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WELDING THERMOPLASTICS

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The introduction of thermoplastics, i.e., polypropylene and polyethylene into prosthetics and orthotics in recent years has demanded that the orthotist-prosthetist master new skills to take maximum advantage of the properties of these new materials. The art of welding plastics is one such skill. Welding is very useful for repairing plastic orthoses and is essential for fabrication of such things as the ultra-lightweight prosthesis (*3*) and the pelvic girdle of the Boston system for scoliosis control (*2*). Welding is also useful for attaching elastic panels to thermoplastics, and, in some areas, the long flexible welding rods are bunched together and used as twister cables.

The basic plastics welding system, which costs less than $200, consists of a compressed air source, a regulator for it, a tank of water-pumped nitrogen with its regulator, a third regulator to control the air-nitrogen mixture, a welding gun, and a variety of welding tips and welding rods (Fig. 1). The welding unit is designed to direct a flow of compressed gas, either air, water-pumped nitrogen, or a combination of the two, in a fine stream over an electric heating element and onto the plastic. In general, nitrogen is used for welding and air is used to maintain a functional welding temperature between welding operations. The regulators on the compressed air and nitrogen should be set at 20 psi and the combination regulator should be set at 3½ to 4 psi for most orthotics and prosthetics welding. The setting varies according to material thickness, i.e., the thicker the material, the more heat required.

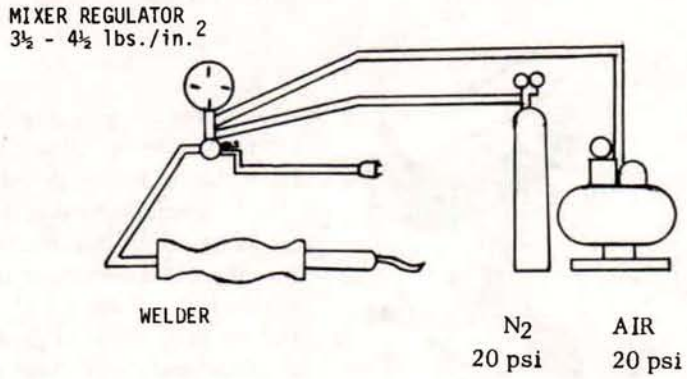

Fig. 1. Schematic of the welding system. A combination of compressed air and nitrogen is recommended, although some practitioners claim satisfactory results with compressed air alone.

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The pieces to be welded and the welding rod must be the same kind of plastic i.e., polypropylene to polypropylene, and they must be of the same type and density. The edges should be clean and level, any stray slivers of plastic should be removed, and the pieces cleaned with a solvent such as acetone. Using the tacking tip, the pieces should be tack welded together. Either the round welding tip or the high speed welding tip can be used for the final weld.

The end of the welding rod should be cut to a 60 deg. angle with a diagonal cutter. When the round welding tip is used the rod should be held at a 90 deg. angle to the joint and the hot air stream directed at the junction of the rod and the material to be welded (Fig. 2). As the weld begins to form, proper heat and pressure will ensure that the rod rolls smoothly into the joint.

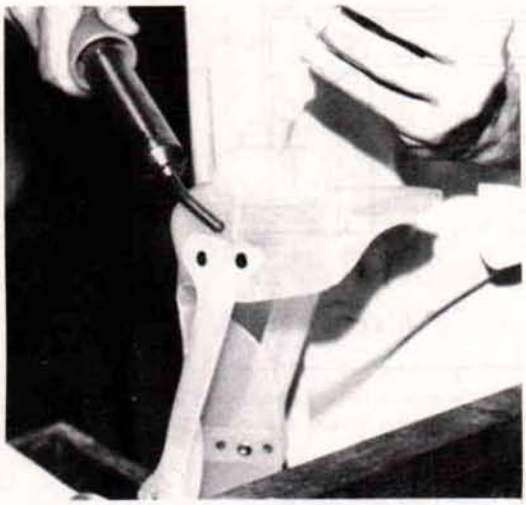

Fig. 2. The welding rod is held at 90 deg. to the seam when the round welding tip is used.

When the high speed tip is to be used, the rod is fed through the tube at the end of the high speed tip. As the weld begins to form, the tip is moved along the joint at a 45 deg. angle while pressure is applied through the welder on to the welding rod (Fig. 3). It is essential that proper rate of feed be maintained because a fast speed will not permit the formation of a secure weld (Fig. 4), while too slow a speed will permit the rod to melt in the tip. Plastic welds differ from metal welds in that with plastics the welded portion is generally weaker than the surrounding material. For this reason, one or more reinforcing welds are placed on each side of the first weld (Figs. 4 & 5).

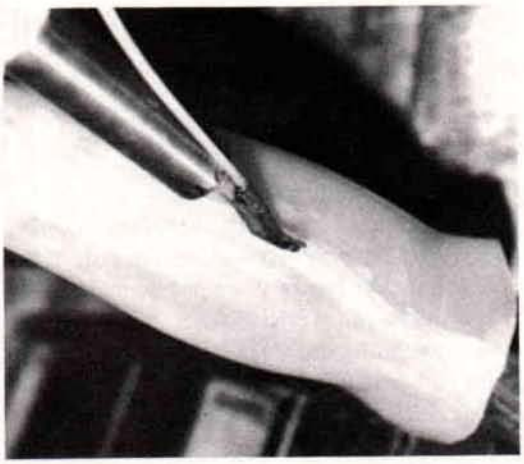

Fig. 3. The rod is fed through the tube in the high speed tip. The proper amount of heat and speed are the critical elements of good plastics welding.

The six basic tenets of good welding are:

1. A small bead should form along each side of the weld where the rod meets the base material (Fig. 4).

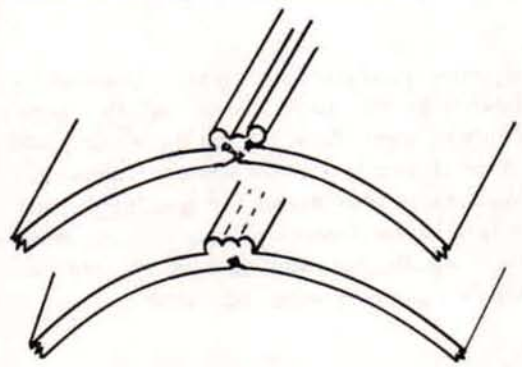

Fig. 4. The butt weld in the top drawing will not hold. This can be caused by insufficient heat or welding too fast. The weld shown at the bottom will hold.

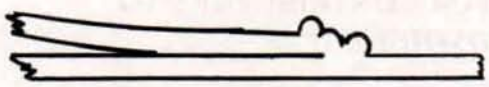

Fig. 5. Lap weld. One central weld and two reinforcing welds generally suffice for most orthotics and prosthetics uses.

2. The rod should hold its basic round shape.
3. Neither the rod nor the base material should char or discolor.
4. The welding rod should not be stretched during the welding process.
5. The heating element is disconnected and allowed to cool before the air flow is turned off. Conversely the airflow is always turned on before the heating element.
6. Oxygen or other flammable gases are never used.

More information about welding plastics is available in the pamphlet "All About Welding Plastics" (*1*).

LITERATURE CITED

1. Seelye Plastics Inc., 9700 Newton Avenue South, Minneapolis, Minnesota, 55431. "All About Welding Plastics."

2. "A Refined Concept in the Orthotic Management of Scoliosis" Hall, J. T., Miller, M. E., Schumann, W. and Stanish, W. *Orth. & Pros.* Vol. 29, No. 4, pp. 7–13. December 1975.

3. "Ultra Light Prostheses for Below-Knee Amputees" Wilson, A. Bennett, and Stills, Melvin, *Orth. & Pros.*, Vol. 30, No. 1, pp. 43–47, March 1976.