Installation Guide
Including Handling and Storage

This guide will be of particular interest to those who are responsible for handling, transporting and installing FiberSystems' products.

It is not intended to supply design information or assume the role of the engineer in establishing specific installation procedures for each project.

This guide may involve hazardous materials, operation, and/or equipment. This guide does not purport to address all the safety problems associated with its use. It is the responsibility of the user of this guide to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

FiberSystems' pipe is manufactured in accordance with nationally recognized specifications, project specific specifications, and it's in-house extensive quality standards. Pipe diameters are nominal inside diameters with the outside diameter controlled by total wall thickness.

Specific inside and/or outside diameters are available by special order.

Inspecting Pipe and Fittings

Upon receipt of ordered items, check shipment for possible transit damage. All FiberSystems' pipe and fittings are carefully cradled, palletized or packaged and are thoroughly inspected prior to shipment. Nevertheless, damage can occur in transit because of the extreme magnitude of physical shock that transportation methods can occasionally cause. The carrier accepts responsibility to deliver each shipment in good order and condition.

It is the responsibility of the receiver to make certain there has been no loss or damage.

The material list that accompanies each shipment provides a complete record of all items included. Carefully check the load against the material list and report any error to the transportation agent immediately with proper notation made on the delivery receipt.

Persons accepting delivery of each load are reminded to check for the following:

1. Make an overall examination of the load. If the items have shifted or indicate rough treatment, carefully inspect each piece for possible damage. Both inside and outside inspections are required.

2. If the load has shifted or shows rough treatment, each piece should be carefully inspected for damage.
   A. Check top of load for any sign of breakage or abrasion.
   B. Check widest part of load.
   C. Check shipping cradles for any sign that they may have shifted.
   D. Check at strapping for any sign that load shifted and strapping damaged item.
   E. Check end blocking for contact damage.

3. Most of the inspection will be concerned with damage caused by reverse impact: i.e., because of physical impact on the exterior, the pipe wall bent in to the point where it cracked the interior resin rich surface and then returned to its normal position. There is usually a readily visible whitening of the pipe wall in these areas. Such damage, confined solely to the exterior surface, may be merely superficial. Whenever there are cracks or star shaped crazes that are actual breaks in the interior resin rich surface, repair work, which is usually quite simple, is essential.

4. Check total quantities of each item against the material list.

5. Any damaged or missing items should be noted on the delivery receipt or bill of lading.

6. Notify carrier immediately and make claim in accordance with their instruction.

7. Do not dispose of any damaged material. Carrier will notify you of the procedure to follow.

8. Shortages and damaged materials are not automatically re-shipped. If the replacement material is needed, reorder must be initiated by the buyer.

9. Pipe is factory marked in compliance with its manufacturing specification.

10. Do not use pipe or fittings that appear to be defective. These items can be returned to the factory for inspection and repair, or a factory representative can visit the job site for inspection of questioned items.

Unloading and Handling

The means by which FiberSystems' pipes are unloaded in the field is the decision and the responsibility of the customer. The preferred unloading method is using mechanical equipment such as forklifts, cherry picker or front end loader with forks. Any straps or "chokers" in direct contact with pipe should be nylon or a similar material.

Unloading FiberSystems' fiberglass pipe is the responsibility of the customer. Be sure to maintain control of the pipe or fitting during unloading. Do not drop, impact or bump the pipe, particularly at pipe ends.

Use pliable straps, slings or rope to lift. **Do not use steel cables or chains to lift or transport fiberglass pipe or fittings**. It is good practice to lift at two support points, although some pipe lengths less than 40 feet can be lifted with only one support point.

When unloading, the following instructions should be carefully followed. Remove one unit or piece at a time.

1. Remove the shipping tie downs from the pipe.

2. If there are boards across the top of down the sides of the pipe, remove them carefully. Use a forklift, front end loader equipped with forks or cherry picker with fabric straps to remove one top piece at a time from the truck.

3. Use care during removal and handling as fork ends may strike and damage other pieces. Also, use care that the pieces do not strike each other or other objects. Severe impact may cause damage.

4. **Do not handle pieces with chains or wire cables.**

5. Pieces should be stored on level ground. Pieces may be protected by the dunnage in the same way they were protected while loaded on the truck. Used carefully, the dunnage should support all the pieces. If pieces are to be set directly on the ground, take care to remove stones or other objects that could cause point loading.

6. To unload lower pieces, repeat steps 1 through 5 above.

For guidance in unloading, refer to the table of weights for individual lengths of pipe in FiberSystems' published literature.

To support the pipe in storage, it is a good practice to use the dunnage and chock blocks from the load, assuming they are inspected and determined to be free of damage. Individual lengths of pipe should be stacked no higher in storage than they were stacked for shipment.

FiberSystems' pipe has an ultraviolet inhibitor to reduce degradation caused by direct exposure to sunlight. FiberSystems' pipe, stored outdoors, requires no covering or other protection from direct sunlight.

Storing Fiberglass Pipe and Fittings

Pipe less than 4 feet in diameter may be stored directly on sandy soil. When storing pipe directly on the ground, be sure the ground is flat and free of rocks larger than 1" in diameter and other potentially damaging debris.

Pipe 4 feet in diameter and larger shall be placed on a minimum of two cradles, placed so they support the pipe at the exterior surface. Narrow flat supports are not adequate substitutes.

All ribbed pipe shall be stored in away that will avoid point loading of the rib area.

Fabricated pipe spools should not be stacked. Straight lengths of pipe through 16" in diameter may be stacked using shipping dunnage. Stacking pipe lengths should only be used when lay-down space is limited. Careful planning must be used to insure stacked pipe do not shift and/or fall. This could cause damage to the pipe and/or anyone struck by the shifting or falling pipe.

Storage of Fiberglass Weld Kits and Resin

Fiberglass field weld kits should remain in their original containers until used. Storage should be in a cool, dry location where they are not exposed to high humidity or likely to become wet.

Field weld kit resin should remain in its shipping container until used. Storage should be in a cool, dry location. Storage should be either indoors or in a shaded location. Avoid storage in direct sunlight to maximize shelf life.

Installation

Installation of fiberglass pipe is in many ways similar to installation of steel or alloy pipe. Fiberglass pipe is stronger than steel when compared by weight. However, it is fragile. If a steel pipe were made the same weight as a comparable fiberglass pipe, the pipe wall would be so thin it would be fragile.

Fiberglass pipe should be handled carefully to avoid damage to ends and protrusions. End covers, flange covers, etc. should be kept in place until the pipe spool is at the installation point.

Pipe supports and pipe hangers may be used to set fiberglass spools into their final resting place. Care should be taken in aligning adjacent pipe spools to make the alignment "natural". Do not align pipe by force. Adjust pipe hangers and/or supports or temporary dunnage to align the pipe. Using force against fiberglass pipe may cause immediate damage, or, if the stress caused by forced alignment is not relieved, the pipe will be susceptible to phenomena called stress corrosion. Stress corrosion will reduce fiberglass pipe to a fraction of its expected useful life.

When fiberglass pipe spools are properly aligned and held securely in place, the spool is ready for welding.

Fiberglass Welding

Butt and strap joint construction is a standard method to join fiberglass pipe spools. This section covers the procedure for making the butt and strap joining technique for fiberglass pipe.

Butt and strap joints are produced by aligning the pipe sections to be joined and manually fabricating a joint with fiberglass and resin. Welds can be made quickly and safely in the field or in the shop. The results are a corrosion resistant joint as strong or stronger than the pieces joined. The step-by-step procedures involve relatively quick and simple processes. However, since a certain amount of know how is required, it is recommended that properly trained personnel do this work.

Special Note: Each weld kit is supplied with a premeasured quantity of glass strips for making the butt and strap joint for a particular pipe size with a desired pressure rating. Therefore, it is extremely important that all material be properly applied to the joint to insure that the finished product will have the required wall thickness and pressure rating of the pieces that are joined.

Tools and Supplies Required

Power disc sander, with 16-24 grit grinding discs.
Saber saw, with 24 tooth metal cutting blade or tungsten carbide blade
10” scissors or retractable razor knife
Serrated aluminum or nylon rollers, 1” diameter x 3” wide
Wrap-a-round or straight-edged material for pipe marking
Cleaning solvent – acetone or methylene chloride
3” wide stiff bristle brushes, for wetting out glass strips
3” or 6” wide mohair paint roller, for wetting out glass strips
Cellophane, mylar film or unwaxed paper, for prewetting glass strips
Mixing sticks, wooden tongue depressors
Plastic mixing buckets, 2 qt.
Paper or plastic mixing cups
Milliliter graduated devices for measuring resin and catalyst
Safety goggles or glasses
Protective gloves, neoprene or polyethylene

Butt and Strap Welding Procedure

Step 1. Firmly support and steady pieces to be joined. Use the wrap-a-round or straight-edged material to insure square cuts. Gaps between the sections should not exceed ¼”. Cut with saber saw or grind to acceptable tolerance as necessary.

Step 2. Using a power disc sander, sand the surface to be welded about 2" beyond the area of the completed weld. The finished weld width will coincide with the width of the mat cover used on the outside weld. The surface resin glaze and any other contaminant, such as grease, dirt or moisture, must be removed prior to making a joint. Freshly sanded surfaces should be dusted with a clean dry cloth just prior to applying the overwrap weld. Sanded joints left for extended periods, such as overnight, should be re-sanded.

Step 2.A. If the inside of the pipe will be accessible after joining, prepare the inside of each pipe prior to joining using the method outlined above.

Step 3. Coat raw ends and edges with a paintbrush before joining, using catalyzed resin. Large voids should be filled with a silica filled resin paste.

Step 4. Place the two components together in the position in which they are to be welded. When in perfect alignment, support firmly to prevent any movement during the weld cure period. Saturate 3 pieces of 2" square chopped strand mat with resin (use about three times the normal amount of catalyst). Apply the 'hot patches' or tac-bonds at intervals around the pipe. Curing or hardening in a matter of minutes, they secure the sections to be joined in the proper alignment. Discard unused resin.

Step 5. The gaps between the pipe sections should be filled with a silica resin-base putty. Putty can be made by mixing the resin with silica or milled glass fibers and then adding the catalyst. Fill all gaps or changes in elevation with putty. The putty should be fairly smooth during application because any rough bumps in the cured putty will interfere with the laying of the first mat strip. Any bumps should be sanded off prior to beginning the weld. The putty is normally applied from the outside. However, if an inside weld is to be applied to the inside, the putty must be smooth on the inside. Do not overuse putty; it must not be spread over a wide area because it may prevent a good bond between the pipe and the overwrap materials.

Pipe Spool Exterior Welds

Step 6. Using a 3' or 4' x 8' work table or plywood sheet covered with cardboard or kraft paper (for replaceable table cover), lay out the material for the exterior weld. Field weld materials are precut to both width and length. Material will be placed in the welding sequence from narrowest to widest. In preparing for the actual weld, material should be placed near the "wet out" area with the widest piece on bottom so the pieces can be transferred to the wet out area easily and in the proper sequence.

Step 7. The overlay on the outside of the joints will be built up in layers of material of various widths, with a single layer of chopped strand mat as the outermost layer. The initial layers will be a minimum of 4" wide. Successive layers will increase in width to provide the minimum total width and thickness required.

Apply a thin coat of catalyzed resin to the cleaned, sanded surface of the pipe O.D. where the material will be applied. Starting with the narrowest strip of material previously laid out, saturate the material

with a brush or mohair roller. Caution, excessive amounts of resin may cause separation of the material when lifting.

Pick up the wetted strip; drape the material over the joint with any woven surface facing outward. Center the material so an equal amount is on each side of the joint. The length of the material allow for a slight overlap on the ends. Using the serrated roller, roll out any air bubbles.

Step 8. Saturate and apply the remaining material sections, centering each over the joint. Stagger the ends so circumferential laps are not in the same place.

Roll out as much air as possible with the serrated roller as each additional layer is applied. Air bubbles will appear as light spots. These should be rolled to the edge where they will be released. At this stage, resin may be added where necessary if any mat appears to not thoroughly wetted. It is better to have too little resin on the weld strip, when initially applied, than too much. Over wetting may cause resin runs and/or glass sagging on the bottom of the joint.

Wet out and apply the final single layer of mat that completes the lay up sequence as a cover over the entire welded area. The last layer of chopped strand mat prevents external corrosion and improves the appearance of the joint.

Roll out as smooth as possible with the serrated roller, finish smoothing with the mohair roller and allow to harden.

Coat the remaining sanded areas with resin. Allow the completed weld to completely cure, thoroughly tack free. Do not move or disturb the weld until it is completely cured. If temperature is below 55 degrees f., keep the weld area warm with a safe heat source. For exterior installations, protect the weld from the weather.

NOTE: Laminates over 3/8" thick should be done in additional operations to allow the exothermal heat to escape from the previous layer before applying the next layer. Excessive heat may result in blistering and delamination.

On pipe 20" in diameter and larger, lay up half of the circumference at a time. From top to bottom of the pipe, working alternate sides to prevent sagging.

Step 9. The hardened joint should be smoothed with a power sander, wiped clean and a final coat of resin applied for chemical and ultra violet light resistance.

Pipe Interior Welds

Pipe 20" in diameter and larger, and smaller diameter where accessible, should have an inside weld applied.

Step 10. Material for inside welds is packed with, but separate from, exterior welds. Inside welds consist of two layers of chopped strand mat against the pipe inner surface and one layer of veil, which will be exposed directly to the chemical environment.

The interior surface should be prepared for bonding in the same manner as the outside.

The length of the inside weld material is slightly longer than the circumference of the pipe to allow for a material overlap. For most sizes, the wetted material should be applied in two applications, starting from the bottom, working toward the top.

Mix prescribed amount of catalyst with required amount of resin when ready for immediate use. Resin will harden in about 20-30 minutes. Place the veil material on the previously prepared kraft paper covered table. Saturate the veil with catalyzed resin using the paintbrush or mohair roller. Repeat this procedure with each of the strips of chopped strand mat, centering each on the veil. The veil should be larger than the chopped strand mat.

Lift the inside weld from the work table and place the entire piece over the joint, centering the material over the seam, with the veil layer facing the interior of the pipe spool. Starting at the bottom of the pipe joint, apply the weld material, and remove entrapped air. As on the exterior weld, roll the inside weld with a serrated roller, working the air bubbles to the edge for removal. When the inside weld is in place and air bubbles removed, it can be smoothed using a (catalyzed) resin coated mohair roller. Attention must be maintained to the inside weld until the curing has initiated and the welder is assured the material will not sag away from the pipe interior.

Step 11. After the inside weld is fully cured, apply a final coat of a thin layer of catalyzed resin.

General Recommendations

1. Store resin and catalyst at ambient room temperature or below for maximum shelf life. Keep out of direct sunlight.

2. All weld kit materials must be kept in a dry place. If glass material is damp, or if the resin contains moisture, they cannot be used for making corrosion resistant joints.

3. No joints are to be made in rain, snow or excessively high humidity.

4. Clean all equipment immediately after use in solvent such as acetone or methylene chloride. Shake off tools and allow solvent to evaporate before reusing.

5. Gaps, voids and crevices should be filled with resin base putty. If there is a difference in the outside diameter of the sections being joined, smooth the putty to form a gradual slope.

6. Cut edges should be covered with resin before alignment and joining.

7. Serrated aluminum or nylon rollers are recommended for rolling out air bubbles in welds in place of common mohair or paint rollers.

8. Pipe stored on supports must be protected against impact on metal or pointed projections. Wide supports should be used with a support spacing not to exceed fifteen feet for storage.

9. Generally, work should not be done at temperatures below 55 degrees F., unless an external source of heat such as infrared heat lamp is applied. Care must be exercised when using an external heat source to prevent overheating, which can cause cracking or crazing of the fiberglass material.

10. A Barcol Hardness tester can be used to determine if the field weld is cured adequately.

Safety Recommendations

1. Provide adequate ventilation or use a good chemical vapor respirator, especially when working inside a pipe spool.

2. Under no conditions should smoking or open flame be permitted anywhere in the work area.

3. Hands and utensils should be cleaned immediately.

4. Safety glasses should be worn at all times. Should eye contact occur, wash with flowing water and see a physician if eyes are irritated.

5. Use a dust mask to prevent inhalation of dust when sanding or grinding. Fiberglass dust is an iterant but is not normally otherwise harmful.

6. Catalyst and any other promoters must always be added separately. One must be thoroughly mixed in the resin before the other is added. This separation of ingredients is necessary because of the combustible nature of such mixture.

7. Excess catalyzed resin should be discarded immediately to prevent spontaneous combustion that may result from exotherm. Foaming and bubbling are signs that exotherm has begun.

8. Never put a cover on a container of catalyzed resin. A closed container may build up pressure resulting in an explosion.

Condensed Outline, Butt Weld Construction

1. Pipe ends to be joined will be sanded back 1” beyond the weld area.

2. Cut ends will be coated with resin to cover any exposed fibers.

3. Pipe will be placed in the position in which they are to be welded.

4. A catalyzed thixotrophic resin paste will be applied to the joint seam. This will eliminate resin flow through he crack as the actual weld is applied.

5. The pre-cut fiberglass kit is then saturated with catalyzed resin along side the joint area.

6. The saturated weld is then picked up like a bandage and wrapped around the joint.

7. An aluminum or nylon roller is then used to smooth the weld and remove any air bubbles trapped beneath the weld.

8. An inside weld is made following steps 1,4,5,6 &7; however, this is only a sealing weld and is not and cannot be relied upon for any strength. The inside weld will consist of two layer of chopped strand mat and one inside layer of veil.

9. A final resin coat is applied after the weld has taken its initial cure.

Flange Joint Installation

Fiberglass flanges should be installed in accordance with the following steps to insure that the flange is not damaged and a seal is achieved.

1. Check to insure both flange faces and the gasket are clean before assembly.

2. Position the gasket between the flanges. Mate the flanges, install all nuts and bolts with a washer between the bolt head and the flange and between the nut and the flange.

3. NOTE: Use a lubricant on all bolts/nuts. Any bolt lubricant that ensures a friction coefficient of between 0.10 to 0.14 is acceptable.

4. Hand tighten all nuts.

5. Tighten all bolts to a maximum initial torque of 5 foot-pounds. This should be done by tightening two bolts at a time. The first pair should be oriented at 12 o'clock and 6 o'clock. The second pair should be at 3 and 9 o'clock. Tightening should continue in pairs, each alternating at 180° separation, until all bolts have been tightened to the 5 foot-pound level.

6. Additional torque increments of 10 foot-pounds or less should be applied until the maximum bolt torque is reached. Bolts should also be tightened in pairs for this step. After all bolts have been tightened to the required level, torques should be rechecked in the sequence that the bolts were

tightened because bolt tension tends to relax as subsequent bolts are tightened. If a seal is not achieved, see the Trouble Shooting Section.

7. The maximum bolt torques should not exceed the values indicated in the following table. Excess torque can damage fiberglass flanges and can cause the loss of seal.

Maximum Bolt Torque in ft. lbs.

Pipe Diameter, inches	Bolt Diameter	Bolt Torque, ft. lb.
1	1/2	15
2	5/8	25
3	5/8	25
4	5/8	25
6	3/4	40
8	3/4	40
10	7/8	65
12	7/8	65
14	1	100
16	1	100
18	1-1/8	140
20	1-1/8	140
24	1-1/4	200
30	1-1/4	200
36	1-1/2	320
42	1-1/2	320
48	1-1/2	320
54	1-3/4	600

Torques result in a bolt stress of 12,000 psi. Threads & bearing surfaces should be well lubricated. Bolts 1" and larger are 8 thread series. Maximum bolt torque is not required for low pressure systems.

Note 1: The above figures are based on full faced gaskets having a Shore A Durometer of 60-70; 1/8" thickness through 24", 3/16" thickness 30" through 42" diameter and ¼" gasket thickness 48" diameter and over.

Note 2: Flanging to raised face flanges, lined pipe, fitting bodies and wafer valves require careful workmanship. Reduce bolt torque is **required** to prevent over stressing of fiberglass flanges.

Trouble Shooting

If the flange joint installation procedures are followed, installation problems should be kept to a minimum. If problems do occur, the following steps are suggested as means of isolation the problem.

1. Remove all bolts, nuts, washer and gaskets.

2. Check alignment. Realign if necessary.

3. Check flange sealing surface, particularly that near the I.D. of the pipe, for damage. Flanges with damaged inner seal surfaces should be repaired.

4. Check for gasket damage. Replace damaged gaskets.

5. Repeat the flange joint installation procedure. A seal should be achieved.