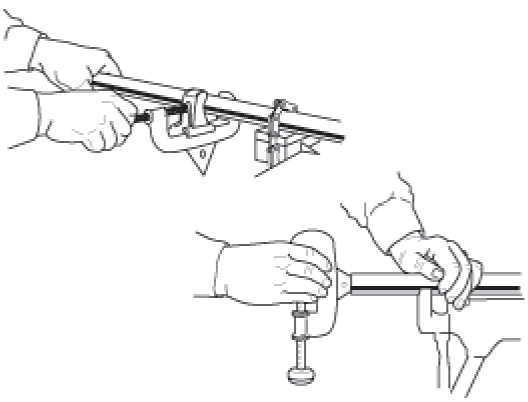
The Fine Art of Soldering

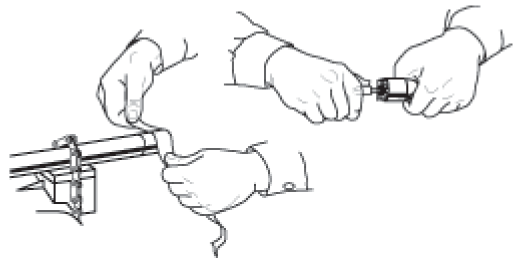
When adjoining surfaces of copper and copper alloys meet under proper conditions of cleanliness and temperature, solder will make a perfect adhesion. The strength of joint is equal to or even greater than the strength of tube alone. Surface tension seals the joint. Capillary attraction draws solder into, around, and all about the joint. It's easy to learn to make a perfect solder joint when you use NIBCO Fittings.

WITH 95-5 SOLDER AND INTERMEDIATELY CORROSIVE FLUX

1. Cut tube end square, ream, burr and size.

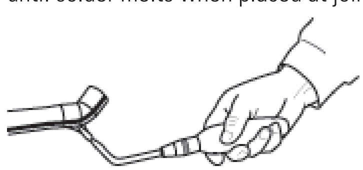


2. Use sand cloth or steel wire brush to clean tube and cup to a bright metal finish.



3. Apply solder flux to outside of tube and inside of cup of fitting carefully so that surfaces to be joined are completely covered. **Use flux sparingly.**

4. Apply flame to the fitting to heat tube and solder cup of fitting until solder melts when placed at joint of tube and fitting.



5. Remove flame and feed solder into the joint at one or two points until a ring of solder appears at the end of the fitting. The correct amount of solder is approximately equal to $1^1/_2$ the diameter of the fitting… $^3/_4$" (20mm) solder for $^1/_2$" fitting, etc.

6. Remove excess solder with a small brush or wiping cloth while the solder is plastic.

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The Fine Art of Brazing

Best results will be obtained by a skilled operator employing the step-by-step brazing technique that follows:

1. The tube should be cut to desired length with a square cut, preferably in a square-end sawing vise. The cutting wheel of the type specifically designed for cutting copper tube will also do a satisfactory job. The tube should be the exact length needed, so that the tube will enter the cup of the fitting all the way to the shoulder of the cup. Remove all slivers and burrs left from cutting the tube, by reaming and filing, both inside and outside.

2. To make a proper brazing joint, the clearance between the solder cup and the tube should be approximately 0.001" to 0.010" (0.0254mm to 0.254mm). Maintaining a good fit on parts to be brazed insures:

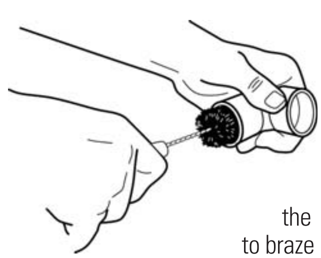
   Ease of Application — Excessively wide tolerances tend to break capillary force; and, as a result the alloy will either fail to flow throughout the joint or may flush out of the joint.

   Corrosion Resistance — There is also a direct relation between the corrosion resistance of a joint and the clearance between members.

   Economy — If brazing alloys are to be used economically, they, of necessity, must be applied in the joint proper and in minimum quantities, using merely enough alloy to fill the area between the members.

3. The surfaces to be joined must be clean and free from oil, grease and heavy oxides. The end of the tube need be cleaned only for a distance slightly more than it is to enter the cup. Special wire brushes designed to clean tube ends may be used, but they should be carefully used so that an excessive amount of metal will not be removed from the tube. Fine sand cloth or emery cloth may also be used with the same precautions. The cleaning should not be done with steel wool, because of the likelihood of leaving small slivers of the steel or oil in the joint.

4. The cup of the fitting should be cleaned by methods similar to those used for the tube end, and care should be observed in removing residues of the cleaning medium. Attempting to braze a contaminated or an improperly cleaned surface will result in an unsatisfactory joint. Brazing alloys will not flow over or bond to oxides; and oily or greasy surfaces tend to repel fluxes, leaving bare spots which will oxidize, resulting in voids and inclusions.

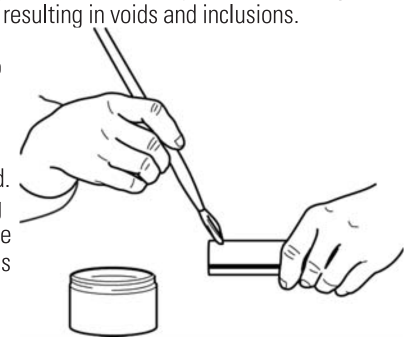


5. Flux should be applied to the tube and solder cup sparingly and in a fairly thin consistency. Avoid flux on areas not cleaned. Particularly avoid getting excess flux into the inside of the tube itself. Flux has three principal functions to perform:

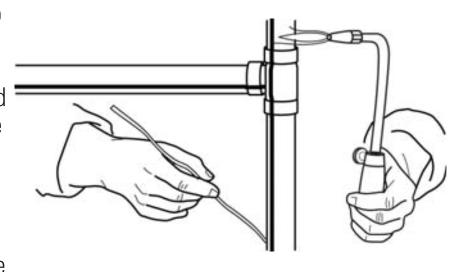
   A. It prevents the oxidation of the metal surfaces during the heating operation by excluding oxygen.

   B. It absorbs and dissolves residual oxides that are on the surface and those oxides which may form during the heating operation.

   C. It assists in the flow of the alloy by presenting a clean nascent surface for the melted alloy to flow over. In addition, it is an excellent temperature indicator, especially if an indicating flux is used.

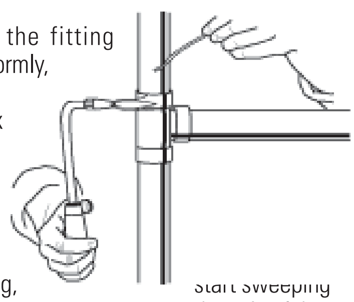


6. Immediately after fluxing, the parts to be brazed should be assembled. If fluxed parts are allowed to stand, the water in the flux will evaporate, and dried flux is liable to flake off, exposing the metal surfaces to oxidation from the heat. Assemble the joint by inserting the tube into the cup, hard against the stop. The assembly should be firmly supported so that it will remain in alignment during the brazing operation.



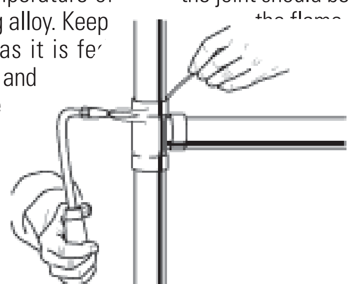
7. Brazing is started by applying heat to the parts to be joined. The preferred method is by the oxyacetylene flame. Propane and other gases are sometimes used on smaller sizes. A slightly reducing flame should be used, with a slight feather on the inner blue cone; the outer portion of the flame, pale green. Heat the tube first, beginning at about one inch from the edge of the fitting. Sweep the flames around the tube in short strokes up and down at right angles to the run of the tube. It is very important that the flame be in continuous motion and should not be allowed to remain on any one point to avoid burning through the tube. Generally, the flux may be used as a guide as to how long to heat the tube, continuing heating after the flux starts to bubble or work, and until the flux becomes quiet and transparent, like clear water. The flux will pass through four stages:
   A. At 212°F (100°C) the water boils off.
   B. At 600°F (315.6°C) the flux becomes white and slightly puffy and starts to work.
   C. At 800°F (426.7°C) it lays against the surface and has a milky appearance.
   D. At 1100°F (593.3°C) it is completely clear and active and has the appearance of water.

8. Now switch the flame to the fitting the base of the cup. Heat uniformly, sweeping the flame from the fitting to the tube until the flux on the fitting becomes quiet. Avoid excessive heating of cast fittings.

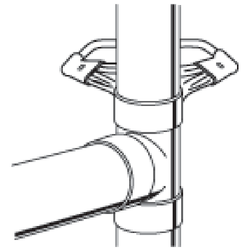


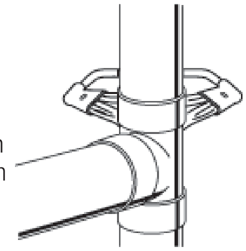
9. When the flux appears liquid on both the tube and the fitting, start sweeping the flame back and forth along the axis of the joint to maintain heat on the parts to be joined, especially toward the base of the cup of the fitting. The flame must be kept moving to avoid burning the tube or the fitting.

10. Apply the brazing wire or rod at a point where the tube enters the socket of the fitting. The temperature of the joint should be hot enough to melt the brazing alloy. Keep the flame away from the rod or wire as it is fe the joint. Keep both the fitting and the tube heated by moving the flame back and forth from one to the other as the alloy is drawn into the joint. When the proper temperature is reached, the alloy will flow space between the tube outer fitting socket, drawn in by the natural force of capillary attraction. When the joint is filled, a continuous fillet of brazing alloy will be visible completely around the joint. Stop feeding as soon as the joint is filled, using table on page 54 as a guide for the alloy consumption.

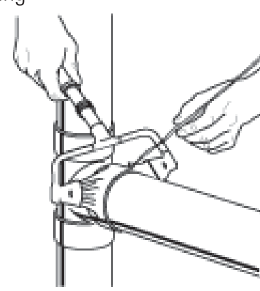


NOTE: For tubing one inch and larger, it is difficult to bring the whole joint up to heat at one time. It frequently will be found desirable to use a double-tip torch to maintain the proper temperature over the larger area. A mild pre-heating of the whole fitting is recommended. The heating then can proceed as in steps 7, 8, 9, and 10. If difficulty is encountered in getting the whole joint up to heat at one time, then when the joint is nearly up to the desired temperature the alloy is concentrated in a limited area. At the brazing temperature the alloy is fed into the joint and the torch is then moved to an adjacent area and the operation carried on progressively all around the joint.



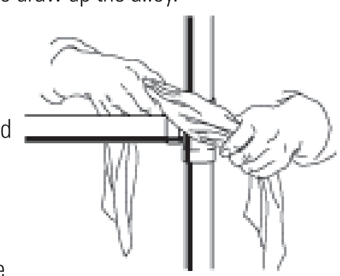


HORIZONTAL JOINTS — When making horizontal joints, it is preferable to start applying the brazing alloy at the 5 o'clock position, then move around to the 7 o'clock position and then move up the sides to the top of the joint, making sure that the operations overlap.



VERTICAL JOINTS — On vertical joints, it is immaterial where the start is made. If the opening of the cup is pointed down, care should be taken to avoid overheating the tube, as this may cause the alloy to run down the tube. If this condition is encountered, take the heat away and allow the alloy to set. Then reheat the solder cup of the fitting to draw up the alloy.

After the brazing alloy has set, remove residual flux from the joint area as it is corrosive and presents an unclean appearance and condition. Hot water or steam and a soft cloth should be used. Wrot fittings may be chilled; however it is advisable to allow cast fittings to cool naturally to some extent before applying a swab. All flux must be removed before inspection and pressure testing.



TROUBLE SPOTS

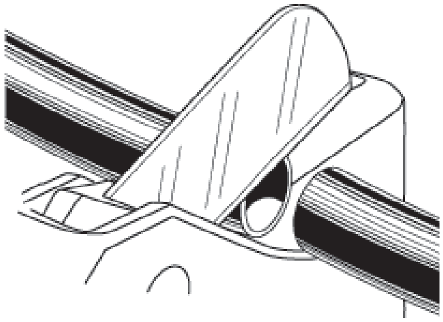
If the alloy fails to flow or has a tendency to ball up, it indicates oxidation on the metal surfaces, or insufficient heat on the parts to be joined. If work starts to oxidize during heating, it indicates too little flux, or a flux of too thin consistency. If the brazing alloy refuses to enter the joint and tends to flow over the outside of either member of the joint, it indicates this member is overheated, or the other is underheated, or both. In both cases, operations should be stopped and the joints disassembled, recleaned and fluxed.

Polybutylene Tubing

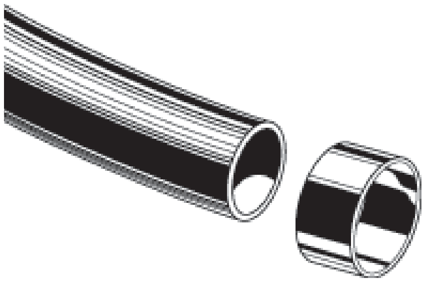
FITTING SYSTEM – INSERT/CRIMP TYPE MADE BY NIBCO

Making a Connection

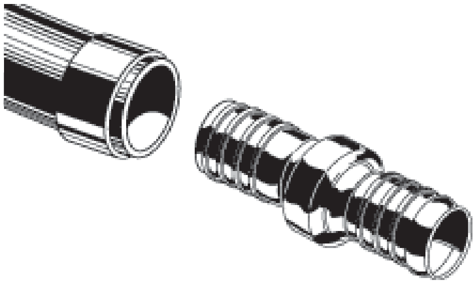
1. Using a tube cutter, cut tubing squarely and remove burrs.



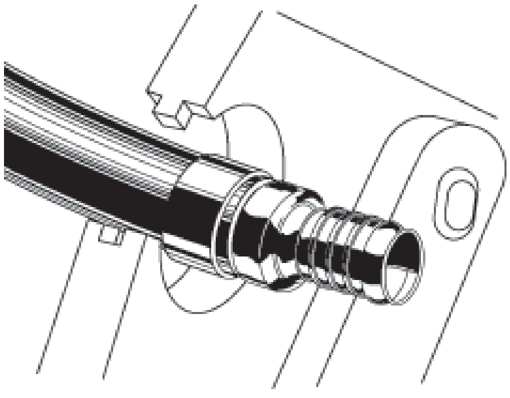
2. Slide copper crimp ring on tubing. Only copper crimp rings should be used to ensure the highest quality connection.



3. Insert fitting into tubing, then position crimp ring squarely over barbs. Proper alignment is important for making the best connection.



4. Center the crimping tool jaws exactly over the ring, and bring the tool handles together until totally closed to the stop indicator. Check each crimp ring with the caliper gauge after completion. If the small flats on the gauge do not fit over the crimped ring, the ring is undercrimped. Cut out any undercrimped rings and fittings, and completely replace.



TOOLS AND RINGS

- Use tools recommended by fitting and tubing manufacturers. All tools must make a full-circle crimp.
- Check tool adjustment at least daily, and readjust as necessary.
- Use crimp rings of copper as recommended by NIBCO INC.

Frequently Asked Questions

Q: What is the pressure rating of a given fitting?

A: Fittings are rated per Table 1 of ASME B16.22. The system rated pressure shall be the lowest of the fitting, tube or joint.

Q: When copper fails in a system, what is the problem?

A: MOST COMMON:

1. Velocity – fluid is moving too fast. Recommendation: 2-3 fps (0.0508-0.0762 m/s) hot water 140°F, 5-8 fps (0.127-0.2032 m/s) cold water. Refer to pages 68-93.
2. Turbulence – burrs left on the cut tubing causes a tumbling effect causing localized erosion and eventual failure.
3. Aggressive Waters – tend to cause pitting or green staining of fixtures. Aggressive, hard well waters that cause pitting typically are found to have total dissolved solids including suflates and chlorides, a pH in the range of 7.2 to 7.8, a high content of carbon dioxide gas and the pressence of dissolved oxygen gas. Soft acidic waters that cause green staining typically tend to be more corrosive. Low alkalinity, low mineralization, pH levels of 7 or lower should be avoided.

LESS COMMON:

1. Flux Corrosion – using too much flux when making joints can potentially leave residue and cause isolated corrosion. Flux should be used sparingly and system adequately flushed.
2. Electrolysis – stray (D.C.) current; inadequate grounding for the piping.
3. Sand or other solid particulates – erosion/corrosion problems can occur. Lower velocities must be maintained if solids are present in flow media.
4. Galvanic Corrosion – destruction of a material by electrochemical interaction between the environment and the material.

Q: Copper tubing wall thickness is designated “K,” “L” or “M.” What are the copper fittings applicable to?

A: Copper fittings' wall thickness is determined by standards (ASME B-16:22 and MSS-SP-104). These standards address minimum wall thickness (per size) for the full range of copper fittings and are not intended to match tubing wall thicknesses.

Q: Can dissimilar metals (i.e., copper and iron) be joined together without use of dielectric insulators to prevent corrosion?

A: In most situations dissimilar metals (copper/iron/steel) can be joined successfully without using dielectric insulators. Factors to consider:

1. The composition of the two metals.
2. The rate of liquid flow past the two metals.
3. Chemicals in the water which could enhance or destroy protective films.
4. The relative areas of the two metals - unless the surface area of the less noble (steel) material is less that 5% of the more noble (copper) material, the need for a dielectric separator is not needed. (Failures due to galvanic corrosion are very unusual and only occur under very strict conditions.)
5. Local code requirements.

Q: What should the installer of copper unions know and do in order to assure a proper leak-free installation?

A. The following should be done:

1. Make sure the ground-joint(mating area of unionís tail and thread pieces) are free of nicks and scratches.
2. Spray the ground-joint area with a food grade silicone spray or apply bees wax to enhance seating.
3. Make sure alignment of line does not put lateral stress on the ground-joint seal.
4. Make sure that excess solder (droplets) do not reach the ground-joint area.

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