

Copper and Plastic Piping

An HVAC technician must be able to handle, cut, bend and join several kinds of piping including copper, steel, iron and plastic. This module focuses on copper and plastic piping.

Refrigerant piping should be clean and free of contaminants that could harm the system. Using sealed, ACR copper piping and fittings minimizes system contamination.

Remove the charge from a pressurized system before soldering or brazing. Keep fittings to a minimum to reduce leaks and pressure drop.

Residential and light commercial HVAC systems normally use small-diameter copper tubing to connect components.

Depending on function, some tubes may be pre-charged with refrigerant and covered with insulation. Large commercial refrigeration systems typically use larger diameter refrigerant lines.

Soft copper tubing is used in smaller systems and ranges in size from 1/8" to 1 3/8" in diameter. The term tubing generally applies to thin-wall materials that are joined together by methods other than threading.

Thin-walled copper tubing can be joined by soldering or brazing or by using mechanical fittings called flare fittings. Refrigerant pipe is sized by the outside diameter (O.D.) of the pipe.

ACR pipe sizes are the actual outside diameter of the pipe. Copper pipe used in plumbing uses a nominal size that is actually about 1/8" larger than its stated size.

Copper pipe must be labeled by the manufacturer with a color code. For example, ACR copper pipe used in HVAC systems is labeled blue.

Special annealed (softened by heat treatment) copper tubing is used in air conditioning and refrigeration work and is known as ACR tubing.

Type K (heavy wall) and Type L (medium wall) tubing are ACR-rated. Type K is used where heavy corrosion is expected, while Type L is used in normal refrigeration applications. Both are available as soft- or hard-drawn types.

Soft and hard ACR tubing are used for refrigerant piping. Soft copper is available in sizes up to 1 3/8" OD, while hard copper tubing is available up to 6" OD for large commercial systems.

Copper pipe can be measured using several different methods. Read paragraph 4.2.0 in its entirety for the different methods of measuring copper pipe.

Tubing can be cut with a hacksaw, but that can introduce copper chips into the system. The preferred tool for cutting tubing is a tubing cutter.

To use the tube cutter, place it on the tube, and tighten the knob while rotating the cutter around the tube.

Use the deburring tool on the cutter to remove any burrs from the inside of the tube. Burrs can act as a restriction in the tube.

Midget tubing cutters are available for cutting tubing in areas too restricted for a standard cutter.

A fixture is helpful when cutting hard-drawn tubing with a hacksaw. Use a 32 teeth-per-inch blade and avoid getting metal chips inside the tube.

Soft tubing should be bent using a spring bender or hand-held tubing bender. Bending tubing by hand risks kinking or flattening the tube.

Small-diameter soft tubing can be bent in a radius as small as 5 times the tube's diameter. Larger tubing can be bent in a radius as small as 10 times the diameter.

Copper tubing can be joined using heat-bonding methods such as soldering or brazing, or by mechanical methods using flare or compression fittings that have the advantage of being able to be taken apart.

A flared connection is a popular method of joining soft copper tubing. Properly made flared connections are leak-proof. A special tool is used to make the flared joint.

Both single-thickness and double-thickness flares can be made. The double-thickness flare is used when added strength is needed.

A variety of flare fittings and adapters are available. They are sized based on the tubing diameter they will be used with. Special wrenches are used to tighten flare nuts.

Before flaring the tubing, remember to slide the flare nut onto the tube with the threaded portion facing the end of the tube.

A swaged joint allows tubing of the same diameter to be joined by soldering or brazing without the use of a coupling.

Any one of three types of swaging tools can be used: a combination flaring tool, a tube expander, or a hammer-driven swaging tool.

Compression joints are sometimes used for joining refrigerant tubes from 1/4" to 1 1/8" OD.

When using elbows, use a long radius 90° elbow or (preferably) two 45° elbows to reduce pressure drop.

Tee fittings should be installed so that refrigerant flows into the straight-through section and not into the right angle leg. This minimizes turbulence that can cause a pressure drop.

Elbows and other specialized sweat fittings allow copper tubing to be joined a variety of different ways.

Saddle tees are a special fitting used to tap into water lines. They should never be used in refrigeration or air conditioning piping.

The Rigid® ProPress® System is a flameless and solderless pipe joining system that mechanically joins copper using specially designed fittings that are applied with a special tool.

A variety of plastic piping materials are used in HVAC applications where water or water vapor is present.

ABS pipe is rigid and has good impact strength at low temperature. It is used in water systems and for vents and drains.

PE pipe is used in cold-water systems such as water-source heat pumps. It is joined with clamps.

PVC is a rigid pipe that is usually joined with cement but it can be threaded and joined to steel pipe with a transition fitting.

CPVC pipe has similar application and joining methods as PVC pipe.

PEX is a heat transfer tubing commonly used in radiant and floor heating systems.

Plastic pipe may be cut with a hacksaw, tubing cutter, or a special tubing shear.

PVC and CPVC pipe are joined using cement and special fittings. Read paragraph 5.6.0 in its entirety and study Figure 20 for the procedure for joining plastic pipe.

PVC cement is toxic and flammable, so it must be used with great care in a well-ventilated area.

Schedule 80 PVC and CPVC pipe can be threaded for connection to metal pipe or fittings. Different dies are used for threading plastic and metal pipe.

Building codes and local ordinances determine how HVAC piping should be hung or supported. Various hangers, clamps and straps are available to do this.

Hangers are designed to keep the pipe in alignment and to prevent it from bending or distorting.

When fastening pipes to beams and other metal structures, beam clamps or C-clamps are used.

Vertical hangers, called pipe risers consist of a friction clamp that can be attached to a structural component.

Some refrigerant or cold water lines may require insulation to prevent heat loss or gain or to prevent condensation from forming on cold surfaces.

Various insulating materials can be used. Some ACR tubing is available with pre-installed insulation. Otherwise, insulation must be field-installed according to local codes, manufacturer's specifications or job requirements.

If it is necessary to slit insulation in order to install it on existing piping runs, the ends must be joined with adhesive rather than tape.

The use of pressure from a cylinder of regulated nitrogen is the preferred method of testing to see if a refrigeration system is leak-free. A trace amount of refrigerant may be mixed with the nitrogen.

Oxygen, air acetylene, or other gases must never be used to pressurize a system.

A pressure regulator and pressure-relief valve must be included in the nitrogen hookup.

Leak testing is done by pressurizing the system with nitrogen and applying a soap solution or leak-detecting liquid to all joints. Bubbles indicate a leak.

After refrigerant has been charged into the system, an electronic leak detector can be used to find leaks.

Piping practices are governed by national codes and local codes that may take into account local climatic and geographic conditions. Always be aware of and comply with the codes in the area where you are working.

HVAC systems are electrically powered and operate under pressure, posing potential safety hazards. Make sure that electrical equipment is shut off, locked-out and tagged before working on it.

Depressurize refrigerant piping before disconnecting and use only regulated nitrogen to pressurize systems for leak testing. Never use oxygen, compressed air, or acetylene.

Wear the appropriate safety equipment and do not work in poorly ventilated areas.

Be aware that some refrigerants can become toxic when exposed to an open flame.