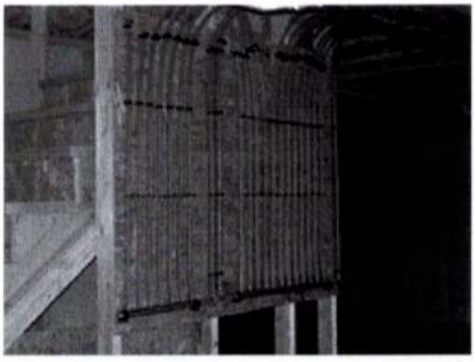
PEX Plumbing: What to Inspect After Installation



A majority of homes in the U.S. have copper pipe plumbing systems. Copper has a proven track record as a reliable material for carrying water. However, a relative newcomer to the scene is quickly gaining popularity as a material that offers even greater benefits than copper. This newcomer is known as PEX, or cross-linked polyethylene. PEX is a type of plastic composed of individual molecules that have been permanently linked together, creating a flexible, durable, and stable material. Through rigorous testing, PEX has proven itself as a material well-suited for plumbing systems.

Installing a PEX plumbing system is easier than installing copper or CPVC. Fewer fittings and joints, as well as a lightweight, flexible nature help installers save significant time on installation. And these are just a few of the benefits from the installer's point-of-view. From the homeowners' point-of-view, they're getting a system that resists freezing, increases the response time of hot water, decreases the amount of energy the water heater uses to deliver hot water, dampens water hammer, and provides excellent flow. In order for homeowners to really see these benefits, though, it's important for the homebuilder to properly inspect the system after installation to make sure everything works.

Below is a list of important areas of a PEX plumbing system to inspect after installation. Keep in mind that this list doesn't include every area, so always refer to the PEX manufacturer's instructions as well.

- Make sure fasteners hold the piping in position and prevent strain on the fittings when the piping is bent. Pipes should be fastened as they enter the bend and as they leave the bend.
- Make sure vertical runs are fastened at every floor level.
- Make sure piping is fastened every 6' in attics.
- Make sure horizontal runs in floors are fastened every 32" o.c.
- Make sure long runs have a 12" horizontal offset or a loop in the piping for expansion and contraction. If the piping is looped, make sure the loop's radius is at least 8 times the pipe's diameter.
- Make sure the piping has enough slack for contraction. PEX expands or contracts 1" for every 100' of pipe with every 10°F of temperature change.
- Make sure fasteners are firm but loose enough to allow the piping to move.
- Make sure a nailing plate is installed to protect pipes run within 2" of the face of a stud or joist.
- Make sure all PEX piping is protected with plastic sleeves where it penetrates the slab.
- Make sure a pipe support is installed where piping exits a framed wall.
- Make sure a rigid sleeve protects piping that penetrates a structural wall below grade.
- Make sure the central manifold (if applicable) is installed near the water heater but not closer than 18". Installing the manifold close to the water heater will improve the response time of hot water. Ensure that piping is at least 6" away from the exhaust vent

of a gas-fired water heater.

- Make sure all valved manifold runs (if applicable) are labeled, so they can be readily identified and shut off in case of a leak.
- Make sure all valved remote manifolds (if applicable) are accessible by a removable panel, so they can be maintained and shut off as necessary.
- Make sure all fittings hidden in a floor or wall cavity are installed and joined correctly.
- Make sure all lavatories and sinks have a shutoff valve at the fixture and are prepared to receive a small diameter feed pipe.

To see these checkpoints and others paired with photographs, check out our PEX Plumbing: Post-Installation Inspection PDF. You can also learn more about plumbing systems in BuildIQ University's online training course, Mechanicals: Plumbing.

Home Inspection & Plastic Plumbing Systems, Part 2

KENNY HART

Do you know your plastic plumbing pipes?

In the December ASHI Reporter, Kenny Hart covered the positives and negatives of plastic plumbing, PVC, ABS and CPVC pipe, and pipe connections and support issues.

He explained that since the late 1950s, plumbers have been introduced to a wide variety of plastic pipe and fittings to be used in drainage, waste and vent systems (DWV), supply piping, and hot and cold-water distribution. Today, as plastic continues to evolve, more do-it-yourselfers are attempting to install and repair plumbing systems-something most of them would not have considered doing 30 years ago. When amateur installers or misinformed tradesmen use the wrong pipe for the job, the system is more likely to fail, or even worse, the installation can be an accident waiting to happen. This is where the home inspector can have a huge impact. Home inspectors see the improperly used products, and can alert owners and clients to dangerous situations. But home inspectors need to be able to do more than describe the pipe they find; they need to be certain of its application.

Flexible Plastic Tubing: Polyethylene (PE), Cross-linked Polyethylene (PEX) and Polybutylene (PB)

Plastic fittings and hose clamps are used extensively in irrigation plumbing

Polyethylene tubing (PE) Polyethylene (PE) is used in residential plumbing for cold-water service piping. Because of its low cost, it's used extensively for irrigation. Sold in rolls, the pipe can be purchased from plumbing wholesalers and at many home improvement stores. Plastic barbed fittings and hose clamps are used in many residential applications to make connections, although some systems do not require the hose clamps.

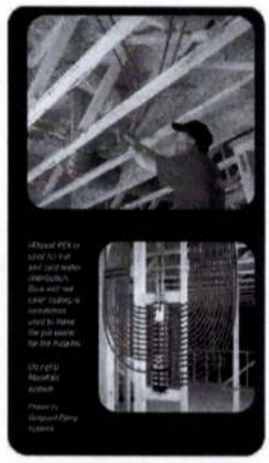
Since I will not be covering all the pipe applications of specific materials, be aware there are many, such as the extensive use of PE as an electrical conduit material and for gas piping. Also, many municipalities use PE products to
provide other utility service needs.

Cross-Linked Polyethylene or PEX

Cross-linked polyethylene, known as PEX, is created by one of several processes that link different polyethylene molecules to create a more durable piping material. The final result is a product said to be more durable than PE alone, and a plastic ideal for use in hot water applications. PEX comes in a variety of colors including red, white, blue and even orange. In addition to being used for hot and cold water supply and distribution, it is used in various heating applications such as radiant floor heat and geo-thermal systems.

PEX tubing has been used in hot and cold water distribution systems and for hydronic radiant heating in

Europe for many years. It was introduced in the United States in the 1980s. Because of concerns about leaking, fear of lawsuits, code changes and limited availability, PEX has replaced polybutylene (PB) as the most widely used flexible plumbing pipe. It is similar to polybutylene in that it installs easily, can be purchased in long rolls, and has better freeze protection than most rigid pipe. It is also similar in that it is not solvent welded. In fact, solvent cement will damage the product and should never be applied. Gary Morgan of Vanguard Piping Systems points out that due to problems encountered with polybutylene piping systems, PEX manufacturers have developed tougher testing protocols for their products, particularly in areas of concern such chlorine concentrations.



PEX is often installed as a manifold system. With manifold systems, a battery of tee fittings are generally installed at one location in the house. Fed by a large hot or cold water line, small single lines are then plumbed from the manifolds to stub-out fittings behind each fixture. Plumbers often refer to this as a "Home Run" system. This method reduces the number of fittings installed and can eliminate potential leaks. Manifold systems are used frequently with hot and cold water distribution and in radiant floor heat. Factory-built manifolds are also popular. Because of its flexibility, PEX is currently a big seller in the radiant floor heat and snow melting markets.

Fittings on the left are PEX fittings. The fittings on the right are Polybutylene. They are similar, but not interchangeable.

With PE, PEX and PB, there are several methods of connecting pipe to fittings you will likely observe in homes. Mechanical joint and insert compression fittings, also known as crimp fittings, are the primary methods used in residential plumbing. The insert compression fittings are very similar to those used with polybutylene, but the fittings are not interchangeable. PEX crimp fittings are made of copper and brass, and some plastic insert-type fittings are sold. Crimp rings are annealed copper and colored black for PEX use. The earliest PB crimp rings were aluminum and are no longer used.

Transition crimp fittings are available to allow PEX to be spliced into an existing PB system. The crimp fitting used to make the connection is slightly larger on the PB side to accommodate the slightly thinner PB pipe wall.

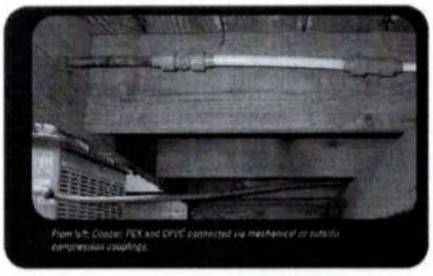
Home inspectors will not be able to see the actual fitting if it is properly installed because it will be covered by the overlapping pipe. When these crimp-type transition fittings are installed to join the two products, home inspectors should see one black and one copper crimp ring. The black ring secures the PEX pipe and the copper ring secures the PB pipe.

PB to PEX crimp fitting

Another method of connecting pipe and fittings uses a compression fitting that secures a plastic ring around the exterior of the pipe as it pulls the pipe into the fitting. These fittings also can be used to connect unlike CTS (Copper Tube Size) tubing material together. It is quite common

to find PB and copper connected in this manner and any combination of piping materials such as PB, PEX, CPVC and copper are possible.

PEX can be damaged by UV rays and is not recommended for use where it will be exposed to sunlight. It can also suffer from prolonged periods of high chlorine concentrations. Chlorine numbers above 4 ppm (parts per million) appear to be an area of real concern for many manufacturers.



From left: Copper, PEX and CPVC connected via mechanical or outside compression couplings.

The manufacturer or a local ordinance sometimes prohibits directly connecting a water heater with PEX. Some require an 18" metal or otherwise-approved connector between the PEX pipe and water heater tank connections. Some manufacturers such as Zurn(r) will allow a direct connection to electric water heaters, but suggest using metal flex connectors to obtain a required 6" clearance from gas water heater flues. By using the flexible metal connectors, the installer can bend and position them away from the flue to obtain the 6" clearance; then the connector can be joined to the PEX. Your local plumbing supplier should be aware of the PEX products used in your area and, along with the code officials, can help you verify the requirement.

Polybutylene (PB)

Most experienced home inspectors have heard about polybutylene plumbing. I wrote two follow-up articles to Mike Casey's 1995 article on the leak concerns with this plumbing product. They were published in the November and December 2001 ASHI Reporter. PB has been a major concern for home inspectors for quite some time.

PB was installed extensively in certain areas of the United States from the late 1970s through the mid 1990s. After a high incidence of fitting and pipe failures resulted in one of the largest class action settlements in U.S. history, new installations, for the most part, had stopped by 1995. Polybutylene is a copper-tube-size water supply and distribution pipe. It is primarily gray, but in the early years, dull blue cold water supply tubing was also sold.

Plastic fittings and aluminum crimp rings were once common with polybutylene.

Initially, acetal or plastic insert fittings were used along with aluminum crimp rings to join pipe and fittings. Because of reported failures, fittings were later made of copper and brass, and the newer crimp rings were made of copper. Manifold systems, similar to the ones used today with PEX, were extremely popular with PB.

Many believe that PB is no longer sold, but I recently located a supplier on the internet that sells some pipe and fittings, and I deal with a plumbing supplier in Virginia Beach that keeps the fittings and crimp rings stocked along with the PEX products. Since many municipalities have banned the use of the product, I'm told purchases are primarily for repairs. Though this is likely true, the product remains listed in the 2003 International Plumbing Code.

Specific disclosures for PB might be in order

Throughout the country, I make presentations on polybutylene plumbing concerns. I installed the product in the 1980s and 1990s. Sometimes I find home inspectors who are misinformed about the pipe and fittings or are just skeptical about the problems. I always recommend that no matter what a home inspector believes about PB problems, or about the product concerns, he or she make a formal disclosure to the client. Here are some indisputable statements that can be included:

- Polybutylene has been involved in several major class action settlements.
- Over a billion dollars has been paid from settlement funds.
- Some hazard insurance companies will no longer insure homes piped with this product.
- Some home warranty companies exclude PB leaks from
- coverage

Support issues for flexible pipe

With PE, PEX and PB, the so-called poly products, support and expansion are major issues. Poorly supported sections of the system can whip as faucets and appliances such as washing machines shut off. This is not only noisy; it can cause fittings and tubing to separate. A properly installed system with support clamps every 32" will still show some slight sagging because it is equally important that the system not be over-supported. Over-supporting the pipe or using extremely tight clamps can interfere with pipe expansion. Though installed within covered walls and rarely seen by home inspectors, plumbers sometimes create expansion loops to allow for pipe movement. An expansion loop is simply a 360° loop in a section of tubing. It will most likely be found in a vertical pipe called a riser.

Plastic talons are probably the most popular device used to provide support for poly distribution systems. Because these products easily snap onto the pipe and have a pre-set nail, they also are used with copper pipe and CPVC as well. Talons allow for some pipe movement, which seems to accommodate normal expansion and contraction well. When metal clamps and metal strapping are used on poly piping, the possibility of pipe damage and a leak is substantial. As a plumber, I've made many repairs where loose metal strapping was used instead of a plastic talon.

Beyond the Scope: Testing plastic plumbing systems

Plumbers know that testing plastic plumbing systems can be serious business. Failure to locate leaks before walls are covered can cause extensive structural damage. Once a water service line is covered by soil, a leak can be difficult to locate and costly to repair. Testing procedures are often determined by the manufacturer; sometimes, they are determined by local code officials. One common thread that runs throughout testing procedures for plastic piping systems is that hydrostatic testing is the best and safest method for testing these systems. In other words, test with water.

The makers of plastic pipe used for DWV, water supply and distribution piping strongly discourage using compressed air or gas to test plastic pipe and fittings for leaks. Testing with air can lead to a complete failure of the piping system and can cause serious injury. Compressed air or gases contain a great deal of energy. Under certain circumstances, this energy could cause the pipe and fittings to rupture or break. Pipe shards and fittings can be blown throughout the job site, injuring anyone nearby. Charlotte Pipe Company notes that testing with water can get somebody wet. Testing with air can lead to injury or death.

PVC DWV and ABS DWV plastic pipe and fittings are not designed for pressure use. The actual pressure rating of both products is zero. Because of this, the manufacturers do not recommend pressure testing DWV systems. For most DWV installations, manufacturers recommend a 10-foot hydrostatic pressure test. To do this, plumbers connect a section of 3" or 4" diameter pipe and allow it to stand 10 feet above the DWV plumbing system or portion of the system to be tested. The system is then slowly flooded with water until the water runs over the standing pipe. Then the system is visually checked for leaks.

Now in the real world, plumbers rarely test just a portion of a residential DWV system, which would be necessary to stay within the hydrostatic test's recommended 10 feet. Unlike commercial high-rise properties or multi-story apartments where plumbers might divide up and test portions of the building, residential plumbers generally test a single-family home at one time and in its entirety. On a two-story or taller house, this could cause some lower fittings to have more than 10 feet of water above them. I speak from experience when I say that, occasionally, you might blow a fitting, test cap or plug. This could account for some of the strange water stains you sometimes see when performing a framing inspection or when checking out a crawlspace.

During a home inspection, you might discover a test cap (see photo) secured to a plumbing vent at a lower roof level. For residential testing, all drain openings are sealed below the highest level's plumbing vents. The system is then filled with water until it flows over a vent and onto the roof. The cap was likely placed there to force water to the highest level of the building to meet the 10-foot requirement for the hydrostatic test. After the system is tested, the cap is sometimes overlooked and not discovered until the home inspection. Of course, removing the cap is beyond the scope of the inspection, but I always recommend reporting it as it sometimes robs the system of the air needed for good operation.


A test cap secured to a plumbing vent

As previously noted, DWV systems should be tested using the fill test. Testing a water supply or distribution system should also be done hydrostatically; but will likely require the use of a hydrostatic pump. Some localities allow a street pressure test of the piping; but many, along with manufacturers, suggest a hydrostatic pump be used to elevate the water pressure to 100 psi or more. In my area, 200 psi is required for some poly systems.

Finally, my disclaimer

I spend a lot time in plumbing supply houses. Recently, I was introduced to a new fitting that could be installed without the use of pliers, wrenches, solder or glue. The fittings simply snap onto the pipe. When I see these things, it reminds me of how far plumbing has come over the past century or so. But as with many piping materials and fittings, there is more to trying something new than simply following the manufacturer's instructions. Code acceptance often determines not only how something is used, but if it's used at all.

After more than thirty years in the trades, I've learned localities will amend, restrict and sometimes interpret portions of the code in ways that can cause uninformed plumbers to lose thousands of dollars on jobs and make home inspectors standing their ground look foolish. So verify what I've written with your city and county officials, and talk to local plumbers about what is normal, customary and acceptable in your part of the world. And from time to time, verify again. Because when it comes to plastic plumbing systems, the only thing constant is change.

For more information on plastic pipe, go to the Plastic Pipe Institute Web site, www.plasticpipe.org, or to the Plastic Pipe and Fitting Association site at www.ppfahome.org.

A Short Guide to Plumbing Acronyms

- DWV - Drain Waste and Vent
- PVC - Polyvinyl Chloride
- ABS - Acrylonitrile Butadiene Styrene
- CTS- Copper Tube Size
- PB - Polybutylene
- PEX - Cross-linked Polyethylene
- CPVC – Chlorinated Polyvinyl Chloride
- PE - Polyethylene
- UV – ultraviolet
- PPM – parts per million

Poly pipe inspection tips for home inspectors

Many of the same rules apply when inspecting different poly pipe installations. Here's a list of some of the conditions that should be noted when observed during a home inspection:

- Identify gouged, sliced, kinked, discolored or otherwise damaged material.
- Note poor support.
- Note overly tight straps.
- Protective sleeves should be installed where the material passes through concrete slabs or concrete block walls.
- Note poor crimps - Good crimps will be perpendicular to the centerline of the pipe, about 1/8" to 1/4" from the end of the tubing.
- Note exposure to direct sunlight as it can cause degradation of the pipe.
- Note multiple cut-out crimps fittings found in crawlspaces and attics as they could indicate a history of leaks.
- Sillcocks should not be directly attached to poly pipe material.
- The pipe should be installed at least 12" above and 6" laterally away from a heat source such as a can light, flue, etc.
- Poorly supported tub and/or shower valves can cause fittings to fail.
- Poly pipe materials should not be used in highly chlorinated water such as found in swimming pools and some other recreational facilities.
- These products should not be used for Temperature Pressure Relief Valve discharge piping. Note: With some PEX products, this appears to be a support issue more than a temperature issue, and some manufacturers are working to change the restriction.

A confusing issue for some inspectors is poly use on domestic hot water circulating loops. Some poly products such as PB should not be used on domestic hot water circulating loops. PEX products such as Vanex® (PEX) are approved by the manufacturer for this use. A Zurn® representative stated that when the water temperatures exceed 140°F and chlorine levels exceed 2ppm, they do not recommend their PEX product for this use. Check with your local code authorities.

Special thanks to Dewey Manus of the Charlotte Pipe Company; Lorry Ebeling and Gary Morgan of Vanguard Piping Systems; and Mary Berklich of Genova Products.

Kenny Hart is an ASHI Member, Virginia State-Certified Home Inspector and Master Plumber from Hampton Roads, Va. Kenny has been a speaker and instructor at numerous home inspector conventions. Meet Kenny at the 2006 InspectionWorld in Fort Lauderdale.