Fabrication

Hot gas welding

Thermoplastic materials can be successfully welded using a hot gas welding torch and plastic welding rod. This method is used extensively to fabricate special parts or vessels that may be used for many applications.
Hot gas welding requires an understanding of the materials and training in the correct methods. The plastics welder should have obtained the knowledge and skill required either through long-term experience or specific training on the subject, such as The Welding Institute (TWI) CSWIP qualification.

This welding method uses a plastic welding rod that should be manufactured from the same raw material as the pipe, fitting or sheet to be welded. Typically, round rods with a diameter of 3mm to 4mm are used, but other profiles are available for special situations, such as triangular, trefoil or oval. The welder holds the welding torch so that the material and the welding rod are heated into a plastic condition and joined under low pressure. Once cooled, the joint assumes full strength.

Plastics that can be hot gas welded include PVC-U, PVC-C, Polypropylene, Polyethylene, PVDF and ECTFE. It is not possible to hot gas weld ABS.

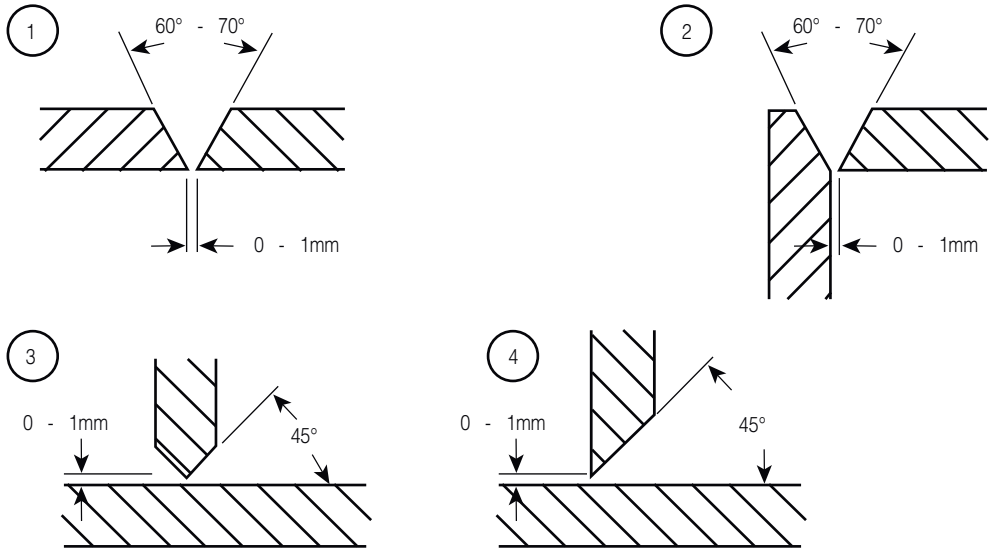
Hot gas welding of plastic sheets

Plastic sheet materials can be welded together using a variety of techniques, including butt-fusion welding and extrusion welding. These techniques require specialist welding equipment and it is recommended that they are carried out only by highly trained welders.

Hot gas welding of plastic sheets requires that a welding seam is prepared prior to welding. The guidelines are shown below. All materials to be joined must be completely clean, and the surface scraped if necessary to remove any surface deterioration, such as UV damage. It is recommended that Polypropylene is scraped in all cases.

Once prepared, welding can be carried out using the method described.

Preparation of Plastic Sheet



Fabrication

Hot gas welding of pipes fittings

Although it is possible to hot gas weld connections between pipes this method is limited mostly to special fabrications, such as welding small diameter branches to pipes perhaps for drain valves or for instrumentation points. This is because the pressure sustaining capabilities of a joint made in this way are limited, unless additional reinforcing is added - usually in the form of a fibreglass wrap.
It is also possible to use hot gas welding to repair small leaks at joints in solvent welded or fusion welded plastic piping systems. Note, however, that if the leak has a steady stream it may not be repaired, and it must be cut out and replaced.
Before making repairs to a plastic piping system, the piping must be drained and allowed to dry completely. It is not possible to weld on wet materials. The area to be welded must be clean and scraped if necessary to remove any contamination - including the residue of solvent cement if it has been used.

Hot gas welding method

Before starting the welding process, ensure that all surfaces are clean, dry and free from contamination.

- Select a welding rod from the same material as the pipe or sheet to be welded.
- If welding polypropylene, scrape the surface of the welding rod to remove any oxidization.
- Cut the end of a 3mm or 4mm welding rod to an angle of 45°.
- Check and adjust the heated air or gas temperature and the flow.
- Hold the cut end of the rod just above the weld starting point. Apply heat to the rod end and the base material seam at the same time until both are tacky. Press the tacky end of the rod down into the tacky starting point of the base materials. Only the surface of the rod and base materials will be tacky but will bond properly. The rod will continue to hold its basic shape, for the most part, throughout the welding work.
- Continue the weld holding the rod at a 75° to 90° angle directly above the weld seam pressing firmly and evenly into the weld joint as heat is applied in the direction of the weld seam with a short fanning motion. As the rod and base material become tacky, if the welding is at the correct temperature, a loop will form where the rod joins the base materials and small beads will form on either side of the complete weld.
- It is important to maintain the correct balance of temperature and pressure during the welding process. Too much heat will char, melt or distort the material. Too much pressure on the welding rod can stretch the weld bead, causing cracks.
- When welding plastic sheets, it will be necessary to build the welding seam using several layers of welding rods until the seam is completely filled.
- If the weld is to repair a leaking pipe, a small drip leak can usually be repaired with a single weld, but if necessary it is possible to build up several layers of welds.

Recommended Gases and Temperatures

	Plastic Material					
	PVC-U	PVC-C	PP	PE	PVDF	ECTFE*
Welding Temperature °C	330 - 350	360 - 410	280 - 330	300 - 350	350 - 400	340 - 350
Welding Gas	Air	Air	Air or Nitrogen	Air or Nitrogen	Air	Nitrogen

* Note: At ECTFE melting temperatures hydrogen chloride and hydrofluorics are released. The workplace must be well ventilated. Welders should wear eye and hand protection.