Silver Brazing

By John Lisherness

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Technical Program Summary for 14 March 2003

John Lisherness gave a demonstration of silver brazing. This process was previously known as silver soldering or hard soldering. Current terminology defines soldering as taking place below 840 degrees F and brazing as being done above that temperature. In each case the base metal is heated, but only the filler metal melts to form the joint. John focused his talk on silver brazing.

Silver brazing readily joins the metals commonly used in model engineering projects. Be sure to consult with your supplier regarding the best brazing alloy to use for the metals to be joined. The important features to consider in an alloy include:

1. Temperature range of the alloys can be selected so that subsequent heating doesn't upset previously brazed joints.
2. Fluidity will determine the fillet size, which considering the cost of silver alloys, should be a small as possible to avoid waste.
3. Special metals added to the alloy. Cadmium increases the joint quality by "wetting " the base metal, but unfortunately it is toxic and its use is not recommended on that basis. The addition of nickel to the alloy makes it better for use with stainless steel. Alloys of silver and phosphorous result in a brazing material that does not need any flux. However, such alloys are not to be used on steel and may suffer from sulfur contamination when used in a coal-burning firebox. Further, they suffer upon re-heating.

A sound joint can only be made if the base metal is clean and free of oxides. Mechanical abrading of the base metal surface by wire brushing or sanding followed by cleaning with a solvent is done first. The application of a flux to the joint is the most common way to deal with the oxides. The flux consists of very active chemical salts made into a paste and, in some instances, as a covering on the alloy rod. The paste type is applied to the joint during fabrication and that implies that brazing will follow shortly.

Joint design involves:

1. Maintaining a clearance of .002 to .005 inches during heating. Center punch pop marks are an easy way to keep a joint open.
2. Fixturing to hold the parts in alignment. Screws, rivets, clamps, and clever part design are common ways to accomplish that. Since screws and rivets will be come a permanent part of the joint, make certain their alloy is compatible with the job.
3. Preplacing brazing alloy tape in the joint is sometimes done to advantage.

Making the Joint

1. Clean the joint surfaces and apply the flux paste.
2. Heat may be from a variety of gas torches from the small, hand-held propane tank and torch to the oxyacetylene torch with a large rosebud tip. Adjust the flame to be slightly reducing. Heat as evenly as possible and from the backside if possible. Keep the

torch moving to prevent burning any one spot. Avoid playing the torch directly on the joint.

3. As the joint reaches brazing temperature, the flux paste will first dry out then melt and flow into the joint space by capillary action. Touch the alloy rod to the base metal to see if it melts. The printed word is that the base metal should be hot enough to melt the alloy rod, but practice shows that the rod needs a little help from a direct hit from the torch to get going. When the correct temperature is reached, the filler rod will melt and flow into the joint space by capillary action displacing the flux as it goes. If the heating was uniform and the joint small, evidence of the alloy should be seen as a bright line all around the joint. If not, apply the common rule that the alloy will flow toward the heat. Thus, by moving the torch to bare spots the alloy should follow. For large joints several touches of the alloy rod may be necessary for a complete fill.

Clean Up

An unwanted by-product of brazing is a residue of flux and discoloration of the base metal because of oxidation. A hot water bath will remove the flux residue and often some scraping will be necessary to all of it off. Complete flux cleanup is important particularly in crevices where it will cause corrosion and contamination. Oxide removal may be done mechanically by bead blasting or chemically using an acid bath. Some model engineering articles suggest dipping the entire object (usually a copper boiler) while still hot from brazing into an acid bath. A claimed advantage is rapid removal of flux and oxide in one step. However, as can be imagined this is a step fraught with peril given the possibility of hot acid flying all over.

Safety

Silver brazing involves materials and processes that can be harmful to the model engineer and the environment. Wear clothing resistant to flame and acid. Remove all flammable materials from the brazing area. Use firebricks to protect the workbench surface and to contain the heat. Work in a well-ventilated space and avoid breathing toxic fumes.. Finish the job properly by disposing of toxic materials according recommended procedures.

Demonstrations

John concluded his presentation with the following examples

1. Steel bushing in a steel bar using a popular silver brazing alloy wire and paste flux.
2. Two copper sheets joined using silver phosphorous copper alloy rod. No flux was used.
3. Two copper sheets joined with pre-placed alloy foil and paste flux.
4. Two copper sheets joined using paste flux and flux coated alloy rod.

Once again, a big thanks goes to John for a very interesting and informative talk. Also, special mention to Rich Croll who provided the portable oxyacetylene rig.