

Plastic Plumbing Comes of Age

In cost, reliability, and ease of installation, PEX tubing is poised to compete with copper

by Thorp Thomas



If your plumber is up-to-date, you may have heard of a new product for potable water piping — cross-linked polyethylene, or PEX, tubing. In fact, this product is not so new: PEX has been available for potable water piping in Europe since 1971, and the tubing has been used for heating in the United States since 1980. With polybutylene (PB) off the market, many U.S. plumbers who had been using PB for domestic water piping are switching to PEX.

My company has been installing PEX tubing since 1981, for both heating and plumbing. We have hundreds of jobs to our credit, from simple bath remodeling to multimillion dollar homes, big condo projects, and large underground distribution systems. After using hundreds of thousands of feet of every kind of copper and plastic tubing, in just about every kind of application imaginable, I think PEX tubing is the best product. Versatile and reliable, it has made my job easier, faster, and more profitable.

Lightweight, tough, and flexible, PEX tubing is ideal for sub-slab jobs (above) and messy retrofits. At right, the author connects a home-run supply line to a basement manifold.





Figure 1. Standard manifolds are available from PEX suppliers (left), but the author prefers to make his own from copper pipe and brass fittings (right).

Manifold System

Almost all PEX plumbing is installed using the “home-run” system, where separate hot and cold supply lines for each fixture run back to a central manifold. Several companies supply manifolds for these systems (see “Sources of Supply”), but I prefer to make my own manifolds out of copper and brass components (see Figure 1). My shop-built or site-built manifolds cost less than the store-bought brands, give me more flexibility, and are easier to modify if the customer wants to add runs later on. And since I make my manifolds from common materials that are readily available, I don’t have to worry that parts won’t be available if I need them five or ten years from now.

Each manifold has a hot and cold main, with fittings as needed for each fixture. We pair up the hot and cold supply for each sink or shower opposite each other, and clearly label each line to show which fixture it serves. Some brands of PEX come in a variety of colors so hot and cold lines can be color-coded; alternatively, we simply mark hot and cold lines with red and blue tape.

Each line has its own shutoff valve at the manifold, as well as the usual shutoff valve at the fixture. The hot and cold manifold mains also have individual shutoff valves in case we need to make a repair or expand the system.



Cutting PEX

PEX is best cut with a special scissors-type cutter with a sharp blade (Figure 2). With a slight rotation while you squeeze the handles, you have a perfect square cut. Several PEX manufacturers supply various versions of this tool.

My partner always uses the scissors tool, but I almost never do: Now that I’m used to it, I find it’s easy to cut PEX with a pocketknife. If you use a knife, make sure your cuts are good and square — a diagonal cut will not make a good joint when the tube is slid over the fitting.

Making Joints

Every PEX manufacturer supplies fittings to go with its tubing. Naturally, if you’re using a company’s tubing, they want you to use their fittings, too — no company recommends mixing brands of tubing and fittings.

The different methods of making joints vary quite a bit. Wirsbo’s basic joint for residential plumbing is a simple expansion joint, based on the tubing’s “memory,” or tendency to return to its original shape whenever it’s deformed. To make the joint, you expand the tube with a special Wirsbo insert tool and quickly slide the expanded tube over the nipple of the fitting. In a split second, the tube shrinks and grabs the fitting (Figure 3). You have to move fast to slip in the fitting, and once the joint’s

together, you can’t pull it apart. For added strength, you slip a second ring of PEX over the tube before expanding it. After 30 minutes, the joint can be pressure-tested to 200 psi.

I prefer the crimp fittings supplied by Vanguard, because they’re easier to use. With this fitting, the tube doesn’t have to be expanded: The male end of the fitting slides into the tube easily. You use a special crimping tool supplied by Vanguard to crimp a copper ring over the joint (Figure 4).

Unlike the expansion joints, which are permanent right away, crimp joints can be pulled apart until the ring is actually crimped. This allows us to make a temporary joint at the end of a line, using a fitting that doesn’t belong there, until we come back with the correct part. However, you can get in trouble leaving joints assembled but uncrimped. Sometimes it seems quicker to make a bunch of joints, then go back and crimp them all at once. But you’d better not forget one, or you’ll have a leak.

Vanguard supplies a go/no-go gauge for checking joints to make sure they’re properly crimped. If the gauge slips over the ring, it’s a go. But Vanguard’s new crimp rings also have a black coating that gets scraped off when the ring is crimped — if the ring’s still black, you know it hasn’t been crimped. However, you still have to routinely



Figure 2. PEX tubing can be cut with a special scissorslike tool (above), or simply with a sharp pocketknife. A crisp, square cut is critical for a lasting joint.

check the crimped joints with the gauge to make sure your crimping tool is properly calibrated.

A third type of joint, which uses a compression fitting, comes as standard issue on manifolds (and the valves I use in making my own manifolds). To make these joints, you simply slide the tubing over the nipple, then tighten down a locknut that pushes a compression ring over the tubing. Depending on the tube's inside diameter and the fitting size, you may have to expand the tube first. When these joints are only finger-tight, they can be backed out; but once you tighten them with a wrench, they'll never come loose. For added security, though, we use a thread lock like Loctite to make sure the nuts don't work off.

The mother of all joints is a compression-ring fitting system supplied by Rehau. To make those connections, you expand the tube and slip it over the fitting, then use a foot-operated hydraulic press to force a heavy-duty brass ring over the tube and fitting (Figure 5). The Rehau tool currently costs more than \$2,000, although the price is expected to drop. I have one in my truck, but I rarely use it on residential jobs. That super-joint is worth making for high-pressure water lines or underground supplies and other inaccessible locations, but it's the slowest and most complicated of the connecting methods, and it's overkill for most potable water plumbing. However, our town will accept that kind of joint on their side of the water meter, where they won't accept our crimp joints.

Hangers and Supports

PEX has to be supported every 2 to 3 feet on horizontal runs, and every 4 to 5 feet on vertical runs. The common hanger styles that are used to support copper tubing can be used for PEX. However, because PEX is soft, we only use plastic or plastic-coated hangers. Each manufacturer also sells special clips and brackets as part of its system (Figure 6).

PEX should be run with a little slack in the lines to allow for linear expansion and contraction due to temperature

PEX: A High-Tech Plastic

The word "PEX" is an acronym for "cross-linked polyethylene." PEX plastic is made up of the same molecular polymer chains as ordinary polyethylene, but in PEX tubing, the long plastic molecules are physically bound to one another along their lengths — cross-linked. Cross-linking makes the plastic stronger and more durable.

Different kinds of PEX. Two different methods are currently used to produce PEX tubing for the U.S. market. In the "Engel method," used by Wirsbo, and Rehau, the plastic feedstock is mixed with a peroxide chemical that causes cross-linking at the moment the tubing is extruded.

"Silane PEX," a newer type of tubing recently introduced in America by Qest (a division of U.S. Brass) and Vanguard, is made by adding silicon to the raw materials before extruding.

Qest and Vanguard developed Silane PEX because they needed a substitute for PB, which is no longer available because of performance problems and major lawsuits. They manufacture their Silane PEX using the same extrusion equipment they formerly used for making PB.

My understanding is that both manufacturing methods produce an acceptable product. In my experience, all brands of PEX tubing perform the same in service, so I purchase based on price and availability. However, it's worth noting that Wirsbo's Aquapex has by far the longest track record of the bunch. Wirsbo has had test plumbing assemblies under continuous observation at 200 psi and 180°F since the early 1970s, with no sign yet of failure. While it's reasonable to expect the newer brands of PEX to perform the same way, Wirsbo's 25-year guarantee is clearly based on long-term testing

and field experience, not just predictions. If a customer wants the added security of that guarantee, I stick with Wirsbo on their job. But that Wirsbo guarantee only applies when the material is installed by a Wirsbo-trained and Wirsbo-certified contractor.

HEPEX and PEPEX. PEX tubing comes in different varieties for heating and plumbing. HEPEX, the type primarily used for heating, is coated with an oxygen barrier to prevent corrosion of metal elements like tanks and pumps. PEPEX is uncoated tubing primarily used for potable water.

HEPEX and PEPEX tubing are clearly labeled as such. Companies that do both heating and plumbing, like mine, need to take care not to mix the two. HEPEX generally isn't permitted for a fresh-water distribution system: Although it's the same material as PEPEX, it hasn't passed the appropriate ASTM testing process. And using PEPEX in heating systems would lead to corrosion problems.

PEX vs PB. Superficially, PEX tubing is similar to polybutylene, the infamous gray plastic tubing (no longer being manufactured) that experienced a rash of failures resulting in multimillion-dollar lawsuits. Both tubings are plastic, but that is where the resemblance ends. PEX and PB are very different types of plastic, manufactured differently, and with different performance characteristics.

My own company has stopped using polybutylene, although we have a continuing problem with some of our past polybutylene installations, particularly in high-temperature situations. But we are entirely satisfied with PEX — we have found it to be significantly more reliable than copper.

—T.T.



Figure 3. To make a simple joint using Wirsbo's method, you slide a PEX ring over the tube, expand the tube with Wirsbo's expanding tool (left), and quickly insert the fitting (right) before the PEX returns to its original diameter.



Figure 4. In the Vanguard joint system, tubing slides over the fitting without expanding (left) and is secured with a copper crimp ring. Crimping with Vanguard's crimping tool takes only a few seconds (right).



Figure 5. Rehau's joint method uses a foot-operated hydraulic press to force a heavy-duty brass ring over the tube and fitting. The author rarely uses these heavy-duty joints in residential work.

changes. Going from room temperature to 120°F can make a hot water line grow by as much as 5% in length.

When we run lines, we try to “take the high road,” running our PEX on top of natural supports like framing and other plumbing. A note of caution, however: Never run PEX above, or anywhere near, high-temperature pipes like exhaust flues. The tubing will soften and droop if it gets hot. Years ago, a section of PEX tubing I ran too close to a hot flue sagged down onto the flue pipe and melted right through. I've never repeated that mistake.

By the same token, you can't connect

PEX directly to a boiler or water heater. Most codes call for a 3-foot run of copper at the water heater, or a 7-foot copper run at the boiler, before switching to PEX.

Pros and Cons of PEX

PEX tubing comes in all standard nominal sizes ($\frac{1}{8}$ inch through 2 inches). National plumbing codes mandate certain minimum pipe sizes to each fixture or bathroom group, but they also mandate maximum line pressures in pounds per square inch (psi) and minimum flow rates in gallons per minute (gpm) — after all, it's the flow at the faucet that really determines whether the customer's needs are met.

In this regard, manifold systems using PEX tubing often give better service than copper systems, because they provide better flow rates. The major difference in flow between equal runs of PEX and copper comes when you add fittings to a copper pipe layout to accommodate corners and bends — each fitting reduces flow and pressure.

In calculating required pipe sizes for copper water supply lines, plumbers use tables that account for numbers of joints as well as lengths of run. In terms of flow restriction, each copper elbow adds the equivalent of 10 linear feet to the “developed length” of a run. Piping layouts with fittings necessitate larger diameter pipes to provide the required volume to the fixture. PEX has the same flow rate as copper tubing per equivalent size and length, but because it easily bends around obstacles and snakes through framing cavities, PEX lines generally run all the way from the manifold to the fixture with no joints, and thus less pressure drop or flow reduction.

Even the straight joints that are needed to make long straight runs with copper pipe can reduce the pressure and flow in the pipe, if (as often happens) the ends of the pipe are not properly reamed out before each joint is made: Resistance to water flow really occurs at the inside surface of the tube, and turbulence around the rough joints causes significant pressure drops in a straight pipe.

Parts and labor. Every sweated joint in a run of copper pipe takes time.

Plastic tubing is only a little cheaper to buy than copper, but with so few joints to make, it's much cheaper to install.

On the other hand, copper fittings are a fraction of the cost of equivalent PEX fittings. So for short, simple runs with few joints, copper is the more economical choice.

Reliability. In addition to reducing flow and pressure, the many elbows you often need to run copper lines to a fixture are a potential source of leaks. Leaks usually happen at joints, and with copper, the joints are often buried in a wall or floor. To fix a leaking joint can mean destroying and repairing finish work — usually the biggest expense involved. With PEX, the only joints are usually at the manifold or at the fixture, easily accessible in case of a leak. For underslab work, we have to use PEX — no joints are allowed beneath a slab, and concrete will corrode copper pipe.

Plumbing leaks often happen because someone — a carpenter, drywaller, or homeowner — punctures the tube with a nail or screw. Believe it or not, that is much more likely with copper than with PEX. The average nail-banger can easily make a hole in a rigid copper pipe, but PEX is so flexible that it will usually slide out of the way rather than suffer a puncture. PEX gets a hole only if it's trapped and can't move.

If PEX is punctured, repairs are simple. Snip the tube, slide in a fitting, crimp the ring, and you're done — no fire, no solder, no chemicals. I've even repaired tubes when the water pressure couldn't



be shut off. I got good and wet, but I fixed it. That's not so easy with copper.

Workmanship counts. Performance problems are rarely an issue with PEX. However, customers will notice a sloppy job. The flexible plastic tubing tends to droop and sag, and when it's exposed to public view it leaves a sense of unprofessionalism. PEX also expands and contracts quite a bit from changes in temperature, so no matter how neat it looks when it's installed, it may move around later and not look as nice. For reasons of appearance, I switch to copper when running lines through occupied space.

No matter where our lines run, we always bundle our tubing together with plastic tape as we go, then go back later with pull-ties. That way, the tubes sup-



Figure 6. Various clips and supports are available from pipe manufacturers to help support PEX runs (above). Where possible, individual tubes should be bundled together for support and a neat appearance (left).

port one another and keep each other from moving around as much. This makes for a professional-looking job.

The movement of PEX sometimes causes a noise problem. When hot water moves through the tube, the tube's linear expansion will cause it to slide slowly through the holes in joists or studs, making a noticeable "tick, tick, tick" sound. To prevent that, suppliers make a soft foam insert to wrap around the tubes where they pass through framing members (a rolled-up piece of cardboard also works). ■

Thorp Thomas owns and operates Heatkist, Inc., a plumbing and heating contractor in Exeter, N.H. He has more than 15 years' experience working with plastic tubing.

Sources of Supply

IPEX

7346 S. Alton Way, Suite G
Englewood, CO 80112
800/473-9808

Rehau

1501 Edwards Ferry Rd.
Leesburg, VA 27076
800/247-9445

Stadler Corp.

3 Alfred Circle
Bedford, MA 01730
617/275-3122

U.S. Brass

17120 Dallas Pkwy.
Dallas, TX 75248
800/872-7277

Vanguard Industries

831 N. Vanguard St.
McPherson, KS 67460
800/775-5039

Wirsbo Co.

5925 148th St. West
Apple Valley, MN 55124
800/321-4739