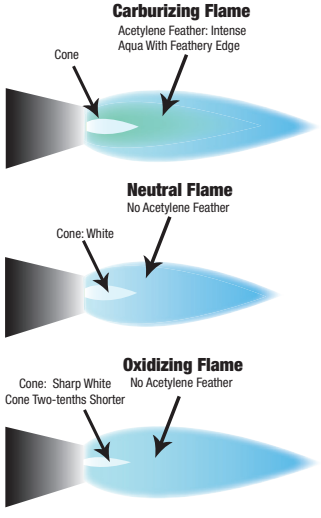
ADJUST TORCH FLAME

OXYGEN/ACETYLENE

For most brazing jobs using oxy-acetylene gases, a slightly carburizing or neutral flame should be used. The neutral flame has a well defined inner cone. Avoid an oxidizing flame.



AIR/ACETYLENE USING INFERNO® SWIRL COMBUSTION TIPS

Brazing with air/acetylene torches is a popular alternative to oxygen mixed fuel gas. The fuel gas flow aspirates air into a mixer that contains an internal vane that spins the gas to improve combustion and increase flame temperature.

If the tank has a delivery pressure gauge, set the delivery pressure to 14-15 PSI. If the tank has only a contents gauge delivery pressure is preset at the factory. Open the regulator adjusting screw all the way by turning it clockwise until it bottoms.

OPEN THE TORCH VALVE

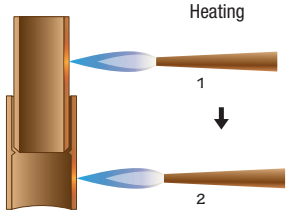
Opening the torch valve about 3/4 of a turn will provide sufficient fuel gas delivery. Do not try to meter pressure (reducing the flame) by using the torch handle valve. If a higher or lower flame is required, change to a different tip size.

OTHER FUEL GASES

Alternate fuel gases such as propane, propylene, and natural gas can be mixed with oxygen for brazing. Refer to the Harris equipment catalog or website for equipment and setting information.

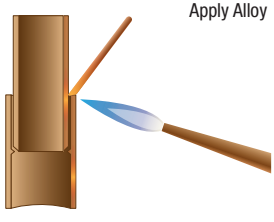
HEATING THE JOINT AREA.

Always keep the torch in short motion.

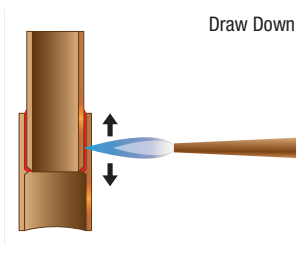


1. Start heating the tube, by first applying the flame to a point just adjacent to the fitting. Work the flame alternately around the tube and fitting until both reach brazing temperature, before applying the brazing filler metal.

2. When a flux is used, it will be a good temperature guide. Continue heating the tube until the flux passes the “bubbling” temperature range and becomes quiet, completely fluid and transparent. Watch for this on both sides of the joint to ensure even heating.



3. Direct the flame from the tube to the fitting. When alloy is applied it should quickly melt and flow into the joint.



4. Sweep the flame back and forth along the axis of the assembled joint, tube, and fitting to reach and then maintain uniform heat in both parts.

APPLY THE BRAZING ALLOY.

Feed the alloy into the joint between the tube and the fitting. Only after the base metals have been heated to brazing temperatures should the filler metal be added. At that time, the flame may be deflected momentarily to the tip of the filler metal to begin the melting process. Always keep both the fitting and the tube heated by playing the flame over the tube and the fitting as the brazing alloy is drawn into the joint. The brazing alloy will diffuse into and completely fill all joint areas. Do not continue feeding brazing alloy after the joint area is filled. Excess fillets do not improve the quality or the dependability of the braze and are a waste of material.

WHEN MAKING VERTICAL ALLOY-UP JOINTS

Heat the tube first, then apply heat to the fitting. It is important to bring both pieces up to temperature evenly. Keep the flame directed toward the fitting. If the tube is overheated, the brazing alloy may run down the tube rather than into the joint.

CLEAN AFTER BRAZING

All flux residue must be removed for inspection and pressure testing. Immediately after the brazing alloy has set, quench or apply a wet brush or swab to crack and remove the flux residue. Use emery cloth or a wire brush, if necessary.

TO SEPARATE A BRAZING JOINT

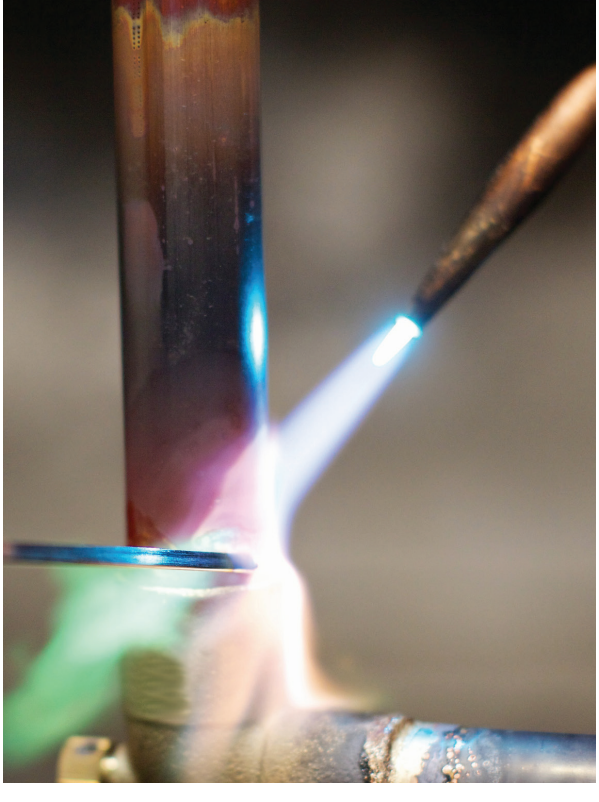
First clean the joint thoroughly, then flux the visible alloy and all adjacent areas of the tube and fitting. Next, heat the joint (tube and fitting) evenly, especially the flange of the fitting. When brazing alloy becomes fluid throughout the joint area, the tube can be easily removed. To re-braze the joint, clean the tube end and the inside of the fitting and proceed as directed to make a new brazed joint.

NITROGEN PURGE

During braze heating, oxide scale forms on the inside of the copper tube. These dark scales flake off and are carried by refrigerant and can potentially clog small orifices.

For HVAC/R and medical gas installations flow nitrogen through the tube during brazing to prevent internal scale formation. Use a low flow rate to avoid excess pressure inside the tube. A small hole at the line end will allow the nitrogen to escape.

BRAZING PIPE AND TUBING



The art of brazing is relatively simple, and the rules of common sense apply. Occasionally, however, things do go wrong, and the brazing process fails to do its job satisfactorily. The check lists below have been prepared to assist in such instances. They are intended to provide practical tips on what to what to look for and steps to correct them.

TROUBLESHOOTING

IF BRAZING ALLOY DOES NOT FLOW INTO THE JOINT, EVEN THOUGH IT MELTS AND FORMS A FILLET

1. The outside of the joint is hot, but the inside is not up to brazing temperature.
   Review correct heating procedure on page 9. Remember to heat the tube first to conduct heat inside the fitting.

2. There is a flux breakdown due to excessive heat. If overheated, the flux can become saturated with oxides and the brazing alloy won't flow. Try using a softer flame and/or applying a heavier coating of flux. On thick sections where heating is prolonged, or on stainless steel, Harris Stay-Silv® black flux is recommended.

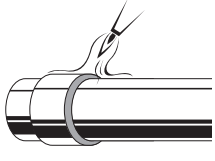
IF BRAZING ALLOY DOES NOT WET SURFACES BUT BALLS UP INSTEAD OF RUNNING INTO THE JOINT

1. Review heating techniques:
   (a) The base metals are not up to brazing temperature, and the alloy has been melted by the torch flame.
   (b) The joint has been overheated and the flux is no longer active.

2. Base metals have not been properly cleaned.

IF BRAZING ALLOY FLOWS AWAY FROM INSTEAD OF INTO THE JOINT

1. Make sure fitting is up to temperature and the flame is directed towards the fitting.



IF THE FILLER METAL CRACKS AFTER IT SOLIDIFIES

1. When brazing dissimilar metals, the different coefficient of expansion may put the filler metal in tension just below the liquidus temperature during cooling. This sometimes occurs in a copper-to-steel joint. The copper expands and contracts at a greater rate than the steel. Brazing alloys are stronger in compression, so a steel-to-copper assembly would help alleviate the problem.

2. Brazing steel (or other ferrous metals) with an alloy containing phosphorus can lead to formation of a brittle phosphide, that is prone to cracking. Braze ferrous metals with non-phosphorus content alloys.

3. Excessive joint clearance can lead to filler metals cracking under stress or vibration. Make sure clearances are held to .002" - .006" at brazing temperature (depending on alloy).

4. Too rapid quenching can sometimes cause cracking. Let joint cool more before washing off flux residue.

IF JOINT LEAKS IN SERVICE

90% of "leakers" in service are due to incorrect brazing techniques. The most common causes are:

1. Improper or uneven heating of joint. The effect of this is inadequate or incomplete penetration by the filler metal. Review proper techniques on page 9.

2. Overheating, causing volatilization of elements (phosphorus, zinc, etc.).

3. Incorrect torch flame adjustment, leading to deposition of carbon or causing excessive oxidation.

REPAIR OF LEAKS

Pinhole leaks in copper-to-copper joints brazed with phosphorus/copper or phosphorus/copper/silver filler metals can often be repaired using Blockade®. If care is taken, you can re-braze the joint with Blockade® without re-melting the original braze. Clean thoroughly before brazing.

We **DO NOT** recommend brazing over joints previously soldered with tin/lead solders. The low melting elements in the solder may prevent proper filler metal / base metal alloying.

Pinhole leaks in joints brazed with either the phosphorus or high silver alloys can usually be repaired with Stay-Brite® solder. Clean the joint thoroughly before soldering and use Stay-Clean® liquid flux.