Fig. 1. The author uses these tools and materials for soldering brass and steel parts. Clockwise from top: propane torch, soldering gun, soldering iron, heat sinks, Nokorode brand paste flux, brass-bristled brush for cleaning tips, 50/50 solid lead-tin solder, sal ammoniac block, and Microflame oxygen torch.

Fig. 2. Paul's favorite soldering tool is this high-wattage gun. He fabricated the metal bracket on the back of the gun so he could hang it at his workbench.

Basic soldering techniques

A useful method for joining parts where strength is important

BY PAUL BUDZIK

OFTEN the answer to the problem of models that require delicate parts is to make such parts from materials other than plastic. Stretched sprue is nice but its strength is questionable — this may not seem important, until someone breathes on your model! And, plastic parts with thin cross sections can react in strange and unusual ways during painting.

I frequently substitute brass for plastic in such situations. Brass is strong, yet easy to cut and form. For many modelers a stumbling block in using it is the need to solder. Soldering is not a black art, and if you follow a few basic principles, it's fast and trouble free. Nothing else will allow you to build as quickly — and as strong.

The basic basics. There are only three considerations in soldering: the right tools, the right materials, and an understanding of how heat transfer works. Figure 1 shows my soldering equipment. I do most soldering with a soldering gun rated for 240-325 watts, Fig. 2. Unlike a soldering iron, which takes time to heat up and must remain hot throughout a work session, the gun can be left plugged in but heated up only when needed. Occasionally I use a small gas torch for joining large pieces or for silver soldering.

The solder I use is a 50/50 solid (uncored) type, which flows well and is easy to scrape. Don't use rosin-cored solders — they are messy and the rosin flux is tough on the tip of the soldering gun. I prefer a good acid paste flux. Some metals can be soldered, and some can't. I consider brass the best material both for workability and for soldering, and nickel silver also solders well. Steel can also be soldered, and some of the steel wire available in hobby shops is useful.

If there's any secret to soldering, it's ensuring good heat transfer. Both the parts to be soldered and the tip of the soldering gun must be clean. For the soldering gun this means properly tinning the tip.

Tinning the soldering gun tip. "Tinning" means cleaning the soldering gun tip and applying a thin coating of clean solder. At the same time I usu-

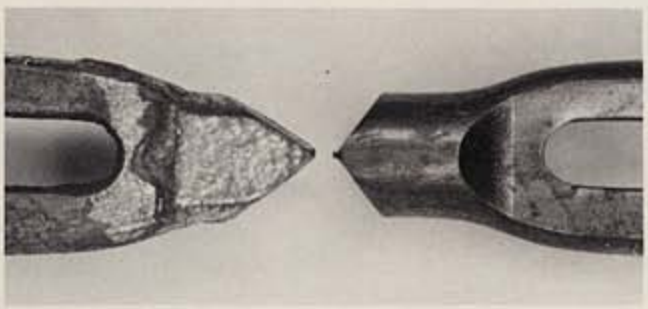


Fig. 3. The soldering gun tip on the right is stock; Paul has reshaped the one on the left and applied a thin coat of clean solder. This is called tinning.

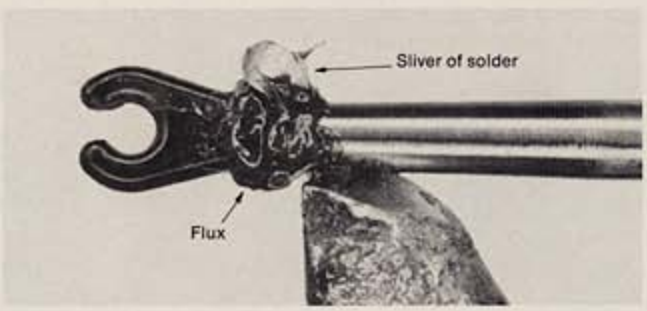


Fig. 4. Here Paul is soldering a 1/12 scale rod end to the rod. The flux will keep the joint clean until both parts are hot enough to melt the small piece of solder placed on top of the joint.

ally reshape my soldering tips with a file so they'll fit into small areas, Fig. 3. You don't have to make the tip extremely small; instead, try to shape it so it can be placed into a small joint area and concentrate the heat there.

After shaping, apply flux to the tip and begin heating. When the tip is hot enough apply enough solder to coat the tip, then brush off the excess with a brass bristle brush. The tip is now tinned and ready to use. Periodically during use you can renew the coating by repeating the above process. When a tip becomes heavily oxidized, clean it with a sal ammoniac block, or in case of really heavy buildup, reshape the tip with a file, then re-tin.

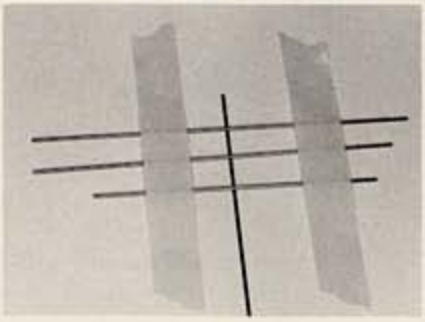
Heat transfer. Now for an important concept: heat transfer. Successful soldering requires that all parts to be joined be heated sufficiently for solder to melt, flow across the surface, and form a molecular bond with the materials to be joined. This can only be accomplished if the parts are scrupulously clean, not only at the joint, but also where the heat is applied.

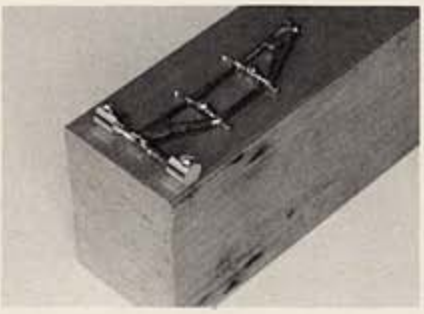
Flux, a liquid or paste preparation applied to the joint before heating, keeps the materials clean while they are heated, Fig. 4. Flux prevents oxide from forming during soldering; it is not meant to be a substitute for inadequate cleaning.

Applying the heat. Both parts to be joined must be heated, either by positioning them in such a way that the tip of the soldering gun can touch both at the same time, or by clamping them so that heat will transfer from one to the other. The pieces must then remain steady until the solder cools. It's well worth the effort to construct a jig or fixture to hold parts for soldering. This can be anything from a special soldering holder to something as simple as taping the parts to a piece of glass or aluminum, Figs. 5, 6, and 7.

With the parts cleaned and in position, apply a small amount of flux to the joint. Next, shave off a small piece of solder and place it at the joint where you won't have to touch it with the soldering tip, Fig. 4. There are several reasons for applying the solder this way instead of melting it on the tip and allowing it to flow into the joint. First, if there is too much solder on the tip you have no way to control how much will be applied to the joint. Second, placing the solder away from where the heat will be applied helps verify that the parts are heated enough to cause the solder to flow to them.

Properly heated solder flows freely and leaves a flat, shallow surface fillet; solder that has not been heated sufficiently sits on the surface of the joint as a steep-sided glob, Fig. 8. The glob means the solder was hot but the joint wasn't. When solder flows properly, a tiny amount will go a long way. Conversely, too much solder will obliterate details and require hours of scraping to remove the excess. Most solder joints require at least a little dressing, but you can keep the cleanup to a minimum by using solder sparingly.





Figs. 5, 6, and 7. Three typical soldering jigs. (Above left) Using masking tape to hold four wire parts in alignment, and (below and below left) more-elaborate fixtures for soldering an auto dashboard and a complicated suspension part.

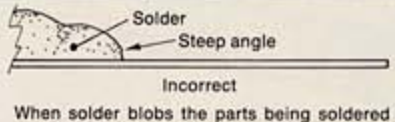
The notorious cold joint. Heating the parts properly will minimize your chances of having a "cold" joint, which is a weak solder bond caused by poor heat, unclean parts, lack of flux, or movement of the parts while the solder cooled. One tip-off that you have a cold joint is that the surface of the solder may appear dull and grainy — a good joint looks shiny and smooth.

If you have a cold joint, start over. Remove all solder, clean the parts, make sure your soldering tip is cleaned and tinned, and resolder the joint.

Multiple joints and large parts. Assemblies with multiple joints are challenging, because you have to heat the parts enough to make a good new joint without unsoldering the previous ones. In this situation it's often a good idea to preheat the soldering tip before placing it at the joint. This will minimize the time that the parts are heated, which will help prevent heat transfer to the other joints. Metal heat sinks around the joint can also slow the heating of the surrounding areas, as can wet rags or wads of wet tissue paper.

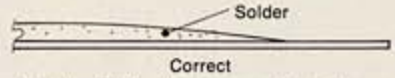
When large parts must be soldered, you may need a torch. Although the heat source is different, the steps involved are the same. The important thing to remember is to use the proper part of the flame, Fig. 9. Keeping this reducing portion of the flame focused at the area to be soldered prevents oxide formation and ensures correct heating and bonding.

That's it — a brief description of how I go about soldering. There is no substitute for hands-on experience and practice, but once you've mastered soldering techniques you will have acquired a valuable addition to your modeling skills, especially considering the increasing popularity of the new photo-etched metal parts in our hobby. FSM



Incorrect

When solder blobs the parts being soldered weren't hot enough, weren't sufficiently clean, or both.

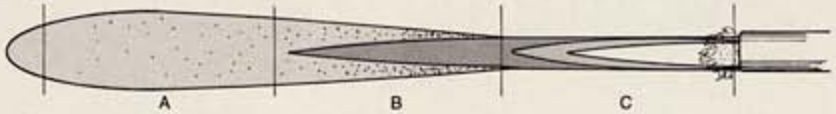


Correct

A shallow fillet indicates adequate heating.

Fig. 8 CORRECT AND INCORRECT SOLDER FILLETS

Fig. 9 TYPICAL GAS TORCH FLAME



A. This portion of the flame contains incompletely burned gases that will oxidize the parts to be joined.

B. The correct part of the flame, this is the hottest region and will not oxidize the joint.

C. This is the coldest part of the flame, made up of unburned gases. In addition to inadequate heating, this region of the flame will cause oxidation of the work.