PPFA Plastic Pipe and Fittings Association

PUBLICATIONS | User Bulletin

A Guide to Common Sources and Control of Noises in Plumbing Systems

December 2019

Published by the
Plastic Pipe and Fittings Association
www.ppfahome.org

Introduction

Understanding and managing noise is important for builders and designers. Once a building is completed it can be costly and difficult to deal with noise complaints from building occupants. The purpose of this paper is to explain some of the fundamentals of noise and to educate readers that managing noise should be a consideration in the design of plumbing systems.

Background

Plumbing system noise is a common irritant to building owners and tenants. Three main factors contribute to this problem: 1) lack of awareness on the part of owners/developers and design teams regarding the application of specific products and practical installation solutions; 2) lack of contractor awareness and training regarding the application of specific solutions; and 3) noise not being a design consideration.

There *have been* recent advancements *regarding the issue of plumbing noise mitigation. Resources are now available from a product and service standpoint that can* be utilized *to* reduce noise as an irritant. *If systematically implemented, a holistic plumbing system that includes noise and vibration solution components will develop within the marketplace.*

Varying levels of plumbing noise are expected and tolerated without complaint by many people. Noise generated within a tenant's or owner's own space that resulted *from their use of plumbing fixtures is often tolerated. Conversely, intrusive plumbing noise from an adjoining space that results in sleep disturbance or in some cases, where it is simply identifiable, may be regarded as annoying. In multifamily residential buildings, plumbing noise is a source of complaint.*

At the onset of a project, the project plan should include a discussion on acceptable noise levels. The engineer or architect needs to have a clear understanding of the owner's requirements regarding the level of acceptable noise for the project in order to develop a plan of attack for noise abatement. While this document covers acoustics in plumbing systems, it is apparent that the building layout must also be carefully considered. Coordination with the project architect and the plumbing/mechanical design team should occur early in the design stage. For some projects, an acoustical consulting firm may be an essential addition to the project team. These specialists, or acousticians, are typically members of the Acoustical Society of America and/or the Institute of Noise Control Engineering.

Building Design for Noise

1. Party and Plumbing Walls

Ideally, plumbing walls should not be located near quiet rooms. Party walls should be constructed to minimize sound transfer from one tenant to another or from common areas to tenant space and vice versa. Consider designs and configurations including increased physical separation (airspace) between walls, staggered studs, dense insulation within wall cavities, multiple layers of sheetrock, and a variety of resilient channel configurations. In Canada, the National Building Code requires that every dwelling unit shall be separated from every other space in a building in which noise may be generated by a construction providing an STC (Sound Transmission Class) rating of at least 50.

2. Floor and Ceiling System Construction and Configuration

Avoid routing plumbing system piping in ceiling spaces that are positioned above sensitive areas such as bedrooms. Minimize the use of hard floor surfaces where possible. Soft floor coverings help minimize the transfer of noise generated by plumbing fixtures and appliances between occupant levels of a building.

If pipes must be installed in the walls and ceilings of acoustically sensitive rooms, provide noise reduction as appropriate with sound-absorbing materials. Pipes should be decoupled from lightweight walls through the use of vibration-isolating clamps or other materials.

3. Documenting Construction Requirements and Observing Installation

After building-related design issues are resolved, the acoustical engineer or other responsible entities should draft the needed documents and establish means and methods that will be required of the plumbing or mechanical contractor. These documents typically include a project-specific plumbing noise and vibration specification, which establishes submittal requirements and procedures, specifies the acoustical materials and methods required for the project, and contains plumbing installation detail drawings, which establish how quality control will be monitored throughout construction.

On-site inspection during the building process often reveals errors that can be corrected easily and early. Waiting too long to visit the site can result in concealed errors that cannot be easily uncovered or repaired in a finished building.

Acoustical testing in a partially completed building can be helpful to prevent repeated errors and allow for timely correction.

The most common plastic pipe and fitting materials used in these systems within buildings include Schedule 40 PVC or ABS DWV. Other drainage products include CPVC, PP, and PVDF which are used for acid waste drainage.

Pressure piping/tubing is constructed from a variety of materials that each radiate airborne and structure-borne noise at varying levels. The most common plastic pipe and fitting materials used in these systems within buildings include CPVC, PEX, PP, PERT, and PVC Schedule 80.

Always check local codes for choosing plumbing systems materials.

Sources of Plumbing System Noise

A common cause for noise generation in a water system is simply the flow of water due to the operation of a fixture or faucet. In this scenario, several factors contribute to increased levels of noise generation: water pressure, flow velocities, undersized tubing, turbulence caused by changes in direction, and obstructions in valves and equipment. The largest contributing factor is direct contact between the water system's tubing and the building's various components.

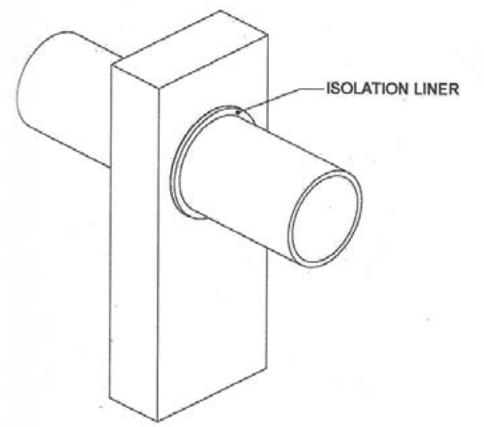
Another common noise generator is water hammer, which results when water moving at a high velocity stops suddenly. This occurs when valves are closed quickly, producing a shock wave in the system that causes the pipes to vibrate. Some of the items in a common plumbing system that cause this problem are laundry washing machines, icemakers, and dishwashers, each of which have electric solenoid, or fast-closing, valves. Other common contributors include flush valves on urinals and water closets in commercial buildings.

Another noise source is due to *also apparent in a drainage section. When water tubing experiences thermal expansion and contraction due to temperature changes* where *water piping can be heard creaking or squeaking at contact points with various building components and support points.*

Valves emit varying levels of noise depending on the amount of friction and turbulence they generate. Globe valves, for instance, are very noisy because they are designed in such a way that turbulence is very high.

Pumps often generate high levels of structure-borne noise if they are in direct contact with building components or are piped incorrectly, resulting in turbulence and cavitation.

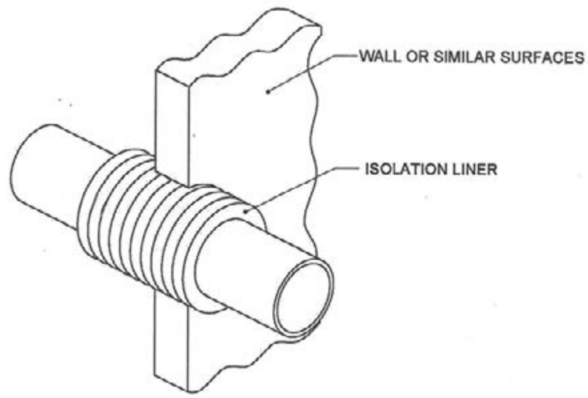
Equipment generates noise and vibration over a wide frequency range. Equipment noise control and vibration isolation have been handled by plumbing and mechanical engineers for many years and are better controlled than many of the other components of a plumbing or piping system.



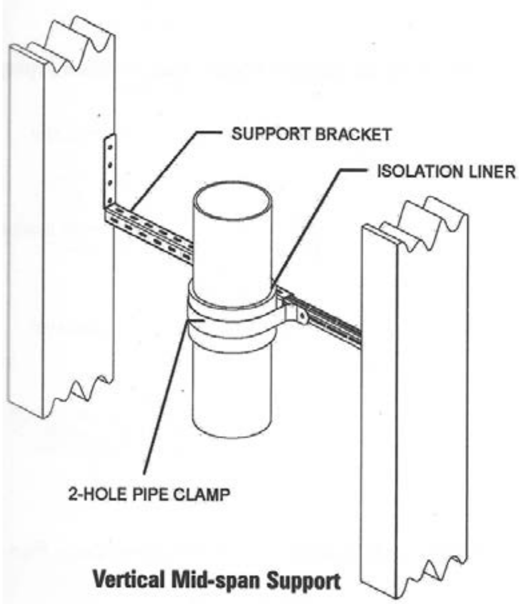
Pipe Isolation Through Framing Member

Mitigating Noise from Drainage Systems

The most common plastic pipe and fitting materials used in DWV systems within buildings include Schedule 40 PVC or ABS. Other drainage products include CPVC, PP, and PVDF which are used for acid waste drainage. *To minimize noise and vibration transferred to the building, the contact between the piping and the building's components (drywall, studs, joists, floor structure, etc.) should be broken (see Figures). This often is accomplished by the use of various types of isolating materials such as felt or rubber when passing through studs, joists, hangers, etc.*



Resilient Pipe Isolation



Vertical Mid-span Support

When pipes pass through floors, noise transfer often is minimized with the use of various types of rubber or neoprene pads placed under the ears of riser clamps. On very large and heavy riser pipes, the use of spring-loaded riser isolators is effective. Numerous manufacturers provide these types of isolation pads in various thicknesses ranging from ¼ to ¾ inch (6.35 to 19.05 mm) and even thicker. These typically are made of rubber or neoprene, which is often more resistant to chemicals than rubber. Others are also available with steel bearing plates, which help evenly distribute the weight across the surface of the pad. Use only lab-tested and proven materials.

Additionally, piping must be isolated from contact with the edges of the floor penetration, whether wood, concrete, or metal pan decking. This typically is done with the use of acoustical sealant within the annular space surrounding the piping.

Finally, the designer needs to include provisions for expansion and contraction of the DWV system. The manufacturer of the plastic pipe system can provide design guidance for expansion and contraction. There are also some devices which can assist in managing expansion and contraction.

PPFA has guidance documents for expansion and contraction issues in non-pressure and pressure systems;

UB17, "Provisions for Expansion and Contraction in Plastic DWV and Roof Drain Systems".

UB20, "Provisions for Expansion and Contraction in Plastic Pressure Piping Systems"

Mitigating Noise from Water Distribution Systems

Water piping/tubing is constructed from a variety of materials that each radiate airborne and structure-borne noise at varying levels. The most common plastic pipe and fitting materials used in these systems within buildings include CPVC, PEX, PP, PERT, and PVC Schedule 40 or 80.

Very similar to drainage piping, steps should be taken to break any direct contact between the water piping system and the building's components.

As with drainage systems, when passing through floors, steps should be taken to isolate noise transfer to the wood, metal, or concrete floor system by placing rubber or neoprene pads under the ears of riser clamps. Additionally, the piping must be isolated from contact with the edges of the floor penetration with the use of acoustical sealant within the annular space surrounding the piping. Another important factor is the isolation of water piping from hangers and other support systems. In the case of hangers, this often is accomplished by the use of either a spring isolated hanger attachment point at the supporting structure or a hanger lining of felt or rubber/neoprene material to break the connection between the hanger and the water tube.

A better solution is the use of shock arrestors or water hammer arrestors, which are mechanical devices similar to spring-loaded shock absorbers. These should be introduced in the piping near appliances or equipment with fast-closing valves, such as washing machines, and act as cushions to reduce the shock. Both the Uniform Plumbing Code (UPC) and the International Plumbing Code (IPC) require water hammer arrestors to be installed at the location of quick-acting or quick-closing valves such as found in dishwashers, laundry washers, and icemakers.

Finally, as with DWV systems, the designer needs to include provisions for expansion and contraction of the water distribution system. The manufacturer of the plastic pipe system can provide design guidance for expansion and contraction. There are also some devices which can assist in managing expansion and contraction. *If more detailed information is needed see the full ASPE document, "Acoustics in Plumbing Systems".*

There are methods of enhanced hot water delivery, hot water circulation pump / on demand systems. Noise is not reported or expected to be an issue with these systems.

In an extreme case, where sound levels must truly be minimal, such as a meditation room, library, or quiet area designated by a green building rating system, consider routing piping other than fire sprinkler or hydronics away from the area.

Summary

Failure to take noise into account may result in complaints from tenants which can be difficult to resolve once the building is completed. The purpose of this paper is to highlight that noise needs to be a consideration at the onset of Building design.