

Forma 5

ACOUSTIC INSULATION

The importance of
creating the correct
acoustic environment



What is noise?

Human beings pick up sound vibration through the air, or by other means.

This vibration has a mechanical effect on the ear drum which transmits information to the brain, where it can be processed and interpreted.

Therefore, sound becomes an objective perception for us, but **what is noise?**

When talking about **noise**, we refer to an unwanted sound, which produces a feeling of discomfort when perceived. This perception and interpretation as unwanted or unpleasant is, therefore, **completely subjective** and it depends on the conditions of each individual to determine what is noise and what is not.



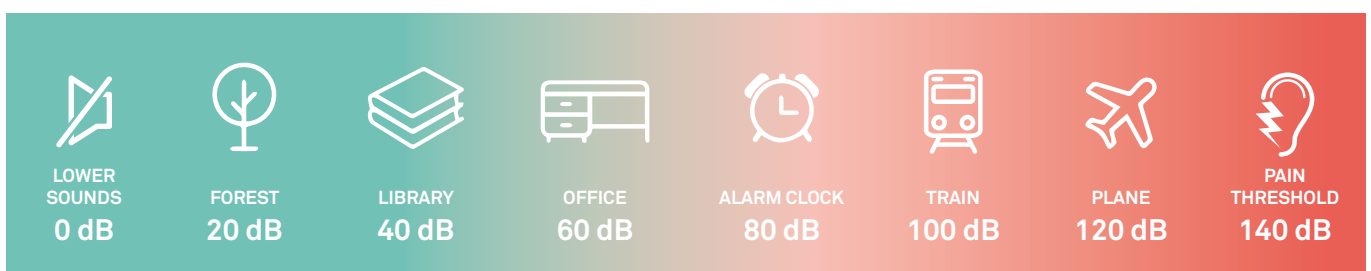
All noises are sound, but not all sounds are noise

The quality of sound is measured in its height, timbre, duration and intensity. The intensity being the quality at which we are interested in focusing. Intensity affects the rest and determines how an individual perceives undesired sound.

Intensity is the power at which a sound is emitted, being able to measure on a scale from weak to strong, using the decibel as the unit of measurement.

A decibel scale **between 0 dB and 140 dB** is the established range that human beings can perceive sound. A human cannot perceive sound lower than 0 dB. This is called the **auditory threshold**. Above 140 dB is referred to as the **pain threshold**. Anything above 140 dB could stimulate a sensation of pain in an individual. Again this could take the form of a subjective perception and must only be regarded as a standard level.

A sound greater than 60 dB could be considered loud (and, therefore, unpleasant or unwanted).

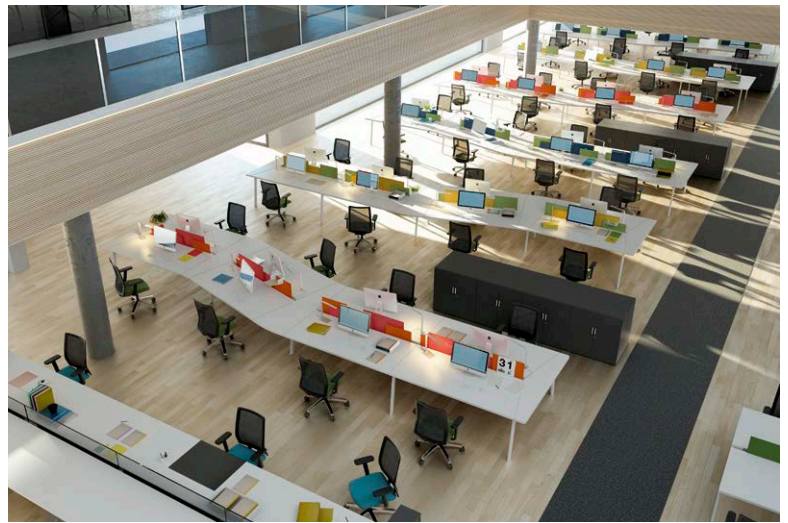


What produces noise in today's office?

Noise at the office is a complex issue and can come from many different sources.

*On the assumption that external sound does not affect, or minimally affect, the work undertaken in any given Facility; it must be other internal factors that 'disturb the peace' such as adjoining offices, movement or manufacture of materials. Realistically, however, it is **the human factor** and **the technological factor** which is going to have the strongest influence on ambient sound within the office environment.*

The modern office promotes flexible and Dynamic communication between its employees. This is the concept of the **Open Office**. Offices "without barriers" where their workers move freely from one job to another, favoring transparency and a more direct flow of communication. The economic factor has also contributed a lot to the growing development of this type of office, since these spaces with fewer and fewer limitations make the costs of build much cheaper.



Office in open space with a configuration of jobs with benches.

*The problem is that it is this free flow of communication and interaction that has greatly increased the creation of noise. It is not easy to develop a task when one can clearly hear the conversation of a partner, especially if the work requires a high **concentration** level.*

This factor is increased with the progressive reduction of cellular work spaces that, in addition, leads to a parallel increase in the number of workers within the open plan, leading to greater bustle in work environments where group activities or Different work teams are increasingly clashing.



What produces noise in today's office?

*It is also important to bear in mind that, in a world where telecommunications are becoming easier and cheaper, and where companies often seek international markets to do business, it is logical that **telephone conversations** and **teleconferences** are a constant within the atmosphere at work and, therefore, coupled with conventional conversations, the spaces are not really designed for purpose.*



We must also analyze the issue of “white noise” and its progressive disappearance. Previously, constant low-intensity noise such as engine noise from ventilation equipment or the humming of old computers provided these frequencies, which served to mask conversations that can be seen in a silent office, making them unintelligible and, at the same time, time, providing a non-annoying ambient sound that favored concentration. Currently, the development of new technologies and their applications also for domestic use have favored a **“culture of silence”**, but **this is not beneficial for office work**, as we have said.

Problems associated with noise



Continuous exposure to unwanted noise can **seriously affect** the health of a worker in terms of being able to fulfill their task and therefore subsequently **affecting the productivity of the company**.

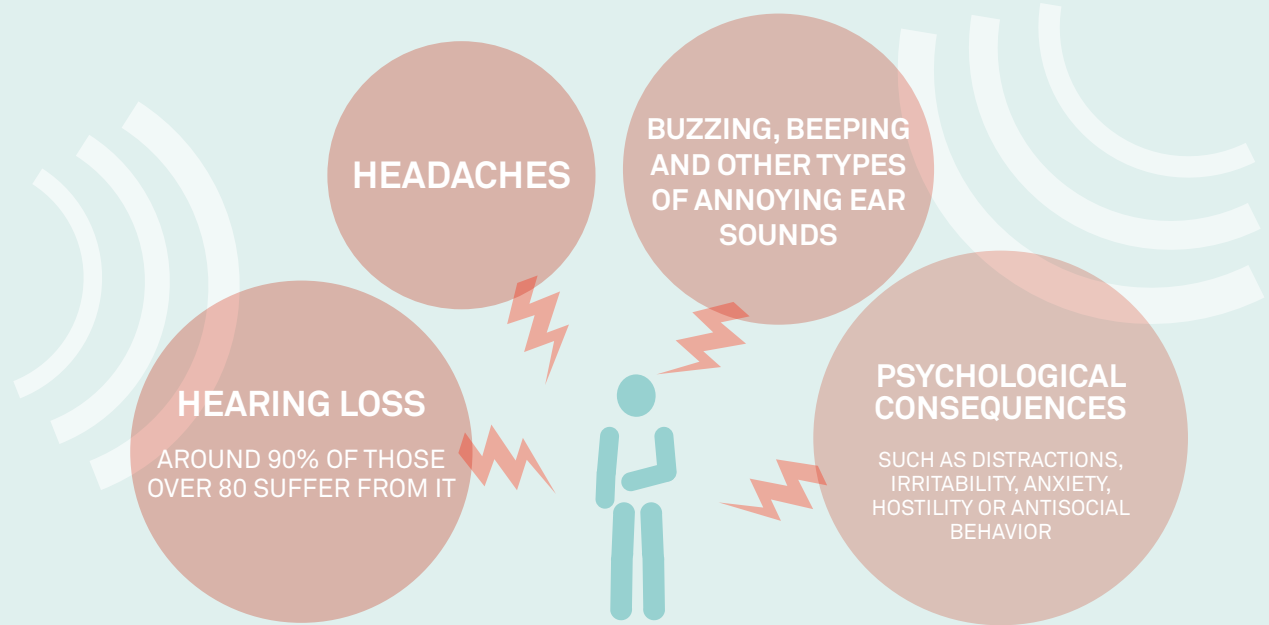
Hearing problems within a work area is an, ironically, silent problem: it is not common for employees to notice the gradual deterioration of auditory perception, due to the direct influence of specific, intense and boisterous environments.

In the same way, the managers of the companies rarely realize the importance of this **potential problem** and the repercussions that it can have for the productive development of the activity of the company.

A space must be comfortable to be productive.
Noise is one of the main factors that impede productivity.

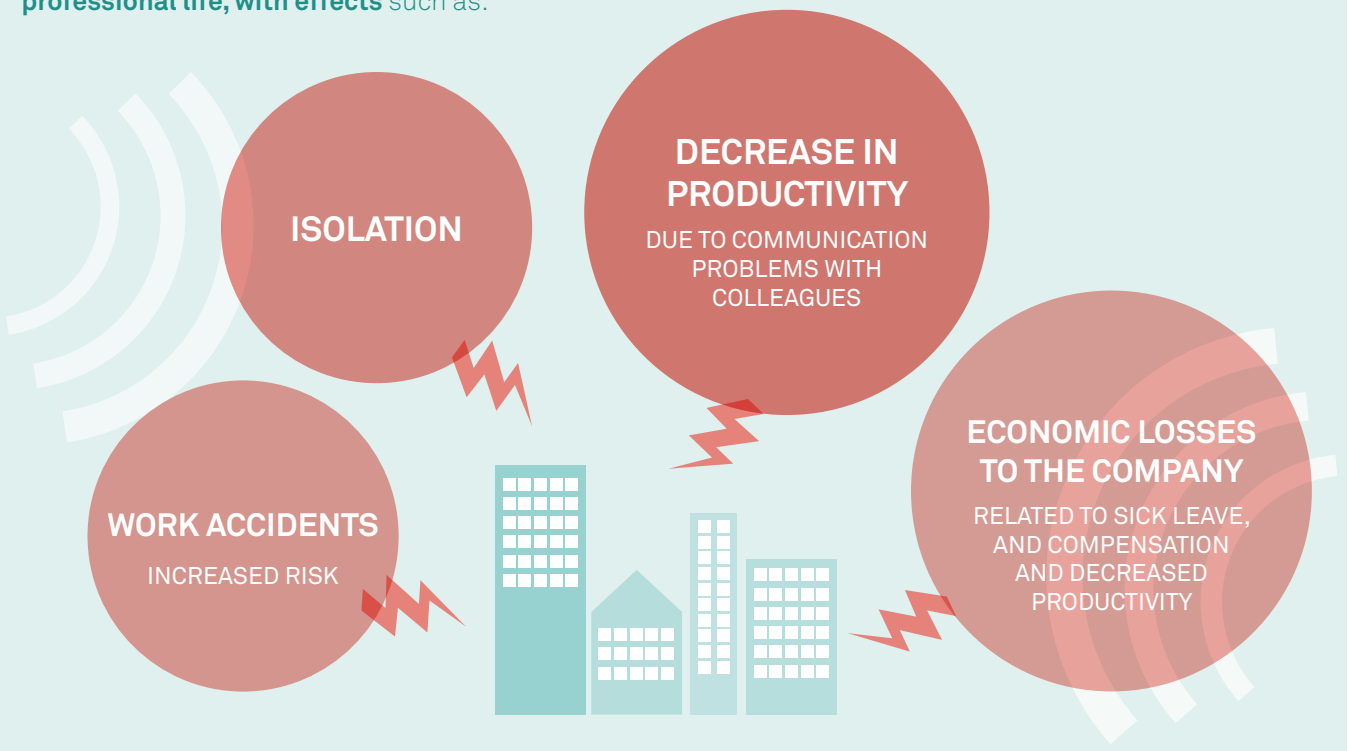
Problems associated with noise

Constant exposure to sources of unwanted sounds can create, in the first place, **direct effects on employee health**, such as:



It should be noted that the biggest problem that occurs in any work space is **the level of stress** of the employee, which can be significantly increased by the noise level in an office. This stress can lead to **serious health problems**: high blood pressure, heart problems, respiratory diseases, poor development of the fetus, ulcers, insomnia ...

These problems of physical and psychological health impact fully on **the development of a person's professional life, with effects** such as:



Create a noise-free environment

Although experts in acoustics warn us that noise within a work environment does not have a definitive solution, but is **a responsibility that must be constantly analyzed and reviewed**, it is essential to **reduce the risk factors** that noise can create to provide the members of the company with a comfortable working environment.



Conditioning a workspace to avoid harmful noises that interfere with the activity is not an easy task, and it must be considered at the design stage of the workplace.

Create a noise-free space

There is a necessity to do some intelligent structuring especially when there is limitation in the workspace in order to provide an adequate atmosphere conducive to productive working.

The distribution of the differing workspaces is crucial from the start and to formulate how they will develop.

When considering the space available; **it must be designed around whom is going to use it and for what purpose**, both individually and collectively. The possibilities are endless and they are directly related to the space available.

Acoustic conditioning of the infrastructure within the facility can provide support in minimizing the unwanted effects of interior sounds. Though in this solution, costs are usually less accepted, due to the little versatility it offers. **The selection of suitable equipment, made with the best materials to absorb or repel noise, is usually a more practical and a smarter solution.**

Another interesting solution is the so-called **“Sound Masking Systems”**: sound equipment strategically placed in places in the office to reproduce an optimal “ambient sound” to disguise the conversations of others and unwanted sounds. This solution is increasingly on the rise in today’s companies and helps combat the effects of a noisy workspace.

Our contribution

Forma 5 offer interesting solutions from the point of view of furnishing an office, with different ranges of products oriented to certain functions within the facility.

The right acoustics for a productive office

According to everything we have seen, the most productive office acoustically is one in which **employees feel comfortable**, without their work being affected or interrupted by annoying sounds.

Potential acoustic problems must be **anticipated from the beginning**, with a studied layout of workspaces and positions, clearly defined according to functions and orientation. The design should account for these in the appropriate way. Likewise, there must be **a careful selection of furniture and materials**, to satisfy the varying activities.

When an Office is designed correctly, space becomes a powerful business tool. However, if the design fails, and the acoustics are poor, this will affect productivity significantly.

In an Open Office work environment, where interactivity and communication is a constant, it is also essential to give a prior **orientation of the worker to raise awareness**. It is important to respect a series of internal policies that highlight the need for a respectful work environment so as not to invade the privacy of a neighbour or colleague.

However, as we have seen, experts in acoustics say that a “sepulchral” silence is neither desirable nor beneficial: the conversations of others become intelligible and distract from the task itself, sporadic intense sounds — falling objects, slamming doors, etc. — They stand out and can alarm the workers. In addition, a complete silence usually causes an oppressive and tense environment, which can induce a level of stress sometimes greater than that of a noisy office.

Emphasis on the acoustic quality of a work space, reducing noise and promoting a clean sound atmosphere, is backing quality in the work and the welfare of the employee, it is to save costs derived from the problems produced, it is to increase the benefits derived from the best performance. It is, ultimately, to increase the productivity of the company. It is an intelligent bet.

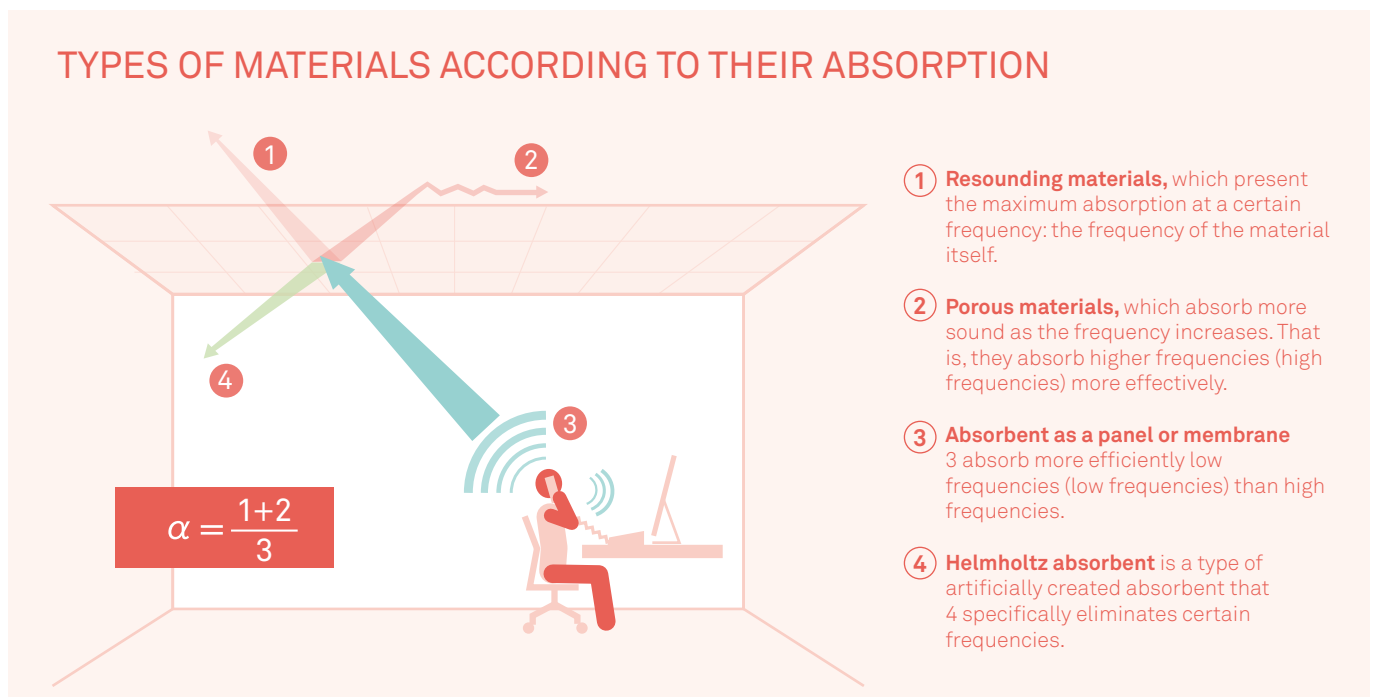


What is the acoustic insulation?

The acoustic insulation or acoustic absorption is the property that all materials have to absorb acoustic energy, allowing only a part of it to be reflected. So we can say that the acoustic absorption is **greater when the reflected sound is less**.

In practice, we can experiment with acoustic absorption if we compare two materials such as marble and a thick curtain. If we speak in front of a marble wall we hear how our sounds become longer. And if we place a curtain over it, we will hear how our sounds are “deafened”, that is, they get shorter.

We are comparing two materials with two different types of surfaces and, therefore, have different degrees of absorption. The absorption depends on the degree of porosity of the surface of the material. The pores cause the sound energy to be “trapped” in them with multiple reflections. Within the pore, this energy is converted into heat energy due to the friction of the energy with the pore limits as it bounces inside, and this energy dissipates. If we look at the marble, we see that it has no pores, so that most of the sound emitted towards it is reflected, however, as textiles are rough, with multiple braids and small cavities, the sound is trapped in them, that is to say ‘absorbed’.



When a sound wave reaches a surface, most of its energy is reflected, but a percentage of it is absorbed by the new medium. **All means absorb a percentage of sound they propagate.**

Acco absorption, it is important to take into consideration:

- The **absorption coefficient** that indicates the amount of sound that a surface absorbs in relation to the incident.
- The **critical frequency** is the frequency from which a rigid wall begins to absorb part of the energy of the incident waves.

Product solutions from Forma 5

Faced with the growing need for comfortable, acoustically efficient solutions within the office space Forma 5 have developed solutions that offer real value to the user.

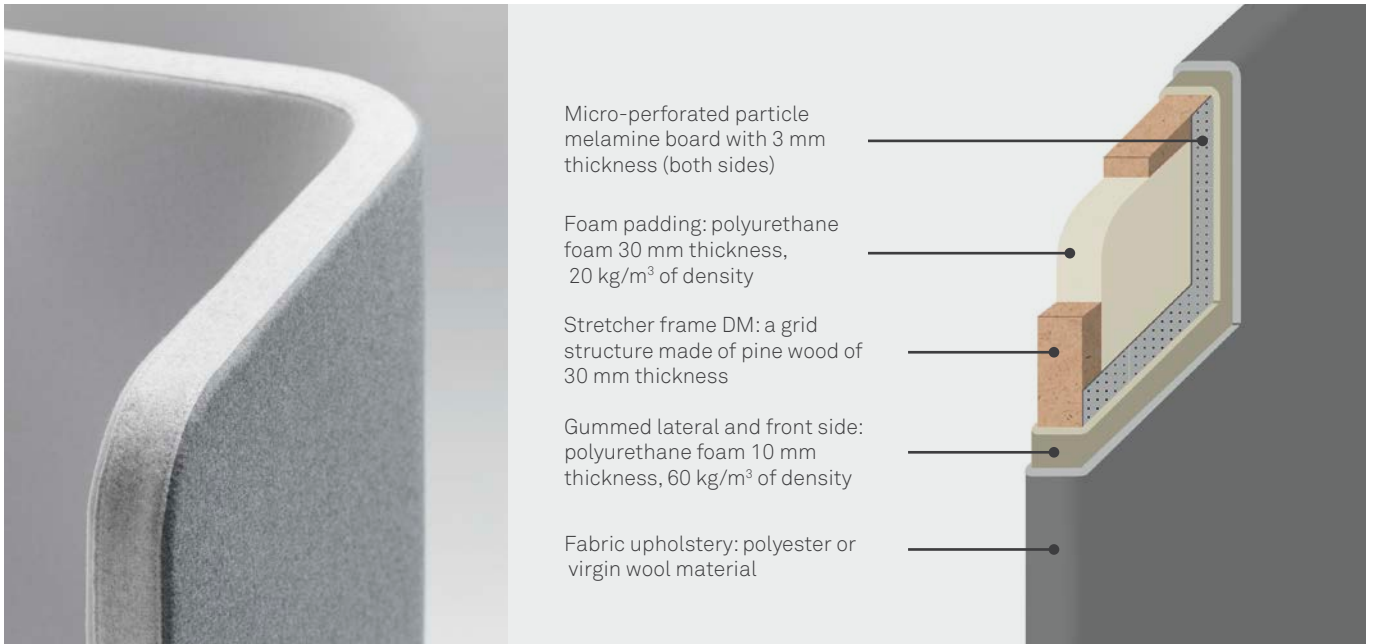
LET'S

The **Let's** programme provides a family of solutions; many including sound absorbing panels 8cm thick. These panels can be linked together to form microarchitectural spaces with a high design and acoustic function.

The different solutions of **Let's -Talk, Meet and Think-** provide the acoustic sound absorbing solutions that are so necessary in today's office, favoring the health of the users and their concentration and their productivity in the workplace. The materials are especially selected for their sound absorbing properties. They are then formed into different shaped panels which then create spaces that solve the most demanding of acoustic challenges.



Product solutions from Forma 5



Union between panels: the connecting pieces connect the panels in such a way that there is no gap between them and allow the sound of the exterior and the interior of the assembly to be isolated to a greater extent.



Additional seat-back modules: The modules that go in the Let's series next to the panels are constructed with polyurethane foams of different densities and subsequently upholstered in polyester or virgin wool fabrics, which adds to generate greater sound absorption of the whole.

CUBICLES: PSYCHOLOGICAL EFFECT

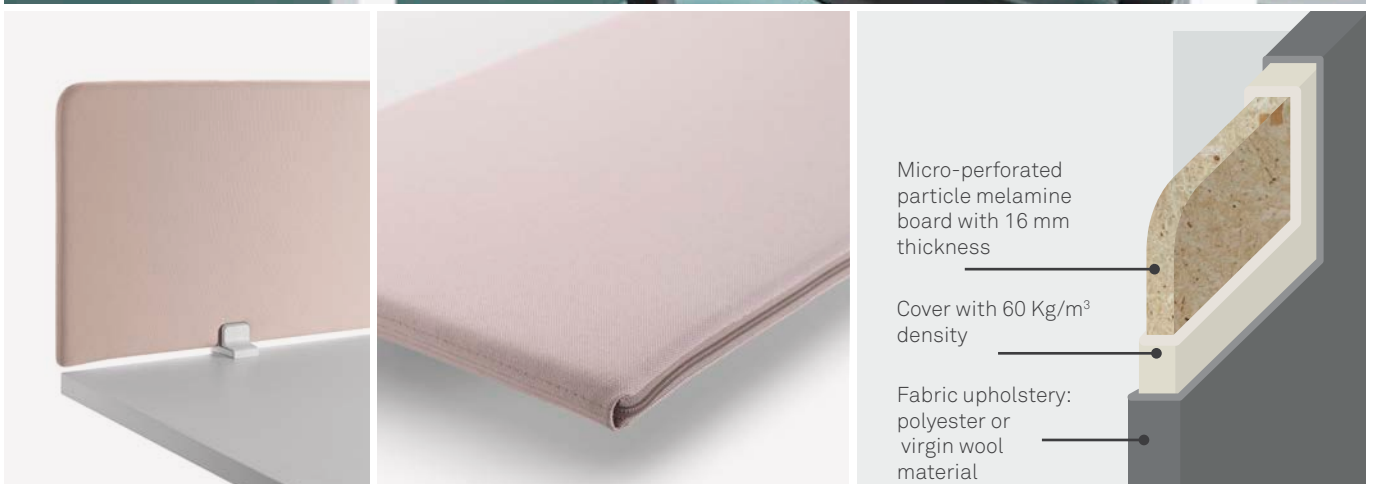
In addition, there is a psychological effect when a user tends to lower his/her voice when entering a closed space. In this way, in addition to the sound-absorbing capabilities of the elements of the set, the user helps create a good acoustic climate by modulating their voice; by adapting the sound intensity to the space in which they are located.

ACOUSTIC DESK SCREEN

These screens have an internal structure of melamine sheathed in high density foam and then upholstered. This structure reduces the noise within the environment at medium and high frequencies, achieving a better acoustic comfort. These acoustic screens are gentle on the eye with their soft rounded corner design. They can be installed to any single table or bench configuration.

TECHNICAL FEATURES

16 mm thick particleboard base covered with a 5 mm thick foam cover with 60 Kg/m³ density and upholstered on both sides. Double perimeter seam. Fixing to the structure of the desk by specific fittings.



Functionality: Acoustic insulation and concentration

Both expressions, “acoustic insulation” and “concentration” are closely linked, because the first is necessary to get the second.

An acoustically friendly space, with sound-absorbing elements, helps in a directly proportional way to maintain a climate of concentration in the workplace. It is the most creative tasks that require a greater degree of comfort in the workplace, because the necessary concentration must be high. As we have seen previously, we should not confuse a sound-absorbing space with a silent space, because what really should be prevented in a workspace is not sound, but noise.

In this way, the elements that help generate an acoustically pleasing space can be:

GEOMETRY AND ARCHITECTURE OF SPACE: CEILING HEIGHT, BUILDING MATERIALS, ACCESS

DISTRIBUTION OF AREAS ACCORDING TO TASKS

① MEETING ROOM ② COLLECTIVE SPACE ③ COLLABORATION SPACE
④ CONCENTRATION SPACE ⑤ TASK SPACE

ELEMENTS WITH MATERIALS OF SOUND ABSORBING PROPERTIES

Carpet

Acoustic panels

Upholstered furniture: chairs, desk screens

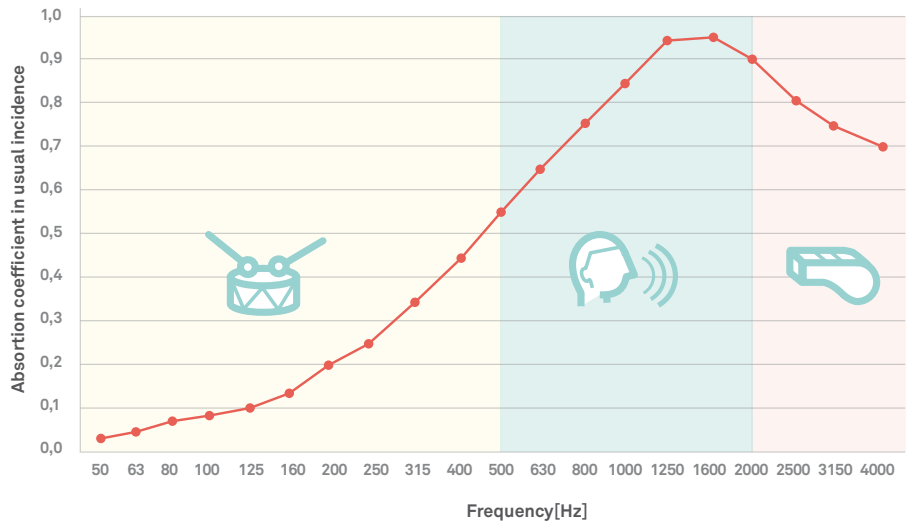
In addition to the above, **a culture of respect for concentration among the employees of the office is essential**, avoiding situations that break the sound harmony of the space.

Acoustic absorption coefficient

LET'S

Acoustic absorption coefficient - UNI EN ISO 1534-2

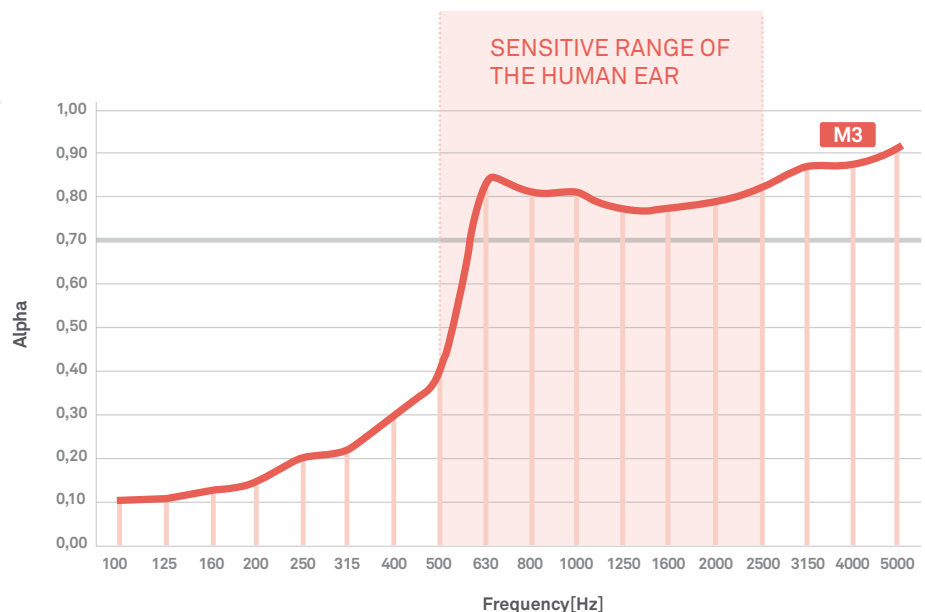
The materials behave differently depending on the frequency of the sound (see graphic). The human ear is not prepared to perceive very low or very high frequencies. In a usual environment, it is recommended that the degree of absorption of materials be between 500 and 2500 Hz, that is, within the range that the human ear can perceive.



Regarding office furniture, it is recommended that materials have their “ α ” as close as possible to 1 with a sound absorption capacity greater than 500 Hz. The red line in the graph above shows how Let’s panels starting at 500 Hz have an α greater than 0.7 and maintained between 0.7 and 0.8 within the range of 500 to 2500 Hz.

Normal incidence absorption coefficient by frequency (10534-2:2002) for prototype M3

These measuring instruments allow us to affirm that panels and meeting cabinets of Let’s, booth meet the noise-absorbing needs of an office space.



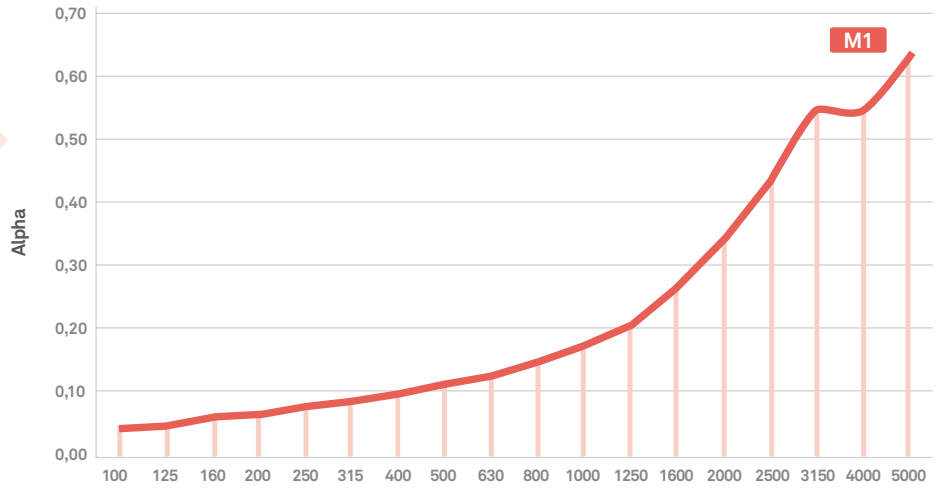
Values, in thirds of an octave, of the Normal Incidence Sound Absorption Coefficient for each tested sample.

f (Hz)	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000
Alpha M3	0,10	0,10	0,12	0,14	0,20	0,22	0,30	0,40	0,83	0,81	0,81	0,77	0,77	0,79	0,82	0,87	0,87	0,91

ACOUSTIC DESK SCREEN

Normal incidence absorption coefficient by frequency (10534-2:2002) for prototype M1

In a usual environment, it is recommended that the degree of absorption of materials be between 500 and 2500 Hz, that is, within the range that the human ear can perceive.



How acoustic absorption is tested: Kundt's Tube



UNE-EN ISO 10534-1:1998

Acoustic: determination of the acoustic absorption coefficient and the acoustic impedance in impedance tubes. Part 1, Stationary wave range method.

The Kundt's Tube is a device designed by August Kundt that allows us to visualize sound waves in a glass tube. At present, it is still used in different applications today as the measurement of the acoustic impedance of materials. A current Kundt's Tube consists of a tube with a metric scale to measure distances, with which you can study the standing waves generated inside. At one end of the tube

there is a microphone and a speaker, connected to a function generator, which emits sound waves at a certain frequency. At the other end, a movable piston slides inside the Kundt tube. The microphone picks up the existing sound level at the end where it is located.

The sound waves emitted by the loudspeaker (at a certain frequency) propagate through the tube until they reach the piston, where they are refracted and reflected. The reflected waves overlap with the incident waves resulting in interference and the phenomenon of "standing waves" inside the tube. Both the position where the speaker is and the position of the piston are closed ends, therefore a node of the stationary displacement wave will be formed in both.