ejectors. These noise sources may cause long sections of pipes to radiate noise because noise will propagate in the pipe with little attenuation.
Acoustic insulation in pipes typically consists of a sound-absorbing and/or resilient material as mineral wool (“porous layer”) on the piping and an impermeable outer cover (“cladding”). An optional intermediate mass layer in direct contact with the cladding can also be added to improve the acoustic performance.

When spacers are needed to support the cladding, they shall be resilient instead of rigid as the ones used in distance rings for thermal insulation (following the most common acoustics regulations).

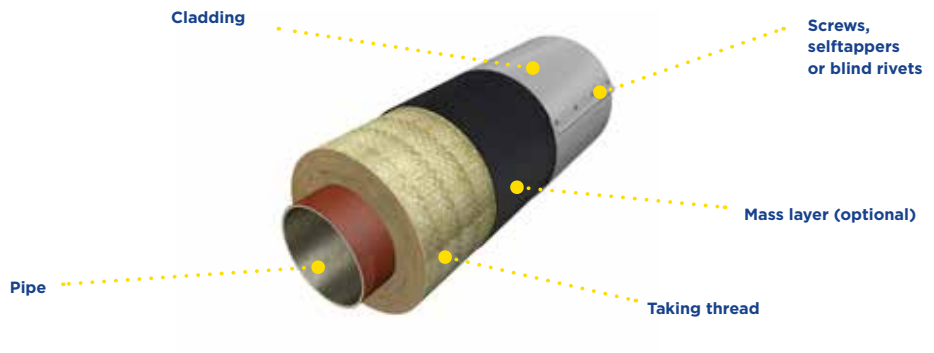
Straight pipe (pipe section), small diameter



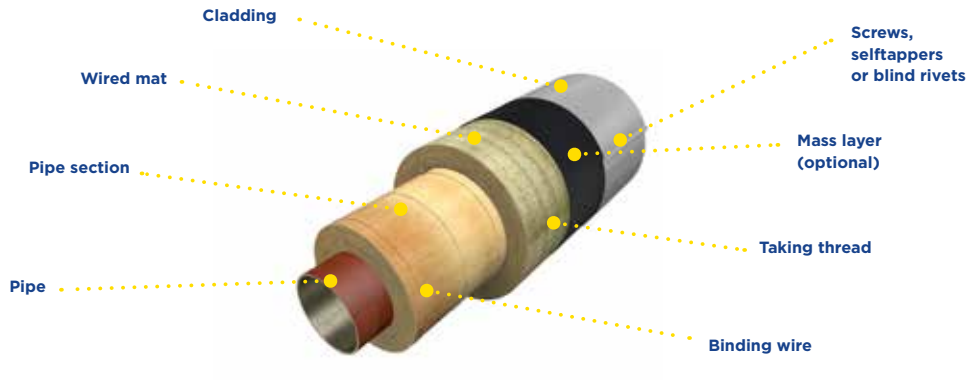
DID YOU KNOW?

Pipes, valves and flanges that are thermally insulated also benefit from a certain degree of sound insulation.

Straight pipe (wired mat)



Straight pipe (pipe section + wired mat)



Insulation significantly reduces acoustic vibrations between the pipe and the cladding while absorbing noise.

The sound insulation performance requirements of systems for reducing noise produced by pipes, valves and flanges of an installation are defined in the standard document ISO 15665: 2003 “Acoustics. Acoustic insulation for pipes, valves, and flanges”.

Engineers and large operators in the field of industry use it to specify efficient soundproofing systems for specific noise reduction.

This International Standard defines the acoustic performance of three classes (Classes A, B and C) of pipe insulation in terms of minimum insertion loss requirements. The diameters of the pipes are divided into three groups of pipe sizes (1, 2 and 3) because the insertion loss of sound insulation is also related to the diameter of the pipe to which it is applied. In addition, a more demanding class «D» (Shell specification DEP 31.46.00.31-Gen.) has also been widely adopted in the industry sector.

DID YOU KNOW?

Insertion loss refers to the reduction of sound by adding insulation and cladding to a pipe to prevent sound from travelling outward. The difference in ambient (exterior) noise level between the bare pipe and the insulated pipe is the insertion loss.

Below is the minimum insertion loss required for the above mentioned classes (A, B, C, D)

MINIMUM INSERTION LOSS PER CLASS									
CLASS		NOMINAL DIAMETER D MM	OCTAVE BAND CENTRE FREQUENCY, HZ						
			125	250	500	1,000	2,000	4,000	8,000
			MINIMUM INSERTION LOSS, DB						
A	A1	D < 300	-4	-4	2	9	16	22	29
	A2	300 ≤ D < 650	-4	-4	2	9	16	22	29
	A3	650 ≤ D < 1,000	-4	-2	7	13	19	24	30
B	B1	D < 300	-9	-3	3	11	19	27	35
	B2	300 ≤ D < 650	-9	-3	6	15	24	33	42
	B3	650 ≤ D < 1,000	-7	2	11	20	29	36	42
C	C1	D < 300	-5	-1	11	23	34	38	42
	C2	300 ≤ D < 650	-7	4	14	24	34	38	42
	C3	650 ≤ D < 1,000	1	9	17	26	34	38	42
D*	D2	300 ≤ D < 650	-3	4	15	36	45	45	45
	D3	650 ≤ D < 1,000	3	9	26	36	45	40	40

(*) System D according to Shell DEP 31.46.00.31-Gen. specification

YOUR INSULATION SOLUTION

The most suitable formats for pipe insulation are pipe sections or wired mats, depending on the diameter of the pipe and the thickness of the insulation. When choosing your acoustic insulation, you may also consider the thermal requirements.

SAINT-GOBAIN TI SOLUTIONS FOR CLASS 1 (PIPE DIAMETER < 300 MM) ACCORDING TO ISO 15665						
INSULATION	THICKNESS	MASS LAYER	CLADDING	CLASSES		
TECH PS MT 4.1	50 MM	-	Steel cladding 1 mm (7.8 kg/m²)		B1	
U TECH PS MT 4.0	50 MM	-	Steel cladding 1 mm (7.8 kg/m²)	A1	B1	
U TECH PS MT 4.0	50 MM	≥ 12 kg/m²	Steel cladding 1 mm (7.8 kg/m²)	A1	B1	C1
U TECH PS MT 4.0	100 MM	-	Steel cladding 1 mm (7.8 kg/m²)	A1	B1	C1
TECH WM MT 5.1	100 MM	-	Steel cladding 1 mm (7.8 kg/m²)	A1	B1	
TECH WM MT 4.1	100 MM	-	Steel cladding 1 mm (7.8 kg/m²)	A1	B1	C1
U TECH WM MT 4.0	100 MM	-	Steel cladding 1 mm (7.8 kg/m²)	A1	B1	C1
TECH PS MT 4.1 + TECH WM MT 5.1	2 X 60 MM	≥ 12 kg/m²	Steel cladding 1 mm (7.8 kg/m²)		B1	C1
U TECH PS MT 4.0 + U TECH WM MT 6.0	2 X 60 MM	-	Steel cladding 1 mm (7.8 kg/m²)		B1	C1

***PS** = Pipe Section ; **WM** = Wired Mat*

SAINT-GOBAIN TI SOLUTIONS FOR CLASS 2 (PIPE DIAMETER 300-650 MM) ACCORDING TO ISO 15665							
INSULATION	**THICKNESS**	**MASS LAYER**	**CLADDING**	**CLASSES**			
U TECH PS MT 4.0	100 MM	-	Steel cladding 1 mm (7.8 kg/m²)	A2	B2	C2	
U TECH PS MT 4.0	100 MM	≥ 12 kg/m²	Steel cladding 1 mm (7.8 kg/m²)	A2	B2	C2	D2
TECH WM MT 5.1	100 MM	-	Steel cladding 1 mm (7.8 kg/m²)	A2	B2	C2	
U TECH WM MT 4.0	100 MM	-	Steel cladding 1 mm (7.8 kg/m²)	A2	B2	C2	
U TECH WM MT 4.0	100 MM	≥ 12 kg/m²	Steel cladding 1 mm (7.8 kg/m²)	A2	B2	C2	D2

***PS** = Pipe Section ; **WM** = Wired Mat*

SAINT-GOBAIN TI SOLUTIONS FOR CLASS 3 (PIPE DIAMETER 650-1000 MM) ACCORDING TO ISO 15665							
INSULATION	**THICKNESS**	**MASS LAYER**	**CLADDING**	**CLASSES**			
TECH WM MT 5.1	100 MM	≥ 8 kg/m²	Alu cladding 1 mm (2.7 kg/m²)	A3	B3		
TECH WM MT 5.1	2 X 100 MM	≥ 16 kg/m²	Alu cladding 1 mm (2.7 kg/m²)	A3	B3	C3	D3
U TECH WM MT 4.0	100 MM	≥ 8 kg/m²	Alu cladding 1 mm (2.7 kg/m²)	A3	B3	C3	
U TECH WM MT 4.0	100 MM	≥ 12 kg/m²	Alu cladding 1 mm (2.7 kg/m²)	A3	B3	C3	D3
U TECH WM MT 4.0	2 X 100 MM	≥ 5 kg/m²	Alu cladding 1 mm (2.7 kg/m²)	A3	B3	C3	D3

***PS** = Pipe Section ; **WM** = Wired Mat*

KAISOUND SB from KAIMANN was considered as a mass layer when needed.
The acoustic class assigned to each system is based on values obtained from laboratory tests under certain conditions and given modelling processes. Real life conditions may differ due to various environmental and operational factors.

Reports for each system are available upon request. In addition, we can test or model other custom systems at your request (e.g. systems for pipe diameters >1,000 mm).

EACH SETUP IS UNIQUE, SO WE INVITE YOU TO CONTACT YOUR LOCAL REPRESENTATIVE OR GET IN TOUCH THROUGH OUR WEBSITE.

DID YOU KNOW?

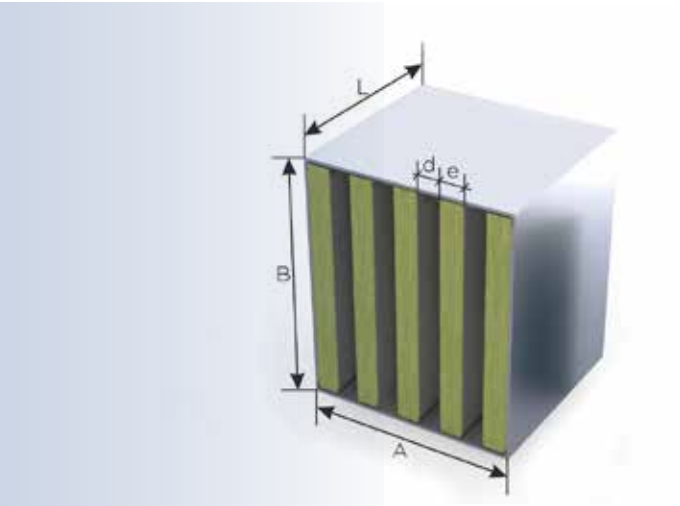
In addition to our range of mineral wools, we also offer - through our sister company KAIMANN - elastomeric foam insulation.

INDUSTRIAL SILENCERS

A silencer reduces sound transmission along a duct, pipe or opening. It relies on the following noise reduction mechanisms:

- **Absorption:** Using a porous insulating material converts sound energy - when it reaches the absorbent material - into low levels of heat.
- **Reflection:** Certain spaces inside silencers (e.g. a duct with changes in section) allow for a large volume of reflections within the cavity causing a dissipation of sound energy.
- **Diffusion:** Sound attenuation is produced by diffuser tubes with small holes that can increase the peak frequency to higher values.

Passive or absorptive silencers



Most industrial silencers are passive silencers, in which gradual dissipation of sound energy is achieved by using absorbent materials. One example is a duct whose walls are covered with an absorbent material. These silencers reduce noise over a wide range of frequencies, especially at medium and high frequencies.

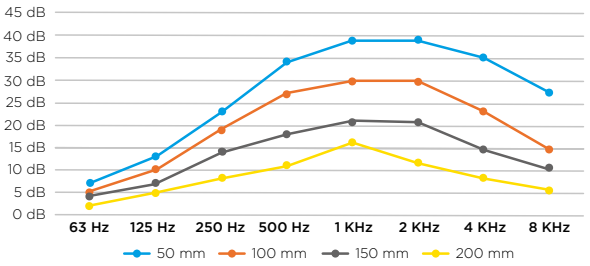
Industrial silencers can be either rectangular or circular. They are often installed outdoors where they must withstand all weather conditions. Air or gas flowing through them can reach high temperatures, as well as high humidity values and high dust concentrations.

Silencers are defined by their dimensions (W x B x L), by the width of the baffle (e), and by the air passage (d), i.e. the distance between the baffles.

WE WILL HELP YOU DEFINE THE MOST SUITABLE SOLUTION AMONG OUR WIDE RANGE OF MINERAL WOOL SOLUTIONS, FROM GLASS WOOL TO STONE WOOL.

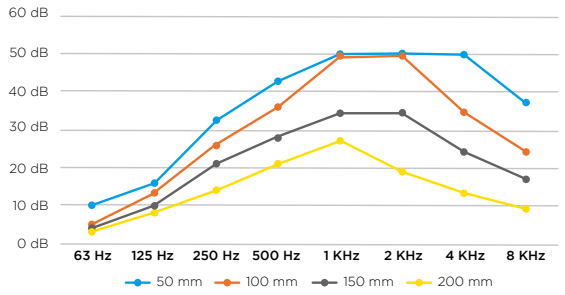
SILENCER BAFFLE 200 MM (E) AND LENGTH (L) 900 MM

Acoustic Mitigation Values (dB)								
Air passage (d)	Frequencies							
	63 Hz	125 Hz	250 Hz	500 Hz	1 KHz	2 KHz	4 KHz	8 KHz
50 mm	7	13	23	34	39	39	35	27
100 mm	5	10	19	27	30	30	23	15
150 mm	4	7	14	18	21	21	14	10
200 mm	2	5	8	11	16	11	8	6



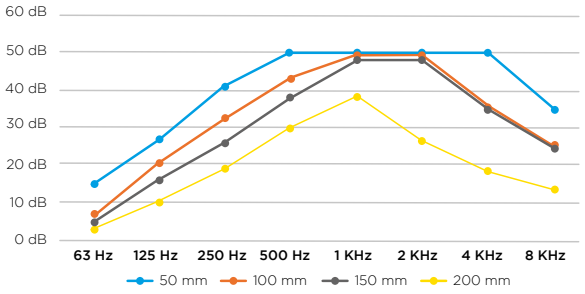
SILENCER BAFFLE 200 MM (E) AND LENGTH (L) 1500 MM

Acoustic Mitigation Values (dB)								
Air passage (d)	Frequencies							
	63 Hz	125 Hz	250 Hz	500 Hz	1 KHz	2 KHz	4 KHz	8 KHz
50 mm	10	16	32	43	50	50	50	37
100 mm	5	13	26	36	50	50	35	24
150 mm	4	10	21	28	35	35	24	17
200 mm	3	8	14	21	27	19	13	9



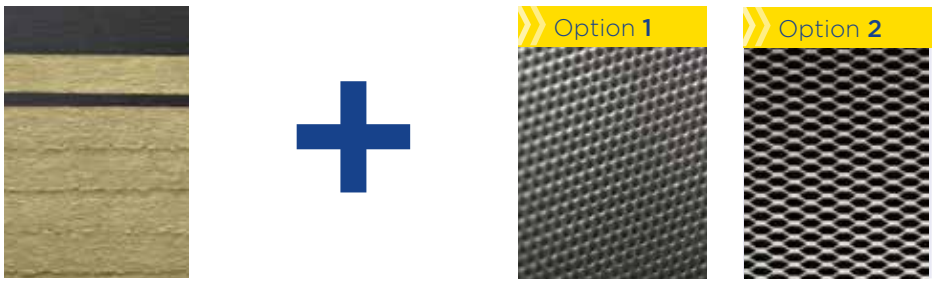
SILENCER BAFFLE 200 MM (E) AND LENGTH (L) 2100 MM

Acoustic Mitigation Values (dB)								
Air passage (d)	Frequencies							
	63 Hz	125 Hz	250 Hz	500 Hz	1 KHz	2 KHz	4 KHz	8 KHz
50 mm	14	27	41	50	50	50	50	35
100 mm	6	20	32	43	50	50	35	25
150 mm	4	16	26	38	48	48	34	24
200 mm	3	10	19	30	38	26	19	13



YOUR INSULATION SOLUTION

Choose mineral wool slabs with an air flow resistivity of approx. 5 – 18 kPa s/m² and a density between 20 – 70 kg/m³, and with a glass cloth or glass wool facing. In some cases, depending on performance requirements, it may be necessary to incorporate perforated foil, expanded wire mesh, or electro-welded wire mesh.



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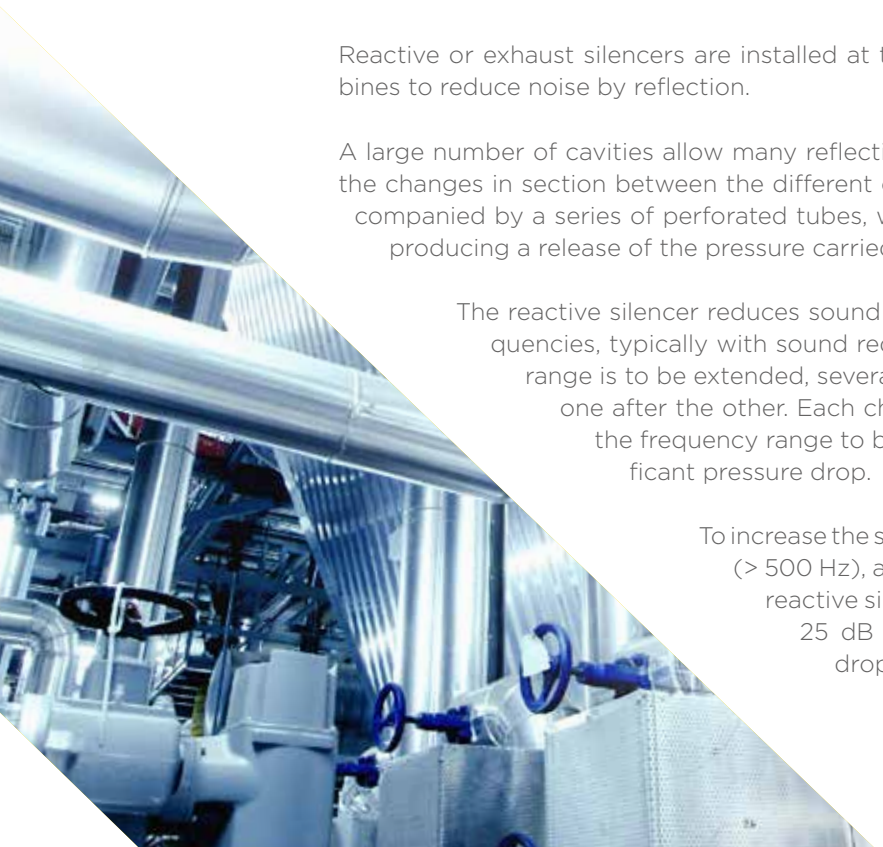
Reactive Silencers



Reactive or exhaust silencers are installed at the outlet of combustion engines and gas turbines to reduce noise by reflection.

A large number of cavities allow many reflections that reduce noise. Energy is dissipated by the changes in section between the different cavities. These section changes are usually accompanied by a series of perforated tubes, which change the direction of gas flow by 90º, producing a release of the pressure carried by the gas.

The reactive silencer reduces sound in a narrow frequency band, primarily low frequencies, typically with sound reduction values of 25 to 35 dB. If the frequency range is to be extended, several chambers are required and can be combined one after the other. Each chamber will have a different size depending on the frequency range to be reduced. This part of the silencer has a significant pressure drop.

To increase the sound reduction at medium and high frequencies (> 500 Hz), an absorption silencer stage is installed after the reactive silencer stage. This step typically produces about 25 dB of attenuation and involves a slight pressure drop.

YOUR INSULATION SOLUTION

To address the thermal requirements of this application, use unfaced mineral wool slabs or wired mats with a high maximum service temperature for the walls and core of the absorption silencer part. You can incorporate a stainless steel needle-punched fabric in addition to a perforated stainless steel sheet for protection.

DID YOU KNOW?

Most silencers consist of two parts: one part is a reactive silencer and the other part is an absorptive silencer.

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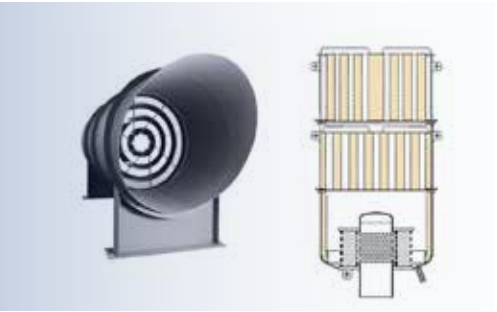
Steam discharge silencers



Discharge silencers are designed to reduce noise caused by the release of gaseous fluids, steam, air, and compressed gases. Those fluids at high pressures create noise from turbulence and shock waves when released into the atmosphere: 150 to 170 dB PWL (acoustic power level).

The discharge silencer is used in steam purge and pressure release lines, trapping the gas flow by a loss of pressure, and reducing noise by slowing the flow rate at the outlet.

Diffusers with small holes (< Ø 8 mm) relieve the pressure of this gas, providing noise reduction through a silencer with baffles. Applying an absorbing insulation material immediately after the pressure steps helps reducing the vortex formation, and the remaining flow noise is partially absorbed.

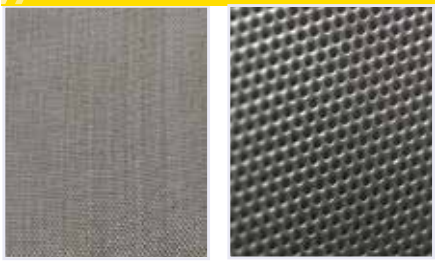
DID YOU KNOW?

Higher frequency noise can be attenuated more easily than lower frequency noise, allowing for more compact silencers.

YOUR INSULATION SOLUTION

For the silencer walls (expansion chamber), use unfaced mineral wool slabs or wired mat, in combination with caramelised (heat treated) glass cloth, or stainless steel needle-punched fabric, and perforated protective sheet.

Option **1**



Option **2**

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ACOUSTIC ENCLOSURES AND CABINS

Acoustic enclosures and cabins provide a noise reduction on the propagation path from the machine (or a set of machines) to nearby work stations or to the environment.

An acoustic enclosure is a structure that surrounds a sound source (typically a machine), to protect the environment from its noise emissions.

An acoustic cabin is a closed structure designed to isolate people (e.g. machine operators) from ambient noise.

Acoustic cabins or enclosures can be fixed or self-supporting, made of sandwich panels, removable panels or tray panels.

To define the right level of insulation for acoustic enclosures or cabins, it is necessary to take into account their exact location (space, civil works, accesses), dimensions, ventilation systems, and other technical and/or aesthetic issues.

Enclosures and cabins with a removable panel system

This type of cabin is manufactured by means of an internal steel tube structure, forming a gantry with the external configuration. The removable acoustic panels are installed on the structure. They are very rigid and are joined to each other and to the structure by means of special flashing that allows for easy assembly and disassembly. Dismantling systems can also be carried out with quick-release fasteners between the acoustic panels.

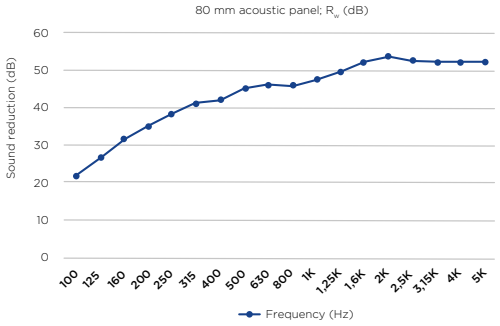
The acoustic panels are assembled using a profiled galvanised sheet frame, which serves as a support for two galvanised steel sheets:

- The exterior sheet: smooth, 1.5 mm thick or more (depending on the required sound reduction level)
- The interior sheet: perforated (diameter and % of perforation depending on the required sound reduction level, but preferably greater than 33 %)

To optimise sound insulation, mineral wool slabs are placed between the sheets.
The performance of the acoustic panels will depend on the thickness of the galvanised steel sheets and on the mineral wool inside. Typical sound reduction values of acoustic panels are between 30 and 45 dB.

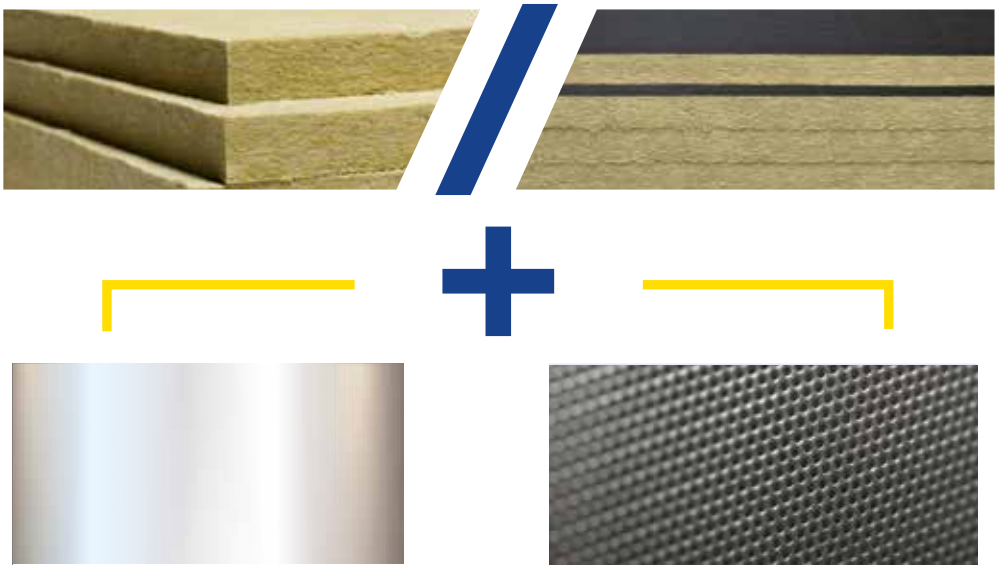
EXAMPLE OF ACOUSTIC PANEL MITIGATION

1 MM SMOOTH GALVANISED SHEET + TECH SLAB MT 3.1 IN 80 MM + 1 MM GALVANISED PERFORATED SHEET																			ACOUSTIC REDUCTION	
80 mm acoustic panel	Freq (Hz)	100	125	160	200	250	315	400	500	630	800	1 K	1,25 K	1,6 K	2 K	2,5 K	3,15 K	4 K	5 K	R_W (db)	R_A (dBA)
	R (dB)	8.7	11.4	13.8	16.9	19.3	24.1	27.3	29.5	34.0	36.2	39.7	42.0	43.9	41.5	41.5	39.5	38.9	39.0	31 (-2;7)	30.20



YOUR INSULATION SOLUTION

Use smooth galvanised steel sheet + mineral wool + perforated galvanised steel sheet:



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Enclosures and cabins with sandwich panel system

These cabins are built from an internal support structure made of steel tubes and auxiliary profiles, on which the prefabricated acoustic sandwich panels are installed.

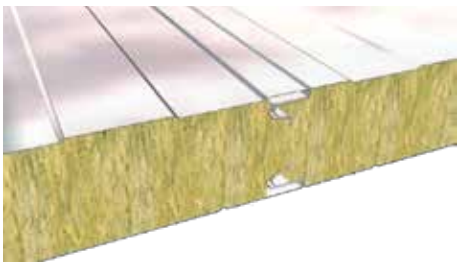
The sandwich panels have a standard width of 1 m and are available in a range of thicknesses (50, 80 and 100 mm or more) and variable lengths depending on the dimensions of the cabin. They consist of two 0.5 mm thick cold-formed finishing sheets, the outer is blind corrugated and the inner is perforated, and a high density stone wool insulation core (with the fibres positioned perpendicular to the faces of the panel, which offers a high resistance to compression and ensures its uniformity). A tongue-and-groove seal guarantees complete sealing, good adaptability and quick assembly.

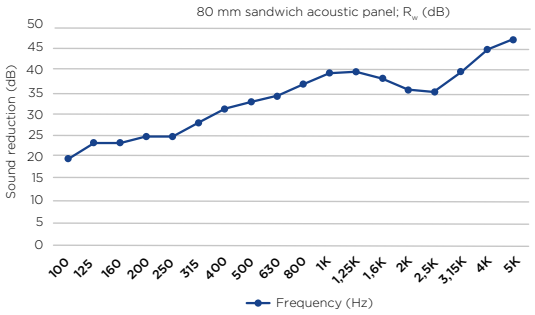
This system is used mainly for the construction of fixed enclosures.

Acoustic performance varies depending on the thickness and core of the mineral wool.

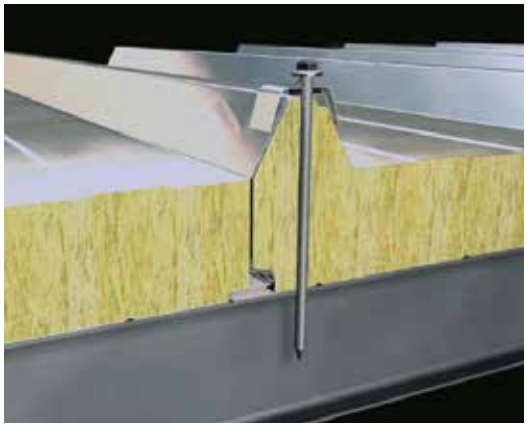
EXAMPLES OF SANDWICH PANEL MITIGATION

80 MM SANDWICH PANEL																			ACOUSTIC REDUCTION	
80 mm sandwich panel	Freq (Hz)	100	125	160	200	250	315	400	500	630	800	1 K	1,25 K	1,6 K	2 K	2,5 K	3,15 K	4 K	5 K	R_W (db)	R_A (dBA)
	R (dB)	19.5	23.2	23.3	24.8	24.7	28.0	31.2	32.9	34.1	36.9	39.6	39.8	38.2	35.6	34.9	39.9	44.9	47.3	36(-2;4)	35.10





YOUR INSULATION SOLUTION



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Enclosures and cabins with acoustic tile systems

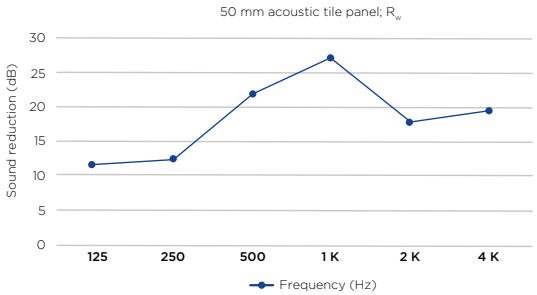
Tiles are small, practical acoustic panels specially designed for the enclosure or individual insulation of machinery or equipment that requires regular maintenance.

The tiles are made on the outside of galvanised sheet with a standard thickness of 1 or 1.5 mm, or the appropriate thickness depending on the sound insulation required, and on the inside of a mineral wool insulation slab. This system allows easy opening and closing.

The sound insulation values guaranteed by this solution are 15 dB (A) and more.

EXAMPLES OF MITIGATION WITH ACOUSTIC TILE PANELS

1 MM SHEET + 50 MM TECH SLAB 3.0 G1								ACOUSTIC REDUCTION	
50 mm tray panel	Freq (Hz)	125	250	500	1K	2K	4K	R_W (dB)	R_A (dBA)
	R (dB)	11.5	12.2	21.8	27.2	17.8	19.4	21.50	19.90



YOUR INSULATION SOLUTION

Combine mineral wool slabs with smooth galvanised sheet:

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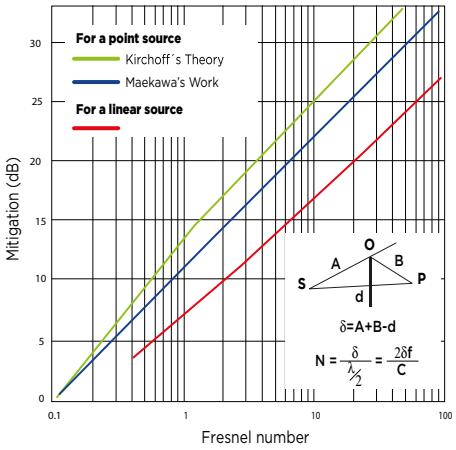
ACOUSTIC BARRIERS

Acoustic barriers or screens are installed between the sound source and the receiver in order to be an obstacle to the propagation of sound. They must have a surface density of at least 20 kg/m³.

The value of this reduction is usually less than 20 dB. The calculation of acoustic screens is based on Fresnel diffraction theories and experimental data. Approximate acceptable values can be obtained from the Maekawa table below.



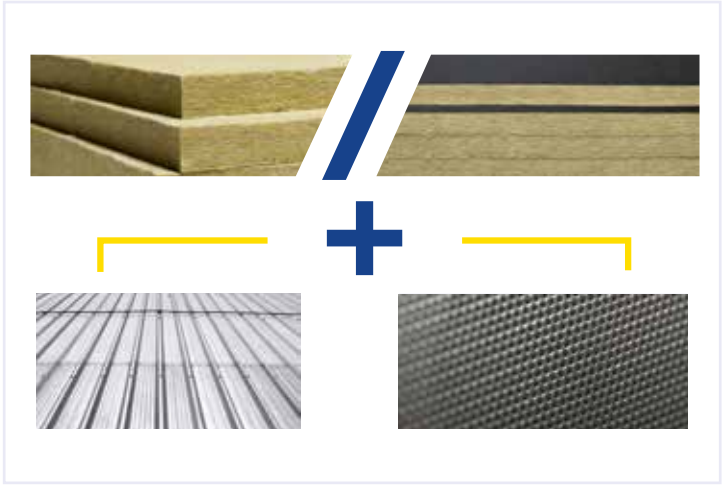
The graph shows that the sound reduction offered by the barriers depends on the dimensionless number N, which reflects the difference in path that the sound should take between the emitter (E) and the receiver (R), as well as the location of barrier and wavelength.

The acoustic panels used for acoustic barriers are similar to those used for enclosures and cabins, i.e. custom panels (removable panels) and sandwich panels. In general, they will consist of a smooth sheet, a mineral wool core and a perforated sheet oriented towards the noise source.

Effective acoustic panels must have good sound absorption coefficients.

YOUR INSULATION SOLUTION

Choose mineral wool slabs, in combination with galvanised sheet metal (normally lacquered to match the colour of the surroundings), and galvanised perforated sheet.



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AIR HANDLING UNIT (AHU)

An Air Handling Unit is used to re-condition and circulate air as part of a heating, ventilating and air-conditioning system. The basic function of the AHU is to take in outside air, re-condition it and supply it as fresh air.

Unbearable noise levels can be produced by its various components, such as fans, heat / cold exchangers, humidifiers and mist eliminators.
The use of sound insulation materials, like mineral wool, will reduce them considerably.

YOUR INSULATION SOLUTION

Preferably mineral wool slabs no thicker than 50 mm.

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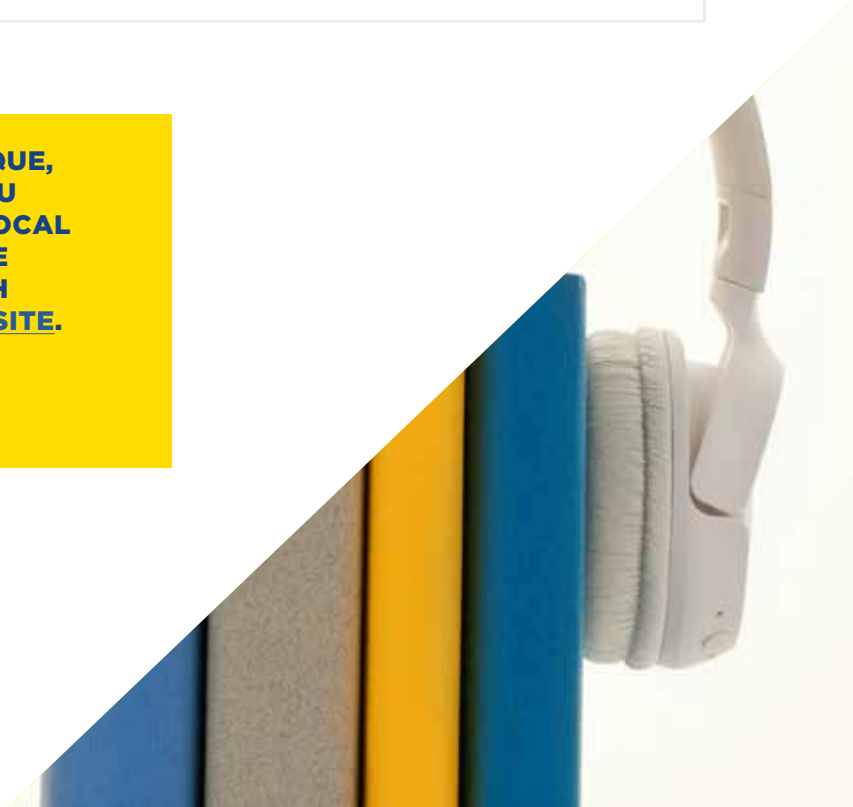


ABSORBENT ACOUSTIC PANELS

Designed for industrial premises where there are multiple sound sources and high noise levels, absorbent acoustic panels reduce direct wave reflections, reducing reverberation levels in the room. They can be installed on walls and ceilings.

DID YOU KNOW?

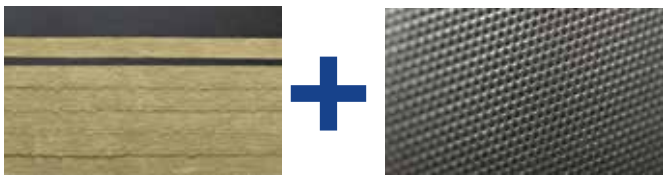
The noise reduction will be all the more important near the walls or ceilings where the acoustic panels are installed, and less significant near the source.

Perforated sheet panels

Perforated sheet panels with a minimum 33% perforation and absorbent material inside are a common solution.

YOUR INSULATION SOLUTION

As these panels require high sound absorption, the mineral wool inside must have high absorption coefficients.



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Decorative absorbent panels

Room reverberation can also be reduced with decorative acoustic panels suspended vertically or horizontally.

These panels are usually made from a U-shaped metal frame, with mineral wool on the inside and a decorative textile facing on the surface.

YOUR INSULATION SOLUTION

Choose from our highly absorbent stone wool slabs:

DISCOVER
THE DECORATIVE
ABSORBENT PANELS
FROM OUR
SISTER COMPANIES
EUROCOUSTIC
AND ECOPHON:

WWW.EUROCOUSTIC.COM
WWW.ECOPHON.COM

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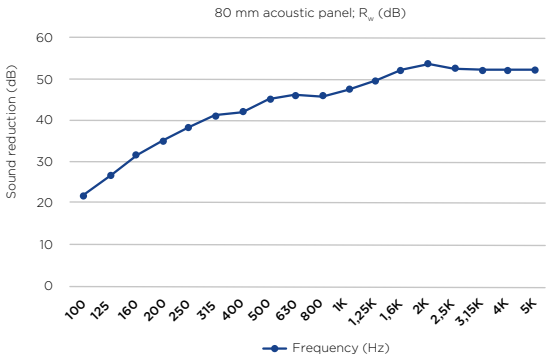
ACOUSTIC DOORS

Acoustic doors provide access to the interior of warehouses or acoustic cabins, while protecting the interiors from the noise that surrounds them.

They must have at least the same sound insulation as the surrounding walls. Normally these are metal doors filled with highly absorbent mineral wool.

EXAMPLES OF ACOUSTIC DOOR INSULATION

2 MM SMOOTH GALVANISED SHEET + 60 MM TECH SLAB MT 5.1 + PYL 15 MM + 2 MM SMOOTH SHEET																			ACOUSTIC REDUCTION	
80 mm acoustic panel	Freq (Hz)	100	125	160	200	250	315	400	500	630	800	1 K	1,25 K	1,6 K	2 K	2,5 K	3,15 K	4 K	5 K	R_W (db)	R_A (dBA)
	R (dB)	21.5	27.0	31.5	35.0	38.5	41.0	42.0	45.5	46.5	46.0	47.5	49.5	52.0	53.5	52.5	52.5	52.5	52.5	46(-1;4)	45.30



YOUR INSULATION SOLUTION

Trust our highly absorbent mineral wool slabs:

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A RANGE OF PRODUCTS DESIGNED FOR INDUSTRY ACOUSTICS

Choose from a comprehensive range of mineral wool and elastomeric foam solutions, trusted by customers around the world.

A RANGE OF PRODUCTS DESIGNED FOR INDUSTRY ACOUSTIACS

Choose from a wide range of mineral wool and elastomeric foam solutions suitable for acoustic applications in industry

Whatever your precise acoustic needs, whatever industrial applications you need to insulate against noise, Saint-Gobain Technical Insulation offers you the widest range of acoustic insulation solutions on the market, with optimised solutions in mineral wool and elastomeric foam.

Our products have been tested against all the most relevant acoustic parameters such as air flow resistivity, sound absorption, dynamic stiffness and open porosity.

To help you better model your industrial installations and choose the best sound insulation solution for each application, we indicate these values on the technical data sheets of most of our solutions.

Example:

product	AFR (σ)	Sound absorption (α)													
	(kPa·s/m²)	(αw medium)		(αp 125 Hz)		(αp 250 Hz)		(αp 500 Hz)		(αp 1,000 Hz)		(αp 2,000 Hz)		(αp 4,000 Hz)	
		50 mm	100 mm	50 mm	100 mm	50 mm	100 mm	50 mm	100 mm	50 mm	100 mm	50 mm	100 mm	50 mm	100 mm
TECH SLAB HT 6.1	Afr > 90	0.9	0.9	0.2	0.66	0.84	0.69	0.81	0.82	0.9	0.95	0.98	1.02	1.05	1.09
TECH SLAB MT 4.1	Afr > 40	1	-	0.26	-	0.87	-	1.06	-	1.04	-	1.05	-	1.12	-
TECH SLAB MT 5.1	Afr > 50	1	1	0.28	0.74	0.90	0.93	1.01	0.92	1.01	1.01	1.05	1.06	1.11	1.15
TECH WIRED MAT MT 3.1	Afr > 25	1	1	0.34	0.89	0.95	0.98	1.16	1.02	1.11	1.08	1.10	1.06	1.12	1.08
TECH WIRED MAT MT 4.1	Afr > 25	1	1	0.28	0.72	0.93	1.07	1.09	1.03	1.07	1.11	1.08	1.06	1.08	1.09
TECH WIRED MAT MT 5.1	Afr > 50	1	1	0.41	0.76	0.97	0.90	1.03	0.99	1.03	1.06	1.05	1.08	1.10	1.11
TECH WIRED MAT MT 6.1	Afr > 65	0.95	1	0.19	0.73	0.87	0.80	0.86	0.90	0.93	0.98	0.98	1.05	1.09	1.13
U TECH SLAB 2.0	Afr > 10	1	1	0.17	0.57	0.80	1.19	1.03	1.13	1.08	1.07	1.08	1.06	1.10	1.11
U TECH SLAB MT 3.1	Afr > 20	1	1	0.18	0.70	0.82	1.15	1.09	1.09	1.07	1.09	1.02	1.05	1.09	1.11
U TECH WIRED MAT MT 4.0	Afr > 30	1	1	0.24	0.86	0.94	1.05	1.15	1.01	1.08	1.03	1.04	1.07	1.09	1.10
U TECH WIRED MAT MT 5.0	Afr > 40	1	1	0.35	0.88	1.01	1.00	1.07	0.97	1.02	1.04	1.06	1.05	1.09	1.08
U TECH WIRED MAT MT 6.0	Afr > 50	1	1	0.44	0.87	1.11	0.91	1.01	0.99	1.01	1.03	1.05	1.02	1.09	1.08

These values come from laboratory tests under certain given conditions. Real life conditions may differ due to various ambient and operational factors. These values are therefore indicative and should only be used as a guide for estimation purposes. ISOVER takes no responsibility in the case of not achieving the required acoustical performance.
Tests available upon request.

FOR MORE INFORMATION, DOWNLOAD THE TECHNICAL DATA SHEETS FROM OUR WEBSITE.

REGULATIONS IN FORCE

Find out more about the most important regulations applicable in industrial acoustics.

Relevant REGULATIONS

The acoustic environment has an impact on several areas of the quality of the workspace:

- Health (risk of hearing problems, even deafness)
- Safety (communication problems and detection of danger signals)
- Acoustic comfort (the noisy environment being more or less uncomfortable)

As part of the application of European Directive 89/391 / EEC of 12 June 1989 on the implementation of measures to promote the improvement of the safety and health of workers at work, the European Union has adopted a new directive for the protection of workers against noise:

- Directive 2003/10/EC of the European Parliament and of the Council of 6 February 2003 concerning the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (noise).

European directives set the minimum health and safety conditions to be taken into account for workers exposed to noise at their workplace. In other words, European member states can apply these conditions as such or adopt more stringent requirements.

Directive 2003/10/EC provides a detailed description of the obligations of the employer, the worker and the Member States, with a view to protection against noise at work.

The best way to do this is to act at the source of the noise.

The requirements of the European directive are based on a set of values:
- on the one hand, the exposure values triggering the action, i.e. from which certain procedures or protective measures must be implemented,
- on the other hand, the exposure limit values which must never be exceeded.

As in most industrialised countries, noise regulations stipulate three stages of control over noise exposure limits in the workplace. These relate to the average noise exposure levels of employees during a specific working day or week as well as the maximum noise to which employees are allowed to be exposed during a working day.

- Lower Exposure Action Values: LAeq,T > 80 dB(A) or Lpeak > 135 dB(C)
- Upper Exposure Action Values: LAeq,T > 85 dB(A) or Lpeak > 137 dB(C)
- Exposure Limit Values: LAeq,T > 87 dB(A) or Lpeak > 140 dB(C)

Where LAeq,T is the A-weighted Leq (equivalent continuous sound level) over the time period T and Lpeak is the Peak exposure value.

Both the Upper and Lower Action Values relate to noise levels throughout the workplace without taking the effect of Hearing Protective Devices (HPDs) into account while the Exposure Limit Values do take the effect of HPDs into account.

Exceeding each level involves a series of actions to be taken as shown below:

	LOWER EXPOSURE ACTION VALUES	UPPER EXPOSURE ACTION VALUES	EXPOSURE LIMIT VALUES
	LAEQ,T > 80 DB(A) OR LPEAK > 135 DB(C)	LAEQ,T > 85 DB(A) OR LPEAK > 137 DB(C)	LAEQ,T > 87 DB(A) OR LPEAK > 140 DB(C)
HEALTH ASSESSMENT	Triennial	Annual	Annual
TRAINING AND INFORMATION	Yes	Yes	Yes
HEALTH MONITORING: PREVENTIVE ACOUSTIC CONTROL	On a five-yearly basis as a minimum	On a three-yearly basis as a minimum	On a three-yearly basis as a minimum
HEARING PROTECTION EQUIPMENT	Available. Its use being optional	Mandatory provision and use	Mandatory provision and use
SIGNPOSTING	Recommended	Mandatory	Mandatory
DEVELOPMENT AND IMPLEMENTATION OF A SCHEDULE OF TECHNICAL AND/OR ORGANISATIONAL MEASURES	Recommended	Mandatory	Mandatory

Here is the list of the most commonly used acoustic regulations in industrial environments:

- ISO 532. Acoustics. Methods for calculating loudness
- ISO 5135. Acoustics. Determination of the acoustic power levels of noise emitted by air outlets, output units, regulators, and valves by means of measurement in a reverberant room
- ISO 7235. Acoustics. Laboratory measurement procedure for ducted silencers and air-terminal silencer units. Insertion loss, noise flow, and total pressure loss
- ISO 9612. Acoustics. Determination of noise exposure in the workplace. Engineering method.
- ISO/TR 3352. Acoustics. Assessment of noise with respect to its effect on the intelligibility of speech
- ISO 8201. Audible emergency evacuation signals
- ISO 9921. Ergonomics. Assessment of speech communication
- ISO 11546-1. Acoustics Determination of sound insulation performances of enclosures — Part 1: Measurements under laboratory conditions (for declaration purposes)
- ISO 11546-2. Acoustics. Determination of sound insulation performances of enclosures — Part 2: Measurements in situ (for acceptance and verification purposes)
- ISO 11688-2. Acoustics. Best practices for the design of low-noise machinery and equipment. Part 2: Introduction to the physics of low-noise level design
- ISO 11689. Acoustics. Procedure for comparing sound emission data of machinery and equipment
- ISO 11690-1. Acoustics. Recommended practice for the design of low-noise workplaces containing machinery. Part 1: Noise control strategies
- ISO 11690-2. Acoustics. Recommended practice for the design of low-noise workstations containing machinery. Part 2: Noise control measures
- ISO 11690-3. Acoustics. Recommended practice for the design of low-noise workplaces containing machinery. Part 3: Sound propagation and noise prediction in workplaces
- ISO 11820. Acoustics. Measurements on silencers in situ
- ISO 11957. Acoustics. Determination of acoustic insulation characteristics of cabins. Laboratory and on-site measurements
- ISO 11961. Acoustics. Measurement of insertion loss of ducted silencers without flow — Laboratory survey method
- ISO 14163. Acoustics. Guidelines for noise control by means of silencers
- ISO 14257. Acoustics. Parametric measurement and description of spatial sound distribution curves in workplaces to evaluate acoustic behaviour
- ISO 15665. Acoustics. Acoustic insulation for pipes, valves, and flanges
- ISO 15667. Acoustics. Guidelines for noise control by means of enclosures and cabins

ABOUT US

Discover the Saint-Gobain Group,
and read more about
Saint-Gobain Technical Insulation,
the world-leading supplier
of sustainable insulation solutions.

MAKING THE WORLD A BETTER HOME

Saint-Gobain designs, manufactures and distributes solutions for the construction, mobility, healthcare and other industrial application markets. Developed through a continuous innovation process, they provide wellbeing, performance and safety while addressing the challenges of sustainable construction, resource efficiency and the fight against climate change.

This strategy of responsible growth is guided by the Saint-Gobain purpose, “MAKING THE WORLD A BETTER HOME”, which responds to the shared ambition of the women and men in the Group to act every day to make the world a more beautiful and sustainable place to live in.

SAINT-GOBAIN

Aligned with this commitment, Saint-Gobain Technical Insulation has been delivering sustainable insulation solutions to customers since 1937. Across all technical markets - from Marine to Industry, HVAC, automotive and household appliances - and with a worldwide presence deployed locally, we support our customers at every step of the project, from design to installation. This means customising our approach based on specific needs. This means adding value through high levels of comfort, health, safety and performance. This also means helping limit environmental impact of each project, while managing costs.

With expertise in an array of insulation materials, we are constantly pushing the limits of our solutions. These unwavering R&D efforts also enable us to reduce the carbon footprint of each product, whether through high levels of recycled content, recyclability or lower energy consumption.

Drawing on a unique combination of global resources, local deployment and multi-material expertise, Saint-Gobain Technical Insulation strives to always be more efficient and responsible. Together with our customers, we are making this an everyday reality.

Saint-Gobain Technical Insulation

PUSHING THE LIMITS OF SUSTAINABILITY TOGETHER.

INSULATE AND DECARBONISE THE INDUSTRY

Climate change affects all countries on all continents. It disrupts national economies and affects lives. Weather conditions are changing, sea levels are rising and weather events are becoming more and more extreme.

This is why the transition to a climate neutral society is an urgent challenge. But if it is a challenge, it is at the same time an opportunity to build a better future for all.

In this context, the European Union has set itself two ambitious objectives:
- **reduce greenhouse gas emissions by at least 55% by 2030**
- **be climate neutral by 2050, with zero net CO_2 emissions.**

And the decarbonisation of the industry is one of the major challenges to achieve this goal.

INSULATION IS A COST-EFFECTIVE SOLUTION TO ADDRESS THIS TARGET.

Improving the thermal insulation of industrial installations directly leads to energy savings and the reduction of CO_2 emissions. But the full potential of this is currently still untapped.

The level of energy efficiency of many industrial plants is relatively low. Existing insulation systems are most often limited only to safety requirements to maintain surface temperatures below 55° C. In addition, many plants are aging and in urgent need of insulation repair.

THE SAVINGS POTENTIAL FOR EU 27 IS EQUIVALENT TO THE ANNUAL ENERGY CONSUMPTION OF:

MORE THAN **10 MILLION HOUSEHOLDS**

OR

MORE THAN **20 MILLION CARS**

Calculation based on the national average energy consumption provided by the Odyssee-Mure EU project www.odyssee-mure.eu

SAINT-GOBAIN IS A MEMBER OF EiiF.

ISOVER is one of the Founding Partners of EiiF, a neutral, non-profit institution, which promotes insulation as a primary method to improve sustainability and profitability. Since its creation in 2009, EiiF has established itself as a resource for industries that need to reduce CO_2 emissions and save energy.

EiiF provides facts and figures and publishes reports, fact sheets and studies showing that the saving potential of industrial insulation is great and exists in all regions and sectors.

DISCOVER THE EiiF 2021 STUDY «THE INSULATION CONTRIBUTION TO DECARBONISE INDUSTRY».

SAINT-GOBAIN

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Graphic design : Délicate Essence 2021 0142723676