Star® Threaded Line Pipe Installation/ Application Practices

www.fgspipe.com

fgspipe@nov.com

NOV Fiber Glass Systems

NOV FIBER GLASS SYSTEMS PIPE INSTALLATION HANDBOOK

1. It is the End Users/Contractors/Customers responsibility to read and understand all engineering and installation related manuals and guides for the product to be installed.

2. Fiber Glass Systems, L.P. does not warranty the installation of the goods nor shall it be responsible for the performance or workmanship of any person or entity engaged in the installation or installation supervision.

3. It is strongly recommended all installers be properly trained. Fiber Glass Systems offers several types of certification training classes and/or installation job startups.

4. Fiber Glass Systems recommends a pre-installation start up meeting with the Distributor and/or Regional Manager and/or Field Service Representative to discuss specifics of the installation to include but not limited to:

    - Review handling and storage.
    - Review installation procedures.
    - Tools and materials required for a proper installation.
    - Job start up and/or certification training by a certified FGS Field Service representative.

5. Fiber Glass Systems strongly recommends early hydro testing to ensure the reliability of the field workmanship. Testing is recommended at the following points of the installation:

    - High pressure line pipe – 5000' maximum
    - Low pressure long straight runs of pipe – 2500' maximum
    - Fitting Intensive piping projects – 50 joints maximum.

6. It is the End Users/Contractors/Customers responsibility to read and understand the Field Service Policy as it relates to on-site training and/or certification.

TABLE OF CONTENTS

TABLES

FIGURES

SECTION 1

INTRODUCTION

This manual presents special techniques unique to glass reinforced epoxy (GRE) pipe. During the installation, NOV Fiber Glass Systems recommends that a company-trained field service representative be on site for the purpose of training the installation crew and inspection of delivered product.

Piping systems may carry hazardous material and/or operate at elevated pressures. The instructions in this manual must be followed to avoid serious personal injury or property damage. Improper installation can cause injury or damage. Installers should read and follow all cautions and warnings on epoxy kits, heat packs, propane torches, and observe general safety practices with all saws and tools to avoid personal injury. Wear protective clothing when necessary. Make sure work surfaces are clean and stable and that work areas are properly ventilated.

Prior to Starting an installation, several parameters must be defined:

- Type of service
- Service conditions such as natural gas require an additional safety factor of 0.67
- Buried or above-ground installation
- Low pressure or high pressure pipe
- Type of joining system
- Required fittings
- Acquire proper tools, make-up wrenches, select lubricant/sealant and accessories
- Check the effect of make-up thread loss on the quantity of pipe ordered (Table 4.4)

Pre-Bid / **Installation Meeting**

- Review handling and storage
- Review installation procedures
- Qualify equipment (power tongs, hand tools, etc.)
- Review installation schedule

Responsibility of the NOV Fiber Glass Systems Service Representative

- Train and advise the supervisor and crew members in recommended practices.
- Provide testing after training to qualified personnel who handle pipe.
- Any new or substitute crew member and supervisor must be trained prior to taking over activities. At a minimum, two experienced and qualified crew members and a supervisor must be on location. Their qualification must be in according to the procedures in this manual.

Note: NOV Fiber Glass Systems representatives will not substitute for a crew member, nor be responsible for supervising the crew, nor does their presence warrant that the installation practices have been correctly performed.

Procedure / **Personnel Qualification**

- It is recommended that each person responsible for working on the connections be qualified and tested in accordance with recognized standards such as:

  API 15TL4, Appendix B
  ISO 14692, Section 4

SECTION 2 - Tools and Equipment

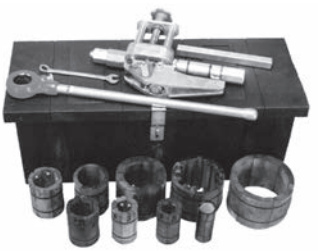
Metal Friction Wrenches

Designed to give 360 degrees of uniform compression on the male pipe upset, STAR metal friction wrenches are used for make-up and break out of GRE pipe 8rd threaded connections. The wrenches are equipped with replaceable dies which firmly grip the pipe without slipping. The dies may require replacement if they become dull from heavy usage. These wrenches are hand operated tools; handle extensions which reduce the required force can be used successfully and are recommended for larger pipe sizes.

Strap Wrenches

The STAR recommended strap wrenches are designed to be used by hand on GRE pipe. These wrenches should always be used on the pipe end connection upsets, never on the pipe body. Handle extensions can be used successfully on wrench sizes No. 11 and larger. These wrenches require the use of abrasive powder to assist the grip of the strap on the pipe. Never use the point of the wrench against the strap onto the pipe; always use the heel which provides uniform compression 360° around the pipe.

FGS' Tapering Tool - Model 010



The Tapering Tool Model 010 series is designed to accurately cut tapers on GRE pipe in normal pipe sizes 2" through 6". It can be operated manually by a ratchet or by an electric power drive. (Ridgid® #700). The Tapering Tool Model 010 series is factory assembled with 2" expandable collets, Ridgid 11-R ratchet, ¾" end wrench, 1" nipple bar and detailed instructions in a plastic box.

FGS' Grinding Tool Model 10-612 (2"-12")

The Grinding Taper Tool - Model 10-612 is designed to accurately cut tapers on GRE pipe in normal pipe sizes 2" through 12". The motor operates on 120V or 230V and comes with a flex cable 7 ft. in length and the switch box is on an 8 ft. cable for safe operation.

Pin Molds

Pin molds are used to make molded field threads on upset ends or nipple stock.

Epoxy Kit

Epoxy kits are used for field fabrication of our patented 8rd molded threads or assembly of bonded fittings. The kit comes in either small or medium sizes and includes pre-measured epoxy and amine hardener. Also, included in the kit are complete mixing instructions, a small piece of sand paper and a mixing stick.

***STAR*tec® Threaded Connection Lubricant/Sealant**

The STAR API 10rd and 8rd Patented Advanced Composite Thread (ACT) and Precision Ground Thread (PGT) connection is designed to utilize a Teflon®-based lubricant for make-up. *STAR*tec assures power tight makeup at low torque and allows easy breakout without seizing, stripping or galling. It also provides a permanent seal and maintains joint efficiency under vibration, pressure, surge and temperature fluctuations. Use of any other lubricant can void the product warranty and requires special approval from NOV Fiber Glass Systems. Do not use *STAR*tec lubricant on STAR Super Seal (SSS). STARtec is available in a one-gallon container.

Hi Pro Plus Kit

Hi Pro Plus is a two-part, manganese dioxide cured poly sulfide based PTFE (poly-tetrafluoroethylene) filled sealant that is lead free and solvent free. Hi Pro Plus is used as pipe thread sealing compound for joining and coupling threaded oil field pipe. The mixed compound has a paste consistency and can be readily applied with a spatula or brush to the threaded surfaces. It will cure to a fuel-resistant rubber at temperatures above 60°F with very low shrinkage. Hi Pro Plus exhibits excellent adhesion to a wide range of substrates including reinforced GRE, stainless steel, carbon steel and galvanized pipe. Hi Pro Plus has superior chemical resistance to oil and fuels and should be considered on all 3000 psi, 4" 2500 psi, 6" 1500-2000 psi and 8" 1000-2000 psi products.

Heat Collars

Electric heat collars are used for the purpose of curing field threads or bonded connections. They are available in a variety of sizes and ordered by the nominal pipe size. Specify either 110V or 220V-240V when ordering. Chemical heat packs are also available.

Woven Roving

Woven roving glass mat is used for increasing the outside diameter of a pipe body to the correct size for a pin mold inside diameter when the pipe outside diameter is insufficient to apply a field thread. Application of this material requires the use of an Epoxy Kit and special training by a NOV Fiber Glass Systems representative.

SECTION 3 - Receipt, Handling and Inspection

TRANSPORTATION

Domestic U.S.A. or Inland Shipments Require:

- Dedicated (GRE Only) 34 ft. to 40 ft. flat bed or drop deck trailers (oil field hauler).
- Do not hang pipe off trailer.
- Transporting the pipe on racks above a small truck can cause potential impact damage.
- Use nylon straps for tie downs, do not use chains.
- Tie downs should be located near the dunnage, four locations minimum.

International shipments require:

- Dedicated (GRE Only) 40 ft. either open top or high cube containers.
- All containers are loaded at the factory.
- It is highly recommended that the containers are not unloaded at port of destination.
- Shipments where the containers cannot be transported inland require the pipe to be crated at the factory.
- Crates can be installed inside of containers for removal at the port of destination and then transported inland.
- Seaworthy crates and insertion crates for containers are available.

LOAD INSPECTION

On arrival the shipment should be inspected as follows:

- Check quantities, report deviations.
- Check for load shifting, and for missing dunnage.
- Look for excessive bending caused by over-tightening of straps.
- Check for missing thread protectors and thread damage, replacement protectors are available.
- Look for impact damage (blister caused by abrasion or blow with a sharp object).
- Quarantine or mark joints which appear damaged, do not install damaged pipe. Contact your local distributor/ agent or NOV Fiber Glass Systems representative.

- Receiving party is responsible for noting shipping damage and contacting carrier.

UNLOADING

- Forklifts are commonly used to off load bundled pipe. Use a spotter to avoid damaging other bundles.
- Use padded forks when possible.
- Use a spreader bar and slings for off loading with a crane.
- Never allow pipe to roll off trailer to racks or ground.
- Breaking a bundle allows the pipe to move freely and can be off loaded individually.

STORAGE

- Set the pipe on a surface free of sharp rocks.
- Leave the separator boards between the pipe layers.
- If pipe racks are used, strip them with lumber to protect the pipe from sharp edges.
- Use four racks equally spaced to avoid permanent bending particularly for long-term storage.
- Storage of more than six months requires coverage with a tarp.
- Thread protection must remain in place to avoid degradation of thread tolerance.

ULTRAVIOLET EFFECTS

- Ultraviolet effects on the pipe are limited to surface discoloration. Eventually, “fiber bloom” or fuzzing will occur if the pipe is left exposed for long periods; the degradation is limited to the outer 0.005”-0.01” (0.13-0.25 mm) of the pipe. (Table 1)

  Fiberglass pipe may be protected from the ultraviolet rays by painting with a heavily pigmented industrial coating or by coating with an ultraviolet absorbing agent.

  Since STAR pipe has an added design safety factor, the surface effect of ultraviolet is minimal and does not reduce the long-term performance of these products.

Table 1 Ultraviolet Effects on GRE Pipe

Time Exposed	Pipe Conditions
6 months	Pipe color changes from amber/ green to tan. No effect on physical properties
1 year	Pipe color becomes dull tan and shiny fibers. No effect on physical properties
2 years	Approximately 50% of the pipe surface shows shiny fibers. No effect on physical properties
3 years	Approximately 90% of the pipe surface shows shiny fibers. No effect on physical properties
5 years	Pipe will be fuzzy with the entire outer layer of glass exposed. No further damage to pipe will occur. Pipe will operate at 100% of rating.

RESHIPPING AND STRINGING LINE PIPE

Necessary precautions include:

- Loose pipe must be loaded with the joints staggered.
- Separate each layer of pipe with wooden dunnage. **Caution**: never groove pipe and pyramid.
- Always use nylon straps to tie down pipe, never chains.
- Do not drop pipe off the trucks to avoid pipe damage.
- Place uprights on the trailer to keep the pipe from falling off the trailer while stringing.
- Lay the pipe on the opposite side of the ditch from where the dirt is piled.
- Do not remove thread protectors, prior to installation.

SECTION 4 - Line Pipe Installation

BURIAL GUIDELINES

Fluid Applications:

- **High pressure** line pipe requires a minimum of 3 feet (900 mm) of stable cover.
- Compacted, sandy or fine grain soil installation conditions are preferred.
- GRE line pipe must be buried below the freeze depth or insulated to protect against freezing.
- **Rocky conditions** require extra precaution of a minimum 6" (150 mm) of sand pad or select backfill around the pipe.
- The **ditch bottom** must be level such that the pipe does not bridge along the bottom.

Gas Application:

- **ALL gas applications** - Line pipe requires a minimum of 3 feet (900 mm) of stable cover.

DITCH PREPARATION

Stable soil bedding procedures:

Fiberglass pipe can be damaged by point contact or wear with the trench bottom and walls, improper bedding materials, or adjacent pipe. Remove all debris from ditch including tree roots. Use recommended bedding material a minimum of 6 inches thick at the bottom, sides, and top of the piping. The piping can be laid directly on the undisturbed trench bottom if the native soil meets the requirements of a recommended bedding material. Never 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. (Figure 1).

Table 2 - Recommended Bedding Materials

Bedding Material	Compaction Proctor Density
Crushed rock or pea gravel ¾" 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%

Backfill Guidelines

Loose backfill free of large rocks or debris must be used in the pipe zone (6" (150 mm) around the pipe). See Table bedding material recommendations.

Backfill leaving 2' (600 mm) on each side of connections exposed for inspection during hydro test.

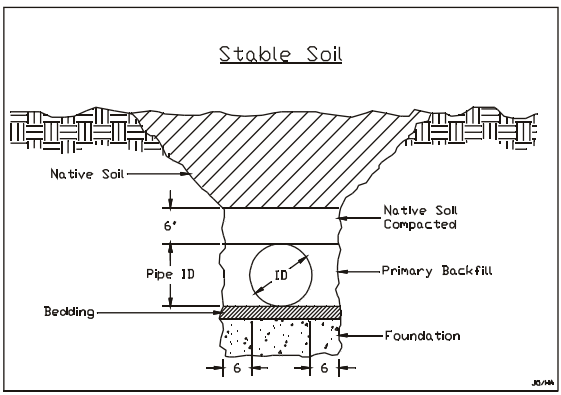


Fig. 1

Do not backfill over connections until hydro testing is complete.

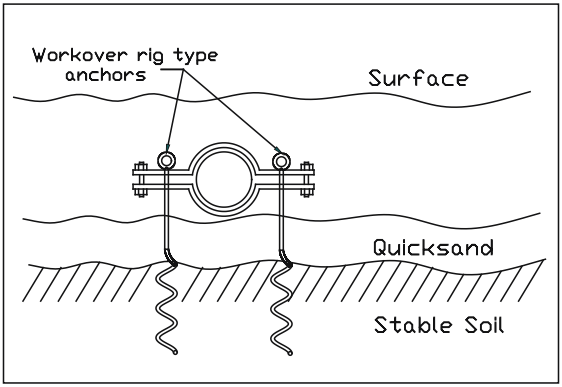


Fig. 2

Cold weather backfilling with frozen material in the pipe zone must be avoided since impact damage can occur.

Never compress the backfill on top of the pipe by driving heavy equipment on the ditch line as this can crack the pipe.

DO NOT backfill a ditch full of water. Pump the ditch out, check the layout of the pipe for voids beneath the pipe. Fill any voids that are found, then backfill with dry soil.

Swampy, unstable soil procedures:
First, attempt to excavate deep enough to find a stable layer of soil. If this is not possible, there are several options.

A. Saddle bag style weights can be used to prevent pipe from floating in unstable soil.

B. Special anchors can be designed to prevent pipe from floating or raising. These anchors are designed depending on the conditions. Many are 360° saddles around the pipe that are welded to work over rig type screw anchors (Figure 2). The spacing between anchors is the same as the support span for above ground supports. (Contact factory for spacing.)

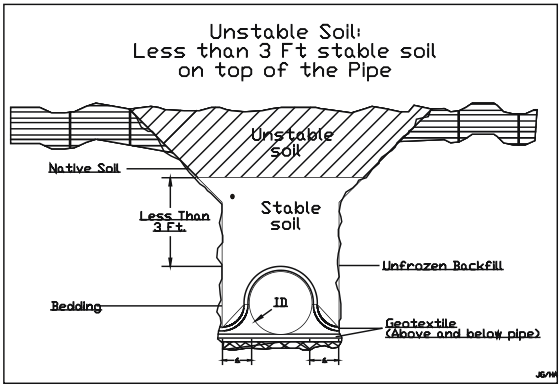


Fig. 3

C. **Stabilization of the soil** can be achieved with a filter cloth such as Geotex®. This material has proven useful to stabilize the ditch bottom in boggy, wet conditions. Geotextile can be placed below the pipe to reduce sinking and above the pipe to stabilize backfill (Fig. 3).

D. Steel casing with end seals may become necessary in the event that a stable bottom cannot be found or Geotextile will not work. Centralizers are required if steel casing is used.

Frozen Soil

Stabilization of the ditch in some regions, such as Canadian muskeg, may only be possible in the winter when the ground is frozen. The following are some techniques which have been used successfully:

A. Prior to installing the pipe gradual compaction of the ice can be achieved by driving over the pipe route with light vehicles over a period of time.

B. The ditch is prepared by first pushing away the snow and then excavating the surface ice. Lay the surface ice away from the installation area so it does not become mixed with the unfrozen material.

C. Excavate until you find a stable layer of soil. If this is not possible, use Geotextile and sand bags.

D. Steel casing with end seals may become necessary in the event that a stable bottom cannot be found or Geotextile will not work.

E. Since frozen backfill cannot be put in the pipe zone, it is recommended that the pipe is installed as the ditch is excavated.

F. Backfill which has been excavated and left overnight will freeze. This material cannot be used in the pipe zone. Never attempt to compact backfill by driving heavy vehicles on the ditch line.

BURIED INSTALLATION

Joining Connections Above Ground

- Do not exceed the minimum bending radius when the pipe is lowered into the ditch.
- Use only straps for handling pipe, never chains.

Joining Connections in the Ditch ("Including" Cross Lines or Repairs)

- The ditch width must accommodate full movement of the wrenches or it must be widened (bell holes) at the connections.

Road Crossings (Fig. 4)

- Road crossings require steel casing, centralizers and end seals.
- Protect the pipe at the entry and exit of casing against settling shear from sharp edges.
- Avoid over bending pipe to enter or exit road bore casings. Either prepare the ditch for a gradual elevation change, or use fittings.
- Stabilize soil beneath casing to minimize settling.
- Sand bags eliminate pipe movement due to pressure or temperature fluctuations.

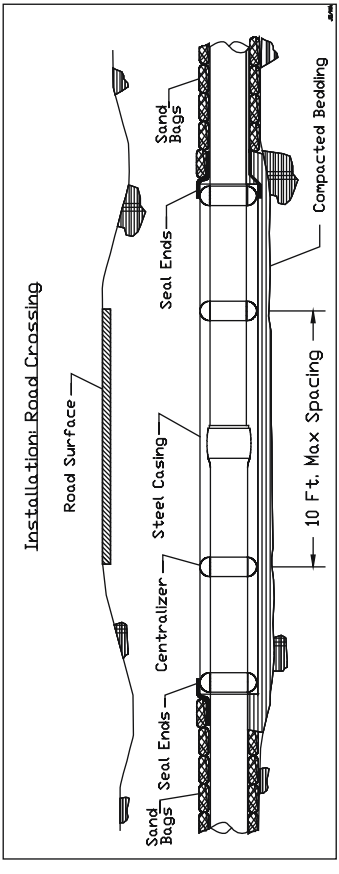


Fig. 4

Fittings Thrust Blocks (Fig. 5 & 6)

It is the responsibility of the engineer to evaluate the need and design for thrust blocks. A complete evaluation must consider the combined effects of temperature changes, internal pressure surges and pipeline geometry. Pipe, components and joints are intended to operate safely with maximum free end internal pressure thrust, axial loads in excess of those produced by operating at maximum internal pressure rating should be considered for external thrust restraint. Thrust blocks should be considered at directional changes where the pipeline may approach its axial stress limits. Higher pressure rated components cannot be used to compensate for additional loading.

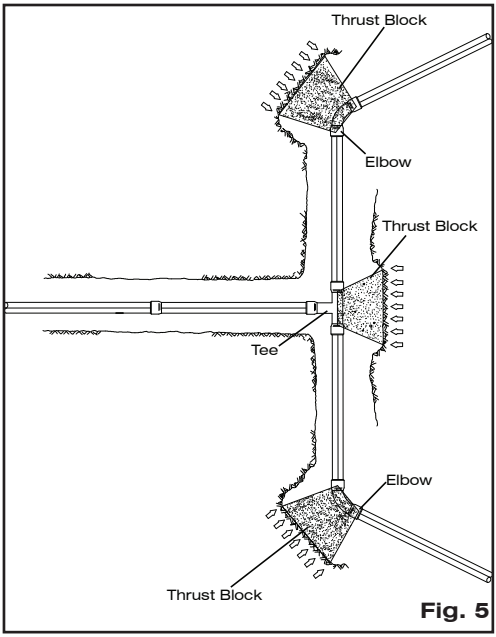

Thrust Block
Elbow
Thrust Block
Tee
Elbow
Thrust Block

Fig. 5

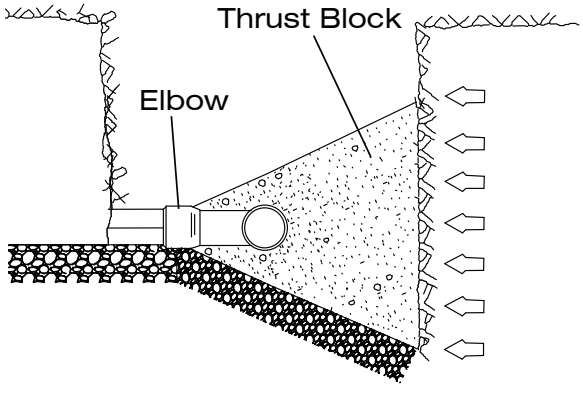

Thrust Block
Elbow

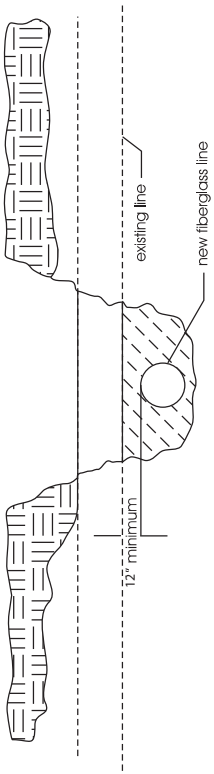
Fig. 6

Line Crossings

- **Line crossings** must be padded for abrasion.
- It is common practice to install the fiberglass under existing lines when possible.
- Good practice is to leave a minimum of 12" (300 mm) between lines.

Multiple lines laid in a single ditch require a minimum spacing of 6 inches (150 mm) clearance between connections. It is recommended that sufficient spacing is allowed for flange sets to be installed, see Typical Flange Dimensions table.

Avoid over bending pipe by avoiding sharp horizontal and vertical changes. Do not install pipe at less than the minimum bending radius or exceed the maximum deflection per joint, see Maximum Deflections Table.



Line Crossing Burial Depth

Fig. 7

Table 3 - Maximum Deflections (Per Joint)
Standard Design

Size in	Anhydride In/Jt	Anhydride (Cm/Jt)	Aliphatic Amine In/Jt	Aliphatic Amine (Cm/Jt)
Series 500				
3	-	-	34	(86,4)
4	26	(66,0)	26	(66,0)
5	21	(53,3)	21	(53,3)
6	17	(43,2)	17	(43,2)
8	13	(33,0)	13	(33,0)
8 SS	-	-	13	(33,0)
10 SS	-	-	10	(25,4)
12 SS	-	-	9	(22,9)
Series 800				
2	-	-	49	(124,5)
2½	-	-	41	(104,1)
3	33	(83,8)	33	(83,8)
4	25	(63,5)	26	(66,0)
5	21	(53,3)	21	(53,3)
6	17	(43,2)	18	(45,7)
6	-	-	17	(43,2)
8	13	(33,0)	13	(33.0)
8 SS	-	-	13	(33,0)
10 SS	-	-	10	(25,4)
12 SS	-	-	9	(20,3)

Size in	Anhydride In/Jt	(Cm/Jt)	Aliphatic Amine In/Jt	(Cm/Jt)
Series 1000				
2	-	-	49	(124,5)
2½	40	(101,6)	41	(104,1)
3	32	(81,3)	33	(83,8)
4	25	(63,5)	25	(63,5)
5	21	(53,3)	21	(53,3)
6	17	(43,2)	18	(45,7)
6	-	-	16	(40,6)
8	13	(33,0)	13	(33,0)
8 SS	-	-	13	(33,0)
10 SS	-	-	10	(25,4)
12 SS	-	-	8	(20,3)
Series 1250				
2	48	(121,9)	49	(124,5)
2½	39	(98,1)	40	(101,6)
3	32	(81,3)	32	(81,3)
4	24	(61,0)	25	(63,5)
5	20	(50,8)	20	(50,8)
6	16	(40,6)	17	(43,2)
6	-	-	16	(40,6)
8	13	(33,0)	12	(30,5)
8 SS	-	-	12	(30,5)
10 SS	-	-	10	(25,4)
12 SS	-	-	8	(20,3)

Size in	Anhydride In/Jt	(Cm/Jt)	Aliphatic Amine In/Jt	(Cm/Jt)
Series 1500				
1½	-	-	64	(162,6)
2	46	(116,8)	48	(121,9)
2½	38	(96,5)	40	(101,6)
3	31	(78,7)	32	(81,3)
4	24	(61,0)	24	(61,0)
5	20	(50,8)	20	(50,8)
6	16	(40,6)	17	(43,2)
6	-	-	16	(40,6)
8	13	(33,0)	13	(33,0)
8	-	-	12	(30,5)
Series 1750				
1	-	-	63	(160,0)
1½	61	(154,9)	-	-
2	46	(116,8)	47	(118,4)
2½	38	(96,5)	39	(99,1)
3	31	(78,7)	31	(78,7)
4	24	(61,0)	24	(61,0)
5	20	(50,8)	19	(48,3)
6	17	(43,2)	17	(43,2)
6	-	-	16	(40,6)
8	12	(30,5)	12	(30,5)
8	-	-	12	(30,5)

Size in	Anhydride In/Jt	(Cm/Jt)	Aliphatic Amine In/Jt	(Cm/Jt)
Series 2000				
1½	59	(149,9)	62	(157,5)
2	45	(114,3)	46	(116,8)
2½	37	(94,0)	38	(96,5)
3	30	(76,2)	31	(78,7)
4	23	(58,4)	24	(61,0)
5	19	(48,3)	19	(48,3)
6	17	(43,2)	16	(40,6)
6	-	-	15	(38,1)
8	-	-	12	(30,5)
8	-	-	12	(30,5)
Series 2500				
1½	57	(144,8)	60	(152,4)
2	44	(111,8)	45	(114,3)
2½	36	(91,4)	37	(94,0)
3	29	(73,7)	30	(76,2)
4	23	(58,4)	23	(58,4)
6	-	-	16	(40,6)
Series 3000				
1½	56	(142,2)	58	(147,3)
2	43	(109,2)	43	(109,2)
2½	35	(88,9)	36	(91,4)
3	28	(71,1)	29	(73,7)
3½	-	-	25	(63,5)
4	23	(58,4)	22	(55,9)
Series 3500				
1½	-	-	56	(142,2)
2	-	-	42	(106,7)
2½	-	-	34	(86,4)
3	-	-	28	(71,1)
3½	-	-	24	(61,0)
4	-	-	21	(53,3)

Table 3, Continued - Maximum Deflections (Per Joint) - API Design

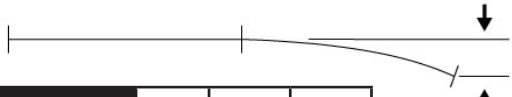
Size in	Anhydride In/Jt	Anhydride (Cm/Jt)	Aliphatic Amine In/Jt	Aliphatic Amine (Cm/Jt)	Aromatic Amine In/Jt	Aromatic Amine (Cm/Jt)
Series 500						
3	41	104,1)	34	(86,4)	40	(101,6)
4	32	(81,3)	26	(66,0)	30	(76,2)
5	25	(63,5)	-	-	-	-
6	20	(50,8)	17	(43,2)	21	(53,3)
8	16	(40,6)	16	(40,6)	16	(40,6)
Series 750						
2	-	-	50	(127,0)	-	-
2½	50	(127,0)	41	104,1)	46	(116,8)
3	40	(101,6)	33	(83,8)	38	(96,5)
4	31	(78,7)	25	(63,5)	30	(76,2)
5	24	(61,0)	21	(53,3)	24	(61,0)
6	20	(50,8)	18	(45,7)	20	(50,8)
8	15	(38,1)	13	(33.0)	16	(40,6)
Series 1000						
2	60	(152,4)	49	124,5)	55	(139,7)
2½	49	(124,5)	40	101,6)	45	(114,3)
3	39	(99,1)	33	(83,8)	38	(96,5)
4	30	(76,2)	25	(63,5)	29	(73,7)
5	24	(61,0)	20	(50,8)	23	(58,4)
6	19	(48,3)	17	(43,2)	20	(50,8)
6	-	-	16	(40,6)	-	-
8	15	(38,1)	12	(30,5)	16	(40,6)

Size in	Anhydride In/Jt	(Cm/Jt)	Aliphatic Amine In/Jt	(Cm/Jt)	Aromatic Amine In/Jt	(Cm/Jt)
Series 1250						
1½	64	(162,6)	-	-	-	-
2	58	(147,3)	48	121,9)	53	(134,6)
2½	48	(121,9)	39	99,1)	44	(111,8)
3	39	(99,1)	32	(81,3)	37	(94,0)
4	30	(76,2)	24	(61,0)	28	(71,1)
5	23	(58,4)	-	-	23	(58,4)
6	19	(48,3)	17	(43,2)	21	(53,3)
6	-	-	16	(40,6	-	-
8	15	(38,1)	12	(30,5)	15	(38,1)
Series 1500						
1½	62	(157,5)	62	(157,5)	69	(175,3)
2	58	(147,3)	46	116,8)	52	(132,1)
2½	47	119,4)	38	(96,5)	43	(109,2)
3	38	(96,5)	31	(78,7)	36	(91,4)
4	29	(73,7)	24	(61,0)	27	(68,6)
5	23	(58,4)	-	-	22	(55,9)
6	19	(48,3)	15	(40,6)	20	(50,8)
6	-	-	15	(38,1)	-	-
8	14	(35,6)	12	(30,5)	14	35,6)

Size in	Anhydride In/Jt	(Cm/Jt)	Aliphatic Amine In/Jt	(Cm/Jt)	Aromatic Amine In/Jt	(Cm/Jt)
Series 1750						
1½	-	-	61	154,9)	67	(170,2)
2	56	(142,2)	45	(114,3)	51	(129,5)
2½	46	(116,8)	37	(94,0)	42	(106,7)
3	37	(94,0)	30	(76,2)	35	(88,9)
4	29	(73,7)	23	(58,4)	27	(68,6)
5	22	(55,9)	16	(40,6)	-	-
6	19	(48,3)	15	(38,1)	19	(48,3)
6	-	-	12	(30,5)	-	-
Series 2000						
1½	60	(152,4)	60	152,4)	66	(167,6)
2	55	(139,7)	44	111,8)	50	(127.0)
2½	45	(114,3)	36	(91,4)	41	(104,1)
3	37	(94,0)	29	(73,7)	34	(86,4)
4	28	(71,1)	22	(55,9)	27	(68,6)
5	19	(48,3)	16	(40,6)	-	-
Series 2500						
1½	58	(147,3)	56	142,2)	63	(160,0)
2	54	(137,2)	42	106,7)	51	(129,5)
2½	44	(111,8)	36	(91,4)	42	(106,7)
3	35	(88,9)	29	(73,7)	36	(91,4)
3½	-	-	25	(63,5)	-	-
4	23	(58,4)	22	(55,9)	29	(73,7)
Series 3000						
1½	-	-	54	137,2)	-	-
2	-	-	42	106,7)	-	-
2½	-	-	34	(86,4)	-	-
3	-	-	28	(71,1)	-	-
3½	-	-	24	(61,0)	-	-
4	-	-	21	(53,3)	-	-

Maximum Deflection Layout

Note: Below 32°F (0°C) reduce allowable maximum deflection



Temperature °C	0	-20	-40
Multiplier	0.9	0.8	0.7

Example: 2" API Series 1750 Anhydride with a temperature of 0°C = 56" x 0.9 = 50.4 in/jt

Transition From Buried To Above Ground

Transition to above-ground piping can be accomplished in several manners. Proper restraint of buried risers should be analyzed by the engineer or installer. (See Thrust Blocks)

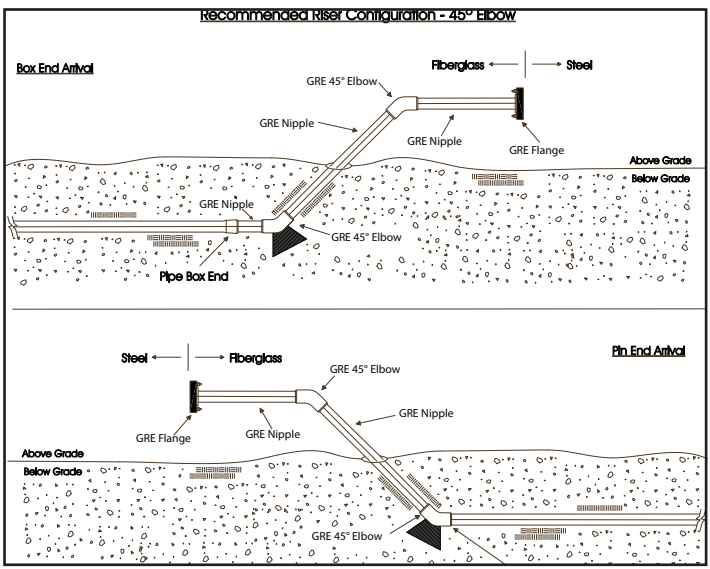


Figure 8

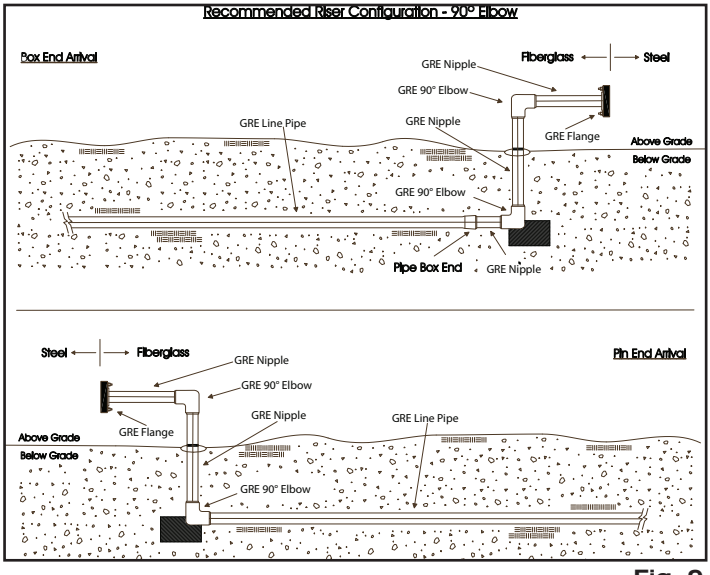

Recommended Riser Configuration - 90° Elbow
Box End Arrival
Fiberglass
Steel
GRE Nipple
GRE 90° Elbow
GRE Line Pipe
GRE Nipple
GRE Flange
Above Grade
Below Grade
GRE 90° Elbow
Pipe Box End
GRE Nipple
Steel
Fiberglass
Pin End Arrival
GRE Nipple
GRE 90° Elbow
GRE Flange
GRE Nipple
GRE Line Pipe
Above Grade
Below Grade
GRE 90° Elbow

Fig. 9

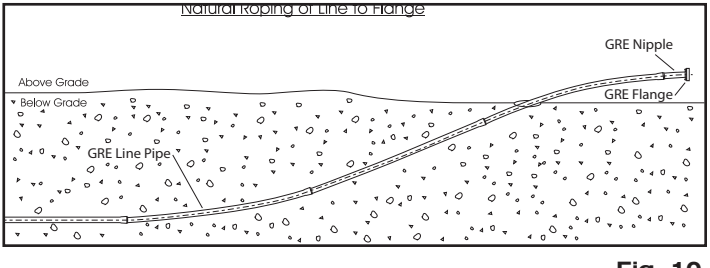

Natural Roping of Line to Flange
GRE Nipple
Above Grade
Below Grade
GRE Flange
GRE Line Pipe

Fig. 10

ABOVE GROUND INSTALLATION

Support and Guide Spacing

- Contact factory for support and guide spacing.

Wear Saddles

- Wear saddles 360° around the pipe must be used to protect the pipe against pulsation abrasion or pipe movement due to temperature fluctuation.

Thrust Blocks

- Thrust blocks for above ground installation must be constructed to support fittings listed in Figures 11 & 12. The design must simulate the same support as buried concrete thrust blocks; abrasion padding is recommended.

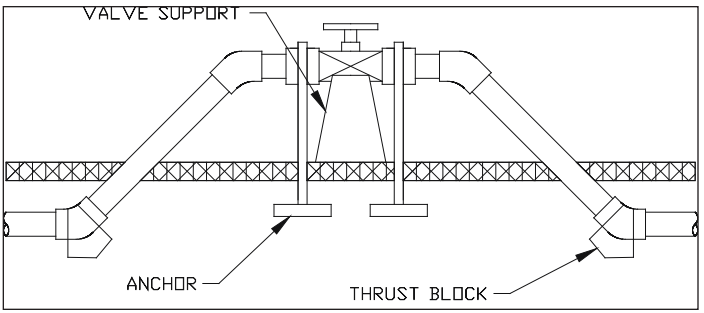


Fig 11

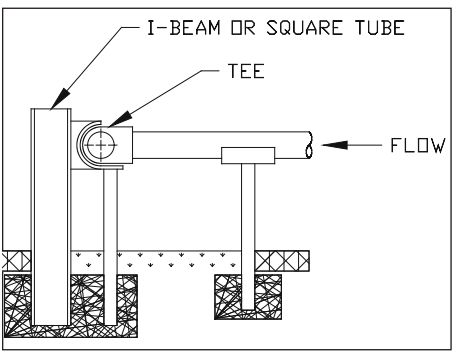


Fig 12

API Threaded Connections

Threaded connections manufactured to API 5B long-form specifications are provided as patented Advanced Composite Thread (ACT) or precision ground (PGT) thread. API thread for lower pressure line pipe. Depending on the size and pressure rating, the connection utilizes either a Teflon®-based lubricant (STARtec) or a proprietary sealant Hi Pro Plus to achieve the seal. All API threaded products can be installed using Hi Pro Plus. Table 4 lists by size and pressure the recommended lubricants and the estimated number of connections, which can be made up per container with daily installation rates.

Make-Up Tools

Make-up tools are designed to provide uniform 360° compression on the pipe while applying the required make-up torque. The STAR friction wrench, along with one of three different strap wrenches, are required for proper make-up. Friction wrenches are designed to fit the cylindrical male end upset diameters. Use on conical shaped integral joint upset ends can cause point loading and damage to the pipe wall. The Table 4 shows the combinations of recommended wrenches for each size pipe.

Precautions

- **Never use typical oil field pipe wrenches on fiberglass pipe**. Chain tongs may be used on high pressure GRE fittings only.
- The strap wrench may be used both male upsets and conical shaped integral female joint ends.
- Metal Friction Wrench (MFW) may only be used on the **cylindrical male end** upset diameters.

Table 4 Recommended Tools, Lubricant, Crew Size and Installation Rate

Thread Size in	1.90	2 3/8	2 7/8	3½	4	4½	5½	6 5/8	7	8 5/8	9 5/8
Make-Up Length Loss	2.06	2.56	2.86	3.13	3.88	3.50	4.38	3.88	4.50	4.50	4.75
Male Upset	Metal Friction Wrench										
Strap Wrench Size	No. 5			No. 11			MFW or No. 20	No. 20		No. 30	
STARtec - Jts./Gal.	100	100	100	68	50	50	34	34	34	26	26
Hi Pro Plus - Jts./Kit	33	25	20	16	12	12	10	8	8	4	3
Installation Feet/Day	5000 to 7000 ft.	5000 to 7000 ft.	5000 to 6000 ft.	3000 to 4000 ft.	3000 to 4000 ft.	2000 to 3000 ft.	2000 to 3000 ft.	1000 to 2000 ft.	1000 to 2000 ft.	1000 to 2000 ft.	1000 to 2000 ft.
Crew Size(1)	4 to 5	4 to 5	4 to 5	5 to 6	5 to 6	5 to 6	6	6	6	6	6
Thread Standoff	STAR industry standard API EUE 10rd, 8rd and OD 8rd threads are designed to advance to the “power tight” position with 2 thread standoff; 1 to 3 thread standoff,are typical due to manufacturing tolerances.										

(1) - Includes contractor supervisor.

Cleaning and Inspection

- Thread protectors must be left in place until just before joining pipe.
- Ice will make thread protectors impossible to remove; heat the ends of the pipe with a propane torch to melt the ice.
- If an open flame is not permitted, methyl alcohol can be used to melt the ice or a heat blanket (electric or chemical) may be used.
- Clean threads with a soft bristle brush (solvents can be used, but the threads must be dried thoroughly).
- Sand, dirt, ice or other debris must be removed from the threads prior to joining.

Lubricant

- Two different lubricants are available for use with API threaded connections. The standard lubricant is a Teflon-based lubricant, STARtec, which offers excellent lubrication for ease of make up along with optimum sealing characteristics.

  A specialty two-part thread sealant, Hi Pro Plus, can be used on all API threaded connections. When cured, Hi Pro Plus becomes a solid thread seal. The primary usage of Hi Pro Plus is for high pressure applications or when field installation expertise is limited. Installations where Hi Pro Plus should be considered are on all 3000 psi, 4" 2500 psi, 6" 1500-2000 psi and 8" 1000-2000 psi products. Hi Pro Plus works best on installations above 50°F (10°C). When ordering Hi Pro Plus, specification of job site temperature is required. Curing of Hi Pro Plus at low temperatures can be accelerated by the use of electric heat blankets.
- ***STA*Rtec lubricant or Hi Pro Plus thread sealant must be used to maintain the warranty of NOV Fiber Glass Systems products.**

***STA*Rtec Lubricant**

- Apply lubricant evenly with a typical lube brush to **both the male and female** threads (the entire base of the thread must be coated).
- The lubricant must be kept warm 65°F (18.3°C) in order to apply it evenly.

- **Never use solvent to thin the lubricant, even in cold weather.**
- Agitate or stir the lubricant frequently to keep it from balling.

Hi-Pro Plus Thread Sealant

- **Hi-Pro Plus requires mixing of ingredients prior to using.**
- Using the wooden stir stick, scoop out **all** of the contents of hardener Component B into jar of base Component A. **Do not split the kit.** The base is a light-colored paste; the hardener is a dark paste.
- Thoroughly mix the two components together until a uniform color is achieved and the particles in the bottom of the container are evenly dispersed.
- Use the brush provided to spread a thin, even coat of sealant on all exposed pin and box threads, removing any excess.
- If the sealant is difficult to spread, warm the joint enough for the sealant to spread easily. Do not overheat.
- **The cure of Hi Pro Plus below temperatures of 50°F (10°C) requires the use of electric heat blankets.**
- **Hi Pro Plus must be fully cured prior to hydro testing.**

Joining Procedure

- Support pipe behind the female end to allow tool movement and leveling.
- Alignment is very important for full thread engagement (particularly on large diameter pipe).
- Weather near or below freezing requires heating of the male and female ends with a propane torch or electric heating collar. The ends shall feel warm by touch to the back of your hand.
- Apply lubricant

- Stab the joint **gently** until full engagement is felt.
- **Avoid cross threading** by careful alignment.
- Rotate the pipe by hand.
- Rotation of the pipe can be assisted by using a strap wrench or a spinning tong. (See Fig. 13)
- **Cross-threaded connections** must be backed out, cleaned and inspected for damage, then restart the procedure.
- **Final torque** is applied using a friction wrench on the male upset only and a strap wrench on the female connection with wrenches close to connection. A strap wrench maybe used on the male end also.
- STAR API threaded connection are designed to allow torque control monitoring the joint make-up position. (Refer to Table 4 for thread standoff)
- Some instances may require a handle extension on the wrench which will reduce the required force to reach full makeup.
- The use of an abrasive powder may be needed to prevent slippage of strap wrench on final torque.
- Power tongs can be effectively used on sizes 4" (2500-3500 psi), 6" (1500-2500 psi), and 8" (1000-2000 psi).

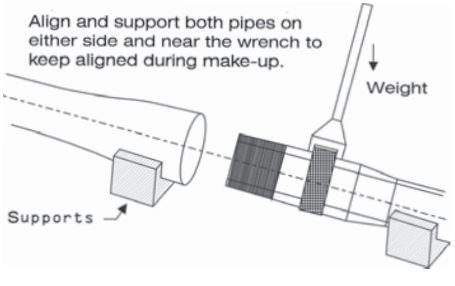


Fig. 13

Lowering pipe in trench (Roping)

- Exercise caution not to over bend the pipe during the process of lowering it into the ditch. (See Table 3, for Maximum Deflection).
- Never allow the pipe to whip into the ditch on its own weight.
- Always use straps on the pipe, Never use chains for lifting.
- Construction of a side boom support cradle has proven successful for heavy pipe support and leveling.

STAR SUPER SEAL CONNECTION

Star Super Seal connections are a proprietary self restrained mechanical O-ring seal.

SSS Low Pressure		SSS High Pressure	
Pipe Size in	Threads	Pipe Size in	Threads
2 - 6	4 threads/inch	2 - 6	3 threads/inch
8	2 threads/inch	8 - 12	2 threads/inch

The connection provides fast, reliable installation, even in very severe weather conditions. The seal is achieved by compressing an O-ring between two parallel mating surfaces without the use of a taper. Several types of O-rings are available for various applications.

Standard O-ring Sizes And Types

- It is recommended that extra O-rings are ordered and kept on the installation site for replacement of any that are found damaged or missing.
- O-rings are shipped separate from the pipe.

Make-Up Tools

Two strap wrenches are the required make-up tools. Strap wrenches allow the installer to “feel” the O-ring seal engagement. Power tool make-up provides no “feel” or feedback to operator and are not recommended. The make-up torque for Super Seal is minimal; therefore, friction wrenches are not recommended.

Table 5

Star Super Seal - Low Pressure Amine

Size in	Pipe I.D.	Pressure Rating	O-Ring Durometer	O-Ring Compound	O-Ring Size
2	2.22	500	70	Nitrile	2-228
3	3.33	500	70	Nitrile	2-237
4	4.33	375	70	Nitrile	2-245
6	6.39	300	70	Nitrile	2-260
6	6.39	450	70	Nitrile	2-260
8	7.74	300	70	Nitrile	2-369
8	7.74	1250*	70	Nitrile	2-369
10	9.84	1250*	70	Nitrile	2-449
12	11.81	1250*	70	Nitrile	2-453

Star Super Seal - High Pressure Anhydride

Size in	Pipe I.D.	Pressure Rating	O-Ring Durometer	O-Ring Compound	O-Ring Size
2	2.00	2500	70	Nitrile	2-227
3	3.00	2500	70	Nitrile	2-338
4	3.91	2000	70	Nitrile	2-346
6	5.85	1500	70	Nitrile	2-361

* For CO_2 contact FGS

Caution: Never use typical oil field pipe wrenches on fiberglass pipe. Installation rates are based on warm climate. conditions. Additional time will be required in freezing weather.

Cleaning and Inspection

- **Ice** will make thread protectors impossible to remove, heat the ends of the pipe with a propane torch until they release.
- If an open flame is not permitted, methyl alcohol can be used to melt the ice out of the connections or a heat blanket (electric or chemical) may be used.
- Thread protectors must be left in place until just before joining pipe.

Table 6 Make-Up Tool Recommendations

Pipe Size		2”	3”	4”	6”	8”	10”	12”
Make Up Length Loss (SSS LP)		2.63	2.63	2.88	3.13	4.75	5.125	6.11
Make Up Length Loss (SSS HP)		3.75	4.35	4.35	4.85	---	---	---
Lubrication	Joints/Gallon	120	100	80	50	40	35	30
	Joints/Liter	31	26	31	13	10	9	8
Pipe Male Upset (Strap Wrench)		No. 5			No. 11			
Pipe IJ Female (Strap Wrench)		No. 5		No. 11				
Installation (Feet/Day) SSS LP		6500 to 9100 ft.	3900 to 5200 ft.	2600 to 3900 ft.	2000 to 3000 ft.	1800 to 2800 ft.	1500 to 2500 ft.	1500 to 2000 ft.
Installation (Feet/Day) SSS HP		9100 ft.	5200 ft.	3900 ft.	3000 ft.	---	---	---
Crew Size (1)		3 to 4	4 to 5	4 to 5	5 to 6	5 to 6	5 to 6	5 to 6

(1) Includes contractor supervisor - Note: A friction wrench may be required for fittings alignment.

- Once the protectors are removed, inspect the male and female connection for debris and damage to sealing surfaces.
- Inspect O-ring making sure it is clean with no nicks, cuts or gouges.
- Do not use metal brushes or compounds containing solvents for cleaning.
- If the surfaces are contaminated clean with the use of a soft bristle brush and water (dry before proceeding).
- Keep connections clean and off the ground.

Lubrication

- Do not use thread compounds of any kind.
- Lubricants must be protected from contamination by dirt, sand, and debris.
- Clean, hydraulic fluid, light-weight motor oil or silicone-based lubes are recommended for make-up.
- Lightly lubricate the female threads, the male threads, the O-ring and O-ring seating area.

Joining Procedure

Caution - Do not over-tighten the connection; the O-ring will make the seal.

- Sub-freezing temperature requires the warming of the male and female end of the pipe.
- Check alignment to prevent connection damage.
- The 8", 10", and 12" Super Seal connections are match marked for thread engagement. Align the starter thread marks on the male and female prior to engagement.
- Turn the connection slowly to the right by hand until the threads engage.
- The make-up will gently slow as the O-ring compresses.
- Use of the strap wrenches will become necessary as rotation becomes more difficult.
- The make-up will completely stop all at once.
- Super Seal pipe can be backed up one-half rotation for fitting alignment once full engagement is felt. If more than one-half rotation is required, revert to next nearest joint.
- Installation rates and crew sizes are listed in Table 6 (improved rates can be achieved depending on crew and conditions).

LINE PROOF TESTING

Frequency

- **Pressure testing** is recommended on all lines to ensure line integrity. The first test must occur before 5,000 feet of pipe is installed. Thereafter, test in segments which are as small as practical.

Preparation

- Backfill must be sufficient to minimize pipe movement with 2 feet on either side of the connection left exposed for joint inspection.
- Soft pigs must be provided to fit the inside diameter of the pipe. Pigs are used to displace the air when filling the pipe with water.
- Test equipment should be capable of monitoring pressure and temperature as a function of time.

Caution: Test with fresh water. Gas and air are not recommended for proof testing. Produced water is not reliable as it is often contaminated and foamy.

- **Testing at freezing or sub-freezing temperatures** may require the mixing of up to 50% methyl alcohol with the fresh water used for hydro testing. Other additives must be approved by NOV Fiber Glass Systems. Test equipment lines must also be filled with 50% methyl alcohol to prevent freezing.

Testing

- Place two soft pigs in the line at the lower end of the line one behind the other Pump the pig through the line by pushing it with fresh water.
- A 50% methyl alcohol may be mixed with water for sub-freezing temperatures.
- Bleed the air at the highest elevation of the line since trapped air will become compressed during testing and will give erroneous results
- If water appears before the pig, air may be trapped in the line.
- Beware of water temperature versus the line temperature. Always let the line temperature stabilize before testing.
- Once the air is removed, begin slowly elevating the pressure in increments up to 500 psi.

- Stop and hold the pressure at each increment for 5 minutes.
- Maximum test pressure is equal to pipe rating.

Caution: Do not exceed the maximum rated pressure of the lowest rated component of the system**.**

- **Do not test at higher than rated pressure without written permission from a NOV Fiber Glass Systems' Representative.**
- Test durations of 2 to 4 hours are typical.
- Inspect the line during the test by walking the line and visually inspecting for leakage, over bending,or evidence of damage.
- Variations in ambient temperatures will cause fluctuations in pressure over an extended test.
- **Contact NOV Fiber Glass Systems prior to any pneumatic testing.**

Caution: Do not allow uncovered or uninsulated test lines filled with water to freeze since the expansion of the ice in the lines can damage the pipe.

Locating a Leak
Locating a leak in a line may become difficult. Techniques that can be used to find leaks include:

- Walking the line and visually inspecting for leakage.
- Adding dye or odorant to the water.
- Add geophones, dye or ordor agents (use as mercaptan) to the water.

Fiberglass-To-Steel Connections
- Changing over to steel pipe from threaded connections can be accomplished in a variety of ways. Each changeover method has distinct advantages depending on the pressure requirement.

Options:
- Fiberglass flat faced female threaded flanges are recommended.
- Fiberglass API 8rd change-over nipples or couplings.*****
- Steel API 8rd change-over nipples or couplings are available from various supply stores.*****
- Super Seal x Male NPT crossovers. (<500 PSI)
- Super Seal x API 8rd Male. (<500 PSI)
- Super Seal x Groove. (<500 PSI)

***Threaded API 8rd Change-Overs**

- **Expansion** - Due to the higher expansion rate of fiberglass versus steel, the preferred threaded change-over is a fiberglass male to steel coupling.
- **Thread Compatibility** - Fiberglass API 8rd threads are long-form type and vary with typical steel short form 8rd threads per Table 7:

API 8rd Thread Removal

Some fiberglass 8rd (long form) threads may require removal (using hacksaw) for proper sealing with steel 8rd (short form) connections. Most steel equipment and steel changeovers are prepared with short form 8rd threads. The steps prior to thread removal are as follows:

1. Chase the steel connection with a steel nipple.
2. Dry fit the fiberglass to steel connection.
3. If the connection seizes up premature to full engagement, then the steel is probably short form. Use Table 8 for thread removal from front of the fiberglass male.

Table 7

Thread Size in	API Thread Specification	Thread Length	Make-Up Loss	Thread Length Diff.***
1.90	EUE 10rd API 5B*	2.36	2.06	.500
2 3/8	EUE 8rd API 5B*	2.94	2.56	.625
2 7/8		3.25	2.88	.625
3 1/2		3.50	3.13	.750
4 1/2		3.88	3.50	.875
5 1/2		4.75	4.38	.625
6 5/8		4.25	3.88	.750
7	OD 8rd API 5B*	4.88	4.50	.875
8 5/8		4.88	4.50	1.125
9 5/8		5.13	4.75	1.375

* API Specification Standard 5B, Fourteenth Ed. August 1996, Table 2.5a (L4 min)
** API Specification Standard 5B, Fourteenth Ed., August 1996, Table 2.3 (L4 min)
*** Fiberglass threads are longer by this length

Fiberglass Flat-Faced Flanges

- API 8rd threaded flanges are available in a variety of pressure ranges. Proper gaskets, spacer rings, backing plates, and length bolts must be addressed for installation.
- Fiberglass flanges are thicker than steel flanges and therefore the required bolt length is longer. (See Table 9)

Washers

- All fiberglass flanges require washers, unless a steel backing plate is used.

Flange Gaskets

- Spiral wound type are recommended.
- Gaskets are purchased separately from flanges.

TABLE 8 Thread Removal

API EUE in	1.90	2 3/8	2 7/8	3 1/2	4	4 1/2	5 1/2	6 5/8	7	8 5/8	9 5/8
No. of Threads to Cut Off	6	5	6	6	7	7	5	6	7	9	11

Note: Dry fit prior to cutting off threads.

To take full advantage of the performance of the fiberglass thread, it is good practice to have the steel threaded connection order to match the fiberglass long form thread.

Steel Backing Plates

- Required for higher pressure flanges. (See Table 9)
- Failure to use specified backing plates will void product warranty.
- Requires longer bolts to accommodate extra thickness, add ½" per steel backing plate to bolt length.

Connecting to Raised Faced Steel

- Requires a **special spacer ring** or machining off raised face to avoid shearing or cracking the flange when bolts are tightened.
- Specify thickness of flange raise when ordering.
- Raised face spacers rings are required for make-up of flanges ANSI 600 and higher to steel raised face flanges.

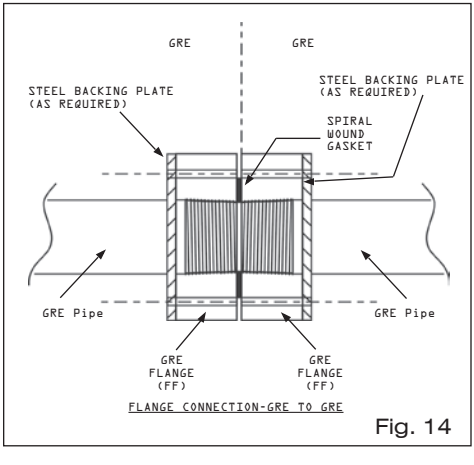
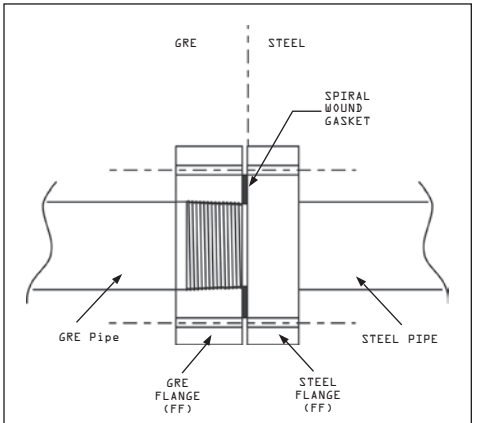
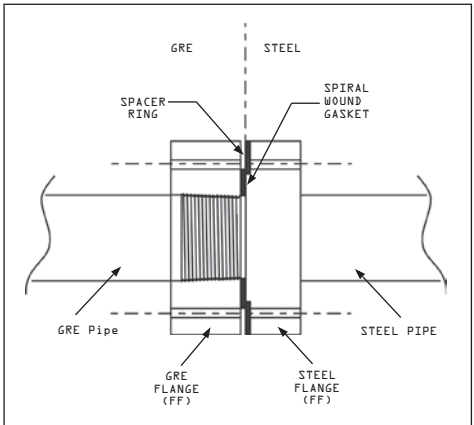


Fig. 14



FLANGE CONNECTION-FLAT FACE TO FLAT FACE

Fig. 15



FLANGE CONNECTION-FLAT FACE TO RAISED FACE

Fig. 16

Table 9 TYPICAL FLANGE DIMENSIONS in

Thread Size in	Flange O.D.	Flange Width	Bolt Circle	No. of Bolts	Bolt Size	Bolt Lg. FG to FG	Bolt Lg. FG to Steel	Bolt Hole	Wt. Lb/ Face
ANSI 150 - Bolt Pattern									
2 3/8	6.0	3.06	4.75	4	.63	10.0	5.63	.750	4.6
2 7/8	7.0	3.38	5.50	4	.63	12.0	6.06	.750	7.0
3 1/2	7.5	3.63	6.00	4	.63	10.0	6.38	.750	8.1
4 1/2	9.0	4.00	7.50	8	.63	14.0	7.25	.750	12.0
6 5/8	11.0	4.38	9.50	8	.75	14.0	7.44	.875	17.5
7	11.0	5.00	9.50	8	.75	14.0	8.06	.875	18.4
8 5/8	13.5	5.00	11.75	8	.75	14.0	8.44	.875	28.5
9 5/8	13.5	5.25	11.75	8	.75	14.0	8.44	.875	24.8
8SS	13.5	5.00	11.75	8	.75	14.0	8.44	.875	28.2
10SS	16.0	5.75	14.25	12	.875	15.0	10.0	1.00	37.2
12SS	19.0	6.43	17.00	12	.875	16.0	10.6	1.00	61.1
ANSI 300 - Bolt Pattern									
4 1/2	10.0	4.00	7.875	8	.75	14.0	7.81	.875	15.8
5 1/2	11.0	4.88	9.25	8	.75	14.0	8.00	.875	22.6
6 5/8	12.5	4.38	10.63	12	.75	14.0	8.13	.875	25.2
7	12.5	5.00	10.63	12	.75	14.0	9.19	.875	27.2
8 5/8	15.0	5.00	13.00	12	.875	14.0	9.19	1.00	38.7
9 5/8	15.0	5.25	13.00	12	.875	14.0	9.19	1.00	35.4
8SS	15.0	5.00	13.00	12	.875	14.0	9.19	1.00	38.3
10SS	17.5	5.75	15.25	16	1.00	15.0	10.9	1.13	50.4
12SS	20.5	6.43	17.75	16	1.13	16.0	11.6	1.25	77.4

Note: When ordering valves, check the ANSI bolt pattern versus the thread size ANSI Rating. Some high pressure line pipe sizes require jump threads.

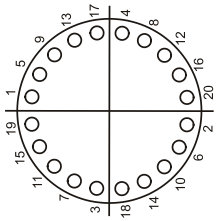
Thread Size in	Rated Pressure PSI	Flange Width	Bolt Circle	No. of Bolts	Bolt Size	Bolt Lg. FG to FG	Bolt Lg. FG to Steel	Bolt Hole	Wt. Lb/ Face
ANSI 300/600 - Bolt Pattern									
1.90	1400	2.56	4.50	4	.75	10.0	5.69	.875	4.3
2 3/8	1400	3.06	5.00	8	.63	10.0	6.06	.750	5.3
2 7/8	1400	3.38	5.88	8	.75	12.0	6.75	.875	7.6
3 1/2	1400	3.63	6.63	8	.75	10.0	7.13	.875	9.7
ANSI 600 - Bolt Pattern									
4 1/2	1480	4.00	8.50	8	.875	14.0	8.50	1.00	18.8
5 1/2	1480	4.88	10.50	8	1.00	14.0	9.00	1.13	34.9
6 5/8	1480	4.38	11.50	12	1.00	14.0	9.00	1.13	33.3
7	1480	5.00	11.50	12	1.00	14.0	9.63	1.13	36.5
8 5/8	1480	5.00	13.75	12	1.13	14.0	10.69	1.25	49.8
9 5/8	1480	5.25	13.75	12	1.13	14.0	10.87	1.25	47.1
8SS	1480	5.00	13.75	12	1.13	14.0	10.87	1.25	49.4
10SS	1480	5.75	17.00	16	1.25	15.0	11.75	1.38	76.9
12SS	1480	6.43	19.25	20	1.25	16.0	12.37	1.38	95.4
ANSI 900/1500 - Bolt Pattern									
1.90	3705	2.56	4.88	4	1.00	10.0	6.56	1.13	5.6
2 3/8	3705	3.06	6.50	8	.875	10.0	7.06	1.00	9.7
2 7/8	3705	3.38	7.50	8	1.00	12.0	7.75	1.13	13.6

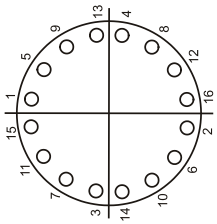
Note: When ordering valves, check the ANSI bolt pattern versus the thread size ANSI Rating. Some high pressure line pipe sizes require jump threads.

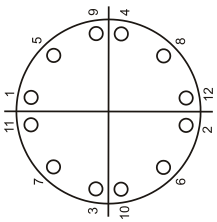
Thread Size in	Flange O.D.	Flange Width	Bolt Circle	No. of Bolts	Bolt Size	Bolt Lg. FG to FG	Bolt Lg. FG to Steel	Bolt Hole	Wt. Lb/ Face
ANSI 900 Bolt Pattern									
3 ½	9.50	3.63	7.50	8	.875	10.0	7.63	1.00	13.7
4 ½	11.50	4.00	9.25	8	1.13	14.0	9.25	1.25	21.5
5 ½ (1)	13.75	4.88	11.00	8	1.13	14.0	9.88	1.38	38.9
6 5/8 (1)	15.00	4.38	12.50	12	1.13	14.0	10.87	1.25	39.4
7 (1)	15.00	5.00	12.50	12	1.13	14.0	10.87	1.25	43.5
9 5/8 (1)	18.50	5.25	15.50	12	1.38	14.0	11.75	1.50	64.9
ANSI 1500 - Bolt Pattern									
3 ½	10.50	3.63	8.00	8	1.13	12.0	8.75	1.25	16.8
4 ½	12.25	4.50	9.50	8	1.25	12.0	10.38	1.38	28.0
4 ½ (1)	12.25	4.00	9.50	8	1.25	14.0		1.38	24.9
5 ½ (1)	12.25	4.88	9.50	8	1.25	14.0		1.38	28.5
5 ½ (1)	14.75	4.88	11.50	8	1.50	14.0	11.75	1.63	44.9
6 5/8 (1)	15.50	4.38	12.50	12	1.38	14.0	12.25	1.50	41.1
7 (1)	15.50	5.00	12.50	12	1.38	14.0		1.50	45.4
9 5/8 (1)	19.00	5.25	15.50	12	1.63	14.0		1.75	72.0
(1) - Steel backing plate required									

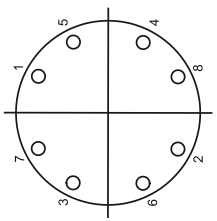
Note: When ordering valves, check the ANSI bolt pattern versus the thread size ANSI Rating. Some high pressure line pipe sizes require jump threads.

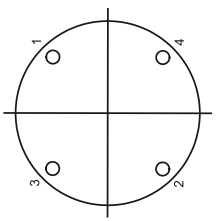
Bolt Torque Sequence











Torque Requirements

Bolt Torque vs. Bolt Length

Bolt Size in	Torque			
	Grade 2		Grade 5	
	ft/lb	N/m	ft/lb	N/m
5/8	54	73	89	120
3/4	96	130	160	216
7/8	155	210	258	349
1	230	311	386	523
1 1/8	324	439	544	737
1 1/4	460	623	776	1052
1 3/8	595	806	1006	1363
1 1/2	795	1077	1347	1826
Multiply by 0.9 for plating				

Note: Regardless of bolting material, do not exceed Grade 5 torque.

SECTION 5 - Field Fabrication

FIELD FABRICATION OF NIPPLES

High Pressure vs. Low Pressure

Special length nipples are often required to locate a fitting in a certain location or to make a repair. The methods for fabricating a special length nipple differ depending on whether the product is high pressure (≥ 500 psi) or low pressure (≤500 psi). These two product ranges have different inside diameters and joining systems. However, many of the same tools and required accessories are the same.

High Pressure API 8rd Thread Nipples ≥ 500 psi

There are six methods for fabricating a nipple or spacing out of a fitting for an API 8rd thread product. Methods #1 and #2 go on the body of the pipe, not requiring upset. Methods #3- #6 take into consideration the fact that the API 8rd thread requires an upset on the pipe body or factory nipple stock.

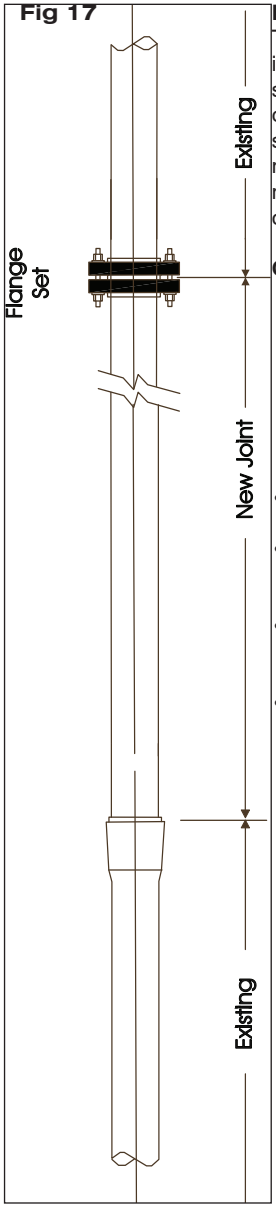
1. Bell x male 8rd thread adapters applied on the pipe body.
2. Field molded threads with a hand build-up on the body of the pipe.
3. Field molded threads on nipple stock (full pressure rating of the nipple stock).
4. Pre-fabricated factory nipples with molded threads from nipple stock.
5. Pre-fabricated factory nipples with precision ground threads from nipple stock.
6. Threads can be molded in the field on existing pipe by using the upset behind the pin thread. The upset must be long enough for new threads and width of wrench without using transition, i.e., full pressure rating of pipe.

Table 10

Thread Type	Thread Size in / Maximum Pressure Ratings												
	1 ½	2 3/8	2 7/8	3 ½	4 ½	5½	6 5/8	7	8 5/8	9 5/8	8 SSS	10 SSS	12 SSS
Bell x Male Adapter	2500	2500	2500	2500	2000	1500	1250	---	1000	---	800	500	500
Molded Threads on Standard Nipple Stock	4000	4000	3500	3000	2500	2000	1000	2000 2500*	1400	2000	---	---	---
Molded Threads Hand Build Up	2500	2500	2500	2500	2000	1250	800	1500	800	N/R	---	---	---
Min. Layers of Reinforcement	2	2	2	2	2	2	2	2	3	---	---	---	---
Recommended Product Range**	2000 to 2500	2000 to 2500	2000 to 2500	1500 to 2500	1500 to 2000	1250	800	1250 to 1500	500 to 800	N/R	---	---	---

* Note: 5.95 ID-2000 psi; 5.50 ID-2500 psi

** Lower rated products require many layers of reinforcement



High Pressure Repairs

The repair of line pipe primarily involves the installation of a flange set. Lower pressure products offer alternative methods to flange sets but are limited in pressure rating. The following are the repair methods and the limitations of each:

Option One: Purchase a prefabricated repair joint designed to replace a full joint of pipe and allow room for a flange set. This method works for API 8rd and is recommended for high pressure STAR Super Seal products.

- Cut the damaged joint of pipe using a hack saw.
- Remove both remaining ends using two STAR metal friction wrenches.
- Replace the damaged joint with the special length repair joint.
- Install the flange set.

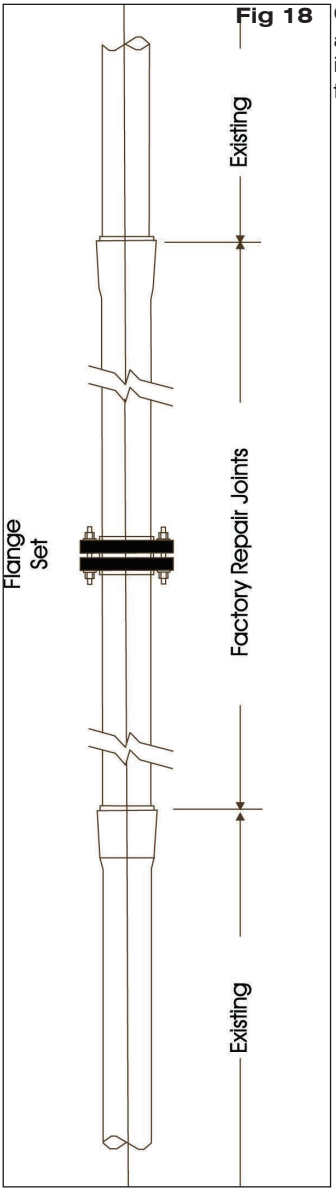


Fig 18

Option 1.a: For aliphatic amine pipe, the repair joint is one male x male nipple. A flange set is also required.

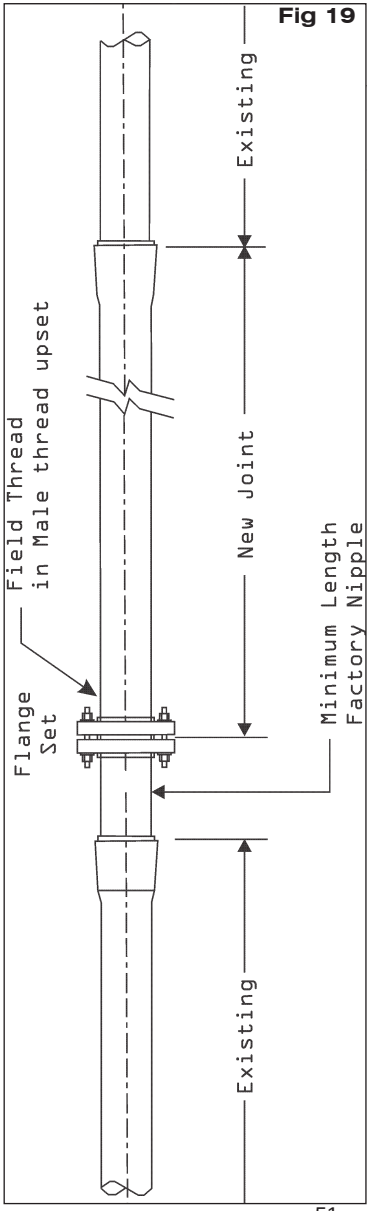


Fig 19

Option Two:

If extra pipe is available, replace the damaged joint with a new joint which can be shortened in the field to make room for the flange set and a minimum length nipple.

- Cut the damaged joint using a hack saw.
- Remove both remaining ends using two (2) STAR metal friction wrenches.
- Replace with a new joint of pipe.
- Shorten the joint as required to fit the flange set and a minimum length nipple.
- Cut the pipe on the upset only. If this is not possible, either use nipple stock or build up pipe body, see Field Fabrication of Pipe Upset section.
  - Field thread the pipe.
  - Install the flange set.

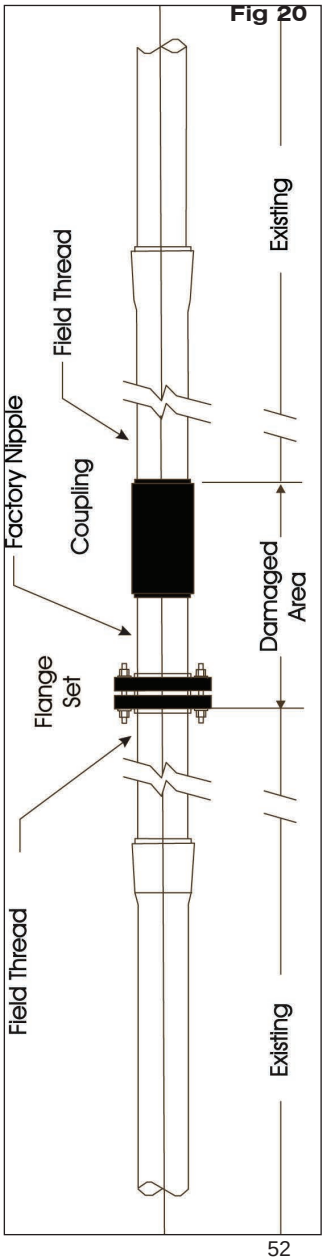


Fig 20

Option Three:
Make use of the undamaged pipe by re-threading the ends in the field allowing for the flange set. Reference the field thread rating Table 10 for the proper threading method to maintain the system pressure rating. (not for high pressure STAR super seal)

- Consider the length of the damage. If the width of a set of flanges will repair the area, a nipple (long enough to repair the damage area) and a coupling will be required along with the flange set.
- Cut out the damaged area of the pipe using a hack saw taking into consideration the total laying length of the parts needed to make the repair.
- Depending on how long the damaged area is, an extra joint of pipe may be required.
- Re-thread both square cut ends using procedures in Field Fabrication of Pipe Upset section for field threads or bell x male adapters.
- Install the flange set.

Low Pressure Repair
(Less than 500 psi STAR Super Seal)

Bonded Flanges, Bell x Groove Adapters,
Bell x Bell Sleeve Couplings

- Requires STAR approved tapering tool set at 1¾° taper angle.
- Follow bonding procedure in bonded threaded adapters.
- Limited to pressure ranges listed in Table 11.

Bonded Saddle Patch

Bonded saddle patches are not considered permanent repairs and they cannot be applied over a wet surface. The following is the maximum pressure that a bonded saddle patch should be attempted:

Table 11

Pipe Size in	1½ - 2	2½ - 3	4 - 12
MAX. PRESSURE RATING psi	450	300	225

- **Patch length** - A length of good pipe is cut and split longitudinally for 180° of circumferential coverage and long enough to cover the damaged area plus 1 foot on each side.
- Sand the area to be patched and the interior of the saddle with 40 grit sand paper; remove all gloss or shine.
- Sanded areas must be thoroughly cleaned of all foreign material, oils, grease and fingerprints; if cleaning solvent is used, the surfaces must be thoroughly dried.
- Use a heavy coat of epoxy adhesive on both surfaces.
- Snap the patch in place over the damaged area.
- During **curing** hold the patch in place with several hose clamps, spaced 6" (152 mm) along the patch.
- **Do not pressurize until fully cured**, check hardness with knife blade.
- Leave the patch visible for inspection during pressure test.

To order bonded threaded adapters use the codes in the following table.

Table 12 Bonded Bell X Male Thread Adapter Codes

• Select the proper bell x male adapter by thread size and pressure rating as follows:

Thread Size	Pipe Pressure Rating	Anhydride STD	Anhydride 15HR	Aliphatic STD	Aliphatic 15HR	Aromatic 15HR
1.90	1250	N/A	R	N/A	N/A	N/A
	1500	R	R	R	R	R
	1750	R	R	R	R	Q
	2000	R	Q	R	R	Q
	2250	R	Q	R	Q	S
	2500	Q	S	R	P	N/A
2 SSSHP	2000	S	N/A	N/A	N/A	N/A
2 3/8	750	N/A	S	N/A	R	N/A
	800	N/A	N/A	R	N/A	N/A
	1000	N/A	S	R	R	S
	1250	S	S	R	R	S
	1500	S	S	R	R	S
	1750	S	S	R	S	Q
	2000	S	Q	R	Q	P
	2250	Q	P	R	P	N/A
	2500	Q	P	S	N/A	Q
2 7/8	750	N/A	T	N/A	U	T
	800	N/A	T	U	N/A	N/A
	1000	T	T	U	U	T
	1250	T	T	U	U	T
	1500	T	T	U	T	Q
	1750	T	S	U	S	Q
	2000	S	Q	U	Q	N/A
	2250	Q	Q	T	Q	N/A
	2500	Q	N/A	R	Q	Q

Table 12 BONDED BELL X MALE THREAD ADAPTER CODES

Thread Size	Pipe Pressure Rating	Anhydride STD	Anhydride 15HR	Aliphatic STD	Aliphatic 15HR	Aromatic 15HR
3 SSSHP	2500	S	N/A	N/A	N/A	N/A
3 1/2	500	N/A	T	U	U	T
	750	N/A	T	N/A	U	T
	800	T	N/A	U	N/A	N/A
	1000	T	T	U	U	T
	1250	T	T	U	U	S
	1500	T	S	U	S	S
	1750	T	S	U	S	Q
	2000	S	R	S	R	P
	2250	S	Q	S	R	S
	2500	R	P	R	Q	S
4 SSSHP	2000	S	N/A	N/A	N/A	N/A
4 1/2	500	T	T	U	U	T
	750	N/A	T	N/A	U	T
	800	T	N/A	U	N/A	N/A
	1000	T	T	U	U	S
	1250	T	S	U	T	R
	1500	S	R	T	R	Q
	1750	S	R	S	Q	P
	2000	R	P	R	P	Q

Table 12, Continued - BONDED BELL X MALE THREAD ADAPTER CODES

Thread Size	Pipe Pressure Rating	Anhydride STD	Anhydride 15HR	Aliphatic STD
5 1/2	500	R	R	R
	750	N/A	R	N/A
	800	R	N/A	R
	1000	R	R	R
	1250	R	Q	R
	1500	Q	P	T
6 SSSHP	1000	S	N/A	N/A
6 5/8	500	V	V	S
	750*	N/A	V	N/A N/A
	800*	V	N/A	U (5.50 ID) S (5.93 ID)
	1000*	V	S	U (5.50 ID) R (5.93 ID)
	1250	S	Q	T
8 5/8	500	U	U	S
	750	N/A	U	N/A
	800	U	N/A	S
	1000	T	S	R
8SS	500	N/A	N/A	R
	800	N/A	N/A	R
10SS	500	N/A	N/A	R
12SS	500	N/A	N/A	R

* It is important to know the I.D, before ordering 6 5/8" Threaded Adapters

Thread Size	Pipe Pressure Rating	Aliphatic 15HR	Aromatic 15HR
5 1/2	500	N/A	N/A
	750	N/A	R
	800	N/A	N/A
	1000	N/A	Q
	1250	N/A	P
	1500	N/A	N/A
6 SSSHP	1000	N/A	N/A
6 5/8	500	S	V
	750*	U (5.50 ID) S (5.93 ID)	S
	800*	N/A	N/A
	1000*	T (5.50 ID) R (5.93 ID)	Q
	1250	N/A	V
8 5/8	500	S	U
	750	R	T
	800	N/A	N/A
	1000	N/A	R
8SS	500	N/A	N/A
	800	N/A	N/A
10SS	500	N/A	N/A
12SS	500	N/A	N/A

* It is important to know the I.D, before ordering 6 5/8" Threaded Adapters

Application Of API 5B 8rd Threads in the Field

Bonded Bell x Male Thread Adapter Procedure
Required Tools and Accessories:

- Hack saw or circular saw equipped with carbide blade.
- Conventional tapering tool capable of making a 1¾° taper (1" increase of OD in 16" of length or 1 to 16 ratio)
- Epoxy kit and rubber gloves.
- Electric heat collar, propane torch or chemical heat pack.

Preparation

- Calculate the length of the nipple by subtracting the laying length (center to center) of the fittings to be assembled and adding the insertion depths (see Fittings Data Sheet) of the nipple.
- Add adhesive lubricating factor to the nipple of ⅛" to ¼" for each taper to be bonded to the nipple length previously calculated.

Example:

Measured Distance	-	Fittings Laying Lengths	+	Taper Insertion Depths	+	Adhesive Lubricating Factors	=	Nipple Length To Cut

- Mark the pipe with a wrap around.
- Cut the pipe with a saw.
- Apply a 1¾° taper with tapering tool.
- Avoid over tapering the end of the nipple.

Taper Tool Model 010

Collets - (Be sure to select the correct collets)

Other than 2" - mount collets on tool before sliding collets into pipe.

Slide tool into pipe until pipe and the collets are flush, collets contracted.

Expand collets in the pipe by turning torque knob clockwise.

* Hand tight for thin wall pipe
* Hand tight - plus ¼ turn with wrench for thick wall pipe.

Caution:
1. For all cutting and tapering the pipe must be held securely.
2. End of pipe must be as straight as possible to ensure proper insertion length.

Cutting the taper operation

a. For cutting a taper the tool must be turning clockwise - feed the head down slowly every few turns by turning hex head bolt clockwise.
b. Continue turning the tool and lowering the head alternately until the taper length is reached.
c. Rotate the tapering tool until tool stops cutting to eliminate any cutting ridge formed by the cutting blade.
d. Loosen hex head bolt by turning counter clockwise before loosening torque knob to contract collets and removing the Tool from the pipe.

Note: Cut a test taper, checking fitting to taper. The fit should be snug without clearance.

Bell x Male Adapter Bonding Procedure

Environment

- The pipe surface temperature during bonding should be 65°F to 100°F (18.3°C to 37.8°C). At higher temperatures, shade connection from direct sunlight (make sure adhesive is "cool" when applied).
- The bonding surface must be completely dry.
- Humidity during bonding must be addressed; bonding is not recommended on wet surfaces.
- Work areas must be protected against blowing sand or dust.

Surface Bonding Preparation

- The joining surfaces must be visually examined for cleanliness, damage, and UV degradation.
- UV degradation is detected by sanding and looking for color changes or loose fiber.
- Refinishing by sanding or re-tapering is required if UV degradation is detected.
- Rewarming of the bonding surface if the temperature falls below 65°F (18.3°C).

Joint Cleaning

- Solvents can be used to remove grease, oil, mud or fingerprints; however, the surfaces must be completely dry before bonding can proceed after solvent has dried.
- *All prepared surfaces must be lightly sanded prior to applying adhesive.*

Adhesive Mixing

- Always wear rubber gloves.
- Stir the epoxy contents of the can with the mixing stick to ensure mixture of settled material. Particular attention to stirring is required for kits which have been stored more than 6 months. The adhesive should be smooth and free of lumps.
- Warm the epoxy by heating the can if the temperature is below 80°F (26.6°C).
- Pour the entire contents of the pre-measured amine hardener vial into the epoxy can.
- Do not attempt to split a kit.
- Cut the amine hardener into the epoxy using the mixing stick.
- Care must be taken so that the amine hardener is not spilled (affecting the mixture).
- Scrape the inside of the can to ensure that all epoxy is mixed. Mixing should take at least 2 to 3 minutes.
- The working time (pot life) for thoroughly mixed adhesive varies from 30 minutes at 70°F (21.1°C) to 10 minutes at 100°F to 120°F (37.8°C to 48.9°C).
- **DO NOT USE THE MIXED ADHESIVE IF IT IS TOO HOT TO TOUCH.**

Note: CAB-O-SIL (WHITE POWDER) IS SUPPLIED WITH EACH ADHESIVE KIT. DO NOT USE CAB-O-SIL TO THICKEN THE ADHESIVE FOR BONDED JOINTS. CAB-O-SIL IS ONLY USED FOR FIELD MOLDING 8RD THREADS.

Joint Assembly

- The joints must be axially aligned.
- Bonding surfaces must be at the appropriate bonding temperature. (65°F to 100°F, 18.8°C to 37.8°C)
- Bonding surfaces should never be touched by fingers or tools after cleaning.
- Apply a thin layer of the mixed adhesive, normally with a clean brush, onto the bell end of the adapter first, then the female end.
- The adhesive coat should be 3 to 10 mils (excessive adhesive may interfere with obtaining a locked position).
- Slowly stab the tapered male end into the bell end of the adapter.
- Push and turn the male connection to the right until full engagement is felt.
- Wipe off excessive adhesive with disposable towels.
- Use of a block of wood and a hammer maybe required to achieve full lock up.

Heat-Assisted Curing

- The adhesive bonded connection must be heat cured if the temperature is below 70°F (21°C).
- The adhesive will set up in 24 hours at temperatures above 75°F (24°C).
- Electric heat collars or chemical cure packs are available that generate 250°F (121°C) for a minimum of 30 minutes.
- Heat assisted curing ensures that the connection has reached its full chemical and physical properties.
- Use a propane torch to assist curing a bell x male adapter if a steel coupling can be screwed onto the adapter. Only apply the propane flame to the body of the steel coupling to heat the joint. Direct application of the flame to the fiberglass or adhesive will damage the material.

Examination / Documentation

- Each joint must be visually inspected and documented.
- Number each connection made and add initials of person responsible.
- Keeping an inspection sheet per API 15TL4, Appendix C is good practice.

Field Molded Thread Procedure

- Prior to beginning the process of making a thread, the pipe must be qualified to the diameter of the thread mold. If the pipe is not large enough to accept the full thread, either **nipple stock must be purchased or a field upset must be fabricated to obtain product pressure rating as listed in Table 10**.

Additional Tools and Accessories Required

- Steel thread mold (STAR).
- Mold release (Trewax®) and application brush.
- Epoxy thread paste kit.
- Strap wrench

Environment

- Pipe surface temperature of 65°F (18.3°C) to 80°F (26.6°C),warm the connection if below 65°F (18.3°C).
- Thread surface shall be clean and completely dry.
- Protect surface from blowing sand and dust.

Pipe Preparation

- Square cut the pipe to the proper length using a hacksaw or cut off saw with carbide blade, taking into consideration the laying length of the fittings and the insertion depth of the thread.
- Taper the pipe using a conventional tapering tool with a 1¾° taper.
- The taper should cover the entire length of the mold and 1/8" of the pipe should stick through the mold.
- Verify the mold fit to the taper; it should be snug with no movement.
- Make sure all oil, grease, mud, fingerprints, and sand are removed with sand paper before bonding.
- Once cleaned, the bonding area should not be touched.

Mold Preparation

- Clean and warm factory supplied and approved thread molds to touch (100°F to 130°F (37.8°C to 54.4°C)).
- An even, smooth coat of release agent should be applied uniformly with a soft brush to the threads and both mold faces.
- Excess releasing agent must be removed. There should be no visual signs of release agent.

Thread Paste Preparation

- Always wear rubber gloves.
- Stir the epoxy contents of the can with the mixing stick to ensure mixture of settled material. Particular attention to stirring is required for kits which have been stored more than 6 months. Adhesive should be smooth and free of lumps.
- Warm the epoxy by heating the can if the temperature is below 65°F (18.3°C).

- Pour the entire contents of the pre-measured amine hardener vial into the epoxy can.
- Do not attempt to split a kit.
- Cut the amine hardener into the epoxy using the mixing stick.
- Care must be taken so that the amine hardener is not spilled (affecting the mixture).
- Scrape the inside of the can to ensure that all epoxy is mixed (mixing should take at least 2 to 3 minutes).
- The working time (pot life) for thoroughly mixed adhesive varies from 30 minutes at 70°F (21.1°C) to 10 minutes at 100°F to 120°F (37.8°C to 48.9°C).
- **DO NOT USE THE MIXED ADHESIVE IF IT IS TOO HOT TO TOUCH.**
- Depending on the thread paste temperature, adjust the paste viscosity with CAB-O-SIL (white powdery substance) provided with epoxy kit.
- The consistency of the paste should adhere to the mixing stick.
- Make sure the CAB-O-SIL is thoroughly mixed into the adhesive.

Threading

- Fill the thread mold with the mixed thread paste using the mixing stick.
- Force the paste into the thread cavity by moving it along the thread, in one direction, from the small end of the mold to the large.
- Cover the full surface of the thread. Break or remove any air pockets present in the thread.
- Cover the tapered end of the pipe with approximately 1/8" of mixed epoxy paste.
- Roll the paste around the tapered area in a fashion which assists breaking any air pockets that are present.
- Build a ¼" thick bead of paste around the small end of the taper.
- Using a stabbing motion, insert the large end of the thread mold on to the tapered pipe. Push the mold on in a straight, smooth fashion.
- Once the surfaces touch, turn the mold clockwise until the mold is locked onto the tapered surface.
- Thoroughly clean the excess epoxy paste from the front and rear of the mold. Excessive thread paste left on the mold will cause difficult torque requirements for mold removal.

Heat Assisted Curing

- Complete cure requires 24 hours at 75°F (23.9°C).
- Faster cure time and optimum chemical and physical performance requires the application of heat. See Table 13
- Thread cure can be checked at the back of the mold with a knife blade.
- The thread must resist puncture.

Mold Removal

- Tap the mold lightly on all way around using a small hammer.
- Unscrew the mold using a strap wrench; avoid using a pipe wrench since this type wrench can damage the mold.
- Support the pipe during the mold removal such that it does not become bent due to torque of mold removal.
- Using a metal friction wrench or a 360° padded vise for backup during mold removal is a good practice.

Thread Inspection

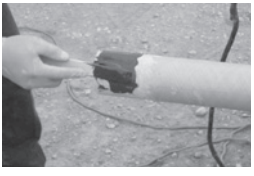
- A fully cured thread should be shiny in appearance and substantially free of voids.
- Check the thread hardness using a center punch on the back two threads.
- Full quality inspection requires reference to thread visual inspection standards.

Pre-Heat Thread Mold

Apply Mold Release Agent

Mix Thread Paste

Apply Paste to Mold



Apply Paste to Pipe

Stab Mold Onto Pipe

Clean Excess Paste From Mold

Tap Mold Lightly

Unscrew Mold

Inspect Thread

Table 13

CURE METHODS	REQUIRED STEPS
Electric Heat Collars	250°F (121.1°C) for 30 minutes. Do not overlap. Insulate in cold weather.
Propane Torch	Contact FGS
Chemical Heat Blanket	Follow manufacturers instructions. **Caution**: Wear respirators and avoid breathing fumes. Insulate in cold weather

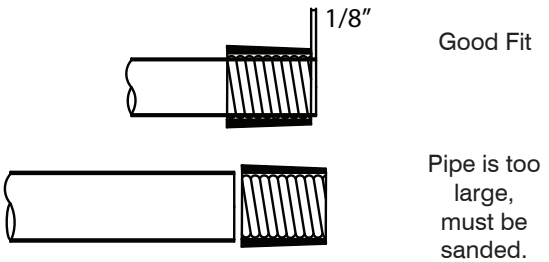
Field Fabrication of Pipe Build Up

The first step is to check the fit of the pin mold on the pipe. This is performed by sliding the pin mold onto the pipe. If the mold does not slide completely on the pipe, a good fit does not exist. Pipe surface must be sanded with an Emery cloth to prepare the surface for the build up of the pin. The pin build up consists of a special woven roving reinforcement and resin lay up on the pin to form the threads. A step-by-step procedure follows:

- Cut pipe square and to length
- Check pin mold fit
  - Good fit if it slides on completely
  - Poor fit if it does not completely slide onto the pipe
  - If poor fit exists,the pipe surface must be sanded to allow the mold to completely slide onto the pipe. A slight tapering of the pipe surface is preferred and will make it easier to slide the mold into position and to squeeze excess resin out of the mold.
- The surface must be smoothed for pin build up by sanding with an Emery cloth. The glossy layer on the pipe surface must be completely removed to provide a good bonding surface. Failure to remove all glossy material will result in a poor thread performance. This bonding surface must be clean and free of any contamination by oil or other foreign material.

- The epoxy adhesive must be mixed per instructions on page 61. The supplied CAB-O-SIL filler must be used for adhesive viscosity control. The viscosity must be high enough to prevent the resin from running or leaking out of the mold during setup.
- The viscosity must be high enough to prevent the resin from running or leaking out of the mold during setup.
- The woven roving glass strips must be thoroughly saturated with epoxy thread paste. This glass will be on a roll 2 to 4 inches wide depending on the pin diameter.
- The saturated glass must be carefully laid up by wrapping around the prepared end of the pipe. Care should be taken not to contaminate the saturated glass with foreign matter during this process.
- The number of wraps of woven roving required is dependent on the size difference in the pipe outside diameter and the diameter of the required upset for the thread. Specific data is provided in Table 10.
- Once the buildup is large enough, the normal field threading procedure can be followed over the wet uncured upset.

Note: This method has shown satisfactory results; however, it requires an expert competence level obtained only by special training and experience. Training by FGS Technical Service Representative is required.



National Oilwell Varco has produced this brochure for general information only, and it is not intended for design purposes. Although every effort has been made to maintain the accuracy and reliability of its contents, National Oilwell Varco in no way assumes responsibility for liability for any loss, damage or injury resulting from the use of information and data herein nor is any warranty expressed or implied. Always cross-reference the bulletin date with the most current version listed at the web site noted in this literature.

South America
Estrada de Acesso á Zona
Industrial Portuária de Suape, s/no.
Recife, PE, Brazil 55.590-000
Phone: 55 81 3501 0023

Europe
P.O. Box 6, 4190 CA
Geldermalsen, The Netherlands
Phone: 31 345 587 587

Asia Pacific
No. 7A, Tuas Avenue 3
Jurong, Singapore 639407
Phone: 65 6861 6118

Middle East
P.O. Box 17324
Dubai, UAE
Phone: 971 4881 3566
Phone: 55 81 3501 0023

www.fgspipe.com

NOV Fiber Glass Systems

North America
17115 San Pedro Ave. Suite 200
San Antonio, Texas 78232 USA
Phone: 210 477 7500

INS8000 - May 2013