



measures, such as fans or heaters. When system conflicts result, the actual effect is to increase the energy consumption of the building. One should remember that a cooling fan is a 100% energy-to-heat converter, which adds to the interior load to be sent to the cooling system. In one building investigated in the early 80s, the occupants had installed 1.5 w/ft<sup>2</sup> (16.2 W/m<sup>2</sup>) of fans to offset the 80°F (27°C) space temperature that resulted from the 78°F (26°C) setpoints. Buildings with constant volume reheat systems, such as the library at the University of Richmond, used more gas for heating in July than in January. Humidity levels in schools can be significantly increased, resulting in better breeding grounds for mold and mildew.

### The Open Plan Office

**Issue:** The open plan office became a reality in the 1970s. A number of parameters were investigated and, usually, understood as design parameters. Basically, the overall design produces well-mixed air distribution and a measure of speech privacy. Many researchers conducted studies on both thermal parameters and IAQ/ventilation mixing measures and showed that with properly selected and located ceiling diffusers, using air diffusion performance index measures, high levels of comfort and excellent ventilation mixing are expected. Acoustical privacy often required background sound-masking systems along with high quality ceiling tiles and partitions.

**Observation:** We and other VAV and GRD manufacturers observe that diffusers are often being selected without regard to the effect of VAV turn down on diffuser performance, noise generation. We also recognize an unfounded concern over the performance of air-distribution systems in conjunction with partitions. The consequence is that occupants complain of “stiffness,” which is most often a thermal comfort issue and not an air quality problem, and is usually a result of poor delivery of cool HVAC air to the occupant’s location. It may result in selection of expensive, but probably unnecessary, alternate designs such as individual task air conditioning to solve this non-problem.

**Discussion:** Several papers have been presented on the proper selection of diffusers. In at least one case, all the diffusers on a project were replaced with ones meeting the ASHRAE requirements (at the design engineer’s expense). The overall cost difference between a properly performing diffuser and a lower cost (non-performing) alternate is small in the scope of the whole building, but significant to the supplying contractor. Diffusers that make a little noise (NC-40) at full flow in a VAV system do not detract from open plan speech privacy, and often work best when selected at this performance level. In the 80s and 90s, the personal computer was often a major source of background noise in a cubicle, and with the increase of laptops as the main computer for many “mobile” workers, this source of “good” noise is often significantly missing. This makes the diffuser generated noise even more important to the acoustical design.

### Acoustical Specifications

**Issue:** Specification of acoustical parameters is an important issue in the selection of VAV terminals. Certified octave

band sound power data has been available since the 80s through Air-Conditioning and Refrigeration Institute (ARI) Standard 880, *Air Terminals*, originally released in 1981 (updated in 1991, 1994 and 1998). Following ARI-880, an application standard, ARI Standard 885-1998, *Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets*, was developed and released in 1990. This standard provides accepted methods of determining the path attenuation factors for estimating and specifying sound levels, both in the room (typically as NC), and at the source (as octave band sound power).

**Observation:** In the consulting engineer poll mentioned above, the engineers were questioned regarding awareness of the ARI 885 standard. Of those polled, only five actually had copies of the standard, which is available at no cost from the ARI website ([www.ARI.org/std](http://www.ARI.org/std)). Even today, specifications are frequently received requiring tests to the ADC test code (obsoleted in 1984 in favor of the ARI standard) or worse, to ASHRAE Standard 36B, which was obsoleted in 1972. Often, these specifications require a set room NC level based on one of the above obsolete test codes with no guidance on the acoustical assumptions to be employed in the analysis. These specifications often omit significant variables such as design inlet static pressure, which is critical to any analysis. Other specifications simply contain a favored manufacturer’s published NC levels, which may be based on nothing that is specific to the design.

**Discussion:** When no guidance is given, the supplier has the option of selecting whatever application factors favor his selection. As the engineer has probably been burned in the past with this approach, products are often specified at much lower sound levels than necessary. This results in oversizing units and/or adding unnecessary silencers, which results in poor operation, poor ventilation, excessive energy use and shortened motor life. Sound power should be used to compare products, and each octave band should be reviewed within the design parameters to ensure the desired outcome.

### Summary

As an industry, we have conducted significant research into the proper way to apply systems to buildings to maintain energy efficiency, first costs, comfort and productivity. These lessons have apparently been lost on many in the design community, as well as the agencies and politicians affecting the operation of buildings. The information is available, often in the ASHRAE handbooks, and certainly in the body of ASHRAE-sponsored research. Manufacturers are being asked to provide products that we know will not perform when installed. Due to competitive pressures, we often have no choice but to meet the flawed specifications with products that will cause discomfort when applied as specified. Setting uncomfortable temperatures has repeatedly been shown to create reduced productivity and often actually increase energy consumption as occupants try to maintain their comfort levels, causing the systems to be operated in ways contrary to both their design and good sense. History has shown how to do it right. All we have to do is look back. ●