Workplace acoustics

How to solve acoustic problems

Acoustic Comfort

Make your workplace more efficient

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acoustic comfort by screen solutions

Poor acoustics, what does it cost?

Are you aware that poor interior acoustic design adversely affects your organisation's ability to operate efficiently?

80% of most companies' overhead is employment costs.
Poor interior acoustics cause staff distractions and therefore loss of production. By adopting even small improvements to make your workspace more efficient, your business would generate **a significant return on investment**.

Where does your organisation sit on the scale below?

Number of employees	Annual employment cost *(London average no senior managers or directors)*	18.75% of time lost to distractions *(IPOS survey of 10,000 office workers)*	Return on investment if distractions reduced by 50%
50	£2,076,470	£389,338	**£194,669**
150	£6,229,411	£1,168,014	**£584,007**
350	£14,535,292	£2,725,367	**£1,362,683**
1,000	£41,529,408	£7,786,764	**£3,893,382**
2,000	£83,058,816	£15,573,528	**£7,786,764**

Studies show that noise is the number one problem to working effectively.

Do you often mis-hear conversations?

70% of workers said they could be more productive in a less noisy environment.

ASID study

Are you worried about confidentiality breaches?

72% of workers are dissatisfied with their speech privacy.

University of California at Berkeley study

Do you get distracted by vocal colleagues?

64% of office workers are interrupted up to 20 times a day.

Brother research

Aesthetically pleasing, but acoustically challenging!

80%
of most companies' overhead is employment costs

Life in the workplace has changed dramatically over the last 10 years and, with further advances in technology, it is not going to stop.

Circa 80% of most organisations' overhead is down to employment cost. Yet, we seem to concentrate more on how to fit the maximum amount of people into a building to reduce real estate cost and/or design the spaces to be as contemporary as we dare to impress our clients and attract and retain staff.

There is nothing wrong with these objectives, but if the acoustics are not considered within the interior design, the results will include the following:

- Increased noise disruptions for all
- Lack of speech clarity in all areas
- Breach of confidentiality
- Reduced levels of concentration of all staff
- Increased number of mistakes, some major
- Reduction in staff and business productivity
- Increased staff absenteeism
- Reduction in staff retention
- Increase in replacement staff recruitment and training costs

General arrangement drawing demonstrates high density floor plan

"We have found the sound masking so successful that we now actively advertise Acoustic Comfort to our customers."

John Horan, Head of Facilities,
Office Depot UK & Ireland

Most companies do not have the time or expertise to monitor the acoustic effects of the numerous elements of the design of the interior spaces. The effects can range from complicated areas, such as the mechanical and electrical services; IT infrastructure; communications; which furniture and wall finishes will be the most suitable for the various functions within the business, to name just a few.

The individual companies supplying these products and services employ trade specialists in their subjects to ensure the correct specifications in their area are designed to meet the business needs for today and the future.

But how many of these specialists have the time or inclination to understand the effect their design process will have on the acoustic landscape of the finished workspace? A negative result could have significant implications to the organisation's overhead costs.

10
years acoustic experience

It's not as simple as pricing from an acoustics product catalogue. One has to thoroughly understand the physics of the building; the staff's functions within the workspace; the business objectives and then decide which of the acoustic solutions should be applied.

For over ten years, the Acoustic Comfort Division of Screen Solutions has been assisting each of these disciplines, to look up from their designs and understand the implications of how they will affect the acoustic landscape of the staff occupying the spaces, with regard to their ability to effectively deliver the output required by their employer organisation.

The experience of the Acoustic Comfort team, and the software systems we have developed, enable us to quickly analyse how all the elements will affect the all-important acoustic landscape. For example, choice of interior construction materials, the amount of people and the nature of their activity in the working space.

How do we rectify interior acoustic problems?

Firstly, we break down each area of the noise issues into three categories:

A absorption

B block

C cover

This is commonly known as the '**ABC of Acoustics**'.

**The design and layout of a space is an important aspect of acoustic control but is often predefined by the client and is not always within our control.*

***For the purpose of this document we've ignored 'D', diffusion of sound.*

A Absorption

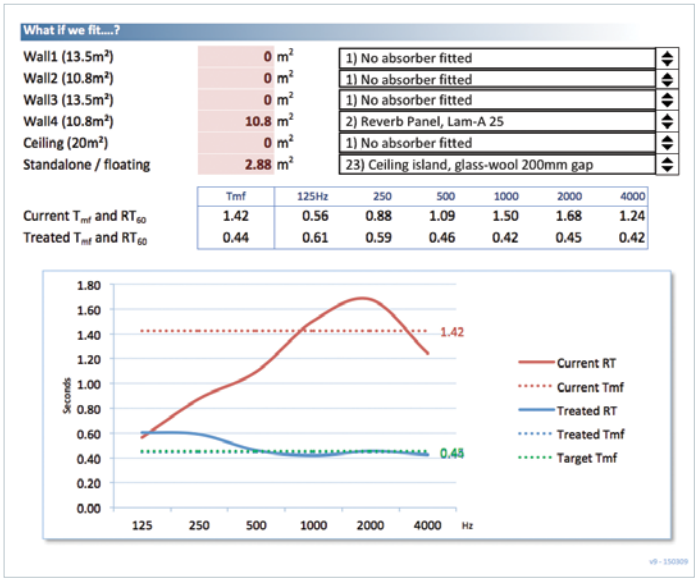
We research and understand which building materials and interior furniture, etc. that have been specified or, are already in place. These contribute to the absorption of sound energy likely to be created in the individual spaces. Office activities can differ greatly to one another. For example, a noisy Call Centre with constant telephone calls, or at the opposite end of the spectrum, a quiet Research Department with only the sound of keyboard strokes as staff concentrate on their computer screens.

Each space and activity has its own specific acoustic target which is calculated using our own software designed to measure the acoustic absorption required.

The diagram below displays one of the outputs from our reverberation calculator software.

The software allows us to measure the reverberation time of an existing space or planned design and then understand the effect of introducing different absorbing materials in various positions. This interactive process allows us to fine tune the ideal acoustic design of each room/space.

The next stage is to work with either our own designers or the client's to produce a scheme that works aesthetically for each space and the building architecture.



Reverberation Calculator software

The examples below demonstrate how the acoustic treatments mimic the building architecture and suite with the furniture.

Acoustic ceiling islands to suite with the lighting and furniture

Acoustic wall panelling printed to match the building brickwork

B Block

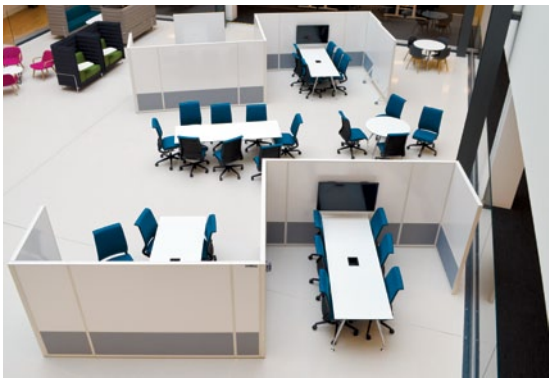
Represents the blocking of the sound energy that travels freely through the air.

Acoustic pods for private meetings

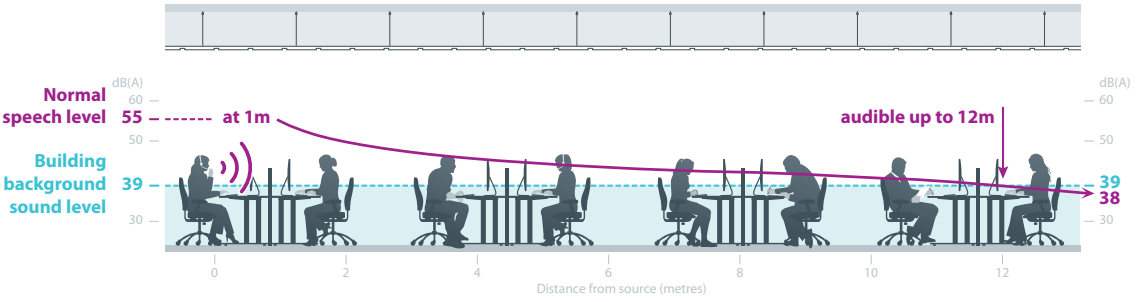
We examine the interior design to see what barriers are, or should be in place that will prevent the free travel of the sound energy across the entire space. If acoustic products have already been introduced into the designs, we then measure their attenuation levels and absorption coefficients for suitability for the purpose which they are intended. If they do not meet the standard required, we recommend the necessary adjustments to achieve the best acoustic environment.

If too few barriers are in the proposed layout, we work with the designer to sensitively introduce them, ensuring they have the correct acoustic properties.

Examples on the right show screens and pods used to block sound energy from travelling freely across the space.



Acoustic screen barriers to reduce sound propagation



The diagram above is an illustration showing our acoustic tests to measure how far conversations were intelligible in the open plan areas.

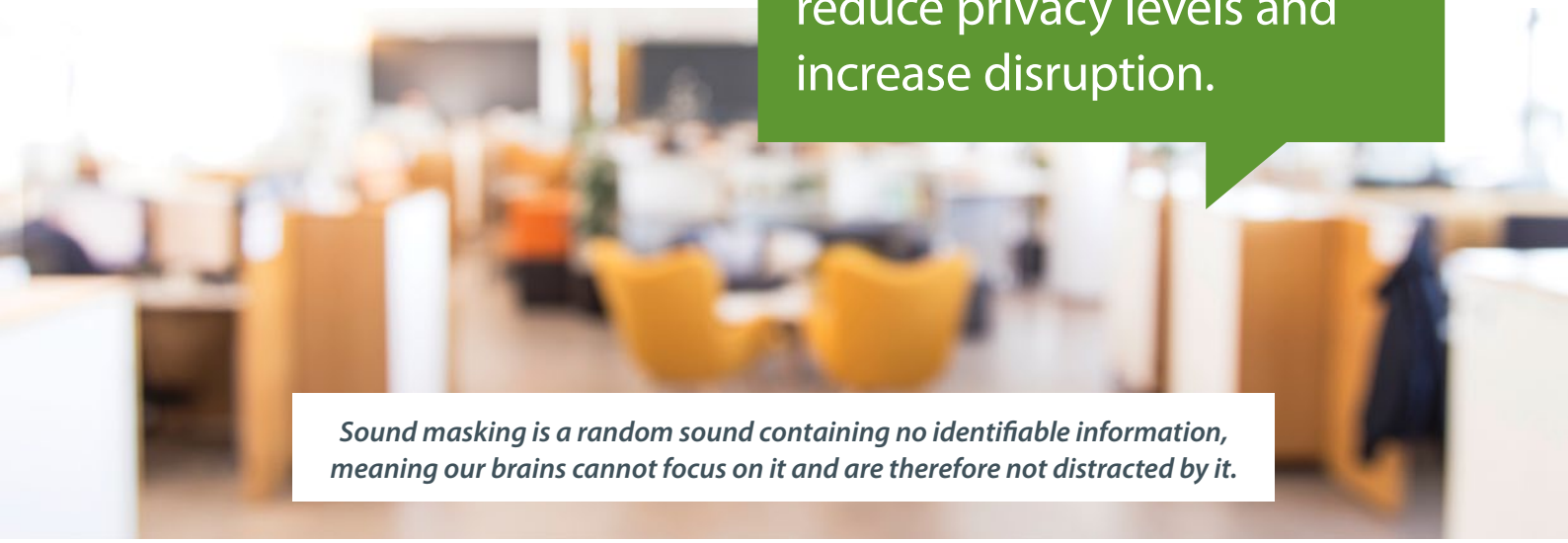
Displayed in the above site test, the existing workstation screens were designed too low to block the conversations from travelling freely across the space (1100mm high – below head height). The recommended height is 1400mm when seated.

The background sound level or 'noise floor' of the building was 38dBA (which is low) and meant that conversations were intelligible for up to 12m from the speaker (positioned at the far left in the illustration).

As the diagram demonstrates the speaker affects everyone within a 24m diameter circle.

C Cover

Quiet spaces significantly reduce privacy levels and increase disruption.



Sound masking is a random sound containing no identifiable information, meaning our brains cannot focus on it and are therefore not distracted by it.

This is the term used by the treatment employed to reduce unwanted conversation and other noises from disturbing the listener by 'covering' them up.

Until recently, the driver for setting the 'noise floor' of the open plan office building was the balancing of the heat, ventilation and air conditioning systems (HVAC) which are targeted at 35-38dBA. Unfortunately, this is the level you would expect in a library, where the large acoustic dynamic range results in any noise or conversation being heard over a long distance, nearly always distracting concentration.

The world's leading design and assessment method for sustainable buildings BREEAM, has now set targets for ambient noise levels within the office workplace:

- Small offices (single occupancy): 35-40 dBLaeq,T
- Medium offices (up to 4 people): 40-45 dBLaeq,T
- Large offices (open plan): 45-50 dBLaeq,T

Spaces that are quiet will be at risk of poor privacy levels and increased disruptions.

A new challenge is that many of today's buildings are being produced with chilled beams or naturally aspirated systems. These have no mechanical noise so reduce the 'noise floor' to 25dBA which, according to the specifications listed above, is nowhere near BREEAM's recommendations.

There is only one solution to this dilemma which is to add sound energy into the space to a level that is comfortable. This will 'cover' (mask) the unwanted sounds and has no recognisable pattern or information in it to distract you.

Let's explain

Covering or masking sound can be achieved by turning on a radio to mask unwanted sounds, but the radio features information, so it will also distract you. According to studies from Germany, you use 30% of your cognitive energy when listening to music with no lyrics. Therefore, anything containing information or a message is a 'no go' if you want your staff to concentrate and be productive.

Another example of masking can be explained with a dripping tap. At night a dripping tap becomes an irritant as an emerging sound creating a large acoustic dynamic range. During the day the dripping tap is masked by higher levels of ambient sound (masking) and therefore has a smaller dynamic range and becomes unnoticeable.

'Let's use White Noise or even Pink Noise' to solve the problem people say, but do they really mean White or Pink Noise – we hope not.

An essential characteristic of sound masking is that the sound must be truly random so that our brains cannot identify any pattern in it and hence be distracted. The sound pressure (volume) at each frequency must be precisely tuned to maximise the masking effect while at the same time minimising its intrusiveness. If the sound is not tuned correctly, it will be either less effective at masking unwanted noise or irritating.

White and pink noise explained

Sound masking is sometimes colloquially referred to as 'white noise'. The term 'white noise' is a theoretically pure way of expressing that the sound **pressure** is the same at each frequency across the audible spectrum. 'Pink noise' means that the sound **power** is the same at each frequency. Both white noise and pink noise are redundant as sources of sound masking. With the advent of new technology and precise tuning of each frequency an optimum sound masking spectrum will be achieved.

'Sound masking' is the correct term to use. There are numerous systems on the market, like most things in life some are very poor and ineffective whilst the high quality systems deliver excellent results . All systems require thorough investigation during the selection process.

There is a danger, in using one of the A, B or C treatments in isolation, of making your current acoustic landscape worse.

Let's look at a series of simplified diagrams showing how to manage a problematic workspace.

In Diagram 1, we can see the average sound level (Leq) is too loud. Also, the dynamic range (i.e. the difference between the lowest and the highest noise) is much too large. This makes the space too uncomfortable to work in.

1 No acoustic treatment

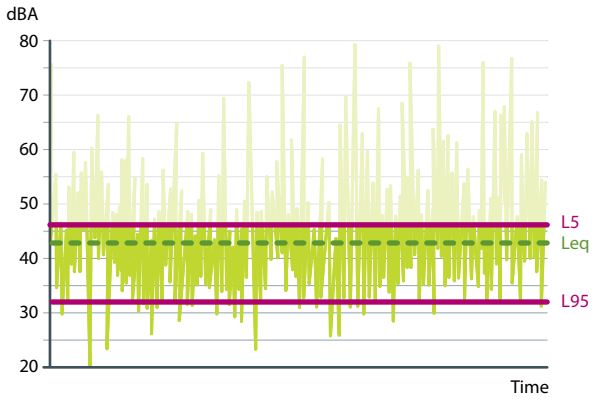
Diagram 1 illustrates the noise volume in dBA in a space with no acoustic treatment.

Leq = 52dBA, dynamic range = 14dBA
This is too loud, uncomfortable and offers poor privacy.

2 Absorbing material added

Diagram 2 illustrates the noise volume in dBA in the same space after absorbing materials have been introduced.

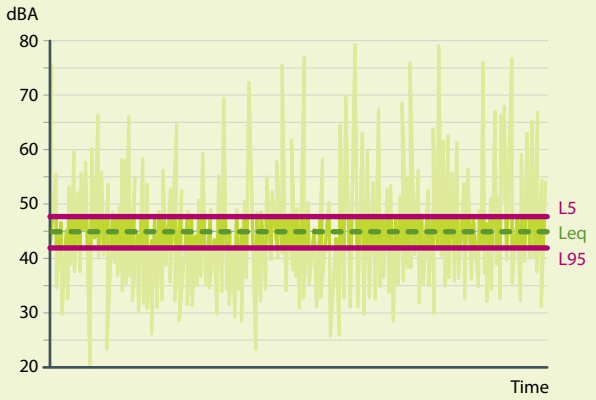
Leq = 43dBA, dynamic range = 14dBA
Absorption lowers the sound level (Leq) but the dynamic range stays the same and will interrupt staff as before.



3 Sound masking added

Diagram 3 illustrates the noise volume in dBA in the space with the introduction of the absorbing materials and sound masking.

Leq = 45dBA, dynamic range = 5dBA
Masking reduces the dynamic range, improving comfort and privacy.



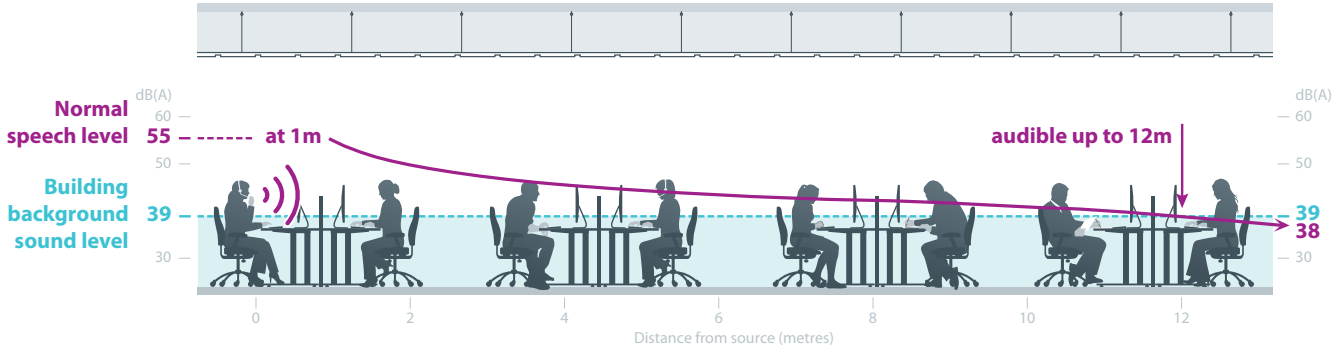
With the introduction of the absorbing materials to reduce the noise level and sound masking to reduce the dynamic range, the space is now comfortable to work in, which will allow the staff to concentrate and be more productive due to less interruptions.

Case study

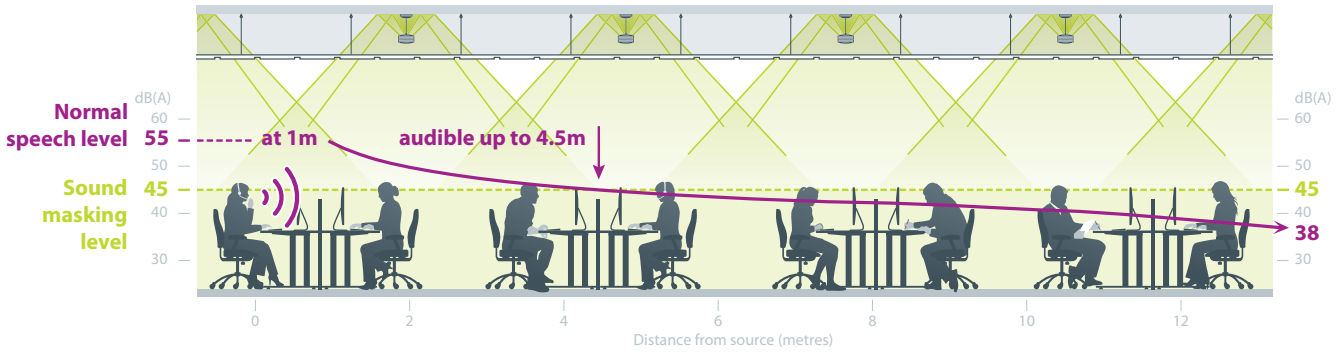
Intelligibility in the open plan

The following set of simplified diagrams illustrate our tests to measure the distance at which we can understand conversations in the open plan, and the levels of speech privacy in closed rooms.

1 **The diagram below demonstrates that the intelligibility distance from the speaker (on the left of the diagram) is 12m with no sound masking.**



2 **The diagram below is an illustration of our second acoustic test result, after sound masking is introduced, reducing the intelligibility to 4.5m.**



The conversation intelligibility has now reduced from 12m to 4.5m allowing staff to communicate with nearby colleagues without disturbing others outside the 4.5m distance.

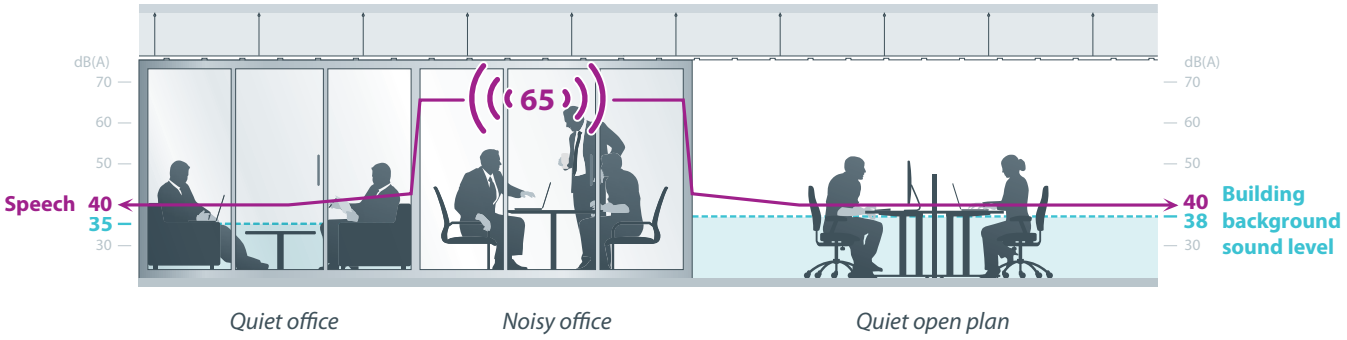
This has two effects on the space:

1. Staff are more productive due to fewer unnecessary interruptions.
2. Employees do not need to raise their voices to compete with the volume of the others already speaking (called the Lombard syndrome), which keeps the noise a constant, comfortable, level throughout the day.

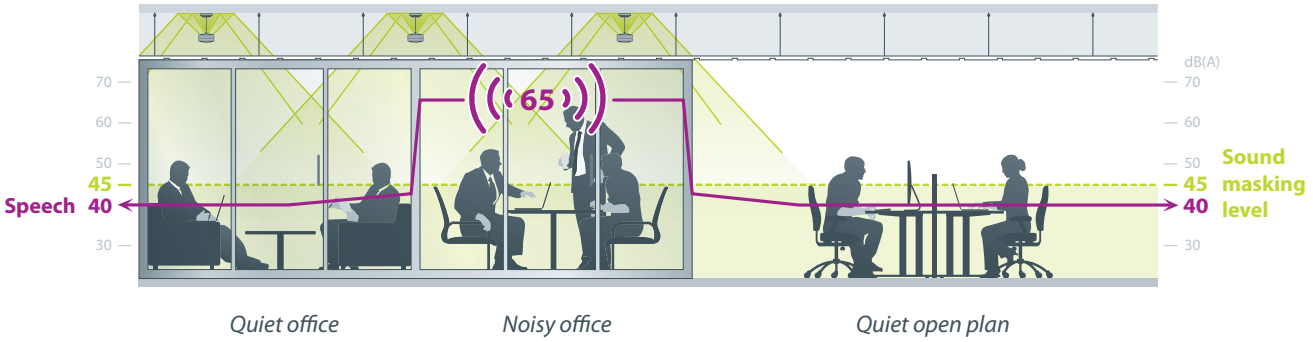
Case study

Speech privacy in closed rooms

1 **This diagram shows how the raised conversation in the noisy office is understood by those in the quiet office and the open plan area. This is due to the poor sound blocking of the partition system (25dBA), caused by leaks in the office structure.**



2 **The diagram below demonstrates the introduction of sound masking. Leaked conversation in the noisy office is covered up by the sound masking treatment, providing privacy and reducing distractions.**



Sound masking treatment of closed spaces guarantees confidentiality where needed, but also provides the user with greater flexibility of the closed spaces, as slab to slab construction required for speech privacy is often not necessary.

This in turn allows the organisation to adjust more easily to changing demands and, in the long term, reduces expensive dilapidation costs.

Sound masking systems

Buyer beware! Sound masking systems are available in differing specifications and levels of performance. The most sophisticated systems will deliver a significantly higher level of effectiveness through the quality of their design, hardware and software/firmware.

- Simple White and Pink Noise systems and those with sound generators that distribute the same signal to all the speakers or large zones of speakers cannot be finely tuned for individual speakers, zones and/or times of the day.

Network Hubs

- Low quality systems that lack tuning and volume functionality will be turned off, or the volume reduced, so as not to annoy the occupants.

Loudspeakers

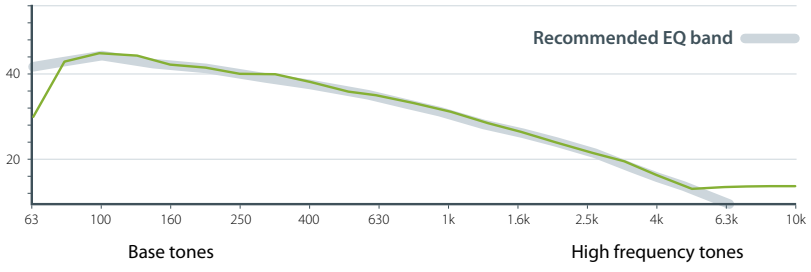
- The systems should have complete controllability to tune each hub and control its volume to + or - 0.5dBA. Adjustment for the equalisation of the frequency range to mimic the narrow band of our speech range is essential.

Control Panel

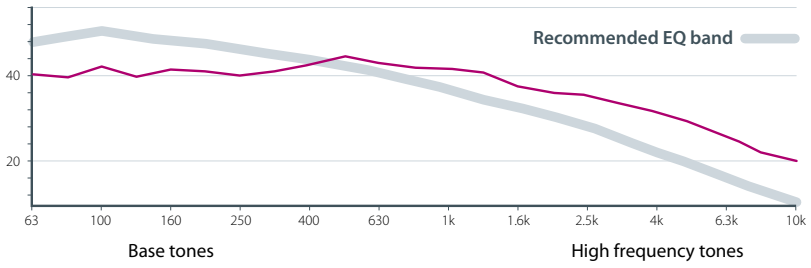
- Individual volume levels and frequency ranges of each speaker must be measured from the listener's location and not in the ceiling plenum from where the sound signals emanate.

The diagrams below depict the system used to tune to the desired frequency curve.

Sophisticated systems guarantee to hit the desired frequency curve



Undesired frequency curve results for basic systems like White and Pink noise systems



Executive question:

The burning question that should be high on the agenda when designing new interiors, or refreshing existing is: **what is the cost to your organisation of not providing the best acoustic landscape, promoting staff productivity and effectiveness?**

This overview of managing the acoustic landscape should provide you with an initial insight into areas to question and investigate.

Acoustic Comfort employ the science of acoustics, but also understand that businesses and organisations require practical, cost effective and timely solutions – not just the theory of the subject, **this is our speciality**.

Would you like an interior space acoustic assessment by one of our specialists?

Please contact **Mark Stevens**
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