SOUND MASKING SYSTEMS: A GUIDELINE

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1. Why Sound Masking?

Recognizing the importance of good office acoustics, PWC has established commitments for acoustic performance in the office (see reference 1): maximum background noise levels; and maximum length of reverberation time. The lower limits presented for background noise are considered optimal: in the open office this equates to about 45 - 48 dB(A); in closed offices 37 - 42 dB(A).

The highest possible levels of background noise maximize noise isolation (privacy), and thus, the optimum office will be characterized by noise levels which are based on these levels as *targets*, rather than *maximums*.

Levels which are too high cause raised voices and stress, levels which are too low are distracting since occupants can hear quieter, distant sounds. Consider the sound of a dripping tap: during the day with other noises present it is inaudible; at night-time in the silence it can become very distracting.

Sound masking should be considered for all new fit-up and for retrofit to existing fit-up, when the levels of background noise are (or are anticipated to be) more than 5 dB below the optimum levels at frequencies between 250 and 4000 Hertz, at some or all locations. Sound masking should only be considered when adequate levels of acoustic absorption are present: an acoustic ceiling and screens are essential prerequisites.

Sound masking is suitable for both open and closed offices to improve acoustic privacy. Space planning with sound masking can avoid the need to build partition walls above the ceiling to achieve confidential privacy between closed offices (when the door is closed). The judicious use of sound masking around closed offices and meeting rooms can increase acoustic security by reducing the signal to noise ratio in the surrounding areas. Further information on this aspect of the application of sound masking can be found in reference 2.

Persons with hearing impairments require low background noise levels for proper functioning of hearing aids, and thus sound masking is *not* suitable for the spaces which they occupy.

2. What is Sound Masking?

Sound masking is the artificial introduction of the optimum levels and spectrum of background sound into the office. The spectrum is shaped and is NOT white noise or pink noise, although these terms are sometimes used incorrectly to describe sound masking.

Masking sound contains a smooth spectrum of multiple sound frequencies, primarily in the human voice range. Natural sources of sound masking include waterfall and wave noise. HVAC noise is usually unsuitable for sound masking since it is unlikely to have the right spectrum, is often too quiet, and usually varies in space and time. Similarly, music is also unsuitable since it contains tonal sounds (information) and can thus be distracting.

Sound masking uses speakers located in the ceiling plenum to introduce sound into the workplace. The depth of the ceiling plenum and the tile material (mineral or glass fibre) are important issues: each speaker will normally cover from 24 to 40 square metres of floor space. The speakers are normally anchored to the slab using cable or chain. Power requirements can vary from low voltage AC or DC, to 120 VAC.

Depending on the voltage and local code requirements conduit may be necessary, although this is normally not the case - local authorities should always be consulted to determine if conduit is required. In Ontario, cabling rated to FT6 or better does not require conduit.

Ideally, all areas on a floor should be covered, as partial systems will draw attention to their presence and thus reduce their effectiveness.

3. Types of Sound Masking Systems

Centralized systems use signal generation and amplification equipment located in a central place, usually a closet or control room, which should be secure to prevent tampering. Distributed systems provide signal generation and amplification equipment at each (or every two or three) speakers. Centralized systems offer greater potential for system-wide and zone control, but at the expense of the more localized adjustment and tuning possible with distributed systems. Centralized systems may offer greater economies of scale. Distributed systems are less likely to fail on a system-wide basis due to the failure of one component.

Most sound masking systems provide the capability for both music and paging inputs.

Sound masking is normally a tenant fit-up expense, and costs approximately $10 per square metre of floor space.

4. Supply, Installation and Maintenance

While there are firms which supply and assemble components provided by others, and those which will sell the client components which they must install and adjust themselves, PWC experience has been that sound masking systems purchased in such a manner are unlikely to meet requirements. Ideally, one firm should quote for the design, installation, tuning, *and* maintenance of a sound masking system to ensure client satisfaction. Few firms in Canada meet this criteria.

Suppliers of sound masking systems will bid based on a specification of what is required (most firms have developed their own performance standard), and drawings of the space identified for coverage. They will also provide recommendations on the timing for installation, and should be knowledgeable and able to provide advice on related acoustic issues. Beware of those who claim that sound masking is a panacea for all that is wrong with open office acoustics.

Maintenance of sound masking systems is normally limited to ensuring continued function of all components, periodic adjustments of levels to account for any drift, and re-evaluation when changes to the use of configuration of the space occur.

For further information contact Greg Clunis, P.Eng., Interior Environmental Engineer, Public Works Canada HQ, (613) 736-2151.

References

1. Making Your Workplace Work: A Tenant's Guide to PWC Buildings, 1990.
2. Acoustics Guidelines for High Security Spaces, Public Works Canada, 1992.

Canadian Acoustics / Acoustique Canadienne 20(3) 37-38 (1992)

PRELIMINARY SIMPLIFIED MODELS FOR PREDICTING SOUND PROPAGATION CURVES IN FACTORIES

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In this summary paper, the simplified models are incorrect. The correct models are as follows:

Frequency-independent models

Empty: $SP_E(r) = -11.4 - 7.3 \log r$

Empty+absorption: $SP_{EA}(r) = -11.4 - 10.3 \log r$

Fitted: $SP_F(r) = -9.1 - 12.3 \log r$

Fitted+absorption: $SP_{FA}(r) = -9.1 - 15.3 \log r$

Frequency-dependent model

$$SP(r) = (I_E + \Delta I_F) - 3.3\ (S_E + \Delta S_F + \Delta S_A) \log r$$

Band	I_E	ΔI_F	S_E	ΔS_F	ΔS_A
125	-11.6	1.9	2.2	1.7	0.6
250	-11.3	2.1	2.1	1.7	1.0
500	-11.5	2.6	2.2	1.3	1.5
1000	-11.1	3.3	1.9	1.5	1.4
2000	-11.4	2.4	2.1	1.3	0.6
4000	-11.2	1.7	2.6	1.7	0

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