



The Building Team Delivers Value by Specifying PVC Pipe

In applications ranging from cold water delivery and landscape irrigation systems to drain, waste and vent (DWV) systems and sewage transport, PVC plays a vital role in providing dependable piping service. PVC has become the leading material for large diameter buried pipelines installed by water and wastewater utilities as well as for smaller diameter DWV applications and cold-water delivery systems. Technological advances in PVC piping, such as cellular core construction, make it a more economical choice than ever. Its durability, reliability,

and ability to meet water quality and fire performance standards, coupled with its comparatively lower cost, make it a solid choice for building owners when evaluated against alternatives.

PVC pipe is available in a variety of lengths, diameters, wall thicknesses and pressure classes, along with a full complement of standard fittings, valves and couplings. Pipe and fittings are usually joined by elastomeric sealing connections or solvent cementing. PVC pipe also is compatible with other pipe materials and can be specified for system upgrades.

At an environmental education center, PVC pipes create an ecological wastewater-treatment system that reprocesses all of the water from the visitor center, filtering it through a "constructed wetland" of PVC pipes, gravel and marsh plants.

Courtesy William Buchanan, Cusano Environmental Education Center, Philadelphia



Courtesy Mike Wilkes



Courtesy Plastic Pipe and Fittings Association





Engineered Tough

PVC pipe offers specifiers and building owners unmatched resistance against costly leakage and breaks caused by corrosion. In settings far more demanding than the typical in-building applications – such as public utilities – PVC's performance is reflected in its low break rates against alternatives: a National Research Council of Canada study found PVC water distribution pipe experienced on average 0.5 breaks per 100 km (62 miles) per year compared to 32.6 breaks for cast iron and 7.9 breaks for ductile iron.

The smooth plastic surface of PVC pipe is not electrically conductive and is not affected by extremely hard or soft water, by changes in pH or by the chemical constituents found in both domestic and industrial wastewater. PVC piping resists attack by cleaners and other household chemicals, and can withstand pressure surges, shock impact, general wear and abrasion. It delivers water as clean and pure as it receives, imparts no taste or odor, helps maintain uniform water temperature and preserves its high flow efficiency over time. There is virtually no need for disassembly and maintenance for the life of the system. Because it is lightweight, PVC pipe costs less to ship, and generally can be fabricated, cut and installed more quickly than alternatives.

CPVC pipe takes the heat

Chlorinated polyvinyl chloride (CPVC) pipe is a cost-effective product capable of handling higher temperatures than PVC pipe, making it a viable alternative for fire sprinkler applications. CPVC's strength makes it an appropriate material for hot- and cold-water distribution systems, especially where aggressive, corrosive (acidic) water and soil conditions exist. Depending on the compound used, PVC's upper temperature limit as a pressure pipe is 140 F, while CPVC's is 220 F. CPVC's higher chlorine content gives it higher temperature resistance than PVC, although the two are very similar in terms of chemical resistance. CPVC maintains its properties in high alkaline and sodium levels and trapped moisture environments.

In an assisted living facility, CPVC pipe delivers hot and cold water (gold stripe and gray) and is the fire sprinkler piping material (orange).
Courtesy Noveon, Inc., Cleveland, Ohio



Tested Safe, Code Approved

For more than 40 years, both pressure and non-pressure PVC applications have been rigorously tested for reliability and safety by nationally recognized, independent certifiers such as the American Water Works Association, NSF International and Underwriters Laboratories, according to strict standards established by the American Society for Testing and Materials and other organizations. PVC pipe consistently exceeds requirements of NSF 14: "Plastics Piping System Components and Related Materials" and NSF 61: "Drinking Water System Components — Health Effects." Markings to this effect ("NSF-pw") can and should be specified. Similar markings exist for DWV and drain pipe ("NSF-dwv" and "NSF-drain.")

The model plumbing codes of the International Code Council, the International Association of Plumbing and Mechanical Officials, and the Plumbing-Heating-Cooling Contractors Association all approve the use of PVC pipe without limitation in any water service, sanitary DWV and storm drainage system. Local jurisdictions may adopt their own variations on these codes. Design professionals should always determine local requirements in the design and specification process.

Addressing Important Design Issues

With proper installation, PVC pipe will provide building owners safe, decades-long performance. It is advisable to follow manufacturers' specifications when putting the piping system in the building – and to select a location protected from sharp objects, rough handling and high heat sources. Short-term exposure to sunlight, such as during construction, is typically not a problem for PVC pipe due to natural UV inhibitors present in the material. PVC piping may be used in outdoor applications when the piping system is painted with a light-colored water-based acrylic or latex paint that is

chemically compatible with PVC. When painted, the effects of UV exposure are significantly reduced. The manufacturer may also recommend another type of coating or protective device, depending on the application.

Noise Containment

Noise produced by water running through pipes in the walls is a common concern for the building team, whose members must consider the physics of water flowing through pipe to reduce the effect of noise on building occupants. All acoustical isolation issues, especially in sensitive applications, should be investigated and addressed at the earliest stages of a project's design.

Despite the other advantages of PVC's lighter weight and lower mass, PVC pipe will tend to vibrate more than heavier, metal alternatives when acted upon by equal amounts of energy from flowing water. This differential can be managed by appropriate de-coupling to isolate the pipe from contact with structural elements, and thermal or rubber isolation to absorb sound and vibrations from water movement. To determine acceptable levels of sound and vibration, consult the manufacturer's data or the 2003 ASHRAE Handbook, HVAC Applications (Ch. A47: "Sound and Vibration Control").

Water hammer is an inherent characteristic of building water supply systems. The intensity of water hammer in PVC pipe is approximately one third its intensity in copper or steel pipe. To reduce water hammer, installations should be designed for a maximum flow rate of less than 5 feet per second in pipe diameters of 1¼ inch or larger, and less than 8 feet per second for diameters of less than one inch. Other ways to minimize the problem include following these design and specification practices:

- Avoid critical areas of the structure, such as those where differential movement is expected or where pipe would have close contact with the wall material.
- Use a pipe chase or cavity wall of adequate thickness.
- Support the pipe properly away from wall material.
- Use long-radius fittings to reduce turbulence.
- Wrap piping with sound-deadening material or pack the wall cavity with fibrous insulation material such as glass fiber or mineral wool.

Fire Performance and Firestopping

PVC pipe is made from a naturally fire retardant polymer, which makes it different from other plastics. When PVC pipe does burn, the combustion toxicity of the gases produced is very similar to what would be produced by other combustible materials found in homes and offices, including wood and fabric.

Most piping systems – including those made from PVC – are installed behind non-combustible materials such as gypsum wallboard. This common finish material predictably resists the thermal effects of fire, and provides an important measure of protection for PVC piping products. In addition, where PVC piping is used, it generally represents less than one percent of the total combustible materials present in the building.

Building assemblies are typically rated for fire resistance according to the requirements of ASTM E-119: "Standard Test Methods for Fire Tests of Building



PVC Schedule 80 pipe is used in a pressure application in Freedom Plastics' chiller room. *Courtesy Freedom Plastics, Janesville, Wisc.*

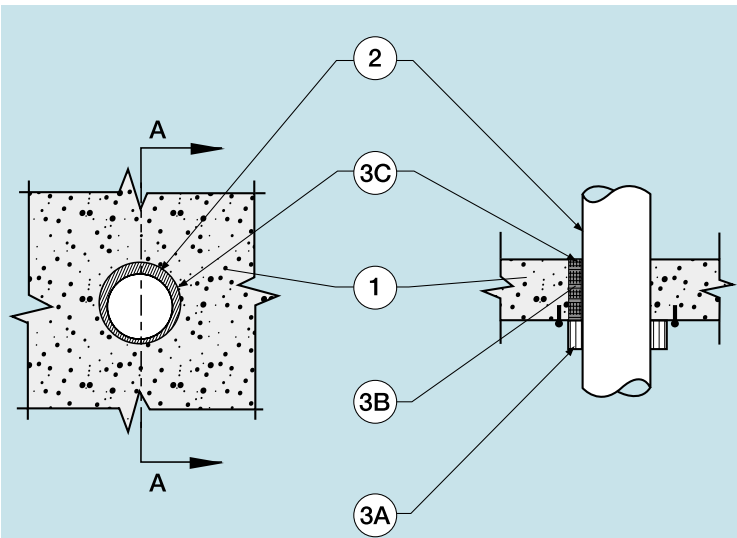


Office tower plumbed with PVC DWV pipe and fittings *Courtesy IPEX, Toronto, Ontario*

Technical Assistance

Technical assistance on PVC pipe is available from the following resources:

- **The Vinyl Institute's electronic binder on all vinyl building products, including pipe, is at www.vinylbydesign.com Product manufacturers are included.**
- **Comprehensive information for users of plastic piping and related systems, including installation handbooks, is available from the Plastic Pipe and Fittings Association (PPFA), www.ppfahome.org**
- **For the full text of individual ASTM standards, go to the ASTM Store at www.astm.org**
- **For information on NSF International standards, visit www.nsf.org/Standards**
- **To purchase the 2003 ASHRAE Handbook, go to <http://resourcecenter.ashrae.org/store/ashrae>**



This floor or wall assembly drawing shows a typical through penetrant and firestop device. Tightly packed mineral wool insulation fills the opening, sealed with a proprietary fill material flush with the surface of the penetrated assembly. Construction details of this type are available from manufacturers and should be included in a project's working drawings. *Courtesy Passive Fire Protection Partners, Delta, British Columbia.*

1. Floor or Wall Assembly - Reinforced lightweight or normal weight concrete.
2. Through Penetrants - PVC pipe, rigidly supported.
- 3A. Firestop Device - Proprietary plastic pipe collar.
- 3B. Packing Material - Mineral wool insulation, tightly packed.
- 3C. Fill Void or Cavity Material - Proprietary fill material applied within annulus, flush with top surface. Additional bead of fill material applied at penetrant interface.

Construction and Materials.” Penetrations of these assemblies are permissible as long as they are properly firestopped using materials and techniques approved by the building code authority having jurisdiction. ASTM E-814: “Standard Test Method for Fire Tests of Through Penetrations Fire Stops” has been used to establish the performance criteria for through penetrations of fire resistance-rated assemblies. Tested assemblies including such penetrations will not be adversely affected if the openings for PVC piping for supply, DWV, HVAC and electrical service are not oversized, and are sealed carefully.

Multiple through penetrations require use of through-penetration firestopping systems incorporating thermal insulating and/or intumescent devices (which swell up when heated), or those that fill or cut off openings when exposed to heat. Passive systems primarily rely on insulation to stop fire or smoke. Materials as simple as wrap strips, metal sleeves, sheets or collars, insulating solids and grout are also used successfully as firestopping components. It is important that all materials used in these assemblies be tested and fire resistance-rated for the particular application in question, and that they be installed in compliance with manufacturers’ instructions.

“Plastic Pipe in Fire Resistive Construction,” an installation manual available from The Plastic Pipe and Fittings Association, contains 450 illustrations indicating how PVC pipes can be installed within or through fire resistance-rated assemblies.

Thermal Expansion

Even though PVC has low thermal conductivity, PVC piping has a greater co-efficient of thermal expansion than cast iron, steel and copper pipe, a fact that needs to be considered in system design. This translates into a movement of 3.36 inches for every 100 feet of pipe per each 100 degrees F change in temperature. Most PVC applications are selected for environments with minimal temperature changes, such as in soil or in air-conditioned buildings. Even in the case of considerable temperature fluctuations, most installations involve relatively short pipe segments where dimensional change is not great. Where necessary, expansion and contraction can be accommodated by piping offsets or expansion joints, by snaking the line or making similar provisions at changes in direction, or by suspending the pipe and avoiding contact with the building structure.

PVC Pipe – Tough, Safe, Code Approved

PVC piping systems have been used successfully in North America since the early 1950s, and millions of installations still in service function as well as they did the day they were installed. Understanding the characteristics of PVC as a material in the pipe application and following these design and specification guidelines should lead to many more successful, long-lasting installations.



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