

## CHAPTER 49

## NOISE AND VIBRATION CONTROL

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**H**VAC 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  $\pm 2$  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**].)

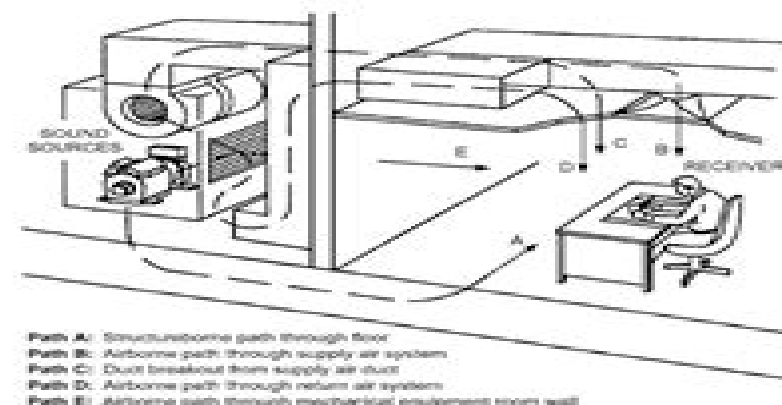


Fig. 1 Typical Paths of Noise and Vibration Propagation in HVAC Systems

# Noise Control Handbook Of Principles And Practices

**Mark Steyvers**



## **Noise Control Handbook Of Principles And Practices:**

Noise Control David M. Lipscomb,1978      **Noise Control** ,1986      **Noise Control** David M. Lipscomb,Arthur C. Taylor,1978      Noise Control: Handbook Of Principles And Practices D.M. Lipscomb,      **The Shock and Vibration Digest** ,1992      **Selected Library Acquisitions** United States. Department of Transportation,      **Sound & Vibration** ,1991

**Vibration, Acoustics and Strain Measurement** C. Sujatha,2023-02-22 This textbook provides a comprehensive description of a variety of vibration and acoustic pickups and exciters as well as strain gauge transducers It is an exhaustive manual for setting up basic and involved experiments in the areas of vibration acoustics and strain measurement using strain gauges only It further serves as a reference to conduct experiments of a pedagogical nature in these areas It covers the various theoretical aspects of experimental test rigs as well as a description and choice of transducers equipment The fundamentals of signal processing theory including the basics of random signals have been included to enable the user to make a proper choice of settings on an analyser or measuring equipment Also added is a description of modal analysis theory and related parameter extraction techniques All chapters are provided with conceptual questions which will provoke the reader to think and gain a better understanding of the subjects The textbook illustrates around fifty experiments in the areas of vibration acoustics and strain measurements Given the contents this textbook is useful for undergraduate and postgraduate students in the areas of mechanical engineering with applications that range from civil structures architectural and environmental systems and all forms of mechanical systems including transport vehicles and aircraft      The Journal of the Acoustical Society of America Acoustical Society of America,2000      **Hearing Conservation in Industry** Alan S. Feldman,Charles T. Grimes,1989      *Technology for a Quieter America* National Academy of Engineering,Committee on Technology for a Quieter America,2010-10-30 Exposure to noise at home at work while traveling and during leisure activities is a fact of life for all Americans At times noise can be loud enough to damage hearing and at lower levels it can disrupt normal living affect sleep patterns affect our ability to concentrate at work interfere with outdoor recreational activities and in some cases interfere with communications and even cause accidents Clearly exposure to excessive noise can affect our quality of life As the population of the United States and indeed the world increases and developing countries become more industrialized problems of noise are likely to become more pervasive and lower the quality of life for everyone Efforts to manage noise exposures to design quieter buildings products equipment and transportation vehicles and to provide a regulatory environment that facilitates adequate cost effective sustainable noise controls require our immediate attention Technology for a Quieter America looks at the most commonly identified sources of noise how they are characterized and efforts that have been made to reduce noise emissions and experiences The book also reviews the standards and regulations that govern noise levels and the federal state and local agencies that regulate noise for the benefit safety and wellness of society at large In addition it presents the cost benefit trade offs between efforts to mitigate noise and the improvements

they achieve information sources available to the public on the dimensions of noise problems and their mitigation and the need to educate professionals who can deal with these issues Noise emissions are an issue in industry in communities in buildings and during leisure activities As such Technology for a Quieter America will appeal to a wide range of stakeholders the engineering community the public government at the federal state and local levels private industry labor unions and nonprofit organizations Implementation of the recommendations in Technology for a Quieter America will result in reduction of the noise levels to which Americans are exposed and will improve the ability of American industry to compete in world markets paying increasing attention to the noise emissions of products     *The Publishers' Trade List Annual* ,1986

*Planning* ,1979     **Industrial Pollution Control** Nancy Jean Sell,1981 Industrial Pollution Control Issues and Techniques Second Edition Nancy J Sell This revised guide incorporates all the important information on pollution sources control methods and pollution regulations generated since publication of the previous edition in 1981 This edition surveys the impacts of every type of pollution on health plants materials and weather It discusses how different types of pollution are produced laws governing specific emissions and both existing and emerging air water and solid waste control techniques Detailed sections zero in on processing methods pollution production and control methods in specific industries including chemical physical and economic factors that inhibit better pollution control Case studies offer insights into processes that directly minimize emissions or indirectly reduce them by decreasing energy needs Pollution issues of iron and steel manufacturing foundry operations metals finishing cement manufacture glass manufacture paper and pulp food processing brewing tanning and chemical industries are probed in depth Among the new pollution control strategies covered are Regulations treatment techniques and disposal methods for hazardous wastes Direct steelmaking processes that reduce pollution Modified glassmaking furnaces that decrease pollution Non chlorine pulp bleaching sequences that curtail production of toxic substances such as dioxin Secondary fiber utilization and reduction of PCB emissions Resource recovery from sludges and ashes Chemical spill containment and cleanup Uses of degradation and recycling to reduce plastics waste Coverage of the impact of U S regulations status of the U S environment continuing problems economic costs and cost benefit issues further increases the value of this source to environmental engineers and scientists working for the EPA state regulatory agencies or consulting engineering firms This guide is also a vital reference for environmentalists working with advocacy groups and environmental or process engineers in industry     Industrial Research/development ,1978-07     New Technical Books ,1926     DB ,1981     **Library of Congress Catalogs** Library of Congress,1980     **Annual Report - Advisory Council on Occupational Health and Occupational Safety** Ontario. Advisory Council on Occupational Health and Occupational Safety,1979     **Subject Catalog** Library of Congress,1978

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