
Breaking the sound barrier

by Neil Jarman

Designing for grille and diffuser noise is of paramount importance. Neil Jarman looks at the data currently provided by manufacturers and provides some design tips.

Diffuser noise and vav systems

Making appropriate diffuser selections for vav systems can be a difficult exercise. A diffuser which gives NR37 at 100% volume while not 'dumping' at low volumes can be difficult to find.

Using special diffusers can help, but one should ask whether it is necessary to achieve the noise criterion at 100% volume. Typically, 100% volume may only be supplied for a few hours of a few days each year. Designing to achieve the noise criteria on 80% volume can result in better supply air conditions when operating on low volumes, while occasionally compromising the noise criteria by only 3-4dB.

Noise levels generated by grilles and diffusers have a significant effect upon total noise levels within a room and therefore designing for grille and diffuser noise is important. If a system is commissioned under the correct operating conditions and the grilles are too noisy, then changes have to be made to the grilles themselves.

Unlike most other components in the system, you cannot fit acoustic lagging or a silencer to a grille. There is, however, one reason why the installed diffusers and grilles should be too noisy, if noise generation is given proper consideration in the design programme.

Empirical vs manufacturers' data

There are several empirical formulae for the prediction of diffuser noise, but inevitably there is some marginal error in these. Manufacturers' generated noise data for grilles and diffusers should be available from potential suppliers and should therefore be used in preference. If one manufacturer's data appears doubtful then comparison with empirical predictions (using formulae from the *CIBSE Guide*) or other manufacturer data can be beneficial. Also, read the small print – again!

Manufacturers' noise data often includes predicted NC/NR values in a room. Reference to the small print usually indicates that the prediction is based upon a room absorption of 8 dB, i.e. that the room noise level is taken as 8 dB less than the sound power level radiated to the room from a single grille. For most practical situations these predicted NC/NR values are optimistic. This is illustrated in figures 1 and 2 which show a large cellular office (10m by 6m, carpeted and fitted with an acoustic suspended ceiling).

In these examples, if the diffuser type selected was claimed to be NR35, assuming an 8 dB room effect, then, in the first example, resultant noise levels would be NR35, but in the second example NR41.

For most engineers, the second example is more realistic of current design practice. The modern, heavily serviced office has more than a single diffuser. It is also reasonable to assume that office workers will be as close as 1.5m from diffusers.

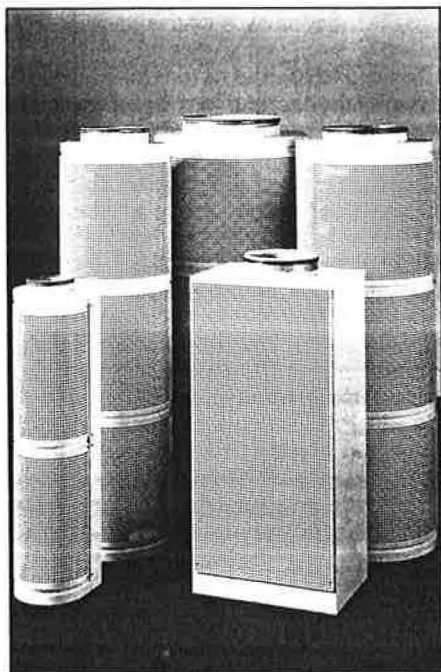
This is not a criticism of any individual manufacturer; while all diffuser and grille

Acoustic problems of slot diffusers

It is proving popular to provide continuous slot diffusers around office perimeters, with 'dummy' diffuser sections between live plenum boxes. This can create problems when offices are partitioned up and good privacy between offices is desired. Filling in the gaps between diffuser blades where the diffuser passes over the top of the partition is possible, but labour intensive.

Blanking-off the back of the dummy section of diffusers near the partitions is possible, provided the dummy sections are not required for return air. Better still is to design for solid blanking plates to be installed along the line of the diffusers at the location of notional partitions.

Manufacturers generally give noise predictions based upon 8 dB room effects, individual grille and diffuser manufacturers should not reasonably be expected to 'break rank' and give more realistic predictions of room noise levels. This would make their own grilles and diffusers out to



Displacement units – quiet if a little obtrusive. Will their appeal to architects increase?

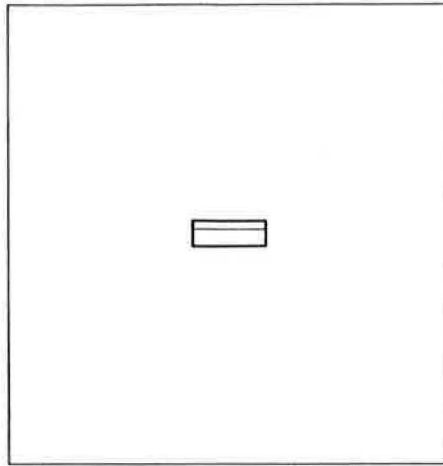


Figure 1: Single 900 mm long diffuser in centre of ceiling. At 2.5 m from diffuser, noise level, typically sound power level radiated from single diffuser – 8 dB.

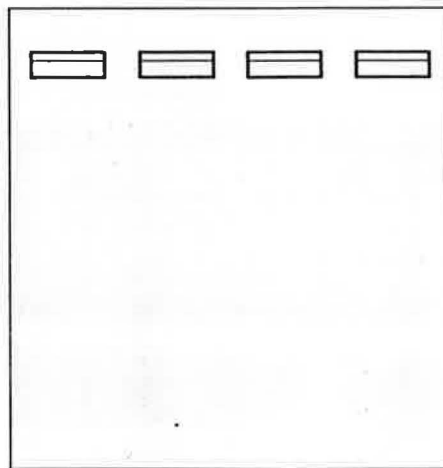


Figure 2: Four 900 mm long diffusers at room perimeter. At 1.5 m from diffusers, noise level, 'NR' typically equals 'NR' sound power level radiated from single diffuser – 2 dB.

be noisier than the competition's. Perhaps, though, there is scope for an industry-wide change.

Limiting sound power levels

Changing manufacturers' ways on publishing predicted room noise levels would not solve all the problems that occur with grille and diffuser noise. Different projects have different grille and diffuser layouts and different architectural finishes, and these differences affect noise levels.

For instance, there can be a tendency to assume that if an area has a suspended ceiling, it will be acoustically absorptive. This is not in fact the case.

Popular with architects today (despite the reservations of acoustic consultants) are the plain-type tiles, which have a good visual appearance and are less prone to flake at the edges, but which have poor sound absorption properties. When using this type of ceiling, room noise levels can be a couple of dB higher than expected.

An additional matter for consideration is the fact that grille and diffuser noise may not be the only noise source within the room. There may be a contribution from VAV units, fan coil units or main plant itself.

By the time final grille and diffuser

Grilles and diffusers

acoustics

selections are to be made, limiting sound power levels for diffuser and grilles should be calculated. These calculations should take account of the layouts, architectural finishes and contributions from other plant. It is not recommended for the specification to simply ask for grille noise not to exceed NR35 or similar. The grille supplier has no control over noise from other sources, so one can easily end up with noise levels above the set noise criterion.

The limiting sound power levels calculated should be compared with the appropriate manufacturer's data. Full data may not be in the glossy brochure. However, if the manufacturers are able to claim NC/NR levels based on an 8 dB room effect in the brochure, then they should have in their files the actual octave band sound power level data you need.

Is this the correct data?

Obtaining manufacturers' sound power level data is only the start. The errors in interpretation that can occur are numerous:

- sound power levels quoted are for a unit length of diffuser. If diffusers are twice the length then noise levels radiated will be approximately 3 dB higher;
- sound power level figures are for diffusers with straight rather than sideways throw (differences of 5 dB are not unusual);
- the sound power levels quoted do not allow for balancing dampers behind the grille (even a fully-open damper will typically increase noise levels by 5 dB).

Where balancing dampers are used directly behind grilles they should only be used for fine tuning, otherwise noise levels are likely to be higher than the manufacturer's figures would predict.

Using manufacturers' data to predict noise levels within a room will only give true results if installation conditions on site are representative of conditions under which the manufacturer's noise tests were carried out. 'Spaghetti junction' flexible ductwork connections to diffusers are to be avoided and always use the suppliers recommended sizes for ductwork and plenum connections. Avoid having sideways throw diffusers built into the grid of a recessed grid suspended ceiling system as excess noise generation due to air movement past tile edges is possible.

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