VYCOM®

CORZAN™

FABRICATION GUIDE

CORZAN® ADVANTAGES

Some of the outstanding features of Corzan® CPVC products include:

- High temperature capabilities
- Excellent chemical resistance to a wide range of highly corrosive liquid and vapor environments
- Resistance to galvanic corrosion
- Low heat transfer
- Good electrical insulation properties
- Lighter weight for ease of installation

In addition to pipe, fittings, valves, pumps, tower packing, and other fluid handling product which are manufactured from CPVC, sheet and duct products are also available. Specialized parts such as tanks and tank linings, as well as ventilation and vapor scrubbing equipment, can be fabricated. Corzan Industrial Systems components can be fabricated using the most common thermoplastic fabrication techniques.

THE PRINCIPLE OF THERMOPLASTIC WELDING

In order to weld thermoplastics, the material must be heated to reach its melt state. The pieces to be welded must then be pressed together with the proper amount of pressure over a given period of time. The combination of heat and pressure will allow the surface molecules of the parts to interlock, fusing the parts together.

Corzan Industrial Systems components are welded through two primary processes:

- High Speed Hot Gas Welding
- Hot Plate Butt Welding

WELDING CORZAN® SHEET AND PIPE

It is possible to weld sheet and pipe together. However, it is important to remember that the sheet and pipe will heat differently when welded at different speeds. As a result, it will appear that the adhesion to the pipe is not as good as it is to the sheet.

Follow these recommendations to ensure a successful bond:

1. Solvent wipe the surface to be welded prior to heating using acetone. This will help to etch the surface to be welded.
2. Preheat the pipe surface to be welded, in addition to the area where the tack welding to be performed.
3. Use a thicker welding rod (i.e. 4 mm). This will require a longer heating time.

HIGH SPEED HOT AIR WELDING

Corzan® system components can be hot air welded to give approximately 80% of the tensile strength of solid sheet. Actual performance will depend upon the equipment used, the welding conditions employed, and the individual technique of the person doing the welding. As a result, the recommendations given on this page are intended to be general guidelines and do not guarantee actual performance.

The Essentials of Hot Air Welding Corzan CPVC

- Availability of clean, dry air
- Accurate temperature control of welding equipment
- Beveled edges on base material
- Prepare by buffing or scraping welding surface and rod
- Ensure both base material and rod are Corzan CPVC
- Ideal rod diameter: 1/8 - 5/32-in.

- Optimum temperature range:
  - 710-800°F (375-425°C) - Dial Selected
  - 680-770°F (360-410°C) - Measured and adjusted - 3/16-in. (5mm) inside main opening of welding tip.
- Optimum air flow: 40-60 lpm

EQUIPMENT

When thermoplastics are being welded, the quality of the air used as the heat transfer medium is a critical factor in the overall quality of the weld.

High-speed hot air welding requires the use of air that is supplied at low pressure and high volume and is free of oil and moisture. Common shop compressors generally do not supply air of adequate quality for use in high-speed hot air welding. Many manufacturers of hot air welding equipment also have blowers available that are specifically designed for this purpose.

When Corzan system components are being welded, the accuracy of the temperature controlling equipment is equally as important. The optimum temperature range for welding Corzan system components is typically slightly narrower than for other thermoplastics, such as polyolefins. The quality of the weld produced is therefore dependent on having an optimum and consistent temperature at the welding tip.

Welding equipment used with Corzan system components preferably should control the temperature by regulating power to the heating element rather than by varying the air flow. The ideal temperature control arrangement for welding Corzan system components should incorporate closed loop controls which hold the temperature constant even when air flow or supply voltages fluctuate.

A high-speed welding tip is designed to perform three functions:

- Preheating the base material
- Guiding and preheating the welding rod
- Applying pressure to the weld area

MATERIAL PREPARATION

The ends of the pieces of material to be joined must be beveled to produce the highest quality weld. The bevel may be produced with an adjustable saw, router, or other suitable tool. The angle between the bevels of the two pieces to be joined should be between 60 and 70°, except when one piece is joined perpendicularly to another, in which case, the angle is reduced to 45°.

For optimum performance, the parts to be assembled must be very clean. To remove surface residue, slight grinding or scraping with a sharp blade at the area to be welded and the weld rod is strongly recommended. Acetone is the only solvent that is suitable for use to clean the area to be welded. Other solvents may have potentially negative effects on Corzan CPVC.

If the joint will not be tacked prior to welding, it is recommended to leave a gap of 0.5 to 1 mm wide between the two pieces to be joined so that the welding material may penetrate to the root of the bevel and overflow slightly on the other side. If the parts will first be tacked, they should be butted together with no gap. The parts to be joined should be mounted firmly in place with appropriate clamps as necessary.

WELDING ROD SELECTION

When Corzan CPVC parts are being joined, the welding rod selected should also be produced from Corzan CPVC. Triangular rod may be used where the appearance of the joint is the most important factor, but round welding rod should be used when structural integrity is more critical.

While welding rod is commonly available in sizes up to 1/4 in. (6 mm) in diameter, the strongest joints are obtained by using rod in smaller diameters with multiple beads as necessary. In order to obtain the strongest weld with Corzan, it is recommended to use rod no larger than 5/32 in. (4 mm) in diameter.

It is important to match the diameter of the welding tip with the diameter of the rod selected. An oversized tip will negatively impact guidance and pressure applied to the rod and may also cut into the parts being welded.

TACK WELDING

The first step in the process is tack welding. The objective is to put the parts in place, align them, and prevent any slippage of the material during the structural welding process.

Tacking is done with a pointed shoe tip. The operator should place the tacking tip directly on the material to be welded and draw it along the joint. Hot air from the welder softens the material, and pressure applied by the operator to the tip fuses the material together. Continuous or spot tack welding can be used as necessary. Larger structures or thick gauge materials may require additional clamping.

Any tank should be tack welded continuously to achieve a leak free connection. This prevents solutions from penetrating between the tank wall and the bottom in case of a problem with the filler weld.

THE WELDING PROCESS

The optimum temperature range for hot air welding of Corzan system components is dependent on the type of welding equipment being used and the way in which the temperature is measured.

If the welding torch incorporates closed-loop controls which maintain the temperature selected on a dial setting, the optimum range is typically 710 to 800°F (375 to 425°C). If the temperature cannot be directly selected on a dial setting, it must be measured by the operator and then adjusted by varying power to the heating element or regulating the air flow. The temperature should be measured with a pyrometer approximately 3/16 in. (5 mm) inside the main opening of the high-speed welding tip. When the temperature is controlled in this manner, the optimum temperature for welding Corzan system components is typically 680 to 770°F (360 to 410°C).

The actual temperature within the range that will produce the best weld will depend on several factors and must be adjusted accordingly. The list of variables includes, but is not limited to:

- Diameter of rod
- Brand of rod
- Speed of welding
- Ambient temperature

To make it easier to initiate welding, a sharp angle may be cut on the lead end of the welding rod. The welding rod should not be inserted into the high speed-welding tip until immediately before the operator is ready to begin welding. Otherwise, the rod may burn.

To begin welding, the operator should grasp the welding torch like a dagger, with the airline trailing away from the body or over the shoulder, so that the operator will be able to move quickly and smoothly once the process has begun.

Holding the welding tip approximately 8 cm above the area to be welded to prevent scorching the material before work begins, insert the welding rod into the preheating tube and then place the pointed tip of the shoe on the material at the starting point of the weld. Maintaining the welder at roughly a 45° angle, push the rod through the tip until it contacts the base material.

Continue to feed the rod with the other hand, using slight pressure. If the rod is not guided, the welding rod will stretch fully apart. The weight of the welder is the only pressure needed as the weld is pulled along the joint.

As welding progresses, visual inspection of the weld may indicate its quality. Browned or charred edges occur when the welder is moving too slowly and/or overheating. If the rod has been softened too much by overheating, it will stretch and break or flatten out. Once welding begins, it must be continued at a relatively constant rate of speed. The welding torch must not be held still or burning will result.

To stop welding before the rod is used up, the operator should tilt the welder backward, cut the rod off with the tip of the shoe and immediately remove the remaining rod from the welding tip. Welding may also be terminated by pulling the welder tip up over the remaining rod and cutting the rod. For best results, the welding tip should be cleaned occasionally with a wire brush. Multiple beads should be applied as necessary until the joint is completely filled, as specified in Figure 1.

If the joint to be welded is a double V or a double half V joint, the best results are obtained if layers of beads are put down alternately on opposite sides of the joint. The following table presents recommendations for bead lay-up for different material thicknesses and joint configurations.

Recommendations for Bead Lay Up

	MATERIAL THICKNESS	NUMBER OF BEADS X ROD DIAMETER
SINGLE V JOINT	1/8" (3mm)	3 x 1/8" (3mm)
	5/32" (4mm)	1 x 1/8"(3mm) + 2 x 5/32" (4mm)
	3/16" (5mm)	6 x 1/8" (3mm)
DOUBLE V JOINT	5/32" (4mm)	2 @ 1 x 5/32" (4mm)
	3/16" (5mm)	2 @ 3 x 1/8" (3mm)
	1/4" (6mm)	2 @ 3 x 1/8" (3mm)
	5/16" (8mm)	2 @ 1 x 1/8" (3mm) + 2 x 5/32" (4mm)
	3/8" (10mm)	2 @ 6 x 1/8" (3mm)

Figure 1.

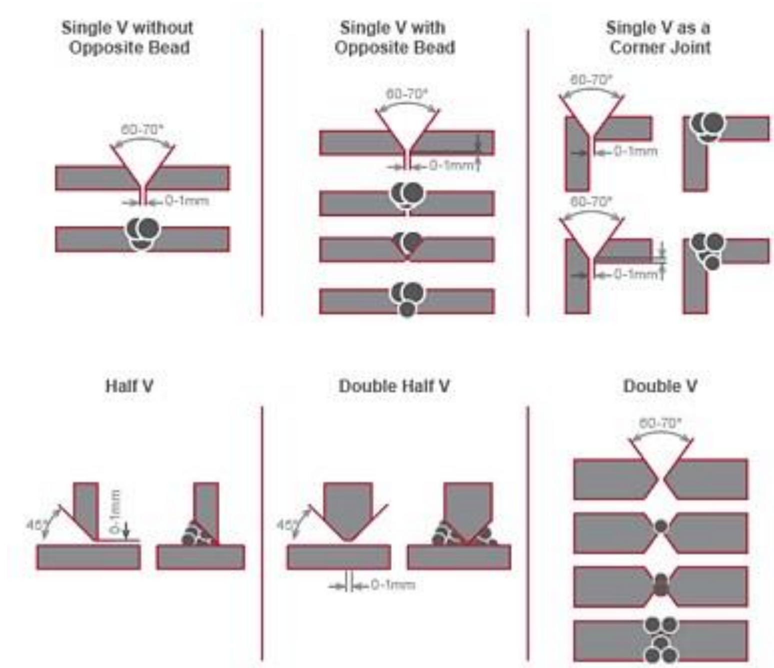
HEAT STRESS PROBLEMS

During hot air welding, the material will expand as it is forced into position. When cooling, it will shrink back to its original volume. A welded sheet that is straight while still hot may become bent after cooling. Using a double V joint is one way to avoid this problem.

WELD FACTOR

When properly hot air welded, Corzan CPVC sheet can be expected to perform to approximately 80% of its nominal tensile strength.

TYPICAL WELDED JOINT CONFIGURATION



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HOT PLATE (BUTT) WELDING

Butt welding of thermoplastics involves holding two pieces of the material with defined, constant pressure against a heated plate element until the material melts. The two pieces are then brought together quickly and held so that they fuse into one piece.

Some of the most common uses for butt welding are to join:

- Two pieces of flat sheet
- Both ends of a rolled or bent sheet to form a round or rectangular shape
- Segments of pipe together to form fabricated fittings.

The following recommendations are based primarily on working with sheet but could be modified by an experienced welder for pipe.

The Essentials of Hot Plate (Butt) Welding Corzan® CPVC

The following are essential aspects and numbers to know when hot plate or butt welding Corzan® CPVC:

- Use a PTFE (Polytetrafluoroethylene)-coated heating element
- Accurately control the temperature
- Changeover time: less than 3 seconds
- Optimum temperature: 440 to 445°F (225 to 230°C)
- Optimum melting pressure: 95 to 100 psi (65 to 70 N/cm2)
- Optimum heating pressure: 30 psi (20 N/cm2)
- Optimum welding pressure: 95 to 100 psi (65 to 70 N/cm2)
- Heating and welding / fusion times are dependent on material thickness (see tables)

EQUIPMENT

The heating element should be PTFE-coated stainless steel to prevent sticking of the melted plastic to the element. The heating element should be kept very clean. If necessary, a clean cotton rag or paper towel can be used to wipe off any residue.

Controlling the temperature of the heating element is very important when Corzan CPVC sheet is butt welded. Butt welding of Corzan CPVC sheet should be performed in an area free of drafts to maintain the best temperature control environment possible.

The changeover time, during which the element is removed and the two pieces of heated plastic are pressed together to form the weld, should be as short as possible. Ideally, the changeover time should be no more than three seconds.

MATERIAL PREPARATION

The edges of the pieces of material to be welded should be as square as possible so that they will contact the heating element and each other evenly. Cutting debris and any oil or dirt should be removed from the welding area. The pieces to be welded should be clean and dry. Solvents should not be used to clean the surfaces to be welded.

THE WELDING PROCESS

The heating element should be set at the desired welding temperature. For Corzan CPVC sheet, the optimum temperature for butt welding is typically 437 to 446°F (225 to 230°C).

With a microprocessor-controlled machine, only the sheet thickness and length, as well as the melting / welding pressures have to be programmed. The machine will then make the necessary calculations with respect to time and pressure for the welding process.

With a non-microprocessor-controlled machine, the operator has to calculate the welding surface, then multiply the cross section with the optimum melting / fusing pressure and set the machine gauges accordingly. Here, as well, temperature and times must be manually adjusted.

Once the machine is set up, the sheets are inserted on either side of the table tightly against the setting bar and clamped. The heating element should be brought into position and the pieces of material should be pressed against the heating plate with the desired melting pressure. The purpose for the higher-pressure melting time is to assure that the material makes solid contact with the heating element.

Once a bead has formed along the entire weld area, the pressure should be dropped to a nominal heating pressure. This pressure should be sufficient to hold the pieces against the element but prevent excessively large beads from forming. The goal is to heat up the fusion area without pushing molten material out of the weld zone.

With microprocessor-controlled machines, the melting time is preset and can be extended, stopped, or reprogrammed, depending on the accuracy of the cut. The better the cut, the shorter the melting time. The optimum heating pressure for butt welding Corzan CPVC is approximately 30 psi (20 N/cm2).

The time that the plastic should be held against the element under the heating pressure is dependent on the thickness of the sheet. Typical optimum heating times for CPVC sheet are shown in the following table.

Optimum Heating Time

THICKNESS (in.)	HEATING TIME (sec.)
3/16"	75
1/4"	90
3/8"	120
1/2"	150

When the heating time is complete, the element should be removed, and the pieces brought together as quickly as possible. The optimum changeover time is less than three seconds. The pressure should then be brought to the desired level for fusion, which should be maintained for a period of time which is dependent on the thickness of the sheet. The optimum welding pressure for Corzan CPVC sheet is typically 95 to 100 psi (65 to 70 N/cm^2).

The optimum fusion times for CPVC sheet are given in the following table.

Optimum Fusion Times

THICKNESS (in.)	HEATING TIME (min.)
3⁄16"	5
¼"	6
⅜"	9
½"	11

THERMOPLASTICS WELDING KEY CODES, STANDARDS, AND GUIDELINES

DVS 2203-1, 2204-5, 2207-3, 2207-4, 2207-13 – The DVS (German Welding Society) guidelines are international standards referenced for plastic welding. With decades of research and testing, these guidelines provide the most detailed and comprehensive guide to thermoplastic welding. There are "Certified Welder" programs available according to DVS that are recognized internationally.

AWS – The AWS (American Welding Society) B2.4 is qualification document done through the employer to qualify their welding personnel. The B2.4 document references DVS guidelines. New edition to be published 2021.

ASME RTP-1 – American Society of Mechanical Engineering, Reinforced Thermoset Plastics is standard for non-pressure vessels including thermoplastic lined vessels. Standard references AWS B2.4

ASME NM.1 Standard for Thermoplastic Piping Systems issues by ASME to address thermoplastic materials.

ASME NM.2 Standard on Glass-Fiber Reinforced Plastics issued by ASME to address standard production of FRP piping systems.

If you would like more information about Vycom's CORZAN® CPVC sheet including application case studies, please visit our website: https://www.vycomplastics.com/product-families/corrtec/

VYCOM®

Vycom manufactures market-leading brands of highly innovative plastic sheet products designed to replace wood, metal and other traditional materials in a variety of applications. The company's extensive inventory and product offerings provide its customers with the convenience of single-source purchasing and the ability to maximize efficiencies. Vycom's manufacturing agility places it in a prime position to be the essential partner in creating solutions that optimize quality and performance, and in providing a more sustainable future.

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