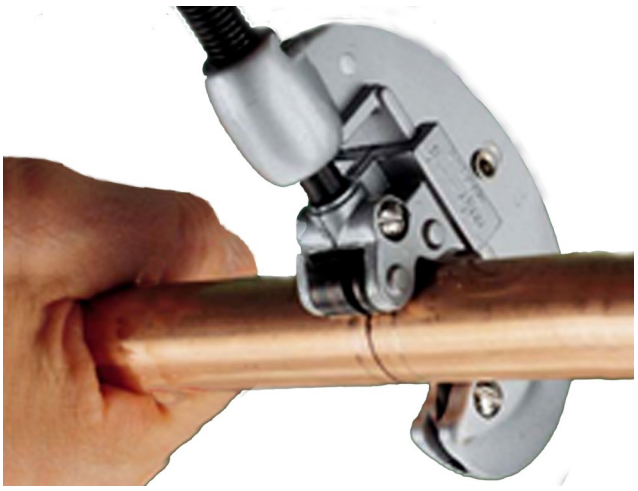
Brazing and Soldering

esco institute

Copper Tubing and Processes



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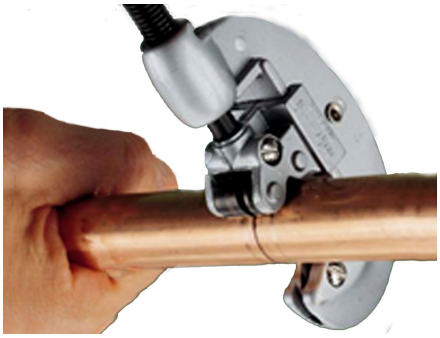
Learning Outcomes:

After completing this section, the reader should be able to:

- understand the types of tubing used in ACR applications and how they are joined.
- describe the brazing process as used to join ACR tubing.
- comprehend proper torch use and setup.
- understand soldering processes, proper torch use and setup, and the various filler metals and fluxes used.
- identify proper methods of leak testing a system after it has been soldered, brazed, or flared.

To use the tubing cutter, it should first be fitted snugly around the copper tubing. Do not overtighten. The handle is used to open and close the jaws. Once snug, rotate the tubing cutter until it feels as if its grip has loosened. Use the handle to tighten the jaws again. Continue this process until the copper is cut. Cutting copper tubing with a tube cutter should be a gradual process and should not be rushed, the tubing can be bent or crushed.



Once the tube has been cut, the end should be deburred or reamed to clear away any metal shavings or burrs left from cutting. Some tube cutters are equipped with a reaming blade for this purpose. There are also separate deburring tools that can be used to perform this task.

Flaring

Flaring is classified as a mechanical method for joining soft copper or aluminum tubing. Flared fittings are an alternative when the use of an open flame is either not desired or impractical. Flaring is the preferred method of joining tubing for many mini-splits systems.

Flaring is the process of expanding the end of a copper tube into a funnel shape. A flare nut is then used to tighten the flared end onto a threaded male fitting. The inside of the tube's flare fits against the cone-shaped end of the fitting. The HVACR industry typically uses a 45° flare angle for copper, while hydraulic hoses are connected using a 37.5° flare angle. A different tool is required for each angle.

An incorrect flare is one of the most common sources of system leaks. To help prevent leaks, cut the tubing with a sharp wheel for a clean, right-angle cut. To avoid tube constriction, don't tighten the jaws too fast. Since unremoved burrs can break off into the tubing or scratch the flared surface, remove burrs with a deburring tool. It is important that a clean cut be made for the most precise flaring.

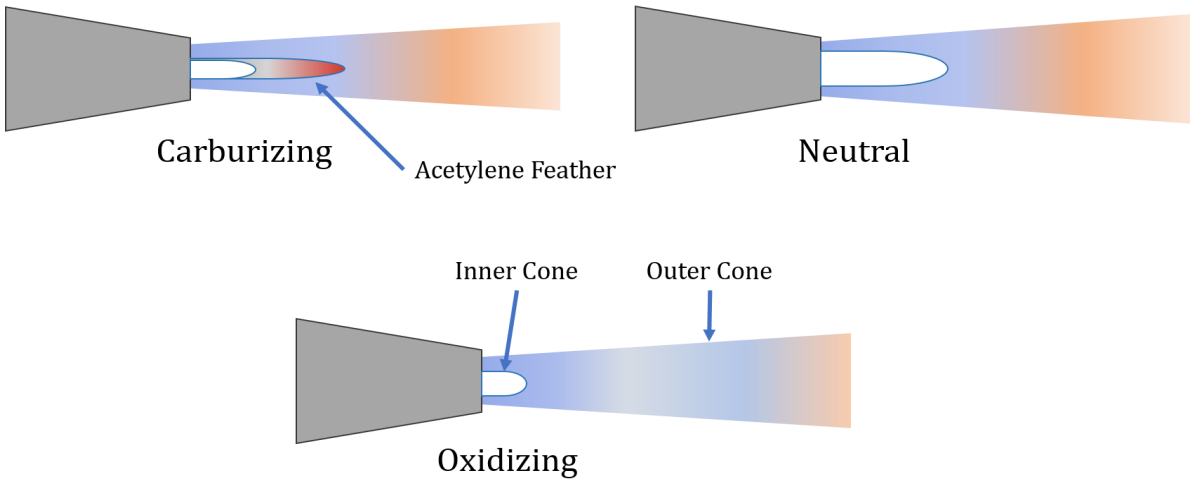
The filler metals used for the brazing process, usually called brazing rods, will depend on the types of tubing that are being joined. For copper-to-copper applications, most brazing rods do not require a chemical flux. When dissimilar metals are being joined, copper-to-aluminum or copper-to-steel, flux will most likely be necessary. Brazing filler metals contain a percentage of silver, from 5% to 56%, depending on the application. Refer to the manufacturer's literature for specific use of filler metals and flux.

Brazing Torch Flames

One of the most critical tasks performed when brazing is adjusting the torch to produce the proper flame. The three most common types of torch flames are the carburizing flame, neutral flame, and oxidizing flame. A neutral flame, typically produced by a 1:1 oxygen to acetylene ratio, has no chemical effect on the metals being brazed. It occurs when an exact amount of oxygen is burned without carburizing or oxidizing. It is characterized by a well-defined inner cone. A neutral flame is the most common flame type used during the brazing process.

A carburizing flame has slightly more acetylene, greater than a 1:1 ratio of acetylene to oxygen. It is also commonly referred to as a reducing flame, due to its lower temperature. It is characterized by an acetylene "feather" that surrounds the inner cone of the flame. A carburizing flame has three distinct flame features: the inner cone, the acetylene feather, and the outer cone. If setup properly, a carburizing flame could be used for copper to copper brazing. It will remove surface oxides from the copper, producing a cleaner joint and tubing.

An oxidizing flame has slightly more oxygen than acetylene, greater than a 1:1 ratio of oxygen to acetylene. It has a higher temperature than a neutral flame and a shorter overall flame length. An oxidizing flame promotes oxidation of copper which inhibits the flow of brazing filler metals. It should not be used to braze copper tubing.



Brazing Techniques and Procedures

When brazing copper tubing, the torch should be slowly moved around the joint to evenly distribute the heat. The highest temperature of the flame is at the end of the inner cone. To adjust the amount of heat being applied

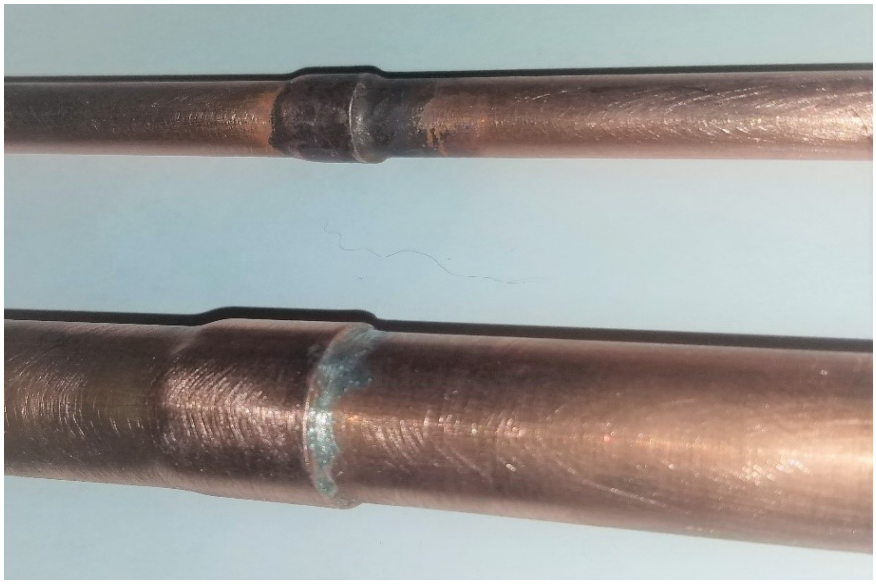
Soldering Techniques and Procedures

When soldering copper tubing, the torch should always be kept in motion to evenly distribute the heat. To adjust the amount of heat being applied to the workpiece, the distance between the flame and the tubing can be increased or decreased. Due to the lower temperatures used, a nitrogen purge is not necessary when soldering as the tubing should not get hot enough to oxidize. The filler metal should be melted by the heated copper tubing, not directly by the torch flame. The following is a general soldering procedure for copper to copper applications.

- Check the workpieces for a proper fit. They should fit together tightly, and there should be little to no movement when assembled. There should not be any large gaps in the joint.
- Clean the pieces to be soldered. The tubing and fitting should be free of any grease, oil, or dirt and should be cleaned with a wire brush or an abrasive material such as a sand cloth. Any dust or particulate from cleaning should be removed.
- Apply the flux. A chemical soldering flux should be applied to the male tubing.
- Assemble the pieces to be brazed. They should fit together tightly to prevent movement during the soldering process.
- Apply heat and filler metal. Start by heating the base metals evenly, moving the torch flame in a slow and steady motion around the joint. When the tubing and fitting are at soldering temperature, the filler metal is applied. It should coat the metal surfaces evenly and be pulled into the joint by capillary action. Do not melt the filler metal with the torch flame, it should be melted by heat from the tubing and fitting.

  TIPS: Watch the flux as it is heated for signs that the base metals are at the correct temperature. The flux will begin to bubble as the water boils off and become calm and stable as the proper temperature is reached. As a general rule, the length of solder required for the joint should be the same as the diameter of the tubing being soldered.

- Clean and inspect the joint. Flux residue must be cleaned from the tubing and fitting with a damp rag. The joint should then be inspected for defects. If necessary, the joint can be cleaned and reheated to correct any imperfections or defects.



The difference in appearance between a brazed joint (top) and a soldered joint (bottom).

13. A _____ is used during the soldering process to prevent oxides from forming and to help the molten solder to flow more easily into the joint.

14. Whether brazing or soldering, the copper tubing should be cleaned using a _____ or _____.

15. Once assembled, a system should be pressurized with dry nitrogen and then inspected for _____.

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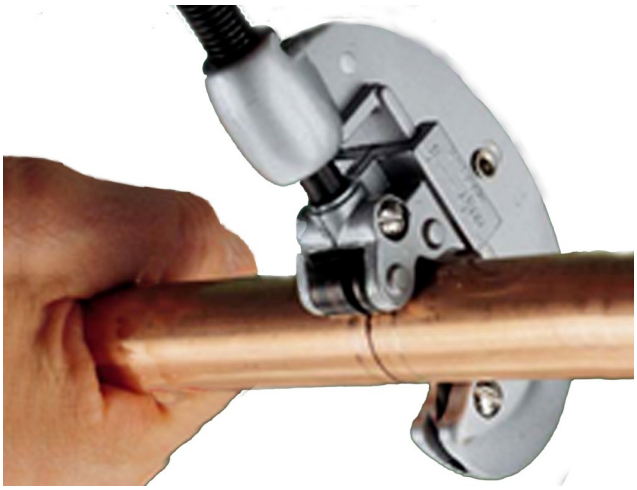

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