Red Thread™ HP, Green Thread™ HP, and Silver Streak™

Pipe Installation Handbook

Matched Tapered
Bell & Spigot Joints

Fiber Glass Systems | NOV

nov.com/fgs

Matched Tapered Bell & Spigot Joints

This fabrication manual is offered to assist you in the proper fabrication and installation procedures when assembling your NOV Fiber Glass Systems piping system.

If you do not find the answer to your questions in the manual, feel free to contact us or your local distributor.

Our products must be installed and used in accordance with sound, proven practice and common sense.

The information supplied by NOV Fiber Glass Systems in its literature must be considered as an expression of guidelines based on field experience rather than a warranty for which the company assumes responsibility. We offer a limited warranty of its products in the Terms and Conditions of Sale. The information contained in the literature and catalogs furnished cannot ensure, of itself, a successful installation and is offered to customers subject to these limitations and explanations.

Installing fiberglass pipe is easier than installing carbon steel, stainless steel, and lined steel due to its light weight. Learning the proper methods to prepare and make-up bell & spigot joints can help ensure the reliability and long-term performance of your piping system.

We offer the TQI Plus (ASME B31.3) Fabrication and Assembly certification program. Qualified Field Service Representatives train fabrication and assembly crews, conduct and supervise fabrication work, and inspect work in progress.

For complete information concerning these training seminars, contact your local distributor or NOV Fiber Glass Systems.

SAFETY

The safety alert symbol indicates an important safety message. When you see this symbol, be alert to the possibility of personal injury

CAUTION

As this pipe may carry hazardous material and/or operate at a hazardous pressure level, you must follow instructions in this manual to avoid serious personal injury or property damage. In any event, improper installation can cause injury or damage. In addition, installers should read and follow all cautions and warnings on adhesive kits, heat packs, propane torches, etc. to avoid personal injury. Also, observe general safety practices with all saws, tools, etc. to avoid personal injury. Wear protective clothing when necessary. Make sure work surfaces are clean and stable and that work areas are properly ventilated.

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Section 1

Pipe Products

Pipe Grades
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Description of pipe products

The performance characteristics of a fiberglass pipe system depend on several important elements including the resin and curing agent, as well as the manufacturing process and type and thickness of the pipe's corrosion barrier.

NOV Fiber Glass Systems' piping systems are manufactured using epoxy, vinyl ester, or isophthalic polyester resin systems. All are heat cured for optimum chemical resistance and physical properties. Match your temperature, pressure and chemical resistance requirements to the piping system.

Pipe Grades

Red Thread HP

Epoxy pipe grade that provides long service life, light weight, and corrosion resistance. Used for light chemical services in salts, solvents, and pH 2 to 13 solutions up to 210°F. Available in 2" - 42" pipe sizes and pressures up to 50 bar (725 psig). Threaded and Bonded bell & spigot (T.A.B.) is the primary joining method for 2"-6" pipe sizes. Matched taper bell & spigot joining method is used for 8" - 42" pipe sizes.

Green Thread HP

Epoxy pipe with 20 mil resin-rich liner that provides excellent chemical resistance to dilute acids and caustics. Rated for temperatures up to 230°F (110°C) and pressures to 40 bar (580 psi). Matched tapered bell & spigot connection is provided on all 1"-42" pipe sizes.

Silver Streak

Custom filament wound pipe is specially designed for abrasive and corrosive services found in flue gas desulfurization. It is a proprietary blend of epoxy resin and abrasion-resistant additives. Rated for temperatures to 225°F and 225 psig. Available in 2"-24" pipe sizes.

Fittings

All fittings are black in color. Green Thread fittings may be used with Red Thread and Green Thread pipe. Be sure to use the correct grade of pipe and fittings for your service. Consult Fittings & Accessories Bulletins for pressure rating limits on various fittings. The lowest rated fitting determines the system pressure rating.

Most compression-molded fittings have a center line dot or cross which will assist you in making measurements.

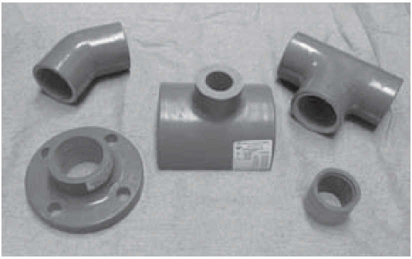


Photo 1
Fittings

Adhesives

Our adhesives are formulated for specific use with the companion pipe grades. Use only the recommended adhesive for the pipe grade. Standard adhesives are a two-component system (Parts A and B) which must be mixed prior to use. Detailed instructions for adhesives are provided with each kit. Read these instructions thoroughly and follow the recommended procedures. The cure time and pot-life of the adhesive is dependent on temperature. Refer to the adhesive instructions. Ambient temperatures above 100°F require extra care by the fabricator to assure sufficient working time of the adhesive. Refer to Adverse Weather Recommendations on page 23.

Adhesive Selection

Standard adhesive kits are designed to be used with specific piping systems as shown in Table 2.

Adhesive Working Life

Working life or pot life is the time it takes for the adhesive to harden in the mixing can. Refer to Table 1 below.

Table 1

Adhesive Estimated Pot Life for Epoxy Resin Systems

Adhesive	Minimum Pot Life @ 70°F	Minimum Pot Life @ 90°F
PSX 20	30	8
PSX 34	30	8
PSX 48	53	27
ZC-275	30	15

NOTE:
Pot life is the time available for fabrication. Times may vary depending upon temperature, humidity, quantity mixed, etc.

Table 2

Number of Adhesive Bonds per Kit

Adhesive	Pipe Size, inch															
	1	1 ½	2	3	4	6	8	10	12	14	16	18	20	30	36	42
PSX 20	28	18	13	9	7	3	2	1	1	½	½					
PSX 34	28	18	13	9	7	3	2	1	1	½	½					
PSX 48	28	18	13	9	7	3	2	1	1	½	½	½	⅓	⅓	⅐	⅛
ZC 275	Applicable for bonding Saddles and FM Repair Couplings to pipe. See Applicable product bulletin															

Table based on standard 6 oz. kit size.

Table based on Silver Streak, Red and Green Thread HP16 products.

Adhesive quantities can be affected by pot life, installation temperature and crew size.

Fabrication Accessories

Heat Collars and Heat Blankets

We offer high temperature heat collars and silicone heat blankets for use in curing of adhesive joints. The blankets and collars have a pre-set thermostat which controls the temperature of the unit. See page 62 for heat collar cure times for adhesive joint fabrications.

Photo 2
Heat Collar

Photo 3
Heat Blanket

Hot Air Gun

High wattage electric hot air guns are also available to heat adhesive joints. The hot air guns are 1600 watt capacity.

Photo 4
Hot Air Gun

Heat Packs

A heat pack unit consisting of ties and reactants in a plastic bag attached to foil paper is also available. Heat packs will cure joints within one hour.

Tapering Tools

Matched tapered joints require various tools for making the tapered spigot in the field (RT, GT, SS). Refer to Table 6 on page 40 for selection of proper tapering tool.

Hydraulic Come-Along

Specifically designed hydraulic come-alongs are available for 8"-42" piping systems (RT, GT, SS). Especially useful for long straight runs of pipe.

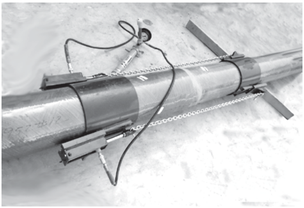


Photo 5
Hydraulic Come-Along

Ratchet-Type Cable Come-Along

Kit consists of two manual cable puller come-alongs and one strap clamp kit. It is a mechanical aid used to join larger diameter piping. The come-along is most useful for 8"-16" pipe sizes to aid in the alignment and landing of the spigot end into the bell.

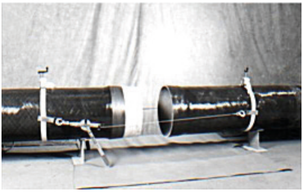


Photo 6
Ratchet-Type Cable Come-Along

Strap Clamp Kit

We offer Strap Clamp Kits that can be used in conjunction with come-alongs for bonding 8"-16" fittings. Strap clamp kits consist of two strap clamps and four D belts.

Photo 7
Strap Clamp Kit

Joining Systems

Bell and Spigot Joint

The adhesive bonded, tapered bell and spigot joint is a primary joining method for the following products:

1"-42" Green Thread piping and pipe to fittings

2"-42" Red Thread piping and pipe to fittings

2"-24" Silver Streak pipe to fittings

Red Thread and Green Thread pipe are supplied with one end tapered (the spigot) and the other end belled (integral bell or factory bonded coupling) to accept a tapered spigot. Silver Streak pipe is supplied with both ends tapered (spigoted). The joint is made by applying adhesive which, when cured, is compatible with the piping systems for joint strength and corrosion resistance.

T.A.B. (Threaded and Bonded) Joint

The T.A.B. joint is the primary joining method for the following product:

2"-6" Red Thread piping and pipe to couplings.

The joining system combines both threads and adhesives on the bonding surfaces. The mechanical locking action of these promotes positive makeup which prevents back out during adhesive curing. Standard tapered bell fittings are used with this system.

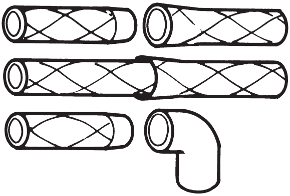


Figure 1
Bell and Spigot Joint

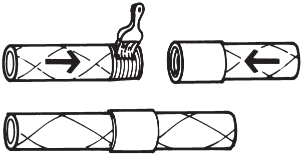


Figure 2
T.A.B. (Threaded and Bonded) Joint

Section 2

Site Considerations

Site Considerations

Storage and Handling

Pipe and Fittings

Fiberglass reinforced pipe, fittings, and adhesives require special attention to storage and handling procedures. Care should be taken in transporting, unloading, handling, and storing products to prevent impact and other damage.

When transporting pipe, spacer blocks under and between the pipe must be of sufficient width to avoid point loading, which could damage the pipe. A minimum of four blocks should be used for supporting 40 foot lengths of 14" and larger pipe.

Due to fiberglass piping's light weight, lifting equipment is usually not required for 1" - 6" pipe. When lifting equipment is required, use nylon slings or chokers. Do not allow chains or cables to contact the pipe during transport or handling. If a pipe or fabrication is more than 20 feet long, lift at two or more points.

For storage, a block (2" x 4" minimum) should be placed approximately every ten feet under each layer of pipe. The intent is to support the pipe and distribute the load evenly. The pipe should also be braced on the sides of the pipe rack to stabilize and prevent pipe movement. Do not place pipe on sharp edges, narrow supports, or other objects that may cause damage to the pipe. When storing pipe directly on the ground, select a flat area free of rocks and other debris that may damage the pipe. Do not stack pipe over 8' high. Factory packaged pipe is shipped in easy-to-handle bundles complete with protective end caps. Leave the end caps in place until installation time to protect the pipe ends as well as to prevent dirt or other material from getting into the pipe. Fittings are packaged in cardboard boxes and should be stored in a clean dry area. If fittings are removed from the boxes, protect machined bells and spigots from foreign matter and exposure to direct sunlight.

If the protection on the pipe ends are damaged or removed, replace immediately with corrugated cardboard and/or heavy duty black plastic.

The pipe can be damaged when joints or bundles of pipe are dropped during handling or shipping. Severe localized impact blows may result in damage to the fiberglass reinforced structure in the pipe wall. **Before installation, inspect the pipe's outer surface for signs of damage.** If impact damage occurs, the damaged areas may be recognized by a visible star type fracture in the pipe wall. Pipe that has been severly damaged must be removed. When in doubt do not use suspect pipe unless inspected and approved by a NOV Fiber Glass Systems' representative. Typically, cutting a two foot section center ed around the impacted site is more than suffcient depending on the severity and size of damaged area.

Handling Cautions:

Do not allow the bell end of the pipe to support any pipe weight.

Do not allow deformation of the pipe due to supports or straps.

Adhesive

Refer to adhesive instructions included in each kit for storage life and userecommendations.

Safety Data Sheets (SDS) are available at nov.com/fgs.

Tools, Equipment and Supplies

Requirements for Installation

For maximum efficiency, the following tools and equipment are recommended prior to any installation:

- Pipe Stands, Jacks, Chain Vise, Come-alongs & strap clamp kit
- Hand Tools

  -Level, Marking Pen, Tape Measure, Pipe Wrap

  -Hacksaw (22-28 teeth/inch)

  -Tapering tool (See pages 38-40)

  -Shop hammer, 3 lbs,and a 2x4 block of wood (for 1"-6" RT, GT, SS)
- Power Tools

  - Power tapering tools (See pages 38-40)

- Circular power saw with a grit edge abrasive blade aluminum oxide, carbide or diamond
- Jigsaw with carbide abrasive blade or fine-tooth metal cutting blade
- Hot air gun, heat blanket or collar
- T.A.B. wrenches (for 2"-6" T.A.B. joint piping systems)

• Expendables
  - Clean, Dry, Lint-Free Shop Cloths
  - Sandpaper Disc/Emery Cloth (80-120 grit for RT, GT, SS)
  - Impermeable gloves
  - Chemical splash goggles

NOTE: You must use the proper tool for tapering each size and type of pipe (see pages 38-40).

Equipment for Cool Weather pipe assembly (Below 70°F):

• Heat source
  - Portable torch with spreader tip, or
  - Portable electric heat lamp, or
  - Industrial hot air gun

• A means of maintaining adhesive kits at 70°-80°F:
  - A box with a 25 watt light bulb, or
  - Inside of a warm vehicle with the heat running.

• Heat assisted curing
  - Electric heating collars or blankets
  - Chemical heat packs

WARNING: Be sure there are no flammable material or gas present when using any type of heating device.

Additional equipment for 8"-42" pipe assembly (RT, GT, SS):

• Manual or hydraulic come-alongs for 8" - 16"
• Hydraulic come-alongs for 18"- 42"

- Strap clamp kit for 8" - 16"
- Strap Clamp kit and manual come-alongs 8" - 16" /HP 32 - HP 40 systems
- Sledge hammer, 10-16 lbs. and a 4 x 4 block of wood

Additional equipment for applying saddles:

- Power sander with 24-60 grit sanding disc
- Hose clamps.

Table 2.1

Suggested labor times for Bell x Spigot Piping Systems

Pipe Size	Setup[1]	Scribe & Cutting Hand/power	Hand Tapering	Power Tapering	Joint Makeup [7,8]
in	min	min/jt	min/jt	min/jt	min
1	3	1.33/1.25	1	0.25[2]	1
1½	3	1.33/1.25	1.5	0.25[2]	1
2	3	1.50/1.25	2	0.25	1.5
3	3	2.0/1.33	3	0.25	2
4	4	5.0/2.5	4	0.25	3
6	5	7.0/3.0	5	2.5[2,3]	4
8	7	4.5/3.5	22	8.0[4,5,9]	5
10	7	NA/5.0	35	10.0[5,9]	6
12	8	NA/5.0	40	12.0[5,9]	8
14	9	NA/5.0	NA	12.0[5,9]	10
16	10	NA/6.0	NA	12.0[5,9]	14
18	12	NA/8.0	NA	25.0[6,9]	14
20	12	NA/8.0	NA	28.0[6,9]	20
24	15	NA/12.0	NA	30.0[6,9]	30
30	18	NA/15.0	NA	60.0[9,11]	36
36	24	NA/20.0	NA	70.0[9,11]	40
42	30	NA/24.0	NA	90.0[9,11]	45

Suggested Labor Times for Bell x Spigot Piping Systems

(1) These numbers are based on installations using experienced crews in typical installation conditions. They do not include extreme weather conditions, time used for gathering supplies and tools, break time, manpower issues, etc. Assume 6 hours of productive labor for every 8 hours worked. Adjustment factors should be applied to these base units to compensate for prevailing production and job conditions. Because of all the variables involved, NOV Fiber Glass Systems is not responsible for any differential between these numbers and actual results.

(2) 2000 series Power Tools

(3) 2"-6" Hand Tapering Tool

(4) Individual Tapering Tool

(5) 8"-16" Taper/Scarf Tool

(6) 18"-24" Taper Tool

(7) Each joint makeup calculation includes cleaning, sanding, applying adhesive and proper engagement. Allow three minutes for mixing adhesive.

(8) The units (time) listed above are based on using experienced crews on fitting intensive runs. For straight run pipe, contact your local representative.

(9) Time doubles for HP 25 products.

(10) Includes set up for hydraulic or manual come-along and setting pipe stand levels.

(11) Use the 30"- 42" taper tool.

Suggested Crew Setup and Assembly

Manpower requirements change depending on whether the installation is simple, consisting of long, straight runs, or complex. It also depends on pipe size, installation temperature, and other similar influences. Following are some general guidelines that are applicable to most installations. If you have any questions, please contact an NOV Fiber Glass Systems representative for information.

Suggested Crew Size for 1”-6” straight long pipe runs

A three-worker crew is the minimum recommended crew size. A four-worker crew is sometimes more efficient, even when installing 1" - 6" diameter pipe.

Man #	Crew Description
1	**Clean/prep/align** Removes end caps, sands and cleans joint and aligns pipe for bonding.
2	**Adhesive mixer/bonder** Mixes adhesive and applies to bell and spigot.
3	**Assembly man** Helps make up joint and checks for lock up.
4	**Preheat/prep/supplies** *(Optional through 4"; recommended on 6")* Preheats joints and helps keep pipe aligned. Also applies heat collars during cool weather. (All help in moving supplies and equipment from joint to joint.)

Suggested Crew Size for 8"-42" straight long pipe runs

A six or seven crew members is recommended.

Man #	Crew Description
1	**Clean/prep/align** Removes end caps, sands and cleans joint and aligns pipe for bonding.
2	**Adhesive mixer/bonder** Mixes adhesive and applies to bell and spigot. Marks insertion depth and determines when joint is locked up. Assists with come-along.
3	**Adhesive mixer/bonder** Helps #2 with adhesive and assists with come-along.
4	**Preheat/alignment man** Preheats joints, helps align joints and assists with come-along.
5	**Alignment man** Sets level of pipe and aligns joint for proper insertion; directs tractor driver.
6	**Truck driver/Supply man** (optional) Drives supply truck and assists with all aspects of installation. Also coordinates heat collars during cool weather and ice chest during hot weather.
7	**Tractor Operator** Operates side boom tractor, track hoe or backhoe. (All help in moving supplies and equipment from joint to joint.)

In more complex pipe assemblies, the crew size will depend on the amount of tapering and prefabrication needed. In most cases, a three-worker crew is the minimum for any size piping installation. In some instances (small jobs with only a few joints) only one or two crewmen will be required.

Recommendations for Fabrication in Adverse Weather Conditions

The piping can be installed in adverse weather conditions when the necessary precautions are taken.

Actual work will often be more quickly completed in high temperature conditions. Low temperatures can increase the work time 20%-35% over normal shop conditions. A similar increase is common for high moisture conditions.

Hot Weather Installation Tips

Hot weather conditions, temperatures above 90°F, will greatly reduce the working time of the adhesive. The following steps are recommended when fabricating in hot weather conditions:

1. Avoid direct sunlight on the joining surfaces.
2. Store adhesive in a cool area.
3. Keep mixed adhesive in an ice chest with sealed bag of ice or ice pack.

Cold Weather Installation Tips

Adhesive cure time is directly related to the temperature. Colder temperatures result in longer cure times.

CAUTION: Overheating the adhesive could result in high temperature exothermic reactions.

The following steps should be used when fabricating in colder temperatures:

1. Adhesive kits should be placed in a warm room for six to twelve hours before application in order to reach temperatures of 80°F -100°F. This will make mixing much easier and speed cure times. Or use a box with a 25 watt light bulb to warm adhesive kits.
2. When possible, piping should be bonded indoors into sub-assemblies. The warmer conditions of these areas will allow faster cure times.
3. Warm bonding surfaces to 80°F - 100°F when temperature falls below 70°F.

4. A hot air gun or heat collar may be used to obtain a faster cure time.

Extreme Moisture

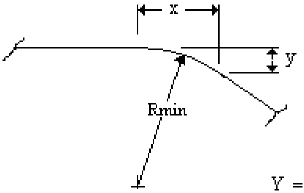
Adhesive Joints - If fittings or pipe have moisture on the bonding surface, wipe them dry prior to sanding and if within safety guidelines use some type of heat to complete drying.

- Sand pipe or fittings immediately before applying the adhesive to bond the joint. Sand surfaces until a fresh, dry surface is present, then remove dust with a clean dry cloth, and apply adhesive.
- Cure per the previous recommendations for normal, extreme heat or extreme cold temperatures.

Buried Installations

These are general guidelines only. For more details see Engineering and Piping Design Guide.

Minimum Bending Radius Layout



$$Y = R \cdot \left(1 - \cos\left(\operatorname{asin}\left(\frac{X}{R}\right)\right)\right)$$

Where:
X = Run, ft(m)
Y = Offset, ft(m) m)
R = minimum bend radius, ft(m)
(trigonometric function based on radians)

Offset Bending Allowance
Green & Red Thread HP 16-35 Piping Series

Pipe Size	X-Run		Y-Offset	
in	ft	m	ft	m
2	20	6.1	3	0.9
	40	12.2	15	4.6
3	40	12.2	9	8.2
	60	18.3	23	7.0
4	40	12.2	7	2.1
	80	24.4	33	10.1
6	40	12.2	4	1.2
	80	24.4	20	6.1
	120	36.6	50	15.2
8	80	24.4	14	4.3
	120	36.6	34	10.4
	160	48.8	66	20.1
10	80	24.4	11	3.4
	120	36.6	26	7.9
	160	48.8	49	14.9
12	80	24.4	9	2.7
	120	36.6	21	6.4
	160	48.8	39	11.9
14	80	24.4	8	2.4
	120	36.6	18	5.5
	160	48.8	33	10.1
16	80	24.4	7	2.1
	120	36.6	16	4.9
	160	48.8	29	8.8
18	80	24.4	6	1.8
	120	36.6	14	4.3
	160	48.8	25	7.6
	200	61.0	40	12.2

Pipe Size	X-Run		Y-Offset	
in	ft	m	ft	m
20	80	24.4	5	1.5
	120	36.6	12	3.7
	160	48.8	22	6.7
	200	61.0	35	10.7
24	80	24.4	4	1.2
	120	36.6	9	2.7
	160	48.8	16	4.9
	200	61.0	26	7.9
30	80	24.4	3	0.9
	120	36.6	8	2.4
	160	48.8	15	4.6
	200	61.0	23	7.0
36	80	24.4	3	0.9
	120	36.6	7	2.1
	160	48.8	12	3.7
	200	61.0	19	5.8
42	120	36.6	5	1.5
	160	48.8	10	3.0
	200	61.0	16	4.9

Table 3 Recommended Burial Depths*

Products (Red Thread and Green Thread HP Series, Silver Streak)	**Minimum**(1)		**Maximum**(2)	
	ft	m	ft	m
1"-4" Piping	2	0.6	15	4.6
6"-24" Piping	3	0.9	15	4.6
30"-42"	4	1.2	15	4.6

(1) Based on a 1000 psi composite constrained soil modulus. Contact Fiber Glass Systems' Applications Engineering for recommendations if other soil conditions or special loading conditions exist.

(2) Consult factory for greater burial depth recommendations.

Burial Depth:

Minimum burial depth in unpaved areas for pipe subjected to vehicular loads depends on pipe grade, pipe size, vehicle axle weight, and the bedding material. Depths for axle loads of 34,000 lbs., minimum depth of cover (from the top of the pipe to the surface) and moderately compacted non-clay bearing soils is shown in Table 3.

Maximum burial depth is dependent on the backfill material. For moderately compacted soils that do not contain large amounts of highly expansive clays, the maximum burial depth is shown in Table 3.

The pipe should always be buried below the frost line.

Trench Preparation - Final bedding of the trench must be as uniform and continuous as possible. Before backfilling, fill all gaps under the pipe with proper bedding material. Avoid sharp bends and sudden changes in slope. It is important to remove all sharp rocks, cribbage, or other foreign objects that could come in contact with the piping.

Bedding Requirements - Fiberglass pipe can be damaged by point contact or wear with the trench bottom and walls, improper bedding materials, or adjacent pipe. Use recommended bedding material a minimum of 6 inches thick at the bottom, sides, and top of the piping (refer to Table 4). Adjacent pipes should be spaced the greater of 6 inches or one pipe diameter. The piping can be laid directly on the trench bottom if the native soil meets the requirements of a recommended bedding material (refer to Table 4). In some situations, the trench bottom can be “scratched” such that a natural cradle of dirt is formed. Never

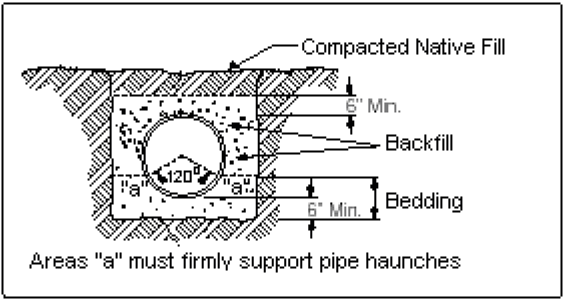


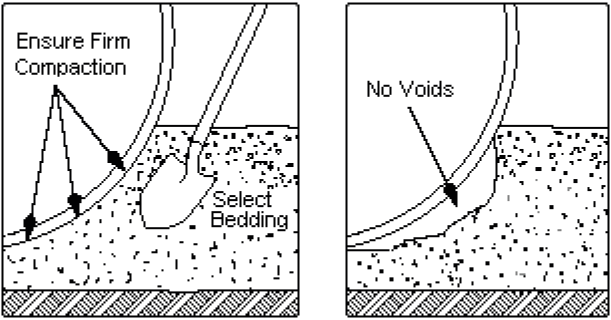
Table 4

Recommended Bedding Materials

Bedding Material	Compaction Proctor Density
Crushed rock or pea gravel 3⁄4” maximum size	Not Required
Coarse-grained sand or soil with little or no fines	75-85%
Coarse-grained sand or soil with more than 12% fines	85-95%
Sand or gravel with more than 30% coarse-grained particles	85-95%
Sand or gravel with less than 30% coarse-grained particles	Greater than 95%

lay fiberglass piping directly against native rock or shale. Always use dry, unfrozen bedding materials that do not contain foreign objects or debris. Never use water flood for compaction. Slurries can be used that are intended for burial of flexible piping systems. When using slurries, care must be taken to prevent floating or deformation of the piping.

Pipe Support - Fiberglass pipe is flexible and requires the support of the bedding material to keep the pipe round in burial applications. It is very important that a recommended bedding material is properly compacted around the entire circumference of the pipe. (Refer to Table 4) Tamp the bedding material under the bottom half of the piping to prevent voids or areas of low compaction. Vibratory or similar tamping equipment can drive



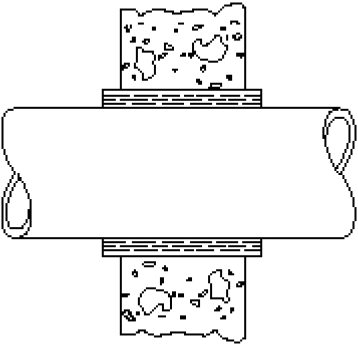
small stones or debris into the pipe wall if they are present in the bedding material. Avoid striking the pipe with tamping equipment as the pipe may be fractured.

High Water Tables or Vacuum - Consult factory for recommendations.

Road Crossings - When laying fiberglass pipe under road crossings, it may be necessary to pass the pipe through conduit to protect the pipe. Pad the pipe to prevent rubbing or point loads against the conduit.

Wall Penetrations

Where the pipe goes through or passes under a concrete structure, precautions must be taken to prevent bending or point loading of the pipe due to settling. A minimum 2” thick pad of



resilient material should be wrapped around the pipe to provide flexibility and prevent contact with the concrete. If bolts are used in the resilient material, care should be taken that the bolts, nuts, or washers cannot come into point load contact with the pipe. Bedding depth under the pipe should be increased to a minimum of 12" or one pipe diameter, whichever is greater, for one pipe joint length away from the concrete.

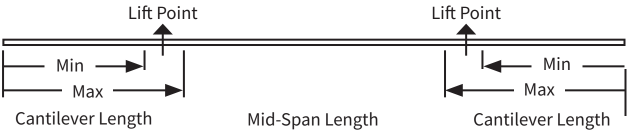
Timing - Test and cover the pipe as soon as possible to reduce the chance of damage to the pipe, floating of the pipe due to flooding, or shifting of the line due to cave-ins.

Two Point Lifting of Red Thread & Green Thread HP Series Piping The Lift Points table provides the locations for safe two point lifting with straps at least 4 inches in width. The cantilever

Lift Points

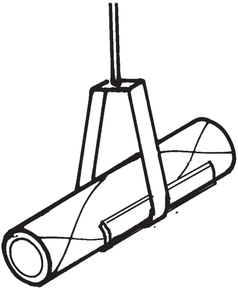
Nominal Size	Pipe Lengths (ft)		Cantilever Lengths (ft)		Mid-Span Lengths (ft)	
in	**Number**	**Length**	**Min.**	**Max.**	**Min.**	**Max.**
8	3	120	24	26	68	72
10	3	120	20	28	64	80
12	3	120	22	31	58	76
14	3	120	22	31	58	76
16	3	120	20	35	50	80
18	3	120	19	36	48	82
20	4*	160	31	37	86	98
24	4*	160	30	40	80	100
30	4*	160	30	40	80	100
36	4*	160	30	40	80	100
42	4*	160	30	40	80	100

* The same cantilever length applies for 3 pipe lengths.

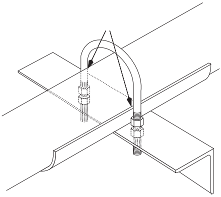


lengths are critical and should be followed without exception. Lifting and moving of the pipe should be performed by smooth motions. Avoid aggressive jerking or rough movement of pipe during installation.

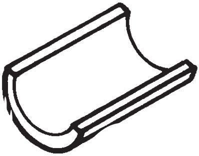
Anchors, Guides and Supports



Pipe Hangers - Pipe hangers such as those shown are often used to support pipe in buildings and pipe racks. However, the use of too many hangers in succession can result in an unstable line when control valves operate, and during pump start-up and shutdown. To avoid this condition, the designer should incorporate auxiliary guides periodically in the line to add lateral and axial stability.



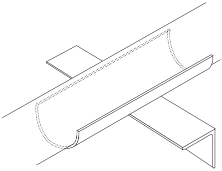
Pipe Guides - are rigidly fixed to the supporting structure and allow the pipe to move in the axial direction only. Proper guide placement and spacing are important to ensure proper movement of expansion joints or loops and to prevent buckling of the line.



The guiding mechanism should be loose so it will allow free axial movement of the pipe. "U" bolts, double-nutted so they cannot be pulled down tight, are often utilized for guides.

Primary and secondary guides, i.e., those immediately adjacent to expansion joints, are spaced more closely than intermediate guides. Refer to Engineering & Piping Design Manual, for details.

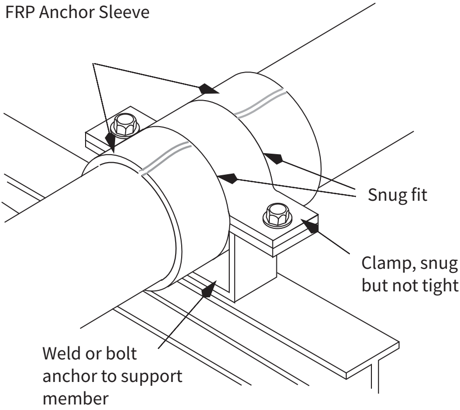
Piping entering expansion joints or expansion loops require additional guides. Refer to Engineering & Piping Design Manual for details.



Pipe Supports - spacing should be spaced at intervals as shown in the product bulletins.

NOTE: Properly spaced supports do not alleviate the need for guides as recommended in the preceding section. Supports that make only point contact or that provide narrow supporting areas should be avoided. Some means of increasing the supporting area should be used; sleeves made from half of a coupling or pipe are suitable. Support pumps, valves and other heavy equipment independent of the pipe. Refer to pump and valve connection instructions on page 80.

Pipe Anchors - divide a pipeline into individual expanding sections. In most applications, major pieces of connected equipment, such as pumps and tanks, function as anchors. Additional anchors are usually located at valves, near changes in direction of the piping, at blind ends of pipe, and at major branch



connections. Provisions for expansion should be designed into each of the individual pipe sections.

Refer to Engineering & Piping Design Guide, for a thorough discussion on supports, anchors and guides.

Section 3

General Installation Instructions

Read This First
Cutting Fiberglass Pipe

Installation Statement

Important - Read this First

Before beginning the actual assembly procedures, read and make sure all installers thoroughly understand the following instructions.

All bonding surfaces must be clean, dry and factory fresh in appearance before applying adhesive. When end caps have been lost, surfaces will weather and result in loss of bond strength. When surfaces are weathered, re-taper (RT, GT, SS) spigots to achieve a factory fresh appearance. (Note: T.A.B. couplings that have weathered must be replaced.)

Matching tapered bell and spigot joints require a very thin adhesive bond line for maximum strength and durability. The adhesive used with tapered joints is very strong when used in bond lines a few thousandths of an inch thick. The same adhesive may be brittle in thick sections resulting in poor bond strength. To achieve a thin bond line, the matched tapered angles of the joint are designed to mechanically "lock-up" when wedged together.

Using mechanical force assures "lock up" and a thin bond line. Hammering a wooden block placed against the bell end of pipe, or using mechanical devices such as come-alongs should be used to "lock up" the joint. The use of Hydraulic Come-Alongs is required to achieve reliable "lock-up" of 8" and larger pipe sizes.

NOTE: For T.A.B. joints, special T.A.B. wrenches are required to achieve the mechanical lock up in the joint.

Adverse weather conditions require special precautions when bonding pipe. (See page 24, Recommendations for Fabrication in Adverse Weather Conditions) The adhesive is very viscous (thick) when cool or when applied to cool pipe. The thick adhesive can actually be stiff enough to prevent joint "lock up." When the adhesive is hot or when it is applied to hot pipe, the available working time may be significantly reduced. For Installers new to fiberglass it is strongly recommended that the system be hydro tested within the first 2500' or 50 joints.

Matched tapered bell and spigot joints that are not "locked up" can fail prematurely.

Cutting Fiberglass Pipe

NOV Fiber Glass Systems' pipe should be cut using one of the methods referred to under Tools and Equipment on page 18.

1. Measure pipe, remembering to allow for spigot and fitting dimensions.
2. Scribe a cutting guide around the pipe to ensure a perpendicular cut for proper fit.
3. Hold the pipe firmly but not to the point of crushing. If chain vises or other mechanical holding devices are used, care should be taken to prevent crushing or point loading of the pipe. To prevent damage to the pipe, 180 degree sections of pipe can be used for protective covers.
4. Saw the pipe as smoothly as possible. The pipe ends should

be square within 1⁄8 inch.

NOTE: For integral joint (IJ) bell ends, the bell end must be cut off before tapering. Measure the O.D. of the pipe near the bell end until you see the O.D. start to get larger. Cut the pipe at this point. Depending on pipe size the distance from the end of the bell can vary anywhere from 12" to 36".

Section 4

Fabrication of Red Thread HP, Green Thread HP and Silver Streak Pipe and Fittings

Tapering Pipe

Various tools are available from NOV Fiber Glass Systems for making the tapered spigot in the field.

To reproduce a standard taper, the tapering tool must be marked or adjusted. The process varies depending on the tool being used and the product being tapered. Please refer to individual tool instructions for tapering.

Refer to Table 6 on page 40 for specific bulletin number and proper taper angle for each size and type of pipe. **Do not** taper over the bell end of integral joint pipe. See page 36 for cutting instructions.

1"-6" Tool - A hand-held tool that can be adapted for power when a large number of tapers is necessary. Different piping systems require different mandrels.

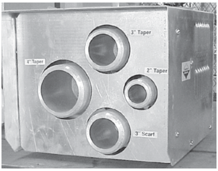
Model 2100/ 2102/2106 Tool - Power tool for tapering and scarfing Red Thread and Red Thread IIA piping.

Model 2300/2306 Tool - Power tool especially designed for tapering 1" - 6" Green Thread piping.

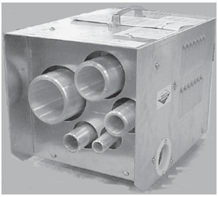
8", 10", or 12" Tapering Tool - These tools are designed for manual or power (i.e., Ridgid® 300 or 700 power drive or equal) operation; there is a tool for each size pipe.

NOTE: Red Thread and Green Thread mandrels can be purchased separately and used on this tool.

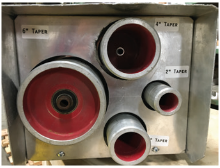
1"-6" Tool



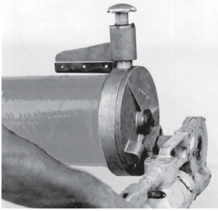
Model 2100/2101 Tool



Model 2300/2306 Tool

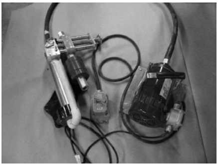


Model 2106/2306 Tool



8", 10" or 12" Tapering Tool

2"-12" Remote Power Tool - Tapers 2"-12" pipe. Must change angle for 8" and larger pipe. Recommended for 6" tapers.

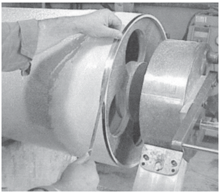

2”-12” Remote Power Tool

Additional material will be needed for 8" and larger tools: Sturdy work bench (preferably with a metal top) or stand to hold the tool. Strap Clamp kit to restrain pipe while tapering.

8"-16" Taper/Scarf Tool - This is an electrically powered tapering tool. When using the 8"-16" tool you must find a method to secure the pipe. This can be done with strap clamps, a heavy duty table for short sections or heavy duty pipe stands for full lengths.


8”-16” Taper/Scarf Tool

18"-24" Tapering Tool - This is an electrically powered tapering tool. The tool comes with different size mandrels to taper 18"-24" pipe.


18”-24” Tapering Tool

Note for HP 32/35/40/50 pipe: For 2"-6" pipe, use the 2"-12" Remote Power Tool. For 8"-16" pipe, use the 8"-16" Single Point Taper tool. The 2"-12" Remote Power Tool can taper 8"-12" pipe if necessary but the 8"-16" tool is preferred for those sizes.

For 2" - 24" pipe sizes in these pressure classes, the taper angle is 1 3/4 degrees.

Table 5

Extension Cord Length*

Wire Size AWG	Maximum Length (ft)
12	20
10	30
8	50

*The 8"-24" single point taper tools may not operate properly with an extension cord over 25'.

Table 6

Tapering, Scarfing and Cutting Tool Reference Chart

Tool	Product	Tool Taper Angle	Bulleting #	Comments
1" - 6" Hand Tapering	RT GT	1" = 3°; 1½ = 2½° 2" - 6" = 1¾°	TLS 6600	Specify product to receive correct mandrels. Order scarfing adapter kit for secondary containment power adapter separate. Uses Ridgid 700 or equivalent power drive with a Ridgid 774 adapter.
2100 Power	RT	1¾°	TLS 2000	Tapers 2" & 3"; Scarfs 3" & 4"
2102 Power	RT	1¾°	TLS 2000	Tapers 2"-4"; Scarfs 3"
2300 Power	GT	1¾°	TLS 2000	Tapers 2"-4"
2106/2306 Power	RT/GT	1¾°	TLS 2000	The 2106 tapers 2"-6" RT. The 2306 tapers 2"-6" GT. The tools are interchangeable between RT/GT. Mandrels can be purchased separate.
2700 Power	SS	1¾°	TLS 2000	Tapers 2"-4" Silver Streak
8" Tapering Tool	RT/GT	0 or 1°	TLS 6608 Taper TLS 6609 Scarf	Tapers and scarfs 8" Red Thread and Green Thread
10" & 12" Taper or Scarfing Tool	RT/GT	0 or 1°	TLS 6612 Taper TLS 6613 Scarf	Tapers and scarfs. Order scarfing adapter kit for Secondary Containment. Uses Ridgid 700 or equivalent power drive with a Ridgid 774 adapter.
8"-16" or 18"-26" Single Point Taper Tool	8"-26" RT, GT, SS	1° or 1¾°	TLS 6622 TLS 6621	Tapers or scarfs 8"-16" RT, GT, SS. Scarfs 8"-12" GT, or 8"-16" secondary containment.
2"-12" Remote Power Tool	RT, GT, SS	2"-6" - 1¾° 8"-12" - 1°	TLS 6601	Tapers 2"-12" pipe. Must change angle for 8" and larger pipe.
30"-42" Taper Tool	RT, GT, SS	1¾°	TLS 6636	Taper 30", 36", and 42"

Joint Prep for Red Thread, Green Thread and Silver Streak

All bonding surfaces must be clean and dry before bonding.

- For T.A.B. joints, clean with an acceptable solvent and clean rag. Wire brushes may also be used for cleaning T.A.B. surfaces; however, they must be clean and free of oily contaminates.
- All bonding surfaces must be clean and dry before bonding. For T.A.B. joints clean with an acceptable solvent and a clean rag. Never sand T.A.B. X T.A.B. surfaces.
- For smooth tapers, before applying adhesive the surfaces should always be lightly sanded to freshen the bonding surfaces. Solvent may be used to remove surface contaminates followed by light sanding.
- Use caution as over-sanding can change the taper angle or end dimension, and create flat spots on the spigot.
- When surfaces have weathered, sand or re-taper spigots and sand bells to achieve a factory fresh appearance. Cut at least 1" from spigots before re-tapering. T.A.B. couplings must be replaced.
- Bonding surfaces must be dry, so be sure all solvent has evaporated before applying adhesive.

When ambient temperature is below 70°F, warm the bonding surfaces. Use a hot air gun, propane torch or other clean burning heat source that has a spreader type tip, to apply heat uniformly to bell and spigot until warm to the touch. Check temperature by touching bonding surfaces with the back of your hand. Do not touch with the front of your hand as this may contaminate the joint. If hot to the touch, let cool before applying adhesive. When using a torch to heat, warm the bell first. The bell is thicker and will hold heat longer. If an electric heating collar is used to warm surface, assemble the joint dry, then heat the O.D. of the bell. This avoids contaminating the spigot with a dirty heating collar . Do not use chemical heat packs to warm. **Warning:** Do not use propane torch around flammable gases or liquids.

NOTE: Use of a solvent as a cleaning method is optional.

WARNING: Before using heating devices or open flames be sure all safety checks and regulations are followed. Do not use if flammable gases or liquids are present.

Some alternate cleaning solvents are acetone, methylene chloride, and methyl ethyl ketone. After cleaning, be sure any residual solvent has evaporated before applying adhesive. DO NOT USE SOLVENTS THAT LEAVE AN OILY FILM ON THE BONDING SURFACES. Only use fresh solvent directly from the manufacturer's container. Do not use dirty solvent or solvent poured in a secondary bucket.

WARNING: Some degreasers and solvents are extremely flammable. Do not smoke or use near an open flame. Wear eye protection. Be sure to read warning labels on containers. Do not use alcohol as most alcohol contains water and could contaminate the joint.

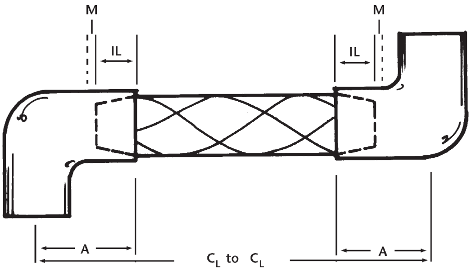
Never use gasoline, turpentine, or diesel fuel to clean joints.

Solvent containers may be under pressure. Use caution when removing inner seals, especially in warm weather. Use with adequate ventilation.

Close Tolerance Piping - The tapered bell and spigot system employed by FGS can be readily used to achieve dimensional accuracy where required by a particular pipe layout. When the installation is such that close tolerances must be maintained, you must follow these instructions. You must accurately reproduce tapers (spigots) in the field with the field tapering tools. This provides a means of achieving dimensional accuracy.

Calculation to Achieve a Desired Length - Most close tolerance installations are made to prints calling out CL to CL (center line to center line) dimensions.

When fabricating to these dimensions, follow these procedures per the figure below.



1. Obtain the center line to face dimension (A) of fittings to be used from Tables 8 or 9 on pages 46-50.

2. Create an insertion gauge by cutting a short section of pipe; 12" long for small diameters and 18" long for larger diameters. Taper the pipe using the instructions supplied with each tool. Check dry insertion. The insertion length should be within ± 1⁄8" of a factory spigot insertion. NEVER USE A FACTORY TAPER FOR A GAUGE.
3. Obtain insertion length (IL) by inserting the gauge (made with the tool being used) into a fitting and measuring. (**NOTE:** Measure each end of each fitting, because the insertion may vary for each bell.) You can prepare and use a short nipple as a standard insertion gauge.

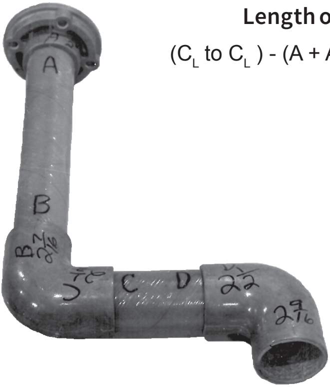
NOTE: You must prepare a new gauge if you change tapering tools or make any changes to the tool you are using.) Always add a make-up dimension (refer to Table 7) to this measurement, since the adhesive will act as a lubricant and allow greater penetration than when the surfaces are dry. Measure each end of each fitting with your gauge.

Table 7

Approximate Make-up Dimensions SS/HP16/HP25 (M)*

Pipe Size	Approximate Make-up Dimensions*
1 - 6"	0
8, 10"	⅛"
12 - 18"	¼"
20"	⅜"
24, 30"	½"
36"	⅝"
42"	¾"

4. To achieve a specified CL to CL dimension, the length of pipe to cut is equal to the CL to CL distance minus the sum of the center line to face dimension of the fittings ("A" dimension) plus the sum of the measured insertion lengths (IL) plus the sum of the make-up allowance (M), or length of pipe to cut = $(C_L \text{ to } C_L) - (A + A) + (IL + IL) + (M + M)$.



Length of Pipe to Cut =

$$(C_L \text{ to } C_L) - (A + A) + (IL + IL) + (M + M)$$

***CAUTION:** Make-up dimensions depend on the tightness of the dry fit. If the field developed dimensions vary, use field developed dimensions.

NOTE: Use field dimensions for HP 32/35/ 40 systems.

Adhesive Mixing

When the weather is cool or the adhesive has been stored in a cool environment (below 70°F), warm the adhesive kits. (Do not heat above 100°F.)

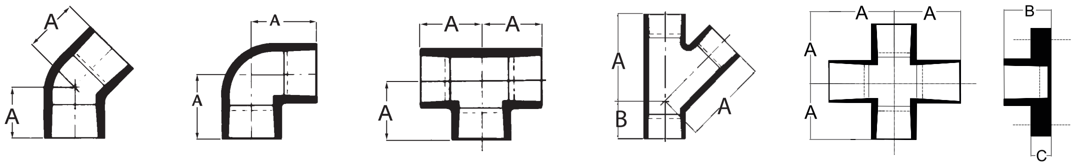
1. For epoxy empty all of the contents of the hardener bottle into the can of base adhesive.
2. Mix all of the base epoxy adhesive with all of the hardener. NEVER ATTEMPT TO SPLIT A KIT. Cut through the adhesive with the edge of the mixing stick to assist in mixing the two components.
3. Mix until the adhesive has a uniform color and a consistent flow off the mixing stick. Wipe down the sides, bottom, and under the rim of the can with the mixing stick to assure complete mixture.

Complete information and safety precautions are packaged with each adhesive kit. Review all safety precautions thoroughly before mixing the adhesive.

ADHESIVE DISPOSAL: Once the adhesive and hardener have been mixed and reacted, nothing can be extracted, and it is classified as non-hazardous material. Dispose of in a normal manner as other solid waste. Excess adhesive and hardener can be mixed, allowed to react, and disposed of as above. If extra jars of adhesive or hardener have accumulated without the other component to mix and react, contact your regional manager. Hardener jars, when empty are not subject to EPA regulation and can be disposed of in a normal manner. These guidelines are based on federal regulations. State and local regulations and ordinances should be reviewed.

Table 8.0

Take-off Dimensions for RTHP16, GTHP16, Fittings (Contact FGS for SS)



Size	45° Elbow	90°Elbow	Tee	Lateral		Cross	M/FW*	M/FW*
	A	A	A	A	B	A	B	C
1	2 3/8	2 3/4	2 3/4	3 7/8	2 1/2	2 3/4	1 3/4	3/4
1 1/2	2 7/8	3 3/8	3 3/8	5 1/4	3 1/4	3 3/8	1 3/4	3/4
2	2 5/8	3 3/8	3 3/8	6 5/8	2 3/4	3 3/8	2 1/4 / 2 1/8	3/4
3	3 3/4	4 5/8	4 5/8	7 3/4	4 1/4	4 5/8	2 5/8	1 3/8
4	3 7/8	5 1/8	5 1/8	9	4 3/8	5 1/8	2 5/8 / 3 1/2	1 3/8
6	4 3/8	6 1/8	6 1/8	12 1/2	5 3/4	6 1/8	3 / 3 3/4	1 1/2
8	8 1/8	11 5/8	11 5/8	16 1/4	7 3/8	11 5/8	4	1 3/4
10	8 5/8	13	13	19 5/8	8 3/4	13 1/8	4 3/4	2
12	9 1/2	14	14	24 3/4	11 3/4	14	5	2 1/4
14	12 1/2	19	19	32 1/2	15 3/4	16	3 1/8	2 1/2
16	13 1/4	20 1/4	20 1/4	35 3/4	17 3/4	17 1/4	3 1/8	2 1/2

***Flanges**
M-Molded
FW-Filament Wound

Dimensions are used to calculate pipe length requirements to meet pipeline center line to center line dimensions.

Table 8.1a

Dry insertion depths for standard Red Thread HP16 and Green Thread HP16 pipe and fittings

Size	90° & 45° Degree Elbows & Tees		Crosses		Laterals		Molded Flanges		FW Flanges		Couplings		Integral Joints	
in	X-RT	X-GT	X-RT	X-GT	X-RT	X-GT	X-RT	X-GT	X-RT	X-GT	X-RT	X-GT	X-RT	X-GT
1	-	1	-	1	-	1	NA	1	-	1	-	-	-	1¼
1 ½	-	1	-	1	-	1	-	1	-	1⅛	-	-	-	1½
2	1½	1½	1½	1⅝	1½	1⅝	1½	1⅝	1½	1⅝	-	-	1¾	1½
3	1⅝	1⅞	1⅝	1⅞	1⅝	1⅞	1½	1⅞	1⅞	2	-	-	1¾	1¾
4	1½	1⅞	1½	1⅞	1½	1⅞	1¾	1⅞	1⅞	2⅝	-	-	2⅛	1⅞
6	2⅛	2⅜	2⅛	2⅜	2⅛	2⅜	2¼	2½	2½	2½	-	-	2⅜	2⅛
8	3¾	3¼	3¼	2⅞	3¼	2⅞	2⅝	2¼	3⅜	3⅜	3⅞	3⅞	3⅞	3⅜
10	3⅞	3⅝	3¼	3	3⅛	2⅞	3¾	3⅜	3	3	3 ¾	3⅜	3¾	3⅜
12	4	3¾	3⅝	3¼	3¼	3	3¾	3⅜	3	3	3⅞	3⅝	3⅞	3⅝
14	6⅛	6	3⅝	3⅝	3⅝	3⅝	-	-	2¼	2⅜	4⅜	4¼	4⅜	4¼
16	6⅛	6⅛	3⅞	3⅞	3⅞	3⅞	-	-	1⅞	2	4½	4½	4½	4½

The X values are the nominal dry spigot insertions used to set up tapering tools.

The tolerances for dry insertion are ±⅛" for 1"-6" and ±¼" for 8"-16”"pipe sizes. The final insertion referred to as the wet locked up position will be larger than the X dimension. Do not use these dry insertion depths for close tolerance piping calculations.

Table 8.2

Take off and nominal dry insertion dimensions for Silver Streak piping systems. Refer to Silver Streak bulletin or www.nov.com/fgs for more information.

Size	Coupled/Mitered	Filament Wound
in	in	in
2	1⅞	2⅝
3	2⅜	2⅞
4	2	3⅛
6	2⅞	2¾
8	3½	5¼
10	4⅜	5⅛
12	4⅞	6⅜
14	5½	4½
16	6¼	5⅝

Table 8.3

Dry insertion depth "X" for Stub Ends

Size	Green Thread	Red Thread[1]	Red Thread T.A.B.[2]
in	in	in	in
2	2 ⅛	2 ⅛	1 ⅞
3	2 ⅞	2 ¼	1 ⅞
4	2 ¼	1 ⅞	1 ⅞
6	3 ⅜	3 ¼	3

[1] Smooth Taper as built in field

[2] Factory T.A.B. spigot

Table 9a

Take off dimensions for RT/GT HP 25 products. X dimensions are nominal dry insertion lengths. Pipe must be driven together and fully locked up to assure full joint strength. Actual insertions should be +¼" for 8" and larger joints. Insertion depths are for tool set up only. Do not use insertion depths (x) for close tolerance piping. Refer to joint assembly instructions for complete information on joint lock up

Size	45° Degree Elbows (Long Radius) (in)			90° Degree Elbows (Long Radium) (in)			Tee (in)			FW Flanges (in)		Van Stone Flanges (in)	Coupling (in)		Integral Joint (in)	
in	A	X-RT	X-GT	A	X-RT	X-GT	A	X-RT	X-GT	X-RT	X-GT	A	X-RT	X-GT	X-RT	X-GT
1	-	-		-	-		-	-		-	-	-	-	-	-	-
1 ½	-	-		-	-		-	-		-	1⅛	-	-	-	-	-
2	-	-	2½	-	-	2 ½	-	-	2½	-	1¾	-	-	-	-	-
3	-	-	2¾	-	-	2 ¾	-	-	2¾	-	2⅞	-	-	-	-	-
4	-	-	3	-	-	3	-	-	3	-	3¼	-	-	-	-	-
6	-	-	2¾	-	-	2 ¾	-	-	2¾	-	3⅝	-	-	-	-	-
8	12½	6	5⅛	19½	6	5⅛	13½	6	5⅛	-	3⅜	6¼	5¾	5¼	4⅝	4⅛
10	14½	6½	6½	23¼	6½	6½	15¾	6½	6½	-	5	7	5½	5¼	5¾	5⅜
12	16½	7	7	27	7	7	17¾	7	7	-	5⅝	7¾	6⅛	5⅞	6¼	6
14	17¾	5¾	5¾	30	5¾	5¾	19½	5¾	5¾	-	4⅝	8	5¾	5¼	6	5⅜
16	20	-	5¾	34	5¾	5¾	21½	5¾	5¾	-	4½	9	6⅜	5⅛	6⅜	5⅛
18	24⅞	-	10⅞	40	-	-	26⅜	-	-	-	7⅜	10½	-	-	-	-
20	29⅝	-	12⅝	47¼	-	-	31¼	-	-	-	8	12½	-	-	-	-
24	35⅞	-	15⅝	57	-	-	35	-	-	-	10⅜	15½	-	-	-	-

Dimensions are used to calculate pipe length requirements to meet pipeline center line to center line dimensions.

Table 9b

Dry insertion depth for Green Thread HP 32/35 fittings

Size	90° & 45° Degree Elbows & Tees	FW Flanges
in	X-GT	X-GT
1*	-	-
1½*	-	-
2*	-	-
3*	-	-
4*	-	-
6*	-	-
8*	-	-
10*	-	-
12*	-	-
14	8⅛	6¾
16	9⅝	8
18	10⅛	8⅜
20	11⅞	10
24	15	12¾

* These sizes are rated to HP 40. See Table 9c for HP 40 insertion depths.

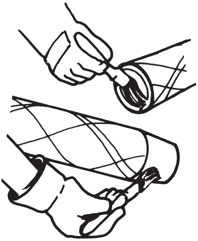
Table 9c

Dry insertion depth for Green Thread HP 40 fittings

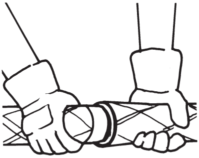
Size	90° & 45° Degree Elbows & Tees	FW Flanges
in	X-GT	X-GT
1	-	-
1½	-	-
2	2½	1¾
3	3⅛	2½
4	3¾	3⅛
6	4⅜	3⅝
8	7⅜	6⅝
10	8½	7⅝
12	9⅞	8¾

Installing 1" - 6" joints with a block of wood and a hammer

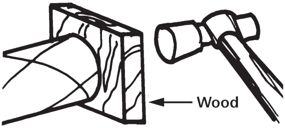
When ambient temperature is below 70°F, warm the bonding surfaces. Use a hot air gun, propane torch or other clean burning heat source that has a spreader type tip, and apply heat uniformly to bell and spigot until warm to the touch. Check temperature by touching bonding surfaces with the back of your hand. Do not touch with the front of your hand as this may contaminate the joint. If hot to the touch, let cool before applying adhesive. When using a torch to preheat, warm the bell first. It is thicker and will hold heat longer. If an electric heating collar is used to warm, place the joint together dry, then heat the O.D. of the bell to avoid contaminating the spigot. Do not use chemical heat packs to warm. **WARNING: ⚠ Do not use propane torch around flammable gases and liquids.**



Brush adhesive on both the bell and spigot bonding surfaces, applying a thin uniform coating to each . To minimize contamination, apply adhesive to the bell first. Adhesive should always be worked into the machined surface by applying pressure during application. This will "wet out" the machined surface and maintain the required thin bond line. Be sure that adhesive is deep down into the bell past the insertion depth and that all machined taper surfaces on the spigot and the cut end of the pipe are uniformly covered. Excess adhesive will make the joint more difficult to lock.



Align and lock the joint. For 2" or smaller pipe, insert the spigot into the bell until surfaces touch, then push and turn at the same time until a lock is achieved. Only a quarter to a half turn is usually needed. On 3"-6" diameter pipe or on fittings, pushing and turning to lock the joint is impractical and driving force must be used. A hammer may be used to assist in joint lock-up. Place a 2x4 board flat across the bell. The first few raps should be light to prevent any tendency of the joint to back out.



If the adhesive or the pipe surfaces are cool, push and hold for a few seconds to allow time for the adhesive to start flowing out of the tapered joint.

Check lock up by moving a free end of the pipe in an up and down or side to side motion. The movement must be sufficient to move the joint being checked. No movement should be visible in the joint. If any movement exists, the joint is not properly locked up. Avoid excess movement as this could damage the spigot.

For installing 8" - 16" fittings and pipe with manual come-alongs and strap clamps, the following recommendations should be followed:

- Strap clamps should only be tightened by hand. Do not use cheater bars or wrenches to tighten them for the clamps may be overstressed.
- The clamps should be covered to prevent flying debris should a clamp failure occur.
- If the strap slips on the pipe surface, Emery cloth placed between the strap and pipe will increase the frictional resistance to slipping. Abrasive powders such as Ajax® or Comet® powdered cleaners will likewise increase the resistance to slippage.
- Only use on pipe joint sizes 8" - 16".

Hydraulic come-alongs are required on all matched tapered joint sizes 18" and larger. When pipe joints are pulled together with come-alongs, they must be vibrated during joint make up. The vibrating reduces the joints resistance to movement.

Installing 8" - 16" HP 16 and HP 25 products using an FGS Hydraulic Come-along. (See manual TLS6618) Hydraulic Come-alongs are recommended for long pipe runs. All threaded parts should be checked before every use to ensure engagement of threads to prevent tool damage and possible physical injury.

The operator should be positioned in a safe position to the side of the pipe. The hydraulic pump is supplied with a pressure gauge to allow monitoring of the loads. Do not exceed the recommended loads.

The 8" - 16" hydraulic come-alongs are supplied with wedge style pipe clamps. Attach the clamps and drive the wedges on tight. Clean and prep the bonding surfaces and apply adhesive. Stab the joint together by hand and attach come-along chains. Use the hand pump and apply the required pressure from Table 10. As the joint is pulled together use a 5 lb dead blow hammer (supplied with the come-along) to vibrate the joint hitting it 360 degree around the IJ head or fitting. Keep pressure on the joint until all of the adhesive has squeezed out and there is not forward movement seen at the joint. With full pressure on, hit across the joint three times. When the pressure drop is 200 psig or less, the joint is considered locked up. After the pipe has been properly supported, you may remove the come along and clamps and move to the next joint immediately. Come along pressure must be left on until all pipe movement, blocking up, etc. is finished and the pipe is secure.

Joint Support During Cure

During joint assembly, the uncured bonded joint MUST be supported at all times until the adhesive is fully cured. Blocks, sand bags or skids may be used to support the pipe during installation. At least two supports are required for each pipe length. Place the supports 5’ from each end. After the joint has been pulled together and locked up, leave the come-along pressure on until the supports have been placed under the pipe and the pipe is heading in the right direction/orientation. If the middle of the pipe starts to sag, place supports under them as well. Excess movement across the joint before it has cured could result in damage to the pipe spigots. After the joint has been supported properly you may remove the clamps and go to the next joint.

Table 10

Come-Along pump guage pressure for Red Thread and Green Thread pipe

	HP16				HP20 and HP 25				HP32/40			
	using **small** pull cylinders		using **large** pull cylinders		using **small** pull cylinders		using **large** pull cylinders		using **small** pull cylinders		using **large** pull cylinders	
	Effective Pull area				**Effective Pull area**				**Effective Pull area**			
Pipe Size	(0.55 in^2 each)		(1.13 in^2 each)		(0.55 in^2 each)		(1.13 in^2 each)		(0.55 in^2 each)		(1.13 in^2 each)	
in	**max**	**min**	**max**	**min**	**max**	**min**	**max**	**min**	**max**	**min**	**max**	**min**
10"	1750	1500	850	730	2000	1500	970	730	5130	4100	2500	2000
12"	1750	1500	850	730	2000	1500	970	730	5130	4100	2500	2000
14"	2000	1750	970	850	2500	2000	1210	970	6160	5130	3000	2500
16"	2000	1750	970	850	2500	2000	1210	970	6570	5540	3200	2700
18"	2000	1750	970	850	2500	2000	1210	970	6570	5540	3200	2700
20"	-	-	2700	2500	-	-	3200	3000	-	-	3200	3000
22"	-	-	2900	2700	-	-	3200	3000	-	-	3200	3000
24"	-	-	3100	2900	-	-	3200	3000	-	-	3200	3000
30"	-	-	3300	3100	-	-	-	-	-	-	-	-
36"	-	-	3500	3300	-	-	-	-	-	-	-	-
42"	-	-	3700	3500	-	-	-	-	-	-	-	-

Installing 18"- 42" Pipe and Fittings with Hydraulic Come-Along

Hydraulic come-alongs are required for 18" and larger products. The operator should be in a safe position to the side of the pipe. **Check all threaded parts before each use to ensure full engagement of the threads and prevent tool damage and possible physical injury.** The hydraulic pump is supplied with a pressure gauge to monitor the pressure loads. Steel fitting clamps and 1 1/4" bolts are shipped with each come-along unit. Do not over pressurize as this could lead to joint back out.

Bolt up style pipe and fitting clamps are available in 18" - 42" sizes. The fitting clamps are narrower than the pipe clamps. The come -along clamps are supplied with a small hook on the handle. This hook is designed to hold the two clamps together while the bolts are tightened. The use of an impact wrench and a portable air compressor is recommended. Basic wrenches can be used but add time to the process.

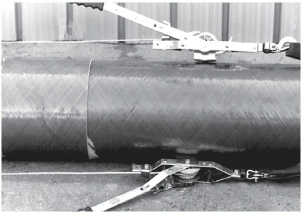
Place the clamps approximately 3’ from the end of the joint on both sides. Screw the cylinder base extension to the cylinders and place between the clamps. Tighten bolt to prevent slippage. Place a bolt through the cylinder base with no threads and tighten. Connect chain thru the cylinder bases. Prep joint and apply adhesive. Using a tractor or side boom slowly stab the joint together. Tighten chains and hang through the “claw” on the cylinders. Apply the required pressure from Table 10. As the joint is pulled together use a 5 lb dead blow hammer (supplied with the come-along) to vibrate the joint hitting it 360 degree around the IJ head or fitting. Keep pressure on the joint until all of the adhesive has squeezed out and there is not forward movement seen at the joint. With full pressure on hit across the joint three times. When the pressure drop is 300 psig or less, the joint is considered locked up.

When installing 18" - 24" it is recommended that the come-alongs be left on for approximately 5 minutes before releasing come-along pressure to ensure lock up and the pipe has been properly supported.

When installing 30" - 42" joint the clamps must be left on until the joint is fully cured per the required cure time.

Ratchet-Type Cable Come-alongs are recommended when it is not practical to use hydraulic come-alongs. Strap clamp kits or special fitting collars are available for use with the manual come-alongs. Only for use on 8"-16" piping.

Strap clamps should only be tightened by hand power. DO NOT use cheater bars or wrenches to tighten them as this could result in personal injury.



The clamps should be covered to prevent flying debris should a clamp fail.

If the straps slip on the slick pipe or fitting surface, emery cloth placed between the strap and the pipe or fitting will increase the frictional resistance to slipping. Abrasive powders such as Ajax or Comet may also be used under the straps to help prevent sliding.

Two cable come-alongs are required to make up a joint. The come-alongs should be positioned on opposite sides of the pipe joint to achieve a straight pull. The come-alongs are attached to the pipe via heavy-duty strap clamp kits or metallic pipe clamps. These straps/clamps should be placed far enough away from the joint to allow the positioning and use of the come-alongs. They are generally placed 24" - 36" away from the joint, one on each side of the joint but actual placement requirements will be governed by the size of the come-alongs.

Clean and prep the joint and apply the adhesive. Gently stab the joint together. The two come-alongs should be tightened at the same time to maintain a straight joint while pulling the joint together. Vibrating of the pipe by rapping the fitting bell or coupling surface with a 5# dead blow hammer will reduce the frictional resistance in the joint being pulled together. The load on the cables should be held firm until the joints are aligned and completely locked up. The joint is considered locked up when no forward movement is noted. After a joint is made up, do not aggressively move the pipe and joint until the adhesive is completely cured. Relieve tension on cables before attempting to remove strap clamps.

Operation of cable come-alongs should be in accordance with the device manufacturer’s instructions.

Installing 18" - 42" Green Thread Flanges (ANSI 150 & 300)

1. Install the flange onto the pipe spigot without adhesive to determine the dry-fit measurement. Use a dead blow hammer to force the flange onto the pipe spigot. See Photo #8
2. The factory tapered pipe spigot may extend through the flange. If so, it will need to be trimmed off. Draw a cutting guide around the pipe spigot that sticks through the flange face. See Photo #9
3. Remove the flange from the pipe spigot.
4. Saw the pipe spigot off at the trimming guide line drawn in Step 4. See Photo #11
5. Saw the pipe spigot off as smoothly as possible. Sand the new pipe spigot end to remove jagged edges. See Photo #12
6. Sand the bonding surfaces of the pipe spigot and flange I.D. using 60-grit sand paper. Remove dust generated by the sanding process with a clean paint/chip brush. See Photo #13.
7. Bond the flange to the pipe spigot using a hydraulic come-along and the appropriate pressure from Table 11. See Photo #14
8. Use wood blocks between the flange and the come-along bar to prevent damage to the flange face. See Photo #15


Photo #8


Photo #9


Photo #10


Photo #11

9. Remove any excess adhesive from the serrated flange face using a solvent such as acetone. Take care not to get solvent on the adhesive bead at the end of the spigot.

10. Allow to gel and then post cure according to Table 13.


Photo #12

Installing 2" - 16" HP 32/35/40 Products

For 2" - 6" sizes use the same methods referred to in the HP 16/25 system. Because the 8"- 16" HP 32/35/40 systems have a steeper 1 3/4 taper angle vs the 1 degree on the HP 16/25 system, hydraulic


Photo #13


Photo #14

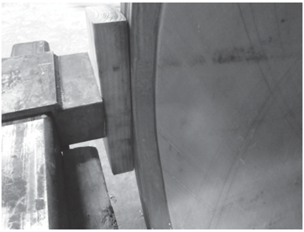


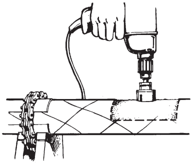
Photo #15

Table 11

Size		Come-Along Pressure	
in	mm	psi	MPa
18	450	2500-2750	17.2-19.0
20	500	2500-2750	17.2-19.0
24	600	2500-2750	17.2-19.0
30	750	2750-3000	19.0-20.7
36	900	3000-3500	20.7-24.1
42	1050	3000-3500	20.7-24.1

come-alongs are not required. Use FGS approved strap clamp kits (these can be purchased through FGS) or rubber lined riser clamps fitted to the pipe OD. Place clamps approximately 3' from the end of the joint and tighten securely where they will not slip. A gritty cleaning powder such as Ajax or Comet may be used under the straps if they start slipping. Attach ratchet or chain style come-alongs rated to a minimum of 2000 lbs to the strap or riser clamps on each side of the joint. Clean and prep the joint and apply adhesive. Stab the joint together by hand and attach the come along. Slowly pull the joint together. A 5 lb dead blow or rubber hammer may be used to help vibrate the joint as it is being pulled together. Firmly hit the joint 360 degrees around the IJ head or fitting. Keep pressure on the joint until the adhesive has squeezed out and there is no forward movement seen. For all HP 32/35/40 systems, the come-alongs must be left on until the joint is fully cured.

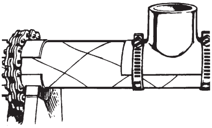
Saddles and Reductions (HP 16) - The recommended adhesives for RT or GT systems are ZC-275 or PSX 34, 48 & 60. To develop full strength of an adhesive bonded joint, it is important to properly prepare the bonding surfaces as recommended in the following paragraphs. Heat curing the saddle joint reduces cure time, improves the chemical resistance as well as the ultimate strength of the bond.



Position the saddle on the pipe and mark around the saddle base. Use a sander or sanding tool (24 to 40 grit) to remove all surface gloss from the pipe O.D. where the saddle is to be bonded. (For large diameter pipe, a disc sander is usually more practical.) Use circular or random pattern motion during sanding to eliminate grooves on the pipe surface. After sanding, position the saddle on the pipe and mark the hole to be cut in the pipe. Cut a hole the same size as the saddle outlet using a pilot drill and circular hole or saber saw. Do not force the cutter or it will fray the edges of the hole excessively. Clean all bonding surfaces as required.

Apply a thick coat of adhesive to the O.D. of the pipe and the I.D. of the saddle, and the edges of the pipe wall exposed by the hole. Place the saddle over the hole and clamp with two hose clamps or a strap clamp. The clamps may be left on after the joint is cured.

Using a large screw driver, hand tighten the hose clamps alternately until secure and adhesive squeezes out all the way around the saddle. This will ensure that the pipe O.D. conforms to the saddle run. To cure a saddle it is recommended that two heating collars be used , one on each side of the saddle "run". An alternate method is to use a box lined with industrial heavy duty foil and an industrial hot air gun. When using the foil method cut a 12" section of 2" pipe and insert hot air gun in the end to prevent over heating. Allow adhesive to cure before bonding in the side run.



Installing Reducer Bushings - Install reducer bushings using a block of wood and a hammer and the same procedures as for bell and spigot pipe. The wood block should be sized to allow the reducer bushing to be counter-sunk in the bell. Some reducer bushings will be counter-sunk before they are actually locked up. For maximum chemical resistance with 8" and larger Green Thread reducer bushings, coat all machined surfaces with adhesive just before assembly.

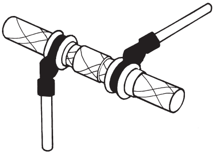
Making Short Nipples - To make short nipples, be sure the overall length is equal to two insertion lengths plus a minimum of ½" (gap between mating fittings).

The most common way is to:

1. Cut off an existing section of pipe from the bell end that is long enough to be securely contained in a pipe vise or clamped to a table.
2. Use a factory taper or set your taper tool up and taper one end of a longer section of pipe. Cut pipe with taper to the required length you want your pipe nipple to be. Jam the tapered end in to the bell of the pipe in step 1. Be sure it is secure enough to hold the pipe nipple without spinning.
3. Taper the pipe. The same method "loose bell method" can be used with the 2000 series box tools. Never hold your hand over the end of the pipe when working with the box tools."

T.A.B. Joints (Threaded and Bonded)

Two T.A.B. wrenches are recommended for 2" and 3" and are required for 4" and 6" T.A.B. x T.A.B. joints. T.A.B. to smooth connections do not require T.A.B. wrenches. Prep bonding area and mix adhesive. Spread adhesive over both T.A.B. connections. Stab joint together and start thread engagement by hand and turn until hand tight. Place T.A.B. wrenches 12" away from the bonding area. Using the T.A.B. wrenches screw together until firm. Check lock up by moving the joint up and down. No movement should be visible at the joint.



Joint Cure

Ambient Cure - The hardening of the adhesive in an assembled joint. The time required to cure depends on the adhesive type and the temperature, as shown in Table 12 . Ambient temperature cure times for other NOV adhesives are in the usage instructions included with adhesive kits.

Heat Collar Cure - Electric heat collar use will shorten adhesive cure time and improve the chemical resistance and physical properties. Refer to heat collar bulletin TLS6643 for heat collar operating instructions. Cure times are adhesive type dependent and provided in the usage instructions included in each adhesive kit.

Pipe and Fittings - Recommended heat collar sizes for pipe are provided in Bulletin TLS6643. Standard fititings use the same size heating collar as recommended for the pipe size. Do not use a heating collar that is designed for a larger size pipe.

Flanges:

For 1", 1½" and 2" flanges, an industrial hot air gun may be used to cure the joint. The end of the air gun should be kept at least six inches from the opening of the flange to prevent over heating.

For flanges use the smallest heat collar that will fit inside the ID of the flange joint. Position the Velcro strap outside the flange joint and roll the heat collar up with the inner collar surface against the pipe ID.

Allow the joint to return to ambient temperature before applying any type of load on the joint.

NOTE: Electric heating collars are designed to fit around fittings, and will overlap on pipe joints and couplings. Exceeding the recommended cure time on pipe joints where the heating collar overlaps may shorten the life of the heating collar and/or damage the pipe.

Heat Packs - Heat packs that cure joints in approximately one hour are also available. Refer to bulletin TLS4500 for complete instructions that are included with each kit. Observe all safety precautions listed on the instruction sheets that accompany the heat packs.

CAUTION: The adhesive bead will cure faster than the adhesive in the joint. Do not pressurize the piping system until every bonded joint has been properly cured and allowed to cool down to ambient temperature.

Table 12

Minimum Ambient Temperature Cure Times

Temperature		PSX 20 - PSX 34	PSX 48
°F	°C	Hours	Hours
60	16	6	10
70	21	5	7
80	27	4	5
90	32	3½	4
100	38	3	3
110	43	2	2

Table 13

Heat Collar Assisted Curing Times For Red Thread, Green Thread HP Series and Silver Streak Piping Systems

Adhesive	Pipe Size	Cure Time (minutes)		
	Inch	HP16 & SS	HP20/25	HP32/35/40
PSX 20* PSX 34 PSX 48	1-8	20	30	60
	10	30	35	60
	12	30	40	150
	14	35	45	150
	16	40	60	150
PSX 20 PSX 48*	18	90	120	-
	20	90	120	-
	24	90	120	-
	30	120	-	-
	36	120	-	-
	42	150	-	-

Notes:

* Preferred Adhesive

** HP16 Series 1”, 1½” & 2” flanges require the use of an industrial hot air blower.

NOTE: These cure times are for environments warmer than 70°F. If cooler, see “Cold Weather Installation Tips” or consult Fiber Glass Systems. The use of insulation over heat collars is not recommended

Repairs for Red Thread, Green Thread & Silver Streak Piping Systems

CAUTION: Always determine exactly what fluid has been in the piping system as it may be flammable. Contact may be harmful to humans. Take necessary precautions.

Always use the same pipe grade, fittings, and adhesive on new parts as is in the existing system. Do not mix pipe grades.

Inspecting for Potential Causes of Joint Failure

Joint Back Out – If the bead is no longer next to the edge of the bell, the joint backed out before the adhesive cured.

Cocked Joint – If a joint is cocked or misaligned, there will usually be a large gap between the bell and spigot on one side.

Improperly Cured Joint – If the adhesive bead is soft or flexible, the adhesive is not sufficiently cured.

Weathered Joint – If the machined area appears yellow, the joint may have been exposed to UV degradation.

Repairing Weather Damage

If machined surfaces of pipe or fittings are exposed to direct sunlight prior to installation, a loss of joint bonding strength may occur. If ultraviolet exposure is greater than two hours, the following steps must be taken:

1. For exposed spigot ends, use 60 to 80 grit sand paper or Emery cloth and lightly sand to remove UV degradation. If UV degradation is too severe, cut 1" from the end of the pipe and re-taper.
2. For exposed bell ends (pipe or fittings), sand thoroughly until the entire surface appears fresh. Hand sanding with 40 grit sandpaper is recommended. Use a light sanding operation to prevent changing the taper angle.

NOTE: Couplings or integral bells with T.A.B. threads that have been overexposed must be replaced.

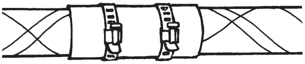
Repairing Minor Pipe Body Damage

Minor pipe body damage consists of surface impacts or scratches less than one inch in diameter that do not penetrate the entire pipe wall. If the service fluid is water or contains light chemicals the area may be repaired by patching a pipe rated up to 232 psig. Any temperature deratings applied to the piping system apply to patch repairs as well.

Minor Repair Using a Patch

1. Cut a length of good pipe to cover and extend 3”-4” on both sides of the damaged area.
2. Slit the “patch” lengthwise twice to remove a section that leaves about ¾ of the circumference for 1’-4” pipe or ½ the circumference for 6” and larger pipe.

3. Clean and thoroughly sand the inner surface of the patch and the mating surface of the pipe around the damaged section.
4. Clean the surfaces to be bonded, then apply a thick coat of adhesive to both, snap the patch in place, and apply pressure to the patch with the hose clamps. The clamps may be left on or removed after the adhesive has cured.

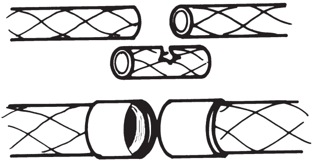


Repairing Extensive Damage

When the damaged area in the pipe wall is larger than one inch in diameter or penetrates the pipe wall, repair per one of the following instructions:

1. When damage is local (less than one inch long, but more than two inches around the circumference of the pipe), check to see if there is enough slack in the pipe to cut out the damaged section, re-taper the cut ends, and bond a sleeve coupling between the tapered ends.
2. When damage is extensive (too large for replacement by a single sleeve coupling), cut out the damaged section, taper the cut ends, and install two sleeve couplings and a pipe nipple.

This procedure requires sufficient slack in the line to make the final joint by lifting the pipe (or moving the pipe to one side) to engage the bell and spigot joint.

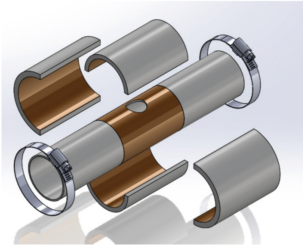


3. If the line cannot be moved sufficiently to install a sleeve coupling or a sleeve coupling spool piece, taper both ends of the pipe and install flanges.
4. If it is impossible to taper the pipe in the ditch, you can install a new section of pipe by over wrapping the plain cut ends.
   a. Clean an area large enough for installers to work on both sides and under the pipe. Cut out the damaged section of pipe and measure the gap. Cut a section of good pipe that is not more than one-half inch shorter than the length to be replaced (1⁄4" maximum gap on each end).
   b. Sand the ends of the pipe to remove all resin gloss. Align the replacement pipe section with the pipeline and block up all sections to maintain alignment. All sections must be rigid so they will not move during the over wrapping procedure. Tack welds should be used by placing 1" x 2" patches of glass cloth and adhesive (four patches spaced at 90° intervals around the pipe). See Over-wrapping.

5. If the damaged area can be removed with a hole saw up to 1/3 the nominal diameter of the damaged pipe, then a NOV Fiber Glass Systems' Maintenance Coupling may be used to repair the damaged area. See bulletin INS2004 for available sizes, pressure ratings and installation procedures. The following procedure should be followed to remove the damaged pipe wall material.

   a. Using a hole saw remove the damaged pipe wall area

   b. Dry and clean the freshly cut edge where the



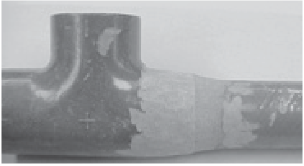
damaged pipe wall was removed. Remove any splintered pieces of the pipe wall at this time.

c. Seal the edge of the hole with an adhesive suitable for the service and piping material.

d. Center the Maintenance Coupling over the hole. Follow the installation procedures in bulletin INS2004 to prepare and bond the Maintenance Coupling onto the pipe body.

6. If the damaged area is larger than 1/3 the nominal pipe diameter then the damaged pipe section must be completely removed and replaced with new pipe. This may be accomplished using Butt-End joints with Maintenance Couplings as described in bulletin INS2004.

Repairing Leaking Joints



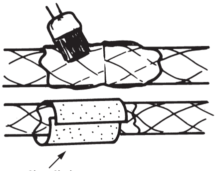
Over-wrapping – If a joint leaks because of improper installation, you can repair it by over wrapping with glass cloth and resin. The temperature in the work area should be 70°F- 90°F. Be sure to protect the over wrap from the sun. System must be open to atmosphere to prevent pressure from building and blowing through wrap.

1. Use FGS 10 oz. glass cloth. Components for the epoxy over wrap are available in the 8088 repair kit (see Table 14).
2. Use a grinder or sander with coarse grit to remove gloss five inches on either side of the joint.
3. Bevel the shoulder to blend in with the pipe wall and add putty to make a smooth transition from fitting to pipe. The length of this putty should be held to a minimum, because the putty has limited pressure capabilities.

CAUTION: There must not be any pressure on the line or any fluid leaking from the joint when performing this procedure.

4. Re-sand and clean surfaces including bevel.
5. Thoroughly mix the adhesive and hardener with the stir stick until there is a uniform color and a consistent flow off the stir stick.

NOTE: Cure time is the time before the line can be tested. Times may vary depending upon temperature, humidity, etc.



6. Using a paint brush, apply the mixed adhesive to all sanded areas.

7. Each piece of glass cloth must be slightly longer than the previous piece, because the O.D. of the pipe becomes larger as you add glass cloth. Cut the first piece to allow for two inches of overlap. When this length is no longer sufficient to overlap at least one-half inch on the ends, determine a new length with two inches of overlap.

8. Center a piece of glass cloth over the joint. Pull on the cloth while positioning it and wet it out by painting with adhesive. Brush to remove any trapped air bubbles in the wrap. Start at one end of the cloth and work around the circumference, wetting the cloth with resin. Work the cloth away from the starting end and from the center of the cloth to the sides. The cloth must be thoroughly wetted with adhesive, but do not spend a lot of time in one area as the cloth will wet out (lose its shiny, white appearance) with time. By the time the cloth has been worked down smoothly with no air beneath it, most of it will be wetted out. An alternate method would be to place a section of clean cardboard or kraft paper on a work table/section of plywood adjacent to the joint to be wrapped. Spread the dry glass out on the table. Wet out each layer by pouring a small amount of adhesive on the glass and spreading it out with the wooden mixing stick or the brush. Be sure the glass is wet out thoroughly but not saturated (dripping). Use the same adhesive to wet out the prepped pipe/fitting surface. Center wet glass over the damaged area or the center of the joint and carefully pull tension around the joint with enough pressure to squeeze out adhesive. Work out any air under the wrap by pushing it out to the side.

9. To prevent thick sections or humps in the over wrap, center the next piece of glass cloth on the joint starting from a new point on the circumference. Never do more than 12 layers at once time. For joints that require more than 12 layers split the procedure into two or more stages. Allow to cure and cool. Lightly sand the glossy areas and repeat Step 8 until all layers are applied.

10. Should the over wrap start to give off heat, discontinue wrapping and let the joint cure and cool with a fan. Sand the cured layers to remove the gloss before restarting the over wrap procedure.
11. Pay particular attention to the bottom of the over wrap as this is the area that may sag and is most difficult to see. Excessive adhesive use may cause this condition.
12. In temperatures above 90°F, protect the over wrap from direct sunlight with some type of sun shade.

Table 14

Weldfast 8088 Overwrap Repair Kits

Pipe Size in	Layers of Glass 16 bar	Layers of Glass 25 bar	Glass Width 16 bar (in)	Glass Width 25 bar (in)	Number Kits Required for 16 bar[1]	Number Kits Required for 25 bar[1]
1"	4	6	4"	4"	0.25	0.25
1½"	4	6	4"	4"	0.25	0.25
2"	6	6	6"	6"	0.75	1
3"	6	7	6"	6"	0.75	1
4"	6	7	6"	8"	1	1
6"	6	9	8"	8"	1.5	2
8"	8	12	8"	8"	1	1.5
10"	10	15	8"	8"	1.75	2
12"	12	18	8"	9 layers 8" 9 layers 10"	2	3
14"	14	20	8"	10 layers 8" 10 layers 10"	3	4
16"	16	23	8"	2 layers 8" 11 layers 10"[2]	4	5
18"	18	26	10"	13 layers 10" 13 layers 12"[2]	4.5	Use Bulk Material
20"	20	29	10"	9 layers 10" 10 layers 12" 10 layers 13"[3]	5	Use Bulk Material
24"	24	34	10"	10 layers 10" 10 layers 12" 14 layers 16"[4]	7.5	Use Bulk Material

NOTE: An 8088L (Large) repair kit is available for 8" and larger over wraps. A 2088 over wrap kit is available for applications with temperatures at or below 200°F.

(1) For 1" – 6" sizes use the 8088S kit. For 8" through 16" sizes use 8088L Glass is also available in bulk 125 yard rolls in widths of 8", 9 ¼" and 12".

(2) Stagger 8" wide glass to the 10" required width.

(3) Stagger 8" or 9¼" wide glass to 10" stagger 12" wide glass to 13" required width.

(4) Stagger 8" or 9¼" wide glass to 10" and 12" wide glass to the 16" required width.

Section 5

Installation Considerations

Hydrotesting

Testing
System Start-Up
Water Hammer
Fiberglass Flanges
Connecting to Other Systems
Painting Pipe

These procedures must be followed in order to avoid serious personal injury or property damage. Failure to do so will result in loss of warranty, and buyer, installer, or any employee, agent, or representative thereof, assumes the risk of any damage or injury to person or property.

Hydro-test Frequency

Hydro tests should be performed on sections of the installation as they are completed to ensure installation procedures are satisfactory. The first hydro test should be performed early during a system assembly to ensure installation techniques are providing the performance required. Long pipe line installations should be hydro tested before 2,500 feet have been installed. Fitting intensive systems as found in industrial systems should be hydro tested before 50 joints have been installed.

Hydrostatic testing should be performed to evaluate the structural integrity of a new or modified piping system. Hydro test pressures must meet any local jurisdiction or code requirements and not exceed the hydro test pressure limits for the particular product.

Safety Precautions

Before hydro testing, supports, anchors and guides must be in place prior to testing an above ground system. A buried piping system must be properly bedded and have sufficient backfill cover between joints to hold the pipe in place. The joints should be left uncovered for visual inspection during test. Never stand over or at the end of a line that is under pressure.

Locate pressure gauges away from the end of the pipe. A pressure gauge with the test pressure at midscale is recommended. When filling the system for hydro testing, open vents to prevent entrapment of air in the system. Then close the vents and slowly pressurize to the test pressure.

Hydro Test Procedures

In order to provide a high degree confidence in the piping system, FGS recommends a 10 cycle hydro test at 1.5 times the design operating pressure not to exceed the recommendations in the product data bulletins ranging from 1.25 to 1.5. Be sure you do not exceed the maximum rating of any other element in the piping system such as valves, expansion joints, various seals and gaskets that may have a lower pressure rating than the fiberglass. The maximum static rating can be found in bulletins CI1200, CI1225, CI1300, CI 1320, CI1325, CI 1330, CI1335, CI1340, CI1350, CI1351, CI1360 and CI1370.

Filling the Line

When filling the system for hydro testing, open high point vents to prevent entrapment of air. High point vents can be made from saddles, tees or flanges with a valve connection. For systems that do not have high point vents it is recommended that soft pipeline pigs be used to remove trapped air. If air is trapped in the system and you have a failure, catastrophic damage could occur.

Hydro Test Start Up

Allow the temperature to stabilize before starting test. Slowly increase pressure to recommended pressure. Initial pressurization should be gradual to prevent pressure surges or water hammer.

Hydro Test

The hydro test pressurization cycle may be repeated up to ten times from 0 psig (or city water or static head pressure) to the test pressure to provide an additional degree of confidence in the piping system. The intermediate pressure cycles should be held a minimum of 5 to 10 minutes. The final pressurization should be held for a period of one to two hours to allow the system to stabilize and slow leaks or pressure drops to be detected. The pressure may be lowered as deemed necessary by the on-site safety engineers prior to a full visual inspection of the piping system after the final pressure cycle.

Monitor the test pressure closely to avoid over pressurization. Pipe lines exposed to the sun can heat up quickly resulting in a pressure rise. If this happens bleed the line to original test pressure. The reverse is possible if the line is exposed to cold temperatures. If left under pressure over night during cold weather the water may cool resulting in a system pressure drop. Allow the water to warm back up to original input temperature before assuming a leak.

Checking The Line For Leaks

Walk the line to check for leaks. Do not stand or walk near the top or end of the line. Generally you are looking for moist spots under the joints. Brown kraft paper under the joints can help ease the visual ability to spot a leak. Do not repair a leak while the system is pressurized.

De-Pressuring The Line

Upon completion of hydro test, slowly open vents and drains to relieve the pressure on the system. Be sure you open vents to allow for complete drainage of the system and prevent a vacuum type failure . If the drain is open and the vents are closed the system could create a vacuum resulting in damage to the pipe.

It is highly recommended that piping systems operating at 150°F or higher and/or have a critical medium, should be tested to the maximum allowable test pressures as determined in the previous paragraphs.

Air Testing: Hydrostatic test should be used instead of air or compressed gas if possible. When air or compressed gas is used for testing, tremendous amounts of energy can be stored in the system. If a failure occurs, the energy may be released catastrophically, which can result in property damage and personal injury. In cases where system contamination or fluid weight prevents the use of hydrostatic test, an air test may be used with extreme caution. To reduce the risk of air testing, use the table below to determine maximum pressure. When pressurizing the system with air or compressed gas, the area surrounding the piping must be cleared of personnel to prevent injury. Hold air pressure for one hour, then reduce the pressure to one half the original. Personnel can then enter the area to perform soap test of all joints. Again, extreme caution must be exercised during air testing to prevent property damage or personnel injury. If air or compressed gas testing is used, NOV Fiber Glass Systems will not be responsible for any resulting injury to personnel or damage to property, including the piping system. Air or compressed gas testing is done entirely at the discretion and risk of management at the job site.

Pipe Size	**1"-6"**	**8"-12"**	**14"-42"**
psig	25	15	10

System Operation and Startup

On any pressurized piping system, initial start-ups should be gradual to prevent pressure surges which may damage or weaken the piping.

One method is to slowly fill the system while bleeding the air before starting any pumps or opening valves connected to pressurized piping. An alternate method is to start the centrifugal pump against a closed, adjacent valve; then slowly open the valve to gradually build up system pressure. The air should be bled off while the line is filling as in the first method.

For positive displacement pumps, consult NOV Fiber Glass Systems' Engineering for recommendations.

Water Hammer - Avoiding Problems

Water Hammer is pressure surge in a piping system that causes a violent movement of the system. Usually this pressure surge is caused by a sudden valve closing, electrical outage, pump failure, or some other out-of-the ordinary situation. The pressure surge is usually brief, but damage can be severe. In FRP piping, water hammer usually results in failed fittings due to pipe system movement. Careful location of supports, anchors and guides during design will help control movement of the piping during water hammers. Reducing the pressure surges by installing slow operating valves, a pump bypass or surge protectors in the system is recommended.

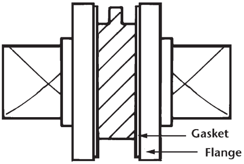
Air in a system can also cause water hammer. Be sure to bleed air out of the piping prior to full pressure operation. Any pipe system which moves suddenly, creates a lot of noise, or is unstable, may be influenced by water hammer.

Fiberglass Flanges

Before bonding the flange onto the pipe, make sure the bolt holes line up with the mating bolt holes on the other system. Do not bolt the flange before bonding, unless insertion depth of the spigot is previously checked to be certain that the spigot does not bottom out or extend through the flange. The use of flat washers on all nuts and bolts is required. The maximum allowable torque is indicated on each flange and is also shown in Tables 15 and 16.

Connecting to Flat-Face Flanges:

Fiberglass flanges may be joined to flat-face flanges at the recommended torque levels when using proper gaskets.



Filament Wound Flanges

Figure 8.3

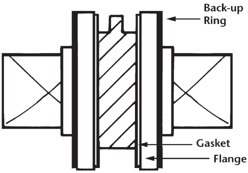
Connecting to Raised-Face Steel Flanges:

When connecting to a raised-face steel flange, one of the following must be utilized:

Option 1 - Use filament wound fiberglass flanges,

Option 2 -Use molded fiberglass flanges and machine the steel flange face until it is flat or use a metal spacer ring to fill the void between the raised-face steel flange and the fiberglass flat-face flange (normally more difficult than machining the steel flange face). If metal spacer rings are not available, it is acceptable to use spacer rings made from materials that are at least as hard as the fiberglass flange.

Option 3 - Use metal back-up rings behind molded fiberglass flanges (See Figs. 8.4 and 8.5).



Compression Molded Flanges

Figure 8.4

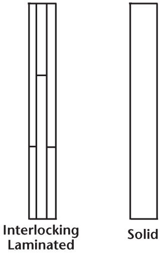


Figure 8.5

Back-Up Ring Thickness	
Pipe Size	**Ring Thickness**
1"-12"	9/16"

Connecting to Lug or Wafer Valves:

Most lined valves need a flat surface to seal against and a sealing surface that is close to their own I.D. to properly seat the lining. Unlined valves with sealing components in the face are in the same category as lined valves.

Sometimes the sealing ridges on the valve face can fall in the wrong place for the grooves in fiberglass flange faces, or they can be too close to the I.D. to seal. When connecting to valves with other than flat-faced flanges, follow these recommendations:

1) For unlined lug and wafer valves without integral seals, use filament wound flanges with no back-up rings or molded flanges with metal back-up rings. (See Fig. 8.3, 8.4, and 8.5)

2) For lug and wafer valves that are lined or have integral seals, use a ¼" steel spacer plate with an I.D. equal to Schedule 40 steel or as required by the valve manufacturer. (See Fig. 8.6).

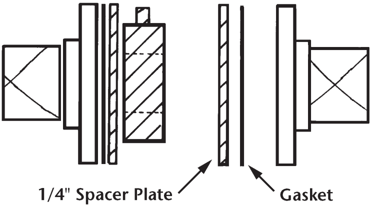


Figure 8.6

Summary

- **Molded flanges** are designed to be used against flat-face flanges. When joining to raised-face flanges and lug or wafer valves, steel back-up rings should be used, or spacers fabricated from any material capable of preventing the flange face from bending.
- **Filament wound flanges** may be mated to raised-face flanges and lug or wafer valves with no back-up rings or spacers if the bolt torque limits shown in Tables 15, and 16 are not exceeded.
- When using lug and wafer valves with integral seals, it may be necessary to use a ¼" thick steel flange between the valve and the fiberglass flange to achieve a proper seal. A ⅛" thick full-face gasket should be used between the steel flange face and the fiberglass flange.

Standard Bolting Conditions

NOV Fiber Glass Systems' flanges are designed to meet ANSI B16.5 bolt hole standards. **For RTHP 16, GT HP16 & SS**, full-face gasket materials, 1/8" thick, with a Shore A hardness of 60 to 70 durometer, are recommended. Flat gaskets made from Teflon® and PVC usually have high durometer ratings and are not acceptable.

Table 15

Stub End Flanges

Size in	Number[1] of Bolts	Machine[2] Bolt Size	Stud[2] Bolt Size	Max. Torque ft-lb
2	4	⅝-11x3	⅝-11x4	66
3	4	⅝-11x4½	⅝-11x5½	66
4	8	⅝-11x4½	⅝-11x5½	66
6	8	¾-10x5	¾-10x6	150

[1] ANSI B16.5 Class 150 lb. bolt hole standard.
[2] Bolt lengths are nominal. When joining our flanges to flanges of other material or manufacturer products, bolt lengths must be calculated.

Table 16

Bolt, Washer & Torque Requirements for RT/GT HP 16, SS Flanges & Flanged Fittings[1], ANSI B16.5 Class 150

Flange Size in	Number of Bolts[3]	Machine Bolt[2] Size	Stud Bolt [2] Size	Maximum Allowable Torque ft-lb
1	4	½ - 13x3	½ - 13x4	25
1 ½	4	½ - 13x3	½ - 13x4	25
2	4	⅝ - 11x3	⅝ - 11x4	30[4]
3	4	⅝ - 11x4½	⅝ - 11x5½	30[4]
4	8	⅝ - 11x4½	⅝ - 11x5½	30[4]
6	8	¾ - 10x5	¾ - 10x6	30[4]
8	8	¾ - 10x5½	¾ - 10x6½	100
10	12	⅞ - 9x6	⅞ - 9x7½	100
12	12	⅞ - 9x6½	⅞ - 9x7½	100
14	12	1 - 8x7	1 - 8x8	100
16	16	1 - 8x7	1 - 8x8	100
18	16	1⅛ - 7x7½	1⅛ - 7x8¾	200
20	20	1⅛ - 7x7½	1⅛ - 7x8¾	200
24	20	1¼ - 7x7¾	1¼ - 7x9½	200

[1] Most flanged fittings are available with molded flanges. Filament wound flanges are available on request.
[2] Bolt lengths are nominal. When joining our flanges to flanges of other material or manufacturers products, bolt length must be calculated.
[3] 1"-24" flanges are ANSI B16.5 Class 150 lb. bolt hole standard.
[4] HD filament wound flanges are available in 2"-6" sizes with a maximum allowed torque of 100 ft. lbs.

Recommended Bolt Torquing Sequence for NOV Fiber Glass Systems' Flanges

Before bonding the flange onto the pipe, make sure the bolt holes line up with the mating bolt holes on the other system. Do not bolt the flange before bonding unless insertion depth of the spigot is previously checked to be certain that the spigot does not bottom out or extend through the flange. Certain flanged fittings have recessed bolt holes to provide clearance for bolt installation during assembly. The number and depth of the recesses are shown in Table 17 for standard fittings. To determine the bolt length and size requirements see Table 16. The required bolt length must account for the recess depth and mating flange thickness. Stud bolts are recommended for ease of assembly

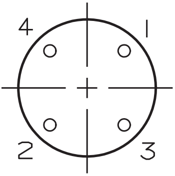
Table 17

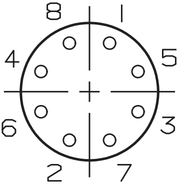
Recessed Bolt Hole Data for Flanged Fittings

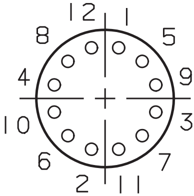
Flange Size in	Recess Depth in	Washer O.D. in	Number of Recessed Holes		
			45° Elbows	90° Elbows	Tees
3	¼	1⁵⁄₁₆	4	-	-
8	½	1½	4	4	8
10	⅝	1¾	4	4	8
12	¾	1¾	4	4	8
14	½	2	4	-	-
16	½	2	4	-	-

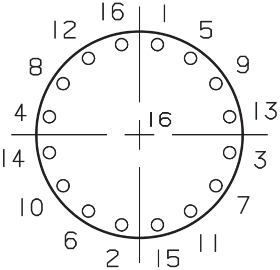
See NOV Fiber Glass Systems' fitting catalogs for the maximum allowable bolt torque, bolt size and quantities required Red Thread and Green Thread HP 25, 32, 35 and 40 bar classes.

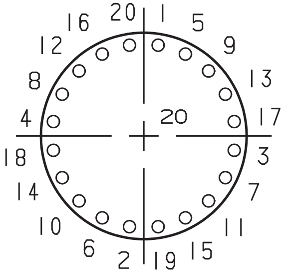
Recommended Bolt Torquing Sequence for Flanges

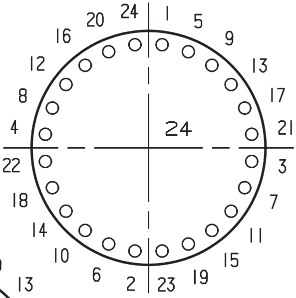


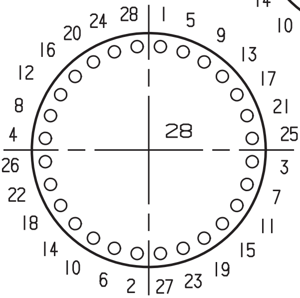


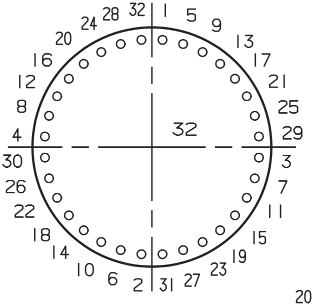








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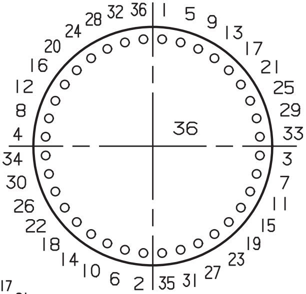
1 5 9 13 17 21 25 29 3 7 11 15 19 23 27 31 2 6 10 14 18 22 26 30 4 8 12 16 20 24 28 32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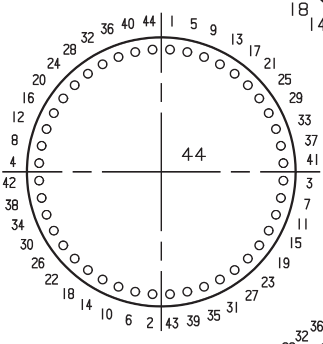
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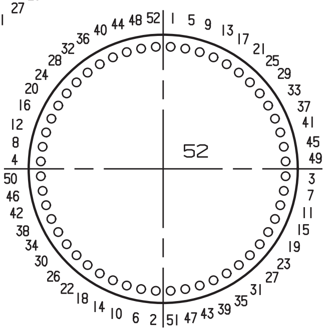

52
1 5 9 13 17 21 25 29 33 37 41 45 49 3 7 11 15 19 23 27 31 35 39 43 47 51 2 6 10 14 18 22 26 30 34 38 42 46 50 4 8 12 16 20 24 28 32 36 40 44 48 52

and the use of washers under nuts is required.

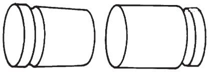
Connecting to Other Systems

It is often necessary to connect a fiberglass piping to another piping system or make a connection that will not be possible using flanges. Two types of adapters are available: bell or spigot by grooved ends and bell or spigot by threaded ends.

Adapters

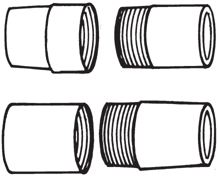
NOTE: When using adapters with spigot ends, it may be necessary to cut off a portion of the factory pipe bell if the groove or threads are not fully exposed.

A. Grooved Adapters



RT, GT, SS Product: Do not use couplings designed for plastic or cement-lined steel as they can leak due to a difference in groove dimensions. Grooved adapters are machined to ES Cut Groove dimensions. Use standard high pressure (Victaulic Style HP70ES) coupling or equivalent.

B. Threaded Adapters

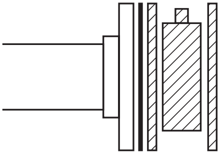


When using threaded adapters, thread them into the other system before bonding onto fiberglass pipe. Otherwise, unless a union is used, it may be impossible to turn the adapter into the mating thread. Use soft set, nonmetallic thread lubricant or two wraps of plumber's tape. **CAUTION: Do not over-tighten. Tighten the adapters as if they were brass or other soft material.**

NOTES:

1. The use of NOV Fiber Glass Systems' adhesive to bond a steel or metal pipe into a fiberglass flange is not recommended.
2. If mating a fiberglass system to steel, the preferred method is with flanges. Terminate the old system with their flange and bolt our flange on the new system.
3. Be sure to check the anchors, guides, and supports of an existing system to avoid transfer of any stresses or thermal expansion loads into the fiberglass system.
4. Do not try to cut or machine threads in fiberglass pipe or fittings.

Special Bolting Conditions



It is often necessary to mate fiberglass flanges with other components which do not have a full flat-face surface such as raised face flanges, butterfly or check valves having partial liner facings, and Van Stone flange hubs. The addition of a hard spacer ring or steel back-up ring placed between the raised face and the outer edge of the flange to form a full flat face on the mating flange is recommended. The purpose of the spacer is to fill the gap outside the raised face to prevent bolt loads from bending and breaking the fiberglass flange.

Pump & Equipment Connection - Fiberglass pipe connections to pumps or other equipment that involve vibration, shock loads or other mechanical movements should include flexible connectors. These flexible connectors allow for the absorption of vibration and eliminate the placing of undue strain on the pipe and fittings. A bellows-type expansion joint is recommended.

Painting Pipe - All piping O.D. surfaces should be clean and dry before painting. Use a fast-drying solvent such as acetone or trichloroethylene to clean the O.D. of RT, GT, or SS. For longer lasting results the O.D. should be thoroughly sanded or sand blasted. If sand blasting, be careful not to cut or groove the pipe O.D. with an aggressive spray. Fiberglass pipe can be painted with any good quality epoxy ester or two-part epoxy paint. Contact your local paint supplier for a detailed recommendation.

Section 6

Helpful Information

Conversions

	Metric Units	U.S. Equivalents
Lengths	1 millimeter	0.03937 inch
	1 centimeter	0.3937 inch
	1 meter	39.37 inches or 1.094 yards
	1 kilometer	1093.61 yards or 0.6214 mile
Areas	1 square millimeter	0.00155 square inch
	1 square centimeter	0.155 square inch
	1 square meter	10.764 square feet or 1.196 square yards
	1 square kilometer	0.3861 square mile
Volumes	1 cubic millimeter	0.000061 cubic inch
	1 cubic centimeter	0.061 cubic inch
	1 liter	61.025 cubic inches
	1 cubic meter	35.314 cubic feet or 1.3079 cubic yards
Capacities	1 milliliter (0.001 liter)	0.0338 U.S. fluid ounce
	1 liter	2.1134 U.S. liquid pints
	1 liter	1.0567 U.S. liquid quarts
	1 liter	0.2642 U.S. gallon
Weights	1 gram	0.03527 avoir. ounce or 15.4324 grains
	1 kilogram(1000 grams)	2.2046 avoir. pounds

	U.S. System Units	Metric Equivalents
Lengths	1 inch	25.4 millimeters or 2.54 centimeters
	1 foot	0.3048 meter
	1 yard	0.9144 meter
	1 mile	1.6093 kilometers
Areas	1 square inch	645.16 square millimeters or 6.452 square centimeters
	1 square foot	0.0929 square meter
	1 square yard	0.8361 square meter
	1 square mile	2.59 square kilometers
Volumes	1 cubic inch	16,387.2 cubic millimeters or 16.3872 cubic centimeters
	1 cubic foot	0.02832 cubic meter
	1 cubic yard	0.7646 cubic meter
Capacities	1 U.S. fluid ounce	29.573 milliliters
	1 U.S. liquid pint	0.47317 liter
	1 U.S. liquid quart	0.94633 liter
	1 U.S. gallon	3.78533 liters
Weights	1 grain	0.0648 gram
	1 avoir. ounce	28.35 grams
	1 avoir. pound	0.4536 kilogram
	1 Troy ounce	31.1035 grams

Decimal Equivalents of Fraction

inches	Decimal of an inch	inches	Decimal of an inch
1/64	0.015625	29/64	0.453125
1/32	0.03125	15/32	0.46875
3/64	0.046875	31/64	0.484375
1/20	0.05	1/2	0.5
1/16	0.0625	33/64	0.515625
1/13	0.0769	17/32	0.53125
5/64	0.078125	35/64	0.546875
1/12	0.0833	9/16	0.5625
1/11	0.0909	37/64	0.578125
3/32	0.09375	19/32	0.59375
1/10	0.1	39/64	0.609375
7/64	0.109375	5/8	0.625
1/9	0.111	41/64	0.640625
1/8	0.125	21/32	0.65625
9/64	0.140625	43/64	0.671875
1/7	0.1429	11/16	0.6875
5/32	0.15625	45/64	0.703125
1/6	0.1667	23/32	0.71875
11/64	0.171875	47/64	0.734375
3/16	0.1875	3/4	0.75
1/5	0.2	49/64	0.765625
13/64	0.203125	25/32	0.78125
7/32	0.21875	51/64	0.796875
15/64	0.234375	13/16	0.8125
1/4	0.25	53/64	0.828125
17/64	0.265625	27/32	0.84375
9/32	0.28125	55/64	0.859375
19/64	0.296875	7/8	0.875
5/16	0.3125	57/64	0.890625
21/64	0.328125	29/32	0.90625
1/3	0.333	59/64	0.921875
11/32	0.34375	15/16	0.9375
23/64	0.359375	61/64	0.953125
3/8	0.375	31/32	0.96875
25/64	0.390625	63/64	0.984375
13/32	0.40625	1	1.0
7/16	0.4375		

Definition of Terms

Adapter – A fitting used to join two pieces of pipe, or two fittings, which have different joining systems.

Adhesive – A material formulated to bond together pipe and fittings resulting in high strength and corrosion resistant fabrications.

Anchors – Device to positively restrain the movement of the pipe against all lateral and axial forces.

Bell and Spigot – A joining system in which two truncated conical surfaces come together and bond adhesively. The bell is the female end. The spigot is the male end.

Bushing – A fitting used to join two different sizes of pipe by reducing the size of the female end of the joint. Joints may come threaded or tapered.

Catalyst – See hardener.

Collar – See coupling.

Compressive Force – The force that occurs when a pipe is subjected to crushing loads. Axial compressive forces occur when a piping system is anchored to restrain thermal growth.

Compression Molding – A process for making fittings in which a molding compound is formed and cured into the finished part configuration through pressure and heat in a die.

Concentric Reducer – A pipe fitting used to join two different sizes of pipe while maintaining the same center line.

Contact Molding – A process for making fittings in which cut pieces of fiberglass reinforcement are laid on a mold, saturated with resin, and cured to the finished part shape.

Coupling (collar) – A short heavy wall cylindrical fitting used to join two pieces of the same size pipe in a straight line. The coupling always has female connection ends which can be bell, threaded or a mechanical joining method.

Cure – The hardening of a thermosetting resin system by the action of heat or chemical action.

Cure Stages – Describes the degree to which a thermosetting resin has cross-linked. Three stages, in order of increasing cross linking, include B stage, gelled, fully cured.

Cure Time – The time required for a thermosetting material to react and develop full strength. The time is dependent upon the temperature of the material.

Curing Agent – See hardener.

Cut and Mitered Fittings –Manufactured by cutting, assembling and bonding pipe sections into a desired configuration. The assembled product is then over wrapped with resin-impregnated roving or glass cloth, to provide added strength.

Epoxy Resin – A thermosetting resin, usually made from Bis-phenol A and epichlorhydrin, cured by a variety of agents such as anhydride and amines. These resins contain cyclic ether groups. See thermosetting resin.

FRP – Fiberglass Reinforced Plastic.

Filament Wound – A manufacturing method for pipe and fittings in which resin impregnated continuous strand roving wraps around a mandrel to achieve high reinforcement concentration and precise filament placement.

Fillers (extender, pigments, inerts; i.e., sand, etc.) – Materials added to a resin which do not affect the cure of the resin but may influence the physical properties of the resin system.

Fitting Types – The classification of fittings by the method of manufacture; i.e., molded, cut and mitered, filament wound, contact molded.

Gel Time – The time it takes for a resin system to harden to a rubber-like state.

Guide – Device that allows free axial movement of the pipe, but restrains lateral movement.

Hand Lay-Up – The forming of resin and fiberglass into finished pipe products or fittings by manual procedures. These procedures include over wrap techniques, contact molding, hand molding and others.

Hardener (accelerator, catalyst, curing agent, promoter) – Chemicals added to the resin, single or in combination, which speed up the hardening process, or cause hardening to occur.

Heat Blanket or Heat Collar – An electrical device used to heat a fabrication to reduce cure time.

Hydrostatic Test – A pressure test of a completed fabrication to confirm good quality. Typically, the system is filled with water and held at the selected pressure while checking for leaks.

Impact Resistance – The ability of a part to absorb a striking blow without damage.

Joining (connecting systems) – Any of a variety of methods for connecting two separate components of a piping system together. Included are bell and spigot, threaded and coupled, mechanical devices, etc.

Joint – A term used to describe an individual length of pipe or the actual joining mechanism; i.e., adhesive bonded bell and spigot, threaded and coupled, etc.)

Liner – A generic term used to describe the interior surface in pipe. Generally, liners are resin-rich regions from 0.005 to 0.100 in. thick. Liners may be reinforced with fibrous material such as veil or mat. Liners can provide extra corrosion protection for severe chemical service. They also form a leak barrier (elastomer bladder). The manufacturer may add a liner before, during, or after construction of the pipe wall depending on the manufacturing process.

Lock-Up –A bell and spigot joint engaged sufficiently to eliminate pivot action in the joint.

Matrix – The material used to bind reinforcement and fillers together. This material may be thermoplastic or thermosetting and dictates to a large extent the temperature and chemical service conditions allowable for a pipe or fitting.

Mechanical Force – Physical exertion of power used to achieve lock-up in tapered bell and spigot joints.

Molded Fittings – Pipe fittings formed by compressing resin, chopped fiber and other ingredients in a mold under heat and pressure.

Molding – Any of several manufacturing methods where pressure or compression molding shapes resin and reinforcing materials into final products.

Polyester Resin – Any of a large family of resins which are normally cured by cross linking with styrene. The physical and chemical properties of polyester resins vary greatly. Some have excellent chemical and physical properties while others do not. Vinyl esters are a specific type of polyester resin. Other polyester resins with properties suitable for use in the manufacture of fiberglass pipe include: isophthalic Bis-phenol A fumarate and HET acid polyesters. Each type of resin has particular strengths and weaknesses for a given piping application.

Pot Life – The time available to use thermosetting adhesives after the reactive materials have been mixed.

Pressure Rating – The maximum anticipated long term operating pressure a manufacturer recommends for a given product.

Reinforcement – Typically, fibers of glass, carbon or synthetic material used to provide strength and stiffness to a composite material.

The type of fiber used as reinforcement plays a major role in determining the properties of a composite, as does the fiber diameter and the type of sizing used. Terms relating to the physical form of the reinforcement include:

Chopped Fiber - Continuous fibers cut into short (0.125 to 2.0 inch) lengths.

Filament - A single fiber of glass; e.g., a mono filament.

Mats - Coarse fabric sheets made from chopped strands randomly placed and held together by resin binders.

Milled Fibers - Glass fibers, ground or milled, into short (0.032 to 0.125-inch) lengths.

Roving - A collection of one or more filaments wound into a cylindrical package. The typical form of glass fiber used in the manufacture of filament wound pipe.

Veil - Surfacing mat of porous fabric made from glass or synthetic filaments. Used to provide a resin rich layer or liner.

Yarn - Glass fiber filaments twisted together to form textile-type fibers.

Yield - The number of yards of material made from one pound of the product.

Resin (polymer) - As applied to fiberglass pipe, resin is the polymer or plastic material used to bind the glass fibers together.

Resin – The polymer (liquid plastic) material which hardens with cure to provide a solid form, holding the fiberglass reinforcement in place. Resins provide the corrosion resistance in FRP parts.

Saddle – A fitting which is bonded to the exterior of a pipe to make a branch connection.

Shelf Life – The storage time for a material until it becomes unusable.

Socket Joint – A joining system in which two straight cylindrical surfaces come together and bond adhesively.

Spacers – Wooden strips used to support pipe during storage and handling.

Stress – The force per unit of cross sectional area. Measured in pounds per square inch (psi). This should not be confused with hydraulic pressures, measured as psig or psia.

Support Spacing (span) – The recommended maximum distance between pipe supports to prevent excessive pipe deformation and bending stress.

Surge Pressure – A transient pressure increase due to rapid changes in the momentum of flowing fluids. Water hammer is one type of surge pressure. Rapid opening or closing of valves often result in a surge pressure or water hammer.

Thermal Conductivity – The rate at which a material transmits heat from an area of high temperature to an area of lower temperature.

Thermal Expansion – The increase in dimensions of a material resulting from an increase in temperature. A decrease in temperature results in a decrease in dimensions commonly called thermal contraction.

Thermosetting Material – A polymeric resin cured by heat or chemical additives. Once cured, a thermosetting resin becomes essentially infusible, (cannot be re-melted) and insoluble. Thermosetting resins used in pipe generally incorporate reinforcements. Typical thermosetting materials include:

- Vinyl esters
- Epoxies
- Novolac or epoxy Novolac
- Unsaturated polyesters

Thrust Forces – Commonly used to describe the dynamic forces resultant from changes in direction of a moving column of fluid. Also used to describe the axial or longitudinal end loads at fittings, valves, etc., resultant from static or continuously applied hydraulic pressure.

Torque – Used to quantify a twisting moment (torsion) on pipe. Torque is measured as a force times the distance from the force to the axis of rotation. Torque is expressed in foot-pounds (ft-lb) or inch-pounds (in-lb).

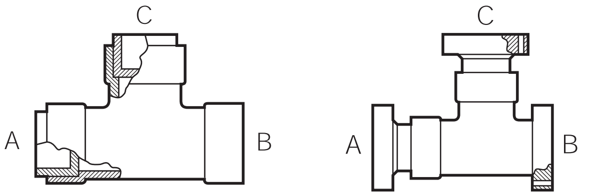
Two Holing – A method of aligning flanges onto pipe or fittings so that the bolt circle will mate with the adjoining flange.

Vinyl Ester – A premium thermalsetting resin system with excellent corrosion resistance. Vinyl ester exhibits high versatility, temperature resistance and excellent corrosion resistance to acids.

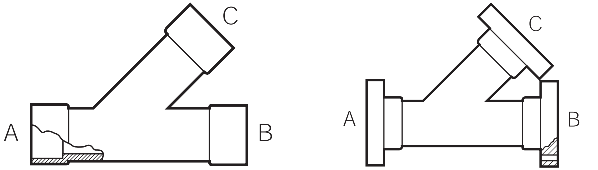
Water Hammer – Pressure surges in a piping system caused by sudden change in fluid velocity, such as operation of a valve, pump, or other component.

Working Life – Same as Pot Life.

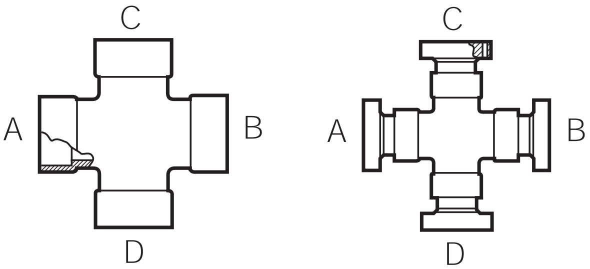
How to Read Flanged or Reducing Fittings



Tee
Run x Run x Branch



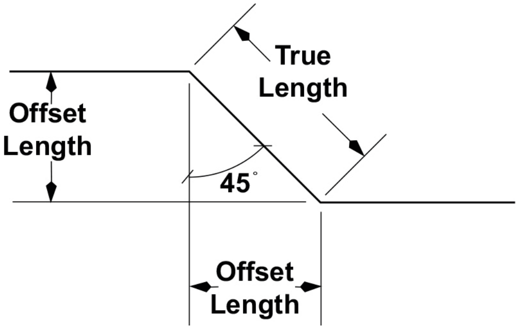
Lateral
Run x Run x Branch



Cross
Run x Run x Branch x Branch

The above sequence should be used when describing fitting outlets. Drawings or sketches showing outlet types, locations, sizes and dimensional requirements are required for more complicated fitting configurations.

How to Figure a 45° Offset



True Length = offset x 1.414
Offset = true length x .707

Examples:
IF: offset = 12"
12" x 1.414 = 16.968 = 1'-5"
true length = 1'-5"
(to nearest 1⁄16")

IF: true length = 24"
24 x .707 = 16.968 = 1'-5"
offset length = 1'-5"
(to nearest 1⁄16")

Notes:

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