Starting out in Plastic Welding

Most all plastics can be joined using mechanical means (e.g., screws) and with cements and adhesives (e.g., PVC cement). *Thermoplastics*--plastics that become soft when heated--can also be welded using a non-flame heat source. Examples of thermoplastics include

- PVC (polyvinyl chloride)
- Polypropylene
- ABS (acrylonitrile Butadiene Styrene)
- Nylon
- Vinyl
- Acrylic
- Polyethylene
- Polycarbonate
- Acetal resin
- Polystyrene

There's another class of plastics that don't become soft when heated--once they're set, that's it. These *thermosetting* plastics can't be welded. Examples include phenolic, polyester, silicone, and epoxy.

To hot-gas weld plastic, air or an inert gas is heated to between 450°F and 800°F. The gas is heated by an electric element rather than a flame. A filler rod of the same material as the pieces to be joined is heated along with the joint, and the filler rod is lightly pressed into the joint (see figure on back). Torches sometimes include a special nozzle that both preheats the filler rod and guides it into the joint. Plastic can also be welded using a heated tool, induction welding, or friction (spin) welding.

Hot gas plastic welders are available from several sources, but often at high prices (e.g, $326 for the low-end Kamweld model). Harbor Freight sells one for $39.99 (item 41592-1VGA), often on sale for $29.99. It includes the torch, air hose, regulator, stand, and a small selection of filler rod for PVC, polypropylene, and ABS.

The “trick” to using a hand-held hot air plastic welder seems to be in part to get the temperature right. The Harbor Freight welder is either “on” or “off”, but the default temperature is likely to be too high for some, if not most, situations, unless the air pressure is increased dramatically, which would then make welding small/thin parts difficult. In the May/June issue of Home Shop Machinist, Glenn Vandiver wrote an article “Getting Started in Plastic Welding” where he discusses the HF welder and how to use a router speed control (item 43060-2VGA, $25, but on sale often for around $12.50) to adjust the temperature. Usually, one varies the air flow through the torch to vary the temperature, since a lower flow causes the gas to heat more as it flows through, but with the motor speed control, the heater element can be reduced in power, and the air flow set to a fixed but low rate (Glenn mentions 2-3 PSI). Kamweld notes that most plastic welding can be done 400°F to 550°F.

There are some big differences between metal welding and plastic welding. Thermoplastics are poor heat conductors, so the filler rod may not even thoroughly melt--in even a good weld, the rod can look unchanged, though the material on either side of the weld should look melted. There is a narrow range of viable temperatures too--just a bit too much heat at one point can char or burn the plastic. In general, plastic welding is not about having the materials flow together as a liquid, but fuse together in a "plastic" state. A proper joint can be up to 90% as strong as the original material. In general, most any joint type normally done in metal welding is possible with plastic welding.

PVC material and filler rod seem to be fairly available--in Ann Arbor a local plastic fabrication company was happy to sell me both. Glenn notes that there are many companies on the Internet that sell plastic material and rod. HF sells 1/8" diameter filler rods, but only in a bag of PVC, polypropylene, and ABS.

Resources

1. *Modern Welding*, Althouse et al, Goodheart-Wilcox Company, 2004, chapter 22.
2. Kamweld.com website, especially their article "Plastic Welding Using Kamweld's Durable Welders" (see under "Resources").
3. "Getting Started in Welding Plastics", Glenn Vandiver, Home Shop Machinist, May/June 2004, pages 44-51.
4. The tiny manual that comes with the HF welder is quite miserable and near useless.