

PERFORMANCE PLASTICS' EASE OF WELDABILITY

by Autumn Werner

Plastic is one of the most versatile materials of the last century. Found in industries and countries all over the world, plastics have served a crucial role in technological advancements. Plastics are increasingly used as an alternative to metals and wood thanks to their chemical compatibility, machinability and affordability. As plastics continue to go head-to-head in previously metal-dominated markets, it is important to understand one of plastics' often overlooked characteristics: ease of weldability.

Plastics have a rich and relatively recent industrial history, first becoming a focus in Germany during the 1930s with the invention of plastic welding and eventually becoming more common as additional types of plastics were developed in the 1960s. Many of the industry standards for the bonding and joining of thermoplastics were created in Germany. In 2000, the German Welding Society (DVS) began translating their standards into English. We have since seen an increase in plastic bonding in the United States as well, even making its way into the American Weld Society (AWS) standards committee in 2015.

Before welding, plastics were machined in manners like those used for wood. These methods focus on using metal fasteners and epoxy to join materials. Although these methods are still used today and preferred in some applications, this approach cannot be used in all applications. This is especially true in the semiconductor and chemical processing industry where those fasteners and glues can contaminate and corrode the application long before the plastic does.

Benefits of plastic welding

Plastic welding offers an alternative to the previous methods used to join plastics. Welding is the joining of two materials using heat and pressure to bond the material. There are multiple ways to weld that use filler made of the material — extrusion and hot gas welding — or alternatively using only pressure and heat: heated tool fusion welding. Each type of welding is used across industry and has its own set of standards and equipment. Although the type of equipment used can vary depending on the application, the

important aspect of each process remains the same: It allows the materials to bond on a molecular level, joining as one as opposed to a surface bond commonly found in glues, which act as a medium between materials.

Each material being welded has specific parameters to follow to get the strongest weld, such as designated heat, time and pressure. These three parameters create an ideal weld factor for the material. The weld factor designates the strength of the weld being a certain percentage of the material's own strength. This creates a much stronger bond than you would get using an epoxy. This also eliminates issues in gluing, such as finding a glue that works with certain plastics as well as tolerance to different temperatures and chemicals.

Plastic welding is designed to join two like materials such as HDPE to HDPE, PVC to PVC, etc. This is because the materials must have similar melt flow rates and molecular weights to form a true bond at a molecular level. This process is what allows welds to be nearly as strong as the original material. The German Weld Society has experience with testing and developed parameters around the weld processes for a variety of different materials. Just as different plastics are extruded at different temperatures, they are also welded at different temperatures.

Plastic welding also has its own set of tests similar to material testing done with metals. To test the integrity of a weld, several tests can be performed, such as bend testing, tensile testing and spark testing. For bend and



A Wegener hot gas welding gun is used to weld CRP-1.



Marilyn Mozeleski practices extrusion welding with a Leister extrusion gun.

SIMONA polypropylene hot gas weld parameters.

Equipment Type	Hot Gas Welding Gun
Gas Type	Air OFA
Gas Temp	320-340°C/608-644°F
Gas Flow	60-65 LPM
Pressure	Typ. - 2.0-4.0 PSI (approx.)

tensile testing, the material must meet a weld factor to be deemed a proper weld. For spark testing, a conductive test is done to check for voids within a finished weld. Other testing includes visual inspections, as different welds will have different indicative factors of what a good weld should look like. These tests provide quality assurance for each weld going out into the field.

Performance plastics are a staple in technological innovation and will continue to be a competitive player in material science in the future. As a

result, technical organizations have begun to recognize the versatility of plastics. NACE now has a subcommittee, STG 10: Nonmetallic Materials of Construction, to emphasize the role of plastics, composites and glass and their impact in industries previously dominated by metals. ASME has formed subcommittees dedicated to standards of building and specifications within industries such as tank building, which uses plastics and metals.

The future of plastics knows no bounds. Plastics are becoming more prevalent in everyday do-it-yourself projects and will continue to carve their own path into markets in the future. Plastic welding will continue to allow the successful bonding of plastics for projects large and small all over the world.

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