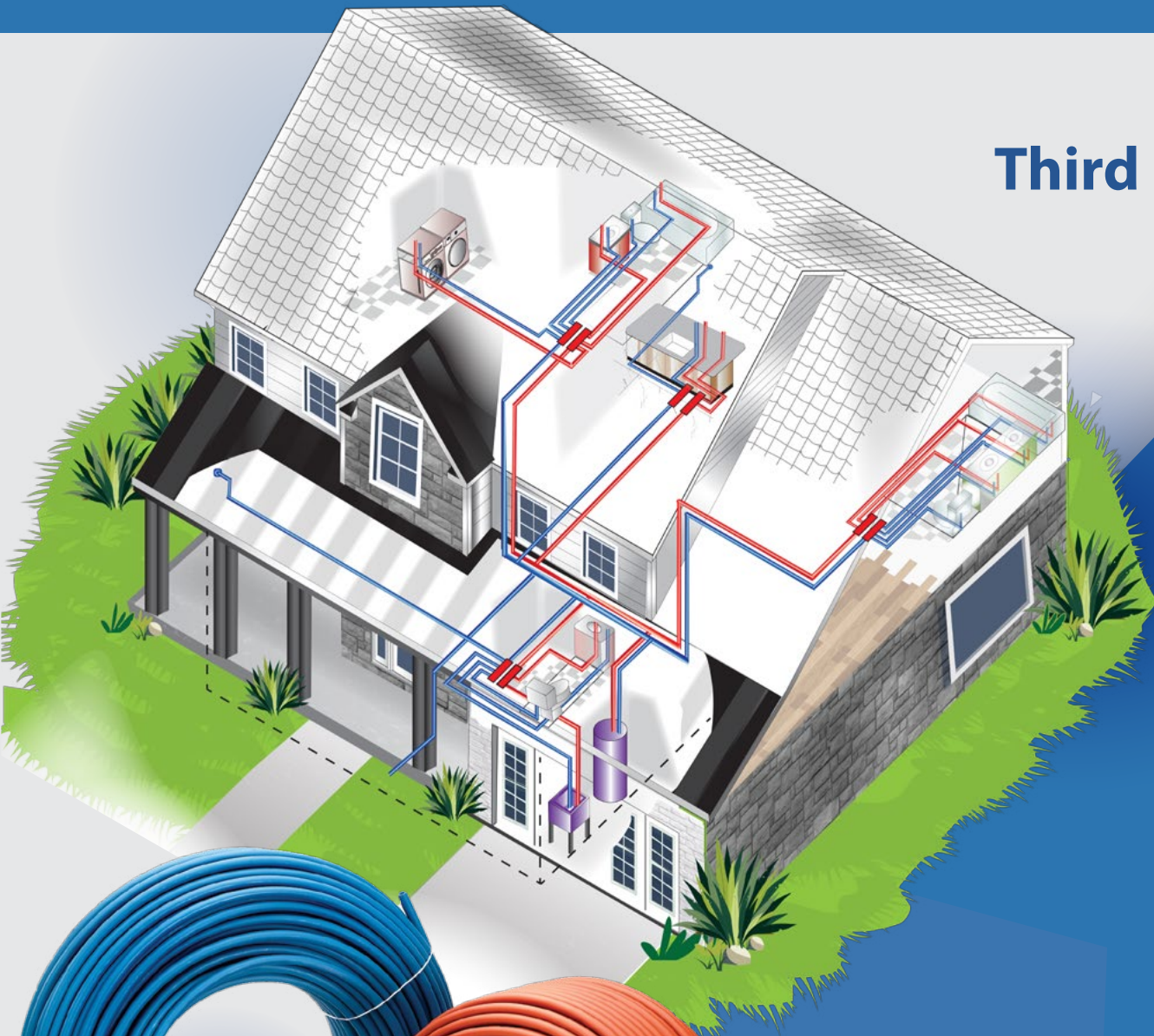


Third Edition



# PEX

## Plumbing Distribution Systems Design and Installation Guide

Advantages

Material Properties

Codes & Standards

Joining Methods

PEX Plumbing Layouts

Optimizing Design

Installation Guidelines

Water Service Line

Other Applications



# PEX

## Plumbing Distribution Systems Design and Installation Guide

### Third Edition

Prepared for

Plastics Pipe Institute, Inc. (PPI)  
105 Decker Court, Suite 825  
Irving, TX 75062  
[www.plasticpipe.org](http://www.plasticpipe.org)

and

Plastic Pipe and Fittings Association (PPFA)  
800 Roosevelt Road, Building C, Suite 312  
Glen Ellyn, IL 60137  
[www.ppfahome.org](http://www.ppfahome.org)

Prepared by

Home Innovation Research Labs  
400 Prince George's Boulevard  
Upper Marlboro, MD 20774  
[www.HomeInnovation.com](http://www.HomeInnovation.com)

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# Advantages and Benefits of PEX Plumbing Systems

## 2

The advantages and benefits of PEX plumbing systems have been well-documented and realized by contractors, builders, specifiers, and owners for many years, and it is important to summarize these advantages within this Guide. Benefits of PEX plumbing systems are introduced in [Chapter 1 Introduction](#) and explained in further detail below.

### Cost Effectiveness

For a variety of reasons, PEX plumbing systems have lower installation costs than metallic plumbing systems. The primary reason for this is that installation time and labor are greatly reduced due to the flexibility of PEX tubing, long continuous lengths, and the speed of joining. This can allow PEX plumbing systems to be installed with significant time savings as compared with rigid piping systems, increasing the productivity of crews and completing projects faster.

In recent years, the cost differential between PEX and copper materials has increased, delivering further savings to plumbers, builders, and owners.

Once in service, the use of PEX plumbing systems can reduce energy and water costs by delivering hot water to the fixtures faster and by reducing heat loss in the piping.

### Durability

Based on extensive testing and real-world material performance since the early 1970s, PEX tubing has proven to be a durable material that does not suffer from some of the historical problems associated with metallic piping, such as reduced interior dimension from mineral build-up (e.g., occlusion, scaling, tuberculation), corrosion (e.g., galvanic, pitting), electrolysis, filming, and erosion corrosion due to excessive velocity. PEX also delivers excellent chemical resistance, environmental stress crack resistance (ESCR), resistance to slow crack growth (SCG), toughness, impact and abrasion resistance (see [Chapter 3 Material Properties](#)).

In addition, PEX tubing will typically expand if water in the system accidentally freezes and will return to its original dimension when the ice thaws. Breakage due to freezing is rare.

## Ease of Installation

The installation of PEX tubing is generally easier than rigid pipes. PEX tubing is available in long coils, which eliminates the need for most coupling joints. Its flexible nature allows it to be bent gently through curves and around obstructions, minimizing the use of fittings such as elbows. No solvent, chemical, or solder joining is required. Various types of fitting systems (e.g., crimp, press, cold-expansion, push-fit, mechanical compression) are secure and reliable when installed properly. PEX tubing is lightweight, making it safe to transport and easy to handle. For a comparison of the installation of rigid metal pipe to PEX pipe, refer to the PATH Field Evaluation in Lincoln, Neb.<sup>1</sup>

## Energy Efficiency

PEX tubing offers reduced heat loss and improved thermal characteristics when compared to metallic pipe (see **Chapter 3 Material Properties** section “Thermal Conductivity/R-Value”). In addition, less water is wasted delivering hot water to fixtures because of shorter delivery times for hot water with parallel (i.e., home-run) plumbing systems. For explanations of how to design PEX parallel plumbing systems, see **Chapter 6 PEX Plumbing Systems Layouts & Design**.<sup>2</sup>

## Noise Reduction

When properly secured, PEX tubing is inherently less noisy and quieter than rigid piping systems due to its flexibility and its ability to absorb the kinetic energy from pressure surges caused by fast closing valves, such as those used in washing machines and ice makers (see **Chapter 3 Material Properties** section “Noise and Water Hammer (Surge Pressure) Resistance.” The flexibility of PEX tubing combined with its comparatively thicker wall also help to reduce sound transmission and vibration through the pipe wall in cases of high water velocities.

## Resilience

For piping materials, resilience refers to a material’s ability to withstand anticipated hazards, adapt to changing conditions, withstand and limit negative effects caused by events, and return to service.

PEX tubing is one of the most resilient piping materials available thanks to several properties:

- Resistance to impact, even at cold temperatures
- Flexibility to resist kinking or breaking if soil or buildings move or settle during seismic or other events
- Fatigue resistance and the ability to withstand repeated load cycles (e.g., thermal expansion, pressure cycling) without damage
- Resistance to corrosion and aggressive water chemistry (e.g., low pH acidic water)
- Resistance to scale and mineral build-up
- Resistance to disinfectants chlorine and chloramines (see **Ch. 3 Material Properties**)
- Freeze-break resistance (see **Chapter 3 Material Properties** and **PPI TR-52 Resistance of PEX Pipe and Tubing to Breakage When Frozen (Freeze-Break Resistance)**)

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1 *Evaluation of Hot Water Distribution Systems by Numeric Simulation*, 2004. Building Technology Center, Oak Ridge National Laboratory.

2 *Performance Comparison of Residential Hot Water Systems*, 2002. NAHB Research Center report available at [Homelnnovation.com](http://Homelnnovation.com).

- PEX tubing delivers a unique combination of toughness and flexibility, allowing it to withstand typical jobsite conditions without damage.

## Sustainability

PEX is an enhanced version of high-density polyethylene (HDPE), an economical and highly cost-effective construction piping material based on one of the most popular plastic materials in the world. HDPE is also one of the most recycled materials in the world. Generally, as indicated by a peer-reviewed life cycle inventory report<sup>3</sup>, the manufacturing of plastic pipe consumes less energy than producing similar lengths of metallic pipe.

As reported in a published study by TEPPFA<sup>4</sup>, PEX has a significantly lower carbon footprint than copper tubing, and its production and usage can reduce carbon dioxide (CO<sub>2</sub>) emissions and water consumption.

The lighter weight of PEX compared to metallic piping helps to reduce transportation costs and energy consumption. For example, 100 feet of 3/4 PEX tubing weighs just 10.1 pounds (4.6 kg), while 100 feet of type L copper tubing weighs 45.5 pounds (20.6 kg); in this example, PEX tubing is just 22% of the weight of copper (i.e., 78% lighter). This lighter weight not only reduces transportation costs, but it also improves worker safety on the jobsite.

At the end of its useful life, PEX tubing can be recycled in a variety of methods. A common technique used recycled PEX tubing as an inert filler material that can be incorporated into other polymers for specific applications and into other construction products, such as asphalt for road building. In 2023, one PEX manufacturer working with a team of other firms announced a full PEX recycling scheme, where scrap PEX tubing can be recycled into new PEX tubing for full circularity.

The use of PEX tubing in hot water plumbing systems also assists with conserving water and energy through faster delivery of hot water, as compared with metallic pipes (see **Chapter 8 Performance Data**).

Due to its resistance to erosion and corrosion, which are known to occur to metallic piping systems and shorten their lifetimes, plastic piping systems such as PEX will often deliver longer service lifetimes.

Finally, PEX tubing does not contain lead, harmful VOCs, or bisphenol A (BPA) and is strictly regulated for drinking water safety through mandatory certifications to **NSF/ANSI/CAN 61 Drinking Water Systems – Health Effects** and **NSF/ANSI/CAN 372 Drinking Water System Components – Lead Content**.

## Versatility

In addition to being used for hot- and cold-water plumbing distribution, PEX tubing has numerous other applications that take advantage of its physical properties (e.g., high temperature resistance, long-term stability and strength, flexibility, ductility, reliability, ease of installation, etc.)

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3 *The Life Cycle Inventory Report Peer-Reviewed Life Cycle Inventory for the Production and Use of Installed Residential Piping Systems for three House Layouts, February 3, 2011*, commissioned by the Plastic Pipe and Fittings Association and prepared by Franklin Associates is available at [ppfahome.org](http://ppfahome.org).

4 The European Plastic Pipes and Fittings Association

PEX is widely utilized for these and other applications:

- Reclaimed water piping
- Fire suppression systems (residential fire sprinklers)
- Municipal water service lines and building supply lines (buried pipes)
- Hydronic heating and cooling using warm or chilled fluids, including radiant systems
- Slab freeze protection below cold-storage freezers, ice rinks, and more
- Ground source (geothermal) ground heat exchangers
- Outdoor snow and ice melting
- Outdoor turf conditioning
- District energy pipelines
- Chilled water piping
- Ice surface piping

In addition, PEX systems are sometimes used for specialized industrial and mining applications.

## Water Conservation

Lengthy delivery time for hot water in plumbing systems represents a significant waste of water and energy, a problem often exacerbated in larger homes. Properly designed PEX plumbing systems have the potential to conserve water (see [Chapter 7 Optimizing Design](#) and [Chapter 8 Performance Data](#)).

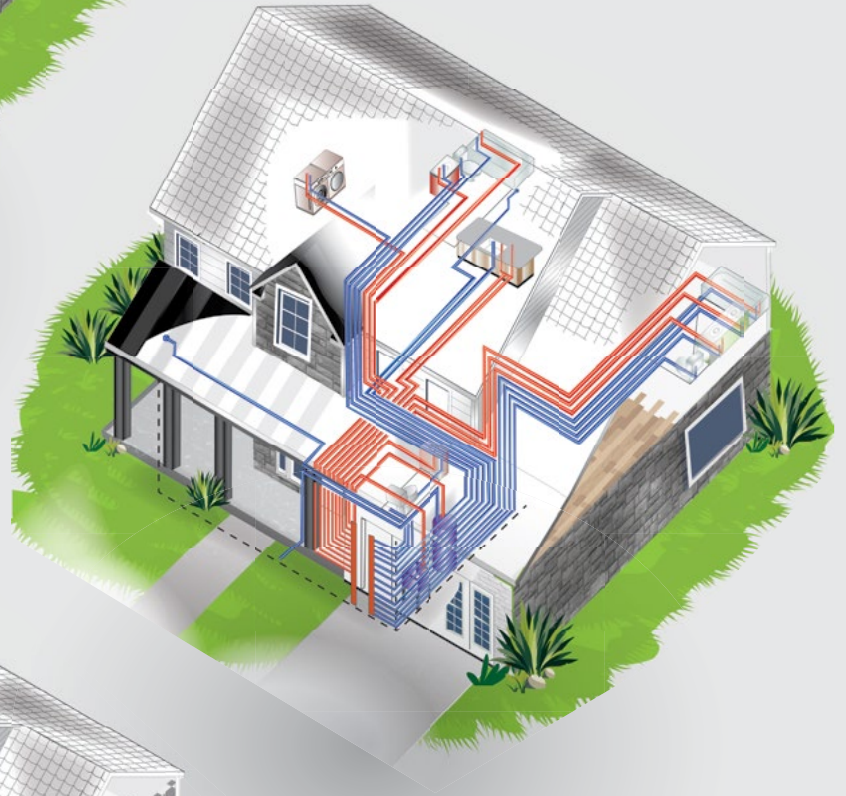
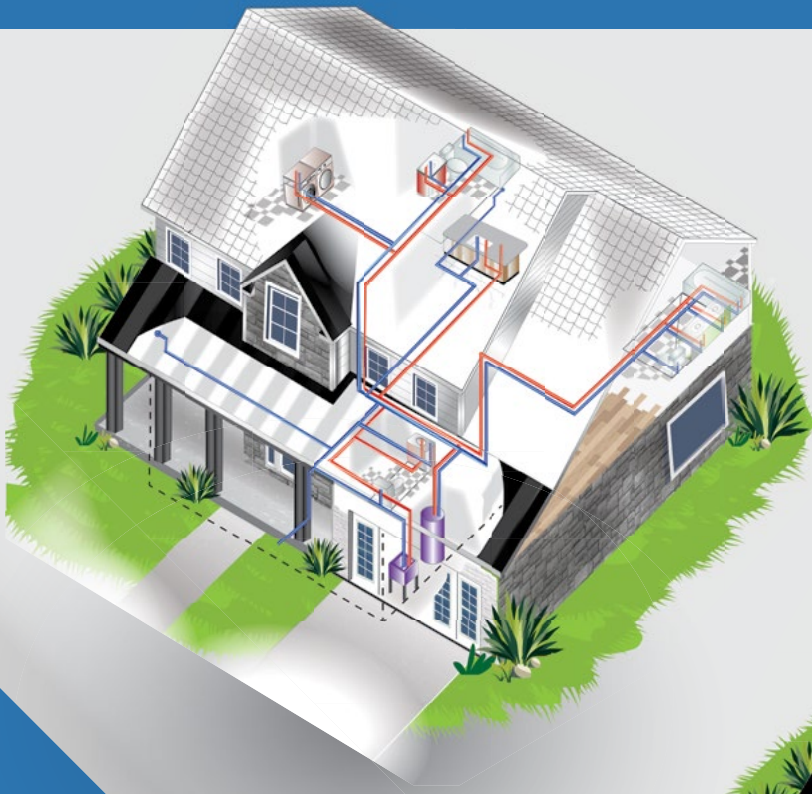
The flexibility of PEX tubing, especially when supplied in coils, allows it to bend around corners and run continuously, reducing the need for fittings such as elbows and couplings. By using fewer fittings, pressure drop through the piping network is reduced. In some installations, this can allow downsizing the pipe diameter to nominal tubing size 3/8 for certain fixtures when this size is supported by hydraulic (i.e., pressure drop) calculations and permitted in codes. The volume of 3/8 PEX tubing is only 55% of that of 1/2 tubing, a 45% volume reduction. This reduction in tubing diameter directly reduces the amount of water flushed when a hot-water plumbing fixture is opened.

In 2002, Home Innovation Research Labs conducted software simulations and laboratory tests on a “typical” hot-water distribution system using a trunk and branch rigid pipe design and one that included a nominal tube size 3/8 parallel PEX system. Results indicated that parallel systems using shorter runs with a manifold reduced the wait time for hot water and wasted less water than longer runs of rigid pipe with numerous elbows and connections.<sup>5</sup>

As demonstrated in [Chapter 8 Performance Data](#), a PEX plumbing system piped in the parallel layout reduced the delivery time for hot water to reach a fixture by 30% to 40% as compared with a trunk and branch plumbing layout, depending on the length to the farthest fixture. Substituting 3/8 PEX for any type of 1/2 tubing, when hydraulic calculations and codes allow, can save even more water by minimizing the amount of hot water stored within pipes.

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<sup>5</sup> *Performance Comparison of Residential Hot Water Systems, 2002*. NAHB Research Center report available at [HomeInnovation.com](http://HomeInnovation.com).



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