Field Duct Joining Procedure

Overview:

This procedure covers material and suggested methods for bonding fiberglass duct in the field. VPC's preferred method of bonding is commonly known as the butt joining technique. This procedure is relatively basic in nature; however, it is extremely important to follow the procedures entirely. Failure to do so can result in improper adhesion, a lack of curing, or porosity (air bubbles). It is imperative that if questions arise and additional clarity is required, please contact a representative of VPC immediately. An instructional video is also available and can be accessed on our website.

Safety Precautions:

Wear proper protective equipment when operating power tools and handling chemicals. The resin, catalyst, and gelcoat mixture provided by VPC in duct field kits are volatile chemicals and proper precautions must be taken. Store the chemicals in a cool, dry place out of direct sunlight. Keep any flames or hot work away from chemicals. Resin and catalyst are flammable. Improper storage of resin can ruin the resin so that it will not catalyze properly. Read and understand all SDS sheets for chemicals. The SDS sheets are provided by VPC and are shipped with the field kit. Work in a well-ventilated area. If you are working with chemicals and feel faint or light-headed, stop work immediately and move to an area with fresh air. Store chemicals separately. Be careful when mixing the catalyst with the resin. When resin is catalyzed it undergoes an exothermic reaction, which means heat is produced. Mixing improper amounts of catalyst with resin can cause a lot of heat, and in extreme cases even start a fire. Once resin is catalyzed in a mixing cup, wait until the resin hardens and cools off before disposing.

Field Kit:

Items provides by VPC are as follows: resin, catalyst with measuring dispenser bottle, gel coat mixture, 4" 1.5 oz chopped strand mat, 24 oz woven, rubber gloves, quart cups, ¾ gallon popcorn tubs, mylar, stir sticks, paint brushes, and laminating rollers. Resin supplied by VPC matches what was used in the fabrication of the duct. Contractors will need in addition: safety glasses, 36 grit grinding pad and grinder, cut off wheel grinder, jigsaw or sawzall, utility knife or scissors, disposable rags, and acetone.

Preparation for Duct:

VPC provides duct in which the ends are pre-scuffed, allowing the field technicians to wipe down and begin the bonding procedure. In the event where a cut needs to be made in the field, cut pipes to desired lengths making sure ends are square. Using 36 grit grinding paper, rough pipe ends removing the exterior glossy finish. Grind down 1-2 inches past your expected joint width. Mock the duct sections together and ensure that the two pieces meet up well without large gaps. Fasten or secure ducts in place to prevent movement during the bonding process. Wipe the joint area down using isopropyl alcohol or acetone and a clean rag.

Workstation Preparations:

Choose a workstation location, ideally away from dust. Lay out your materials and tools from the field kit in an accessible fashion. On tabletop or floor, tape down a sheet of mylar large enough for the biggest piece of fiberglass. The mylar will allow you to wet out the material on the floor before applying to the duct. Pour the catalyst into the catalyst dispensing bottle. Determine the length of your material.

The fiberglass strip should be 2 inches longer than the circumference of the duct you are bonding. For large ducts, instead of one long continuous strip you can use multiple shorter sections if desired. Ensure 2 inches minimum of overlap if you have multiple sections. Determine the appropriate laminate schedule using the attached table below. Rip the CSM (1.5oz chop strand mat) into the number of pieces you need. Also cut the woven roving material to the proper length. You should have all your material prepared and ready to wet out ahead of time. Fill a small bucket with a bit of acetone for your roller and brushes.

Resin Mixing:

VPC provides promoted resin with our field kits. Proper mixing of the resin in the bucket is important so that the additives are evenly distributed throughout the resin. Like a bucket of paint, mixing is important so color is consistent and so the resin hardens properly. Use a spiral mixer and drill to thoroughly mix the resin. Mix for at least 2 minutes and be sure to get the bottom and the sides of the bucket. Determine how much resin you will need. Once you catalyze the resin, it will harden in about 15-25 minutes. You only want to work with how much you can use at a time. Pour some resin into a quart cup for use. Never add the catalyzed resin back into the un-catalyzed resin bucket, as this will cause the whole bucket to harden.

Resin Catalyzation:

Resin needs the correct amount of catalyst added to achieve the proper chemical reaction. If too little catalyst is added, or the mixture is not mixed properly, then the resin may not fully harden. If too much catalyst is added, then the fiberglass might get too hot and material properties may be affected. See the Resin Catalyzation Table below for more detail. A rule of thumb is that 10cc of catalyst are required for 1 quart of resin. Using the attached table below, determine the proper amount of catalyst for your resin. For cool temperatures (50-60 deg.), use the 1.5% column. For warmer temperatures (80-90 deg.), use the 1% column. Measure the catalyst using the catalyst dispenser. Pour it into the cup of resin and mix thoroughly with a stir stick. Proper mixing of the catalyst is critical for all of the resin to harden correctly.

Lay-up:

Using a 4 inch paint brush, coat the joint area with catalyzed resin. Put some resin on the mylar surface on your work surface. Lay your first piece of material down onto the mylar and wet it out using the paint brush. Lay your second piece of material down and wet it out with the brush. Overlap the pieces about ½" inch. See image below for details. Once you have about 3 layers on the mylar, pick up the wetted material and place on the duct. Center the material over the duct joint. Use the laminating roller to roll out any air bubbles. If any dry spots are encountered, more resin can be added to the fiberglass material using the paint brush. With the roller, work the material to push air out to the sides. Trapped air bubbles lead to a weaker joint. Add successive layers as necessary in accordance with the table below. When complete, the thickness of your field joint will be equal or greater than the duct wall thickness. Once all layers are added and the material is rolled out, allow the resin to cure. Leave the joint alone and do not touch until it is hard and cooled down.

Gel-coating:

Gel-coating the part is required to achieve full cure of the resin below and to protect the resin. This top coat mixture contains wax and a UV inhibitor. These additives are pre-mixed into the resin prior to

shipping in the field kit. Like with the resin, thorough mixing of the gelcoat is required so the additives are evenly distributed. Only catalyze small amounts of gelcoat at a time, since it will cure in 20-30 minutes. If desired, multiple duct joints can be gel-coated at the same time. Using a paint brush, paint the gelcoat onto the surface of the duct. You must cover the fiberglass jointed area and anywhere that was ground down past the joint. The gel-coated surface will appear more glossy and darker than any ground down sections. Once the gelcoat is evenly applied over all required surfaces, allow to cure.

Clean-up:

Submerge your brush and laminating roller in the acetone in a small cup. This will prevent the resin from gumming up and will allow you to re-use the tools. Prior to use on your next joint, allow the acetone to dry off the tools so it is not introduced into your joint. Acetone can also be used to clean spilled resin off the floor or table. Catalyzed resin that has hardened and cooled back down can be disposed of in the trash. Wash your hands after handling chemicals prior to eating or touching your eyes or face.

VPC Catalyst Mix Chart

Resin Volume	1%	1.25%	1.50%
4 floz	1 cc	1.5 cc	2 cc
8 floz	2.5 cc	3 cc	4 cc
1 Pint, 16 floz	5 cc	6 cc	7 cc
1 Quart, 32 floz	10 cc	12 cc	15 cc
1/2 Gal, 64 floz	20 cc	25 cc	30 cc
1 Gal, 128 floz	39.5 cc	49 cc	59 cc

VPC Bond Construction Table for Round Duct

Duct Diameter	Min. Bond. Thickness	Layers (inside of joint at left)			
4in - 12in	1/8"	4in CSM	4in Fab-Mat *	4in CSM	N/A
13in - 36in	3/16"	4in CSM	4in Fab-Mat *	5in Fab-Mat*	5in CSM
37in - 72in	1/4"	4in CSM	4in Fab-Mat *	6in Fab-Mat*	6in CSM

* for the Fab-Mat, have the CSM layer face to the inside of the duct

** The 5in mat can be substituted with the 6in mat if desired

VPC Bond Construction Table for Rectangular Duct and Special Parts

Duct Wall Thickness	Min. Bond Thickness	Layers (inside of joint at left)						
1/8"	1/8"	4in CSM	4in Fab-Mat *	4in CSM	N/A	N/A	N/A	N/A
3/16"	3/16"	4in CSM	4in Fab-Mat *	5in Fab-Mat*	5in CSM	N/A	N/A	N/A
1/4"	1/4"	4in CSM	4in Fab-Mat *	6in Fab-Mat*	6in CSM	N/A	N/A	N/A
5/16"	5/16"	4in CSM	4in Fab-Mat *	6in Fab-Mat*	6in Fab-Mat*	6in CSM	N/A	N/A
3/8"	3/8"	4in CSM	4in Fab-Mat *	6in Fab-Mat*	6in CSM	8in Fab-Mat*	8in CSM	N/A
7/16"	7/16"	4in CSM	4in Fab-Mat *	6in Fab-Mat*	6in CSM	8in Fab-Mat*	8in CSM	8in CSM
1/2"	1/2"	4in CSM	4in Fab-Mat *	6in Fab-Mat*	6in Fab-Mat*	8in Fab-Mat*	8in Fab-Mat*	8in CSM

* for the Fab-Mat, have the CSM layer face to the inside of the duct

Note: Measure the duct wall thickness to determine which lay up schedule applies for your joint

1. Assemble your workstation. Choose an appropriate location and gather your materials. Proper preparation is critical to ensure your bonding goes smoothly. Once the resin is catalyzed, the clock begins.

2. Carefully measure your duct to be cut, if required. For best results, mark the duct in multiple locations and draw your cut line using a pipe wrap. This will help to ensure a straight cut. A duct section with a straight cut will fit up better to the next section and result in a stronger joint.

3. Cut the duct as required. Use a grinder with a cut off wheel, jigsaw, sawzall, etc. Ensure that you cut the duct square. This will allow for the duct sections to fit together well. It is recommended that you wear a dust mask when cutting or grinding fiberglass.

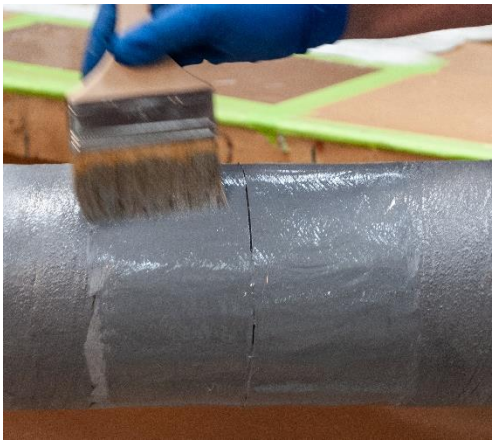
4. Grind down the exterior of the duct at least 1-2 inches past where you expect the fiberglass mat to go. This allows for proper adhesion of the fiberglass material. For example, if your widest fiberglass mat for the bond is 6in wide, grind 4-5inches at the end of each duct section.

5. Mock up your duct sections to be joined together. Ensure that they meet up without large gaps. Secure the duct however possible, with C-clamps, blocking, etc. so that the sections won't move during bonding.

6. Prepare the fiberglass mat in the appropriate lengths. Length should be the circumference of your duct plus 2 inches. If desired for larger ducts, the wrap can be broken into multiple pieces as long as 2 inches of overlap are used for each section. Determine the laminate schedule using the attached table and prepare all of your pieces. You should have each layer of material ready before you mix any resin.

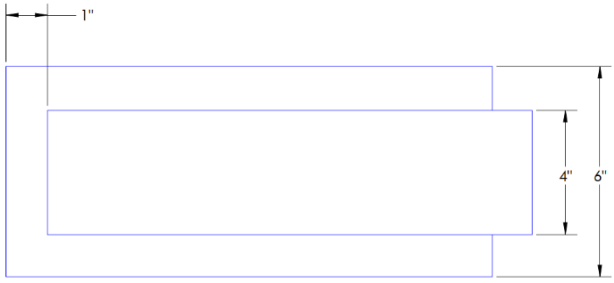
7. Mix the bucket of resin using a drill and stir mixer. Stir thoroughly for at least 2 minutes. Be sure to mix the bottom and sides of the bucket as well. The resin contains additives that help the chemical reaction take place, so not mixing can lead to improper cure.

8. Determine the appropriate amount of resin for your joint and add it to a smaller cup. Determine the correct amount of catalyst by using the attached table. Measure the catalyst with the dispenser and pour into the smaller resin container. Mix thoroughly with a stir stick.



9. Brush a light layer of catalyzed resin onto the ground down area around the duct joint. This will help secure the first layer of fiberglass mat to the duct and prevent air bubbles.

10. With your first layer of fiberglass on the mylar sheet, brush some catalyzed resin onto the material. Wetting the material completely helps prevent air bubbles and leads to a stronger part.



EXAMPLE FIBERGLASS MATERIAL WET-OUT

11. Apply your second layer of fiberglass material on top of the wet layer of material. Stagger the start about 1in from the first piece. Follow the laminate table for the layers. You can break the layers up into groups so you are wetting out three layers on the table if desired.

12. Apply the group of wetted out layers to the duct joint. Center the material over the joint. Pat down the material to ensure that the mat is fully contacting the duct. Be careful to avoid wrinkles in the material which can lead to trapped air pockets.

13. Using the laminate roller, roll out the wet fiberglass material. This removes the air bubbles trapped in the laminate. Push with moderate pressure and move from the center out to release the air bubbles. If necessary, add more resin using the paint brush.

14. Once all laminate layers are added and rolled out, allow the joint to cure. Do not disturb the joint and leave it secured for at least 30 minutes. The resin will heat up and cool down again.

15. Once the resin is cured, apply the exterior gelcoat. The gelcoat contains wax and a UV inhibitor additive. Mix the container thoroughly to evenly distribute the additives. Determine how much gelcoat will be needed and catalyze it in accordance with the attached table. Stir thoroughly with a stir stick. Apply to all ground surfaces and the field joint surface. Full coverage will allow for proper resin cure and surface protection.