

TOOLBASESM TECHSPECS

Home-Run Plumbing Systems using Cross-Linked Polyethylene (PEX)

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TECH @ A GLANCE

BENEFITS (+) / DRAWBACKS (-)

- + **AFFORDABILITY:** Lower total cost (materials plus installation)
- + **ENERGY EFFICIENCY:** Reduced heat loss
- + **MARKETABILITY:** More stable water pressure at fixtures during simultaneous draws of hot water; faster hot water delivery time
- + **DURABILITY:** Fewer joints, especially those hidden behind walls. Piping is resistant to corrosion and will not pit or stress corrode; Piping is resistant to freeze damage
- + **PERFORMANCE:** The smooth interior walls of PEX are resistant to scale build-up
- + **CONVENIENCE:** Faster hot water delivery time. More stable pressure at outlets during simultaneous flow
- + **ENVIRONMENTAL PERFORMANCE:** In a well-design system, PEX reduces wait time for hot water at fixtures and can therefore reduce the amount of water wasted waiting
- **AFFORDABILITY:** Higher materials cost; learning curve may add labor cost for inexperienced installers

INITIAL COST

PEX plumbing system materials often cost more than rigid pipe materials. However, labor savings can make overall installed cost lower than rigid pipe systems. Cost will depend on the system design, house size, distributor, and product availability.

OPERATIONAL COST

Because manifolds are installed in easily accessible locations and have fewer connections, PEX plumbing systems can reduce maintenance and repair costs. Due to its smaller diameter, PEX piping retains less volume of hot water in the pipe at the end of a hot water draw. Consequently, it can contribute to water and energy savings.

CODE ACCEPTANCE

PEX piping has been approved by model building codes since 1993 and is accepted in all major building codes. Check local codes, as PEX may not be approved locally. Each model code outlines requirements for PEX tubing and plumbing system design, including national standards to which the tubing must be tested and comply, design requirements, and acceptable connections and fittings.

RESULTS FROM THE FIELD

PATH field evaluations have demonstrated excellent material and installed cost savings compared with traditional plumbing systems.

WARRANTY

Manufacturers typically offer a 10-year limited warranty on the manifold, piping, and fittings.

MAKING THE SWITCH

- Home-run systems can take significantly less time to install than traditional rigid pipe plumbing systems once the learning curve has been overcome.
- Trades need to receive training in proper handling and installation.
- Installation requires some specialized tools.
- Special care is required to eliminate construction and line debris from sensitive manifolds.



THE BASICS

Cross-linked polyethylene (PEX) is a flexible pipe that is typically installed in a home-run, or parallel, configuration in which hot and cold supply lines originate from a central manifold and serve individual fixtures. PEX piping is suitable for hot water use (up to 200°F at 80 PSI) and is resistant to temperature extremes, chemical attack, and deformation. Because the flexible piping can be snaked through walls in a manner similar to electrical wiring installation, PEX is faster to install than rigid piping. Home-run systems typically only require fittings at the manifold and the fixture, though special fittings or couplings are available for repair or changes in direction tighter than the minimum bend radius allowed for the piping.

The long-term durability and performance of PEX piping is evident by its approval in all model codes. The PEX manufacturing industry is highly regulated and piping must undergo rigorous testing to ensure durability.

Home-run systems equalize pressure, therefore allowing several fixtures to be used simultaneously without dramatic changes in pressure or temperature. In PEX home-run plumbing systems, less hot water is left standing in pipes, so less hot water energy is wasted (standing water creates energy loss to the surrounding air).

PEX tubing may melt, distort or crack if exposed to excessive heat and should not be exposed to freezing or sunlight. Abrasive surfaces that can damage PEX pipe should be avoided.

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DOLLARS AND SENSE

Initial Cost:

Considerable labor and material savings have been documented in the field.

- \$300-\$1,200 less than copper for move-up production homes (Oakwood Homes)
- \$200 less than conventional copper in production builder's "Idea House" (K. Hovnanian)
- \$700 savings compared to copper for a remodeling application (Model reMODEL)
- 20% installed cost savings over copper in affordable new home (Liberty Village)

Operating Cost:

Moderate water and energy savings may be achieved; however, savings are variable and not easily quantified.

THE BASICS *continued*

Be sure to follow manufacturer guidelines and codes regarding clearance from PEX piping and plastic manifolds to heat sources, including water heaters, light fixtures, gas flues, and other heating appliances. Typically, PEX piping should have a minimum 12-inches vertical and 6-inches horizontal clearance, while manifolds need at least 36-inches vertical and 18-inches horizontal from heat sources.

Central manifolds should be installed in a convenient and accessible location, such as a basement wall or a service closet, which allows easy access for shut off to individual fixtures. Because each outlet from the manifold typically has its own valve, plumbing renovations and repairs are simplified.

Manifolds can be mounted between stud framing, and should be secured on a flat surface to prevent warping. A single length of PEX piping can run directly from a manifold through studs and around obstacles. The pipe is pulled, like a wire, from the manifold location to fixture locations. Extra piping, on the order of 1/8-inch per foot of piping, is needed to allow for expansion and contraction. Unrolling the pipe with a reel will prevent kinking. The pipe is then secured with clips and cut with a plastic pipe cutter before fittings are applied. Piping should not be secured too tightly to the framing, to account for expansion and contraction. Options for fittings include crimp or compression; either type takes only a few seconds to make.

RESULTS FROM THE FIELD

This technology has been used by other builders in real-world building situations – learn from their experiences.

Builders who have installed PEX home-run systems as part of PATH Field Evaluations and Demonstrations have realized material and installation savings, and have discovered tips for improving the transition from traditional plumbing. Full details about the Evaluations and Demonstrations are available at the links indicated below.

Lincoln, Nebraska, Liberty Village (2006 PATH Field Evaluation)

www.toolbase.org/fieldevalliberty

- Five side-by-side, 1500-s.f. homes with same floor plan. Three were plumbed with PEX in a manifold, home-run configuration. Two were plumbed with conventional copper in a trunk-and-branch configuration.
- Average labor time for plumbing rough-in in three PEX homes was 19.3 hours; copper rough in averaged 36.1 hours. All installation was performed by the same plumbing crew.
- Material costs (years 2005-2006) for PEX were about one-third higher than that for copper: \$505 for the PEX; \$378 for copper.
- Using an average labor rate of \$21.50 per hour (including fringe benefits), total installed cost was 20% lower for the PEX system (\$920) versus the copper system (\$1,154).
- Pressure and flow rate were measured at each fixture. The PEX system, in most cases, maintained a steadier pressure during simultaneous flow events.
- Delivery time of hot water to the fixture farthest from the water heater was cut in half for the PEX system compared to the copper system. Delivery time to closer fixtures was about the same in both systems.

Denver, Colorado, Oakwood Homes (2002 PATH Demonstration Site)

www.toolbase.org/fieldevaloakwood

- Production builder of move-up homes implemented PEX and a plastic plumbing manifold system
- Cost savings ranged from \$300 to \$1,200 less than lowest copper pricing
- Open-web floor joists facilitated installation of PEX and other technologies
- Flushed main street line of sand and dirt before running water through manifold to prevent damage; installed valve upstream of manifold for this purpose
- To ease overhead work, plumbers used stilts commonly used by drywall contractors

Freehold, New Jersey, K. Hovnanian (2002 PATH Field Evaluation)

www.toolbase.org/fieldevalkhov

- Production builder incorporated several advanced technologies in its "Idea House." System was hybrid copper/PEX
- Savings were approximately \$200 versus conventional copper
- Plumbers did not like transitioning between copper and PEX in this hybrid system; however, they agreed that system can save installation time
- Code officials were reluctant to allow this technology
- Plumbers learned to unroll the tubing before pulling through walls to prevent kinking; pulling tubing may require two workers—one to push, one to pull
- Other lessons learned – tubing tends to become stiff in cold weather; crimping tool can become cumbersome in tight spaces

Philadelphia, Pennsylvania, Model reMODEL (1999 PATH Field Evaluation)

www.toolbase.org/fieldevalremodel

- Remodel of a Philadelphia row home demonstrating numerous technologies including a home-run plumbing manifold with PEX piping
- Cost savings was \$700 compared to conventional copper pipe
- Plumbing system installation took less than half the time to install copper piping

MAKING THE SWITCH

What is required to transition from your current building practices to using this technology?

Consult local codes and manufacturer specifications – Although PEX is approved by all model codes, it may be restricted by local codes. Therefore, it is useful to consult local codes for specific requirements before designing a PEX plumbing system. Obtain a system design from the manufacturer, or use manufacturer-specified design tables.

Optimize home designs – By considering the plumbing layout during the house design phase, many potential problems and inefficiencies can be avoided. The best plumbing design for performance and efficiency will minimize distance from the water heater to the fixtures. This can be accomplished by a few basic design principles including: grouping fixtures (for example, stacked or back-to-back bathrooms); centrally locating the water heater; using common holes and chases to facilitate installing bundles of piping simultaneously to reduce installation time; incorporating building elements, such as open-web floor trusses, which can dramatically decrease installation time; finding a central location for the manifold.

Select piping system type – PEX piping can be configured in three ways: conventional trunk-and-branch, home-run, or remote manifolds. The type selected will depend on materials and installation cost, performance, and installer preference.

Plan piping routing, manifold, and valve locations – Guidelines include: minimize fittings; group fixtures together; minimize pipe lengths; select appropriate pipe diameter; bundle runs of piping; at transitions, provide solid attachment; and use color coded piping for simplicity.

Work with your trade contractors – Trade contractors must be knowledgeable about the proper installation of PEX and about issues such as manifold proximity to water heaters and other heat sources. Trade contractors need special crimping tools to make connections; one tool is needed for each piping diameter. Crimping tools require periodic calibration. Therefore, it is important to check the crimps with a gauge to ensure they are adequately compressed. Tool costs can range up to \$300. Short training videos and a design guide for PEX systems are readily available (see Resources, page 4).



DEFINITIONS

Cross-linked Polyethylene (PEX) Piping

A type of flexible plastic piping, suitable for hot and cold water supply due to its resistance to temperature extremes, chemical attack, and creep deformation

Central Plumbing Manifold

The control center for multiple attachments of hot and cold water flexible plastic piping that run to individual fixtures

Polybutylene (PB) Piping

A type of flexible plastic piping that looks similar to PEX, but experienced failures and caused class-action lawsuits; no longer used in U.S. markets

TECH CHECK

Below is a checklist of steps to follow if you decide to implement this technology in your next building project.

- Train trades.** Although home-run systems can be installed significantly faster than traditional plumbing, trades may require additional training and time for proper installation.
- Consider an “open building” home design [optional].** Home-run plumbing systems lend themselves to “open building” or “disentangled” home designs, where utilities are separated from each other and the building’s structure. This design offers several benefits, including ease of future upgrades and repair.

- Plan placement.** Planning is required for optimal placement of the manifold. The manifold should be installed securely on a flat surface, in an accessible area that is near the water heater, but at a proper clearance to avoid heat damage.
- Ensure proper handling and installation on site.** Plastic plumbing manifolds and PEX tubing both have specific handling and usage requirements to avoid damage from sunlight, heat, freezing or puncturing. When getting started with home-run systems, site supervision may be required to ensure that these requirements are met.
- Conduct pressure test.**

FOOD FOR THOUGHT

This section provides some things to think about before switching to this building technology – make sure it's the right choice for you.

- PEX offers many advantages and is a very durable and rigorously tested material. However, be informed about the differences between PEX and polybutylene piping. Past failures of polybutylene piping have created negative perceptions among many consumers and contractors about plastic piping. A quick primer on the issue can be found at www.plasticpipe.org/pdf/pubs/notes/TN31-2004.pdf.
- Remodelers and home builders may find that PEX is easier to work with because, unlike rigid pipe, flexible piping can be snaked through walls and floors.
- Proper planning and design will help ensure optimal system performance and efficiency. Consult design guides or manufacturer information for help with system design.
- Familiarity with local codes is vital, especially if local code officials are not yet familiar with PEX piping systems.
- If your plumbing contractor is unfamiliar with PEX piping, be prepared for the additional time and training of trades. Manifolds and PEX piping have several restrictions for proper handling; plumbers will need training to ensure that piping is used correctly, and site supervision may be needed to ensure proper installation.
- Although labor savings typically results in a lower installed cost than traditional plumbing, material cost is higher than that of rigid pipe.
- In a home-run configuration, it is beneficial to have an “open-building” design in which the home’s utilities are built to accommodate future changes. By “disentangling” plumbing from the other utilities, the building structure, and interior walls, construction and future changes are simplified.
- Home-run configurations perform best with a centrally-located water heater. Additional remote manifolds

TIP: *An open-web floor joist design allows greater efficiency for PEX installations and can result in a lower plumbing bid.*

- may be needed to serve very large homes with extra plumbing fixtures.
- Not all PEX piping is compatible with manifold systems, and special piping installation tools may be needed.
 - A tee connection on the main supply line upstream of the manifold will allow flushing of the street line to eliminate sand or dirt that collects during construction before running water through the manifold.



The Partnership for Advancing Technology in Housing (PATH) is dedicated to accelerating the development and use of technologies that radically improve the quality, durability, energy efficiency, and affordability of America’s housing. Managed by HUD, the PATH partnership includes the homebuilding, manufacturing, insurance and financial industries, and Federal agencies concerned with housing.

PATH addresses barriers to innovation, provides information on advanced building technologies, and advances housing technology research; making affordable, quality American homes a reality.

For more information on the PATH program, visit www.pathnet.org.

Tech Specs are Prepared for PATH by the NAHB Research Center.

RESOURCES

ToolBase Services

Information on this building technology and many others brought to you by PATH and the building scientists at the NAHB Research Center

Online installation videos are available for immediate download and viewing under the PATH Tech Inventory on ToolBase www.toolbase.org/techpex

Also available is the *Residential PEX Water Supply Plumbing Systems Design Guide* at www.toolbase.org/pexdesignguide

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