PRODUCT BULLETIN

SECOP

Brazing Technique for Compressor Connectors

The refrigeration and air conditioning industries depend on brazed copper tubes as a leak proof carrier for pressurized refrigerant. The common approach to brazing copper to copper or copper to steel is to use filler metal (copper alloy). Torch brazing with oxygen/fuel gas (acetylene in most cases) is standard practice in heating these connections.

Methods and Requirements

Two brazing methods are used

- With filler metal and flux
- With filler metal only

Basic requirements to have a good brazing connection

- Filler metal flows easily when clearance uniform and tight, between 0.0015 inch and 0.003 inch 0.038 mm and 0.076 mm.
- The wide 0.02 inch / 0.5 mm clearance severely limits the flow.
- The overlap need to be about 4 to 9 times of the tube thickness and is a function of the tube thickness and required strength of the joint.

Filler Metal and Flux

Filler metal

Two types of filler rods are used for brazing copper tubes. These fillers are:

- Phosphorus – copper brazing alloys with melting point around 1300°F / 704°C and this temperature depends on the alloy composition.
  When phosphorus content reaches 8.37%, the melting point is 1310°F / 710°C.
  Lower phosphorus content is needed when the clearance is greater than 0.005 inch / 0.127 mm.
  Caution: Alloys containing phosphorus should not be used to braze copper – steel joints.
  In case of Secop compressors with steel copper coated connecting tubes these alloys should not be used.
  The joint will not have sufficient ductility for high vibration application (compressor).
- Silver - to braze the copper-steel joints or other ferrous base metals high silver filler metal should be used. The best are 40%; 45% and 56% silver rods.
- With optimum clearance, many brazing filler metals are suitable. It is necessary to heat only the joint to suitable temperature above filler metal melting point.

Flux

- Fluxes are not design for the removal of oxides, coatings (in our case – painting tubes), oil, grease, dirt or other foreign materials from the tubes to be brazed. All parts prior to brazing must be subjected to appropriate cleaning operation. Major function of flux is to make sure that the filler metal flows freely through the brazing joint.
- Oxides are the principal source of surface contamination. The dissolution and removal of oxides during brazing are also a function of a flux.
- So as not to impair metal flow, the flux must also be fluid and displace readily by the molten brazing filler metal.
- Wetting ability and viscosity of a flux at brazing temperature, therefore, are important properties.
- Some filler metals such as silver and phosphorus are self-fluxing.
- Flux residue generally should be removed to avoid corrosion from the remaining active chemicals. The residue obtained from the flux, particularly when considerable oxide removal has occurred, is a form of glass. Less formation of glass makes for easier flux residue removal. Removing flux from properly cleaned, brazed tubes can usually be accomplished by washing in hot water accompanied by light brushing. Preferably, this rinse should be done immediately after brazing operation. Following the rinse thorough drying is highly recommended.

Corrosion

The type of corrosion affecting brazed joints are often similar to those acting upon the base metal and their alloys. Brazed joints experience corrosion caused by environment, geometric factors, microstructure or composition of the brazed joint. The basic corrosions are:

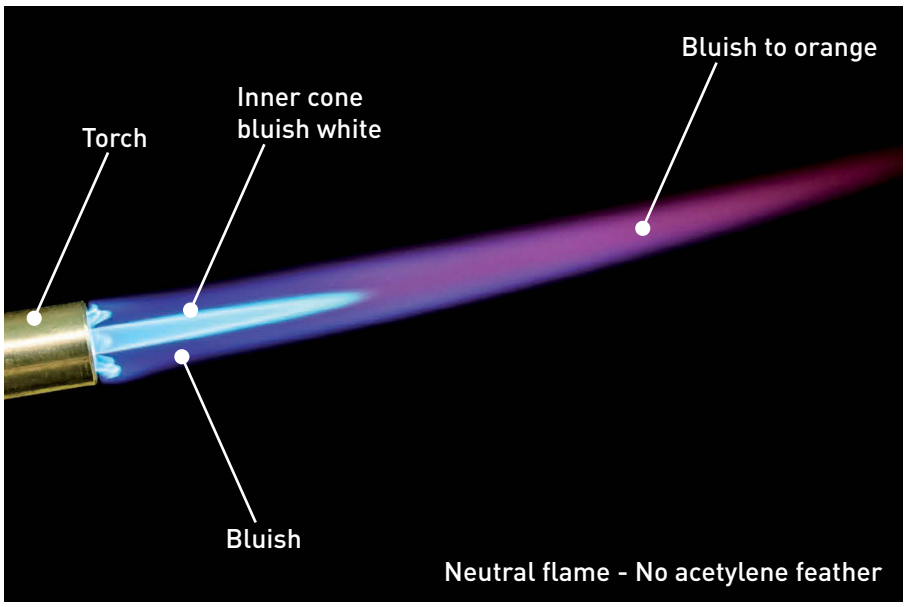
- Galvanic corrosion
- High temperature corrosion
- Cracking complicated by corrosion

Galvanic corrosion can be a major concern because the brazed joints consists often a bond between dissimilar base and filler metal. If the braze is immersed in electrolyte, galvanic corrosion may occur. The electrolyte may be as simple as water. If flux is used and the customer is using water to clean the joint, they create the electrochemical reaction. The distances between the anodic and cathodic reactions are on atomic scale. The worst case scenario is using acid for cleaning the surface. We should remember that water is also present in brazing fluxes either as water of hydration or separate addition for the purpose of making a paste or liquid.

Flame and Heating

Flame

- The neutral flame should be used for copper-copper and copper – steel tubes.



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When the oxygen addition reaches the ratio for the fuel gas to be completely combust, the feather that extended out from the bright inner cone disappears. This flame is used when arc access of carbon in the reducing flame id detrimental to the base metals or when maximum flam temperature is required.

Heating:

When brazing tubes type joints follow the sequence for best results.

- First, heat the inside tube. Copper is very excellent heat conductor and will draw the heat down inside the joint.
- Then bring the torch to the fitting. Move the torch between the tube and fitting to ensure even heat, and apply the filler metal. The phosphorus – copper brazing material will flow toward the heat into capillary for a sound joint. Filler metal through the length of the capillary is desired.
- When copper is heated to the brazing temperature, surface oxides will flake off as the part cools. This flaking can be detrimental inside the tube. In this application an inert gas such as nitrogen is bled through the tube during and after brazing.

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