

NOISE AND VIBRATION CONTROL

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HVAC equipment for a building is one of the major sources of interior noise, and its effect on the acoustical environment is important. Also, noise from equipment located outdoors often propagates to the community. Therefore, mechanical equipment must be selected, and equipment spaces designed, with an emphasis on both the intended uses of the equipment and the goal of providing acceptable sound levels in occupied spaces of the building and in the surrounding community. Operation of HVAC equipment can also induce mechanical vibration that propagates into occupied spaces through structureborne paths such as piping, ductwork, and mounts. Vibration can cause direct discomfort and also create secondary radiation of noise from vibrating walls, floors, piping, etc.

In this chapter, *sound* and *noise* are used interchangeably, although only unwanted sound is considered to be noise.

System analysis for noise control uses the source-path-receiver concept. The source of the sound is the noise-generating mechanism. The sound travels from the source via a path, which can be through the air (airborne) or through the structure (structureborne), or a combination of both paths, until it reaches the receiver (building occupant or outdoor neighbor).

Components of the mechanical system (e.g., fans, dampers, diffusers, duct junctions) all may produce sound by the nature of the airflow through and around them. As a result, almost all HVAC components must be considered. Because sound travels effectively in the same or opposite direction of airflow, downstream and upstream paths are often equally important.

This chapter provides basic sound and vibration principles and data needed by HVAC system designers. Many of the equations associated with sound and vibration control for HVAC may be found in Chapter 8 of the 2017 *ASHRAE Handbook—Fundamentals*. Additional technical discussions along with detailed HVAC component and system design examples can be found in the references.

1. DATA RELIABILITY

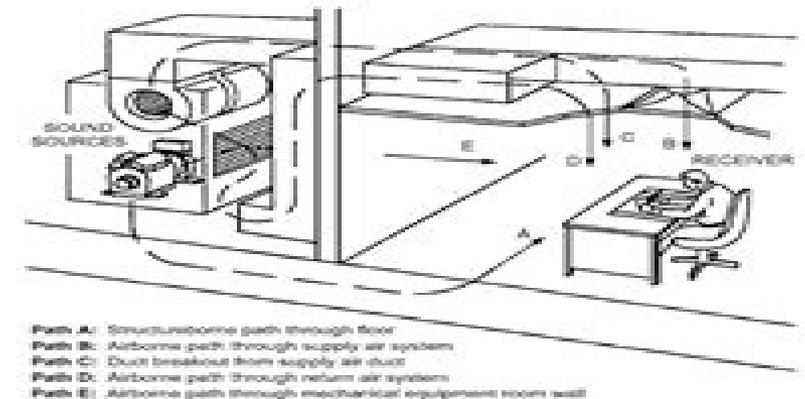
Data in this chapter come from both consulting experience and research studies. Use caution when applying the data, especially for situations that extrapolate from the framework of the original research. Test data tolerances and cumulative system effects lead to a typical uncertainty of ± 2 dB. However, significantly greater variations may occur, especially in low frequency ranges and particularly in the

63 Hz octave band, where experience suggests that even correctly performed estimates may disagree with actual measured levels by 5 dB, so conservative design practices should be followed.

2. ACOUSTICAL DESIGN OF HVAC SYSTEMS

For most HVAC systems, sound sources are associated with the building's mechanical and electrical equipment. As shown in Figure 1, there are many possible paths for airborne and structureborne sound and vibration transmission between a sound source and receiver. Noise control involves (1) selecting a quiet source, (2) optimizing room sound absorption, and (3) designing propagation paths for minimal noise transmission.

Different sources produce sounds that have different frequency distributions, called *spectral characteristics*. For example, as shown in Figure 2, fan noise generally contributes to sound levels in the 16 to 250 Hz octave bands (curve A). (Frequencies that designate the octave bands are often called *octave midband* [or *center*])



Path A: Structureborne path through floor
 Path B: Airborne path through supply air system
 Path C: Duct breakout from supply air duct
 Path D: Airborne path through return air system
 Path E: Airborne path through mechanical equipment room wall

Fig. 1 Typical Paths of Noise and Vibration Propagation in HVAC Systems

The preparation of this chapter is assigned to TC 2.6, Sound and Vibration.

Handbook Of Noise Control

Sebastian Brünink



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