

Secure Sound Technical Note

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WHAT IS THE BEST LOCATION FOR SOUND MASKING SPEAKERS?

As sound masking technology has developed and more types of buildings have evolved, the number of locations for masking speakers has broadened. The most common locations for masking speakers are:

1. Hung above a continuous suspended ceiling tile.
2. Mounted face down in the suspended ceiling tile.
3. Hung in an open ceiling that does not have a suspended ceiling tile.
4. Mounted under a raised access floor.

When several options are available, which is most desirable in terms of performance and acceptability?

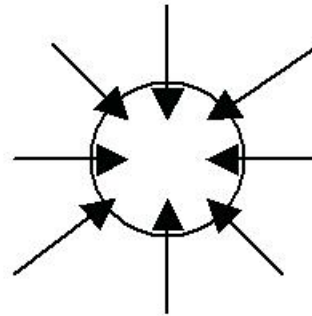
There are several criteria used to create masking systems that perform well. They are: (1) spectrum contour; (2) overall level, and (3) spatial uniformity of the overall level. In most locations, these criteria can be met successfully. However, it has been found that another criterion is needed to improve both performance and acceptability: *diffuseness of the masking sound field*. Sound at a point can be defined as diffuse if it comes from all directions with equal level and with equal probability [1]. For those familiar with lighting it is related to Equivalent Sphere Illumination, an accepted lighting criterion for reducing glare. AA diffuse sound field reduces “acoustical glare” which, in practical terms, means that the source of the sound cannot be located.

The second design rule for sound masking [2] is: “The system shall be truly background”. One corollary of that rule is that the source of the masking shall not be identifiable, either visually or acoustically. A perfectly diffuse sound field cannot exist, but one that is sufficiently diffuse to meet the design rule can be created.

The need for this additional criterion was first identified in offices with extremely high, suspended ceilings. Overall Levels about 2 to 3 dBA above those normally used were found to be acceptable to occupants. The first installation of sound masking under a raised access floor in 1982 yielded the

same results. Numerous installations of under-floor masking systems since that time have confirmed this finding further. How can this criterion be used to rank order the several locations for masking speakers? A simple visualization is to draw a circle and place arrows in the direction from which significant masking sound radiates. If all the arrows are about the same length, the field is reasonably diffuse and identification of the source location is difficult; this is shown in the figure on the right. If any arrow is significantly longer than others the field lacks diffuseness. Using this method we have ordered the favorable locations as follows:

Sound From Above

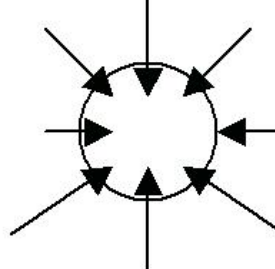


Sound From Below

DIFFUSE SOUND FIELD

1. *Under Raised Floors.* Because the loss of sound through a raised floor is considerably higher than through a suspended ceiling, the amount of sound reaching the listener from other directions is relatively higher, resulting in a high degree of diffuseness. Field experience has shown that the diffuseness is sufficiently high, as suggested in the figure on the right, that neither the source nor the direction of the sound can be identified.

Sound From Above



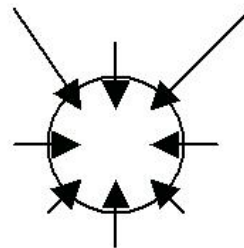
Sound From Below

UNDER FLOOR SPEAKERS

2. *Very high suspended ceilings.* The sound reaching the listener from above arrives from a broad range of angles improving diffuseness. Because it is still possible to determine that the sound is coming from above, it is rated second in preference.

3. *High structural ceilings without a suspended ceiling.* The sound reaching the listener from above arrives from a broad range of angles improving diffuseness. Because it is possible to determine that the sound is coming from above and because the speakers can be seen, it is rated lower in preference.
4. *Normal height suspended ceiling.* This location has been the standard location for many years. Because suspended ceilings are normally near nine feet high, the direction from which the masking comes can be identified, and diffuseness of the sound is reduced. With very high plenum depths the diffuseness is better.
5. *Speakers mounted face-down in suspended ceilings.* Because the listener is in the direct sound field of the speakers, diffuseness is considerably reduced, so the source of masking can be identified acoustically, and in some cases, visually. The figure on the right suggests that if the listener is midway between two speakers, the sound field from those speakers will dominate any reflections that occur. This is the least desirable location for meeting the second design rule of masking.

Sound From Above



Sound From Below

FACE-DOWN SPEAKERS

Whenever possible, masking sound systems should be placed under a raised floor. Experience has shown that installation of such systems is relatively easy, nor is equalization of the system a problem

References

- 1.. Mankovsky, V.S., *Acoustics of Studios and Auditoria*, Hastings House, New York, 1971.
2. Chanaud, R.C., *Sound Masking Manual*, Unpublished, 2006.