

## An Introduction To Brazing by Lloyd Warner

Does the term "silver-soldering" scare you? Are you tired of having your soft-soldered parts break? Have you spent hours and hours trying to solder a complicated assembly together? Then why not try your hand at "silver-soldering"?

First of all, "silver-soldering" is actually 'brazing' using a silver bearing filler metal. Brazed joints are strong, usually 10 to 20 times as strong as soft-soldered joints. Brazing is ideally suited to joining of dissimilar metals. Properly done, there is seldom any need for grinding or filing after the joint is finished. For the most part, the average modeler would only use one of the many brazing alloys available. The most common alloy in use is Easy-Flo. Another commonly used alloy is Sil-Fos which requires slightly more heat than Easy-Flo. A torch is required to reach the temperatures needed for brazing with these alloys. A mini-torch or a small oxygen-acetylene torch or a propane torch can be used for this purpose.

Let's start with the six basic steps in brazing. They are generally simple (some only take seconds), but none of them should be omitted if you want strong, neat-appearing joints.

1. Good fit and proper clearances. Brazing uses capillary action to distribute filler metal between the parts. This means a close fit is important. The closer the fit, the stronger the joint. A gap of 0.001"-0.005" will produce very acceptable joint strength. See figures showing some basic joint configurations.
2. Cleaning the metals. Any oils, grease, rust, scale, etc. must be removed. If not clean, the flux will be repelled, leaving bare spots that upon heating, oxidize and result in voids. In most cases a simple solvent clean after sanding and filing will be all that is needed. Do not touch joint areas with bare hands after cleaning and, it's a good idea to flux and braze as soon as possible after cleaning.
3. Fluxing the parts. Flux is a chemical compound applied to the joint area before brazing. Flux shields the joint area from air, preventing oxide formation which would prevent the filler metal from wetting and bonding the metal surfaces. Flux can be applied with a small brush. It is always better to use a little more than not enough. A little extra is also easier to clean off.
4. Assembly for brazing. Parts that are self-supporting are the best for brazing. Small clamps may be utilized. When using any clamps, try to reduce the contact area to a minimum. Large contact areas conduct heat away from the joint areas. The simplest holding device is the best. See figures showing easy methods for holding during brazing. Again, do it the simplest way.
5. Brazing the assembly. This step involves heating the assembly to brazing temperature and flowing the filler metal through the joint. Keep in mind that both metals in an assembly should be heated as uniformly as possible. The appearance of the flux will tell you when the temperature is hot enough for brazing.

6. **Cleaning the brazed joint.** This is usually a two step operation. First - removal of the flux residues and second - pickling to remove any oxide scale. Since most fluxes are water soluble, the easiest way to remove them is by quenching the assembly in hot water. Most of the flux will crack off and that which remains will usually scrub off easily. The only time the flux will be hard to remove is if not enough flux was used or you overheated the parts during brazing. Then you will have to use a mild acid solution (25% hydrochloric acid) to dissolve the flux. The next step is the pickling to remove oxides. It is best to use pickling agents recommended by the manufacturer of the brazing materials you're using. For most of the work done by the modeler, a quick brushing with a small wire brush or fine sandpaper will do a good job.

Always do your brazing in a safe manner. Remember, safety first! Do your brazing in a well ventilated area. Use sufficient flux. Heat metals broadly, applying heat to base metals, not to the filler wire. Know your base metals (zinc and cadmium coatings give off dangerous fumes when heated). Know your filler metals. Brazing information can usually be obtained from the manufacturers of brazing alloys free of charge.

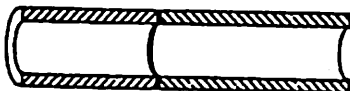
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Butt joint - flat parts



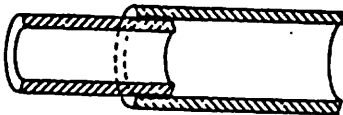
Butt joint - tubular parts (cutaway)



Lap joint - flat parts



Lap joint - tubular parts (cutaway)



Curved surfaces

